Review of Particle Properties

Particle Data Group

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This review of the properties of leptons, mesons, and baryons is an updating of Rosenfeld *et al.* [Rev. Mod. Phys. **40**, 77 (1968)]. Data are evaluated, listed, averaged, and summarized in tables and wallet sheets. A data booklet is also available.

CONTENTS

I. INTRODUCTION

This review is an updating through October 1968 of Rosenfeld *et al.* (1968), with minor changes.

We point out in each edition that it is inappropriate to make reference to this compilation instead of to an original work (to which we even provide a handy citation), but some people still just quote us, without warning the reader that ours is a review and not an experiment. To emphasize this point we ask that this article be referred to as "Review of Particle Properties" and that the tables with the averaged values be referred to as "Particle Properties Tables." Further, please attribute them to the Particle Data Group rather than to individuals.

To make communication easier we now state who has concentrated on each major table. The list for the last 12 months is:

Stable Particles: N. Barash-Schmidt, A. Barbaro-Galtieri, G. Conforto, L. R. Price, and M. Roos; with help from Hans Bichsel and Peter Schmidt (on hyperon masses), and from George H. Trilling and William J. Willis (on K decays).

Mesons: P. Söding, M. Roos, and A. H. Rosenfeld, with assistance from L. Dubal.

Baryons: A. Barbaro-Galtieri and C. G. Wohl. We thank Claude Bricman, Claiborne Johnson, and Herbert Steiner for their advice on phase-shift analyses, Philip Dauber for advice on Ξ^*'s, and Robert D. Tripp for general helpful discussions.

We enjoy and need your help in the form of suggestions, preprints, the verification forms that you return, and even irritated phone calls. Please keep up the necessary communication.

II. GENERAL REMARKS

Our procedures are as follows. We read journals and preprints and from information so obtained we punch data cards and reference cards for each relevant experiment. These cards are listed following the main text.

Computer programs make weighted averages of these data, and the results are summarized in three tables:

(i) Table S covers all stable particles (leptons, mesons, and baryons), i.e., those states which are immune to decay via the strong interaction.
(ii) Meson Resonances.
(iii) Baryon Resonances.

Each table is of slightly different form; thus, Table S

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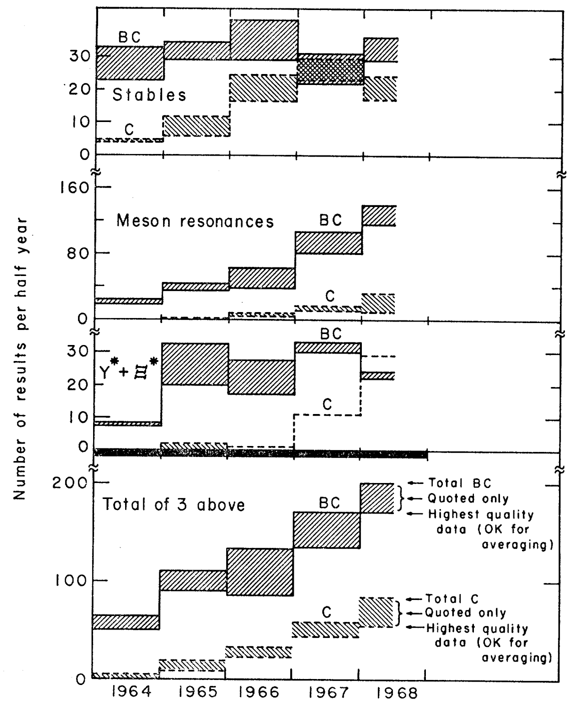

FIG. 1. Statistics on the increasing rate of production of data in particle physics. From the top to the bottom, the number of results per half year are presented for stable particles, meson resonances, $Y^*+\Xi^*$'s, and the total of three above. The full lines correspond to bubble-chamber techniques (BC) and interrupted lines correspond to counters, spark chambers, and mass spectrometers (C). Within each topic (stables, meson resonances, etc.) and for both techniques (BC and C) the lower lines correspond to highest-quality data (accepted for averaging and fitting) and the upper lines correspond to all the results (including those which we only quote). The dashed areas give the number of nonaveraged results.

includes magnetic moments and weak-decay asymmetry parameters, the meson table has two columns of names, one familiar, another more orderly, and the baryon table includes information on what momentum pion and K-meson beams will form certain resonances.

These three tables, along with other useful information, appear at the end of this article on perforated "wallet sheets." The sheets are thin and durable, and the reader can fold them to carry around.

Of course most of our work involves deciding how to handle data. Often it is best not to average a given result, either because it is already incorporated in a later paper or because we have some reservations about the experiment. When the data for a particle have received special treatment, this is noted in a "mini-review" in the listings.

III. SOME STATISTICS

In this section we present two sets of statistics: *first* on the increasing rate of production of data in particle physics by year and by experimental techniques, *second* on our procedure for critical compilation of data.

A. Growth of Data

On our data cards we punch both "year published" and "technique used," so that it is relatively easy to sort input by topic and technique.

In Fig. 1 we have divided the entries into three topics:

(1) Stable Particles.

(2) Meson Resonances.

(3) Baryon Resonances. For baryons we have excluded N^*'s because so many of our references are to review articles rather than to the many counter experiments, the most important of which involve polarization measurements. We have also excluded Z^*'s, where there are only a handful of experiments, and it is not even clear that there are any Z^*'s.

For all the above we have excluded cards appearing in the listings but applying to resonances that are still so tentative that they are excluded from our tables.

We have sorted data entries according to two major *techniques*, omitting about 20 emulsion results and 30 results attributed to "reviews." The two major techniques are called BC (for *B*ubble *C*hambers of all kinds) and C (for *C*ounters, spark *C*hambers, and mass spectrometers).

We wondered whether to count only the highest-quality data (those results which are accepted for averaging and fitting) or all data, including those that we list enclosed in parentheses. We have plotted both in Fig. 1, and they seem to tell the same story.

The entries in Fig. 1 and Table I tend to rise from year to year, and a quick glance may suggest that they give cumulative counts. This is not so; we list entries per unit time, and the slope indicates only that our field is still growing. Naturally, the keenest competition between bubble chambers and "counters" is in experiments with stable particles. Bubble chambers provide almost all the information on mesons, but electronic devices and polarized targets have been needed to disentangle most of the N^*'s.

Professor H. D. Taft recently made a similar sorting by technique of the last 450 publications in *Physical Review Letters*. Nearly $\frac{2}{3}$ were theoretical, but (of the remaining 35%) 15% described bubble-chamber experiments, 20% related to other techniques. How can Taft's count show bubble chambers trailing 15 to 20, whereas at the bottom of Fig. 1 we show them far ahead? The explanation is probably that bubble-chamber experiments tend to produce results bearing on several different states, each of which we count as an entry. By contrast, counter and spark-chamber experiments tend to be single-purpose and produce only one result per experiment.

B. Selection of Data

We hear comments from some of our colleagues that we should be more selective in our acceptance criteria

TABLE I. Results accepted per year. The top two rows of this table are plotted at the bottom of Fig. 1. Note that this table gives results per full year, whereas Fig. 1 gives results per half-year.

		Year					
Technique	Code[a]	1964	1965	1966	1967	1968 (½ year)	Total
Bubble chambers	*a*	33	45	92	73	31	271
	+*b*	+98	+178	+171	+267	+170	+869
	=*c*	=131	=223	=263	=340	=201	=1140
Counters + spark chamb. + missing-mass spectrometers	*a*	1	19	24	28	30	102
	+*b*	+8	+19	+43	+87	+55	+212
	=*c*	=9	+38	=67	=115	=85	=314
Emulsions	*a*	2	2	0	1	0	5
	+*b*	+3	+9	+1	+3	+0	+16
	=*c*	=5	=11	=1	=4	=0	=21
RVUE (review)	*a*	1	4	2	2	6	15
	+*b*	+2	+2	+0	+2	+8	+14
	=*c*	=3	=6	=2	=4	=14	=29

[a] Code: *a* = quoted only, *b* = averaged, *c* = total.

for input data, and from some others that we should be less selective (particularly with the phone list at the end of the Data Booklet!). Accordingly, we have decided to give occasional statistics as to how much we "refine" the input.

At the top of each page of the listings there is a note, "Data in parentheses have not been included in our averages." We now explain when we use this "ignore" feature, although a glance at the listings may be more informative.

After we have read a paper, we keypunch the results, even if we do not want to average them. Of course, if a quantity is presented with no error stated, our averaging programs have to ignore it. In addition, we may want to exclude it for several other reasons:

(i) The result comes from a preprint or conference report, and has not yet been verified by the authors. Our problems with such prepublications are discussed further in Sec. V.B.

(ii) It involves some assumptions that we do not wish to incorporate.

(iii) It is of poor quality, e.g., bad signal-to-noise ratio.

All the above are put in parentheses and ignored in our fitting procedures.

For last summer's edition we surveyed the *Meson Table*. There were 550 reference cards, which generated 860 data entries. Of these, about 50% were considered useful enough to average, and another 5% were significant upper limits which also influenced the tables in some way.

IV. EXPLAINING PEAKS VS EXPLAINING THEM AWAY

We would like to be able to state here some precise criteria for accepting a bump as a resonance; however, the eventual formulation of such criteria must await the solution of some of the most fundamental theoretical problems about the strong interaction, and even when they are finally understood there is no reason to assume that there will be a clean line of demarcation between "particles," background, and other phenomena. For a discussion of resonances, particles, and poles see Chew (1966).

Many physicists feel that even though a bump is experimentally convincing, one should always first try to explain it away in terms of some threshold or t-channel effect, and only if this "fails" should one consider it as a possible resonance. Thus, when we tabulate the A1 mesons, we warn "Existence still in doubt" because there are Deck-effect or similar interpretations. But here we want to warn against such warnings and emphasize that there may be no intrinsic contradiction between s-channel explanations (resonances) and t-channel effects (forces). Thus, for peaks like the A1, we are beginning to realize that we should compile data on the complete uninterpreted peak (without model-dependent background subtractions) and wait for theoretical progress.

There are cases in which we have dismissed an experimentally notable bump, for example, the K^+p bump near $K\Delta$ threshold—called Z_1 in our listings. Enough $K\Delta$ events are now available to permit a partial-wave analysis. It turns out that both the P1 and the P3 wave are large at the bump, and that neither of them looks very resonant. If, later, better partial-wave results (particularly from the elastic channel) should show resonant behavior, we would move Z_1 back into our tables. The point we want to emphasize here is that in judging which bumps to accept we consider that precise data are much more decisive than general criteria, and that we do not try to dismiss a bump just because of a possible nonresonant interpretation.

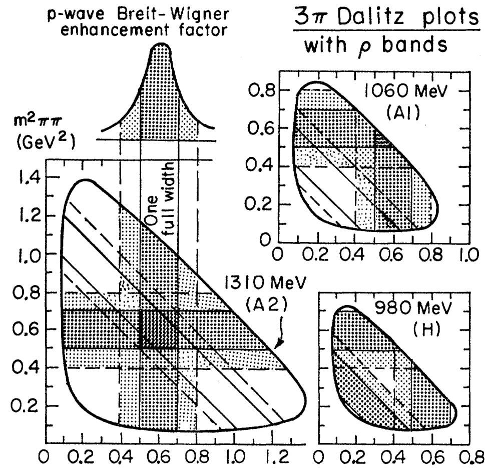

FIG. 2. Dalitz plots for three-pion states of total mass 980, 1060, and 1310 MeV, illustrating the overlap of the ρ bands.

The above should not be taken to mean that we eagerly try to add bumps to the table—we have strict experimental criteria. The data must be statistically sound, and we consider the evidence available from confirmatory or conflicting experiments.

We check also that bumps are not accidentally enhanced by imposing too many selections on the data. For example, see Fig. 2, which we have always carried as a warning about the H meson, a bump said to be mainly in the $\pi^+\pi^-\pi^0$ spectrum near $\rho\pi$ threshold. (We no longer believe in the H, but the discussion still applies in the A1 meson region.) The figure shows that just above $\rho\pi$ threshold the Dalitz plot is almost fully covered by ρ bands; then, as the 3π mass increases, the Dalitz plot grows, so there is a decrease in the fraction covered by ρ bands. Hence, ρ selection causes a relatively smooth 3π spectrum to peak up at $\rho\pi$ threshold. Every experimentalist knows this; nevertheless, one must be on guard that an ordinary 3σ (σ denotes the standard deviation) fluctuation is not accidentally amplified to 4σ or 5σ by this effect and then taken too seriously.

V. NOTES ON THE TABLES

A. General Notes

Quoted errors represent standard deviations. Inequalities are also standard deviations or $1/e$ confidence levels. In $I^G(J^P)C$ we have I = isotopic spin, J = spin, and P = parity. The others—G and C (or C_n)—are discussed in Sec. VII (Mesons). Well-established quanrum numbers are underlined (except in Table S, where most of the quantum numbers are established). We have used flimsy evidence to guess many of the remaining ones, and we have indicated with "?" the ones for which there is almost no evidence.

As is customary, we define antiparticles as the result of operating with CPT on particles, so both share the same spins, masses, and mean lives. Whenever there is a particularly interesting test of CPT invariance we include it on Table S.

For resonances, Γ represents the full width at half-maximum.

For broad resonances there is an inconsistency in the way the central value M_R is usually stated. For a well-studied resonance like $\Delta(1236)$ or $\Lambda(1520)$, it is conventional to call M_R or E_R the energy at which the resonant amplitude would (in the absence of background) become pure imaginary. But this does not mean that the peak in an observed cross section occurs at M_R, because kinematic factors enter into the relation between amplitude and cross section.[1] Thus, the peak in the πp cross section near Δ(1236 MeV) actually occurs at 1223 MeV. Nevertheless, some papers still simply report the energy of the peak in the observed cross section. For well-studied resonances, we have protected the averaging programs from masses and widths obtained without the proper kinematical factors or the proper background treatment. For the others, we have used whatever data were available.

B. Fluctuations in Average Values Since the Preceding Edition

Any quantity which has changed by ≥ 1 (old) standard deviation from its tabulated value in January or August of 1968 is italicized. Our motivation is twofold: (1) we are calling attention to poor procedures either on our part or on the part of the experimenters; (2) we suspect that quantities which have fluctuated unexpectedly in the past may continue to do so in the future. (We are not sure that this latter point is correct, but it seems reasonable. In particular we guess that there is a correlation between harder-than-average experiments and large fluctuations in the results.)

The most common reason for this kind of fluctuation is that physicists often *report* a value and error for a parameter in a conference report or preprint, and then *enlarge* the error by the time the experiment is published in a journal. If the preliminary result is included in our average, the central value is shifted sharply towards this new measurement and the error shrinks. Later, when more reasonable errors are published for the experiment in question, the averaged value again returns close to the old number, which is often a shift of more than one shrunken standard deviation. We are attempting to avoid this in the future by not averaging data from conference reports or preprints *unless* the authors specifically write us that the errors they have quoted are not likely to be enlarged before the paper is published in its final form.

VI. NOTES ON TABLE S (STABLE PARTICLES)

Rates. For K decays we tabulate partial decay rates in addition to branching ratios. For comparison of experimental data with theoretical predictions, it is

[1] See, for example, Jackson, 1964.

necessary to know the rates and errors coming from an over-all fit that takes into account the correlations between the various measured quantities. Our programs provide such fitted quantities. A comparison with the $\Delta I=\frac{1}{2}$ rule is reported in Appendix I.

CP violation in K^0 decays. Parameters of current interest are

$$\eta_{+-}=A(K_L\rightarrow\pi^+\pi^-)/A(K_S\rightarrow\pi^+\pi^-)$$
$$=|\eta_\pm|\exp(i\phi_{+-}),$$
$$\eta_{00}=A(K_L\rightarrow\pi^0\pi^0)/A(K_S\rightarrow\pi^0\pi^0)$$
$$=|\eta_{00}|\exp(i\phi_{00}).$$

The phases ϕ_{+-} and ϕ_{00} have been measured directly, whereas the magnitudes $|\eta_{+-}|$ and $|\eta_{00}|$ are derived parameters. We have used, as far as we could, the directly measured quantities as input, and have calculated $|\eta_{+-}|$ and $|\eta_{00}|$ from the values given by our constrained fits. Therefore, if one looks at the data card listings, most of the $|\eta|$ measurements do not appear as such, but in the form of branching ratios, with appropriate comments.

$\Delta S=\Delta Q$ rule in K^0 decays. The validity of this rule is measured by the parameter x, defined as

$$x=A(\bar{K}^0\rightarrow\pi^-l^+\nu)/A(K^0\rightarrow\pi^-l^+\nu).$$

We list Re x and Im x.

Form factors in K_{l_3} leptonic decays. Assuming that only the vector current contributes to these decays, we write the matrix element as

$$\langle\pi|J_\lambda|K\rangle\propto[f_+(q^2)(P_K+P_\pi)_\lambda+f_-(q^2)(P_K-P_\pi)_\lambda],$$

where P_K and P_π are the four-momenta of K and π mesons; f_+ and f_- are dimensionless form factors which can depend only on $q^2=(P_K-P_\pi)^2$, the square of the momentum transfer to the leptons. The parameters we list are

λ_+, the energy dependence of the $f_+(q^2)$ form factor,

$$f_+(q^2)=f_+(0)[1+\lambda_+(q/m_\pi)^2];$$

and ξ, the ratio of the two form factors,

$$\xi=f_-/f_+.$$

The quantity ξ can be determined in different ways. See the note in the listing, after K^+ decays, for discussions of methods used to measure ξ and of experimental results.

A/V ratio for baryon leptonic decays. The baryon part of the matrix element for these decays may be written as

$$\langle B_f|\gamma_\lambda(g_V-g_A\gamma_5)|B_i\rangle,$$

where B_i and B_f represent initial and final baryons, and g_A and g_V the axial and vector coupling constants. The Pauli metric is used for the γ matrices and therefore the value of g_A/g_V in neutron beta decay is negative. We compile the ratio g_A/g_V for those decays for which it has been measured.

Asymmetry parameters in nonleptonic hyperon decays. The transition matrix for the hyperon decay may be written as

$$M=s+p(\mathbf{P}_Y\cdot\mathbf{q}),\qquad(1)$$

where s and p are the parity-changing and the parity-conserving amplitudes, respectively, $\mathbf{P}_Y$ is the hyperon polarization, and $\mathbf{q}$ is a unit vector along the direction of the decay baryon in the hyperon rest frame.

The asymmetry parameters are defined by the relations

$$\alpha=2\,\mathrm{Re}\,(s^*p)/(|s|^2+|p|^2),$$
$$\beta=2\,\mathrm{Im}\,(s^*p)/(|s|^2+|p|^2),$$
$$\gamma=(|s|^2-|p|^2)/(|s|^2+|p|^2).$$

With the transition matrix (1), the angular distribution of the decay baryon, in the hyperon rest system, is of the form

$$I=1+\alpha\mathbf{P}_Y\cdot\mathbf{q}.$$

The polarization $\mathbf{P}_B$ of the decay baryon is[2]

$$\mathbf{P}_B=\frac{(\alpha+\mathbf{P}_Y\cdot\mathbf{q})\mathbf{q}+\beta(\mathbf{P}_Y\times\mathbf{q})+\gamma\mathbf{q}\times(\mathbf{P}_Y\times\mathbf{q})}{1+\alpha\mathbf{P}_Y\cdot\mathbf{q}},$$

where $\mathbf{P}_B$ is defined in that rest system of the baryon obtained by a Lorentz transformation along $\mathbf{q}$ from the hyperon rest system in which $\mathbf{q}$ and $\mathbf{P}_Y$ are defined. Note that α is the helicity of the decay baryon for unpolarized hyperons.

The three parameters α, β, and γ satisfy the relation

$$\alpha^2+\beta^2+\gamma^2=1.$$

It is then convenient to describe hyperon nonleptonic decays in terms of the two independent parameters α and the angle ϕ defined by

$$\beta=(1-\alpha^2)^{1/2}\sin\phi,$$
$$\gamma=(1-\alpha^2)^{1/2}\cos\phi,$$

which has a more nearly Gaussian distribution than β or γ. Evidently

$$-\tfrac{1}{2}\pi\leq\phi\leq\tfrac{1}{2}\pi\qquad\text{for }\gamma>0,$$
$$\tfrac{1}{2}\pi\leq\phi\leq\tfrac{3}{2}\pi\qquad\text{for }\gamma<0.$$

In discussing time-reversal invariance, the quantity of interest is Δ, defined by

$$\alpha=2|s||p|\cos\Delta/(|s|^2+|p|^2),$$
$$\beta=-2|s||p|\sin\Delta/(|s|^2+|p|^2);$$

[2] Lee and Yang (1957.) Note that this paper contains a misprint. The minus sign in the definition of β should be replaced by a 2. In addition our unit vector $\mathbf{q}$ is the direction of the baryon, whereas their unit vector $\mathbf{p}$ is the direction of the pion.

that is, Δ is the phase angle of s relative to p. Evidently

$$-\tfrac{1}{2}\pi \le \Delta \le \tfrac{1}{2}\pi \qquad \text{for } \alpha > 0,$$

$$+\tfrac{1}{2}\pi \le \Delta \le \tfrac{3}{2}\pi \qquad \text{for } \alpha < 0.$$

(Note that this definition of Δ is slightly different from the one of the 1967 edition.) Under the assumption of time-reversal invariance, the angle Δ must satisfy the relation

$$\Delta = \delta_s - \delta_p,$$

modulo π, where δ_s and δ_p are the pion–baryon scattering phase shifts at the appropriate energy and for the appropriate isospin state. For Λ decay, assuming the validity of the $|\Delta I| = \frac{1}{2}$ rule,

$$\Delta = \delta_s - \delta_p = \delta_1 - \delta_{11} = (6.8 \pm 2.0) \text{ deg.}^3$$

On the data cards, we list α and ϕ for each decay, since they are the most closely related to the experiments and are essentially uncorrelated. Whenever necessary we have changed the signs of the reported values, so as to agree with our conventions. In Table S we give α, ϕ, and Δ with errors; and for convenience we also give the central value of γ, without an error.

VII. NOTES ON THE MESON TABLE

A. The Symbol-Minded Approach

If a meson has a well-accepted colloquial name, we use it. If not, we name it by a single symbol which specifies its atomic mass number A ($=0$ for mesons), its hypercharge Y, its isospin I, and, for a nonstrange meson, its G parity [see Eqs. (2) and (3)]. We choose

$I=0$; η if G is even, ϕ if it is odd

$I=1$; ρ if G is even, π if it is odd

$I=\frac{1}{2}$; K

$I=\frac{3}{2}$; (if ever established) L.

To crowd even more information onto the symbol, we add a subscript giving J^P. Thus $\eta_{0+}(1070)$. If J^P is not known, but must be normal ($0^+, 1^-, 2^+, \cdots$), e.g., because $\pi\pi$ or $\bar{K}K$ decays are seen, we use the subscript N. Thus $K_N(1400)$. If $\pi\pi$ and $\bar{K}K$ modes are *not* seen [and are not otherwise forbidden, e.g., by Eq. (5b) below], we *guess* it is because J is abnormal, and we write, for example, $K_A(1320)$.

When two states have identical quantum numbers, we add a "prime" to the heavier, e.g., η, η'; f, f' [and for baryons we write N, $N'(1400, \frac{1}{2}^+)$].

B. G Parity and the Shorthand C_n

The charge conjugation operator C turns particle into antiparticle, and has eigenvalues ± 1 only for neutral states; so it is useful to define an extension G which has eigenvalues for charged states too.[4] It is usually [4] defined by

$$G = C \exp(i\pi I_y). \qquad (2)$$

A neutral nonstrange state is an eigenstate of $\exp(i\pi I_y)$ with eigenvalue $(-1)^I$. Then we can write the eigenvalue equation for the whole multiplet as

$$G = C_n(-1)^I, \qquad (3)$$

where C_n (n for neutral) is the eigenvalue C would have if applied to the neutral member of the multiplet. Thus, for a π^0, C has the eigenvalue $+1$, and since $I=1$, $G=-1$. For the charged pion there are no eigenvalues corresponding to C and to the isospin rotation, but C_n is still $+1$, and Eq. (3) still gives $G=-1$.

C. C, P, G for Meson↔Particle–Antiparticle (e.g., $\pi\pi$, $\bar{K}K$, $\bar{p}p$, or Quark–Antiquark)

The formulas below, starting with Eq. (6), are useful for several reasons.

(i) The presence or absence of $\pi\pi$ or $\bar{K}K$ decay modes (neutral or charged) helps determine G.

(ii) Since $\bar{p}p$ captures at rest are known to be from S states (Day *et al.*, 1961) there are constraints on the $I^G(J^P)$ of the mesons produced.

(iii) The quark model $\bar{q}q$ predicts unitary multiplets of mesons with P, C, and G defined by Eqs. (11) and (12), below.

We now present a summary of the arguments leading to Eqs. (7) through (13), and put details in Appendix II.

For two identical spinless bosons, like $\pi^0\pi^0$, Bose statistics require that the wave function $\psi(\mathbf{r})$ must be symmetric under an exchange operator X.

Bose symmetry can be extended to $\pi^+\pi^-$. The "indistinguishable" pions now have two coordinates, $\mathbf{r}$ and I_z, or (better for this argument) $\mathbf{r}$ and charge Q. Complete exchange, X, can then be written

$$X\psi(\mathbf{r}, I_z) = X_r(\mathbf{r}) X_I(I_z)\psi,$$

or better,

$$X\psi(\mathbf{r}, Q) = X_r(\mathbf{r}) C(Q)\psi.$$

If the state has angular momentum l, so that $\psi \propto Y^m{}_l(\cos\theta)$, then X_r has eigenvalue $(-1)^l$. [We avoid calling X_r "parity" because when we get to the case of fermion–antifermion X_r will still be $(-1)^l$, but parity will be $-(-1)^l$.]

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[3] This value for $\delta_s - \delta_p$ is derived from the phase-shift analyses by L. D. Roper, R. M. Wright, B. T. Feld, Phys. Rev. **138**, B190 (1965). The error is our estimation of the uncertainty.

[4] Most texts define it as in Eq. (2); see, e.g., Gasiorowicz 1966; however, sometimes the rotation is taken about I_x. The difference between the two conventions is mentioned in a footnote in Källén 1964.

Bose symmetry still requires that

$$X_r C = +1, \tag{4}$$

so $$C_n = X_l = (-1)^l, \tag{5a}$$

and, by (3), $$G = (-1)^{l+I}. \tag{5b}$$

We show in Appendix II that Eq. (5b) can be extended to apply to meson–*anti*meson pairs, both with total charge $Q=0$ (e.g., K^+K^-) and also nonzero (e.g., K^+K^0 or $\pi^+\pi^0$).

We can further allow the meson (and antimeson) to have spin ($\mathbf{S}_1+\mathbf{S}_2=\mathbf{S}$). We exchange spins with an operator X_S, which for two particles each with the same integral spin is

$$X_S = (-1)^S. \tag{6}$$

Then $$X = X^l C X_S = +1 \tag{7}$$

gives $$C_n(-1)^{l+S}, \tag{8a}$$

and $$G = (-1)^{l+S+I}. \tag{8b}$$

The spin factor seldom comes up for meson–antimeson pairs, but it allows us to cast the expressions in a form in which they apply identically to fermion–antifermion, as we now show.

For two identical *fermions*, such as pp, with orbital angular momentum l and spin S, the symmetry requirements of Fermi statistics require $X=-1$. Spatial interchange X_r again introduces $(-1)^l$, and two *spinors* have a spin symmetry

$$X_S = -(-1)^S. \tag{9}$$

Again we extend Fermi statistics to $\bar{N}N$ or $\bar{q}q$ states. Complete interchange can then be written

$$X = X_r C X_S = -1. \tag{10}$$

The minus signs in (9) and (10) cancel, giving

$$C_n = (-1)^{l+S}. \tag{11a}$$

Note that (8a) and (11a) are identical, as we promised.

Finally, from (3), we get the familiar expression for G,

$$G = (-1)^{l+S+I}. \qquad [(11b) = (8b)]$$

Next we give some examples of Eqs. (8).

Examples of meson→$\bar{K}K$

As an example of Eqs. (4), (5) or (7), (8) consider the A2 meson. Its main decay mode is $\pi\rho$, hence $G=-1$. The A2 may actually be *two* nearly overlapping mesons, but at least one component seems to go into $K^-K_S^0$, so $I=1$ for that component. Then, by (5b), l is even.

Or consider the $I=1$ A1 meson. Its main decay is again $\pi\rho$, so again $G=-1$. Hence, by (5b) we'll see a $\bar{K}K$ decay mode only if l is even. In fact no $\bar{K}K$ mode is seen.

Example of neutral meson→$\bar{K}^0K^0$

Whenever l is even, neutral $\bar{K}K$ must appear as K_SK_S, K_LK_L, and K^+K^- in the ratio 1:1:2. If l is odd, we can find only K_SK_L and K^+K^-, in equal numbers (Goldhaber *et al.*, 1958; Inglis, 1961).

Table II and the $\bar{q}q$ model

First we want to note the parity of a $\bar{q}q$ state. Spatial exchange X_l has eigenvalue $(-1)^l$, but an extra minus sign enters into the parity of fermion–antifermion (see Appendix II):

$$P = -(-1)^l. \tag{12}$$

For the $\bar{q}q$ model it is often convenient to multiply (11a) and (12), so that l cancels and we have

$$C_nP = -(-1)^S. \tag{13}$$

Thus for the singlets

$$^1S_0,\ ^1P_1, \cdots C_nP = -1. \tag{13a}$$

and for the triplets

$$^3S_1,\ ^3P_{0,1,2}, \cdots C_nP = +1. \tag{13b}$$

With Eqs. (12) through (13) we can construct Table II (similar to Table III of Goldhaber, 1968). In an attempt to make the logic easy to follow we have put in much redundancy.

Do not confuse the two different meanings of the word "abnormal" on the table. Its first use is in the connection between J and P. We call "normal" the series $J^P=0^+, 1^-, 2^-, \cdots = N$; and "abnormal" the series $J^P=0^+, 1^-, 2^+, \cdots = A$. Its second use is to describe the relation to the eigenvalue of C (or C_n) and J^P. If the sign of C can be explained in terms of a quark–antiquark model ($q\bar{q}$), as in fact it can for all known mesons, we say that C is "normal"; otherwise we call it "abnormal." At the bottom of the table we list such abnormal states, all waiting to be discovered.

As a final remark on Table II, we point out that (except for one special case) these abnormal C states have normal J^P and $CP=-1$. In order to demonstrate this we made a separate column which displays with a subscript normal and abnormal J^P. It is then easy to see that the $J^P=A$ mesons come from both singlet and triplet $\bar{q}q$ states, each with a different value of CP; $J^P=N$ cannot come from singlets, and so cannot have $CP=-1$. The reason for the special case of course is that there is no ^3S state with the same J^P as $^1S_0$.

VIII. NOTES ON BARYON TABLE

Just as we did for mesons, we identify baryon states by a single symbol which specifies atomic number ($A=1$), hypercharge Y, and isospin I, but for baryons no attempt has been made to attach a subscript about

TABLE II. $I^G(J^P)$ of mesons from $\bar{q}q$ model. For the distinction between abnormal J^P and abnormal C, see text. $I=\frac{1}{2}$ states share the same values of J^P as the $I=0$ and 1 states shown, but are not eigenstates of G. The middle column, which gathers together $(J^P)_N$ or $_ACP$, is redundant and serves only to clarify the logic.

	$\bar{q}q$ State CP −	$\bar{q}q$ State CP +	Normal or abnormal (J^P) CP	$I^G(J^P)C_n$	Examples and comments
Parity −	$^1S_0$		$(0^-)_A-$	$0^+(0^-)+$	η, η'
				$1^-(0^-)+$	π
		$^3S_1$	$(1^+)_N+$	$0^-(1^-)-$	ω, ϕ
				$1^+(1^-)-$	ρ
Parity +	$^1P_1$		$(1^+)_A-$	$0^-(1^+)-$	
				$1^+(1^+)-$	A1
		$^3P_0$	$(0^+)_N+$	$0^+(0^+)+$	$\eta_N(1070)$
				$1^-(0^+)+$	$\pi_N(1016)$
		$^3P_1$	$(1^+)_A+$	$0^+(1^+)+$	
				$1^-(1^+)+$	B
		$^3P_2$	$(2^+)_N+$	$0^+(2^+)+$	f, f'
				$1^-(2^+)+$	A2
Parity −	$^1D_2$		$(2^-)_A-$	$0^-(2^-)+$	Regge recurrence of $^1S_0$, 0^-
				$1^+(2^-)+$	
		$^3D_1$	$(1^-)_N+$	same as $^3S_1$	
		$^3D_2$	$(2^-)_A+$	$0^+(2^-)-$	Regge recurrence of abnormal C, $J^P=0^-$, CP = +1
				$0^-(2^-)-$	
		$^3D_3$	$(3^-)_N+$	$J>2$	
Parity +	$^1F_3$		$(3^+)_A-$	$J>2$	
		$^3F_2$	$(2^+)_N+$	same as $^3P_2$	
		$^3F_3$	$(3^+)_A+$	$J>2$	
		$^3F_4$	$(4^+)_N+$	etc.	

ABNORMAL C STATES THAT CANNOT COME FROM $\bar{q}q$ MODEL

Abnormal C states Have no $\bar{q}q$ model	$(0^-)_A+$	$0^-(0^-)-$	All except $J^P=0^-$ are J^P = normal, CP = −1
		$1^+(1^-)-$	
	$(1^-)_N-$	$0^+(1^-)+$	
		$1^-(1^-)+$	
	$(0^+)_N-$	$0^-(0^+)-$	
		$1^+(0^+)-$	
	$(2^+)_N-$	$0^-(2^+)-$	
		$1^+(2^+)-$	
	$(3^-)_N-$	$0^+(3^-)+$	
		$1^-(3^-)+$	

J and P. The symbols are

Z_I for $Y=2$, $I=0, 1$;

N for $Y=1$, $I=\frac{1}{2}$;

Δ for $Y=1$, $I=\frac{1}{2}$;

Λ for $Y=0$, $I=0$;

Σ for $Y=0$, $I=1$;

Ξ for $Y=-1$, $I=\frac{1}{2}$;

Ω for $Y=-2$, $I=0$.

For the lowest-mass state of each Y and I we use the symbol standing alone; mass is in parentheses [i.e., $N(1688)$, $\Lambda(1405)$, $\Sigma(1770)$, etc.]. The J^P assignment is reported in the table as $\frac{1}{2}^+$, $\frac{3}{2}^-$, $\frac{5}{2}^+$, etc., and also by the symbols P_{11}, D_{13}, F_{15}, which refer to the partial-wave amplitude where the resonant state occurs (the first subscript refers to the isospin state).

Most of the N, Δ, Λ, and Σ with $M<2000$ MeV have been discovered either in phase-shift analysis or partial-wave analysis. Masses and widths of most of these states are dependent on the data and on the model used by the different groups that performed these analyses; therefore, we do not quote an error, but only the most plausible values of M and Γ.

Resonances with mass $M>2000$ MeV have been detected primarily in total cross section experiments. Any bump in the total cross section of size σ_{res} at the value of the resonant mass gives information on the elasticity x_e and the J assignment of the resonance through the expression

$$\sigma_{\text{res(total)}}=4\pi\lambda\!\!\!^{-2}(J+\tfrac{1}{2})x_e.$$

If J and x_e are not separately known, the product $(J+\frac{1}{2})x_e$ for the resonance is given in the baryon table.

IX. PROCEDURES FOR TREATING THE DATA

A. General Procedures

Except for trivial cases, all branching ratios and rate measurements are analyzed by computer program AHR. This program makes a simultaneous least-squares fit to all the data, and outputs the partial-decay fractions $\bar{P}_i$, widths $\bar{W}_i$, and their error matrix.

The original version of AHR was written by J. Peter Berge. It is documented separately, and we wish here only to give the simplest nontrivial example that permits us to comment on the error matrix and the scale factor.

Assume that a state has only three partial decay fractions, P_1, P_2, and P_3 ($\sum P_i=1$), which have been measured in four different ratios, $R_1=P_1/P_2$, $R_2=P_1/P_3$, $R_3\cdots$, $R_4\cdots$. Further assume that *each* ratio has been measured by N experiments (we designate each experiment with a greek subscript, e.g., $R_{1\alpha}$). Then AHR finds the best values of P_1, P_2, and P_3 by minimizing χ^2, namely

$$\chi^2=\sum_{r=1}^{4}\left\{\sum_{\alpha=1}^{N}\left[\frac{R_{r\alpha}-R_r(P_1, P_2, P_3)}{\delta R_{r\alpha}}\right]^2\right\}. \quad (14)$$

In addition to the fitted values $\bar{P}_i$, the program calculates an error matrix $\delta\bar{P}_i\delta\bar{P}_j$. We tabulate the diagonal elements $\delta\bar{P}_i=(\delta\bar{P}_i\delta\bar{P}_i)^{1/2}$ (except that some of the errors are "scaled." See the following Section IX.B). But if any of the correlations $c_{ij}=\delta\bar{P}_i\delta\bar{P}_j/(|\delta\bar{P}_i||\delta\bar{P}_j|)$ is $>\frac{1}{2}$, we insert warnings in the listings, except for the obvious binomial cases like charged vs neutral Λ decay.

Two further comments on the example above:

(1) If partial widths had been reported along with the partial fractions, we would have entered them in our listings as W_i; AHR would then introduce another parameter, the total rate Γ, with the condition that $\sum\Gamma_i=\Gamma$.

(2) Note that we do *not* allow for correlations between input data. We *do* try to pick those ratios and widths which are as independent and as close to the original data as possible.

When *inequalities* are reported, on the first iteration we ignore them; we then check to see if the weighted average of the other data violates the inequality. If an upper limit is violated, we change the input data: $<x\rightarrow 0\pm x$. If a lower limit is violated, one cannot always invoke such a simple prescription, and each case must be handled individually.

In *asymmetric* errors, we use a continuous function of $\delta(P)^+$ and $\delta(P)^-$ in the fitting. When no errors are reported, we merely list the data for inspection.

Hyperon decay parameters

The program AHR handles any type of input, α, Φ, Δ, β, or γ, according to the definitions of Sec. VI. If for a particular hyperon decay there are data for more than two of the decay parameters, they are analyzed by using the constraint

$$\alpha^2+\beta^2+\gamma^2=1.$$

Conversion of mean lives to rates

An experimenter has a choice of reporting a mean life or a rate. Suppose he has an infinitely large bubble chamber; then he can report a mean time

$$\tau=N^{-1}\sum t_i,$$

where N is the total number of decays observed, and t_i is the elapsed proper time for each decay.

Alternatively he can report a rate

$$\Gamma=N/\sum t_i.$$

If his errors are large it is probably because N is small. In that case one can see that the distribution of rate Γ,

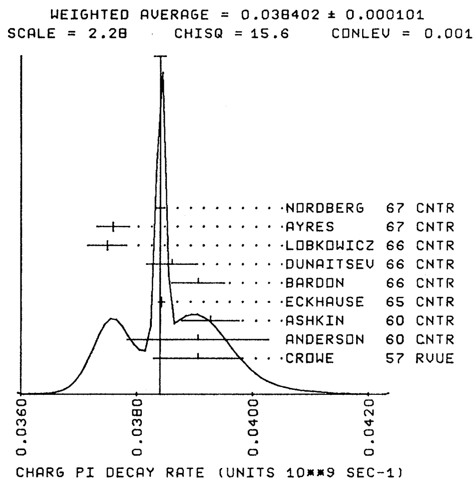

FIG. 3. Typical ideogram: $\pi^{\pm}$ decay rates. Results are usually published as mean lives τ, but we average *rates*, $\Gamma=1/\tau$, because rates are more normally distributed. The rms average $\bar{\Gamma}=(38.40\pm0.10)\ 10^6\ \text{sec}^{-1}$ is drawn as a vertical line, with an error flag at the top scaled up by a scale factor $S=2.3$. (It is easily seen that even after scaling, this final result is not a satisfactory statement of the situation.) Only four experiments, indicated by + error flags, were precise enough to satisfy Eq. (15) and be accepted in the calculation of the scale factor. The less precise experiments were included in the calculation of $\bar{\Gamma}$ but not of scale; they have $\perp$ flags.

with N in the numerator, should be fairly Poisson. But the distribution of mean life τ, with N in the denominator, will be badly skewed. Accordingly, we have inverted all mean lives before averaging data or making ideograms.

B. χ^2 Scale Factor

When we calculate the weighted average $\bar{x}$, we also calculate the χ^2 that all the measurements of x agree. If there are N experiments, each with properly estimated errors normally distributed, the average value of χ^2 should be $N-1$. If χ^2 is much larger than $N-1$, we average the data even though this may not be warranted. But we plot an ideogram (see Fig. 3) to help the reader decide which data to reject. He can then make his own selected average. However, if χ^2 is not much greater than $N-1$, and we cannot select a single bad experiment, we can still be conservative by the following approach: Instead of rejecting one culprit, we can assume that all experimentalists underestimated their errors by the same factor (which is, of course, $[\chi^2/(N-1)]^{1/2}\equiv\text{SCALE}$). If this were true, we should enlarge the output error $\delta(\bar{x})$ by SCALE.

In fact, this is exactly what we do. This scaling approach is already common practice in bubble-chamber experiments, where track distortion is not fully understood. For bubble-chamber data it can be justified. For this compilation, it has all the disadvantages of penalizing a whole class of students because of one naughty child, but (like the schoolmaster) we sometimes know of no other simple solution.

If all the experiments have errors of about the same size, the above (straightforward) procedure for calculating SCALE is carried out. If, however, we are to combine experiments with widely varying errors, we must modify the procedure slightly. This is because it is the more precise experiments that most influence not only the average value $\bar{x}$, but also the error $\delta(\bar{x})$. Now, on the average, the low-precision experiments each contribute about unity to *both* the numerator and the denominator of SCALE, hence the χ^2 contribution of the sensitive experiments is diluted, i.e., reduced. Therefore, we evaluate SCALE by using *only* experiments for which the errors are not much greater than those of the more precise experiments. Explicitly, to calculate SCALE we use only the most sensitive experiments, i.e., those with errors less than δ_0, where the ceiling δ_0 is (arbitrarily) chosen to be

$$\delta_0=3N^{1/2}\delta(\bar{x}). \tag{15}$$

Here $\delta(\bar{x})$ is the unscaled error of the mean of all the experiments. Note that if each experiment had the same error, δ_i, then $\delta(\bar{x})$ would be $\delta_i/N^{1/2}$, so each individual experiment would be well under the ceiling on SCALE.

This scaling approach has the property that if there are two values with comparable errors separated by much more than their stated errors (with or without a number of other experiments of lower accuracy) the error on the mean value, $\delta(\bar{x})$ is increased so that it is approximately half the interval between the two discrepant values.

We wish to emphasize the fact that our scaling procedures for *errors* in no way affect central values. In addition, if one wishes to recover the unscaled errors, $\delta(\bar{x})$, he need only divide the given errors by the SCALE factor given for that error.

A slightly *different approach* must be taken when a number of different (but related) quantities enter the *constrained* averaging program AHR.

According to our simple example, which led to Eq. (14), the double sum for χ^2 is summed over experiments, leaving a single sum over ratios

$$\chi^2=\sum_{r=1}^{4}\{\chi_r^2\}. \tag{16}$$

From these χ_r^2's we form SCALE factors (just as before), i.e.,

$$(\text{SCALE})_r^2=\chi_r^2/\langle\chi_r^2\rangle,$$

and if any $(\text{SCALE})_r$ is greater than ≈1, all N of the measurements of that particular ratio are equally penalized by having their errors increased by SCALE. Program AHR then recycles on all the data, those with errors unchanged as well as those with errors increased.

We then get new values for $\delta(\bar{P}_i)$, i.e., the *errors* of the partial-decay modes. These errors are then folded with the shifts in the central values, to give the tabulated errors, i.e.,

$$\delta(\bar{P}_i)_{\text{tab}}=[\delta(\bar{P}_i')^2+(\bar{P}_i-\bar{P}_i')^2]^{1/2},$$

where $\bar{P}_i$ is the fitted value of the ith partial decay mode before scaling, $\bar{P}_i'$ is its value after scaling, and $\delta(\bar{P}_i')$ is the error in $\bar{P}_i'$. The SCALE factors we finally list in such cases are defined by

$$(\text{SCALE})_i=\delta(\bar{P}_i)_{\text{tab}}/\delta(\bar{P}_i).$$

However, in line with our policy of not letting SCALE affect the central values, we give the values of $\bar{P}_i$ obtained from the original (unscaled) fits. [The differences between the $\bar{P}_i$'s calculated with either the scaled or the unscaled errors are, of course, always within the tabulated errors, $\delta(\bar{P}_i)_{\text{tab}}$.]

X. NOTES ON THE DATA CARD LISTINGS

For each quantity that has been measured by more than one experiment, we have added a line to the data listings, giving the average value and scaled error for that quantity. In addition, if a constrained fit has been made, we have added a line giving the constrained result.

We illustrate with an example: Assume a particular particle has only three decay modes, P_1, P_2, and P_3 ($\sum P_i=1$). Now suppose that three independent branching ratios $R_1=P_1/P_2$, $R_2=P_1/(P_1+P_2)$, $R_3=\cdots$, have been measured (the problem is then overconstrained). From these data our fitting program, AHR, calculates two types of results:

(1) P_i^{fitted} with errors (which have always appeared on the tables).

(2) R_i^{fitted} with errors (which now appear in the listings, since there is no place for them in the tables).

We also give the straight, unfitted average for each R_i.

On most data cards punched since May 1966, we have indicated the date punched. On cards which have been added since our most recent edition (Rosenfeld, 1968), we have put an asterisk after the date.

For two-body decays our computer program calculates the Q value and the momentum of decay. For three-body decays, it calculates Q, and then calculates the maximum momentum that any of the three particles can have.

If skewed errors are reported, as is often the case for mean-life experiments, both the fields "Error+" and "Error−" are used. If there is no entry in "Error−," then the errors are symmetric.

Some of the data on the mass of the ρ, for example, are followed at the far right by the entries $+$, $-$, or 0, with the sign depending on whether the experiment involved ρ^+, ρ^-, or ρ^0.

In the spring of 1966 we removed some of the obsolete data and references. They may be found in our earlier editions, e.g., Rosenfeld (1965).

Starting in September 1966, we decided to punch cross-section information on some rare mesons, providing the information is new and easily available in papers we are processing anyway. We do not check or average these cross sections as carefully as our other input. This is an experiment, pursued randomly by some of us; absence of cross-section cards for a given paper does not imply absence of such information in that paper.

XI. HOW TO OBTAIN WALLET SHEETS, DATA BOOKLETS, AND APPOINTMENT BOOKLETS

Extra copies of the tables from this edition are available from CERN or LRL–Berkeley, both in the form of 7×10-in. wallet sheets and 3×5-in. booklets. We can also supply 3×5-in. pocket diaries for physicists, which cover the academic year starting September 1968. We occasionally receive requests for multiple copies for classroom use; we can supply wallet sheet sets for 5¢ each, data booklets for 10¢ each, or the data booklet plus diary in plastic cover for 50¢.

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EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED ON THE DATA CARDS

Measurement Technique (TECH)

CC	Cloud chamber
CNTR	Counters, electronics
EMUL	Emulsions
HBC	Hydrogen bubble chambers
HEBC	Helium bubble chambers
DBC	Deuterium bubble chambers
PBC	Propane bubble chambers
XBC	Heavy liquid bubble chambers
SPRK	Spark chambers
MMS	Missing mass spectrometer
RVUE	Review of previous experimental data

Journals

ADVP	Advances in Physics
ANP	Annals of Physics
ARNS	Annual Reviews of Nuclear Science
BAPS	Bulletin of the American Physical Society
JETP	English Translation of Soviet Physics JETP
NC	Nuovo Cimento
NP	Nuclear Physics
PL	Physics Letters
PPSL	Proceedings of the Physical Society of London
PR	Physical Review
PRL	Physical Review Letters
PRSL	Proceedings of the Royal Society of London
RMP	Reviews of Modern Physics
ZPHY	Zeitschrift für Physik

The following abbreviations refer to proceedings of Conferences.

AIX	International Conference on Elementary Particles, Aix-en-Provence, 1961
ARGONNE	International Conference on Weak Interactions, Argonne National Laboratory, 1965
ATHENS	Athens Topical Conference on Recently Discovered Resonant Particles, Ohio University, 1963
BALATON	Symposium on Weak Interactions, Balatonvilagos, Hungary, 1966
BERKELEY	International Conference on High Energy Physics, 1966
BNL	International Conference on Fundamental Aspects of Weak Interactions, Brookhaven National Laboratory, 1963
BOULDER	Symposium on Strong Interactions 1965
CERN	International Conference on High Energy Physics, 1958 and 1962
CORAL GABLES	Conference on Symmetry Principles at High Energy, 1964 and 1965
DESY	Internation Symposium on Electron and Photon Interactions at High Energies, Hamburg, 1965
DUBNA	International Conference on High Energy Physics, 1964
KIEV	Ninth Annual International Conference on High Energy Physics, 1959
OXFORD	International Conference on Elementary Particles, 1965
ROCH	Fifth (Sixth, Seventh) Annual Rochester Conference on High Energy Nuclear Physics 1955 (1956, 1957). Annual International Conference on High Energy Physics, Rochester, 1960.
SIENA	International Conference on Nucleon Structure, 1963.

Finally,

BNL	Brookhaven National Laboratory
CU	Columbia University, includes Nevis Reports
NYO	New York Operations Office, AEC
UCRL	Lawrence Radiation Laboratory (University of California)
etc.	refer to unpublished reports of the Author's Institution.

Beginning in January 1969, when we must abbreviate an institutional name on the data cards we will use the following (which is the list used by the HERA group at CERN):

AACH	AACHEN,GERMANY	TECHNISCHE UNIV. AACHEN
AERE	HARWELL,BERKS,ENGL.	ATOMIC ENERGY RESEARCH ESTABLISHMENT
AMES	AMES ,IOWA,USA	IOWA STATE UNIV.
ANL	ARGONNE,ILL,USA	ARGONNE NAT. LAB
ANNA	ANN ARBOR,MICH,USA	UNIV. OF MICHIGAN
ARIZ	TUCSON,ARIZ,USA	UNIV.OF ARIZONA
ATEN	ATHENS,GREECE	NUCLEAR RESEARCH CENTRE DEMOKRITOS
ATHO	ATHENS,OHIO,USA	OHIO UNIV.
BARI	BARI ,ITALY	UNIV. DEGLI STUDI DI BARI
BELG	BRUXELLES,BELGIUM	INSTITUT INTERUNIVERSITAIRE DES SCIENCES NUCLEAIRES
BERG	BERGEN,NORWAY	FYSISK INSTITUTT
BERK	BERKELEY,CAL,USA	UNIV. OF CALIFORNIA
BERL	ZEUTHEN,BERLIN,GERM.	FORSCHUNGSSTELLE FUR PHYS. HOHER ENERGIEN DER DAW
BERN	BERN ,SWITZERLAND	UNIV. BERN
BGNA	BOLOGNA,ITALY	UNIV. DI BOLOGNA
BIRM	BIRMINGHAM,ENGLAND	BIRMINGHAM UNIV.
BNL	UPTON LI,NY,USA	BROOKHAVEN NAT. LAB.
BOHR	COPENHAGEN,DENMARK	NIELS BOHR INSTITUTE
BONN	BONN ,GERMANY	UNIV. BONN
BRAN	WALTHAM,MASS,USA	BRANDEIS UNIVERSITY
BROW	PROVIDENCE,RH.I,USA	BROWN UNIV.
BRUX	BRUXELLES,BELGIUM	UNIV. LIBRE DE BRUXELLES
BUFF	BUFFALO,NY,USA	STATE UNIV. OF NEW YORK AT BUFFALO
CAEN	CAEN ,FRANCE	LAB. DE PHYS. CORPUSCULAIRE
CALT	PASADENA,CAL,USA	CALIFORNIA INST. OF TECHNOLOGY
CARN	PITTSBURGH,PA,USA	CARNEGIE INST. OF TECHNOLOGY
CASE	CLEVELAND,OHIO,USA	CASE WESTERN RESERVE UNIV.
CAVE	CAMBRIDGE,ENGLAND	CAVENDISH LAB.,CAMBRIDGE UNIV.
CCNY	NEW YORK,NY,USA	CITY COLL. OF THE CITY OF NEW YORK
CDEF	PARIS ,FRANCE	COLLEGE DE FRANCE
CEA	CAMBRIDGE,MASS,USA	CAMBRIDGE ELECTRON ACCELERATOR
CERN	GENEVA,SWITZERLAND	EUROPEAN ORGANISATION FOR NUCL. RESEARCH.
CHIC	CHICAGO,ILL,USA	UNIV. OF CHICAGO
COLO	BOULDER,COL,USA	UNIV. OF COLORADO
COLU	NEW YORK,NY,USA	COLUMBIA UNIV.
CORN	ITHACA,NY,USA	CORNEL UNIV.
DARE	DARESBURY,ENGLAND	DARESBURY NUCL. PHYS. LAB.
DESY	HAMBURG,GERMANY	DEUTSCHES ELEKTRONEN-SYNCHROTRON
DUKE	DURHAM,NC,USA	DUKE UNIV.
DURH	DURHAM,ENGLAND	UNIV. OF DURHAM
EFIN	CHICAGO,ILL,USA	ENRICO FERMI INST. FOR NUCL. STUDIES
EPOL	PARIS ,FRANCE	ECOLE POLYTECHNIQUE
ETHZ	ZURICH,SWITZERLAND	EIDGENOSSISCHE TECHNISCHE HOCHSCHULE
FIRZ	FIRENZE,ITALY	UNIV. DI FIRENZE
FLAS	TALLAHASSEE,FLA,USA	FLORIDA STATE UNIV.
FLOR	GAINESVILLE,FLA,USA	UNIV. OF FLORIDA
FRAS	FRASCATI,ITALY	LABORATORI NAZIONALI DEL SINCROTRONE
GENO	GENOVA,ITALY	UNIV. DI GENOVA
GEVA	GENEVA,SWITZERLAND	UNIV. DE GENEVE
GLAS	GLASGOW,SCOTLAND	UNIV. OF GLASGOW
GRAZ	GRAZ ,AUSTRIA	UNIV. GRAZ
HAMB	HAMBURG,GERMANY	UNIV. HAMBURG
HARV	CAMBRIDGE,MASS,USA	HARVARD UNIV.
HAWA	HONOLULU,HAWAII,USA	UNIV. OF HAWAII
HEID	HEIDELBERG,GERMANY	UNIV. HEIDELBERG
HELS	HELSINKI,FINLAND	HELSINGIN YLIOPISTO
ILL	URBANA,ILL,USA	UNIV. OF ILLINOIS
IND	BLOOMINGTON,IND,USA	UNIV. OF INDIANA
IOWA	IOWA CITY,IOWA,USA	UNIV. OF IOWA
IPN	ORSAY ,FRANCE	INST. DE PHYS. NUCLEAIRE
IRAD	PARIS ,FRANCE	INSTITUTE DU RADIUM
IRVN	IRVINE,CAL,USA	UNIV. OF CALIFORNIA
ITEP	MOSCOW,USSR	INST. FOR THEOR. AND EXPERIM. PHYS.
JHOP	BATIMORE,MD,USA	JOHNS HOPKINS UNIVERSITY
JINR	DUBNA ,USSR	JOINT INST. FOR NUCL. RESEARCH
KARL	KARLSRUHE,GERMANY	TECHNISCHE UNIV. KARLSRUHE
KRAK	KRAKOW,POLAND	JAGELLONIAN UNIV.
LANC	LANCASTER,ENGLAND	LANCASTER UNIV.
LEBD	MOSCOW,USSR	LEBEDEV PHYSICS INSTITUTE
LEID	LEIDEN,NETHERLANDS	INST. LORENTZ
LIVP	LIVERPOOL,ENGLAND	LIVERPOOL UNIV.
LOIC	LONDON,ENGLAND	IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY
LOUC	LONDON,ENGLAND	UNIV. COLL.
LOUI	BATON ROUGE,LA,USA	LOUISIANA STATE UNIV.
LRL	BERKELEY,CAL,USA	LAWRENCE RADIATION LAB.,UNIV. OF CALIFORNIA
LUND	LUND ,SWEDEN	UNIV. I LUND
MADR	MADRID,SPAIN	JUNTA DE ENERGIA NUCLEAR
MANH	NEW YORK,NY,USA	MANHATTAN COLL.
MANZ	MAINZ ,GERMANY	UNIV. MAINZ
MASS	AMHERST,MASS,USA	UNIV.OF MASSACHUSETTS
MCGI	MONTREAL,CANADA	MC GILL UNIV.
MCHS	MANCHESTER,ENGLAND	UNIV. OF MANCHESTER
MICH	EAST LANSING,MI,USA	MICHIGAN STATE UNIV.
MILA	MILANO,ITALY	UNIV. DI MILANO
MIT	CAMBRIDGE,MASS,USA	MASSACHUSETTS INST. OF TECHNOLOGY
MPIM	MUNICH,GERMANY	MAX-PLANCK-INST. FUR PHYSIK UND ASTROPHYSIK
NAL	OAK BROOK,ILL,USA	NATIONAL ACCELERATOR LAB.
NAPL	NAPOLI,ITALY	UNIV. DI NAPOLI
NDAM	NOTRE DAME,IND,USA	NOTRE DAME UNIV.
NEAS	BOSTON,MASS,USA	NORTHEASTERN UNIV.
NEVI	IRVINGTON-ON-HUDSON	NEVIS LABS,NY,USA
NIJM	NIJMEGEN,NETHERLAND	R.K. UNIV. NIJMEGEN
NOVO	NOVOSIBIRSK,USSR	INST. OF NUCL. PHYS.
NWES	EVANSTON,ILL,USA	NORTHWESTERN UNIV.
NYU	NEW YORK,NY,USA	NEW YORK UNIV.
OHIO	COLUMBUS,OHIO,USA	OHIO STATE UNIV.
OREG	EUGENE,ORE,USA	UNIV. OF OREGON
ORNL	OAK RIDGE,TENN,USA	OAK RIDGE NAT. LAB.
ORSA	ORSAY ,FRANCE	UNIV. DE PARIS, FACULTE DES SCIENCES
ORUC	OAK RIDGE,TENN,USA	UNION CARBIDE NUCL. DIVISION
OSLO	OSLO ,NORWAY	OSLO UNIV.
OTTA	OTTAWA,CANADA	NATIONAL RESEARCH COUNCIL
OXF	OXFORD,ENGLAND	OXFORD UNIV.
PADO	PADOVA,ITALY	UNIV. DI PADOVA
PENN	PHILADELPHIA,PA,USA	UNIV. OF PENNSYLVANIA
PISA	PISA ,ITALY	UNIV. DI PISA
PITT	PITTSBURGH,PA,USA	UNIV. OF PITTSBURGH
PPPA	PRINCETON,NJ,USA	PRINCETON-PENNSYLVANIA PROTON ACCELERATOR
PRIN	PRINCETON,NJ,USA	PRINCETON UNIV.
PURD	LAFAYETTE,IND,USA	PURDUE UNIV.
REHO	REHOVOTH,ISRAEL	WEIZMANN INST. OF SCIENCE
RHEL	CHILTON,DIDCOT,BERKS	RUTHERFORD HIGH ENERGY LAB. (ENGLAND)
RISO	ROSKILDE,DENMARK	RESEARCH ESTABLISHMENT RISO
RIVS	RIVERSIDE,CAL,USA	UNIV. OF CALIFORNIA
ROCH	ROCHESTER,NY,USA	UNIV. OF ROCHESTER
ROMA	ROME ,ITALY	UNIV. DEGLI STUDI DI ROMA
RUTG	NEW BRUNSWICK,NJ,USA	RUTGERS UNIV.
SACL	SACLAY,GIF-S-YVETTE	CENTRE D'ETUDES NUCLEAIRES SACLAY (FRANCE)
SERP	SERPUKHOV,USSR	INST. OF HIGH ENERGY PHYS.
SHAM	SOUTHAMPTON,ENGLAND	UNIV. OF SOUTHAMPTON
SLAC	STANFORD,CAL,USA	STANFORD LINEAR ACCELERATOR CENTER
STAN	STANFORD,CAL,USA	STANFORD UNIV.
STEV	HOBOKEN,NJ,USA	STEVENS INST. OF TECHNOLOGY
STLO	ST LOUIS,MO,USA	WASHINGTON UNIV.
STOH	STOCKHOLM,SWEDEN	STOCKHOLMS UNIV.
STON	STONY BROOK,LI,NY	STATE UNIV. OF NEW YORK AT STONY BROOK (USA)
STRB	STRASBOURG,FRANCE	CENTRE DES RECHERCHES NUCLEAIRES
SUSS	SUSSEX,ENGLAND	SUSSEX UNIV.
SYR	SYRACUSE,NY,USA	SYRACUSE UNIV.
TENN	KNOXVILLE,TENN,USA	UNIV. OF TENNESSEE
TNTO	TORONTO,CANADA	UNIV. OF TORONTO
TORI	TORINO,ITALY	UNIV. DI TORINO
TRST	TRIESTE,ITALY	UNIV. DI TRIESTE
TUFT	MEDFORD,MASS,USA	TUFTS UNIV.
UCLA	LOS ANGELES,CAL,USA	UNIV. OF CALIFORNIA
UCSB	SANTA BARBARA,CAL	UNIV. OF CALIFORNIA (USA)
UCSC	SANTA CRUZ,CAL,USA	UNIV. OF CALIFORNIA
UCSD	LA JOLLA,CAL,USA	UNIV. OF CALIFORNIA,SAN DIEGO
UMD	COLLEGE PARK,MD,USA	UNIV. OF MARYLAND
UTAH	SALT LAKE CITY,UTAH	UNIV. OF UTAH (USA)
VAND	NASHVILLE,TENN,USA	VANDERBILT UNIV.
WARS	WARSAW,POLAND	UNIV. OF WARSAW
WASH	SEATTLE,WAS,USA	UNIV. OF WASHINGTON
WIEN	WIEN ,AUSTRIA	UNIV. WIEN
WISC	MADISON,WIS,USA	UNIV. OF WISCONSIN
YALE	NEW HAVEN,CONN,USA	YALE UNIVERSITY

PARTICLE PROPERTIES : January, 1969

Table S: STABLE PARTICLES. January, 1969.
(Closing date for data: November 1, 1968)

From Review of Particle Properties, UCRL-8030.

N. Barash-Schmidt, G. Conforto, A. Barbaro-Galtieri, L. R. Price, Matts Roos, A. H. Rosenfeld, Paul Söding, C. G. Wohl

Quantities in italics have changed by more than one (old) standard deviation since January, 1968.

STABLES

Particle	$I^G(J^P)C$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) $c\tau$(cm)	Mass² (GeV)²	Decays: Partial mode	Fraction	Q(MeV)	p or p_{max}‡ (MeV/c)	Partial Rates (sec⁻¹)
γ	0, 1(1⁻)⁻	0 (<2.×10⁻²¹ MeV)		stable	0	stable				
ν (ν_e, ν_μ)	J = ½	ν_e: 0(<0.2 keV); ν_μ: 0(<1.6MeV)		stable	0	stable				
e	J = ½	0.511006 ±.000002		stable (>2×10²¹y)	0.000	stable	μ_e = 1.001159557 ±.000000030 $\frac{e\hbar}{2m_ec}$			
μ	J = ½	105.659 ±.002	−33.920 ±.013	2.1983×10^{-6}	0.011	$e\nu\bar\nu$	100	105	53	
		μ_μ = 1.00116614 ±.00000031 $\frac{e\hbar}{2m_\mu c}$		±.0008		$e\gamma\gamma$	(<1.6)10^{-5}	105	53	
				$c\tau = 6.592\times10^{4}$		3e	(<1.3)10^{-7}	104	53	
						$e\gamma$	(<6)10^{-9}	105	53	
$\pi^\pm$	1 (0⁻)	139.578 ±.013	4.6041 ±.0037	2.604×10^{-8}	0.019	$\mu\nu$	100 %	34	30	
				±.007, S=2.3*		$e\nu$	(1.24±0.03)10^{-4}	139	70	
				$c\tau$ = 781		$\mu\nu\gamma$	e(1.24±0.25)10^{-4}	34	30	
				$(\tau^+-\tau^-)/\bar\tau$ = (0.09±0.07) %		$\pi^0e\nu$	(1.02±0.07)10^{-8}	4	5	
				(test of CPT)		$e\nu\gamma$	e(3.0 ±0.5)10^{-8}	139	70	
π^0	1⁻(0⁻)⁺	134.975		c 0.89×10^{-16}	0.018	$\gamma\gamma$	(98.83±0.04)%	135	67	
				±.18, S=1.6*		γe^+e^-	(1.17±0.04)%	134	67	
				$c\tau = 2.67\times10^{-6}$		$\gamma\gamma\gamma$	(<5)10^{-6}	135	67	
						$e^+e^-e^+e^-$	b(3.47)10^{-5}	133	67	
$K^\pm$	½(0⁻)	493.82 ±0.11	−3.94 ±0.13	1.235×10^{-8}	0.244	$\mu\nu$	(63.65±0.29)% S = 1.1*	388	236	(51.54±0.30)10⁶ S = 1.2*
				±.004 S = 1.8*		$\pi\pi^0$	(21.03±0.30)% S = 1.2*	219	205	(17.03±0.26)10⁶ S = 1.2*
				$c\tau$ = 370		$\pi\pi^-\pi^+$	(5.57±0.04)% S = 1.2*	75	126	(4.52±0.03)10⁶ S = 1.1*
				$(\tau^+-\tau^-)/\bar\tau$=(.09±.12)%		$\pi\pi^0\pi^0$	(1.70±0.05)%	84	133	(1.38±0.04)10⁶
				(test of CPT) S=1.3*		$\mu\pi^0\nu$	(*3.18 ± 0.14*)% S = 2.4*	253	215	(*2.58 ± 0.11*)10⁶ S = 2.4*
						$e\pi^0\nu$	(4.86±0.07)% S = 1.2*	358	228	(3.93±0.06)10⁶ S = 1.2*
						$\pi\pi^\mp e^\pm\nu$	(3.4 ±0.3)10^{-5}	214	203	
						$\pi\pi^\pm e^\mp\nu$	(<7)10^{-7}	214	203	
						$\pi\pi^\mp\mu^\pm\nu$	(1.0 ±0.5)10^{-5}	109	151	
						$\pi\pi^\pm\mu^\mp\nu$	(<3)10^{-6}	109	151	
						$e\nu$	(1.24±0.40)10^{-5}	493	247	
						$\pi\pi^0\gamma$	e(2.2 ±0.7)10^{-4}	219	205	
						$\pi\pi^+\pi^-\gamma$	e(10 ±4)10^{-5}	75	126	
						$\pi e\nu\gamma$	e(6 ±4)10^{-4}	354	227	
						πe^+e^-	(<1.1)10^{-6}	353	227	
						$\pi\mu^+\mu^-$	(<2.4)10^{-6}	143	172	
						$\pi\gamma\gamma$	(<1.1)10^{-4}	354	227	
K^0	½(0⁻)	497.76 ±0.16		50% K_{short}, 50% K_{long}						
K^0_S	½(0⁻)	S = 1.5*	$-0.469\times\frac{1}{\tau_S}$ ±.015	0.862×10^{-10}	0.248	$\pi^+\pi^-$	(68.4 ±1.1)%	219	206	(0.794±0.013)10¹⁰
				±.006 S=1.2*		$\pi^0\pi^0$	(31.6 ±1.1)%	228	209	(0.367±0.013)10¹⁰
				$c\tau$ = 2.59						
K^0_L	½(0⁻)			5.38×10^{-8}	0.248	$\pi^0\pi^0\pi^0$	(*21.5 ± 0.7*)% S=1.2*	93	139	(*4.00 ± 0.20*)10⁶ S=1.3*
				±.20		$\pi^+\pi^-\pi^0$	(*12.7 ± 0.3*)% S=1.1*	84	133	(2.36 ±0.10)10⁶ S=1.4*
				$c\tau$ = 1614		$\pi\mu\nu$	(28.1 ±0.8)%	253	216	(5.22 ±0.25)10⁶ S=1.3*
				S = 1.7*		$\pi e\nu$	(*37.7 ± 0.9*)%	358	229	(*7.01 ± 0.30*)10⁶ S=1.4*
						$\pi^+\pi^-$	(*0.157 ± 0.004*)%	219	206	(0.029±0.001) 10⁶
						c) $\pi^0\pi^0$	still uncertain	228	209	
						$\pi^+\pi^-\gamma$	e(< 0.4)10^{-3}	219	206	
						$\gamma\gamma$	(5.2 ±0.5)10^{-4}	498	249	
						$e\mu$	(< 0.6)10^{-5}	392	238	
						$\mu^+\mu^-$	(< 1.5)10^{-6}	286	225	
						e^+e^-	(< 1.7)10^{-5}	497	249	
η	0⁺(0⁻)⁺	548.8 ±0.6		Γ=(2.63±.64)keV		Neutral decays 71.1%: $\gamma\gamma$	(*38.1 ± 2.3*)% S=1.3* (c)	549	274	
						$\pi^0\gamma\gamma$	(*2.5 ± 2.8*)% S=1.3* (c)	414	258	
						$3\pi^0$	(*29.4 ±2.8*)% S=1.3* (c)	144	179	
						Charged decays 28.9%: $\pi^+\pi^-\pi^0$	(23.3 ±1.1)% S=1.2*	135	174	
						$\pi^+\pi^-\gamma$	(5.5 ±0.5)%	269	236	
						$\pi^0e^+e^-$	(< 0.01)%	413	258	
						$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	268	236	
p	½(½⁺)	938.256 ±0.005	−1.2933 ±.0001	stable (>2×10²⁸ y)	0.880					
n	½(½⁺)	939.550 ±0.005		c(*0.932 ± 0.014*)10³	0.882	$pe^-\nu$	100 %	1	1	
				$c\tau = 2.80\times10^{13}$						
Λ	0(½⁺)	*1115.60 ±0.08* S=1.3*		2.51×10^{-10}	1.245	$p\pi^-$	(65.3 ±1.2)%	38	100	
				±.03 S=1.3*		$n\pi^0$	(34.7 ±1.2)%	41	104	
				$c\tau$ = 7.54		$pe\nu$	(0.85±0.08)10^{-3} S=1.3*	177	163	
						$p\mu\nu$	(1.35±0.60)10^{-4}	72	131	
Σ^+	1(½⁺)	1189.40 ±0.19 S=1.7*	−7.92 ±.13	0.810×10^{-10}	1.412	$p\pi^0$	(52.8 ±1.5)%	116	189	
				±.013		$n\pi^+$	(47.2 ±1.5)%	110	185	
				$c\tau$ = 2.43		$p\gamma$	(1.9 ±0.5)10^{-3}	251	225	
				$\frac{\Gamma(\Sigma^+\to\ell^+n\nu)}{\Gamma(\Sigma^-\to\ell^-n\nu)}$ = <.04 ←		$n\pi^+\gamma$	e(0.9 ±0.3)10^{-4}	110	185	
						$\Lambda e^+\nu$	(2.11±0.45)10^{-5}	73	72	
						$n\mu^+\nu$	(< 0.36)10^{-4}	144	202	
						$ne^+\nu$	(< 0.19)10^{-4}	249	224	
Σ^0	1(½⁺)	1192.46 ±0.12 S=1.2*	−4.86 ±.07	<1.0×10^{-14}	1.422	$\Lambda\gamma$	100 %	77	75	
				$c\tau$<3×10^{-4}		Λe^+e^-	b(5.45)10^{-3}			
Σ^-	1(½⁺)	1197.32 ±0.11 S=1.3*		1.64×10^{-10}	1.434	$n\pi^-$	100 %	118	193	
				±.06 S=2.4*		$ne^-\nu$	(1.08±0.05)10^{-3}	257	230	
				$c\tau$ = 4.92		$n\mu^-\nu$	(*0.48 ± 0.06*)10^{-3}	152	210	
						$\Lambda e^-\nu$	(0.60±0.06)10^{-4}	81	79	
						$n\pi^-\gamma$	e(<1)10^{-3}	118	193	
Ξ^0	½(½⁺)§	1314.7 ±0.7	−6.6 ±.7	3.03×10^{-10}	1.728	$\Lambda\pi^0$	100 %	64	135	
				±.18		$p\pi^-$	(<0.9)10^{-3}	237	299	
				$c\tau$ = 9.10		$pe^-\nu$	(< 1.3)10^{-3}	376	323	
						$\Sigma^+e^-\nu$	(< 1.5)10^{-3}	125	119	
						$\Sigma^-e^+\nu$	(< 1.5)10^{-3}	117	112	
						$\Sigma^+\mu^-\nu$	(< 1.5)10^{-3}	20	64	
						$\Sigma^-\mu^+\nu$	(< 1.5)10^{-3}	12	49	
						$p\mu^-\nu$	(< 1.3)10^{-3}	271	309	
Ξ^-	½(½⁺)§	1321.25 ±0.18		*1.66×10^{-10}*	1.746	$\Lambda\pi^-$	100 %	66	139	
				±.04 S=1.1*		$\Lambda e^-\nu$	d(0.67±0.23)10^{-3}	205	190	
				$c\tau$ = 4.98		$\Sigma^0e^-\nu$	(<0.5)10^{-3}	128	122	
						$\Lambda\mu^-\nu$	(<1.3)10^{-3}	100	163	
						$\Sigma^0\mu^-\nu$	(<0.5)%	23	70	
						$n\pi^-$	(<1.1)10^{-3}	242	303	
						$ne^-\nu$	(<1.0)%	381	327	
Ω^-	0(3/2⁺)§	1672.4±.6 S=1.1*		$1.3^{+0.4}_{-0.3}\times10^{-10}$	2.797	$\Xi^0\pi^-$	8 events seen	217	293	
				$c\tau$ = 3.9		$\Xi^-\pi^0$	3 events seen	216	289	
						ΛK^-	13 events seen	63	210	

General Atomic and Nuclear Constants [a]

N	$= 6.02252\times10^{23}$ mole⁻¹ (based on $A_C12=12$)
c	$= 2.997925\times10^{10}$ cm sec⁻¹
e	$= 4.80298\times10^{-10}$ esu $= 1.60210\times10^{-19}$ coulomb
1 MeV	$= 1.60210\times10^{-6}$ erg
$\hbar$	$= 6.5819\times10^{-22}$ MeV sec $= 1.05449\times10^{-27}$ erg sec
$\hbar c$	$= 1.9732\times10^{-11}$ MeV cm = 197.32 MeV fermi
$k_{Boltzmn}$	$= 8.6171\times10^{-11}$ MeV/° = 1 eV/11605°K
α	$= e^2/\hbar c$ = 1/137.0388
m_e	= 0.511006 MeV/c² = 1/1836.10 m_p
m_p	= 938.256 MeV/c² = 1836.10 m_e = 6.721 $m_{\pi\pm}$ = 1.00727663 m_1 (where m_1 = 1 amu = $\frac{1}{12}m_{C^{12}}$ = 931.478 MeV/c²)
r_e	$= e^2/m_ec^2$ = 2.81777 fermi (1 fermi = 10^{-13} cm)
$ƛ_e$	$= \hbar/m_ec = r_e\alpha^{-1} = 3.86144\times10^{-11}$ cm
a_{∞} Bohr	$= \hbar^2/m_ee^2 = r_e\alpha^{-2}$ = 0.529167 A (1 A = 10^{-8} cm)
$\sigma_{Thomson}$	$= \frac{8}{3}\pi r_e^2 = 0.66516\times10^{-24}$ cm² = 0.66516 barn
μ_{Bohr}	$= e\hbar/2m_ec = 0.578817\times10^{-14}$ Mev gauss⁻¹
μ_{nucl}	$= e\hbar/2m_pc = 3.1524\times10^{-18}$ Mev gauss⁻¹

$\frac{1}{2}\omega_{cyclotron}$ (rad sec⁻¹ gauss⁻¹) $= e/2m_ec = 8.79404\times10^{6}$ $= e/2m_pc = 4.7895\times10^{3}$

(continued on other sheet)

[a] Based mainly on E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. 37, 537 (1965). Note that recent fine structure and ac Josephson effect measurements currently indicate that α is ~20 ppm larger than the value given above. The corresponding readjustment of the fundamental constants will increase e by 60 ppm, $\hbar$ by 100 ppm, m_e by 60 ppm, and decrease N by 60 ppm. For a preliminary analysis see W. H. Parker, B. N. Taylor, and D. N. Langenberg, Phys. Rev. Lett. 18, 287 (1967).

CP violation parameters

$$\eta_{+-\,(00)} = \frac{A(K_L\to\pi^{+(0)}\pi^{-(0)})}{A(K_S\to\pi^{+(0)}\pi^{-(0)})} = \lvert\eta_{+-\,(00)}\rvert e^{i\Phi_{+-\,(00)}}$$

$\lvert\eta_{+-}\rvert = (1.92\pm0.04)\times10^{-3}$

$\Phi_{+-} = (50\pm8)°$

$\lvert\eta_{00}\rvert$ still uncertain, see data listings for published values

Decay Parameters †

Particle	Magnetic Moment ($e\hbar/2m_pc$)	Measured α	Measured Φ(degree)	Derived γ	Derived Δ(degree)
p	2.792763 ±.000030				
n	−1.913148 ±.000066	$\frac{g_A}{g_V}$ = *− 1.231 ± .010* †		δ = (176.1±6.4)° †	
Λ	−0.73 ±.16 S=1.2*	0.646±0.016 ; 0.71 ±0.18	(−6.3±3.5)°	0.76	(7.5±3.9)°
		For $\Lambda\to pe\nu$, $\frac{g_A}{g_V} = -0.97^{+0.14}_{-0.22}$ †			
Σ^+	2.5 ±.5	−.955±0.070 ← S=1.1* ; +.018±0.039	(161±21)°	−0.95	$(-88^{+175}_{-2})°$
Σ^-		−.06 ±0.05 S=1.6*	(4±17)°	1.0	$(230^{+31}_{-125})°$
		For $\Sigma^-\to ne^-\nu$, g_A/g_V = 0.28±0.16 †			
		For $\Sigma^-\to\Lambda e\nu$, g_V/g_A = 0.3 ± 0.3 †			
Ξ^0		−.35±0.08	(25±21)° S=1.3*	0.85	$(229\pm^{+14}_{-38})°$
Ξ^-		−.41 ±.04	(−3±9)° S=1.3*	0.90	(172±18)°

† The definition of these quantities is as follows: [for more details on sign convention, see text]

$$\alpha = \frac{2|s||p|\cos\Delta}{|s|^2+|p|^2};\quad \beta = \sqrt{1-\alpha^2}\sin\Phi$$

$$\beta = \frac{-2|s||p|\sin\Delta}{|s|^2+|p|^2};\quad \gamma = \sqrt{1-\alpha^2}\cos\Phi$$

g_A/g_V defined by: $\langle B_f|\gamma_\lambda(g_V-g_A\gamma_5)|B_i\rangle$

δ defined by: $g_A/g_V = |g_A/g_V|e^{i\delta}$

* S = Scale factor = $\sqrt{\chi^2/(N-1)}$ where N ≈ number of experiments. S should be ≈ 1. If S > 1, we have enlarged the error of the mean, δx, i.e., $\delta x\to S\,\delta x$. This new convention is still inadequate, since if S > 1, the real uncertainty is probably even greater than $S\delta x$. See text of January 1967 edition.

‡ In decays with more than two bodies, P_{max} is the maximum momentum that any particle can have. § Predicted from SU(3).

b. Theoretical value, see also data card listings. d. Assumes rate for $\Xi^-\to\Sigma^0e^-\nu$ small compared with $\Xi^-\to\Lambda e^-\nu$.

c. See note in data card listings.

e. See date card listings for energy limits used in measuring this branching ratio.

STABLES STABLES STABLES

MESONS. January, 1969

Change in Notation. The subscript N stands for "normal spin-parity series" ($J^P=0^+, 1^-, 2^+, \ldots$), A for "abnormal" ($J^P=0^-, 1^+, 2^-, \ldots$).

Quantities in italics have changed by more than one (old) standard deviation since January, 1968.

	Symbol (J^P)	$I^G(J^P)C_n$ ⊢⊣ estab. ?= guess	Mass M (MeV)	Width Γ (MeV)	$M^2 \pm \Gamma M^{(a)}$ (GeV)^2	Partial decay modes: Mode	Fraction %	Q (MeV)	p or p_{max}[(b)] (MeV/c)
$\pi^{\pm}(140)$ $\pi^0(135)$	$\pi(0^-)$	$1^-(0^-)+$	139.58 134.97	7.2 eV ±1.2 eV	0.019483 0.018217	See Table S			
$\eta(549)$	$\eta(0^-)$	$0^+(0^-)+$	548.8 ±0.6	2.63 keV ±.64 keV	0.301 ±.000	all neutral $\pi^+\pi^-\pi^0+\pi^+\pi^-\gamma$	71 29 } See Table S		
ρ (765)	$\rho(1^-)$	$1^+(1^-)-$	765 ±10 (c)	125 ±20 (c)	0.585 ±.095	$\pi\pi$ $\pi^{\pm}\pi^+\pi^-\pi^0$ $\pi^+\pi^-\pi^+\pi^-$ $\pi^{\pm}\gamma$ $\eta\pi^{\pm}$ e^+e^- $\mu^+\mu^-$	≈ 100 < 0.2 < 0.15 < 0.4 < 0.8 .0061±.0005 (d) .0066±.0015 (e)	491 212 212 630 82 769 559	359 247 247 372 146 385 370
$\omega(783)$	$\phi'(1^-)$	$0^-(1^-)-$	783.4 ±0.7 S=2.0*	12.6 ±1.1	0.614 ±.010	$\pi^+\pi^-\pi^0$ $\pi^+\pi^-$ $\pi^0\gamma$ η+ neutral $\pi^+\pi^-\gamma$ $\pi^0\pi^0\gamma$ e^+e^- $\mu^+\mu^-$ $\pi^0\mu^+\mu^-$	≈ 90 seen (f) 9.3±0.8 < 1.5 < 5 < 1 0.0068±.0022(g) < 0.10 < 0.2	369 504 648 234 504 513 782 572 437	328 366 380 199 366 368 392 377 350
$\eta'(958)$ or X^0 See note (h), on name η'.	$\eta'(0^-)$	$0^+(0^-)+$ $J^P = 2^-$ not yet excluded	958.3 ±0.8	<4	0.918 <.004	$\eta\pi\pi$ $\pi^+\pi^-\gamma$(incl. $\rho^0\gamma$) γγ for upper limits see footnote (i)	71 ± 4 22 ± 3 6.2 ± 3.1 (s)	131 958	232 479
δ(962)	?( )	≥1 ( )	962 ±5	<5	0.927 <.005	ηπ possibly seen		278	306
These two could be related, see listings									
$\pi_N(1016) \to K\bar{K}$	$\pi(0^+)$	$1^-(0^+)+$	1016 ±10	~25 } if res.	1.032 ±.025	$K^{\pm}K^0$ ηπ	only mode seen < 80	24 328	110 342
Resonance, virtual bound state, or antibound state, still not distinguished.									
φ(1019)	$\phi(1^-)$	$0^-(1^-)-$	1019.5 ±0.6 S = 1.5*	3.7 ±0.6	1.039 ±.004	K^+K^- K_LK_S $\pi^+\pi^-\pi^0$ (incl. ρπ) e^+e^- $\mu^+\mu^-$ for upper limits see footnote (j)	47.6±1.8 *32.8 ± 1.9 S = 1.5** *19.6 ± 2.3 S = 1.5** 0.036±.006 $0.035^{+.035}_{-.018}$	32 24 605 1018 808	126 109 462 510 499
$\eta_{0+}(1070) \to K_SK_S$	$\eta(0^+)$	$0^+(0^+)+$ if res.	1070§ ±20§ S =2.3*	~ 80 (?) see note (k)	1.14 ±.09	ππ	<65	793	516
Resonance or scattering length both possible.						$K\bar{K}$	>35	76	198
A1(1070) Existence still in doubt	$\pi(1^+)$	$1^-(1^+)+$ ($J^P = 2^-$ not yet excluded)	1070§ ±20§	80§ ±35§	1.14 ±.09	3π see note (ℓ) $K\bar{K}$	≈ 100 < 0.25[$G=(-1)^{\ell+I}$ forbids this]	651	488
B(1220) $J^P = 2^+, 3^-, \ldots$ still poss.	ρ(A) ?	$1^+(1^+)-$	1221 ±16 S=1.2*	123 ±16 S=1.3*	1.46 ±.14	ωπ ππ $K\bar{K}$ for other upper limits see footnote (m)	≈ 100 < 30 } suggests < 2 } $J^P \neq 3^-, 5^-, \ldots$	297 950 240	339 600 360
f(1260)	$\eta'(2^+)$	$0^+(2^+)+$	1264 ±10§	145§ ±25§ S=2.7*	1.57 ±.15	ππ $2\pi^+2\pi^-$ $K\bar{K}$ indic. seen,	large < 4 < 2.5	984 705 267	616 552 388
D(1285) $J^P = 0^-, 1^+, 2^-$ with 1^+ favored	η'(A)	$0^+(A)+$	1285 ±4	31 ±4	1.65 ±.04	$K\bar{K}\pi$(mainly $\pi_N(1016)\pi$) $K^*\bar{K}+\bar{K}^*K$ ππρ	seen not seen	154 -100 256	304 356
$A2_L(1270)$ see footnote(n)	π(N)	$1^-(N)+$	1269 ±5	26 ±7	1.61 ±.03	ρπ (and π+neutrals) ηπ indication suggests J^P = N $K\bar{K}$ indication seen	dominant	364 580	387 504
$A2_H(1315)$ see footnote(n)	$\pi(2^+)$	$1^-(2^+)+$	1315 ±4	24 ±12 S =1.6*	1.73 ±.04	ρπ (and π+neutrals) $K\bar{K}$ ηπ	dominant seen indication seen	410 327 626	420 434 532
E(1420) $J^P = 1^+$ not yet excluded	η(A)	$0^+(0^-)+$	1424 ±6	71 ±10 S=1.2*	2.03 ±.10	$K^*\bar{K}+\bar{K}^*K$ $\pi_N(1016)\pi$ ππη ππρ	50 ± 10 50 ± 10 < 88 not seen	38 268 596 384	157 328 569 455
f' (1515)	$\eta(2^+)$	$0^+(2^+)+$	1514 ±5	73 ±23 S=1.8*	2.29 ±.11	$K\bar{K}$ $K^*\bar{K}+\bar{K}^*K$ ππ ηππ ηη	72 ± 12 (o) 10 ± 10 (o) < 14 18 ± 10 < 40	518 128 1235 686 417	570 294 744 624 522
$\pi_A(1640) \to 3\pi$ Low signal/background; may be partly Deck effect and/or several resonances.	π(A) ?	$1^-(A)+$?	*1633* *±9* S=1.2*	93 ±24	2.73 ±.18	3π †[$\pi^{\pm}\rho^0$/all $\pi^{\pm}\pi^+\pi^-$ †[$\pi^{\pm}f(\to\pi^+\pi^-)$/all $\pi^{\pm}\pi^+\pi^-$ πη $K\bar{K}$ $\pi^{\pm}2\pi^+2\pi^-$	dominant < 40 35±20 < 9 not seen < 10	1245 745 252 966 654 935	797 637 320 727 658 714
$\rho_N(1650)$ ("g" → 2π)	ρ(N) ($J^P = 1^-, 3^-, \ldots$ with 3^- favored)	$1^+(N)-$	1650 (q) ±20	120 (q) ±30	2.72 ±.20	2π $K\bar{K}$ indication seen, (other possible modes see under ρ(1700) below)	dominant < *16*	1385 668	820 667
ρ(1700)? → 4π Not yet clear whether this is just an alternative mode of the $\rho_N(1650)$, or a different resonance. The branching ratios are therefore only tentative.	ρ( )	$1^+(\ )-$	1700 ±20(q)	110 ±25(q)	2.89 ±.19	4π †[$\pi^{\pm}A_2^0(\to\pi^+\pi^-\pi^0)$/all $\pi^{\pm}\pi^+\pi^-\pi^0$ †[$\pi^{\pm}\omega(\to\pi^+\pi^-\pi^0)$/all $\pi^{\pm}\pi^+\pi^-\pi^0$ †[$\rho^{\pm}\rho^0$ $\pi^{\pm}\phi/\pi^{\pm}\pi^+\pi^-\pi^0$ $\pi^{\pm}2\pi^+2\pi^-\pi^0$ 2π (if ≠ $\rho_N(1650)$)	dominant 40±20] 25±10] seen] < 11 < 15 < 10	1141 263 777 170 540 862 1420	792 333 661 371 532 699 838

→ There is no well-established Y = 0 meson resonance with M > 1700 MeV. For a list of some possible states
→ see footnote (p).

	Symbol (J^P)	$I(J^P)$	Mass M (MeV)	Width Γ (MeV)	$M^2 \pm \Gamma M$ (GeV)^2	Mode	Fraction %	Q (MeV)	p or p_{max} (MeV/c)
$K^+(494)$ $K^0(498)$	$K(0^-)$	$1/2(0^-)$	493.82 497.76		0.244 0.248	See Table S			
$K^*(890)$	$K(1^-)$ $m_0 - m_{\pm} = 6.3 \pm 4.1$	$1/2(1^-)$	891.4 ±0.6	49.7 ±1.1 ↳ for charged K^*	0.797 ±.044	Kπ Kππ	≈ 100 < 0.2	259 120	289 216
$K_A(1240)$ or C	K(A) Not well established (footnote (r)). $J^P=2^-$ not yet ruled out completely	$1/2(1^+)$	≈ 1240	≈ 60	1.54 ±.07	Q-Region } Kππ dominant See footnote (r).			
$K_A(1320)$	K(A) $J^P = 2^-$ not yet completely ruled out.	$1/2(1^+)$	≈ 1330	≈ 70	1.77 ±.09				
$K_N(1420)$	$K(2^+)$ $J^P = 3^-$ still possible.	$1/2(2^+)$	*1422* ±4 S=1.3*	90 ±6	2.022 ±.128	Kπ $K^*\pi$ Kρ Kω Kη	51 ± 5 33 ± 3 11 ± 4 3.4± 1.2 2.0± 1.1 } S = 1.5*	787 388 156 143 378	615 413 318 304 482
$K_A(1780)$ or L	K(A) ? $J^P = 1^+, 2^-, 3^+$ favored	1/2(A) ?	1775 ±12 S=1.3*	72 ±26 S=1.4*	3.17 ±.13	Kπ $K^*\pi$ $K_N(1420)\pi$ Kρ Remaining Kππ Kω Upper limits;	< *6* 34 ± 12 19 ± 15 11 ± 9 *28 ± 13* *8 ± 5* Kη < 1%, $K^*\eta$ < 5; Kφ < 5.	1167 772 245 532 1032 519	825 670 317 632 807 624

→ The following bumps, excluded above, are listed among the data cards: σ(410); $\eta_{0+}(720)$; H(990); A1.5(1170); ρρ(1410); $K_SK_S(1440)$; π/ρ(1550), φ(1650), R(1750); η or ρ(1830)→4π; φ or π(1830)→ωππ; S(1930); T(2200); $N\bar{N}_{I=0}(2380)$, U(2380); κ(725); $K_N(1100-1200)$; $K_{A(I=3/2)}(1175)$; $K_{A(I=3/2)}(1265)$; $K_{A(I=1/2)}(1280)$; $K_{N(I=1/2)}(1660)$; $K^*(2240) \to \bar{Y}N$. (See note (p).)

* Quoted error includes scale factor $S = \sqrt{\chi^2/(N-1)}$. See footnote to Table S.

† Square brackets indicate a subreaction of the previous (unbracketed) decay mode.

§ This is only an educated guess; the error given is larger than the error of the average of the published values (see listings for the latter).

(a) ΓM is the half-width of the resonance when plotted against M^2.

(b) For decay modes into ≥ 3 particles p_{max} is the maximum momentum that any of the particles in the final state can have. The momenta have been calculated using the averaged central mass values, without taking into account the widths of the resonances.

(c) The values given for M(ρ) and Γ(ρ) and their errors are not average values from various experiments, but rather are intended to give the range where we believe the actual values are most likely to fall. Contrast the results tabulated in this note:

	M (MeV)	Γ (MeV)	
ρ^0	760±6	112±12	from $e^+e^- \to \pi^+\pi^-$, fits with energy-independent width
ρ^0	754±9	105±20	
ρ^0		105±15	from πN→ππN, ππ phase shift analysis with Chew-Low extrapolation, and energy-independent width
ρ^-	755±5	110± 9	
ρ^-	767±2	135±10	similar, but energy-dependent width and off-shell corrections
ρ^-	764±2	147±4	from πN→ππN, fits in phys. region, energy-dependent width.

Energy-independent width is a narrow-resonance approximation which tends to give lower mass and width. Thus an analysis of all $e^+e^- \to \pi^+\pi^-$ data with Omnès' formula and energy-dependent width gives M = 770±4 MeV, Γ = 122±6 MeV (M. Roos, priv. comm.).

(d) The quoted value of the rate $\rho^0 \to e^+e^-$ is the average from two $e^+e^- \to \pi^+\pi^-$ experiments (which alone give an average of (0.0060±0.0006)%) and one photoproduction experiment of high mass resolution. Interference effects with ω decay are hoped to be small.

(e) Warning: The values given in the literature, and in our table, for the rate $\rho^0 \to \mu^+\mu^-$ may be somewhat too high, due to possible interference with ω decay.

(Footnotes continued on page 124)

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Particle or resonance†	I(J^P) —— = estab.	Beam π, K (BeV) (BeV/c)	Mass (MeV)	Γ (MeV)	$M^2 \pm \Gamma M$ (BeV^2)	Partial decay modes Mode	Fraction (%)	p or $p^{\dagger}_{max}$ (MeV/c)	$4\pi\lambda^2$ (mb)
N									
p n	$1/2(1/2^+)$		938.3 939.6		0.880 0.883		See Table S		
N'(1470)	$1/2(1/2^+)\,P_{11}$	T=0.52πp p=0.64	1460	260	2.13 ±0.38	Nπ Nππ [Nσ][a] [Δπ][a]	55 45 [domin] [seen]	412 360 271 162	28.8
N(1518)	$1/2(3/2^-)\,D_{13}$	T=0.60 p=0.73	1515	115	2.30 ±0.17	Nπ Nππ [Δ(1236)π][a] Nη	50 50 [domin] ~ 0.5	452 406 219 137	23.9
N(1550)	$1/2(1/2^-)\,S_{11}$	T=0.62 p=0.75	1525	80	2.33 ±0.12	Nπ Nη Nππ	35 65 small	459 161 414	23.1
N(1680)	$1/2(5/2^-)\,D_{15}$	T=0.88 p=1.01	1675	145	2.81 ±0.24	Nπ Nππ [Δ(1236)π][a] ΛK Nη	45 55 [?] <1.6 <2.5	564 530 361 209 374	15.4
N(1688)	$1/2(5/2^+)\,F_{15}$	T=0.90 p=1.03	1690	125	2.86 ±0.21	Nπ Nππ [Δ(1236)π][a] ΛK Nη	60 40 [?] <.13 <1.5	574 540 374 234 390	14.9
N'(1710)	$1/2(1/2^-)\,S_{11}$	T=0.95 p=1.08	1715	280	2.94 ±0.48	Nπ	65	590	14.0
N''(1750)	$1/2(1/2^+)\,P_{11}$	T=1.08 p=1.21	1785	405	3.19 ±0.72	Nπ ΛK	34 seen	636	12.1
N(2190)	$1/2(7/2^-)\,G_{17}$	T=1.94 p=2.07	2190	300	4.80 ±0.66	Nπ	35	894	6.21
N(2650)	$1/2(\ ?^-)$	T=3.12 p=3.26	2650	360	7.02 ±0.95	Nπ	$(J+1/2)x=0.45^b$	1154	3.67
N(3030)	$1/2(\ ?\ )$	T=4.26 p=4.40	3030	400	9.18 ±1.21	Nπ	$(J+1/2)x=0.05^b$	1377	2.62
Δ									
Δ(1236)	$3/2(3/2^+)\,P_{33}$ m_0-m_{++} =	T=0.195 p=0.304 0.45±0.85	(++) 1236.0 ±0.6 $m_- - m_{++} = 7.9\pm6.8$	120 ±2	1.53 ±0.15	Nπ $N\pi^+\pi^-$ Nγ	100 0 ~0.6	231 89 262	91.9
Δ(1640)	$3/2(1/2^-)\,S_{31}$	T=0.80 p=0.93	1630	160	2.69 ±0.26	Nπ Nππ	25 75	533	17.2
Δ(1690)	$3/2(3/2^-)\,D_{33}$	T=0.87 p=1.00	1670	225	2.79 ±0.38	Nπ	15	560	15.6
Δ(1910)	$3/2(5/2^+)\,F_{35}$	T=1.27 p=1.40	1880	250	3.53 ±0.47	Nπ	20	697	10.1
Δ(1930)	$3/2(1/2^+)\,P_{31}$	T=1.37 p=1.50	1905	300	3.63 ±0.57	Nπ	25	713	9.62
Δ(1950)	$3/2(7/2^+)\,F_{37}$	T=1.39 p=1.52	1940	210	3.76 ±0.41	Nπ ΣK Σ(1385)K Δ(1236)π Δ(1236)ρ	40 2.4 1.4 ≈ 50 seen	735 450 215 564	8.90
Δ(2420)	$3/2(11/2^+)$	T=2.50 p=2.64	2420	310	5.86 ±0.75	Nπ Nππ	11 > 20	1024 1007	4.67
Δ(2850)	$3/2(\ ?^+\ )$	T=3.71 p=3.85	2850	400	8.12 ±1.14	Nπ	$(J+1/2)x=0.25^b$	1266	3.05
Δ(3230)	$3/2(\ ?\ )$	T=4.94 p=5.08	3230	440	10.4 ±1.4	Nπ	$(J+1/2)x=0.05^b$	1475	2.24
Λ									
Λ	$0(1/2^+)$		1115.6		1.24		See Table S		
Λ(1405)	$0(1/2^-)\,S_{01}$	p<0 K⁻p	1405 ±5[c]	40 ±10[c]	1.97 ±0.06	Σπ	100	140	
Λ(1520)	$0(3/2^-)\,D_{03}$	p=0.392	1518.8 ±1.5	16 ±2	2.31 ±0.02	NK̄ Σπ Λππ Λγ	45±4 }S=1.8* 45±4 10±1 0.9±0.2	235 258 251 350	83.6
Λ'(1670)	$0(1/2^-)\,S_{01}$	p=0.74	1670	25	2.79 ±0.04	NK̄ Λη Σπ	14 33 45	410 66 387	28.5
Λ'(1700)	$0(3/2^-)\,D_{03}$	p=0.78	1690	40	2.86 ±0.07	NK̄ Σπ Λππ Σππ	25 35 ≈ 20 ≈ 20	429 403 419 350	26.1
Λ(1815)	$0(5/2^+)\,F_{05}$	p=1.05	1815 ±5[c]	75 ±10[c]	3.30 ±0.14	NK̄ Σπ Σ(1385)π Λη	65 11 9 ~ 1	538 500 359 346	16.7
Λ(1830)	$0(5/2^-)\,D_{05}$	p=1.08	1830	80	3.35 ±0.15	NK̄ Σπ	10 35	550 510	16.0
Λ(2100)	$0(7/2^-)\,G_{07}$	p=1.68	2100	140	4.41 ±0.29	NK̄ Σπ Λη ΞK Λω	30 4 <3 ~1 <10	748 699 617 483 443	8.68
Λ(2350)	$0(\ ?\ )$ Seen in total c. s.	p=2.29	2350	210	5.52 ±0.49	NK̄	$(J+1/2)x=0.6^b$	913	5.85
Σ									
Σ	$1(1/2^+)$		(+)1189.4 (0)1192.5 (-)1197.3		1.41 1.42 1.43		See Table S		
Σ(1385)	$1(3/2^+)\,P_{13}$	p<0 K⁻p S=4.8*! ←→	(+)1382±1 (-) 1388±3	(+)36±3 S=2.1* (-)38±8, S=3.7*!	1.92 ±0.05	Λπ Σπ	90±3 10±3 S=1.4*	208 117	
Σ(1610)	$1(\ ?\ )$	p=0.62	1615	65	2.61 ±0.10	NK̄ Λπ Σ(1385)π	small domin. mode seen	355 406 171	37.9
Σ(1660)	$1(3/2^-)D_{13}$ Decay modes of these two states not separated yet.	p=0.72	1660	50	2.76 ±0.08	Λ(1405)π NK̄	large small for both	197 400	29.9
Σ(1700)	$1(\ ?\ ?)$	p=0.80	1700	110	2.89 ±0.19	Λπ Σπ	large not disentangled	470 411	25.1
Σ(1765)	$1(5/2^-)D_{15}$	p=0.94	1765 ±5[c]	100 ±15[c]	3.13 ±0.18	NK̄ Λπ Λ(1520)π Σ(1385)π Ση Σπ	46 16 15 15 ~1 ~1	497 519 190 317 140 463	19.4
Σ(1915)	$1(5/2^+)F_{15}$	p=1.24	1905	60	3.63 ±0.11	NK̄ Λπ	10 5	608 615	12.9
Σ(2030)	$1(7/2^+)F_{17}$	p=1.52	2030	120	4.12 ±0.24	NK̄ Λπ Σπ ΞK	10 35 10 <2	700 700 652 412	9.92
Σ(2250)	$1(\ ?\ )$ Seen in total c. s.	p=2.04	2250	200	5.06 ±0.45	NK̄	$(J+1/2)x=0.4^b$	849	6.76
Σ(2455)	$1(\ ?\ )$ Seen in total c. s.	p=2.57	2455	120	6.03 ±0.29	NK̄	$(J+1/2)x=0.3^b$	979	5.08
Σ(2595)	$1(\ ?\ )$ Seen in total c. s.	p=2.95	2595	~ 140	6.73 ±0.36	NK̄	$(J+1/2)x=0.25^b$	1064	4.30
Ξ	$1/2(1/2^+)$		(0)1314.7 (-)1321.3		1.73 1.75		See Table S		
Ξ(1530)	$1/2(3/2^+)$ p-wave		(0)1528.9±1.1 (-)1533.8±1.9	7.3 ±1.7	2.34 ±0.01	Ξπ	100	145	
Ξ(1820)	$1/2(\ ?\ )$		1820	≈20	3.31 ±0.04	ΛK̄ Ξπ Ξ(1530)π ΣK̄	≈60 small ≈10 ≈30(?)	396 413 234 306	
Ξ(1930)	$1/2(\ ?\ )$		1930	110	3.72 ±0.21	Ξπ ΛK̄	large small	499 502	
Ξ(2030)	$1/2(\ ?\ )$		2030	50	4.12 ±0.11	Ξπ ΛK̄ ΣK̄ Ξ(1530)π	small ≈50 ≈50 small	573 587 524 421	
Ω^-	$0(3/2^+)$		1672.4		2.80		See Table S		

(Footnotes are on page 124)

Footnotes for the MESON Table

(f) Reported values range between 1% and 10%, and depend on assumptions on ρ-ω interference.

(g) This $\omega \to e^+e^-$ value is the average from a $\pi^-p \to e^+e^-n$ experiment (giving 0.0040±.0015% [±.0014% from possible $\rho\omega$ interference]) and an $e^+e^- \to \pi^+\pi^-\pi^0$ experiment (giving 0.0085±.0016%).

(h) This 0^- meson was named η' on discovery, when it looked as if it completed the 0^- nonet. With the recent evidence that the E(1420) is probably also 0^-, it is no longer clear whether η', or E or both are mixed in with the π, η, K octet; so the name η' may be misleading.

(i) Empirical limits on fractions for other decay modes of η'(958): $\pi^+\pi^- < 7\%$, $3\pi < 7\%$, $4\pi < 1\%$, $6\pi < 1\%$, $\pi^+\pi^-e^+e^- < 0.6\%$, $\pi^0e^+e^- < 1.3\%$, $\eta e^+e^- < 1.1\%$, $\pi^0\rho^0 < 4\%$, $\pi^0\omega < 8\%$.

(j) Empirical limits on fractions for other decay modes of ϕ(1019): $\pi^+\pi^- < 20\%$, $\eta\gamma < 8\%$, η + neutrals < 13%, $\pi^+\pi^-\gamma < 4\%$, $\omega\gamma < 5\%$, $\rho\gamma < 2\%$.

(k) Width of $\eta_{0+}(1070) \to K_SK_S$: Average value from two bubble chamber experiments is $\Gamma = (72 \pm 13)$ MeV, whereas two spark chamber experiments give $\Gamma > 100$ MeV. The latter also allow a scattering length fit. It is not clear whether the reported narrow ($\Gamma \lesssim 25$ MeV) $\pi^+\pi^-$ enhancements near 1070 MeV have anything to do with the $\eta_{0+}(1070)$.

(ℓ) $\rho\pi$ fraction of 3π mode difficult to distinguish because ρ bands cover most of the Dalitz plot.

(m) Empirical limits on fractions for decay modes of B(1220): $\pi\pi < 30\%$, $K\bar{K} < 2\%$, $4\pi < 50\%$, $\phi\pi < 1.5\%$, $\eta\pi < 25\%$, $(K\bar{K})^{\pm}\pi^0 < 8\%$, $K_SK_S\pi^{\pm} < 2\%$, $K_SK_L\pi^{\pm} < 6\%$.

(n) Although the splitting of the A2 needs further confirmation, we give the results from the two published experiments that have observed a split A2. Since most experiments have only seen one, rather wide, A2 enhancement, we here list its ("combined") properties: $I^G(J^P)C_n = 1^-(2^+)+$; M = 1297±10 MeV (S=1.8*) (§), Γ = 91±10 MeV (S=1.1*) (§); partial decay modes: $\rho\pi$ 86±2%, $K\bar{K}$ 2.4 ± 0.5%, $\eta\pi$ 11±2%, $\eta'\pi$ 0.5±0.4% (S=2.1*); $\pi^+\pi^-\pi^0$ (excl. $\rho\pi$) < 17%.

(o) There is only a weak indication for a $K^*\bar{K} + \bar{K}^*K$ mode of the f'(1514). If this mode does not exist, the $K\bar{K}$ branching fraction will have to be reported as (80±13)% (rather than (72±12)% as given in the table), and $\eta\pi\pi$ as (20±13)%.

(p) See the listings for many statistically weak Y = 0 bumps with M ⩾1700 MeV, seen in bubble chambers. We tabulate here 9 statistically strong bumps seen with a missing mass spectrometer ($\pi^-p \to p(MM)^-$) or in HBC or counter experiments on $N\bar{N}$ elastic scattering or total cross sections.

	Name	I	M (MeV)		Γ (MeV)	Decay Modes Observed	
	R1(1630)	⩾1	1630±15		⩽21	1/3/>3 charg. part. ≈ .37/.59/.04	(MMS)⁻
	R2(1700)	⩾1	1700±15		⩽30	1/3/>3 charg. part. ≈ .43/.56/.01	(MMS)⁻
	R3(1750)	⩾1	1748±15		<38	1/3/>3 charg. part. > .14/<.80/.15	(MMS)⁻
?	$N\bar{N}$(1925)	0, 1	≈1925		≈10	structure in $p\bar{p}$ backw. el. scatt.	(MMS)⁻
?	S(1930)	⩾1	1929±14		<35	1/3/>3 charg. part. ≈ 0/.92/ 0	(MMS)⁻
?	$N\bar{N}$(1945)	0, 1	≈ 1945		≈22	structure in $p\bar{p}$ backw. el. scatt.	
?	$N\bar{N}$(2190)	1	2190±10	! ⇄	≈85	structure in $N\bar{N}$ total cross section	
?	T(2200)	⩾1	2195±15	! ⇄	⩽13	$(MM)^- \to$ 3 charged particl. ≈ 94%	
?	$N\bar{N}$(2345)	1	2345±10	! ⇄	≈140	structure in $N\bar{N}$ total cross section	
?	U(2380)	⩾1	2382±24	! ⇄	⩽30	$(MM)^- \to$ 1/3/>3 chrgd part.≈30/45/25	
	$N\bar{N}$(2380)	0	2380±10		≈140	structure in NN total cross section	

There is no evidence on the G, J, or P quantum numbers of these bumps (apart from the suggestion of ℓ = odd for $N\bar{N}$(1925), ℓ = even for $N\bar{N}$(1945)), nor is there satisfactory agreement between them and the other bubble chamber claims. Further, the $\sigma_{tot}(N\bar{N})$ bumps are broader than the $(MM)^-$ bumps, and there is no evidence for or against their interpretation as resonances.

(q) Taken from compilation by T. Ferbel, Proc. 1968 Philadelphia Conf. See the data listings for averages of the values given in the literature. Also see B. French's review of Mesons (Proc. 14th International Conf. High Energy Physics, Vienna (1968), p. 91) for possible differences between M and Γ of charged and neutral ρ_N(1650).

(r) See note in listings. Some investigators see a broad enhancement in mass ($K\pi\pi$) from 1200 - 1350 MeV, and others see structure. A further bump at 1280 MeV, Γ = 80 MeV, has been suggested. In light of this confusion, the masses, widths, quantum numbers, and branching ratios are at best tentative. For the mass region 1200 - 1350 MeV, the decay rate into $K^*(890)\,\pi$ is large, and a $K\rho$ decay is seen. The $K\eta$, $K\omega$ and $K\pi$ rates are less than a few percent.

(s) This $\eta' \to \gamma\gamma$ value is from a constrained fit under the assumption that $\eta\pi\pi$, $\pi^+\pi^-\gamma$ (inclusive $\rho^0\gamma$), and $\gamma\gamma$ are the only existing decay modes. Note that direct measurement of the $\eta' \to \gamma\gamma$ branching fraction gave the slightly different result of $(5.5^{+3.6}_{-3.0})\%$.

Mixing angles from Quadratic SU(3) Mass Formula: 0^- nonet (π, K, η, η') θ = 10.4° ±0.2°; alternative 0^- nonet (π, K, η, E) θ = 6.2° ±0.1°; 1^- nonet (ρ(m = 765±15 MeV), K^*, ϕ, ω) θ = 39.9±1.1°; 2^+ nonet ($A2_H$, K_N(1420), f', f) θ = 29.9°±2.2°.

Footnotes for the BARYON Table

* Quoted error includes an S(scale) factor. See footnote to Table S.

‡ For decay modes into ⩾ 3 particles p_{max} is the maximum momentum that any of the particles in the final state can have. The momenta have been calculated using the averaged central mass values, without taking into account the widths of the resonances.

a. Square brackets indicate a sub-reaction of the previous unbracketed decay mode.

b. J is not known; x is Γ_{el}/Γ.

c. This is only an educated guess; the error given is larger than the error of the average of the published values (see listings for the latter).

† For the baryon states, the name [such as N(1470)] contains the mass, which shifts by 5 or 10 MeV with each new analysis. We can't keep up with changing labels in the card-listing section, so we don't try. The name (col. 1) is the same as can be found in large print in the listings. The best current value of the mass (col. 4) is what we use to determine the beam parameters, $M^2 \pm \Gamma M$, c.m. decay momenta, etc., that are found in other columns.

→ An arrow at the left of the Table indicates a candidate that has been omitted because the evidence for the existence of the effect and (or) for its interpretation as a resonance is open to considerable question. See listings for information on the following: Δ(1690P$_{33}$, N(1730)D$_{13}$, N(1860)P$_{13}$, N(1980)D$_{13}$, N(2080), N$_?$(3245), N(3690), N(3755), Z$_0$(1865), Z$_1$(1900), Λ(1327), Λ(1745)P$_{01}$, Λ(1750)S$_{01}$, Λ(1860)F$_{07}$, Σ(1440), Σ(1650)S$_{11}$, Σ(1780), Σ(1880), and Ξ(1705).

DATA CARD LISTINGS

STABLE PARTICLES

I.E. IMMUNE TO STRONG DECAY

Data in parentheses have not been included in our averages.

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CODE EVENTS QUANTITY  ERROR+  ERROR-  REFERENCE YR TECN SIGN COMMENTS  DATE
    ABOVE                                                              PUNCHED
  BACKGROUND
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γ

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              0 GAMMA (0,J=1)

              0  GAMMA MASS

M    *     2.0 (10**-21 MEV) OR LESS  PATEL     65                        6/68*

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                          REFERENCES

                          0  GAMMA

PATEL    65 PL 14 105     V. L. PATEL               (NEW HAMPSHIRE)

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ν_e

```
              1  E-NEUTRINO  (0,J=1/2)

              1  E-NEUTRINO  MASS (KEV)

M    *  LESS THAN               0.25     LANGER    52 CNTR
M    *  LESS THAN               0.15     HAMILTON  53 CNTR
M    *  LESS THAN    0.55 +OR-  0.28     FRIEDMAN  58 CNTR

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                          REFERENCES

                          1  E-NEUTRINO  (0,J=1/2)

LANGER   52 PR  88  689   L M LANGER,R J D MOFFAT            (INDIANA)
HAMILTON 53 PR  92  1521  D HAMILTON,W P ALFORD,L GROSS    (PRINCETON)
FRIEDMAN 58 PR 109  2214  LEWIS FRIEDMAN,LINCOLN G SMITH         (BNL)

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ν_μ

```
              2  MU-NEUTRINO  (0,J=1/2)

              2  MU-NEUTRINO  MASS (MEV)

M    *          3.5   OR LESS            BARKAS    56 EMUL
M    *          4.0   OR LESS            DUDZIAK   59 CNTR
M    *          3.6   OR LESS            FEINBERG  63 RVUE                    7/66
M    *          3.0   OR LESS            ALLCOCK   65 RVUE                    7/66
M    *          2.5   OR LESS            BARDON    65 SPRK
M    *          2.1   OR LESS            SHAFER    65 CNTR  CONF LEV = 68PCT  7/66
M               1.6   OR LESS            BOOTH     67 CNTR    90 PERCNT C.L.  3/68*
M               2.2     OR LESS,CL=0.90  HYMAN     67 HEBC    0. K- HE       11/67
M    *        (0.46)    (0.64)   (0.46)  FRANK     68 CNTR     C.L.=0.67      9/68*

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                          REFERENCES
                          2  MU-NEUTRINO  (0,J=1/2)

BARKAS   56 PR 101  778   W H BARKAS,W BIRNBAUM,F M SMITH             (LRL)
DUDZIAK  59 PR 114  336   W F DUDZIAK,R SAGANE,J VEDDER               (LRL)
FEINBERG 63 ARNS 13 431   G FEINBERG, L M LEDERMAN              (COLUMBIA)
ALLCOCK  65 PPSL  85  875 G R ALLCOCK                          (LIVERPOOL)
BARDON   65 PRL  14 449   BARDON,NORTON,PEOPLES + (COLUM+STONY BROOK)
SHAFER   65 PRL  14 923   R E SHAFER,CROWE,JENKINS                    (LRL)
BOOTH    67 PL 26B  39    BOOTH,JOHNSON,WILLIAMS,WORMALD  (LIVERPOOL)
HYMAN    67 PL 25 B 376   +LOKEN,PEWITT,MCKENZIE,KEYES+(ARG+CARN+NWU)
FRANK    68  VIENNA ABS.  365 FRANK,GAMET,LAKIN          (SHAM+LIVP+STAN)

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e

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              3  ELECTRON  (0.5,J=1/2)

              3  ELECTRON  MASS (MEV).

M          0.511006 0.000002          COHEN     65 RVUE

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           3  ELECTRON LIFETIME (UNITS 10**21 YR)

T    *      OVER                    2.0   MOE       65 CNTR                   6/66

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              3  ELECTRON MAGNETIC MOMENT(E/2ME)

MM   *      (1.0011609)(0000024)          SCHUPP    61 CNTR  -
MM   R        1.001159622  +-(27)*10**-9  WILKINSON 63 CNTR  -                8/66
MM   *      (1.001168) (.000011)          RICH      66 CNTR +  POSITRON       8/66
MM            1.001159557  +-(30)*10**-9  RICH      68 CNTR  -                6/68*
MM   R RICH 68 IS REEVALUATION OF WILKINSON 63

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                          REFERENCES
                          3  ELECTRON  (0.5,J=1/2)

SCHUPP   61 PR  121   1   A A SCHUPP,R W PIDD,H R CRANE      (MICHIGAN)
WILKINSO 63 PR 130 852    D T WILKINSON,H R CRANE            (MICHIGAN)
COHEN    65 RMP 37 537    E R COHEN, J W M DUMOND      (NAASC+CALTECH)
MOE      65 PR 140 B 992  M K MOE,F REINES     (CASE INST TECHNOLOGY)
RICH     66 PRL  17  271  A RICH, H R CRANE                  (MICHIGAN)
RICH     68 PRL 20 967    A RICH                             (MICHIGAN)

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μ

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              4  MUON  (106,J=1/2)

              4  MUON  MASS (MEV)

M           105.659    0.002            FEINBERG  63 RVUE
M           . . . . . . . . . .
M    FIT    105.659    0.002     VALUE FROM CONSTRAINED FIT                   6/68*

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              4  MUON LIFETIME (UNITS 10**-6)

T              2.198    0.001     0.001 FARLEY    62 CNTR
T              2.203    0.004           LUNDY     62 CNTR    CONLEV=.98      11/67
T              2.202    0.003     0.003 ECKHAUSE  63 CNTR
T              2.197    0.002     0.002 MEYER     63 CNTR +
T              2.198    0.002     0.002 MEYER     63 CNTR -                   7/66
T           . . . . . . . . . .
T    AVG       2.1983  + .0008   - .0008  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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              4  RATIO OF LIFETIME OF MU+ TO MU-

DT             1.000    0.001            MEYER     63 CNTR  LIFETIME MU+/MU-   7/66

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              4  MUON PARTIAL DECAY MODES

                                                         DECAY MASSES
P1      MUON INTO E (E-NEU) (MU-NEU)                     .5+   0+   0
P2      MUON INTO E 2GAMMA                               .5+   0+   0
P3      MUON INTO 3ELECTRONS                             .5+  .5+  .5
P4      MUON INTO E GAMMA                                .5+   0

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              4  MUON  BRANCHING RATIOS

R1   *  MUON INTO  E+2GAMMA  (IN UNITS OF 10**-5)         (P2)/(P1)
R1   *  LESS THAN                 1.6      FRANKEL 1 63 SPRK

R2   *  MUON INTO 3E (IN UNITS OF 10**-7)                 (P3)/(P1)
R2   *  LESS THAN                 5.0      PARKER 1  62 CNTR
R2   *  LESS THAN                 1.3      ALIKHANOV 62 SPRK
R2   *  LESS THAN                 1.5      FRANKEL 2 63 CNTR
R2   *  LESS THAN                 1.45     BABAEV    63 SPRK

R3   *  MUON INTO  E+GAMMA  (IN UNITS OF 10**-8)          (P4)/(P1)
R3   *  LESS THAN                 1.2      FRANKEL 1 63 SPRK
R3   *  LESS THAN                 0.6      PARKER 2  64 SPRK

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              4  MUON ANOMALOUS MAGN. MOMENT (10**-6*E/(2*MUON MASS))

MM          1162.0       5.0             CHARPAK   62 CNTR +
MM   P     (1165.0)     (3.0)            FARLEY    66 CNTR -  STORAGE RINGS
MM   P     (1166.6)     (0.5)            BAILEY    67 CNTR -  STORAGE RING     6/68*
MM   P     (1166.45)    (0.33)           BAILEY    68 CNTR -  STORAGE RINGS    6/68*
MM          1166.14      0.31            BAILEY1   68 CNTR -  STOR. RINGS.    11/68*
MM   P   BAILEY1 68 IS AN UPDATING OF BAILEY 67 AND FARLEY 66                 6/68*
MM          . . . . . . . . . .
MM   AVG    1166.1241    .3094  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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                          REFERENCES
                          4  MUON  (106,J=1/2)

CHARPAK  61 PRL   6 128      CHARPAK,FARLEY,GARWIN,MULLER,SENS +  (CERN)
HUTCHINS 61 PRL   7 129      D P HUTCHINSON,J MENES +         (COLUMBIA)
ALIKHANO 62 CERN CONF 423    A I ALIKHANOV,A BABAEV +      (ITEP MOSCOW)
CHARPAK  62 PL    1  16      G CHARPAK,F J M FARLEY,R L GARWIN +  (CERN)
FARLEY   62 CERN CONF 415    FARLEY,MASSAM,MULLER,ZICHICHI         (CERN)
LUNDY    62 PR 125 1686      RICHARD A LUNDY                      (EFINS)
PARKER   62 NC  23  485      S PARKER,S PENMAN                    (EFINS)
SHAPIRO  62 PR 125 1022      G SHAPIRO,L M LEDERMAN            (COLUMBIA)

BABAEV   63 JETP 16 1397     BABAEV,BALATS,KAFTANOV,LANDSBERG +   (ITEP)
ECKHAUSE 63 PR 132  422      M ECKHAUSE,T A FILIPPAS +         (CARNEGIE)
FEINBERG 63 ARNS 13 431      GERALD FEINBERG, L M LEDERMAN     (COLUMBIA)
FRANKEL  63 NC  27  894      S FRANKEL,W FRATI,J HALPERN +        (PENNA)
FRANKEL  63 PR 130  351      S FRANKEL,W FRATI,J HALPERN +        (PENNA)
MEYER    63 PR  132  2693    S L MEYER,ANDERSCN,BLESER,LEDERMAN+ (COLUM)
PARKER   64 PR 133B 768      S PARKER,H L ANDERSON,C REY          (EFINS)

FARLEY   66 NC  45A  281     FARLEY,BAILEY,BROWN,GIESCH +          (CERN)
BAILEY   67 SLAC CONF. 48    +BARTL,BROWN,PICASSO,FARLEY +         (CERN)
BAILEY   68 WASH MTNG, APS   +BARTL,BROWN,PICASSO,FARLEY +         (CERN)
BAILEY1  68  VIENNA ABS.  405 +BARTL,VON BOCHMANN,BROWN,FARLEY+    (CERN)


   OLD REFERENCES NOT REFERRED TO IN DATA CARDS

FISHER   59 PRL  3  349      FISHER,LEONTIC,LUNDBY,MEUNIER,STROOT (CERN)
ASTBURY  60 ROCH CONF 60 542 ASTBURY,HATTERSLEY,HUSSAIN +   (LIVERPOOL)
DEVONS   60 PRL  5  330      DEVONS,GIDAL,LEDERMAN,SHAPIRO    (COLUMBIA)
LATHROP  60 NC    17 109     J LATHROP,R A LUNDY,V L TELEGDI +   (EFINS)
LATHROP  60 NC    17 114     J LATHROP,R A LUNDY,S PENMAN +      (EFINS)
REITER   60 PRL   5  22      REITER,ROMANOWSKI,SUTTON +       (CARNEGIE)
TELEGDI  60 ROCH CONF 60 713 V L TELEGDI                           (CERN)

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$\pi^{\pm}$

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              8  CHARGED PION  (140,JPG=0--)  I=1

              8  CHARGED PI  MASS (MEV)

M           139.37     0.20             CROWE     54 CNTR  -
M           139.68     0.15             BARKAS    56 EMUL +
M           139.577    0.013            SHAFER    67 CNTR    MESONIC ATOMS    6/68*
M           . . . . . . . . . .
M    AVG    139.5769    .0129  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
M    FIT    139.578    0.013    VALUE FROM CONSTRAINED FIT                    6/68*

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STABLE PARTICLES

Data in parentheses have not been included in our averages.

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                    8  PI+ MU+ MASS DIFFERENCE (MEV)

D              34.00      0.076           BARKAS     56 EMUL
D              33.89      0.076           BARKAS     56 EMUL
D              . . . . . . . . . .
D    AVG       33.9450     .0550   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
D    FIT       33.920     0.013     VALUE FROM CONSTRAINED FIT                     6/68*

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                    8  CHAR.PI LIFETIME (UNITS 10**-9)

T              25.6       0.5        0.5   CROWE      57 RVUE
T              25.6       0.8        0.8   ANDERSON   60 CNTR
T      8000    25.46      0.32       0.32  ASHKIN     60 CNTR +
T    *                                     MERRISON   62 RVUE
T              26.02      0.04             ECKHAUSE   65 CNTR +                   9/66
T              25.6       0.3              BARDON     66 CNTR                     6/66
T              25.9       0.3              DUNAITSEV  66 CNTR                     6/68*
T    N        (26.40)    (0.08)            KINSEY     66 CNTR +                   6/66
T    N    SYSTEMATIC ERRORS IN CALIBR.IN THIS EXP. DISCUSSED BY NORDBERG 67       8/67
T              26.67      0.24             LOBKOWICZ  66 CNTR                     9/66
T              26.6       0.2              AYRES      67 CNTR                    10/66
T              26.04      0.05             NORDBERG   67 CNTR +                   8/67
T              . . . . . . . . . .
T    AVG       26.0404  + .0688  - .0686  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.3
                          (SEE IDEOGRAM BELOW )
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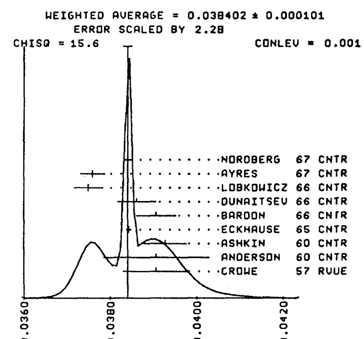

CHARG PI DECAY RATE (UNITS 10**9 SEC-1)

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                    8 MEANLIFE DIFFERENCE,(+)-(-)/AVGE. (PERCENT)

DT   N    THIS QUANTITY IS A MEASURE OF CPT INVARIANCE IN W.I.

DT             0.23      0.40            LOBKOWICZ 66 CNTR     SEE NOTE L        9/66
DT   L    ABOVE IS THE MOST CONSERVATIVE VALUE QUOTED BY AUTHORS                  9/66
DT             0.4       0.7             BARDON    66 CNTR                        7/66
DT             0.56      0.28            AYRES     67 CNTR                       10/66
DT             0.064     0.069           AYRES     68 CNTR     NEW EXPERIMENT     8/68*
DT            -0.14      0.29            PETRUKHIN 68 CNTR                        8/68*
DT             . . . . . . . . . .
DT   AVG        .0871     .0713  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

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                    8  CHARGED PION PARTIAL DECAY MODES

                                                              DECAY MASSES
P1       CHAR.PION INTO MU (MU-NEU)                          105+   0
P2       CHAR.PION INTO E (E-NEU)                             .5+   0
P3       CHAR.PION INTO MU (MU-NEU) GAMMA                    105+   0+    0
P4       CHAR.PION INTO PIO E (E-NEU)                        134+  .5+    0
P5         CHAR.PION INTO E NEU GAMMA                         .5+   0+    0

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                    8  CHARGED PION BRANCHING RATIOS

R1   *   CHAR.PION INTO MU NEU GAMMA  (UNITS 10**-4)       (P3)/(P1)
R1       26     1.24      0.25            CASTAGNOL 58 EMUL    E(MU).LT.3.38 MV

R2   *   CHAR.PION INTO E NEU         (UNITS 10**-4)       (P2)/(P1)
R2              1.21      0.07            ANDERSON  60 CNTR
R2              1.247     0.028           DI CAPUA  64 CNTR
R2             . . . . . . . . . .
R2   AVG        1.2419    .0260   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R3   *   CHAR.PION INTO PIO E NEU     (UNITS 10**-8)       (P4)/(P1)
R3       36     0.97      0.20            BARTLETT  64 SPRK
R3       38     1.07      0.21            BACASTOW  65 SPRK +
R3              1.10      0.26            BERTRAM   65 SPRK                       6/66
R3       43     1.1       0.2             DUNAITSEV 65 CNTR                       7/66
R3      332     1.00      0.08      0.10  DEPOMMIER 68 CNTR                       3/68*
R3             . . . . . . . . . .
R3   AVG        1.0228    .0689   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R4   *     CHAR.PION INTO E NEU GAMMA (UNITS 10**-8)       (P5)/(P1)
R4      143     3.0       0.5             DEPOMMIER 63 CNTR    GAM KE 50-90 MEV   6/66

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                              REFERENCES
                              8 CHARGED PION (140,JPG=0--)I=1

CROWE     54 PR  96  470      K M CROWE,R H PHILLIPS                   (LRL)
BARKAS    56 PR 101  778      W H BARKAS,W BIRNBAUM,F M SMITH          (LRL)
CROWE     57 NC   5  541      K M CROWE                      (STANFORD HEPL)
CASTAGNO  58 PR 112 1779      C CASTAGNOLI,M MUCHNIK              (ROME I F)

ANDERSON  60 PR 119 2050      H L ANDERSON,T FUJII,R H MILLER +    (EFINS)
ASHKIN    60 NC  16  490      ASHKIN,FAZZINI,FIDECARO,LIPMAN +      (CERN)
MERRISON  62 ADVP 11 1        A W MERRISON                     (LIVERPOOL)
SHAPIRO   62 PR 125 1022      G SHAPIRO,L M LEDERMAN             (COLUMBIA)

CZIRR     63 PR 130  341      JOHN B CZIRR                              (LRL)
DEPOMMIE  63 PL  7  285       P DEPOMMIER,HEINTZE,RUBBIA,SOERGEL       (CERN)
BARTLETT  64 PR 136B 1432     BARTLETT,DEVONS,MEYER,ROSEN          (COLUMBIA)
DI CAPUA  64 PR 133B 1333     DI CAPUA,GARLAND,PONDROM,STRELZOFF    (COLUM)

BACASTOW  65 PR 139 B407      +GHESQUIERE,WIEGAND,LARSEN           (LRL+SLAC)
BERTRAM   65 PR 139 B 617     BERTRAM,MEYER,CARRIGAN+       (MICH+CARNEGIE)
CLINE     65 PL   15  293     A CLINE,W F FRY                     (WISCONSIN)
DUNAITSE  65 JETP 20 58       DUNAITSEV,PETRUKHIN,PROKOSHKIN +      (DUBNA)
ECKHAUSE  65 PL 19 348        ECKHAUSE,HARRIS,SHULER+  (WILLIAM AND MARY)

BARDON    66 PRL 16 775       BARDON,DORE,DORFAN,KRIEGER +      (COLUMBIA)
DUNAITSE  66 PL 23 283        +KUTYIN,PROKOSHKIN,RASUVAEV,SIMONOV (DUBNA)
KINSEY    66 PR 144   1132    KINSEY,LOBKOWICZ,NORDBERG (ROCHESTER UNIV)
LOBKOWIC  66 PRL  17  548     LOBKOWICZ,MELISSINOS,NAGASHIMA+ (ROCH+BNL)

AYRES     67 PL 24B  483      D S AYRES,CALDWELL,GREENBERG,KURZ+      (LRL)
 ALSO     67 PR  157  1288    AYRES,CALDWELL,GREENBERG,KENNEY,KURZ+ (LRL)
NORDBERG  67 PL 24B  594      NORDBERG,LOBKOWICZ,BURMAN  (ROCHESTER UNIV)
SHAFER    67 PR 163 1451      ROBERT E. SHAFER                        (LRL)
  SEE ALSO  PRL 14 923        SHAFER,CROWE,JENKINS                    (LRL)

AYRES     68 PRL 21 261       AYRES,CORMACK,GREENBERG,KENNEY+  (LRL,UCSB)
DEPOMMIE  68 NUC PHYS B4 189  DEPOMMIER,DUCLOS,HEINTZE,KLEINKNECHT+(CERN)
PETRUKHI  68 JINR-P1-3862     PETRUKHIN,RYKALIN,KHAZINS,CISEK       (DUBNA)

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π^0

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                    9  NEUTRAL PION  (135,JPG=0--)  I=1

                    9  PI MASS DIFFERENCE (PI+-)-(PIO)(MEV)

D    *       (5.37)    (1.0)          PANOFSKY  51 CNTR  -
D             4.50      0.31          CHINOWSKY 54 CNTR  -
D             4.62      0.05          HADDOCK   59 CNTR  -
D             4.60      0.04          HILLMAN   59 CNTR
D             4.55      0.07          CASSELS   59 CNTR
D             4.6056    0.0055        CZIRR     63 CNTR
D             4.59      0.03          PETRUKHIN 63 CNTR  -
D             4.6034    0.0052        VASILEVSK 66 CNTR  -                         9/66
D             . . . . . . . . . .
D    AVG      4.6041     .0037  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    9  PIO  LIFETIME (UNITS 10**-16)

T    N   76   (1.9)     (0.5)     (0.5)  GLASSER   61 EMUL
T    N   45   (2.3)     (1.1)     (1.0)  TIETGE    62 EMUL
T    N   88   (2.8)     (0.9)     (0.9)  KOLLER    63 EMUL    SEE STAMER 66
T              1.05      0.18      0.18  VON DARDE 63 CNTR
T    N   75   (1.7)     (0.5)            SHWE      64 EMUL
T              0.730     0.105           BELLETTIN 65 CNTR                         6/66
T    N   67   (1.6)     (0.6)     (0.5)  EVANS     65 EMUL                         6/66
T    N   OLD EMULSION MEASUREMENTS NOT USED BECAUSE OF POSSIBLE SYSTEMATIC
T    N        SHIFT TO LARGER LIFETIME VALUES
T   K   232    1.0       0.5             STAMER    66 EMUL                         8/67
T   K     INCLUDES EVENTS OF KOLLER 63                                             8/67
T    *        (0.6)     (0.2)     (0.08) BRAUNSCHW 68 CNTR     PRIMAKOFF EFF.      9/68*
T             . . . . . . . . . .
T    AVG       .8931   + .1815   - .1446  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)
                          (SEE IDEOGRAM BELOW )
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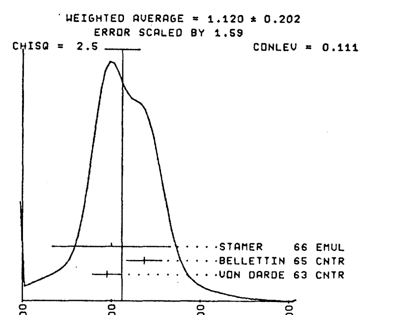

NEUTRAL PI DECAY RATE(UNITS 10**16SEC-1)

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                    9  NEUTRAL PION PARTIAL DECAY MODES

                                                             DECAY MASSES
P1       PIO INTO 2GAMMA                                      0+    0
P2       PIO INTO E+ E- GAMMA                                .5+   .5+    0
P3       PIO INTO 4ELECTRONS                                 .5+   .5+   .5+   .5
P4       PIO INTO 3 GAMMA                                     0+    0+    0

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                    9  NEUTRAL PION BRANCHING RATIOS

R1   *   PIO INTO (GAMMA E+ E-)/(2GAMMA)                       (P2)/(P1)
R1   *       0.01196 THEORETICAL CALC.JOSEPH     61        QUANTUM ELECT.     9/66
R1      27   0.0117   0.0015          BUDAGOV    60 HBC
R1    3071   0.01166  0.00047         SAMIOS     61 HBC     PI-P TO PIO N
R1   S      SAMIOS VALUE USES PANOFSKY RATIO = 1.62
R1          . . . . . . . . . .
R1   AVG        .0117    .0004  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R2   *     PIO INTO (3 GAMMA)/(2 GAMMA) (UNITS 10**-6)    (P4)/(P1)
R2   *     0     5.0 OR LESS               DUCLOS     65 CNTR    CL=90 PERCENT      6/66
R2               5.0   OR LESS             KUTIN      65 CNTR    90 PERCNT  C.L.    3/68*

R3   *     PIO INTO (E+E+E-E-)/(2 GAMMA) (UNITS 10**-5)   (P3)/(P1)
R3   *           3.47   THEORETICAL CAL. KROLL       55          QUANTUM ELECT.     9/66

R3       146     3.18      0.30            SAMIOS     62 HBC     SEE NOTE N BELOW   6/66
R3   N        ABOVE VALUE USES PANOFSKY RATIO=1.62

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STABLE PARTICLES

Data in parentheses have not been included in our averages.

REFERENCES
9 NEUTRAL PION (135,JPG=0--)I=1

PANOFSKY 51 PR 81 565 W K H PANOFSKY,R L AAMODT,J HADLEY (LRL)
CHINOWSK 54 PR 93 586 W CHINOWSKY,J STEINBERGER (COLUMBIA)
KROLL 55 PR 98 1355 N KROLL ,W WADA (COLUMBIA+NRLW)
CASSELS 59 PPS 74 92 CASSELS,JONES,MURPHY,O.NEILL (LIVERPOOL)
HADDOCK 59 PRL 3 478 HADDOCK,ABASHIAN,CROWE,CZIRR (LRL)
HILLMAN 59 NC 14 887 HILLMAN,MIDDELKOOP,YAMAGATA,ZAVATTINI(CERN)

BUDAGOV 60 JETP 11 755 BUDAGOV,VIKTOR,DZHELEPOV,ERMOLOV + (JINR)
JOSEPH 60 NC 16 997 D W JOSEPH (EFI)
GLASSER 61 PR 123 1014 R G GLASSER,N SEEMAN,B STILLER (NRL)
SAMIOS 61 PR 121 275 N P SAMIOS (COLUMBIA+BNL)
SAMIOS 62 PR 126 1844 SAMIOS,PLANO,PRODELL + (COLUMBIA+BNL)
TIETGE 62 PR 127 1324 J TIETGE,W PUESCHEL (MAX PLANCK INST)

CZIRR 63 PR 130 341 JOHN B CZIRR (LRL)
KOLLER 63 NC 27 1405 E L KOLLER,S TAYLOR,T HUETTER (STEVENS)
KOLLER 63 SEE ALSO STAMER 66
PETRUKHI 63 SIENA CONF 208 V I PETRUKHIN,YU D PROKOSHKIN (JINR)
VON DARD 63 PL 4 51 VON DARDEL,DEKKERS,MERMOD,VAN PUTTEN+(CERN)

SHWE 64 PR 136B 1839 H SHWE,F M SMITH,W H BARKAS (LRL)
BELLETTI 65 NC 40 A 1139 BELLETTINI,BEMPORAD,BRACCINI+(PISA+FIRENZE)
DUCLOS 65 PL 19 253 DUCLOS,FREYTAG,HEINTZE + (CERN+HEIDELBERG)
EVANS 65 PR 139 B 982 D A EVANS (OXFORD)
KUTIN 65 JETP LETT 2 243 KUTIN,PETRUKHIN,PROKOSHKIN (JINR)

STAMER 66 PR 151 1108 STAMER,TAYLOR,KOLLER,HUETTER+ (STEVENS)
VASILEVS 66 PL 23 281 VASILEVSKY,VISHNYAKOV,DUNAITSEV + (DUBNA)

BRAUNSCH 68 VIENNA ABS. 297 BRAUNSCHWEIG,HUSMANN,LUBELSMEYER+ (BONN)

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$K^{\pm}$

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         10  CHARGED K  (494,JP=0-)  I=1/2

         10  CHARGED K  MASS (MEV)

M           493.9      0.2            COHEN     57 RVUE +
M           493.7      0.3            BARKAS    63 EMUL  -
M           493.78     0.17           GREINER   65 EMUL +  VIA TAU DECAY    7/66
M           . . . . . . . . . .
M   AVG     493.8099    .1189   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
M   FIT     493.82     0.11       VALUE FROM CONSTRAINED FIT                6/68*
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         10  CHAR.K  LIFETIME (UNITS 10**-8)
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          CHARGED K CONSTRAINED FIT
        OVERALL FIT OF LIFETIME, WIDTHS AND BRANCHING
        RATIOS USES 45 DATA POINTS TO DETERMINE SEVEN
        QUANTITIES.  OVERALL FIT HAS  CHISQ=71.  MAIN
        CONTRIBUTION (12.7) COMES FROM R19 OF AACHEN2
        68 (WE SEE NO REASON TO REJECT THIS EXPERIMENT
        AT THIS TIME)
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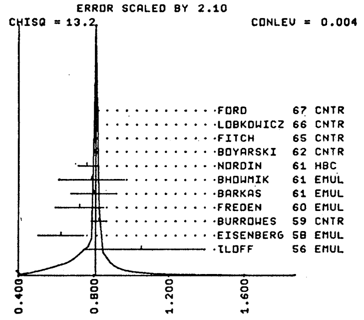
T   *    CHAR. K LIFETIME
T           0.95      0.36     0.25  ILOFF     56 EMUL
T      52   1.60      0.3      0.3   EISENBERG 58 EMUL
T           1.21      0.06     0.06  BURROWES  59 CNTR
T      33   1.38      0.24     0.24  FREDEN    60 EMUL
T           1.25      0.22     0.17  BARKAS    61 EMUL
T      51   1.27      0.36     0.23  BHOWMIK   61 EMUL
T     293   1.31      0.08     0.08  NORDIN    61 HBC   -
T   *      (1.24)    (0.07)          NORDIN    61 RVUE  -
T           1.231     0.011    0.011 BOYARSKI  62 CNTR +
T           1.2443    0.0038         FITCH     65 CNTR +                6/66
T           1.2265    0.0036         LOBKOWICZ 66 CNTR +                9/66
T           1.221     0.011          FORD      67 CNTR +-               8/67
T   G      (1.244)   (0.005)         GIACOMELL 67 CNTR +                8/67
T   G    GIACOMELLI 67 VALUE JUST A CHECK ON APPARATUS
T           . . . . . . . . . .
T   AVG     1.2343  + .0052  - .0052  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.1)
T   FIT      .810     .003     VALUE FROM CONSTRAINED FIT
                         (SEE IDEOGRAM BELOW )
```

WEIGHTED AVERAGE = 0.81016 ± 0.00341
ERROR SCALED BY 2.10



CHARGED K DECAY RATE (UNITS 10**8 SEC-1)

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          10 LIFETIME DIFFERENCE,(+)-(-)/AVGE. (PERCENT)

DT  N   THIS QUANTITY IS A MEASURE OF CPT INVARIANCE IN W.I.

DT         0.049     0.097          LOBKOWICZ 66 CNTR    SEE NOTE L      9/66
DT  L   ABOVE IS THE MOST CONSERVATIVE VALUE QUOTED BY AUTHORS           9/66
DT         0.47      0.30           FORD      67 CNTR                    8/67
DT         . . . . . . . . . .
DT  AVG       .0888     .1232 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
------ --------- --------- --------- --------- --------- --------- --------

          10  DECAY RATES DIFF.,(+)-(-)/AV.  (PERCENT)

D1  *  DIFFERENCE IN K MU2 RATES ((W1+)-(W1-))/W1
D1        -0.54      0.41           FORD      67 CNTR                    8/67

D2  *  DIFFERENCE IN TAU RATES   ((W2+)-(W2-))/W2
D2        -0.04      0.21           FORD      67 CNTR                    8/67
D2        -0.50      0.90           FLETCHER  67 SPRK                    8/67
D2         . . . . . . . . . .
D2  AVG      -.0638     .2045  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

D3  *  DIFFERENCE IN TAU PRIME RATES ((W4+)-(W4-))/AVERAGE
D3  *     (-0.007)  (0.016)         HERZO     68                        10/68*
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          10  CHARGED K PARTIAL DECAY MODES

                                                        DECAY MASSES
P1     CHAR. K INTO MU (NEU)                 K MU2         105+   0
P2     CHAR. K INTO PI PIO                   K PI2         139+ 134
P3     CHAR. K INTO PI PI+ PI-               TAU           139+ 139+ 139
P4     CHAR. K INTO PI 2PIO                  TAU PRIME     139+ 134+ 134
P5     CHAR. K INTO MU PIO NEU               K MU3         105+ 134+   0
P6     CHAR. K INTO E PIO NEU                K E3           .5+ 134+   0
P7     POSIT.K INTO PI+ PI- E+NEU            K E+ 4        139+ 139+  .5+  0
P8     POSIT.K INTO PI+ PI+ E-NEU            K E- 4        139+ 139+  .5+  0
P9      POSIT.K INTO PI+ PI- MU+ NEU         K+MU+ 4       139+ 139+ 105+  0
P10     POSIT.K INTO PI+ PI+ MU- NEU         K+MU- 4       139+ 139+ 105+  0
P11     CHAR. K INTO E NEU                   K E 2          .5+   0
P12     CHAR. K INTO MU NEU GAMMA            K MU RAD      105+   0+   0
P13     CHAR. K INTO PI PIO GAMMA            K PI RAD      139+ 134+   0
P14     CHAR. K INTO PI PI+ PI- GAMMA        TAU RAD       139+ 139+ 139+  0
P15     CHAR. K INTO PI E+ E-                PI E E        139+  .5+  .5
P16     CHAR. K INTO PI MU+ MU-              PI MU MU      139+ 105+ 105
P17     CHAR. K INTO PI GAMMA GAMMA          PI GAM GAM    139+   0+   0
P18     CHAR. K INTO PI E NEUTRINO GAMMA     PI E NEU GAM  139+  .5+  0+   0
P19     NEG.  K INTO PI+ E- E-               PI+E-E-       139+  .5+  .5
P20    CHAR. K INTO PI NEU NEU               PI NEU NEU    139+   0+   0
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          10  CHARGED K DECAY RATES

W1  *  CHAR. K INTO MU NEU (K MU)      (UN. 10**6 SEC-1) (P1)
W1          51.2       0.8          FORD       67 CNTR +-                8/67
W1         . . . . . . . . . .
W1  FIT     51.542     .297    VALUE FROM CONSTRAINED FIT

W2  *  CHARG. K INTO PI PI+ PI- (TAU) (UN. 10**6 SEC-1) (P3)
W2          4.496      0.030        FORD       67 CNTR +-                8/67
W2         . . . . . . . . . .
W2  FIT     4.515      .028    VALUE FROM CONSTRAINED FIT
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          10  CHARGED K BRANCHING RATIOS

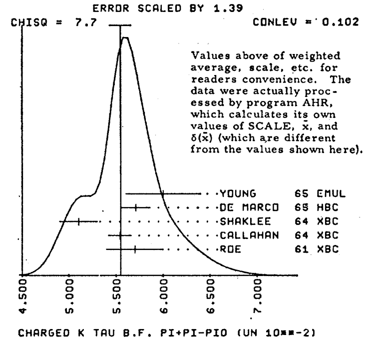
R   O      OLD DATA EXCLUDED

R1  *  CHAR. K INTO MU NEU (MU2)       (UNITS 10**-2)     (P1)/TOTAL
R1  O       (58.5)    (3.0)         BIRGE      56 EMUL +
R1  O       (56.9)    (2.6)         ALEXANDER 57 EMUL +
R1         . . . . . . . . . .
R1  FIT     63.650     .286    VALUE FROM CONSTRAINED FIT

R2  *  CHAR. K INTO PI PIO (PI2)       (UNITS 10**-2)     (P2)/TOTAL
R2  O       (27.7)    (2.7)         BIRGE      56 EMUL +
R2  O       (23.2)    (2.2)         ALEXANDER 57 EMUL +
R2  *       (21.0)    (0.6)         CALLAHAN   65 PBC     SEE R17
R2  *       (21.6)    (0.6)         TRILLING   65 RVUE                   6/66
R2         . . . . . . . . . .
R2  FIT     21.033     .301    VALUE FROM CONSTRAINED FIT

R3  *  CHAR. K INTO PI PI+ PI-(TAU)    (UNITS 10**-2)     (P3)/TOTAL
R3  O        (5.6)    (0.4)         BIRGE      56 EMUL +
R3  O        (6.8)    (0.4)         ALEXANDER 57 EMUL +
R3  O        (5.2)    (0.3)         TAYLOR     59 EMUL +
R3            5.7      0.3          ROE        61 XBC  +                 9/66
R3     2332   5.54     0.12         CALLAHAN   64 XBC  +
R3      540   5.1      0.2          SHAKLEE    64 XBC  +                 9/66
R3            5.71     0.15         DE MARCO   65 HBC                    6/66
R3       44   6.0      0.4          YOUNG      65 EMUL +                 6/66
R3         . . . . . . . . . .
R3  AVG       5.5477   .1112  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
R3  FIT       5.575    .039    VALUE FROM CONSTRAINED FIT
                         (SEE IDEOGRAM BELOW )
```

WEIGHTED AVERAGE = 5.548 ± 0.111
ERROR SCALED BY 1.39



CHARGED K TAU B.F. PI+PI-PIO (UN 10**-2)

Data in parentheses have not been included in our averages.

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R4  *  CHAR. K INTO PI 2PIO (TAU PRIME)(UNITS 10**-2)   (P4)/TOTAL
R4  0        (2.1)    (0.5)          BIRGE      56 EMUL +
R4  0        (2.2)    (0.4)          ALEXANDER 57 EMUL +
R4  0        (1.5)    (0.2)          TAYLOR     59 EMUL +
R4            1.7      0.2           ROE        61 XBC  +                 11/67
R4     108    1.8      0.2           SHAKLEE    64 XBC  +                 11/67
R4          . . . . . . . . .
R4  AVG       1.7500   .1414  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R4  FIT       1.703    .048    VALUE FROM CONSTRAINED FIT

R5  *  CHAR. K INTO MU PIO NEU (MU3) (UNITS 10**-2)     (P5)/TOTAL
R5  0        (2.8)    (1.0)          BIRGE      56 EMUL +
R5  0        (5.9)    (1.3)          ALEXANDER 57 EMUL +
R5  0        (2.8)    (0.4)          TAYLOR     59 EMUL +
R5          . . . . . . . . .
R5  FIT       3.182    .141    VALUE FROM CONSTRAINED FIT

R6  *  CHAR. K INTO E PIO NEU (E3)   (UNITS 10**-2)     (P6)/TOTAL
R6  0        (3.2)    (1.3)          BIRGE      56 EMUL +
R6  0        (5.1)    (1.3)          ALEXANDER 57 EMUL +
R6            5.0      0.5           ROE        61 XBC  +                 11/67
R6     429    4.7      0.3           SHAKLEE    64 XBC  +                 11/67
R6          . . . . . . . . .
R6  AVG       4.7794   .2572  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R6  FIT       4.858    .073    VALUE FROM CONSTRAINED FIT

R7  *  POSIT.K INTO PI+ PI- E+ NEU   (UNITS 10**-5)     (P7)/TOTAL

R8  *  POSIT.K INTO PI+ PI+ E- NEU   (UNITS 10**-7)     (P8)/TOTAL
R8          20.     OR LESS          BIRGE      65 FBC  +  95 PER CT CONF   8/66
R8      0    7.0    OR LESS          ELY        68 HLBC          CL=95 PC. 11/68*

R9  *   POSIT.K INTO PI+ PI- MU+ NEU (UNITS 10**-5)     (P9)/TOTAL
R9      1   0.77     0.54     0.50  CLINE      65 FBC  +                   8/66

R10 *   POSIT.K INTO PI+ PI+ MU- NEU (UNITS 10**-6)     (P10)/TOTAL
R10     0   3.0 OR LESS.             BIRGE      65 FBC  +  95 PER CT CONF   8/66

R11 *   CHAR. K INTO E NEU           (UNITS 10**-5)     (P11)/TOTAL
R11 *      160.0   OR LESS           BORREANI  64 HBC  +  CONLEV=0.95      11/67
R11     4   2.1      1.8       1.3  BOWEN      67 SPRK +                   8/67
R11 *   BOWEN RESULT SHOULD BE CORRECTED TO 1.9(+1.7,-1.2) BECAUSE OF
R11 *   K+ TO E+ NEU GAMMA DECAYS BEFORE COMPARING WITH BOTTERILL 67 R28

R12 *   CHAR. K INTO MU NEU GAMMA    (UNITS 10**-5)     (P12)/TOTAL

R13 *   CHAR. K INTO PI PIO GAMMA    (UNITS 10**-4)     (P13)/TOTAL
R13 *   18  (2.2)   (0.7)            CLINE      64 FBC  +  PI+ KE 55-80 MEV 8/66

R14 *   CHAR. K INTO PI PI+ PI- GAMMA(UNITS 10**-4)     (P14)/TOTAL
R14         1.0      0.4             STAMER     65 EMUL +                   8/66

R15 *   CHAR. K INTO PI E+ E-        (UNITS 10**-6)     (P15)/TOTAL
R15     1   1.1   OR LESS            CAMERINI  64 FBC  +                   8/66
R15 *       0.4   OR LESS            CLINE      67 FBC  +                  11/67
R15         4.4   OR LESS            BISI       67 DBC  +  90 PER CT CONF  11/67

R16 *   CHAR. K INTO PI MU+ MU-      (UNITS 10**-6)     (P16)/TOTAL
R16         3.0   OR LESS            CAMERINI  65 FBC  +  90 PER CT CONF   8/66
R16         2.4   OR LESS            BISI       67 DBC  +  90 PER CT CONF  11/67

R17 *   CHAR. K INTO (PI PIO)/TAU                        (P2)/(P3)
R17    134    3.24     0.34          YOUNG      65 EMUL +                   8/66
R17   1045    3.96     0.15          CALLAHAN  66 FBC  +                   9/66
R17         . . . . . . . . .
R17 AVG       3.8427   .2659  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.9)
R17 FIT       3.772    .062    VALUE FROM CONSTRAINED FIT

R18 *   CHAR. K INTO (PI 2PIO)/TAU                       (P4)/(P3)
R18   2027    0.303    0.009         BISI       65 H+HL +                   8/66
R18     17    0.393    0.099         YOUNG      65 EMUL +                   8/66
R18         . . . . . . . . .
R18 AVG       .3037    .0090  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R18 FIT       .305     .008    VALUE FROM CONSTRAINED FIT

R19 *   CHAR. K INTO (MU PIO NEU)/TAU                    (P5)/(P3)
R19   2175    0.632    0.035         BISI       65 H+HL +                   8/66
R19     38    0.90     0.16          YOUNG      65 EMUL +                   8/66
R19   1505    0.510    0.017         AACHEN 2  68 HLBC +                  11/68*
R19         . . . . . . . . .
R19 AVG       .5366    .0478  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 3.1)
R19 FIT       .571     .025    VALUE FROM CONSTRAINED FIT
                     (SEE IDEOGRAM BELOW )
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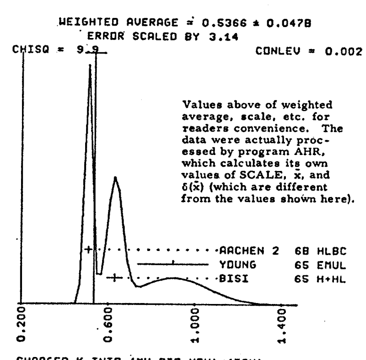


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R20 *   CHAR. K INTO (E PIO NEU)/TAU                     (P6)/(P3)
R20    230    0.90     0.06          BORREANI  64 HBC  +                   8/66
R20     37    0.90     0.16          YOUNG      65 EMUL +                   8/66
R20    854    0.94     0.09          BELLOTT2  67 HLBC                    11/67
R20   4385    0.846    0.021         AACHEN 2  68 HLBC +                  11/68*
R20         . . . . . . . . .
R20 AVG       .8566    .0192  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R20 FIT       .871     .013    VALUE FROM CONSTRAINED FIT

R21 *   POSIT.K INTO (PI+ PI- E+ NEU)/TAU(UNITS 10**-4)(P7)/(P3)
R21     69    6.7      1.5           BIRGE      65 FBC  +                   8/66
R21    269    5.90     0.65          ELY        68 HLBC                    11/68*
R21         . . . . . . . . .
R21 AVG       6.0265   .5964  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R22 *   POSIT.K INTO (PI+ PI- MU+ NEU)/TAU(UNITS 10**-4)(P9)/(P3)
R22     1   2.5    APPROX            GREINER   64 EMUL +                   8/66
R22     7   2.57     1.55            BISI       67 DBC  +                  11/67

R23 *   CHAR. K INTO (E PIO NEU)/(MU2+PI2)(UNITS 10**-2)(P6)/(P1+P2)
R23   1679    5.89     0.21          CESTER     66 SPRK +                   8/67
R23   5110    6.16     0.22          ESCHSTRUT 68 SPRK +                   3/68*
R23         . . . . . . . . .
R23 AVG       6.0187   .1519  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R23 FIT       5.737    .089    VALUE FROM CONSTRAINED FIT

R24 *   CHAR. K INTO (PI PIO)/(MU NEU)                   (P2)/(P1)
R24           0.3253   0.0065        AUERBACH  67 SPRK +                   8/67
R24         . . . . . . . . .
R24 FIT        .330     .006   VALUE FROM CONSTRAINED FIT

R25 *   CHAR. K INTO (E PIO NEU)/(MU NEU)                (P6)/(P1)
R25    472    0.0797   0.0054        AUERBACH  67 SPRK +                   8/67
R25 *  THE VALUE .0785+-.0025 GIVEN IN THE ABOVE REF IS AN AVERAGE OF
R25 *  AUERBACH 67 R25 AND CESTER 66 R23.
R25    960    .0775    .0033         BOTTERIL1 68 SPRK +                   5/68*
R25    561    0.069    0.006         GARLAND   68 SPRK +                   4/68*
R25         . . . . . . . . .
R25 AVG       .0765    .0026  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R25 FIT       .076     .001    VALUE FROM CONSTRAINED FIT

R26 *   CHAR. K INTO (MU PIO NEU)/(MU NEU)               (P5)/(P1)
R26    310    0.0602   0.0046        AUERBACH  67 SPRK +.                  8/67
R26    424    0.055    0.004         GARLAND   68 SPRK +                   4/68*
R26         . . . . . . . . .
R26 AVG       .0572    .0030  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R26 FIT       .050     .002    VALUE FROM CONSTRAINED FIT

R27 *  -CHAR. K INTO (MU NEU)/(TAU)                     (P1)/(P3)
R27 R  427  (10.38)   (0.82)         YOUNG      65 EMUL +                   9/66
R27 R DELETED FROM OVERALL FIT BECAUSE YOUNG 65 CONSTRAINS HIS RESULTS TO
R27 R TO ADD UP TO 1.  ONLY YOUNG MEASURED MU2 DIRECTLY.
R27         . . . . . . . . .
R27 FIT      11.416    .102    VALUE FROM CONSTRAINED FIT

R28 *  CHAR. K INTO (E NEU)/(MU NEU) (UNITS 10**-5)     (P11)/(P1)
R28     10    1.9      0.7       0.5  BOTTERILL 67 SPRK +                 11/67

R29 *  CHAR. K INTO (MU PIO NEU)/(E PIO NEU)             (P5)/(P6)
R29C  1509    0.703    0.056         CALLAHAN1 66 HLBC                     6/68*
R29 A 8050   (0.604)  (0.022)        AACHEN 2  68 HLBC                    10/68*
R29  13371    0.667    0.017         BOTTERIL2 68 SPRK +                   6/68*
R29 A     ONLY INDIVIDUAL RATIOS INCLUDED IN FIT--SEE R19 AND R20--       11/68*
R29         . . . . . . . . .
R29 AVG       .6700    .0163  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R29 FIT       .655     .015    VALUE FROM CONSTRAINED FIT
R29C   FROM THIS EXPERIMENT WE USE ONLY THE MU3/E3 RATIO AND DO NOT
R29C   INCLUDE IN THE FIT THE RATIOS MU3/TAU AND E3/TAU, SINCE
R29C   THEY SHOW LARGE DISAGREEMENTS WITH THE REST OF THE DATA.

R30 *   CHAR. K INTO PI GAMMA GAMMA/TOTAL(UNITS 10**-4)(P17)/TOTAL
R30          1.1   OR LESS           CHEN       68 SPRK +                   5/68*

R31 *  CHAR. K INTO PI E NEU GAMMA/PI E NEU              (P18)/(P6)
R31          0.012     0.008         BELLOTT1  67 HLBC +                  11/67

R32 *   CHAR. K INTO (PI2 + MU3)/(TOTAL)                 (P2+P5)/TOTAL     11/67
R32 *  WE COMBINE THESE TWO MODES FOR EXPTS MEASURING THEM IN XENON BC
R32 *  BECAUSE OF DIFFICULTIES OF SEPARATING THEM THERE
R32          23.4      1.1           ROE        61 XBC  +                  11/67
R32    886   25.4      0.9           SHAKLEE    64 XBC  +                  11/67
R32         . . . . . . . . .
R32 AVG      24.5980   .9802  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
R32 FIT      24.214    .274    VALUE FROM CONSTRAINED FIT

R33 *  K- INTO PI+ E- E-/TOTAL (UNITS 10**-5)            (P19)/TOTAL
R33 *    TEST OF LEPTON NUMBER CONSERVATION
R33          1.5   OR LESS           CHANG      68 HBC   - CL=              3/68*

R34 *  CHAR. K INTO PI NEU NEU/ TOTAL  (UNITS 10**-4)   (P20)/TOTAL
R34 *        1.0   OR LESS           CAMERINI  68       +  TEST NEUTR.CURR. 11/68*

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  THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

      P1 P2      -.844
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K^+ Form Factors

The parameter ξ can be determined in three different ways:

(1) by measuring the $K_{\mu 3}/K_{e3}$ branching ratio and comparing it with the theoretical ratio as given in terms of ξ:

$$\Gamma(K_{\mu 3})/\Gamma(K_{e3}) = C_1 + C_2 \operatorname{Re}\xi + C_3 |\xi|^2 + C_4 \lambda_+ + C_5 \lambda_- \operatorname{Re}\xi,$$

where the C_i are calculable constants;

(2) by measuring the π or lepton momentum spectra and comparing them with the predicted spectra, which are functions of ξ (see, for example, BRENE 61).

STABLE PARTICLES

Data in parentheses have not been included in our averages.

(3) By measuring the muon polarization in $K_{\mu 3}$ decay. In the rest frame of the K the μ is expected to be polarized in the direction $\vec{A}$ with $\vec{P} = \vec{A}/|\vec{A}|$, where $\vec{A}$ is given (CABIBBO 64) by

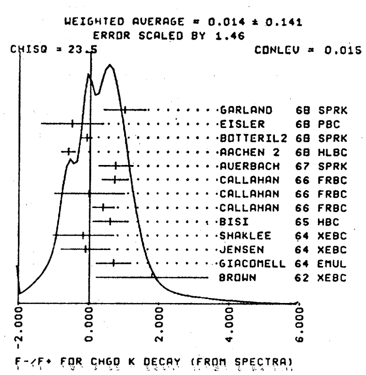
$$\vec{A} = a_1(\xi)\,\vec{p}_\mu - a_2(\xi)\left\{\frac{\vec{p}_\mu}{m_\mu}\left[(m_K - E_\pi) + (\vec{p}_\pi\cdot\vec{p}_\mu)(E_\mu - m_\mu)/|\vec{p}_\mu|^2\right] + \vec{p}_\pi\right\} + m_K \operatorname{Im}\xi(q^2)(\vec{p}_\pi\times\vec{p}_\mu).$$

If time-reversal invariance holds, we expect ξ to be real, and thus expect no polarization perpendicular to the K decay plane.

The value of ξ obtained by using the μ polarization does not seem to be in agreement with the value determined by using spectra and branching ratios, for reasons not yet understood (WILLIS 67, CRONIN 68). For this reason we list the experiments that use polarization measurements separately, and call their values ξ_B. We group the measurements that use spectra and branching-ratio information, and call their values ξ_A.

If the $\Delta I = 1/2$ rule holds, we expect the values of λ_+ and of ξ to be the same for K^+ and K^0_L decays.

We also list the experimental upper limits for the form factors of the scalar and tensor parts of the matrix element (to be added to the matrix element written in the text).



F-/F+ FOR CHGD K DECAY (FROM SPECTRA)

10 CHARGED K FORM FACTORS 8/67

F+ AND F- ARE FORM FACTORS FOR THE VECTOR MATRIX ELEMENT
FS AND FT REFER TO THE SCALAR AND TENSOR TERM

XIA * XIA = F-/F+ (DETERMINED FROM SPECTRA AND KMU3/KE3)

XIA	76	+1.8	1.6		BROWN	62	XEBC	+	MU+,PIO SPECTRA	8/67
XIA	87	+0.7	0.5		GIACOMELL	64	EMUL	+	MU+ SPECTRUM	8/67
XIA		-0.1	0.7		JENSEN	64	XEBC	+	MU+,PIO SPECTRN	8/67
XIA		-0.17	0.75	0.99	SHAKLEE	64	XEBC	+	KMU3/KE3	8/67
XIA		+0.6	0.5		BISI	65	HBC	+	KMU3/KE3,MU SPEC	8/67
XIA *		BTWN +0.2 AND +1.4			CUTTS	65	SPRK	+	MU+ SPECTRUM	8/67
XIA	1509	+0.4	0.4	0.22	CALLAHAN	66	FRBC	+	KMU3/KE3	8/67
XIA	2648	0.0	1.1	0.9	CALLAHAN	66	FRBC	+	MU+ SPECTRUM	8/67
XIA	444	+0.72	0.37		CALLAHAN	66	FRBC	+	PIO SPECTRUM	8/67
XIA		+0.75	0.50		AUERBACH	67	SPRK	+	KMU3/KE3	8/67
XIA		-0.60	0.20		AACHEN 2	68	HLBC	+	KMU3/KE. NOTE B	10/68*
XIA	13371	-0.08	0.15		BOTTERIL2	68	SPRK	+	KMU3/KE. NOTE B	6/68*
XIA	78	-0.5	0.9		EISLER	68	PBC	+	PIO SPECTRUM	6/68*
XIA	976	+1.0	0.6		GARLAND	68	SPRK	+	KMU3/KE3	4/68*

XIA B ASSUMES LM+=.023 - INSENSITIVE TO LM- 11/68*
XIA • • • • • • • • • • •
XIA AVG .0139 .1408 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)
(SEE IDEOGRAM BELOW)

XIB * XIB = F-/F+ (DETERMINED FROM MU POLARIZATION IN KMU3)

XIB * MEAS OF XI USING POLARIZATION IS LESS SENSITIVE TO FORM FACTCR
XIB * VARIATIONS.

XIB	2100	+1.2	2.4	1.8	BORREANI	65	PBC	+	POLARIZATION	8/67
XIB	397	-1.4	1.8		CALLAHAN	66	FRBC	+	TOTAL POLAR.	8/67
XIB	2950	-0.7	0.9	3.3	CALLAHAN	66	FRBC	+	LONG. POLAR.	8/67
XIB	6000	-1.0	0.3		AACHEN	68	FRBC	+	TOTAL POLAR.	6/68*
XIB	3133	-0.95	0.3		CUTTS	68	SPRK	+	TOTAL POLAR.	6/68*

XIB • • • • • • • • • • •
XIB AVG -.9565 .2086 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

FS * FS/F+ RATIO OF SCALAR TO F+ COUPLINGS (ABS. VALUE)
FS * 0.23 OR LESS BOTTERIL1 68 SPRK CL=90 PERCENT 8/66

FT * FT/F+ RATIO OF TENSOR TO F+ COUPLINGS (ABS. VALUE)
FT * 0.58 OR LESS BOTTERIL1 68 SPRK CL=90 PERCENT 8/66

LM+ * LAMBDA + (LINEAR ENERGY DEPENDENCE OF F+ IN KE3 DECAY) 8/67
LM+ * FOR RAD. CORR. TO THE DALITZ PLOT, SEE GINSBERG 67.

LM+ *	217	(+0.038)	(.045)		BROWN	62	XEBC	+	PIO SPEC,NO R.C.	
LM+ *	230	(-0.04)	(.05)		BORREANI	64	HBC	+	E+ SPEC,NO R.C.	8/67
LM+ *	407	(-0.010)	(.029)		JENSEN	64	XEBC	+	PIO SPEC,NO R.C.	8/67
LM+ B	457	(+0.025)	(.018)		BELLOTTI	66	FBC	+	SEE NOTE B BELOW	8/67
LM+ *	854	(0.045)	(0.017)	(0.018)	BELLOTT2	67	FBC	+	SEE NOTE B BELOW	11/67

LM+ B BELLOTT2 67 REPLACES BELLOTTI 66.USES DALITZ PLOT WITH RAD. COR. 11/67

LM+ *	1393	(+0.016)	(.016)		IMLAY	67	SPRK	+	DLTZ PLT,NO R.C.	8/67
LM+ *	515	(+0.028)	(.013)	(.014)	KALMUS	67	FBC	+	E,PI SPEC,NO R.C.	8/67
LM+ *	17000	(.08)	(.04)		BOTTERIL1	68	SPRK	+	E SPEC USES R.C.	6/68*
LM+ *	90	(-0.02)	(0.08)	(0.12)	EISLER	68	PBC	+	PIO SPEC,NO R.C.	6/68*

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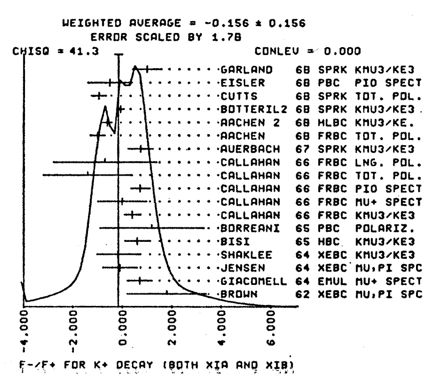
REFERENCES
10 CHARGED K (494,JP=0-)I=1/2

BIRGE	56 NC 4 834	BIRGE,PERKINS,PETERSON,STORK,WHITEHEA (LRL)
ILOFF	56 PR 102 927	ILOFF,GOLDHABER,LANNUTTI,GILBERT + (LRL)
ALEXANDE	57 NC 6 478	ALEXANDER,JOHNSTCN,OCEALLAIGH (DUBLIN INST)
COHEN	57 FUND.CONS.PHYS.	E R COHEN,K M CRCWE,J DUMOND (AI+LRL+CIT)
EISENBER	58 NC 8 663	EISENBERG,KOCH,LOHRMANN,NIKOLIC + (BERN)
BURROWES	59 PRL 2 117	BURROWES,CALDWELL,FRISCH,HILL + (MIT)
TAYLOR	59 PR 114 359	S TAYLOR,HARRIS,OREAR,LEE,BAUMEL (COLUMBIA)
FREDEN	60 PR 118 564	S C FREDEN,F C GILBERT,R S WHITE (LRL)
BARKAS	61 PR 124 1209	BARKAS,DYER,MASON,NORRIS,NICKOLS,SMIT (LRL)
BHOWMIK	61 NC 20 857	B BHOWMIK,P C JAIN,P C MATHUR (DELHI UNIV)
BRENE	61 NP 22 553	BRENE,EGARDT,QVIST /
NORDIN	61 PR 123 2166	PAUL NORDIN JR (LRL)
ROE	61 PRL 7 346	ROE,SINCLAIR,BROWN,GLASER + (MICH+LRL)
BOYARSKI	62 PR 128 2398	BOYARSKI,LOH,NIEMELA,RITSCN (MIT)
BROWN	62 PRL 8 450	BROWN,KADYK,TRILLING,ROE+ (LRL,MICH)
BARKAS	63 PRL 11 26	W H BARKAS,J N DYER,H H HECKMAN (LRL)
BIRGE	63 PRL 11 35	BIRGE,ELY,GIDAL,CAMERINI + (LRL+WIS+BARI)
ADAIR	64 PL 12 67	ADAIR,LEIPUNER (YALE,BNL)
BORREANI	64 PL 12 123	G BORREANI,G RINAUDO,A WERBROUCK (TURIN)
CABIBBO	64 PL 9 352	CABIBBO,MAKSYMOWICZ (CERN)
ALSO	64 PL 11 360	CABIBBO,MAKSYMOWICZ (CERN)
ALSO	65 PL 14 72	CABIBBO,MAKSYMOWICZ (CERN)
CALLAHAN	64 PR 136 B 1463	A CALLAHAN,R MARCH,R STARK (WISCCNSIN)
CAMERINI	64 PRL 13 318	CAMERINI,CLINE,FRY,POWELL (WISCONSIN+LRL)
CLINE	64 PRL 13 101	D CLINE, W F FRY (WISCONSIN)
GIACOMEL	64 NC 34 1134	GIACOMELLI,MONTI,QUARENI+ (BOLOGNA,MUNICH)
GREINER	64 PRL 13 284	D GREINER, W OSBORNE, W BARKAS (LRL)
JENSEN	64 PR 136 B1431	JENSEN,SHAKLEE,ROE,SINCLAIR (MICHIGAN)
SHAKLEE	64 PR 136 B 1423	SHAKLEE,JENSEN,ROE,SINCLAIR (MICHIGAN)



F-/F+ FOR K+ DECAY (BOTH XIA AND XIB)

STABLE PARTICLES

Data in parentheses have not been included in our averages.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BIRGE    65 PR 139 B 1600     BIRGE,ELY,GIDAL,CAMERINI,CLINE +  (LRL+WIS)
BISI     65 NC    35  768     BISI,BORREANI,CESTER,FERRARO +      (TURIN)
BISI     65 PR 139 B 1068     BISI,MARZARI-CHIESA,RINAUDO   (TURINO,INFN)
BORREANI 65 PR 140 B1686      BORREANI,GIDAL,RINAUDO,CAFORIO+(BARI,TURIN)
CALLAHAN 65 PRL   15  129     A CALLAHAN,D CLINE                (WISCCNSIN)
CAMERINI 65 NC    37 1795     CAMERINI,CLINE,GIDAL,KALMUS,KERNAN(WIS+LRL)
CLINE    65 PL    15  293     A CLINE,W F FRY                   (WISCONSIN)
CUTTS    65 PR 138 B969       CUTTS,ELIOFF,STIENING                   (LRL)
DEBOUARD 65 PL 15  58         DEBOUARD,DEKKERS,JORDAN+(MUNICH,CERN,CRSAY)
DE MARCO 65 PR 140 B 1430     DE MARCO,GROSSO,RINAUDO       (TURINO+CERN)
    ALSO 68 PR 169 1045       SAYER,BEALL,DEVLIN,SHEPHARD+(MD+PPA+PALMER)
FITCH    65 PR 140 B 1088     FITCH,QUARLES,WILKINS  (PRINCETON+MT HOLYK)
GREINER  65 ARNS  15  67      QUOTED BY BARKAS                        (LRL)
STAMER   65 PR   138 B 440    STAMER,HUETTER,KOLLER,TAYLOR,GRAUMAN (STEV)
TRILLING 65 UCRL 16473        GEORGE H TRILLING                       (LRL)
TRILLING 65   IS UPDATED FROM 1965 ARGONNE CONF, PAGE   5
YOUNG    65 UCRL 16362        POH-SHIEN YOUNG (THESIS,BERKELEY)       (LRL)
  ALSO   67 PR 156 1464       P-S YOUNG,W.Z.OSBORNE,W.H.BARKAS        (LRL)

BELLOTTI 66 PL   20  690      BELLOTTI,FIORINI,PULLIA+              (MILAN)
CALLAHA1 66 PR 150 1153       CALLAHAN,CAMERINI+(WISC,LRL,RIVERSIDE,BARI)
CALLAHAN 66 NC   44A 90       A C CALLAHAN                      (WISCONSIN)
CESTER   66 PL 21 343         CESTER,ESCHSTRUTH,ONEILL+  (PRINCETON-PENN)
CESTER   66   SEE ALSO FOOTNOTE 1 OF AUERBACH 67
LOBKOWIC 66 PRL   17  548     LOBKOWICZ,MELISSINOS,NAGASHIMA+  (ROCH+BNL)
BELLOTT1 67 HEIDELBERG CONF   BELLOTTI,PULLIA                       (MILAN)
BELLOTT2 67 NC 52A  1287      BELLOTTI,FIORINI,PULLIA               (MILAN)
BISI     67 PL 258  572       BISI,CESTER,CHIESA,VIGONE            (TORINO)
BOTTERIL 67 PRL   19  982     BOTTERILL,BROWN,CORBETT,CULLIGAN + (OXFORD)
BOTTERIL 67   SEE ALSO BOTTERILL 68
BOWEN    67 PR 154 1314       BOWEN,MANN,MCFARLANE,HUGHES+(PENN-PRINCETO)

CLINE    67 HEIDELBERG CONF   CLINE,HAGGERTY,SINGLETON,FRY+   (WISCONSIN)
FLETCHER 67 PRL   19  98      FLETCHER,BEIER,EDWRADS,+         (ILLINOIS)
FORD     67 PRL 18 1214       +LEMONICK,NAUENBERG,PIROUE      (PRINCETON)
GIACOMEL 67 BNL 11056         GIACOMELLI,KYCIA,LI,TEIGER            (BNL)
GINSBERG 67 PR 162  1570      EDWARD S GINSBERG        (U. MASS BOSTON)
IMLAY    67 PR 160  1203      IMLAY,ESCHSTRUTH,FRANKLIN+      (PRINCETON)
KALMUS   67 PR  159  1187     KALMUS,KERNAN                         (LRL)
WILLIS   67 HEIDELBERG 273    W J WILLIS -RAPPORTEUR TALK          (YALE)

AACHEN   68 NC 56A 1106       AACHEN-BARI-BERGEN-CERN-EP-NIJME(EN-ORSAY+)
AACHEN 2 68 PL  278 586       AACHEN-BARI-CERN-EP-ORSAY-PADOVA(VALENCIA)
BOTTERIL 68 PR 171 1402       BOTTERILL,BROWN,CORBETT,CULLIGAN+  (OXFORD)
BOTTERI1 68 PR 174 1661       BOTTERILL,BROWN,CLEGG,CORBETT,+    (OXFORD)
BOTTERI2 68 PRL 21 766        BOTTERILL,BROWN,CLEGG,CORBETT +    (OXFORD)
CAMERINI 68  VIENNA ABS. 537  CAMERINI,CLINE,LJUNG                 (WISC)
CHANG    68 PRL 20  510       CHANG,YODH,EHRLICH,PLANO+(MARYLAND,RUTGERS)

CHEN     68 PRL 20 73         CHEN,CUTTS,KIJEWSKI,STIENING +    (LRL,MIT)
CRONIN   68 VIENNA CONF       RAPPORTEUR TALK                 (PRINCETON)
CUTTS    68 PRL 20 955        CUTTS,STIENING,WIEGAND,DEUTSCH    (LRL,MIT)
EISLER   68 PR  169  1090     EISLER,FUNG,MARATECK,MEYER,PLANO  (RUTGERS)
ELY      68 PR TO BE PUBL     ELY,KALMUS +                (LRL+UCLA+WISC)
ESCHSTRU 68 PR  165  1487     ESCHSTRUTH,FRANKLIN,HUGHES+(PRINCETON,PENN)
GARLAND  68 PR  167  1225     +TSIPIS,DEVONS,RCSEN+  (COLUMBIA,RUTG,WISC)
HERZO    68 VIENNA ABS. 300   HERZO,BANNER,BEIER,BERTRAM,EDWARDS +  (ILL)

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

BLOCK    62 CERN CONF 371     BLOCK,LENDINARA,MONARI          (NWU+BOLOGNA)
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K^0

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            11  NEUTRAL K  (JP=0-)  I=1/2

            11  KO MASS  (MEV)

M          498.1      0.4           CHRISTENS 64 SPRK
M    2223  497.44     0.33          KIM       65 HBC    KO FROM PBAR P    6/66
M    4500  498.9      0.5           BALTAY    66 HBC    KO FROM PBAR P    6/66
M          497.44     0.50          FITCH     67 SPRK                    11/67
M          . . . . . . . . .
M    AVG   497.8653   .3158  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)
M    FIT   497.76     0.16    VALUE FROM CONSTRAINED FIT                  6/68*
                             (SEE IDEOGRAM BELOW )

                WEIGHTED AVERAGE = 497.865 ± 0.316
                    ERROR SCALED BY 1.53
             CHISQ =  7.0                   CONLEV = 0.072
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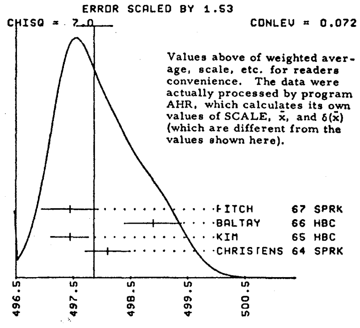


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            11  KO-K CH. MASS DIFFERENCE (MEV)

D          3.9       0.6            ROSENFELD 59 HBC  -
D          5.4       1.1            CRAWFORD  59 HBC  +
D     9    3.90      0.25           BURNSTEIN 65 HBC  -
D     7    3.71      0.35           KIM       65 HBC  -  K- P TO KO N    6/68*
D   417    3.95      0.21           HILL      68 DBC  +  K+D TO KOPP     3/68*
D          . . . . . . . . .
D    AVG   3.9163    .1408  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
D    FIT   3.94      0.13    VALUE FROM CONSTRAINED FIT                   6/68*

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                        REFERENCES
                        11 NEUTRAL K (JP=0-)I=1/2

CRAWFORD 59 PRL   2  112      CRAWFORD,CRESTI,GOOD,STEVENSON,TICHO  (LRL)
ROSENFEL 59 PRL   2  110      A H ROSENFELD,F SOLMITZ,R D TRIPP     (LRL)
CHRISTEN 64 PRL 13 138        CHRISTENSON,CRONIN,FITCH,TURLAY (PRINCETON)
BURNSTEI 65 PR  138 B 895     R A BURNSTEIN,H A RUBIN          (MARYLAND)
KIM      65 PR 140 B 1334     J K KIM,L KIRSCH,D MILLER        (COLUMBIA)
BALTAY   66 PR 142    932     BALTAY,SANDWEISS,STONEHILL +     (YALE+BNL)
FITCH    67 PR 164  1711      FITCH,ROTH,RUSS,VERNON          (PRINCETON)
HILL     68 PR 168  1534      HILL,ROBINSON,SAKITT,CANTER (BNL,CARNEGIE)
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K^0_S

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             12  SHORT-LIVED NEUTRAL K (498, JP=0-)  I=1/2

             12  KOS LIFETIME (UNITS 10**-10)

T   O   90    (1.07)    (0.13)   (0.13) BOLDT      58 CC
T      512     0.94      0.05     0.05  CRAWFORD   59 HBC
T   O   63    (1.09)    (0.18)   (0.15) BOWEN      60 CC
T   O  OLD EXPTS WITH LOW STATISTICS NOT INCLUDED IN AVERAGE.           6/68*
T      378     0.94      0.05     0.05  BERTANZA   62 HBC
T      503     0.87      0.05           CHRETIEN   63 PBC
T      545     0.86      0.04           KREISLER   64 SPRK
T              0.866     0.016          ALFF-STEI  66 SPRK              9/66
T      572     0.90      0.06     0.05  AUERBACH   66 SPRK              8/67
T     4500     0.92      0.04           BALTAY     66 HBC               6/66
T   B         (0.904)   (0.024)         BOTT-BODE  66 SPRK              9/66
T   B  KOS LIFETIME NOT THE PRIMARY QUANTITY MEASURED IN THIS EXPT.     6/68*
T     5000     0.843     0.013          KIRSCH     66 HBC               6/66
T    19994     0.856     0.008          DONALD     68 HBC               6/68*
T    20000     0.865     0.009          HILL       68 DBC               6/68*
T   H   HILL 68 GIVES A DETAILED DISCUSSION OF SYSTEMATICS ENCOUNTERED IN
T   H   IN THIS TYPE OF EXPERIMENT.
T         . . . . . . . . .
T   AVG       .8619  + .0062  - .0062  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)
--------------------------------------------------------------------------

             12  KOS PARTIAL DECAY MODES

                                                          DECAY MASSES
P1       KOS INTO PI+ PI-                                 139+ 139
P2       KOS INTO PIO PIO                                 134+ 134
P3       KOS INTO MU+ MU-                                 105+ 105

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             12  KOS  BRANCHING RATIOS

R1   *  KOS INTO (PI+ PI-)/TOTAL                          (P1)/TOTAL
R1           0.68       0.04          CRAWFORD  59 HBC
R1           0.70       0.08          COLUMBIA  60 HBC
R1   U      (0.740)    (0.024)        ANDERSON  62 HBC
R1          . . . . . . . . .
R1   AVG     .6840      .0358  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1   FIT     .684       .011    VALUE FROM CONSTRAINED FIT

R2   *  KOS INTO (PIO PIO)/TOTAL                          (P2)/TOTAL
R2           0.27       0.11          CRAWFORD  59 HBC
R2           0.26       0.06          BAGLIN    60 PBC
R2           0.30       0.035         BROWN     61 XBC
R2    1066   0.335      0.014         BROWN     63 XBC
R2     198   0.288      0.021         CHRETIEN  63 PBC
R2          . . . . . . . . .
R2   AVG     .3161      .0135  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
R2   FIT     .316       .011    VALUE FROM CONSTRAINED FIT
                      (SEE IDEOGRAM BELOW )

              WEIGHTED AVERAGE = 0.3161 ± 0.0135
                  ERROR SCALED BY 1.25
           CHISQ =  4.7                     CONLEV = 0.195
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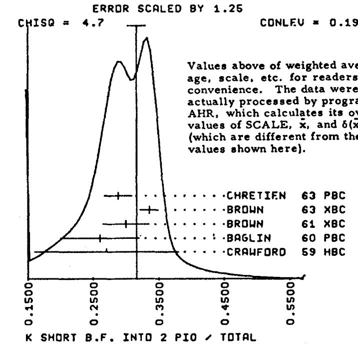


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R3   *   (KOS INTO PI+ PI- PIO)/(KOS INTO PI+ PI- PIO)
R3           0.45   OR LESS           BEHR      66 HLBC    90 PER CT CONF   8/66

R4   *  KOS INTO (MU+ MU-)/CHARGED  (UNITS 10**-5)       (P3)/(P1)
R4          10.0   OR LESS            BOTT-BODE 67 SPRK    90 PER CT CONF   8/67

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                        REFERENCES
             12  SHORT-LIVED NEUTRAL K (498, JP=0-)  I=1/2

BOLDT    58 PRL   1  150      E BOLDT,D O CALDWELL,Y PAL              (MIT)
CRAWFORD 59 PRL   2  266      CRAWFORD,CRESTI,DOUGLASS,GCOD,TICHO + (LRL)

BAGLIN   60 NC   18 1043      BAGLIN,BLOCH,BRISSON,HENNESSY +  (PARIS EP)
BIRGE    60 ROCH CONF 601     R W BIRGE,P P ELY +          (LRL+WISCCNSIN)
BOWEN    60 PR  119 2030      BOWEN,HARDY,REYNOLDS,SUN,MCORE+(PRINCE+BNL)
COLUMBIA 60 ROCH CONF 727     M SCHWARTZ +                       (COLLMBIA)
MULLER   60 PRL   4  418      MULLER,BIRGE,FOWLER,GOOD,PICCIOMI+(LRL+BNL)

BROWN    61 NC   19 1155      BROWN,BRYANT,BURNSTEIN,GLASER,KADYK+ (MICH)
FITCH    61 NC   22 1160      V FITCH,P PIROUE,R PERKINS    (PRINCE+LASL)
GOOD     61 PR  124 1223      GOOD,MATSEN,MULLER,PICCIONI +           (LRL)
ANDERSON 62 CERN CONF 836     J A ANDERSON,F S CRAWFORD +             (LRL)
BERTANZA 62 PREPRINT D105     BERTANZA,CONNOLLY,CULWICK,EISLER +      (BNL)
         (BERTANZA UNPUBLISHED,BUT RECERTIFIED BY AUTHCRS,AUGUST 66)
CRAWFORD 62 CERN CONF 827     F S CRAWFORD                            (LRL)

BROWN    63 PR  130  769      BROWN,KADYK,TRILLING,ROE +   (LRL+MICHIGAN)
CHRETIEN 63 PR  131 2208      CHRETIEN+     (BRANDEIS+BRCWN+HARVARD+ MIT)
KREISLER 64 PR  136 B 1074    M KREISLER,O OVERSETH,J CRONIN  (PRINCETON)
AUERBACH 65 PRL 14 192        AUERBACH,LANDE,MANN,SCIULLI,UTO +    (PENN)
TRILLING 65 UCRL 16473        GEORGE H TRILLING                       (LRL)
TRILLING 65   IS UPDATED FROM 1965 ARGONNE CONF , PAGE 115
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STABLE PARTICLES

Data in parentheses have not been included in our averages.

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ALFF-STE 66 PL 21 595         ALFF-STEINBERGER,HEUER,KLEINKNECHT + (CERN)
AUERBACH 66 PR 149 1052       AUERBACH,DOBBS,LANDE,MANN,SCIULLI+   (PENN)
              SEE ALSO AUERBACH 65
BALTAY   66 PR 142   932      BALTAY,SANDWEISS,STONEHILL +      (YALE+BNL)
BEHR     66 PL  22  540       BEHR,BRISSON,PETIAU+ (EP,MILAN,PADUA,ORSAY)
BOTT-BOD 66     BERKELEY CONF. BOTT-BODENHAUSEN,DE BOUARD +          (CERN)
KIRSCH   66 PR  147  939      L KIRSCH,P SCHMIDT                 (COLUMBIA)
BOTT-BOD 67 PL 248 194        BOTT-BODENHAUSEN,DE BOUARD,CASSEL+   (CERN)

DONALD   68 PL 278 58         DONALD,EDWARDS,NISAR+(LIVERPOOL,CERN,PARIS)
HILL     68 PR 171 1418       HILL,ROBINSON,SARITT +        (BNL,CARNEGIE)

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K^0_L

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        13  LONG-LIVED NEUTRAL K (498, JP=0-)  I=1/2

        13  KOL-KOS  MASS DIFFERENCE
            (UNITS ARE INVERSE KOS LIFETIME)

D  *        (1.9)    (0.3)          FITCH      61 CNTR
D            0.84     0.29     0.21 GOOD       61 PBC
D            0.88     0.20          CAMERINI   62 PBC     SEE NOTE C BELOW  8/67
D  C  VALUE CHANGED FROM 1.5 (SEE TABLE 1 OF CAMERINI 66)                   8/67
D            0.47     0.21          AUBERT     65 PBC                       6/66
D            0.26     0.36     0.26 BALDO-CEO  65 PBC     ASS.CP CCNS.
D            0.55     0.1           CHRISTENS  65 SPRK                      6/66
D  *         0.60  OR LESS          FITCH      65 SPRK    CF. MEISNER 66    7/66
D  V  130   (0.82)   (0.14)         VISHNEVSK  65 SPRK    CU AND AL REGEN   8/67
D  V  VISHNEVSKY 65 NOT CORRECTED FOR INTERFERENCE EFFECTS                  3/68*
D            0.445    0.034         ALFF-STEI  66 SPRK                      6/66
D      84    0.36     0.21     0.31 BALDO-CEC  66 HLBC    KO+N INTO HYPER.  8/67
D            0.480    0.024         BOTT-BODE  66 SPRK                      9/66
D      77    0.50     0.15          CAMERINI   66 HBC, DBC KO+N INTO HYPER  8/67
D  N   72 (+ 0.54)   (0.15)         CANTER     66 DBC     KO SCATTER IN D2 11/66
D  N      ERROR IGNORES UNCERTAINTY OF PHASE SHIFTS
D      95    0.54     0.09     0.14 CHANG      66 HBC     KO+P INTC HYPER.  8/67
D            0.72     0.15          FUJII      66 SPRK    IRON REGENERATOR  9/66
D  C   89   (0.62)   (0.16)         HILL       66 DBC     KO+D INTC HYPER.  9/66
D      59    0.65     0.30          MEISNER1   66 HBC     SEE NOTE M1       6/66
D  M1     + SIGN FAVORED            MEISNER2   66 HBC                       9/66
D  M       (+ 0.44)  (0.06)         MEHLHOP    66 SPRK     SEE NOTE M       9/66
D  C  136   (0.67)   (0.15)         CANTER     67 DBC     KO+D INTC HYPER. 11/67
D  C      CANTER 67 IS A PRELIMINARY RESULT,INCLUDES HILL 66 EVENTS
D           +0.35     0.15          JOVANOVIC  66 SPRK    C+URANIUM REGEN. 11/66
D            0.57     0.10          MISCHKE    67 SPRK                     11/67
D     590    0.53     0.12          BALATZ     68 SPRK    AL REGENERATOR    3/68*
D            0.445    0.038         CARNEGIE   68 HBC     GAP METHOD        3/68*
D           +0.42     0.04          MELHOP     68 SPRK    ST.STEEL REGEN    6/68*
D  M  MELHOP 68 IS A FURTHER ANALYSIS OF MELHOP 66                          6/68*
D          . . . . . . . . . .
D  AVG       .4691    .0149  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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            NEUTRAL K CONSTRAINED FIT
        OVERALL FIT OF LIFETIME  WIDTHS AND BRANCHING
        RATIOS USES 68 DATA POINTS TO DETERMINE FIVE
        QUANTITITES.  OVERALL FIT HAS CHISQ=37.
        VALUES OF BRANCHING RATIOS CHANGED MAINLY BE-
        CAUSE OF NEW MEASUREMENTS OF R1,R10,R18
        PARTIAL WIDTHS HAVE LARGE SCALE FACTORS BE-
        CAUSE LIFETIME HAS S=1.7

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            13  KOL LIFETIME              (MICRCSEC)

T  *   ASSUMED DS=DQ AND DELTA I=1/2 CRAWFORD  59 HBC
T      34    0.081    0.032    0.024 BARDON    58 CC
T      15    0.051    0.024    0.013 DARMON    62 FBC
T            0.053    0.006          FUJII     64 SPRK                      8/67
T    1700    0.061    0.015    0.012 ASTBURY3  65 CC                        8/67
T            0.0515   0.0014         DEVLIN    67 CNTR                      8/67
T  L        (0.050)  (0.005)         LOWYS     67 HLBC    SEE NOTE L BELCW  8/67
T  L  SUM OF PARTIAL DECAY RATES
T          . . . . . . . . . .
T  AVG       .0520  + .0014  - .0013  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0
T  FIT       .054     .001     VALUE FROM CONSTRAINED FIT

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            13  KOL PARTIAL DECAY MODES

                                                        DECAY MASSES
P1     KOL INTO 3PIO                                    134+ 134+ 134
P2     KOL INTO PI+ PI- PIO                             139+ 139+ 134
P3     KOL INTO PI MU NEUTRINO                          139+ 105+   0
P4     KOL INTO PI E NEUTRINO                           139+  .5+   0
P5     KOL INTO PI+ PI-                                 139+ 139
P6     KOL INTO MU+ MU-                                 105+ 105
P7     KOL INTO E+ E-                                    .5+  .5
P8     KOL INTO E MU                                     .5+ 105
P9     KOL INTO TWO GAMMAS                               0+   0
P10    KOL INTO PI+ PI- GAMMA                           139+ 139+   0
P11    KOL INTO PIO PIO                                 134+ 134

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            13  KOL DECAY RATES

W1  *  KOL INTO PIO PIO PIO        (UNITS 10**6 SEC-1)  (P1)
W1      54    5.22    1.03     0.84  BEHR     66 HLBC    ASSUMES CP        8/66
W1          . . . . . . . . . .
W1  FIT       3.998    .202    VALUE FROM CONSTRAINED FIT

W2  *  KOL INTO PI+ PI- PO         (UNITS 10**6 SEC-1)  (P2)
W2      18    3.26    0.77          ANDERSON  65 HBC                       8/66
W2      14    1.4     0.4           FRANZINI  65 HBC                       6/66
W2     136    2.62    0.28     0.27 BEHR      66 HLBC    ASSUMES CP        8/66
W2            2.54    0.43          HILL      66 DBC                       9/66
W2          . . . . . . . . . .
W2  AVG       2.3573   .3207  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.7)
W2  FIT       2.358    .103    VALUE FROM CONSTRAINED FIT
                      (SEE IDEOGRAM BELOW )

W3  *  KOL INTO PI E NEUTRINO      (UNITS 10**6 SEC-1)  (P4)
W3            7.52    0.85     0.72  AUBERT    65 HLBC © DS=DQ,CP ASSUMED  8/67
W3          . . . . . . . . . .
W3  FIT       7.011    .297    VALUE FROM CONSTRAINED FIT

W4  *  KOL INTO CHARGED (3-BODY)   (UNITS 10**6 SEC-1)  (P2+P3+P4)
W4      98   15.1     1.9           AUERBACH  66 SPRK                      8/67
W4          . . . . . . . . . .
W4  FIT      14.593    .543    VALUE FROM CONSTRAINED FIT

W5  *  KOL INTO LEPTONIC (KMU3+KE3) (UNITS 10**6 SEC-1) (P3+P4)
W5     109    9.4     1.3            FRANZINI  65 HBC                      6/66
W5      54   11.3     1.9            GOLDEN    66 HBC                      9/66
W5     335   10.3     0.8            HILL      67 DBC    K+N TO KO P       8/67
W5          . . . . . . . . . .
W5  AVG      10.1949   .6413  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
W5  FIT      12.235    .462    VALUE FROM CONSTRAINED FIT

W6  *  KOL INTO PI MU NEUTRINO      UNITS 10**6 SEC-1)   (P3)
W6      19    4.54    1.24     1.08  LOWYS     67 HLBC                      8/67
W6          . . . . . . . . . .
W6  FIT       5.224    .211    VALUE FROM CONSTRAINED FIT

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            13  DECAY RATES DIFF.,(+)-(-)/(+)+(-)  (PERCENT)

D1 *  KOL INTO (MU+PI-NU)-(MU-PI+NU)/(MU+PI-NU)+(MU-PI+NU)
D1    10**6    0.403    0.134          DORFAN    67 SPRK   DERIVED FROM R16 11/67

D2 *  KOL INTO (E+PI-NU)-(E-PI+NU)/(E+PI-NU)+(E-PI+NU)
D2    1(**7    0.224    0.036          BENNETT   67 CNTR                    11/67

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            13  KOL BRANCHING RATIOS

R1  *  KOL INTO (PIO PIO PIO)/CHARGED                    (P1)/(P2+P3+P4)
R1      24    0.24     0.08          ANIKINA   64 CC                        6/66
R1            0.31     0.06          KULYUKINA 66 CC                        9/66
R1     549    0.251    0.014         BUDAGOV   68 HLBC                     10/68*
R1     444    0.277    0.021         BUDAGOV   68 HLBC                     10/68*
R1          . . . . . . . . . .
R1  AVG        .2604    .0113  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT        .274     .011    VALUE FROM CONSTRAINED FIT

R2  *  KOL INTO (PI+ PI- PIO)/CHARGED                    (P2)/(P2+P3+P4)
R2      59    0.185    0.038         ASTIER    61 CC                        8/66
R2      79    0.151    0.020         ADAIR     64 HBC                       8/66
R2      75    0.157    0.03     0.04 LUERS     64 HBC                       8/66
R2      66    0.15     0.03     0.04 ASTBURY1  65 CC                        8/66
R2     326    0.159    0.015         ASTBURY2  65 CC                        6/66
R2     566    0.178    0.017         GUIDONI   65 HBC                       6/66
R2  * 1729   (0.144)  (0.004)        HOPKINS   65 HBC    SEE HOPKINS 67     6/66
R2     126    0.162    0.015         HAWKINS   66 HBC                       6/66
R2     180    0.17     0.03          KULYUKINA 66 CC                        9/66
R2            0.161    0.005         HOPKINS   67 HBC                       8/67
R2  *        (0.15)   (0.01)         HOPKINS   68 HLBC                     10/68*
R2          . . . . . . . . . .
R2  AVG        .1618    .0041  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R2  FIT        .162     .004    VALUE FROM CONSTRAINED FIT

R3  *  KOL INTO (PI MU NEUTRINO)/CHARGED                 (P3)/(P2+P3+P4)
R3  C  251   (0.356)  (0.07)         LUERS     64 HBC
R3  C  172   (0.39)   (0.08)  (0.10) ASTBURY1  65 CC                        7/66
R3  C  330   (0.32)   (0.07)         KULYUKINA 66 CC                        9/66
R3  C THIS MODE NOT MEASURED INDEPENDENTLY FROM R2 AND R4
R3          . . . . . . . . . .
R3  FIT        .358     .010    VALUE FROM CONSTRAINED FIT

R4  *  KOL INTO (PI E NEUTRINO)/CHARGED                  (P4)/(P2+P3+P4)
R4     153    0.487    0.05          LUERS     64 HBC
R4     202    0.46     0.08     0.10 ASTBURY1  65 CC                        7/66
R4     500    0.51     0.06          KULYUKINA 66 CC                        9/66
R4          . . . . . . . . . .
R4  AVG        .4908    .0353  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R4  FIT        .480     .010    VALUE FROM CONSTRAINED FIT

R5  *  KOL INTO (PI E NEU)/((PI E NEU)+(PI MU NEU))      (P4)/(P3+P4)
R5     320    0.415    0.120         ASTIER    61 CC
R5          . . . . . . . . . .
R5  FIT        .573     .012    VALUE FROM CONSTRAINED FIT

R6  *  KOL INTO(PI+ PI- PIO)/TOTAL                       (P2)/TOTAL
R6
R6          . . . . . . . . . .
R6  FIT        .127     .003    VALUE FROM CONSTRAINED FIT

R7  *  KOL INTO(LEPTON PI NEUTRINO)/TOTAL                (P3+P4)/TOTAL
R7
R7          . . . . . . . . . .
R7  FIT        .658     .007    VALUE FROM CONSTRAINED FIT

R8  *    KOL INTO (2 GAMMA)/TOTAL    (UN. 10**-4)       (P9)/TOTAL

R8  C         (1.3)    (0.6)         CRIEGEE   66 SPRK                      8/66
R8      32    6.7      2.2           TODOROFF  67 SPRK   REPL. CRIEGEE66   11/68*
R8      33    7.4      1.6           CRONIN 1  67 SPRK                     11/67
R8  C     CRIEGEE 66 REPLACED BY TODOROFF 67                               11/68*
R8          . . . . . . . . . .
R8  AVG       7.1578   1.2940  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R9  *  KOL INTO (PI+ PI-)/CHARGED    (UNIT 10**-3)       (P5)/(P2+P3+P4)
R9      45    2.0      0.4           CHRISTENS 64 SPRK ETA +- = 1.94
R9      54    2.08     0.35          GALBRAITH 65 SPRK ETA +- = 2.02
R9            1.93     0.26          BASILE    66 SPRK ETA +- = 1.86        9/66
R9            1.993    0.080         BOTT-BODE 66 SPRK ETA +- = 1.935       9/66
R9          . . . . . . . . . .
R9  AVG       1.9920    .0734  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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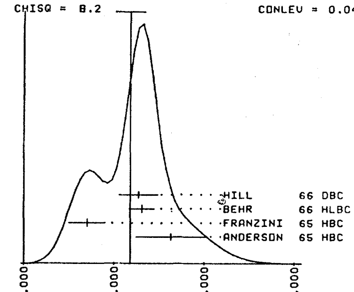
WEIGHTED AVERAGE = 2.357 ± 0.321
ERROR SCALED BY 1.65
CHISQ = 8.2   CONLEV = 0.042



K LONG RATE INTO PI+PI-PIO (10**6 SEC-1)

Data in parentheses have not been included in our averages.

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R10 *  KOL INTO (PI MU NEU)/(PI E NEU)                      (P3)/(P4)
R10          0.81      0.19          ADAIR     64 HBC                     6/66
R10 N       (0.78)    (0.15)         DE BOUARC 65 CNTR   SEE NOTE N BELOW
R10          0.82      0.10          DEBOUARD  67 SPRK   SEE NOTE N BELOW 11/67
R10 N     DEBOUARD 67 REPLACES DEBOUARD 65
R10    273   0.7       0.2           HAWKINS   67 HBC                     8/67
R10          0.81      0.08          HOPKINS   67 HBC                     8/67
R10 *       (0.625)   (0.04)         BASILE1   68 SPRK                   10/68*
R10    770   0.71      0.05          BUDAGOV   68 HLBC                   10/68*
R10 *       (0.65)    (0.05)         HOPKINS   68 HLBC                   10/68*
R10         . . . . . . . . . .
R10 AVG       .7511     .0376  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R10 FIT       .745      .035    VALUE FROM CONSTRAINED FIT

R11 *  KOL INTO (MU+MU-)/CHARGEC   (UNITS 10**-6)         (P6)/(P2+P3+P4)
R11        100.0 OR LESS             ANIKINA   65 CC                      6/66
R11         50.0    OR LESS          ABASHIAN  66 SPRK   90 PER CT CONF   8/66
R11        250.0   OR LESS           ALFF      66 SPRK   0.90 CONF. LEVEL 9/66
R11          2.0   OR LESS           BOTT-BODE 67 SPRK    90 PER CT CONF  8/67
R11         35.0   OR LESS           FITCH     67 SPRK   90 PER CT CONF   3/68*

R12 *    KOL INTO (PI+ PI- GAMMA)/TOTAL (UNITS 10**-3)  (P10)/TOTAL
R12          15.0 OR LESS            ANIKINA   65 CC                      6/66
R12      0    5.0  OR LESS           BELLOTTI  66 HLBC   GAM KE 40-130 MV 8/67
R12      1    3.0 OR LESS            NEFKENS   66 SPRK   GAM KE 120 MEV   6/66
R12           0.4 OR LESS            THATCHER  68 SPRK   90 PER CT CONF  10/68*

R13 *    KOL INTO (E+ E-)/CHARGED     (UNITS 10**-6)      (P7)/(P2+P3+P4)
R13        1000.0 OR LESS            ANIKINA   65 CC                      6/66
R13          50.0  OR LESS           ABASHIAN  66 SPRK    90 PRCT CONF    6/66
R13         200.0  OR LESS           ALFF      66 SPRK   90 PRCT CONF     6/66
R13          23.0   OR LESS          BOTT-BODE 67 SPRK    90 PER CT CONF  8/67

R14 *    KOL INTO (E MU)/CHARGED      (UNITS 10**-4)      (P8)/(P2+P3+P4)
R14          10.0   OR LESS          ANIKINA   65 CC                      6/66
R14           1.0    OR LESS         CARPENTER 66 SPRK   90 PER CT CONF   8/66
R14           0.107 OR LESS          BOTT-BODE 67 SPRK    90 PER CT CONF  8/67
R14           0.08  OR LESS          FITCH     67 SPRK   90 PER CT CONF   3/68*

R15 *   KOL INTO(E+ PI- NEU)/(E- PI+ NEU)
R15 O   97   (0.90)   (0.18)         NEAGU     61 CC
R15 O        (1.01)   (0.16)         LUERS     64 HBC                     8/66
R15 O  894   (0.99)   (0.023)        KULYUKINA 66 CC                      9/66
R15 O 1539   (1.06)   (0.05)         VERHEY    66 SPRK                    8/67
R15 O   LOW PRECISION EXPTS NOT AVERAGED.  FOR MORE PRECISE VALUE,
R15 O   SEE S13D2 (BENNETT 67)

R16 *   KOL INTO(MU+ PI- NEU)/(MU- PI+ NEU)
R16   3200    1.02    0.04           ABASHIAN  66 SPRK                    8/66
R16  10**6    1.0081  0.0027         DORFAN    67 SPRK                   11/67

R17 *       KOL INTO (PIO PIO)/TOTAL  (UNITS 10**-3)     (P11)/TOTAL
R17 C    7  (1.2)    (1.5)    (1.2)  CRIEGEE   66 SPRK                    7/66
R17 C   CRIEGEE EXPT NOT DESIGNED TO MEASURE 2 PIO DECAY MODE
R17 G   87  (3.3)    (1.8)    (1.1)  GAILLARD  67 SPRK   KS REGENER.IN CA 8/67
R17 G  180  (2.5)    (0.8)           GAILLARD  68 SPRK   E00=3.6+-0.6    11/68*
R17 G      GAILLARD 68  REPLACES GAILLARD 67                             11/68*

R18 *    KOL INTO (3PIO)/(PI+PI-PIO)                     (P1)/(P2)
R18    188    2.0       0.6          ALEKSANYA 64 FBC                     9/66
R18   1010    1.80      0.13         BUDAGOV   68 HLBC                   10/68*
R18         . . . . . . . . . .
R18 AVG       1.8090    .1271  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R18 FIT       1.696     .074    VALUE FROM CONSTRAINED FIT

R19 *  KOL INTO (2PIO)/(3PIO)          (UNITS 10**-2)     (P11)/(P1)
R19 C  109   (1.89)   (0.31)         CRONIN 1  67 SPRK   ETA00=4.9+-0.5   8/67
R19 C        (1.36)   (0.18)         CRONIN 2  67 SPRK   ETA00=3.92+-0.3 11/67
R19 C      CRONIN2 IS FURTHER ANALYSIS OF CRONIN1 ,NOW BOTH WITHDRAWN    11/68*
R19 *   58   (0.46)   (0.11)         BANNER2   68 SPRK   ETA00=2.3+-0.3  10/68*
R19 S        (1.2)    (0.2)          UH-LRL    68 SPRK   ETA00=3.6+-0.4  11/68*
R19 S      SYSTEMATICS BEING EVALUATED -VALUE CNLY  PRELIMINARY          11/68*
R19 *   61   (0.45)   (0.18)         BUDAGOV1  68 HLBC   ETA00=2.2+-0.4  11/68*
R19     NO EVENTS SEEN               BARTLETT  68 SPRK   SEE E00 BELOW   11/68*

R20 *  KOL INTO (PI+ PI-)/(KE3 + KMU3)  (UNITS 10**-3)  (P5)/(P3+P4)
R20    309    2.51      0.23         DEBOUARD  67 SPRK                   6/68*
R20    525    2.35      0.19         FITCH     67 SPRK   ETA+-=1.91+-.06 6/68*
R20         . . . . . . . . . .
R20 AVG       2.4149    .1465  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R21 *  (2 GAMMA)/(3 PIO)  (UNITS 10**-3)                  (P9)/(P1)

R21     16    2.5       0.7          ARNOLD    68 HLBC   VACUUM DECAY    11/68*
R21    115    2.24      0.28         BANNER1   68 SPRK   SEE NOTE B      11/68*
R21 B  THIS IS NEW EXPER. -NOT TO BE CONF. WITH  R8 OF CRCNIN1 67-       11/68*
R21         . . . . . . . . . .
R21 AVG       2.2759    .2600  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

  THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

      P3 P4       -.658

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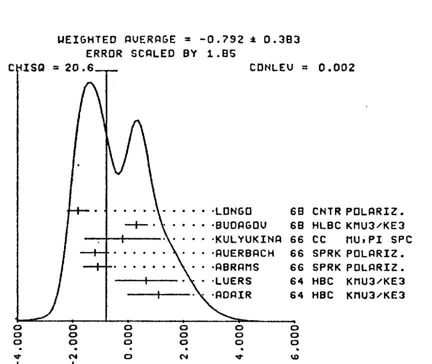

F-/F+ FOR KO DECAY (BOTH XIA AND XIB)

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                    13  KO2  FORM FACTORS                                 8/67

       FOR DISCUSSION OF FORM FACTORS SEE NOTE PRECEDING K+ FORM FACTORS

XIA *  XIA = F-/F+ (DETERMINED FROM SPECTRA AND KMU3/KE3)

XIA    389   +1.1      0.9     1.3   ADAIR     64 HBC     KMU3/KE3        8/67
XIA          +0.66     0.9     1.3   LUERS     64 HBC     KMU3/KE3        8/67
XIA * 1371  (+1.2)    (0.8)          CARPENTER 66 SPRK    MU,PI SPECTRA   8/67
XIA * 1371  (-0.82)   (0.6)          CARPENTER 66 SPRK    MU,PI SPECTRA.C. 8/67
XIA C      2ND CARPENTER VALUE ALLOWS ENERGY DEP OF F+,F-
XIA          -0.2      1.0     1.7   KULYUKINA 66 CC      MU,PI SPECTRA   8/67
XIA *       (-3.9)    (0.1)          BASILE1   68 SPRK +  DALITZ PLOT    10/68*
XIA *       (-0.4)    (0.3)          BASILE1   68 SPRK +  KMU3/KE3       10/68*
XIA    770   +0.3     +0.4           BUDAGOV   68 HLBC    KMU3/KE3       11/68*
XIA *       (-0.2)    (0.4)          HOPKINS   68 HLBC +  KMU3/KE3       10/68*
XIA         . . . . . . . . . .
XIA AVG       .3810     .3440  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

XIB *  XIB = F-/F+ (DETERMINED FROM MU POLARIZATION IN KMU3)

XIB *  MEAS OF XI USING POLARIZATION IS LESS SENSITIVE TC FORM FACTCR
XIB *  VARIATICNS.

XIB          -1.1      0.5           ABRAMS    66 SPRK    POLARIZATION    8/67
XIB   2608   -1.2      0.5           AUERBACH  66 SPRK    POLARIZATION    8/67
XIB          -1.81     0.50    0.26  LONGO     68 CNTR  POLARIZATICN     11/68*
XIB         . . . . . . . . . .
XIB AVG      -1.4562    .2588  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)



LM+ *   LAMBDA +  (LINEAR ENERGY DEPENDENCE OF F+ IN KO E3 DECAY)         8/67

LM+ *   FOR RAD. CORR. TO THE DALITZ PLOT OF KE3, SEE GINSBERG 67.

LM+ *  153  (+0.07)    (.06)           LUERS     64 DLTZ PLT,NO RAD CORR
LM+ *       (+0.15)    (.08)           FISHER    65 SPRKDLTZ PLT,NO RAD CORR  8/67
LM+ *  762  (-0.01)    (.02)           FIRESTONE 67 HBC DLTZ PLT,NC RAD CORR  8/67
LM+ *  531  (+0.01)    (.015)          KADYK     67 HBC E,PI SPEC,NC RAD CCR  8/67
LM+ *  240  (+0.08)    (.10)    (.08)  LOWYS     67 FBC PI  SPEC,NO RAD CORR  8/67
LM+ * 1000  (+0.020)  (0.013)          ARONSON   68 SPRK PI SPEC,NO RAD CORR  3/68*
LM+ * 7233  (+0.023)  (0.012)          BASILE    68 SPRK DLTZ PLT,NC RAD CCR  3/68*

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                 13 X =(DS=-DQ AMPLITUDE /DS=+DQ AMPLITUDE)


REX *    REAL PART OF X

REX     152    0.06     0.18     0.44  BALDO-CE  65 HLBC   K+ CHARGE EXCHNG 11/67
REX *              BALDO-CE 65 GIVES X AND THETA.CCNVERTED BY US TO REX AND IMX 11/67
REX     196    0.035    0.11     0.13  AUBERT    65 HLBC   K+ CHARGE EXCHNG 11/67
REX     109   -0.08     0.16     0.28  FRANZINI  65 HBC    PBAR P           11/67
REX *              FRANZINI 65 GIVES X AND THETA.FOR REX AND IMX SEE SCHMIDT 67 11/67
REX     335    0.17     0.10           HILL      67 DBC    K+D YIELCS KOPP  11/67
REX     116    0.17     0.16     0.35  FELDMAN   67 SPRK   PI-P TO KO LMBDA 11/67
REX            0.03     0.03           BENNETT1  68 CNTR                     7/68*
REX *   121   (0.09)   (0.13)   (0.11) JAMES     68 HBC    PBAR P           10/68*
REX *         (0.11)   (0.18)   (0.14) LITTENBER 68 SPRK   K+ N,KO P        10/68*
REX     242    0.22     0.07     0.09  WEBBER    68 HBC                      7/68*
REX          . . . . . . . . . .
REX AVG         .0598    .0375  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
                         (SEE IDEOGRAM BELOW)


IMX *   IMAGINARY PART OF X (ASSUMES M(KL)-M(KS) POSITIVE -- SEE S13D)

IMX     152   -0.44     0.32     0.19  BALDO-CE  65 HLBC   K+ CHARGE EXCHNG  3/68*
IMX *              BALDO-CE 65 GIVES X AND THETA.CCNVERTED BY US TO REX AND IMX 11/67
IMX     196   -0.21     0.11     0.15  AUBERT    65 HLBC   K+ CHARGE EXCHNG  3/68*
IMX     109   +0.24     0.40     0.30  FRANZINI  65 HBC    PBAR P            3/68*
IMX *              FRANZINI 65 GIVES X AND THETA.FOR REX AND IMX SEE SCHMIDT 67 11/67
IMX     116    0.0      0.25           FELDMAN   67 SPRK   PI-P TO KO LMBCA 11/67
IMX     335   -0.20     0.10           HILL      67 DBC    K+D YIELCS KOPP  11/67
IMX H  FTNOTE 10 OF HILL 67 SHOULD READ +0.58, NOT -0.58 (PRIV COMM)         3/68*
IMX *   121  (+0.22)   (0.29)   (0.37) JAMES     68 HBC    PBAR P           10/68*
IMX *        (-0.21)   (0.08)          LITTENBER 68 SPRK   K+ N,KO P        10/68*
IMX     242   -0.08     0.08           WEBBER    68 HBC                      7/68*
IMX          . . . . . . . . . .
IMX AVG        -.1401    .0531  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)


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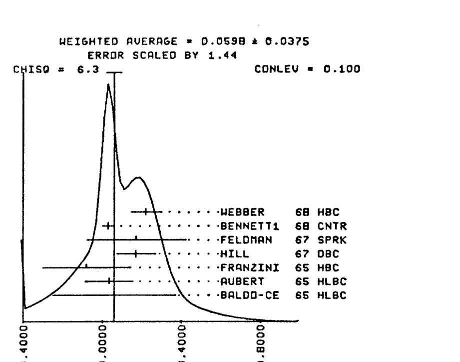

REAL PART OF X

STABLE PARTICLES

Data in parentheses have not been included in our averages.

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                      13  CP VIOLATION PARAMETERS
      ETA+- = A(KL TO PI+PI-)/A(KS TO PI+PI-)
      ETA00 = A(KL TO PI0PI0)/A(KS TO PI0PI0)

      THE MAGNITUDES OF ETA+- AND OF ETA00 ARE DERIVED FRCM BR. RATIOS.
      FOR VALUES OF MAGNITUDE(ETA+-) QUOTED BY INDIVIDUAL EXPTS, SEE
      LISTINGS OF S13R9 AND S13R20.

E00 *    ETA 0 0 = A(KL TO PI0 PI0)/A(KS TO PI0 PI0) (UNITS 10**-3)

E00 *  VALUES NOT AVERAGED BECAUSE OF LARGE DISCREPANCIES               11/68*

E00 *        (2.3)    (0.3)          BANNER2   68 SPRK                  11/68*
E00 *      LESS THAN   3.0           BARTLETT  68 SPRK   (E00)**2=-2+-7 11/68*
E00 *        (2.2)    (0.4)          BUDAGOV1  68 HLBC                  11/68*
E00 *  180   (3.6)    (0.6)          GAILLARD  68 SPRK                  11/68*
E00 S        (3.6)    (0.4)          UH-LRL    68 SPRK   ERROR STATIST. 11/68*
E00 S      SYSTEMATICS BEING EVALUATED -VALUE ONLY  PRELIMINARY         11/68*

F+- *  PHASE OF ETA +-          (DEGREES)

F+-          45.0     50.0           FITCH     65 SPRK   BE REGEN       11/67
F+-          30.0     45.0           FIRESTONE 66 HBC                   11/67
F+-          70.0     21.0           BOTT-BODE 67 SPRK   C REGEN        11/67
F+-          25.0     35.0           MISCHKE   67 SPRK   CU REGEN        7/68*
F+- R       (84.0)   (17.0)          RUBBIA    67 SPRK   CU REGEN        7/68*
F+- R   RUBBIA 67 REPLACED BY BENNETT2 68
F+-C         51.0     11.0           BENNETT2  68 CNTR   CU REG. USES    8/68*
F+-C  MEASUREMENT OF (F+-)-(PHIF) OF ALFF-STEINBERGER 66                 8/68*
F+-.  3560   46.0     15.0           BOHM      68 SPRK   VACUUM REGEN    8/68*
F+- B       (68.0)   (7.5)           BISI      68 CNTR   USES BENNETT2 68 10/68*
F+- B   FOR VALUE OF PHIF,REGENER. PHASE IN CU
F+- *       (59.0)   (6.0)           CRONIN    68 RVUE   INCLUDES BISI68 11/68*
F+-         . . . . . . . . . .
F+- AVG      50.2130   7.7413  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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REFERENCES
13 LONG-LIVED NEUTRAL K (498, JP=0-) I=1/2


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BARDON   58 ANP 5 156          M BARDON,K LANDE,L LEDERMAN  (COLUMBIA+BNL)
CRAWFORD 59 PRL 2 361          CRAWFORD,CRESTI,DOUGLASS,GOOD +          (LRL)
ASTIER   61 AIX CONF 1 227     ASTIER,BLASKOVIC,RIVET,SIAUD +    (PARIS+EP)
FITCH    61 NC  22 1160        V FITCH,P PIROUE,R PERKINS       (PRINCETON)
GOOD     61 PR 124 1223        GOOD,MATSEN,MULLER,PICCIONI,POWELL +  (LRL)
NEAGU    61 PRL  6  552        NEAGU,OKONOV,PETROV,ROSANOVA,RUSAKOV (JINR)

ALEXANDE 62 PRL 9 69           G ALEXANDER,S ALMEIDA,F CRAWFORD       (LRL)
CAMERINI 62 PR 128 362         CAMERINI,FRY,GAIDOS,BIRGE,ELY +  (WISC+LRL)
DARMON   62 PL 3 57            J DARMON,A ROUSSET,J SIX          (PARIS+EP)
JOVANOVI 63 BNL CONF 42        JOVANOVIC,FISCHER,BURRIS +   (BNL+MARYLAND)

ADAIR    64 PL 12 67           R K ADAIR,L B LEIPUNER            (YALE+BNL)
ALEKSANY 64 DUBNA 2 102        ALEKSANYAN,ALIKHANYAN,VARTAZARYAN+ (EREVAN)
 SEE ALSO  JETP 19 1019        ALEKSANYAN+    (LEBEDEV+MOS ENG PHYS+EREVAN)
ANIKINA  64 JETP 19 42         ANIKINA,ZHURAVLEVA+ (GEORG ACAD SCI+ DUBNA)
CHRISTEN 64 PRL 13 138         CHRISTENSON,CRONIN,FITCH,TURLAY  (PRINCETN)
FUJII    64 DUBNA 2 146        FUJII,JOVANOVICH,TURKOT+ (BNL,MARYLAND,MIT)
LUERS    64 PR 133 B 1276      LUERS,MITTRA,WILLIS,YAMAMOTC           (BNL)
STERN    64 PRL 12 459         STERN,BINFORD,LIND,ANDERSON +    (WISC+LRL)

ANIKINA  65 JINR P 2488        ANIKINA,VARDENGA,ZHURAVLEVA,KOTLYA+ (DUBNA)
ANDERSON 65 PRL 14 475         ANDERSON,CRAWFORD,GOLDEN,STERN + (LRL+WISC)
ASTBURY1 65 PL 16 80           ASTBURY,FINOCCHIARO,BEUSCH +  (CERN+ZURICH)
ASTBURY1 65  SEE ALSO M PEPIN  HELV.PHYS. ACTA 39 523
ASTBURY2 65 PL 18 175          ASTBURY,MICHELINI,BEUSCH +    (CERN+ZURICH)
ASTBURY3 65 PL 18 178          ASTBURY,MICHELINI,BEUSCH +    (CERN+ZURICH)

AUBERT   65 PL 17 59           AUBERT,BEHR,CANAVAN,CHOUNET+  (PARIS+ORSAY)
AUBERT   65  SEE ALSO LOWYS 67
BALDO-CE 65 NC 38 684          BALDO-CEOLIN,CALIMANI,CIAMPOLILLO + (PADVA)
BEHR     65 ARGONNE CONF 59    BEHR,BRISSON,BELLOTTI+    (EP+MILANO+PADOVA)
CHRISTEN 65 PR 140 B 74        CHRISTENSON,CRONIN,FITCH,TURLAY (PRINCETON)
  (CHRISTENSON 65 HAS BEEN CORRECTED FOR INTERFERENCE BY FITCH(65, FOOTNO)E)

DE BOUAR 65 PL  15  58         DE BOUARD,DEKKERS,SCHARFF+ (CERN+ORSAY+MPI)
FISHER   65 ANL 7130 83       FISHER,ABASHIAN,ABRAMS,CARPENTER+(ILLINOIS)
FITCH    65 PRL 15 73          FITCH,ROTH,RUSS,VERNCN           (PRINCETON)
FRANZINI 65 PR 140 B 127       FRANZINI,KIRSCH,PLANO +  (COLUMBIA+RUTGERS)
GALBRAIT 65 PRL 14 383         GALBRAITH,MANNING,JONES + (AERE+BRIST+RHEL)

GUIDONI  65 ARGONNE CONF 49    +BARNES,FOELSCHE,FERBEL,FIRESTO+ (BNL+YALE)
HOPKINS  65 ARGONNE CONF 67    H W K HOPKINS,BACON,EISLER   (VAND+RUTGERS)
MESTVIFI 65 JINR P 2449        MESTVIRISHVILI,NYAGU,PETROV,RUSAKOV+ (JINR)
TRILLING 65 UCRL 16473         GEORGE H TRILLING                      (LRL)
TRILLING 65   IS UPDATED FROM 1965 ARGONNE CONF, PAGE 115
VISHNEVS 65 PL  18   339       VISHNEVSKY,GALANINA,SEMENOV +      (MCSCOW)

ABASHIAN 66 BERKELEY 28        ABASHIAN,ABRAMS,VERHEY+ // URBANA
ABRAMS   66 BERKELEY CONF 28   ABRAMS AEASHIAN,CARPENTER+        (ILLINOIS)
ALFF-STE 66 PL 21 595          ALFF-STEINBERGER,HEUER,RUBBIA +       (CERN)
AUERBACH 66 PRL  17  980       AUERBACH,MANN,MCFARLANE,SCIULLI       (PENN)
AUERBACH 66 PR  149 1052       AUERBACH,DOBBS,LANDE,MANN,SCIULLI+    (PENN)
AUERBACH 66    SEE ALSO PRL 14 192
BALDO-CE 66 NC  45A  733       BALDO-CEOLIN,CALIMANI,CIAMPOLILLO+  (PADUA)
BASILE   66  BALATON CONF      BASILE,CRONIN,THEVENET +            (SACLAY)

BEHR     66 PL   22  540       BEHR,BRISSON,BALDO-CEOLIN,AUBERT+(PADUA,EP)
BELLOTTI 66 NC   45A  737      BELLOTTI,PULLIA,BALDO-CEOLIN+ (MILAN,PADUA)
BOTT-BOD 66 PL   23  277       BOTT-BODENHAUSEN,DE BOUARD,CASSEL+   (CERN)
CAMERINI 66 PR   150 1148      CAMERINI,CLINE,ENGLISH,FISCHBEIN+WIS(CNSIN)
CANTER   66 PRL 17 942         +CHO,ENGLER,FISK,HILL +      (CARNEGIE+BNL)
CARPENTE 66 PR   142  871      CARPENTER,ABASHAN,ABRAMS,FISHER  (ILLINOIS)
CHANG    66 PL   23  702       CHANG,BASSANO,KIKUCHI,DODD+  (SYRACUSE,BNL)

CRIEGEE  66 PRL 17 150         +FOX,FRAUENFELDER,HANSON,MOSCAT+ (ILLINOIS)
FIRESTON 66 PRL 16 556         FIRESTONE,KIM,LACH,SANDWEISS+    (YALE,BNL)
FIRESTON 66 PRL 17 116         FIRESTONE,KIM,LACH,SANDWEISS+    (YALE,BNL)
FUJII    66 PRL 13 253         FUJII,JOVANOVICH,TURKOT,ZORN (BNL+MARYLAND)
  (FUJII 66 IS THE CORRECTED VALUE GIVEN BY JOVANOVICH+ 66)
GOLDEN   66  BERKELEY 28       R.GOLDEN,F.CRAWFORD,D.STERN            (LRL)
HAWKINS  66 PL 21 238          C J B HAWKINS                         (YALE)
 ALSO    67 PR  156  1444      C J B HAWKINS                         (YALE)

HILL     66 BNL 10608          HILL,ROBINSON,SAKITT,CANTER+ (BNL,CARNEGIE)
JOVANOVI 66 PRL 17 1075        JOVANOVICH,FUJII,TURKOT,ZORN + (BNL+MD+MIT)
KULYUKIN 66  BERKELEY 28       KULYUKINA,MESTVIRISHVILI,NEAGU,PETR+ (JINR)
MEISNER1 66 PRL 16 278         G W MEISNER,B B CRAWFORD,F CRAWFORD   (LRL)
MEISNER2 66 PRL  17  492       G MEISNER,B CRAWFORD,F CRAWFORD       (LRL)
MEHLHOP  66    BERKELEY CONF. MEHLHOP,GOOD,PICCIONI +          (LA JOLLA)
MELHOP   66  SEE ALSO MURTY 67
MISCHKE  66    BERKELEY CONF. + ABASHIAN,ABRAMS,CARPENTER +    (ILLINOIS)
NEFKENS  66 PL 19 706          NEFKENS,ABASHIAN,ABRAMS,CARPENTER+    (ILL)
VERHEY   66 PRL 17 669         VERHEY,NEFKENS,ABASHIAN+// URBANA

BENNETT  67 PRL  19  993       BENNETT,NYGREN,SAAL,STEINBERGER +(COLUMBIA)
BOTT-BOD 67 PL  24B  194       BOTT-BODENHAUSEN,DEBOUARD,CASSEL +   (CERN)
BOTT-BOD 67 PL  24B  438       BOTT-BODENHAUSEN,DEBOUARD,DEKKERS+   (CERN)
    ALSO 66 PL  20  212        BOTT-BODENHAUSEN,DEBOUARD,CASSEL+    (CERN)
    ALSO 66 PL  23  277        BOTT-BODENHAUSEN,DEBOUARD,CASSEL+    (CERN)
CANTER   67 HEIDELBERG CONF    CANTER,CHO,DRALLE,ENGLER+    (CARNEGIE,BNL)

CRONIN 1 67 PRL 18 25          +KUNZ,RISK,WHEELER               (PRINCETON)
CRONIN 2 67 PRINC CONF(11/67) +KUNZ,RISK,WHEELER               (PRINCETON)
DEBOUARD 67 NC  52A  662       DEBOUARD,DEKKERS,JORDAN,MERMOD +     (CERN)
DEVLIN   67 PRL 18 54          DEVLIN,SOLOMON,SHEPARD,BEALL+ (PRINC+MARY.)
DORFAN   67 PRL  19  987       DORFAN,ENSTROM,RAYMOND,SCHWARTZ +(SLAC+LRL)
FELDMAN  67 PR  155  1611      FELDMAN,FRANKEL,HIGHLAND,SLOAN  (U OF PENN)
FIRESTON 67 PRL 18  176        FIRESTONE,KIM,LACH,SANDWEISS,+   (YALE,BNL)
FITCH    67 PR 164  1711       FITCH,ROTH,RUSS,VERNON           (PRINCETON)
GAILLARD 67 PRL 18 20          +KRIENEN,GALBRAITH,HUSSRI+ (CERN+RUTH+AACH)
GINSBERG 67 PR 162  1570       EDWARD S GINSBERG          (U. MASS BOSTON)

HAWKINS  67 PR  156  1444      C J B HAWKINS                         (YALE)
HILL     67 PRL  19  668       HILL,LUERS,ROBINSON,CANTER+  (BNL,CARNEGIE)
HOPKINS  67 PRL 19  185        HOPKINS,BACON,EISLER                   (BNL)
KADYK    67 PRL 19  597        KADYK,CHAN,DRIJARD,OREN,SHELDON        (LRL)
LOWYS    67 PL  24B  75        LOWYS,AUBERT,CHOUNET,PASCAUD+     (EP,ORSAY)
MISCHKE  67 PRL 18  138        MISCHKE,ABASHIAN,ABRAMS+         (ILLINOIS)
RUBBIA   67 PL  24B  531       C.RUBBIA,J.STEINBERGER           (CERN+COL)
  ALSO 1 66 PL  20  207        ALFF-STEINBERGER,HEUER,KLEINKNECHT+ (CERN)
  ALSO 2 66 PL  21  595        ALFF-STEINBERGER,HEUER,KLEINKNECHT+ (CERN)
  ALSO 3 66 PL  23  167        C.RUBBIA,J.STEINBERGER           (CERN+COL)
SCHMIDT  67 NEVIS 160(THESIS) P. SCHMIDT                        (COLUMBIA)
TODOROFF 67  THESIS            JOHN A TODOROFF                  (ILLINOIS)

ARNOLD   68 PL 28B 56          ARNOLD,BUDAGOV,CUNDY,AUBERT+   (CERN+ORSAY)
ARONSON  68 PRL 20 287         S.H.ARONSON, K.W.CHEN            (PRINCETON)
BALATZ   68 PL 26B  320        BALATZ,BEREZIN,VISHNEVSKY,GALANINA+(MCSCOW)
BANNER1  68 PRL 21 1103        BANNER,CRONIN,LIV,PILCHER        (PRINCETON)
BANNER2  68 PRL 21 1107        BANNER,CRONIN,LIV,PILCHER        (PRINCETON)
BARTLETT 68 PRL 21 558         BARTLETT,CARNEGIE,FITCH+         (PRINCETON)

BASILE1  68 VIENNA ABS. 175    BASILE,CRONIN,THEVENET,TURLAY +     (SACLAY)
BASILE   68 PL 26B  542        BASILE,CRONIN,THEVENET,TURLAY+      (SACLAY)
BENNETT1 68 PL 27B 244         BENNETT,NYGREN,STEINBERGER+ (COLUMBIA+CERN)
BENNETT2 68 PL 27B 248         BENNETT,NYGREN,STEINBERGER+ (COLUMBIA+CERN)
BISI     68  VIENNA CONF       BISI+ ABSTRACT 590          (CERN,AACHEN,TO)
BOHM     68 PL 27B 321         BOHM,DARRIULAT,GROSSO,KAFTANOV        (CERN)
BUDAGOV  68 NC 57A 182         BUDAGOV,BURMEISTER,CUNDY+(CERN,ORSAY,PARIS)
BUDAGOV1 68 PL TO BE PUPLIS.   BUDAGOV,CUNDY,AUBERT,BEHR+  (CERN+ORSAY+EP)

CARNEGIE 68 BAPS  13  16       CARNEGIE,FITCH,KAMAE,ROTH,RUSS+ (PRINCETON)
CRONIN   68  VIENNA CONF       CRONIN,RAPPORTEURS TALK          (PRINCETON)
GAILLARD 68 PREPRINT KPP/H135 GAILLARD,GALBRAITH +     (CERN+RUTH+AACHEN)
HOPKINS  68 VIENNA ABS. 242    HOPKINS,BUDAGOV,NEZRICK +  (CERN,EDINBURGH)
JAMES    68 VIENNA ABS. 332    F. JAMES,H.BRIAND                (PARIS,CERN)
LITTENBE 68 VIENNA ABS. 684    LITTENBERG,FIELD,PICCIONI,MELHOP +   (UCSD)
LONGO    68 PR TO BE PUBLIS.   LONGO,YOUNG,HELLAND          (MICHIGAN+UCLA)
    ALSO 68 PRL 21 257         HELLAND;LONGO,YOUNG          (UCLA,MICHIGAN)

MELHOP   68 PR 172 1613        MELHOP MURTY BOWLES,BURNETT+     (LA JOLLA)
THATCHER 68 PR 174 1674        THATCHER,ABASHIAN,ABRAMS,CARPENTER +  (ILL)
UH-LRL   68  VIENNA CONF       CENCE ET AL, ABST 476  (UN. OF HAWAII+LRL)
WEBBER   68 PRL 21 498         WEBBER,SOLMITZ,CRAWFORD,ALSTONGARNJOST(LRL)
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η

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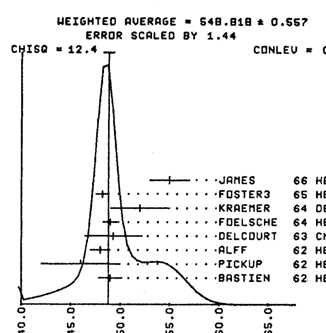
                  14  ETA (549,JPG=0-+)  I=0

      FOR C. BALTAYS REVIEW OF THE ETA MESON, SEE PROC. UNIV.OF PENN.
      CONF. ON MESON SPECTROSCOPY, W.A. BENJAMIN, TO BE PUBLISHEC.


                  14  ETA MASS  (MEV)

M        53  549.0      1.2           BASTIEN   62 HBC
M        35  546.0      4.0           PICKUP    62 HBC
M        91  548.0      1.0           ALFF      62 HBC
M            549.3      2.9           DELCOURT  63 CNTR
M       148  549.0      0.7           FOELSCHE  64 HBC
M       325  552.0      3.0           KRAEMER   64 DBC
M            548.2      0.65          FOSTER3   65 HBC                  7/66
M       250  555.0      2.0           JAMES     66 HBC                  6/66
M            . . . . . . . . .
M   AVG      548.8176   .5570  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
                  (SEE IDEOGRAM BELOW )
```

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                  14  ETA  WIDTH (MEV)

W        91   10.0   OR LESS             ALFF      62 HBC
W       148   10.0   OR LESS             FOELSCHE  64 HBC
W        31   12.0   OR LESS             JAMES .   66 HBC                  6/66
W              4.0   OR LESS             BALTAY    66 DBC                  7/66
W               .9   OR LESS             JONES     66 CNTR   .95 CONF.LEVEL 8/67
    ALSO SEE ETA DECAY RATES (BELOW).

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Data in parentheses have not been included in our averages.

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                    14  ETA PARTIAL DECAY MODES

                                                             DECAY MASSES
P1      ETA INTO 2GAMMA                                       0+    0
P2      ETA INTO 3PIO                                       134+ 134+ 134
P3      ETA INTO PI+ PI- PIO                                139+ 139+ 134
P4      ETA INTO PI+ PI- GAMMA                              139+ 139+   0
P5      ETA INTO   E+E-PIO          VIOLATES C IN E.M.I.    134+  .5+  .5
P6      ETA INTO E+E-PI+PI-                                 139+ 139+  .5+  .5
P7      ETA INTO PIO 2GAMMA                                 134+   0+   0
P8      ETA INTO E+E-GAMMA                                   .5+  .5+   0
P9      ETA INTO 2PIO GAMMA         VIOLATES C              134+ 134+   0
P10     ETA INTO PI+PI-PIO GAMMA                            139+ 139+ 134+   0
P11     ETA INTO PI+PI- 2GAMMA                              139+ 139+   0+   0
P12     ETA INTO MU+MU-                                     105+ 105
P13     ETA INTO MU+MU-GAMMA                                105+ 105+   0
P14     ETA INTO MU+MU-PIO                                  105+ 105+ 134

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                    14 ETA DECAY RATES

W1  *  ETA INTO 2GAMMA (UNITS KEV)                          (P1)
W1  *        (0.93)   (0.2)         BEMPORAD  67 CNTR     PRIMAKOFF EFFECT 11/67
```

The above value for $\Gamma_{\gamma\gamma}$ assumes that $\Gamma_{\gamma\gamma}/\Gamma_{total} = 31.4\%$. However, the results of that experiment may be stated more generally than is given in the paper, as

$$\Gamma_{\gamma\gamma} \times \frac{\Gamma_{\gamma\gamma}}{\Gamma_{total}} = 0.380 \pm 0.083 \text{ keV}$$

(private communication from C. Bemporad). Thus our new value of

$$\Gamma_{\gamma\gamma}/\Gamma_{total} = 38.1 \pm 2.2\%$$

would give

$$\Gamma_{\gamma\gamma} = 1.00 \pm 0.22 \text{ keV}$$

and

$$\Gamma_{total} = 2.63 \pm 0.64 \text{ keV}.$$

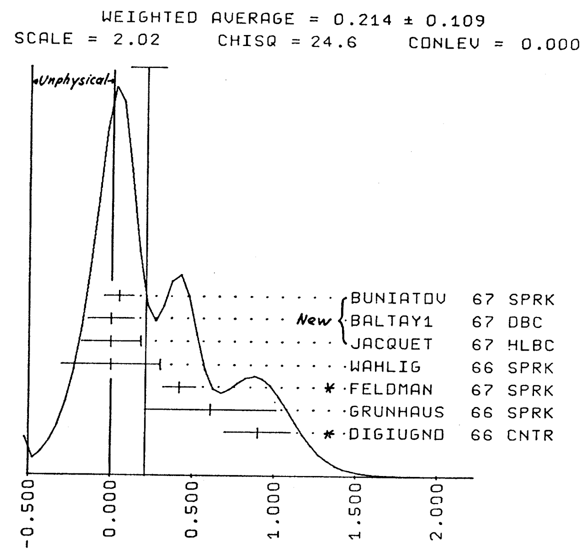
ETA DECAY INTO NEUTRALS

As is well known, there are great inconsistencies among the various experiments which report etas decaying into neutrals. The controversy is over whether the mode $\eta \rightarrow \pi^0\gamma\gamma$ is ≈ 0 (as the newer experiments indicate) or $\gtrsim 20\%$ (as the older experiments indicated).

The discrepancies are displayed in the ideogram below, in which all seven relevant experiments have been converted to a common ratio, $\pi^0\gamma\gamma/\gamma\gamma$. Also upper limits, $<x$, have been converted to $0 \pm x$. The confidence level for consistency of all seven is 4×10^{-4}!

At the time of our last edition, the top three experiments (Buniatov, Baltay, and Jacquet) were new and had not borne the tests of time. Hence we were reluctant to discard older experiments, even though the new were inconsistent with the old. We merely warned that the truth must lie somewhere in between.

But by now, and after fruitful discussion with Charles Baltay,* we feel that we should consider all seven experiments on an *a priori* equal basis, and then follow the prescription



ETA B.R. INTO (PIO 2GAMMA)/(2GAMMA)

of deleting large χ^2 experiments until the confidence level rises to some reasonable value. If we remove the Feldman and DiGiugno experiments, χ^2 decreases from 25 (for all seven) to nearly zero (for the remaining five). Accordingly we have removed these experiments and used the remaining five experiments in our overall fit.

```
                    14 ETA   BRANCHING RATIOS

              (P9) IS ASSUMED = 0 IN ALL RATIOS

R1  *    ETA INTO NEUTRALS/CHARGED                         (P1+P2+P7)/(P3+P4)
R1  N   10   (2.5)    (1.0)          PICKUP     62 HBC
R1  N   53   (3.20)   (1.26)         BASTIEN    62 HBC
R1  N        (2.7)    (0.8)          SHAFER     62 HBC
R1            2.6       .9           BUSCHBECK  63 HBC                          7/66
R1  N  280   (4.5)    (1.0)          JAMES      66 HBC                          6/66
R1  N     THESE EXPERIMENTS HAVE NOT BEEN USED IN COMPUTING THE AVERAGES
R1  N   AS THEY WERE UNABLE TO CLEARLY SEPARATE PARTIAL MODES (3) AND (4)
R1  N   FROM EACH OTHER.  THE REPORTED VALUES THUS PROBABLY CONTAIN
R1  N   SOME (UNKNOWN) FRACTION OF MODE (4).
R1            2.64      0.23         BALTAY2    67 DBC                         11/67
R1         . . . . . . . . . .
R1  AVG       2.6375    .2228  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT       2.481     .161    VALUE FROM CONSTRAINED FIT

R2  *  ETA INTO 2GAMMA/CHARGED                              (P1)/(P3+P4)
R2            0.99      0.48         CRAWFORD  63 HBC
R2         . . . . . . . . . .
R2  FIT       1.326     .115    VALUE FROM CONSTRAINED FIT

R3  *    ETA INTO (PIO 2GAMMA)/NEUTRALS                     (P7)/(P1+P2+P7)
R3  S       (0.375)  (0.072)         DIGIUGNO  66 CNTR    ERROR DOUBLED        6/66
R3  *     THE ERRORS OF DIGIUGNO+ 66 HAVE BEEN INCREASED BY A FACTOR
R3  *   OF TWO, TO TAKE INTO ACCOUNT POSSIBLE SYSTEMATIC ERRORS, AS
R3  *   SUGGESTED BY THE AUTHORS.
R3             .27       .10         GRUNHAUS  66 SPRK                          8/67
R3  S        (.244)    (.05)         FELDMAN   67 SPRK                          8/67
R3  S   SEE THE NOTE ON ETA DECAY INTO NEUTRALS ABOVE.
R3             .028      .044        BUNIATOV  67 SPRK                         11/67
R3         . . . . . . . . . .
R3  AVG        .0673     .0892  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.2)
R3  FIT        .035      .044    VALUE FROM CONSTRAINED FIT

R4  *  ETA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)              (P4)/(P3)
R4            0.14      0.08         FOELSCHE  64 HBC
R4  M   24   (0.73)    (0.25)        PAULI     64 DBC
R4  M     THIS EXPERIMENT HAS NOT BEEN INCLUDED IN THE AVERAGES SINCE
R4  M   IT IS NOT CLEAR THAT THEIR CLASS B EVENTS ARE ACTUALLY FROM ETAS.
R4            0.30      0.06         CRAWFORD  66 HBC                           6/66
R4             .10       .10         KRAEMER   64 DBC                           7/66
R4             .196      .041        FOSTER3   65 HBC                           7/66
R4             .25       .035        LITCHFIEL 67 DBC                           8/67
R4            0.28      0.04         BALTAY2   67 DBC                          11/67
R4         . . . . . . . . . .
R4  AVG        .2377     .0229  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)
R4  FIT        .235      .021    VALUE FROM CONSTRAINED FIT
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*See C. Baltay, Proc. of the 1968 Univ. of Penn. Conf. on Meson Spectroscopy (W. A. Benjamin, to be published).

STABLE PARTICLES

Data in parentheses have not been included in our averages.

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R5  *    ETA INTO (3PIO)+ 2/3(PIO 2GAMMA)/ PI+PI-PIO      (P2+2/3P7)/P3
R5           0.83      0.32          CRAWFORD  63 HBC                        7/66
R5           2.0       1.0           FOELSCHE  64 HBC                        7/66
R5           0.90      0.24          FOSTER1   65 HBC                        7/66
R5        . . . . . . . . . .
R5  AVG       .9148     .1886  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R5  FIT      1.391      .111    VALUE FROM CONSTRAINED FIT

R6  *  ETA INTO 3PIO/2GAMMA                                  (P2)/(P1)
R6            .90  OR MORE           CHRETIEN  62 PBC
R6           0.88      0.16          BALTAY1   67 DBC                       11/67
R6           1.1       0.2           CENCE     67 SPRK                       1/68*
R6  C       (1.06)    (0.31)         STRUGALSK 68 HLBC  CONFERENCE REPORT  11/68*
R6        . . . . . . . . . .
R6  AVG       .9659     .1249  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R6  FIT       .806      .096    VALUE FROM CONSTRAINED FIT

R7  *  ETA INTO 2GAMMA/(PI+ PI- PO)                        (P1)/(P3)
R7           1.61      0.39          FOSTER1   65 HBC
R7        . . . . . . . . . .
R7  FIT      1.637      .144    VALUE FROM CONSTRAINED FIT

R8  *    ETA INTO NEUTRAL/(PI+ PI- PIO)                    (P1+P2+P7)/(P3)
R8     280   3.6       0.8           KRAEMER   64 DBC
R8           3.8       1.1           PAULI     64 DBC                        7/66
R8           2.89      0.56          ALFF-STEI 66 HBC                        9/66
R8     244   3.6       0.6           FLATTE2   67 HBC                        1/68*
R8        . . . . . . . . . .
R8  AVG      3.3488     .3460  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R8  FIT      3.177      .182    VALUE FROM CONSTRAINED FIT

R9  *  ETA INTO  (E+E-PIO)/(PI+PI-PIO)  (UNITS 10**-2) (P5)/(P3)
R9           1.1   OR LESS           PRICE     65 HBC
R9       0   0.77  OR LESS           FOSTER2   65 HBC
R9            .42  OR LESS           BAGLIN1   67 HLBC    .9 CONF.LEVEL     8/67
R9       0    .16  OR LESS           BILLING   67 HLBC    .9 CONF.LEVEL    11/67

R10 *    ETA INTO (E+E-PI+PI-)/TOTAL  (UNITS 10**-2)    (P6)/TOTAL
R10          0.7 OR LESS             RITTENBER 65 HBC                        6/66

R11 *    ETA INTO (E+E-PI+PI-)/(PI+PI-GAMMA)               (P6)/(P4)
R11      1   0.026     0.026         GROSSMAN  66 HBC                        6/66

R12 *    ETA INTO 2 GAMMA/NEUTRALS                         (P1)/(P1+P2+P7)
R12 S      (0.416)   (0.044)         DIGIUGNO  66 CNTR    ERROR DOUBLED     6/66
R12           .44       .07          GRUNHAUS  66 SPRK                       8/67
R12 S       (.579)    (.052)         FELDMAN   67 SPRK                       8/67
R12 S  SEE THE NOTE ON ETA DECAY INTO NEUTRALS ABOVE.
R12 T       (0.39)    (0.06)         JONES     66 CNTR                       8/67
R12 T  THIS RESULT FROM COMBINING CROSS-SECTIONS FROM TWO DIFFERENT EXPTS.
R12           .59       .033         BUNIATOV  67 SPRK                      11/67
R12       . . . . . . . . . .
R12 AVG       .5627     .0579  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.9)
R12 FIT       .534      .030    VALUE FROM CONSTRAINED FIT

R13 *    ETA INTO 3PIO/NEUTRALS                            (P2)/(P1+P2+P7)
R13 S      (0.209)   (0.054)         DIGIUGNO  66 CNTR    ERROR DOLBLED     6/66
R13 R       (.29)     (.10)          GRUNHAUS  66 SPRK                       8/67
R13 S       (.177)    (.035)         FELDMAN   67 SPRK                       8/67
R13 S  SEE THE NOTE ON ETA DECAY INTO NEUTRALS ABOVE.
R13 R       (.41)     (.033)         BUNIATOV  67 SPRK                      11/67
R13 R REDUNDANT INFORMATION FROM THIS EXPERIMENT
R13       . . . . . . . . . .
R13 FIT       .431      .040    VALUE FROM CONSTRAINED FIT

R14 *      ETA INTO PIO (2GAMMA)/2GAMMA                    (P7)/(P1)
R14           .5   OR LESS           WAHLIG    66 SPRK    .9 CONF LEVL      7/66
R14          0.0       0.14          BALTAY1   67 DBC                       11/67
R14 N      (0.05)    (0.04)          BONAMY    67 SPRK  PRELIMINARY RESULT 11/67
R14 C      (0.30)    (0.22)          STRUGALSK 68 HLBC  CONFERENCE REPORT  11/68*
R14       . . . . . . . . . .
R14 FIT       .065      .075    VALUE FROM CONSTRAINED FIT

R15 *      ETA INTO (E+E-PIO)/TOTAL (UNITS 10**-2)         (P5)/TOTAL
R15          0.7 OR LESS             RITTENBER 65 HBC                        6/66
R15          0.084 OR LESS           BAZIN     68 DBC  .9 CONF LEVL          6/68*

R16 *    ETA INTO 2GAMMA/(3PIO + PIO 2GAMMA)               (P1)/(P2+P7)
R16          0.80       .25          BACCI     63 CNTR                       7/66
R16       . . . . . . . . . .
R16 FIT      1.081      .122    VALUE FROM CONSTRAINED FIT

R17 *    ETA INTO (PI+PI-PIO GAMMA)/(PI+PI-PIO)            (P10)/(P3)
R17           .07  OR LESS           FLATTE    67 HBC                        8/67
R17           .009 OR LESS           PRICE     67 HBC                        8/67
R17           .016 OR LESS           BALTAY2   67 DBC     .95 CONF LEVL    11/67
R17          0.017 OR LESS           ARNOLD    68 HLBC     .9 CONF LEVEL    9/68*

R18 *    ETA INTO (PI+PI- 2GAMMA)/(PI+PI-PIO)              (P11)/(P3)
R18           .009 OR LESS           PRICE     67 HBC                        8/67
R18           .016 OR LESS           BALTAY2   67 DBC     .95 CONF LEVL    11/67

R19 *  ETA INTO 3PIO/(PI+ PI- PIO)                         (P2)/(P3)
R19          1.03       .34          MICHAEL   67 HLBC                       8/67
R19          1.3        .4           BAGLIN2   67 HLBC                       8/67
R19          1.47      0.20     0.17 BULLOCK   68 HLBC                       9/68*
R19       . . . . . . . . . .
R19 AVG      1.3596     .1506  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R19 FIT      1.320      .123    VALUE FROM CONSTRAINED FIT

R20 *    ETA INTO 2GAMMA/((3PIO)+2/3(PIO 2GAMMA))          (P1)/(P2+2/3P7)
R20          1.10      0.5           MULLER    63 DBC                        7/66
R20       . . . . . . . . . .
R20 FIT      1.176      .132    VALUE FROM CONSTRAINED FIT

R21 *  ETA INTO NEUTRALS/TOTAL                            (P1+P2+P7)/TOTAL
R21           .79       .08          BUNIATOV  67 SPRK                      11/67
R21       . . . . . . . . . .
R21 FIT       .713      .013    VALUE FROM CONSTRAINED FIT

R22 *  ETA INTO (PIZRO 2GAMMA)/TOTAL                      (P7)/TOTAL
R22           .12  OR LESS           JACQUET   67 HLBC    .9 CONF LEVL     11/67
R22       . . . . . . . . . .
R22 FIT       .025      .031    VALUE FROM CONSTRAINED FIT

R23 *  ETA INTO MU+MU-/TOTAL      (UNITS 10**-5)           (P12)/TOTAL
R23      0   2.     OR LESS          WEHMANN   68 SPRK    .95 CONF.LEVEL    4/68*

R24 *  ETA INTO MU+MU-PIO/TOTAL  (UNITS 10**-4)            (P14)/TOTAL
R24          5.     OR LESS          WEHMANN   68 SPRK                       4/68*

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  THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

      P2 P7       -.665

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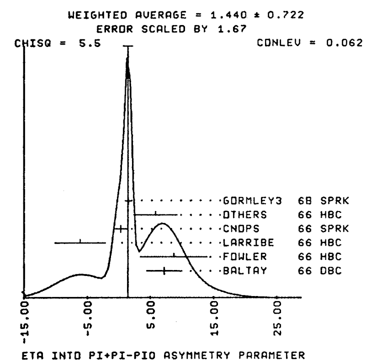
                    14  ETA C-NONCONSERVING DECAY PARAMETER

A   DECAY ASYMMETRY PARAMETER FOR PI+ PI- PIO    (UNITS 10**-2)
A     1351     7.2      2.8          BALTAY     66 DBC                 8/66
A      355     8.7      5.3          FOWLER     66 HBC                 8/66
A      705    -6.1      4.0          LARRIBE    66 HBC                 8/67
A    10665     0.3      1.0          CNOPS      66 SPRK                8/67
A     1300     5.8      3.4          OTHERS     66 HBC                 8/66
A    36800     1.5       .5          GORMLEY3   68 SPRK                6/68*
A           . . . . . . . . . .
A   AVG       1.4398    .7225  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.7)
                        (SEE IDEOGRAM BELOW )
```



H. Yuta and S. Okubo (PRL 21, 781) have pointed out that an asymmetry in the decay $\eta \rightarrow \pi^+\pi^-\pi^0$ of about 2% need not imply a breakdown of C invariance, since an asymmetry of this amount could be caused by an interference between the η and the 3π background.

```
B   DECAY ASYMMETRY PARAMETER FOR PI+ PI- GAMMA (UNITS 10**-2)
B      33   -2.      17.               CRAWFORD  66 HBC              11/66
B    1620    1.5      2.5              BOWEN     67 SPRK              8/67
B   N ABOVE EXPERIMENT IS SENSITIVE ONLY TO UPPER .4 OF GAMMA-RAY SPECTRUM
B           -4.       8.               LITCHFIEL 67 DBC               8/67
B    6710    2.4      1.4              GORMLEY2  68 SPRK              6/68*
B         . . . . . . . . . .
B   AVG       2.0239   1.2045  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
```

Any simple model of C noninvariance in the decay $\eta \rightarrow \pi^+\pi^-\gamma$ predicts a maximum asymmetry in the lowest part of the γ-ray energy spectrum (i.e., as $E_\gamma \rightarrow 0$). This is easily seen by remembering that (experimentally) the C-conserving part of the decay puts the dipion in a J = 1 state. However, the C-violating part of the interaction must put the dipion in an even J state (and J ≥ 2). One then expects the competition between J = 1 and J = 2 (4, 6, ···) to be the greatest when $m_{\pi\pi}$ is largest, i.e., as $E_\gamma \rightarrow 0$.

However, the lower limits on γ-ray energies detected in the experiments on this asymmetry range from about 50 MeV to about 125 MeV (the maximum energy of the γ in this decay is 204 MeV). Thus no experiment has yet really investigated the potentially most sensitive region.

Data in parentheses have not been included in our averages.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                          REFERENCES
                          14 ETA(549,JPG=0-+)I=0

PEVSNER  61 PRL 7 421          PEVSNER,KRAEMER,NUSSBAUM,RICHARDSON + (JHU)

ALFF     62 PRL 9 322          ALFF,BERLEY,COLLEY,BRUGGER +  (COL+RUTGERS)
BASTIEN  62 PRL 8 114          BASTIEN,BERGE,DAHL,FERRO-LUZZI +      (LRL)
CHRETIEN 62 PRL 9 127          CHRETIEN+  (BRAND+BROWN+HARVARD+MIT+PADOVA)
PICKUP   62 PRL 8 329          E PICKUP,ROBINSON,SALANT      (NRC+CAN+BNL)
SHAFER   62 CERN CONF 307      J SHAFER,FERRO-LUZZI,MURRAY +       (UC+LRL)

BACCI    63 PRL 11 37          BACCI,PENSO,SALVINI +  (ROME U+CNEN FRASCA)
BUSCHBEC 63 SIENA CONF 1 166   BUSCHBECK-CZAPP,COOPER +  (VIENNA+CERN+AMS)
CRAWFORD 63 PRL 10 546         F S CRAWFORD,LLOYD,FCWLER         (LRL+DUKE)
   AND      PRL 16 907         F S CRAWFORD,L LLOYD,E FOWLER     (LRL+DUKE)
DELCOURT 63 PL 7 215           DELCOURT,LEFRANCOIS,PEREZ Y JORBA+  (ORSAY)
MULLER   63 SIENA CONF 99      MULLER,PAULI +  (LPCHE+SACLAY IF+ROME+INFN)

FOELSCHE 64 PR 134 B 1138      H W FOELSCHE,H L KRAYBILL              (YALE)
KRAEMER  64 PR 136 B 496       KRAEMER,MADANSKY,FIELDS +    (JHU+NW U+WOOD)
PAULI    64 PL 13 351          E PAULI,A MULLER                (LPCHE+SACLAY)

FOSTER1  65 PR 138 B 652       FOSTER,PETERS,MEER,LOEFFLER + (WISC+PURDUE)
FOSTER2  65 ATHENS             FOSTER,GOOD,MEER                 (WISCONSIN)
FOSTER3  65 THESIS             M.C.FOSTER                       (WISCCNSIN)
PRICE    65 PRL  15  123       L.R.PRICE,F.S.CRAWFORD                 (LRL)
RITTENBE 65 PRL 15 556         RITTENBERG,KALBFLEISCH             (LRL+BNL)

ALFF-STE 66 PR 145 1072        ALFF-STEINBERGER,BERLEY+ (CCLUMBIA+RUTGERS)
BALTAY   66 PRL 16 1224        +FRANZINI,KIM,KIRSCH+(COLUMBIA+STONY BROOK)
CRAWFORD 66 PRL  16  333       F.S.CRAWFORD,L.R.PRICE                 (LRL)
DIGIUGNO 66 PRL 16 767         DIGIUGNO,GIORGI,SILVESTRI+ (NAP+TRST+FRASC)
GROSSMAN 66 PR 146  993        R GROSSMAN,L PRICE,F CRAWFCRD          (LRL)
GRUNHALS 66 THESIS             J.GRUNHAUS                        (COLUMBIA)
JAMES    66 PR 142   896       F E JAMES,H L KRAYBILL            (YALE+BNL)
JONES    66 PL 23  597         JONES,BINNIE,DUANE,HORSEY,MASON,+(ICL+RUTH)
WAHLIG   66 PRL  17  221       WAHLIG,SHIBATA,MANNELLI           (MIT+PISA)

BAGLIN1  67 PL 24B 637         BAGLIN,BEZAGUET,DEGRANGE,+        (E.POLY+UC)
BAGLIN2  67 BAPS 12 567        BAGLIN,BEZAGUET,DEGRANGE,+        (E.POLY+UC)
BALTAY1  67 PRL 19 1495        BALTAY,FRANZINI,KIM,NEWMAN+   (COLUM+BRAND)
BALTAY2  67 PRL 19 1498        BALTAY,FRANZINI,KIM,NEWMAN+(COLUM+STONY BK)
BEMPORAD 67 PL 25B 380         BEMPORAD,BRACCINI,FOA,LUBELSMEY+(PISA,BONN)
   AND      PRIVATE COMMUNICATION
BILLING  67 PL 25B 435         BILLIG,BULLOCK,ESTEN,GOVAN,+        (UCL,OXF)
BONAMY   67 HEIDELBERG CONF.   BONAMY,SONDEREGGER                   (SACLAY)
BUNIATOV 67 PL 25B 560         BUNIATOV,ZAVATTINI,DEINET,+     (CERN,KARLS)
CENCE    67 PRL 19 1393        CENCE,PETERSON,STENGER,CHIU+    (HAWAII+LRL)
FELDMAN  67 PRL 18 868         FELDMAN,FRATI,GLEESON,HALPERN,+        (PENN)
FLATTE   67 PRL 18 976         S.M.FLATTE                              (LRL)
FLATTE2  67 PR 163 1441        S.M.FLATTE AND C.G.WOHL                 (LRL)
JACQUET  67 PL 25B 574         JACQUET,NGUYEN-KHAC,BAGLIN+(EC.POLY,BERGEN)
LITCHFIE 67 PL 24B 486         LITCHFIELD,RANGAN,SEGAR,SMITH+(RUTH+SACLAY)
MICHAEL  67 THESIS             W.B.MICHAEL                              (UC)
PRICE    67 PRL 18 1207        L.R.PRICE,F.S.CRAWFORD                  (LRL)

ARNOLD   68 PL 27B 466         +PATY,BAGLIN,BINGHAM+ (STRB+MADR+EPOL+BERK)
BAZIN    68 PRL 20 895         BAZIN,GOSHAW,ZACHER,+     (PRINCETON,QUEENS)
BULLOCK  68 PL 27B 402         +ESTEN,FLEMING,GOVAN,HENDERSON,OWEN+ (LOUC)
STRUGALS 68 VIENNA ABS. 112    STRUGALSKI,CHUVILO,IVANOVSKAJA,+      (DUBNA)
WEHMANN  68 PRL 20 748         WEHMANN,ENGELS,+(HARV+CASE+SLAC+COR+MCGILL)

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

BASTIEN  62 PRL 8 114          BASTIEN,BERGE,DAHL,FERRO-LUZZI;MILLER+(LRL)
CARMONY  62 PRL 8 117          D CARMONY,A ROSENFELD,VAN DE WALLE     (LRL)
ROSENFEL 62 PRL 8 293          A ROSENFELD,D CARMONY,VAN DE WALLE     (LRL)

          REFERENCES ON ETA ASYMMETRY PARAMETERS

BALTAY   66 PRL  16  1224      BALTAY,FRANZINI,KIM,KIRSCH+(COLUM+STONY BK)
CNOPS    66 PL 22 546          CNOPS,FINOCCHIARS,LASSALLE,+(CERN+ZUR+SACL)
CRAWFORD 66 PRL  16  333       F.S.CRAWFORD,L.R.PRICE                 (LRL)
FOWLER   66 BAPS 11  380       E.C.FOWLER                            (DUKE)
LARRIBE  66 PL 23 600          LARRIBE,LEVEQUE,MULLER,PAULI,+  (SACL+RUTH)
OTHERS   66 PR 149  1044       COLUMBIA,LRL,PURDUE,WISCONSIN,YALE

BOWEN    67 PL 24B 206         BOWEN,CNOPS ,FINOCCHIARO,+  (CERN+ZUR+SACL)
LITCHFIE 67 PL 24B 486         LITCHFIELD,RANGAN,SEGAR,SMITH+(RUTH+SACLAY)
GORMLEY2 68 PRL 21 399         GORMLEY,HYMAN,LEE,NASH,PEOPLES+  (COLU+BNL)
GORMLEY3 68 PRL 21 402         GORMLEY,HYMAN,LEE,NASH,PEOPLES+  (COLU+BNL)
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p

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                 16  PROTON  (938,J=1/2)  I=1/2

                 16  PROTON  MASS (MEV)

M          938.256    0.005          COHEN     65 RVUE                      7/66

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                 16  PROTON LIFETIME  (UNITS 10**26 YR)

T    *      OVER  10**20  YRS        GOLDHABER 54 TH 232 FISS.MODE INDEPEN
T    *      OVER  2.0 * 10**23 YRS   FLEROV    57 TH 232 FISS.MODE INDEPEN
T    *  OVER                  1.5    BACKENSTO 60 CNTR
T    *  OVER                 60.0    KROPP     65 CNTR                      6/66
T    *    KROPP AND BACKENSTOSS SENSITIVE TO PARTICULAR DECAY MODES OF PROT
T    *  OVER                200.0    GURR      67 CNTR DEP. ON DECAY MODE   6/68*

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                 16 PROTON MAGNET. MOMENT(E/2MP)

MM         2.792763 0.000030         COHEN     65 RVUE                      7/66

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                          REFERENCES
                          16 PROTON (938,J=1/2) I=1/2

GOLDHABER 54 PR 96 1157 FNOTE2 M GOLDHABER,F REINES+     (LOS ALAMOS,BNL)
FLEROV    57 SOV PHYS DOK 3 78 FLEROV,KLOCHKOV,SKOBKIN,TERENTEV      (USSR)
BACKENST 60 NC    16   749      BACKENSTOSS,FRAUENFELDER,HYAMS +      (CERN)
COHEN    65 RMP 37 537          E R COHEN, J W M DUMOND        (NAASC+CALTECH)
KROPP    65 PR 137 B 740        W R KROPP,F REINES    (CASE INST TECHNOLOGY)
GURR     67 PR  158  1321       GURR,KROPP,REINES,MEYER (CASE,JOHANNESBURG)
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n

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                 17  NEUTRON (939,J=1/2)  I=1/2

                 17  NEUTRON-PROTON MASS DIF.(MEV)

D            1.2939  0.0004          BONDELID  60 CNTR
D            1.2933  0.0001          SALGO     64 CNTR
D          . . . . . . . . . .
D    AVG     1.2933   .0001   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)
D    FIT    1.2923   0.0001    VALUE FROM CONSTRAINED FIT
D    FIT    1.2923   0.0001    VALUE FROM CONSTRAINED FIT

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                 17  NEUTRON MAGNETIC MOMENT (MAGNETONS,938.2 MEV)

MM        -1.913148 0.000066         COHEN     56 RVUE                      7/66
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Neutron Lifetime and Coupling Constants in Beta Decay

The measurement of the neutron lifetime by Sosnovskii et al. has been discarded, since (i) it is in disagreement with the better and more recent result of Christensen et al., (ii) the value of g_A/g_V derived from the new value of the neutron lifetime agrees better with the one obtained from the free neutron data.

The angle δ is defined by the relation

$$g_A/g_V = |g_A/g_V|e^{i\delta},$$

and is equal to $0 + n\pi$ if time-reversal invariance holds (see JACKSON 57).

We list below the values of g_A/g_V calculated under the assumption of time-reversal invariance and the values for the phase angle δ.

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                 17  NEUTRON LIFETIME (UNITS 10**3 SEC)

T    *     (1.012)  (0.021)          SOSNOVSKI 59 PILE      SEE NOTE E      7/68*
     E  ERROR CHANGED BECAUSE ERROR IN CROSS SECTION FOR NEUTRON ABSCRPTION
     E  IN GOLD HAS BEEN REDUCED
T           0.932    0.014           CHRISTENS 67 PILE                      3/68*

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                 17  BETA DECAY COUPLING CONSTANTS.

AV   *   GA/GV  (SEE TEXT FOR SIGN CCNVENTION)
AV   B      (-1.18)   (0.02)         BHALLA    66 RVUE                      11/67
     B   THIS VALUE NOT USED SINCE CORRESPONDING  LIFETIME HAS BEEN DISCARDE
AV          -1.250    0.044          CONFORTO  67 RVUE  SEE NOTE C BELOW
AV   C      CONFORTO VALUE COMBINES ALL FREE NEUTRON DECAY DATA
AV          -1.23     0.01           CHRISTENS 67 CNTR  SEE NOTE D BELOW    11/68*
AV   D      CHRISTENSON MEASUREMENT NOT SENSITIVE TO SIGN OF GA/GV
AV         . . . . . . . . . .
AV   AVG     -1.2310   .0098  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

F    *   PHASE ANGLE OF GA RELATIVE TO GV  (DEGREES)
F          176.1      6.4            CONFORTO  67 RVUE                      11/68*
     *  VALUE DERIVED FROM FREE NEUTRON DECAY CNLY

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                          REFERENCES
                          17 NEUTRCN (939,J=1/2) I=1/2

COHEN    56 PR 104 283          V W COHEN, CORNGOLD, RAMSEY   (BNL+HARVARD)
JACKSON  57 PR 106 517          JACKSON,TRIEMAN,WYLD             (PRINCETON)
SOSNOVSK 59 JETP  9  717        SOSNOVSKII,SPIVAK,PROKOFEV +   (IAE MOSCOW)
BONDELID 60 PR  120  887        BONDELID,BUTLER,KENNEDY + (USNRL+CATH UNIV)
SALGO    64 NP   53  457        R SALGO, STAUB, WINKLER, ZAMBONI  (ZURICH)
COHEN    65 RMP 37 537          E R COHEN,DUMOND    . (NAASC+CAL INST TECH)
BHALLA   66 PL 19  691          C P BHALLA                        (ALABAMA)
CHRISTEN 67 PL 26B 11           +NIELSEN,BAHNSEN,BROWN,RUSTAD(RISO-DENMARK)
CCNFORTC 67 ACTA PHYS ACAD
   HUNGARICA 22  15 G. CONFORTO                                      (CERN)
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                 18  LAMBDA (1115,JP=1/2+)  I=0

                 18  LAMBDA  MASS (MEV)

M    N  SINCE OUR FINAL VALUES FCR THE SIGMA AND LAMBDA MASSES COME FROM
M    N  DOING AN OVERALL FIT TO ALL MEASURED MASSES AND MASS DIFFERENCES,
M    N  WE HAVE USED THE UNCORRELATED MEASUREMENTS FROM SCHMIDT 65 RATHER
M    N  THAN THE ONES COMING FROM THE OVERALL FIT REPORTED IN THAT PAPER.
M    N  SINCE THERE SEEMS TO BE NO CONVINCING ARGUMENT AS TO WHY ONE SHOULD
M    N  IGNORE DATA USING RANGE MEASUREMENTS, WE HAVE INCLUDED HERE VALUES
M    N  DEPENDING ON PROTON AND PION RANGES.

M          1115.44     0.12          BHOWMIK   63 RVUE +  SEE NOTE L BELOW
M    L  ABOVE LAMBDA MASS HAS BEEN RAISED 35 KEV TO ACCOUNT FOR 46 KEV
M    L  INCREASE IN PROTON MASS AND 11 KEV DECREASE IN CHARGED PION MASS.
M    S  635(1115.86)   (0.09)        BALTAY    65 HBC    ERRCR IS STATIS.   6/66
M       488 1115.63     0.07         SCHMIDT   65 HBC  SEE NOTE N           6/68*
M    S 1147(1115.74)   (0.04)        CHIEN     66 HBC      6.9 PBAR P       9/67
M    S  972(1115.69)   (0.05)        CHIEN     66 HBC      6.9 PBAR PANTIL  9/67
M          1115.6      0.4           LONDON    66 HBC                       6/66
M    *     (1116.0)    (0.2)         BADIER    67 HBC    2.4 PBAR P,LLBAR   8/67
M     195 1115.39      0.12          MAYEUR    67 EMUL                     11/67
M    S      ERROR PURELY STATISTICAL
M          . . . . . . . . . .
M    AVG   1115.5440   .0748  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
M    FIT    115.60     0.08     VALUE FROM CONSTRAINED FIT                  6/68*
                          (SEE IDEOGRAM BELOW )
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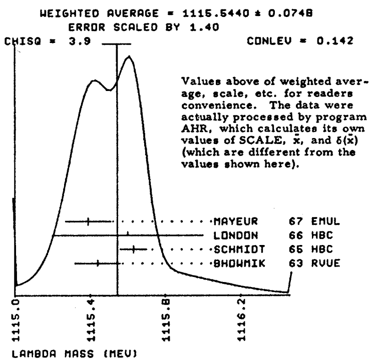
STABLE PARTICLES

Data in parentheses have not been included in our averages.

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              18  LAMDA - ANTILAMBDA MASS DIFFERENCE (MEV)
DM          0.05      0.06            CHIEN     66 HBC     6.9 PBAR P       9/67
DM          0.29      0.15            BADIER    67 HBC     2.4 PBAR P       8/67
DM        . . . . . . . . .
DM   AVG      .0831     .0828  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)

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              18  LAMBDA LIFETIMF (UNITS 10**-10)

T      188    2.63      0.21     0:21  BOLDT      58 CC
T      825    2.72      0.16     0.16  CRAWFORD   59 HBC
T      140    2.72      0.29     0.27  BOWEN      60 CC
T      186    2.60      0.28     0.20  CHANG      62 HBC
T      799    2.69      0.11     0.11  HUMPHREY   62 HBC
T     2239    2.36      0.06     0.06  BLOCK      63 HEBC
T      706    2.76      0.20           CHRETIEN   63 PBC
T      794    2.59      0.09           HUBBARD    64 HBC
T     2260    2.31      0.10           KREISLER   64 SPRK
T     1378    2.59      0.07           SCHWARTZ   64 HBC
T      635    2.51      0.16           BALTAY     65 HBC                      6/66
T     2534    2.6       0.1            HILL       65 SPRK
T      916    2.35      0.09           BURAN      66 HLBC                     6/66
T    S 1147   (2.50)    (0.14)         CHIEN      66 HBC     6.9 PBAR P       9/67
T    S  972   (2.70)    (0.20)         CHIEN      66 HBC     6.9 PBAR P,ANTI  9/67
T     2213    2.452     0.056   0.054  ENGELMANN  66 HBC                      9/66
T      585    2.68      0.13     0.11  AUERBACH   67 SPRK                     8/67
T             2.44      0.15           BADIER     67 HBC     2.4 PBAR P       6/68*
T             2.55      0.15           BADIER     67 HBC     2.4 PBAR P,ANTIL 6/68*
T    G 8342   (2.535)   (0.035)        GRIMM      68 HBC                      6/68*
T     2600    2.47      0.08           HEPP       68 HBC                      8/68*
T    S      ERROR PURELY STATISTICAL
T    G      TEMPORARELY NOT AVERAGED SINCE ERRORS ARE ONLY STATISTICAL       11/68*
T         . . . . . . . . .
T    AVG     2.5141  + .0300  - .0294  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                      (SEE IDEOGRAM BELOW )

              18  LIFETIME DIFFERENCE,(LAMBDA-ANTILAMDA)/AVERAGE
DT          0.044     0.085            BADIER    67 HBC     2.4 PBAR P       8/67
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              18  LAMBDA MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

MM          -1.5      0.5              COOL       62 SPRK
MM           0.0      0.6              KERNAN     63 CC
MM    8553  -1.39     0.72             ANDERSON   64 HBC
MM     151  -0.5      0.28             CHARRIERE  65 EMUL
MM          -0.75     0.19             HILL       66 SPRK                     9/66
MM        . . . . . . . . .
MM   AVG    -.7289    .1654  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)
                      (SEE IDEOGRAM BELOW )

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              18  LAMBDA PARTIAL DECAY MODES

                                                         DECAY MASSES
P1     LAMBDA INTO PROTON PI-                            938+ 139
P2     LAMBDA INTO NEUTRON PIO                           939+ 134
P3     LAMBDA INTO PROTON MU- NEUTRINO                   938+ 105+    0
P4     LAMBDA INTO PROTON E- NEUTRINO                    938+  .5+    0

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              18  LAMBDA BRANCHING RATIOS

R1  *  LAMBDA INTO (P PI-)/((P PI-)+(N PIO))              (P1)/(P1+P2)
R1            0.627     0.031         CRAWFORD  59 HBC
R1            0.65      0.05          COLUMBIA  60 HBC
R1  U        (0.685)   (0.017)        ANDERSON  62 HBC
R1      903   0.643     0.016         HUMPHREY  62 HBC
R1        . . . . . . . . .
R1  AVG       .6404     .0137  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT       .653      .013    VALUE FROM CONSTRAINED FIT

R2  *  LAMBDA INTO (N PIO)/((P PI-)+(N PIO))              (P2)/(P1+P2)
R2            0.23      0.09          EISLER    57 PBC
R2            0.43      0.14          CRAWFORD  59 HBC
R2            0.28      0.08          BAGLIN    60 PBC
R2            0.35      0.05          BROWN     63 XBC
R2       75   0.291     0.034         CHRETIEN  63 PBC
R2        . . . . . . . . .
R2  AVG       .3044     .0250  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R2  FIT       .347      .012    VALUE FROM CONSTRAINED FIT

R3  *  LAMBDA INTO (P E- NEU)/TOTAL   (UNITS  10**-3)    (P4)/(P1+P2)
R3       15   2.0       0.5           HUMPHREY  61 RVUE
R3        8   2.9       1.5       1.2 AUBERT    62 FBC
R3      150   0.82      0.12     0.13 ELY       63 FBC
R3       20   1.55      0.34          LIND      64 HBC
R3      102   0.78      0.12          BAGLIN    64 FBC
R3      137   0.8       0.1           MALONEY   68 HBC    PRELIMINARY     11/68*
R3        . . . . . . . . .
R3  AVG       .8500     .0813  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                     (SEE IDEOGRAM BELOW )

R4  *  LAMBDA INTO (P MU- NEU)/TOTAL  (UNITS  10**-4)    (P3)/(P1+P2)
R4  *     1   0.2    OR GREATER       GOOD      62 HBC
R4  *     1   1.0    OR LESS          ALSTON    63 HBC
R4  *     2   1.0    OR LESS          KERNAN    64 FBC
R4  *    BETWEEN 1.3 AND 6.0          LIND      64 HBC
R4        3   1.3       0.7           LIND      64 RVUE                   7/66
R4        2   1.5       1.2           RONNE     64 FBC
R4        . . . . . . . . .
R4  AVG       1.3508    .6046  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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              18  LAMBDA DECAY PARAMETERS

A-  *  ALPHA LAMBDA- (LAMBDA INTO PI- PROTON)
A-    1156    0.62      0.07          CRONIN    63 CNTR    LAMBDA FROM PI-P  8/67
A-  *        (0.663)   (0.022)        BERGE     66 RVUE  INCLUDES ABOVE      9/66
A-   10130    0.645     0.017         OVERSETH  67 SPRK    LAMBDA FROM PI-P  8/67
A-    3520    0.67      0.06          DAUBER    68 HBC   FROM XI DECAY       6/68*
A-  M 2529   (0.747)   (0.086)        MERRILL   68 HBC   REPL BY DAUBER 68   6/68*
A-        . . . . . . . . .
A-  AVG       .6455     .0159  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

AO  *  ALPHAO /ALPHA- FOR LAMBDA (L INTO PIO N/L INTO PI- P)
AO            1.10      0.27          CORK      60 CNTR

F-  *   PHI ANGLE (SIN(PHI)/COS(PHI)=BETA/GAMMA)  (DEGRESS)
F-    1156   13.0      17.0           CRONIN    63 SPRK    LAMBDA FROM PI-P 11/67
F-   10130   -8.0       6.0           OVERSETH  67 SPRK    LAMBDA FROM PI-P 11/67
F-  * 7377   (-9.2)    (5.2)          CLELAND   67 SPRK    REP BY ANDERSSON 11/68*
F-            -6.7      4.5           ANDERSSON 68 SPRK                     11/68*
F-        . . . . . . . . .
F-  AVG      -6.3024    3.5219  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

AL  *      ASYMMETRY PARAMETER IN ELECTRON - LAMBDASPIN CORRELATION
AL            0.06      0.19          BARLOW    65 SPRK                     7/66

AV  *   GA/GV FOR LAMBDA BETA DECAY (SEE TEXT FOR SIGN CONVENTION)
AV  C   22  (-1.03)                   LIND      64 HBC                     6/68*
AV  C  102 ABS VALUE GREATER THAN 0.6 BAGLIN    65 HLBC                    6/68*
AV  C      BETW 0. AND -1.1           BARLOW    65 SPRK                    6/68*
AV          -1.14       0.23     0.33 CONFORTO  65 RVUE                   11/67
AV  C  102 ABS VALUE GREATER THAN 0.7 ELY       65 HLBC   95 PCT CCNF LEV  6/68*
AV M   137  -0.77       0.17     0.25 MALONEY   68 HBC    PRELIMINARY     11/68*
AV  *   30  (-0.23)    (0.20)   (0.33) CHU      68 SPRK   PRELIMINARY     11/68*
AV  A      (-0.97)     (0.14)  (-0.22) AVERAGE OBTAINED BY ADDING LOG OF  11/68*
AV  A     LIKELIHOOD FUNCTIONS OF CONFORTO 65 AND MALONEY 68              11/68*
AV  C          EXPTS INCLUDED IN CONFORTO 65, RVUE                         6/68*
AV M   MALONEY 68 MEASURES THE ABSOLUTE VALUE OF A/V
AV        . . . . . . . . .
AV  AVG      -.9032     .1776  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

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REFERENCES
18 LAMBDA (1115,JP=1/2+) I=C


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EISLER    57 NC      5 1700      EISLER,PLANO,SAMIOS,SCHWARTZ +  (COLUM+BNL)
BOLDT     58 PRL     1  148      E BOLDT,D O CALDWELL,Y PAL            (MIT)
CRAWFORD 59 PRL      2  266      CRAWFORD,CRESTI,DOUGLASS,GOOD +       (LRL)

BAGLIN    60 NC     18 1043      BAGLIN,BLOCH,BRISSON,HENNESSY +  (PARIS-EP)
BOWEN     60 PR    119 2030      BOWEN,HARDY,REYNCLDS,SUN +      (PRINCETON)
CORK      60 PR    120 1000      CORK,KERTH,WENZEL,CRONIN,COOL  (LRL+PR+BNL)
COLUMBIA 60 ROCH CONF 726        M SCHWARTZ +                     (COLUMBIA)
HUMPHREY 61 PRL      6  478      HUMPHREY,KIRZ,ROSENFELD,RHEE +  (LRL+SYRAC)
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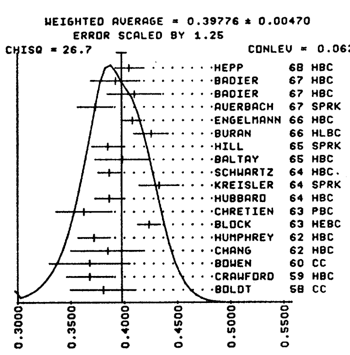

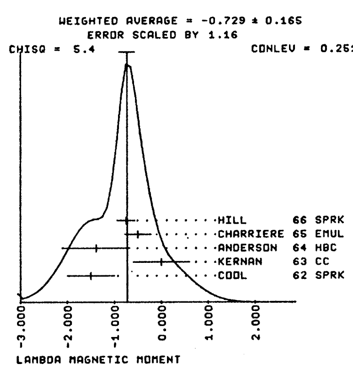

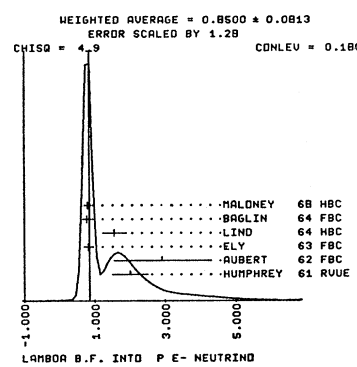

STABLE PARTICLES

Data in parentheses have not been included in our averages.


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ANDERSON 62 CERN CONF 832      ANDERSON,CRAWFORD,GOLDEN,LLOYD +        (LRL)
ARMENTER 62 CERN CONF 236      ARMENTEROS+(CERN+EP+LONDON+BIRM+CEN-SACLAY)
AUBERT   62 NC   25  479       AUBERT,BRISSON,HENNESSY,SIX +     (PARIS-EP)
BALTAY   62 CERN CONF 233      BALTAY,FOWLER,SANDWEISS,CULWICK+ (YALE+BNL)
CHANG    62 THESIS DUKE        CHUEN CHUEN CHANG                     (DUKE)
COOL     62 PR  127 2223       COOL,HILL,MARSHALL +        (BNL+MIT+NYU+ANL)
GOOD     62 PRL   9  518       M L GOOD,V G LIND                (WISCONSIN)
HUMPHREY 62 PR  127 1305       W E HUMPHREY,R R ROSS                   (LRL)

ALSTON   63 UCRL 10926         ALSTON,KIRZ,NEUFELD,SOLMITZ,WOHLMUT     (LRL)
BERGE    63 THESIS (BERKELEY)  J PETER BERGE                           (LRL)
BHOWMIK  63 NC    28 1494      B BHOWMIK,D P GOYAL                   (DELHI)
BLOCK    63 PR   130  766      BLOCK,GESSAROLI,RATTI,KIKUCHI +  (NW+BLGNA)
BROWN    63 PR   130. 769      BROWN,KADYK,TRILLING,ROE +   (LRL+MICHIGAN)
CHRETIEN 63 PR   131  2208     CHRETIEN,CROUCH+  (BRAND+BROWN+HARVARD+MIT)
CRONIN   63 PR   129 1795      J W CRONIN,O E OVERSETH           (PRINCETON)
ELY      63 PR   131  868      ELY,GIDAL,KALMUS,OSWALD,POWELL +        (LRL)
KERNAN   63 PR   129  870      KERNAN,NOVEY,WARSHAW,WATTENBERG   (ANL+ILL)

ANDERSON 64 PRL   13  167      J A ANDERSON,F S CRAWFORD               (LRL)
BADIER   64 DUBNA CONF 1 593   BADIER,BARLOUTAUD +          (EP+SACLAY+AMSTDM)
BAGLIN   64 NC    35  977      BAGLIN,BINGHAM+ (EP+CERN+UC LOND+RHEL+BERG)
HUBBARD  64 PR   135 B 183     HUBBARD,BERGE,KALBFLEISCH,SHAFER +      (LRL)
KERNAN   64 PR   133 B 1271    KERNAN,POWELL,SANDLER +  (LRL+UN-COLL-LOND)
KREISLER 64 PR 136 B 1074      M N KREISLER,O OVERSETH,J CRONIN   (PRINCE)
LIND     64 PR   135 B 1483    LIND,BINFORD,GOOD,STERN          (WISCONSIN)
RONNE    64 PL    11   357     RONNE+    (CERN+EP+UCOL-LONDON+UNIV.BERGEN)
SCHWARTZ 64 UCRL 11360 THESIS  JOSEPH ADAM SCHWARTZ                    (LRL)

BAGLIN   65 NC 35 977          BAGLIN +    (EP,CERN,UC LONDON,RUTH,BERGEN)
BALTAY   65 PR 140 B 1027      BALTAY,SANDWEISS,CULWICK,KOPP +  (YALE+BNL)
BARLOW   65 PL   18  64        J BARLOW,BLAIR,CONFORTO+  (CERN+RUTH+PENNA)
CHARRIER 65 PL    15    66     CHARRIERE,GIBSON+      (EPUL+BRIST+CERN+MPI)
   ALSO     NC   46A  205      CHARRIERE,GIBSON +    (EPUL,BRIST,CERN, MPI)
CONFORTO 65 EC INT HERZEGNOVI  G CONFORTO                             (CERN)
ELY      65 PR 137 B1302       ELY,GIDAL,KALMUS,POWELL +   (LRL,UC LONDON)
HILL     65 PRL  15     85     D A HILL,K K LI                         (MIT)
SCHMIDT  65 PR 140 B 1328      P SCHMIDT                          (COLUMBIA)

BERGE    66    BERKELEY CONF.  BERGE,CABIBBO                          (RVUE)
BURAN    66 PL 20 318          BURAN,EIVINDSON,SKJEGGESTAD,TOFTE +  (OSLO)
CHIEN    66 PR  152  1171      +LACH,SANDWEISS,TAFT,YEH,OREN +  (YALE+BNL)
ENGELMAN 66 NC 45A  1038       ENGELMANN,FILTHUTH,ALEXANDER+(HEIDBG+WEIZM)
HILL     66  BERKELEY CONF     HILL,LI,JENKINS,KYCIA,RUDERMAN         (BNL)
LONDON   66 PR 143 1034        LONDON,RAU,GOLDBERG,LICHTMAN+ (BNL+SYRACUS)

AUERBACH 67 NC  47A  19        AUERBACH,BOWEN,DOBBS,LANDE,MANN+  (U OF PA)
BADIER   67 PL 25B 152         +BONNET,BRIANDET,SADOULET       (EP (PARIS))
MAYEUR   67 U.LIBR.BRUX.BUL32  C.MAYEUR,E.TOMPA,J.WICKENS (UL.BRUX+UC.LON)
CLELAND  67 PL 26B 45          CLELAND,BIENLEIN,CONFORTO+  (CERN,GVA,LUND)
OVERSETH 67 PRL  19  391       O E OVERSETH, R F ROTH (MICHIGAN+PRINCETON)

ANDERSSO 68 VIENNA ABS. 270    ANDERSSON,BIENLEIN,CLELAND +(CERN,GVA,LUND)
CHU      68 VIENNA POSTDEADLN  CHU,PHILLIPS, + (ARGONNE,CHICAGO,OHIO,WASH)
DAUBER   68 UCRL 18388         +BERGE,HUBBARD,MERRILL,MILLER           (LRL)
GRIMM    68 NC 54A 187         H.-J.GRIMM                       (HEIDELBERG)
HEPP     68 ZEIT.PHYS.TOBEPUB  V.HEPP,H. SCHLEICH               (HEIDELBERG)
MALONEY  68 VIENNA ABS. 373    MALONEY,SECHI-ZORN                 (MARYLAND)
MERRILL  68 PR 167 1202        MERRILL,SHAFER                          (LRL)
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                  19  SIGMA+   (1189,JP=1/2+)  I=1

                  19  SIGMA+ MASS (MEV)

M   N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M      144 1189.38     0.15            BARKAS    63 EMUL +  SEE NOTE S BELOW
M       58 1189.48     0.22            BHOWMIK   64 EMUL +  SEE NOTE S BELOW
M   S  ABOVE SIGMA+ MASSES HAVE BEEN RAISED 30  KEV TO ACCOUNT FOR 46 KEV
M   S  INCREASE IN PROTON MASS AND 21 KEV DECREASE IN PION MASS
M     4205 1189.68     0.10            SCHMIDT   65 HBC  SEE NOTE N       6/68*
M          1189.16     0.12            HYMAN     67 HEBC                  6/68*
M           . . . . . . . . . .
M   AVG    1189.4516   .1271  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.9)
M   FIT    1189.40     0.19     VALUE FROM CONSTRAINED FIT                6/68*
                    (SEE IDEOGRAM BELOW )
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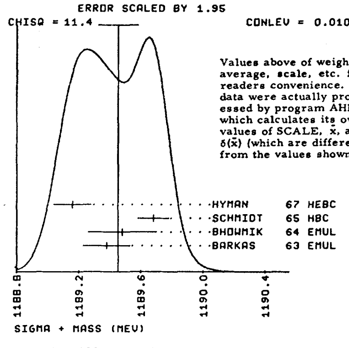

Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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                  19  SIGMA+ LIFETIME (UNITS 10**-10)

T   *                                   GLASER     58 RVUE
T      127   0.98     0.16     0.12  PUSCHEL    60 EMUL
T       41   0.82     0.34     0.20  EVANS      60 EMUL
T      117   0.85     0.14     0.11  FREDEN     60 EMUL
T       54   0.80     0.10     0.067 KAPLON     60 EMUL
T       23   0.76     0.22     0.14  CHIESA     61 EMUL
T       49   0.75     0.13     0.09  BERTHELOT  61 PBC
T      140   0.82     0.10     0.08  BARKAS     61 EMUL
T      192   0.749    0.056    0.052 GRARD      62 HBC
T      456   0.765    0.04     0.04  HUMPHREY   62 HBC
T      203   0.84     0.12     0.08  BHOWMIK    64 EMUL
T      181   0.84     0.09           BALTAY     65 HBC                       6/66
T      900   0.76     0.03           CARAYAN    65 HBC                       6/66
T            0.83     0.018          CHANG      65 HBC                       6/66
T   S  125  (0.86)   (0.15)          CHIEN      66 HBC  +  6.9 PBAR P        9/67
T   S  117  (1.10)   (0.24)          CHIEN      66 HBC  -  6.9 PBAR P,ANTI   9/67
T      381   0.80     0.07           COOK       66 SPRK                      7/66
T   S      ERROR PURELY STATISTICAL
T           . . . . . . . . . .
T   AVG        .8099  + .0131  - .0127  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                  19  SIGMA+ MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

MM     381    1.5      1.1            COOK       66 SPRK                        7/66
MM      52    3.5      1.5            KOTELCHUC  67 EMUL    K-P AT 1.15BEV/C    8/67
MM      51    3.0      1.2            SULLIVAN   67 EMUL    PHOTOPRODUCTION     8/67
MM      69    3.5      1.2            CERN       68 EMUL                       10/68*
MM   29333    2.1      1.0            MAST       68 HBC                         6/68*
MM           . . . . . . . . . .
MM  AVG        2.5710    .5227  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                  19  SIGMA+ PARTIAL DECAY MODES

                                                          DECAY MASSES
P1     SIGMA + INTO PROTON PIO                           938+ 134
P2     SIGMA + INTO NEUTRON PI+                          939+ 139
P3     SIGMA + INTO NEUTRON PI+ GAMMA                    939+ 139+   0
P4     SIGMA + INTO LAMBDA E+ NEU                       1115+  .5+   0
P5     SIGMA + INTO PROTON GAMMA                         938+   0
P6     SIGMA + INTO NEUTRON MU+ NEUTRINO                 939+ 105+   0
P7     SIGMA + INTO NEUTRON E+ NEUTRINO                  939+  .5+   0

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                  19  SIGMA+  BRANCHING RATIOS

R1  *  SIGMA+  INTO (NEUTRON PI+)/(NUCLEON PI)            (P2)/(P1+P2)
R1     308    0.490    0.024          HUMPHREY  62 HBC
R1     534    0.46     0.02           CHANG     65 HBC                          6/66
R1          . . . . . . . . . .
R1  AVG        .4723    .0154  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R2  *  SIGMA+ INTO (NEUT PI+ GAM)/(PI+N)  (UNITS 10**-3) (P3)/(P2)
R2  *  ABOUT  1.8                     BAZIN2    65 HBC                          8/67
R2  *  FOR PI+ MOM LESS THAN 166 MEV/C
R2      19    0.18     0.05           ANG       68 HBC     PREL. SEE NOTE A 11/68*
R2  A  FOR PI+ MOM. LESS THAN 100 MEV/C                                     11/68*

R3  *   SIGMA+ INTO (LAMBDA E+ NEU)/TOTAL (UNIT 10**-5) (P4)/TOTAL
R3       4    3.3      1.7            WILLIS    64 HBC     STOP. K-             9/66
R3       6    2.0      0.8            BAKASH    67 HBC     STOP K-              8/67
R3            1.6      0.7            BALTAY    68 HBC                        10/68*
R3            2.9      1.0            EISELE    68 HBC     PRELIMINARY        10/68*
R3          . . . . . . . . . .
R3  AVG       2.1078    .4495  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R4  *  SIGMA+  INTO (P GAMMA)/(P PIO)  (UNITS 10**-2)   (P5)/(P1)
R4  *    1    0.68  OR LESS           CARRARA   64 HBC
R4      24    0.37     0.08           BAZIN     65 HBC
R4       4    0.17                    QUARENI   65 EMUL                         6/66

R5  *  SIGMA+  INTO (N E+ NEU)/(N PI+)  (UNITS 10**-4) .(P7)/(P2)
R5       0    16220 EFFECTIVE DENOM.  COURANT   64 HBC     SEE NOTE E          11/67
R5       0     2720 EFFECTIVE DENOM.  MURPHY    64 HBC     SEE NOTE E          11/67
R5       1     9690 EFFECTIVE DENOM.  NAUENBERG 64 HBC     SEE NOTE E          6/68*
R5       0    25000 EFFECTIVE DENOM.  EISELE    67 HBC                         6/68*
R5  E               EFFECTIVE DENOM.  TAKEN FROM EISELE 67                     11/67
R5       0    32406 EFFECTIVE DENOM.  BIERMAN   68 HBC                         6/68*

R6  *  SIGMA+  INTO (N MU+ NEU)/(PI+N)   (UNITS 10**-4) (P6)/(P2)
R6  *    1      120 ANALYSED EVENTS   GALTIERI  62 EMUL    NO RATIO QUOTED    11/67
R6       0    10150 EFFECTIVE DENOM.  COURANT   64 HBC     SEE NOTE E          11/67
R6       0     1710 EFFECTIVE DENOM.  NAUENBERG 64 HBC     SEE NOTE E          11/67
R6       1    18750 EFFECTIVE DENOM.  EISELE    67 HBC                         11/67
R6  E               EFFECTIVE DENOM.  TAKEN FROM EISELE 67                     11/67
R6       0    32900 EFFECTIVE DENOM.  BAGGETT   68 HBC     PRELIMINARY        11/68*

R7  *  SIGMA+ INTO LEPTONS / SIGMA- INTO LEPTONS
R7  N    3  (0.04)   (0.04)   (0.02) AVERAGE                                  6/68*
R7  N     AVERAGE OF ALL DATA IN R4 AND R5 UP TO BIERMAN 68.                  6/68*
R7       0    0.034 OR LESS           BAGGETT   67 HBC                         6/68*
R7  *    0    0.026 OR LESS           ANG       68 HBC     PRELIMINARY        11/68*

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                  19 SIGMA+ DECAY PARAMETERS

A+  *   ALPHA+/ALPHAO FOR SIGMA+ (SIG+ TO PI+ N)/(SIG+ TO PIO P)
A+           +0.04     0.11           CORK      60 CNTR    SIG+ FROM PI+P
A+  *       (+0.20)   (0.24)          TRIPP     62 HBC  +  REPLAC.BY BANGER
A+    3500   -.014     0.052          BANGERTER 66 HBC  +  SIG+ FROM K-P        9/66
A+    2600   -.047      .07           BERLEY    66 HBC  +  SIG+ FROM K-P        9/66
A+          . . . . . . . . . .
A+  AVG      -.0175    .0390  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

AO  *  ALPHA SIGMAO (SIG+ INTO PIO PROTON)
AO           -0.80     0.16           BEALL     62 CNTR
AO  *       (-0.90)   (0.25)          TRIPP     62 HBC     REPLAC. BY BANGE
AO    5200   -0.986    0.072          BANGERTER 66 HBC     K-P TO SIG+ PI-      7/66
AO          . . . . . . . . . .
AO  AVG      -.9547    .0696  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

F+  *      PHI ANGLE (SIN(PHI)/COS(PHI)=BETA/GAMMA)  (DEGREES)
F+     370  180.       30.            BERLEY    66 HBC  +  NEUTRON RESCATT.  9/66
F+     560  144.       29.            BANGERTER 68 HBC  +  NEUTRON RESCATT. 11/68*
F+          . . . . . . . . . .
F+  AVG     161.3900  20.8507  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                              REFERENCES
                  19  SIGMA + (1189,JP=1/2+)  I=1
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GLASER   58 CERN CONF 270      GLASER,GOOD,MORRISON              (MICH+LRL)
EVANS    60 NC 15 873          BRIST+BRUSS+IAS-U.COL-DUBLIN+LON(MILAN+PAD)
FREDEN   60 NC 16 611          S FREDEN,H KORNBLUM,R WHITE             (LRL)
KAPLON   60 ANP 9 139          M KAPLON,A MELISSINOS,YAMANOUCHI  (ROCHES)
CORK     60 PR 120 1000        CORK,KERTH,WENZEL,CRONIN,COOL (LRL+PRI+BNL)
PUSCHEL  60 NP 20 254          W PUSCHEL                 (MAX PLANCK INST)

BARKAS   61 PR 124 1209        BARKAS,DYER,MASON,NICHOLS,SMITH         (LRL)
BERTHELO 61 NC 21 693          BERTHELOT,DAUDIN,GOUSSU +    (SACLAY+ORSAY)
CHIESA   61 NC 19 1171         CHIESA,QUASSIATI,RINAUDO       (INFN-TURIN)

BEALL    62 PRL 8 75           BEALL,CORK,KEEFE,MURPHY,WENZEL          (LRL)
GRARD    62 PR 127 607         F GRARD,G A SMITH                       (LRL)
GALTIERI 62 PRL 9 26           GALTIERI,BARKAS,HECKMAN,PATRICK,SMITH (LRL)
HUMPHREY 62 PR 127 1305        W E HUMPHREY,R R ROSS                   (LRL)
TRIPP    62 PRL 9 66           R D TRIPP,M B WATSON,M FERRO-LUZZI      (LRL)

BARKAS   63 PRL 11 26          W H BARKAS,J N DYER,H H HECKMANN        (LRL)
    ALSO 61 UCRL 9450          JOHN DYER (THESIS, BERKELEY)            (LRL)

BHOWMIK  64 NP 53 22           B BHOWMIK,P JAIN,P MATHUR,LAKSHMI   (DELHI)
CARRARA  64 PL 12 72           CARRARA,CRESTI,GRIGOLETTO,PERUZZO+ (PADOVA)
COURANT  64 PR 136 B 1791      COURANT,FILTHUTH+ (CERN+HEIDLB+MD+NRL +BNL)
MURPHY   64 PR 134 B 188       C THORNTON MURPHY                (WISCONSIN)
NAUENBER 64 PRL 12 679         NAUENBERG,MARATECK,BLUMENFELD+ (COL+RUT+PR)
WILLIS   64 PRL 13 291         WILLIS,COURANT,ENGELMAN+ (BNL+CERN+HEID+MD)

BALTAY   65 PR 140 B 1027      BALTAY,SANDWEISS,CULWICK,KOPP +  (YALE+BNL)
BAZIN    65 PRL 14 154         BAZIN,BLUMENFELD,NAUENBERG + (PRINCE+COLUM)
BAZIN2   65 PR 140  B1358         BAZIN,PLANO,SCHMIDT+ (PRINCE,RUTG,COLUM)
CARAYAN  65 PR 138 B 433       CARAYANNOPOULOS,TAUTFEST,WILLMANN  (PURDUE)
CHANG    65 NEVIS 145  THESIS  CHUNG YUN CHANG                    (COLUMBIA)
   ALSO  66 PR  151  1081      CHUNG YUN CHANG                    (COLUMBIA)
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STABLE PARTICLES

Data in parentheses have not been included in our averages.


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QUARENI  65 NC 40 A 928          QUARENI,CARTACCI +       (BOL+FIR+GEN+PARMA)
SCHMIDT  65 PR 140 B 1328        P SCHMIDT                          (COLUMBIA)

BANGERTE 66 PRL  17  495         BANGERTER,GALTIERI,BERGE,MURRAY+       (LRL)
BERLEY   66 PRL 17 1071          +HERZBACH,KOFLER,YAMAMOTO + (BNL+MASS+YALE)
CHIEN    66 PR  152  1171        +LACH,SANDWEISS,TAFT,YEH,OREN +  (YALE+BNL)
COOK     66 PRL  17  223         V COOK,EWART,MASEK,ORR,PLATNER (WASHINGTON)

BARASH   67 PRL 19  181          BARASH,DAY,GLASSER,KEHOE,KNOP +  (MARYLAND)
BRISTOL  67 HEIDELBERG CONF      BRISTOL-CERN-LAUSANNE-MUNICH-ROME(COLLABOR)
EISELE   67 ZEIT.PHYS.205,409    +ENGELMANN,FILTHUTH,FOLISH,HEPP+ (HEIDELB.)
HYMAN    67 PL 25 B 376          +LOKEN,PEWITT,MCKENZIE,KEYES+(ARG+CARN+NWU)
KOTELCHU 67 PRL 18 1166          KOTELCHUCK,GOZA,SULLIVAN,ROSS (VANDERBILT)
SULLIVAN 67 PRL 18 1163          SULLIVAN,MCINTURFF,KOTELCHUCH (VANDERBILT)
    ALSO 64 PRL 13 246           A D MCINTURFF,C E ROOS         (VANDERBILT)

ANG      68 VIENNA ABS. 570,2 ANG,EISELE,ENGELMANN,FILTHUTH +(HEIDELBERG)
    ALSO 68 PRIVATE COMMUNICATION FROM M. L. STEVENSON               (LRL)
BAGGETT  68 VIENNA ABS. 374      BAGGETT,KEHOE                    (MARYLAND)
    ALSO 67 PRL 19 1458          BAGGETT,DAY,GLASSER,KEHOE,KNOP+  (MARYLAND)
    ALSO 68 PRIVATE COMMUNICATION FROM N. BAGGETT                 (MARYLAND)
BALTAY   68 TO BE PUBL.          FRANZINI,BALTAY+ VIENNA 263  (COL,STONYBRK)
BANGERTE 68 PR TO BE PUBL.       BANGERTER,GARNJOST,GALTIERI+           (LRL)
BIERMAN  68 PRL 20 1459          BIERMAN,KOUNOSU,NAUENBERG +     (PRINCETON)
CERN     68 NC 56A 54            CERN-BRISTOL-LAUSANNE-MUNICH-ROME-COLLAB
EISELE   68 VIENNA ABS. 569      EISELE,ENGELMANN,FILTHUTH +    (HEIDELBERG)
MAST     68 PRL 20 1312          MAST,GERSHWIN,ALSTON-GARNJCST +        (LRL)

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

TRIPP    62 PRL 8 175            R TRIPP,M WATSON,M FERRO-LUZZI         (LRL)
ALFF     63 SIENA CONF 1 205     ALFF,NAUENBERG,KIRSCH,BERLEY+(COLU+RUT+BNL)
    ALSO 65 PR 137 B 1105        ALFF,GELFAND,BRUGGER,BERLEY+(COLUM+RUT+BNL)
COURANT  63 SIENA CONF 1 73      COURANT,FILTHUTH,BURNSTEIN,DAY+ (CERN+MARY)
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        20  SIGMA-  (1198,JP=1/2+)  I=1

        20  SIGMA-   MASS (MEV)

M   N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M     3000 1197.47     0.11           SCHMIDT   65 HBC  SEE NOTE N        6/68*
M          . . . . . . . . . .
M   FIT    1197.32     0.11       VALUE FROM CONSTRAINED FIT              6/68*

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        20 SIGMA- MASS DIFFER.(-)-(+)(MEV)

D       87    8.25     0.40           BARKAS    63 EMUL  -
D     2500    8.25     0.25           DOSCH     65 HBC
D          . . . . . . . . . .
D   AVG       8.2500   .2120  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
D   FIT       7.92     0.18    VALUE FROM CONSTRAINED FIT                 6/68*

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        20  (SIGMA-) - (LAMBDA) MASS DIFFERENCE (MEV)

DL  N   SEE NOTE PRECEDING LAMBCA MASS LISTINGS.

DL            81.70    0.19           BURNSTEIN 64 HBC                    9/66
DL      85    81.80    0.24           SCHMIDT   65 HBC  SEE NOTE N        6/68*
DL    2279    81.64    0.09           HEPP      68 HBC                    8/68*
DL         . . . . . . . . . .
DL  AVG       81.6663  .0770  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
DL  FIT       81.72    0.09    VALUE FROM CONSTRAINED FIT                 6/68*

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        20  SIGMA- LIFETIME (UNITS 10**-10)

T             1.67     0.40     0.28 BROWN     58 PBC
T             1.89     0.33     0.25 EISLER    58 PBC
T       45    1.35     0.32     0.17 CHIESA    61 EMUL
T       41    1.75     0.39     0.30 BARKAS    61 EMUL
T     1208    1.58     0.06     0.06 HUMPHREY  62 HBC
T     3267    1.666    0.026         CHANG     65 HBC                     6/66
T   S   61   (2.08)   (0.22)         CHIEN     66 HBC   -  6.9 PBAR P     9/67
T   S   64   (1.46)   (0.31)         CHIEN     66 HBC   +  6.9 PBAR P,ANTI 9/67
T   S      ERROR PURELY STATISTICAL
T      506    1.38     0.07          WHITESIDE 68 HBC                     6/68*
T          . . . . . . . . . .
T   AVG       1.6385  + .0551  - .0536  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.4)
                  (SEE IDEOGRAM BELOW )
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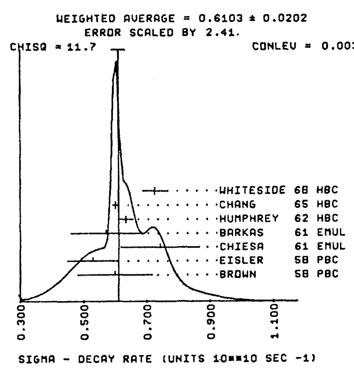


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                  20  SIGMA- PARTIAL DECAY MCDES

                                                          DECAY MASSES
P1      SIGMA - INTO  NEUTRON PI-                         939+ 139
P2      SIGMA - INTO  NEUTRON PI- GAMMA                   939+ 139+   0
P3      SIGMA - INTO  NEUTRON MU- NEUTRINO                939+ 105+   0
P4      SIGMA - INTO  NEUTRON E- NEUTRINO                 939+  .5+   0
P5      SIGMA - INTO  LAMBDA E- NEUTRINO                 1115+  .5+   0

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                  20  SIGMA-  BRANCHING RATICS

R1  *  SIGMA - INTO (N MU- NEU)/(N PI-) (UNITS 10**-3)  (P3)/(P1)
R1      22    0.66     0.15           COURANT   64 HBC
R1      11    0.56     0.20           BAZIN     65 HBC    FROM STCP. K-   6/66
R1            0.45     0.08           ANG       68 HBC   PRELIMINARY     10/68*
R1      57    0.44     0.10           BAGGETT   68 HBC   PRELIMINARY     10/68*
R1         . . . . . . . . . .
R1  AVG        .4840    .0554  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R2  *  SIGMA - INTO (N E- NEU)/(N PI-)  (UNITS 10**-3)  (P4)/(P1)
R2       9    1.0      0.4      0.3 MURPHY    64 PBC
R2      16    1.37     0.34         NAUENBERG 64 HBC
R2      16    1.15     0.4          MILLER    64 FBC
R2      31    1.4      0.3          COURANT   64 HBC
R2     180    1.11     0.09         BIERMAN   68 HBC                      6/68*
R2            0.99     0.09         ANG       68 HBC   SEE NOTE S BELCW 10/68*
R2  S   ERROR INCREASED FROM 0.06 TO 0.09 FOLLOWING SUGGESTION BY
R2  S   M. L. STEVENSON (LRL)
R2            1.11     0.15         BALTAY    68 HBC                     10/68*
R2            1.11     0.15         SECHIZOR  68 HBC   PRELIMINARY       10/68*
R2         . . . . . . . . . .
R2  AVG       1.0830   .0520  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R3  *  SIGMA - INTO (LAMBDA E- NEU)/(N PI-) (UNITS 10**-4)(P5)/(P1)
R3      11    0.75     0.28         COURANT   64 HBC    STOP. K-
R3      35    0.64     0.12         BARASH    67 HBC    STOP K-           8/67
R3            0.52     0.09         BALTAY    68 HBC                     10/68*
R3            0.69     0.12         EISELE    68 HBC    PRELIMINARY      10/68*
R3         . . . . . . . . . .
R3  AVG        .6039    .0603  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R4  *  SIGMA - INTO (N PI- GAMMA)/(NPI-) (UNITS 10**-3)(P2)/(P1)
R4  *  ABOUT  1.1                    BAZIN     65 HBC                     8/67
R4  *  FOR PI- MOM LESS THAN 166 MEV/C
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                  20 SIGMA- DECAY PARAMETERS

A-  *  ALPHA SIGMA-
A-  *        (-0.16)   (0.21)         TRIPP     62 HBC    REPL.BY BANGERTE
A-    6500   -0.010    0.043          BANGERTER 66 HBC    K-P TO SIG- PI+   7/66
A-    6068   -0.104    0.04           BERLEY    67 HBC    K-P TO SIG- PI+  11/67
A-         . . . . . . . . . .
A-  AVG      -.0604    .0469  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)

F-  *  PHI ANGLE (SIN(PHI)/COS(PHI)=BETA/GAMMA)   (DFGREES)
F-    1006  -22.       30.            BERLEY    67 HBC    K-P TO SIG- PI+  11/67
F-    1385   15.       20.            BANGERTER 68 HBC - NEUTR. RESCATT.   11/68*
F-         . . . . . . . . . .
F-  AVG       3.6154  17.0769  AVFRAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

AV  *   GV/GA FOR SIGMA TO LAMBCA BETA DECAY (SEE TEXT FCR SIGN CONVENTION)
AV  *   PREDICTED TO BE ZERO BY CONSERVED VECTOR CURRENT THEORY
AV      45    0.31     0.30           BARASH    67 HBC                   11/67
AV  S       (-0.7)    (0.4)           BALTAY    68 HBC                   10/68*
AV  S       (-0.22)   (0.28)          EISELE    68 HBC    PRELIMINARY    10/68*
AV  S     SIGN CONVENTION NOT CLEAR --TEMPORARELY NOT USEC --

AV1 *   GA/GV FOR SIGMA TO NEUTRON BETA DECAY (SEE TEXT FCR SIGN CCNVENTIC)
AV1     57    0.05     0.23     0.32 GERSHWIN  68 HBC  POLARIZED SIGMAS    6/68*
AV1           0.45     0.35     0.22 EISELE    68 HBC     PREL. SEE NOTE C
AV1     23    0.34     0.27     0.26 COLLERAIN 68 HBC     PREL. SEE NOTE C
AV1 C  COLLERAINE AND EISELE MEASURE THE ABSOLUTE VALUE CF GA/GV         11/68*
AV1        . . . . . . . . . .
AV1 AVG        .2776    .1586  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
AV1 A       (0.28)   (0.16)           OUR AVERAGE
AV1 A     AVERAGE OBTAINED BY ADDING LOG OF MAXI. LIKELIHOOD FUNCTIUNS

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REFERENCES

20 SIGMA-(1198,JP=1/2+)I=1


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BROWN    58 CERN CONF 270        BROWN,GLASER,GRAVES,PERL,CRCNIN +     (MICH)
EISLER   58 NC SER10 10 150      EISLER,BASSI,CONVERSI +  (COL+BNL+BOL+PISA)
BROWN    57 PR 108 1036          J BROWN, D GLASER, M PERL  (MICHIGAN + BNL)

BARKAS   61 PR 124 1209          BARKAS,DYER,MASCN,NICKOLS,SMITH        (LRL)
CHIESA   61 NC 19 1171           A M CHIESA,B QUASSIATI,G RINAUDO     (TURIN)
HUMPHREY 62 PR 127 1305          W E HUMPHREY,R R ROSS                  (LRL)
TRIPP    62 PRL 9 66             R D TRIPP,M WATSON,M FERRO-LUZZI       (LRL)

BARKAS   63 PRL 11 26            W H BARKAS,J N DYER,H H HECKMAN        (LRL)
BURNSTEI 64 PRL 13 66            BURNSTEIN,DAY,KEHOE,SECHI ZCRN,SNOW  (MARY)
COURANT  64 PR 136 B 1791        COURANT,FILTHUTH+  (CERN+HEIDLB+MD+NRL+BNL)
MILLER   64 PL 11 262            MILLER,STANNARD,BEZAGUET+ (LOND+PARIS+BERG)
MURPHY   64 PR 134 B 188         C THORNTON MURPHY                (WISCCNSIN)
NAUENBER 64 PRL 12 679           NAUENBERG,SCHMIDT,MARATECK+ (COL+RUT+PRINC)

BAZIN    65 PR 140 B 1358        BAZIN,PLANO,SCHMIDT +    (PRINC+RUTG+COLUM)
CHANG    65 NEVIS 145  THESIS CHUNG YUN CHANG                    (COLUMBIA)
DOSCH    65 PL 14 239            DOSCH,ENGELMANN,FILTHUTH,HEPP,KLUGE+ (HEID)
  ALSO   66 PR  151  1081        CHUNG YUN CHANG                    (COLUMBIA)
SCHMIDT  65 PR 140 B 1328        P SCHMIDT                          (COLUMBIA)
BANGERTE 66 PRL  17  495         BANGERTER,GALTIERI,BERGE,MURRAY+       (LRL)
CHIEN    66 PR  152  1171        +LACH,SANDWEISS,TAFT,YEH,OREN +  (YALE+BNL)

BARASH   67 PRL 19  181          BARASH,DAY,GLASSER,KEHOE,KNCP +  (MARYLAND)
BERLEY   67 PRL  19  979         BERLEY,HERTZBACH,KOFLER +   (BNL,MASS,YALE)

ANG      68 VIENNA ABS. 572      ANG,EISELE,ENGELMANN,FILTHUTH +(HEIDELBERG)
BAGGETT  68 VIENNA ABS. 374      N.BAGGETT,B.KEHOE                (MARYLAND)
BALTAY   68 TO BE PUBL.          FRANZINI,BALTAY+ VIENNA 262,3(COL,STONYBRK)
    ALSO 68 PRIVATE COM.         FRANZINI OCT. 68                   (COLUMBIA)
BANGERTE 68 PR TO BE PUBL.       BANGERTER,GARNJOST,GALTIERI+           (LRL)
BIERMAN  68 PRL 20 1459          BIERMAN,KOUNOSU,NAUENBERG +     (PRINCETON)
COLLERAI 68 TO BE PUBL.          COLLERAINE,DAY+ VIENNA 811(MARYLAND,PRINCE)
EISELE   68 VIENNA ABS. 569      EISELE,ENGELMANN,FILTHUTH +    (HEIDELBERG)
    ALSO 68 VIENNA ABS. 571      EISELE,ENGELMANN,FILTHUTH +    (HEIDELBERG)
GERSHWIN 68 PRL 20 1270          GERSHWIN,ALSTON-GARNJOST,BANGERTER+    (LRL)
HEPP     68 ZEIT.PHYS. 214 71 V.HEPP,H. SCHLEICH                (HEICELBERG)
SECHIZOR 68 TO BE PUBL.          DAY,GLASSER,KNOP+ VIENNA 375     (MARYLAND)
WHITESID 68 NC  54A  537         H. WHITESIDE,J. GOLLUB            (OBERLIN)
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Data in parentheses have not been included in our averages.

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                 21  SIGMA 0  (1193,JP=1/2+)  I=1

                 21  (SIGMA-) - (SIGMAO) MASS DIFFERENCE (MEV)
D1  N   SEE NOTE PRECEDING LAMBDA MASS LISTINGS.

D1      18    4.75     0.1            BURNSTEIN 64 HBC
D1      37    4.87     0.12           DOSCH     65 HBC
D1      12    4.99     0.13           SCHMIDT   65 HBC  SEE NOTE N          6/68*
D1          . . . . . . . . . .
D1  AVG       4.8486    .0692  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
D1  FIT       4.86     0.07     VALUE FROM CONSTRAINED FIT                  6/68*

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                 21  (SIGMA 0) - (LAMBDA) MASS DIFFERENCE (MEV)

DL  N   SEE NOTE PRECEDING LAMBDA MASS LISTINGS.

DL     208   76.63     0.28           SCHMIDT   65 HBC  SEE NOTE N          6/68*
DL          . . . . . . . . . .
DL  FIT      76.86     0.09     VALUE FROM CONSTRAINED FIT                  6/68*

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                 21  SIGMAO LIFETIME (UNITS 10**-14)

T   *    1.0 OR LESS                  DAVIS     62 EMUL

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            21  SIGMA 0 PARTIAL DECAY MODES

                                                             DECAY MASSES
P1       SIGMA 0 INTO LAMBDA GAMMA                         1115+   0
P2       SIGMA 0 INTO LAMBDA E+ E-                         1115+  .5+  .5

R1  *   SIGMA 0 INTO(LAMBDA E+ E-)/TOTAL                   (P2)/(P1+P2)

R1  *         0.00545   THEORET. CAL. FEINBERG  58        QUANTUM ELECT.    9/66

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REFERENCES

21 SIGMA 0(1193,JP=1/2+)I=1


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FEINBERG 58 PR 109 1019       G.FEINBERG                               (BNL)
DAVIS    62 PR 127 605        D DAVIS,R SETTI,M RAYMOND,G TOMASIN      (CHI)
COURANT  63 PRL 10 409        COURANT,FILTHUTH,FRANZINI+ (CERN+UMD+USNRL)
BURNSTII 64 PRL 13 66         BURNSTEIN,DAY,KEHOE,SECHI ZCRN,SNOW    (MARY)
DOSCH    65 PL 14 239         DOSCH,ENGELMANN,FILTHUTH,HEPP,KLUGE+  (HEID)
SCHMIDT  65 PR 140 B 1328     P SCHMIDT                           (COLUMBIA)

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

ALFF     65 PR 137 81105      ALFF,GELFAND,NAUENBERG+ (CCLUMBIA+RUTC+BNL)P
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                 22  XI-  (1321,JP=1/2 ) I=1/2

                 22  XI-  MASS (MEV)

M   H  11(1317.0)    (2.2)            WANG      61 PBC
M   H  18(1317.9)    (1.9)            FOWLER    61 PBC
M   H (OLD DATA AND LOW STATISTICS DROPPED ON SUGGESTION OF J R HUBBARD)
M   *   1(1322.0)    (1.3)            BROWN     62 HBC     ANTI-XI-         7/66
M     517 1321.4      0.4             JAUNEAU   63 FBC
M      62 1321.1      0.65            SCHNEIDER 63 HBC
M     241 1321.1      0.3             BADIERI   64 HBC
M   * ALL MASSES ABOVE WERE RAISED 0.09 MEV BECAUSE LAMBDA MASS RAISED
M     149 1321.3      0.4             PJERROU   65 HBC                     11/67
M       5 1320.69     0.93            CHIEN     66 HBC  +  6.9 PBAR P,ANTI  9/67
M       6 1321.67     0.52            CHIEN     66 HBC  -  6.9 PBAR P       9/67
M     299 1321.4      1.1             LONDON    66 HBC                      6/66
M   S  12(1321.7)    (0.6)            SHEN      67 HBC     ANTI-XI-         0/67
M   S   THE ERROR IS STATISTICAL ONLY
M          . . . . . . . . . .
M   AVG    1321.2582   .1777  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
M   FIT    1321.25    0.18     VALUE FROM CONSTRAINED FIT                   6/68*

                 22  MASS DIFFERENCE,(XI-)-(ANTI-XI-) IN MEV

DM            1.0       1.1           CHIEN     66 HBC     6.9 PBAR P       9/67

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                 22  XI-  LIFETIME (UNITS 10**-10)

T   H   11   (3.5)    (3.4)    (1.23) WANG      61 PBC
T   H   18   (1.28)   (0.41)   (0.25) FOWLER    61 PBC
T   H (OLD DATA AND LOW STATISTICS DROPPED ON SUGGESTION OF J R HUBBARD)
T     517     1.86     0.15     0.14  JAUNEAU   63 FBC
T      62     1.55     0.31     0.31  SCHNEIDER 63 HBC
T   * 356    (1.77)   (0.12)          CARMONY   64 HBC   REP BY PJERROU 65
T     794     1.69     0.07           HUBBARD   64 HBC
T     246     1.70     0.12           PJERROU   65 HBC                     11/67
T   S   6    (1.37)   (0.51)          CHIEN     66 HBC  -  6.9 PBAR P       9/67
T   S   5    (1.51)   (0.55)          CHIEN     66 HBC  +  6.9 PBAR P,ANTI  9/67
T     299     1.80     0.16           LONDON    66 HBC                      6/66
T   S  12    (1.9)    (0.7)    (0.5)  SHEN      67 HBC    ANTI-XI-          0/67
T    2610     1.61     0.04           DAUBER    68 HBC                      6/68*
T   S   THE ERROR IS STATISTICAL ONLY
T          . . . . . . . . . .
T   AVG       1.6603  + .0366  - .0352  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

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                 22  XI- PARTIAL DECAY MODES

                                                             DECAY MASSES
P1      XI- INTO LAMBDA PI-                                1115+ 139
P2      XI- INTO LAMBDA E- NEUTRINO                        1115+  .5+   0
P3      XI- INTO NEUTRON PI-                                939+ 139
P4      XI- INTO LAMBDA MU- NEUTRINO                       1115+ 105+   0
P5      XI- INTO SIGMAO E- NEUTRINO                        1192+  .5+   0
P6      XI- INTO SIGMAO MU- NEUTRINO                       1192+ 105+   0
P7      XI- INTO NEUTRON E- NEUTRINO                        939+  .5+   0

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                 22  XI- BRANCHING RATIOS

R1  *  XI- INTO (LAMBDA E- NEU)/(LAMBDA PI-) (UNITS 10**-3) (P2)/(P1)
R1       1       155 EFFECTIVE DENOM.  CARMONY   63 HBC                     11/67
R1       0       260 EFFECTIVE DENOM.  JAUNEAU   63 HBC                     11/67
R1       0       220 EFFECTIVE DENOM.  BERGE     66 HBC                     11/67
R1       1       155 EFFECTIVE DENOM.  LONDON    66 HBC                     11/67
R1       0       717 EFFECTIVE DENOM.  TRIPPE    67 HBC                     11/67
R1       2      1976 EFFECTIVE DENOM.  HUBBARD   68 HBC                      6/68*
R1       4    0.90      0.71     0.43  HUBBARD   68 RVUE                     6/68*
R1  *   HUBBARD 68 (RVUE) INCLUDES ALL ABOVE EVENTS                          6/68*

R2  *  XI- INTO (NEUTRON PI-)/(LAMBDA PI-) (UNITS 10**-3) (P3)/(PI)
R2          5.0   OR LESS              FERRO-LUZ 63 HBC                      6/68*
R2          1.1   OR LESS              DAUBER    68 HBC                      6/68*

R3  *  XI- INTO (LAMBDA MU- NEUTRINO)/TOTAL (UNITS 10**-3) (P4)/TOTAL
R3         12.0   OR LESS              BERGE     66 HBC                      6/68*
R3          1.3   OR LESS              DAUBER    68 HBC                      6/68*

R4  *  XI- INTO (SIGMAO E- NEUTRINO)/TOTAL (UNITS 10**-3) (P5)/TOTAL
R4          3.0   OR LESS              BERGE     66 HBC                      6/68*
R4          0.5   OR LESS              DAUBER    68 HBC                      6/68*

R5  *   I  XI- INTO (SIGMAO MU- NEUTRINO)/TOTAL          (P6)/TOTAL
R5  *       0.005   OR LESS            BERGE     66 HBC                      7/66

R6  *      XI- INTO (N E- NEUTRINO) / (LAMBDA PI-)        (P7)/(P1)
R6  *       0.01  OR LESS              BINGHAM   65 RVUE    CONF.LIMIT 0.9   9/66

R7  *  XI- INTO (SIGMAO E NEU + LAMBDA E NEU)/TOTAL (10**-3) (P2 +P5)/TOTAL
R7      14    0.62      0.20     0.30  DUCLOS    68 SPRK    PREL.SEE NOTE D  10/68*
R7  D    THIS EXPERIMENT CANNOT DISTINGUISH SIGMAO FROM LAMBDA. THE CABIBBO
R7  D    THEORY EXPECT SIGMAO RATE ABOUT A FACTOR 6 SMALLER THAN THE LAMBCA
R7  D     TO GET A VALUE FOR THE TABLE R7 HAS BEEN AVERAGEC WITH R1 -

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                 22  XI- DECAY PARAMETERS

A   *  ALPHA XI-
A   C        (-0.44)   (0.12)         JAUNEAU   63 FBC    SEE NOTE D BELOW  6/68*
A   O    62  (-0.73)   (0.23)         SCHNEIDER 63 HBC    SEE NOTE D BELOW  6/68*
A       240   -0.5      0.38          BADIERI   64 HBC    SEE NOTE D BELOW  6/68*
A       356   -0.62     0.13          CARMONY   64 HBC    SEE NOTE D BELOW  6/68*
A      1004   -0.365    0.068         BERGE     66 HBC    SEE NOTE D BELOW  6/68*
A       364   -0.47     0.13          LONDON    66 HBC    SEE NOTE D BELOW  6/68*
A   L    LONDON 66 USES ALPHA-LAMBDA = 0.62
A   *        (-0.391)  (0.032)        BERGE 2   66 RVUE  INCLUDES ALL ABOVE 9/66
A      2781   -0.391    0.045         DAUBER    68 HBC    SEE NOTE A BELOW
A   A    USED ALPHALAMBDA = 0.647 PLUS OR MINUS 0.020
A   M 2529   (-0.375)  (0.051)        MERRILL   68 HBC                      6/68*
A   M    DATA OF MERRILL 68 INCLUDED IN DAUBER 68.
A   O    OLD DATA NOT INCLUDED IN AVERAGE.
A   D    ERRORS MULTIPLIED BY 1.1 DUE TO APPROXIMATIONS USED FOR XI
A   D    POLARIZATION. (SEE DAUBER 68 FOR DETAILED DISCUSSION)              6/68*
A          . . . . . . . . . .
A   AVG       -.4070    .0370  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

F   *  PHI ANGLE (SIN(PHI)/COS(PHI)=BETA/GAMMA) (DEGREES)
F   O       (-16.0)    (45.0)         JAUNEAU   63 FBC    SEE NOTE D BELOW  6/68*
F   O    62  (45.0)    (36.0)         SCHNEIDER 63 HBC    SEE NOTE D BELOW  6/68*
F       356   54.0      30.0          CARMONY   64 HBC    SEE NOTE D BELOW  6/68*
F      1004    0.       12.           BERGE     66 HBC    SEE NOTE D BELOW  6/68*
F       364    0.0      20.4          LONDON    66 HBC    SEE NOTE D BELOW  6/68*
F   L    LONDON 66 USES ALPHA-LAMBDA = 0.62
F     2781  -14.        11.           DAUBER    68 HBC    SEE NOTE A BELOW
F   A    USED ALPHALAMBDA = 0.647 PLUS OR MINUS 0.020
F   M 2529    (9.8)    (11.6)         MERRILL   68 HBC                      6/68*
F   M    DATA OF MERRILL 68 INCLUDED IN DAUBER 68.
F   O    OLD DATA NOT INCLUDED IN AVERAGE.
F   D    ERRORS MULTIPLIED BY 1.2 DUE TO APPROXIMATIONS USED FOR XI
F   D    POLARIZATION. (SEE DAUBER 68 FOR DETAILED DISCUSSION)
F          . . . . . . . . . .
F   AVG       -2.9751   9.1417  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                         (SEE IDEOGRAM BELOW )
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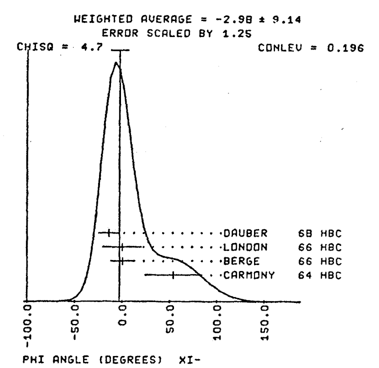


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REFERENCES

22 XI - (1321,JP=1/2) I=1/2


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FOWLER   61 PRL 6 134         FOWLER,BIRGE,EBERHARD,ELY,GCOD,POWELL+(LRL)
WANG     61 JETP 13 512       K WANG,T WANG,VIRYASOV,TING,SOLOVEV+ (JINR)
BERTANZA 62 PRL 9 229         BERTANZA,BRISSON,GOLDBERG,GRAY+(BNL+SYRACU)
BROWN    62 PRL 8 255         BROWN,CULWICK,FOWLER,GAILLCUD +  (BNL+YALE)

CARMONY  63 PRL  10  381      CARMONY,PJERROU                      (UCLA)
FERROLUZ 63 PR 130 1568       FERRO-LUZZI,ALSTCN,ROSENFELC,WOJCICKI (LRL)
JAUNEAU  63 SIENA CONF 4      JAUNEAU+       (PARIS+CERN+LCND+RUTH+BERGEN)
JAUNEAU1 63 PL  5  261        JAUNEAU,MORELLET+ (EP,CERN,LCN,RUTH,BERGEN)
SCHNEIDE 63 PL 4 360          H SCHNEIDER                          (CERN)
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STABLE PARTICLES

Data in parentheses have not been included in our averages.


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CARMONY  64 PRL 12 482           CARMCNY,PJERROU,SCHLEIN,SLATER,STORK+(UCLA)
BADIER1  64 DUBNA CONF I 593     BADIER,DEMOULIN,BARLOUTAUD+ (PARIS+SAC+ZEE)
HUBBARD  64 PR 135 B 183         HUBBARD,BERGE,KALBFLEISCH,SHAFER +    (LRL)
BINGHAM  65 PRSL  285  202       H H BINGHAM                          (CERN)
PJERROU  65 PRL 14 275           + SCHLEIN,SLATER,SMITH,STORK,TICHO   (UCLA)
PJERROU  65 THESIS               G M PJERROU                          (UCLA)

BERGE    66 PR  147  945         BERGE,EBERHARD,HUBBARD,MERRILL +      (LRL)
BERGE 2  66 BERKELEY CONF 46     BERGE,CABIBBO                        (RVUE)
LONDON   66 PR 143 1034          LONDON,RAU,GOLDBERG,LICHTMAN+ (BNL+SYRACUS)
CHIEN    66 PR  152  1171        +LACH,SANDWEISS,TAFT,YEH,OREN +  (YALE+BNL)
SHEN     67 PL 25 B 443          B.C.SHEN,A.FIRESTONE,G.GOLCHABER  (UCB+LRL)
TRIPPE   67 PRIV. COMM.          T. TRIPPE                            (UCLA)
DAUBER   68 UCRL 18388           +BERGE,HUBBARD,MERRILL,MILLER        (LRL)J
DUCLOS   68 TO BE PUBL.          DUCLOS,FREYTAG+ VIENNA 253(CERN,HEIDELBERG)
HUBBARD  68 PRL 20 485           HUBBARD,BERGE,DAUBER                  (LRL)
MERRILL  68 PR 167 1202          MERRILL,SHAFER                       (LRL)J

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

CARMONY  64 PRL 12 482           CARMONY,PJERROU,SCHLEIN,SLATER,STORK+(UCLA) J
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                 23  XI 0  (1314,JP=1/2 ) I=1/2

                 23  XI 0  MASS (MEV)

M        1 1313.4      1.8            PALMER    68 HBC                    3/68*
M           . . . . . . . . . .
M   FIT    1314.69     0.70     VALUE FROM CONSTRAINED FIT                6/68*

                 23  XI        MASS DIFFERENCE (-)-(0)(MEV)

D        23    6.8     1.6            JAUNEAU   63 FBC
D   *    45   (6.1)   (1.6)           CARMONY   64 HBC    REP BY PJERROU 65
D        88    6.1     0.9            PJERROU   65 HBC                    11/67
D        29    6.9     2.2            LONDON    66 HBC                     6/66
D           . . . . . . . . . .
D   AVG       6.3395   .7389  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
D   FIT       6.56     0.68     VALUE FROM CONSTRAINED FIT                6/68*

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                 23  XI 0 LIFETIME (UNITS 10**-10)

T        24    3.9     1.4      0.80  JAUNEAU   63 FBC
T   *    45   (3.5)   (1.0)    (0.8)  CARMONY   64 HBC    REP BY PJERROU 65
T       101    2.5     0.4      0.3   HUBBARD   64 HBC
T        80    3.0     0.5            PJERROU   65 HBC                    11/67
T       340    3.07    0.22     0.20  DAUBER    68 HBC                    6/68*
T           . . . . . . . . . .
T   AVG       3.0327  + .1815  - .1621  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                 23  XI 0  PARTIAL DECAY MODES

                                                     DECAY MASSES
P1      XI 0 INTO LAMBDA PIO                        1115+ 134
P2      XI 0 INTO PROTON PI-                         938+ 139
P3      XI 0 INTO PROTON E- NEU                      938+  .5+   0
P4      XI 0 INTO SIGMA+ E- NEU                     1189+  .5+   0
P5      XI 0 INTO SIGMA- E+ NEU                     1197+  .5+   0
P6      XI 0 INTO SIGMA+ MU- NEUTRINO               1189+ 105+   0
P7      XI 0 INTO SIGMA- MU+ NEUTRINO               1197+ 105+   0
P8      XI 0 INTO PROTON MU- NEUTRINO                938+ 105+   0

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                 23  XI 0  BRANCHING RATIOS

R1  *  XIO INTO (PROTON PI-)/(LAMBDA PIO) (UNITS 10**-3) (P2)/(P1)
R1          27.0   OR LESS           TICHO     63 HBC                     6/68*
R1           5.0   OR LESS           HUBBARD   66 HBC                     6/68*
R1           0.9   OR LESS           DAUBER    68 HBC                     6/68*

R2  *  XIO INTO (PROTON E- NEU)/(LAMBDA PIO) (UNITS 10**-3) (P3)/(P1)
R2          27.0   OR LESS           TICHO     63 HBC                     6/68*
R2           6.0   OR LESS           HUBBARD   66 HBC                     6/68*
R2           1.3   OR LESS           DAUBER    68 HBC                     6/68*

R3  *  XIO INTO (SIGMA+ E- NEU)/(LAMBDA PIO) (UNITS 10**-3) (P4)/(P1)
R3          13.0   OR LESS           TICHO     63 HBC                     6/68*
R3           7.0   OR LESS           HUBBARD   66 HBC                     6/68*
R3           1.5   OR LESS           DAUBER    68 HBC                     6/68*

R4  *  XIO INTO (SIGMA- E+ NEU)/(LAMBDA PIO) (UNITS 10**-3) (P5)/(P1)
R4           6.0   OR LESS           HUBBARD   66 HBC                     6/68*
R4           1.5   OR LESS           DAUBER    68 HBC                     6/68*

R5  *  XIO INTO (SIGMA+ MU- NEU)/TOTAL (UNITS 10**-3) (P6)/TOTAL
R5           7.0   OR LESS           HUBBARD   66 HBC                     6/68*
R5           1.5   OR LESS           DAUBER    68 HBC                     6/68*

R6  *  XIO INTO (SIGMA- MU+ NEU)/TOTAL (UNITS 10**-3) (P7)/TOTAL
R6           6.0   OR LESS           HUBBARD   66 HBC                     6/68*
R6           1.5   OR LESS           DAUBER    68 HBC                     6/68*

R7  *  XIO INTO (PROTON MU- NEU)/TOTAL  (UNITS 10**-3) (P8)/TOTAL
R7           6.0   OR LESS           HUBBARD   66 HBC                     6/68*
R7           1.3   OR LESS           DAUBER    68 HBC                     6/68*

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                 23  XI 0 DECAY PARAMETER

A   *  ALPHA XI 0
A            -0.09     0.46          PJERROU   65 HBC     SEE NOTE D BELCW  6/68*
A      146   -0.13     0.17          BERGE     66 HBC     SEE NOTE D BELOW  6/68*
A       46   -0.2      0.4           LONDON    66 HBC     SEE NOTE D BELOW  6/68*
A   L   LONDON 66 USES ALPHA-LAMBDA = 0.62
A   M  490  (-0.33)   (0.11)         MERRILL   66 HBC     SEE NOTE D BELOW  6/68*
A   M   MERRILL 66 REPLACED BY DAUBER 68
A   D   ERRORS MULTIPLIED BY 1.1 DUE TO APPROXIMATIONS USED FOR XI
A   D   POLARIZATION. (SEE DAUBER 68 FOR DETAILED DISCUSSION)
A      739   -0.43     0.09          DAUBER    68   .     SEE NOTE A BELOW
A   A   USED ALPHALAMBDA = 0.647 PLUS OR MINUS 0.020
A          . . . . . . . . . .
A   AVG      -.3506    .0769  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

F   *  PHI ANGLE  (SIN(PHI)/COS(PHI)=BETA/GAMMA)  (DEGREES)
F      146   -8.       30.           BERGE     66 HBC     SEE NOTE D BELOW  6/68*
F   M  490 (107.0)    (46.0)         MERRILL   66 HBC     SEE NOTE D BELCW  6/68*
F   M   MERRILL 66 REPLACED BY CAUBER 68
F   D   ERRORS MULTIPLIED BY 1.2 DUE TO APPROXIMATIONS USED FOR XI
F   D   POLARIZATION. (SEE DAUBER 68 FOR DETAILED DISCUSSION)
F      739   38.       19.           DAUBER    68 HBC     SEE NOTE A BELCW
F   A   USED ALPHALAMBDA = 0.647 PLUS OR MINUS 0.020
F          . . . . . . . . . .
F   AVG     24.8311  20.7930  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                         (SEE IDEOGRAM BELOW )
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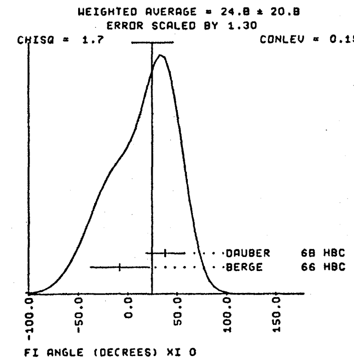


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                     REFERENCES

                     23 XI 0(1314,JP=1/2)I=1/2

ALVAREZ  59 PRL 2 215            ALVAREZ,EBERHARD,GOOD,GRAZIANO,TICHO+ (LRL)
JAUNEAU  63 SIENA CONF 1 1       JAUNEAU+      (PARIS+CERN+LOND+RUTH+BERGEN)
   ALSO  63 PL 4 49              JAUNEAU+      (PARIS+CERN+LCND+RUTH+BERGEN)
TICHO    63 BNL CONF 410         HAROLD K TICHO                        (UCLA)

CARMONY  64 PRL 12 482           CARMONY,PJERROU,SCHLEIN,SLATER,STORK+(UCLA)
HUBBARD  64 PR 135 B 183         HUBBARD,BERGE,KALBFLEISCH,SHAFER +     (LRL)
PJERROU  65 PRL 14 275           + SCHLEIN,SLATER,SMITH,STORK,TICHO    (UCLA)
PJERROU  65 THESIS               G M PJERROU                           (UCLA)

BERGE    66 PR  147  945         BERGE,EBERHARD,HUBBARD,MERRILL +       (LRL)
HUBBARD  66 UCRL 11510           J RICHARD HUBBARD (THESIS,BERKELEY)    (LRL)
LONDON   66 PR 143 1034          LONDON,RAU,GOLDBERG,LICHTMAN+ (BNL+SYRACUS)
MERRILL  66  BERKELEY CONF       MERRILL,SHAFER,BERGE                   (LRL)
   CF.   66 UCRL 16455           DEANE MERRILL (THESIS, BERKELEY)       (LRL)

DAUBER   68 UCRL 18388           +BERGE,HUBBARD,MERRILL,MILLER          (LRL)
PALMER   68 PL 26B 323           PALMER,RADOJICIC,RAU,RICHARDSON+  (BNL,SYR)
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            24  OMEGA-  (1675,JP=3/2+)   I=0
            QUANTUM NUMBERS ASSIGNED FROM SU3

            24  OMEGA-  MASS (MEV)

M   *   1(1620.0)   (25.0)    (10.0) EISENBERG 54 EMUL
M       1 1673.0      8.0            ABRAMS    64 HBC    INTO XI- PIO
M       1 1669.0      4.0            ABCLV     68 HBC    INTO LAMBDA K-    3/68*
M       1 1671.0      5.0            ABCLV     68 HBC    INTO LAMBDA K-    3/68*
M       1 1676.0     14.0            ABCLV     68 HBC    INTO LAMBDA K-    3/68*
M       1 1670.0      2.0            ABCLV     68 HBC    INTO LAMBDA K-    3/68*
M   P   1(1675.6)    (5.4)           PALMER    68 HBC    INTO XIO PI-      3/68*
M   P   1(1673.6)    (1.2)           PALMER    68 HBC    INTO LAMBDA K-    3/68*
M   P   1(1672.5)    (1.8)           PALMER    68 HBC    INTO LAMBDA K-    3/68*
M   P   THE 3 ABOVE EVENTS WERE ORIGINALLY PUBLISHED WITH MASSES 1686(+-12),
M   P   1674(+-3) AND 1671(+-5) IN BARNES1(64),BARNES2(64),AND RICHARDSON 65
M       ALL ARE INCLUDED IN THE MASS GIVEN ON THE FOLLOWING LINE --
M       3 1673.3      1.0            PALMER    68 HBC                      3/68*
M       3 1671.8      0.9            SCHULTZ   68 HBC    ALL 3 LAMBDA K-   3/68*
M       1 1666.0      8.0            SCOTTER   68 HBC    INTO XIO PI-      3/68*
M       1 1674.0      2.0            SCOTTER   68 HBC    INTO LAMBDA K-    3/68*
M   C   THE ABOVE EVENT WAS ORIGINALLY PUBLISHED AS COLLEY 65
M       1 1662.0     15.0            SCOTTER   68 HBC    INTO XIO PI-      3/68*
M       1 1667.0      6.0            SCOTTER   68 HBC    INTO XIO PI-      3/68*
M       1 1678.0      3.0            SCOTTER   68 HBC    INTO LAMBDA K-    3/68*
M          . . . . . . . . . .
M   AVG    1672.4148    .6485  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)
                        (SEE IDEOGRAM BELOW )
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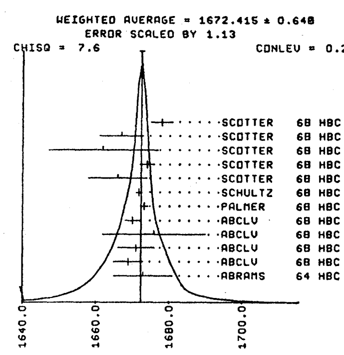

Data in parentheses have not been included in our averages.

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                    24  OMEGA- LIFETIME  (UNITS 10**-10 SEC)

T  A   1   (1.63)                 ABRAMS     64 HBC            7/66
T  A   1   (0.7)                  BARNES 1   64 HBC            7/66
T  A   1   (1.4)                  BARNES 2   64 HBC            7/66
T  A   1   (1.85)                 COLLEY     65 HBC            7/66
T  A   1   (1.5)                  RICHARDSO  65 HBC            7/66
T  A   1   (0.93)                 ABCLV COL  68 HBC           11/67
T  A   1   (2.6)                  ABCLV COL  68 HBC           11/67
T  A   1   (1.6)                  ABCLV COL  68 HBC           11/67
T  A   1   (0.21)                 ABCLV COL  68 HBC           11/67
T  A   1   (1.20)                 SCHULTZ    68 HBC           11/67
T  A   1   (0.06)                 SCHULTZ    68 HBC           11/67
T  A   1   (0.63)                 SCHULTZ    68 HBC           11/67
T  A   1   (0.25)                 SCOTTER    68 HBC            6/68*
T  A   1   (0.30)                 SCOTTER    68 HBC            6/68*
T  A   1   (0.71)                 SCOTTER    68 HBC            6/68*
T  A   1   (0.08)                 SCOTTER    68 HBC            6/68*
T  A   1   (1.04)                 SCOTTER    68 HBC            6/68*
T  A   1   (2.38)                 SCOTTER    68 HBC            6/68*
T  A  ALLISON INCLUDES ALL ABOVE + 3 MORE BNL EVENTS, UNPUBLISHED.   6/68*
T     21   1.31     0.37     0.24 ALLISON    68 RVUE           6/68*

                    24 OMEGA- PARTIAL DECAY MODES

                                                   DECAY MASSES
P1  OMEGA- INTO LAMBDA K-                        938+ 105+   0
P2  OMEGA- INTO XI 0 PI-                         938+ 105+   0
P3  OMEGA- INTO XI- PI 0                         938+ 105+   0
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                    24  OMEGA- BRANCHING RATIOS

    25 EXAMPLES OF OMEGA - PRODUCTION HAVE BEEN REPORTED. 13 HAVE
    DECAYED INTO LAMBDA K-, 8 INTO XIO PI-, 3 INTO XI- PIO, AND ONE IS
    AMBIGUOUS BETWEEN LAMBDA K- AND XIO PI-.

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                         REFERENCES
                         24 OMEGA-(1675,JP=3/2+)  I=0

EISENBER 54 PR 96 541        Y EISENBERG                            (CORNELL)
ABRAMS   64 PRL 13 670       + BURNSTEIN,GLASSER +       (MARYLAND+USNRL)
BARNES 1 64 PRL  12  204     V E BARNES,CONNOLLY,CRENNELL,CULWICK+ (BNL)
BARNES 2 64 PL 12 134        V E BARNES,CONNCLLY,CRENNELL,CULWICK+ (BNL)
COLLEY   65 PL 19 152        COLLEY,DODD +      (BIR+GLA+IC+MUN+OXF+RHEL)
RICHARDS 65 BAPS 10 115      RICHARDSON,BARNES,CRENNEL+    (BNL+SYRACUSE)
SAMIOS   65 ARGONNE CONF 189 N P SAMIOS                        ((RVUE) BNL)

ABCLV    68 NUC PHYS B4 326  AACHEN+BERLIN+CERN+LONDON IMP.(OLL.+VIENNA)
ALLISCN  68 PRIV. COMM.      JOHN ALLISON                        (LANCASTER)
PALMER   68 PL 26B 323       PALMER,RADOJICIC,RAU,RICHARDSON+  (BNL,SYR)
SCHULTZ  68 PR  168  1509    SCHULTZ+     (ILL,ARGONNE,NCRTHWESTERN,WISC)
SCOTTER  68 PL 26B 474       SCOTTER+(BIRM,GLASGOW,IC LCNDON,MUNICH,OXF)

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MESON RESONANCES

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CODE EVENTS QUANTITY  ERROR+  ERROR-  REFERENCE YR TECN SIGN COMMENTS  DATE
      ABOVE                                                          PUNCHED
   BACKGROUND
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π                  PI MESON (JPG=0--)  I=1

                   SEE LISTINGS OF STABLE PARTICLES

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σ(410)             7  SIGMA MESON (410, JPG=0++)  I = 0

                   NO EVIDENCE FOR RESONANCE
                   OMITTED FROM TABLE.
   ------->        SEE NOTE ON ETA 0+(720)

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                         REFERENCES ON SIGMA

SAMIOS   62 PRL 9 139          +BACHMAN,LEA+                  (BNL+CCNY+CO+KY)
BLOKHINT 63 JETP 17 80         BLOKHINTSEVA,GREIBINNIK,ZHUKOV +      (DUBNA)
BOOTH    63 PR 132 2314        + ABASHIAN                              (LRL)
KIRZ     63 PR 130 2481        +SCHWARTZ + TRIPP                       (LRL)
BARISH   64 PR 135 B 416       BARISH,KURZ,PEREZ-MENDEZ,SOLOMON        (LRL)
CRAWFORD 64 PRL 13 421         +GROSSMAN,LLOYD,PRICE,FOWLER            (LRL)
DEL FABR 64 PRL 12 674         DEL FABRO,DE PRETIS,JONES+         FRA(CATI)
KALMUS   64 PRL 13  99         +KERNAN,PU,POWELL,DOWD      (LRL+WISCONSIN)
BIRGE    65 PR 139 B 1600      +ELY+GIDAL+KALMUS+CAMERINI+        (LRL+WISC)
BROWN    65 CORAL GABLES 219   BROWN+FAIER                    (NORTHWESTERN)
WOLF     65 PL 19 328          WOLF                                   (DESY)
JACOBS   66 PRL 16 669         +SELOVE                                 (LRL)
KOPELMAN 66 PL   22  118       +ALLEN,GOODEN,MARSHALL +     (COLORADO+IOWA)
LOVELACE 66 PL   22  332       LOVELACE,HEINZ,DCNNACHIE               (CERN)
ANDERSON 67 PRL 18 89          +FUKUI+KESSLER+   (CHIC+ANL+OTT+MCGILL+QMC)
CORBETT  67 PR 156 1451        +DAMERELL+MIDDLEM(S+NEWTON     OXF+RUTHERF)
MALAMUC  67 PRL 19 1056        E.MALAMUD + P.E.SCHLEIN                (UCLA)
WALKER   67 PRL 18 630         +CARROLL,GARFINKEL,OH             (WISCONSIN)
BANDER   68 PR 168 1679        M. BANDER, G.L. SHAW, J.R. FULCO (UCI+UCSB)
BISWAS   68 PL 27 B 513        +CASON,JOHNSON,KENNEY,POIRIER+ (NOTRE DAME)
EISENHAN 68 PRL 20 758         EISENHANDLER,MISTRY,MOSTEK +        (CORNELL)
FOSTER   68 NP B 6 107         +GAVILLET+LABROSSE+MONTANET+    (CERN+PARIS)
GUTAY    68  COO-1428-65       +CARMONY,CSONKA,LOEFFLER,MEIERE    (PURDUE)
JONES    68 PR 166 1405        +CALDWELL+ZACHAROV+HARTING+BLEULER+  (CERN)
MARATECK 68  VIENNA ABS.   803 +HAGOPIAN,SELOVE              (         PENN)

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η                  14  ETA   (549,   JPG=0-+)   I=0

                   SEE LISTINGS OF STABLE PARTICLES

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η0+(720)           14  ETA 0+(720,JPG=0++) I=0
                   OMITTED FROM TABLE.
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Narrow $J^P = 0^+$ $\pi\pi$ resonances have been claimed around 400 MeV ("σ meson") and 700 MeV ("ϵ"), but the evidence is unconvincing. It is, however, suggested from several recent attempts at determining the $\pi\pi$ phase shifts (CLEGG 67, MALAMUD 67, GUTAY 68, JONES 68, MARATECK 68) that δ_{00} (the I = 0, S-wave $\pi\pi$ phase shift) may have the behavior characteristic of a wide resonance in the region between 650 and 850 MeV. Such a possibility was first advocated by LOVELACE 66, who observed that to interpret πN elastic scattering data in a dispersion theoretic framework one has to assume the exchange of such a $\pi\pi$ resonance in the t channel.

The $\pi\pi$ phase-shift analyses yield two (or three) different possible solutions for δ_{00}, all of which are quite large in the region 600 to 900 MeV; for one (or two) of these solutions, δ_{00} passes through 90 deg somewhere near 700 MeV. From the small rate of rise of $\delta_{00}(m_{\pi\pi})$ one estimates that the width of this possible $J^P = 0^+$ resonance may be 100 to several hundred MeV.

There is even more uncertainty about the behavior of δ_{00} in the lower energy region $m_{\pi\pi} < 600$ MeV. At present, there is no indication for δ_{00} to be as large as 90 deg anywhere here.

MESON RESONANCES

Data in parentheses have not been included in our averages.

REFERENCES


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CLARK    65 PR 139 B1556      +CHRISTENSON+CRONIN+TURLAY        (PRINCETON)
COHN     65 PRL 15 906        H D COHN,BUGG+ (ORNL+TENN+UNCAR+COLU+EFINS)
DURAND   65 PRL 14 329        L. DURAND AND Y.T. CHIU                (YALE)
FELDMAN  65 PRL 14 869        FELDMAN,FRATI,HALPERN,CHOUDRY+(PENNA+COLUM)
FORINO   65 PL 19 65          +GESSAROLI,LENDINARA+    (BOL+ORSAY+SACLAY)
HAGOPIAN 65 PRL 14 1077       HAGOPIAN,SELOVE,ALIT+(PENNA+SACLAY+BOLOGNA)
WOLF     65 PL 19 328         G WOLF                                 (DESY)

GOLDHABE 66 BERKELEY CONF 102 G.GOLDHABER, MESON REVIEW               (LRL)
JABIOL   66 PRL 17 1065       +JAMES+NGUYEN HUU KHANH (SACLAY+YALE+ORSAY)
JACOBS   66 UCRL-16877        L.J.JACOBS                              (LRL)
LOVELACE 66 PL  22  332       LOVELACE,HEINZ,DONNACHIE               (CERN)

BANDER   67 PR 155 1675       M.BANDER + G.L.SHAW                     (UCI)
BUHLER   67 NC 49A 183        +DALPIAZ,MASSAM,ZICHICHI+    (CERN+BOLOGNA)
CLEGG    67 PR 163 1664       A.B.CLEGG                         (LANCASTER)
CORBETT  67 PR 156 1451       +DAMERELL+MIDDLEMAS+NEWTON    (OXF+RUTHERF)
GUTAY    67 PRL 18 142        +JOHNSON+LOEFFLER+MCILWAIN+    (PURDUE+UCRL)
JOHNSON  67 PR 163 1497       +EISNER+GUTAY+KLEIN+PETERS+SAHNI+  (PURDUE)
MALAMUD  67 PRL 19 1056       E.MALAMUD + P.E.SCHLEIN                (UCLA)
STRUGALS 67  JINR E1-3100     STRUGALSKI+CHUVILO+IVANOVSKAJA+       (DUBNA)
  (SEE ALSO G. GOLDHABER, MESON REVIEW, PROC. 1966 BERKELEY CONF.)
WALKER   67 PRL 18 630        +CARROLL,GARFINKEL,OH            (WISCONSIN)
WALKER   67 RMP 39 695        W.D.WALKER                       (WISCONSIN)

ARMENISE 68 NC 54 A 999       +FORINO+CARTACCI+(BARI+BOLOG+FIRENZE+ORSAY)
BISWAS   68 PL 27 B 513       +CASON,JOHNSON,KENNEY,POIRIER+ (NOTRE DAME)
BRAUN    68 PRL 21 1275       BRAUN,CLINE,SCHERER              (WISCONSIN)
BUNIATOV 68  VIENNA ABS.  714 +SCHMITT,DEINET,MENZIONE,MULLER+(CERN+KARL)
DUTTA-RO 68 PR 169 1357       B. DUTTA-ROY, I.R. LAPIDUS      (HOBOKEN,NJ)
FOSTER   68 NP B 6 107        +GAVILLET+LABROSSE+MONTANET+   (CERN+PARIS)
GUTAY    68  COO-1428-65      +CARMONY,CSONKA,LOEFFLER,MEIERE    (PURDUE)
JONES    68 PR 166 1405       +CALDWELL+ZACHAROV+HARTING+BLEULER+  (CERN)
MARATECK 68  VIENNA ABS.  803 +HAGOPIAN,SELOVE               (       PENN)
SMITH    68 PR 171 1399       G.A.SMITH, R.J.MANNING            (   UCRL)
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ρ (765)

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9 RHO (765, JPG = 1-+)  I=1
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          9 RHO  MASS (MEV)
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THERE ARE WIDE FLUCTUATIONS IN THE MEASURED VALUES FOR MASS AND WIDTH OF THE RHO DUE TO DIFFERENCES IN PRODUCTION MECHANISM, BACKGROUND, METHOD OF ANALYSIS AND PARAMETRIZATION. UNCERTAINTIES IN THEORY GIVE RISE TO SYSTEMATIC ERRORS OF ABOUT 20 MEV IN MASS AND WIDTH.

THE FOLLOWING FIVE ENTRIES ARE THE MOST SIGNIFICANT ONES. THEY ILLUSTRATE THE DISCREPANCIES, AND ARE ALSO REPEATED IN FOOTNOTE (H) OF THE MESON TABLE.

```
    AUSLENDER 68 (RHO 0 FROM E- E+ COLLIDING BEAMS)
    BATON 67     (RHO - IN CHEW-LOW EXTRAPOLATION AND PHASE SHIFT ANALYSIS)
    MARATECK 68  (RHO 0 IN CHEW-LOW EXTRAPOLATION AND PHASE SHIFT ANALYSIS)
    PISUT 68     (COMPILATION AND DISCUSSION OF RHO+-0 IN PI N COLLISIONS
                  AND DISCUSSION OF RHO 0 IN E+ E- COLLIDING BEAMS)
    SCHLEIN 68   (RHO 0 FROM PION-PION PHASE SHIFT ANALYSIS)
    SEE ALSO AUGUSTIN 68 (UNPUBLISHED RHO 0 FROM E+ E- COLLIDING BEAMS)
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M+  R       (760.0)   (9.0)             CARMONY   64 HBC  +   3.5 PI+P,TCUT 4
M+           760.     10.               ARMENISE  65 HBC  +   2.8 PI+P
M+  R       (765.0)   (5.0)             ALFF-STEI 66 HBC  +   2-3 PI+ P        6/66
M+  R       (783.0)   (6.0)             JAMES     66 HBC  +   2.1 PI+ P        6/66
M+  R       (758.0)  (10.0)             JAMES     66 HBC  +   2.1 PI+,TCUT2.5  8/66
M+           777.0     7.0              ABC COLL. 68 HBC  +   8 PI+P TO P+3PI  5/68*
M+           . . . . . . . . . . .
M+  AVG      771.4094   7.9866  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)

M+  S       (750.0)   (3.0)             BALTAY    66 HBC  +-  0.0 PBAR P       6/66
M+           755.     10.               ALLES-BOR 67 HBC  +-  5.7 PBAR P      12/66
M+           730.     11.               BARLOW    67 HBC  +-  1.2 PBAR P      11/66
M+           782.      5.               FOSTER    68 HBC  +-  PBAR P AT REST   6/68*
M+           . . . . . . . . . . .
M+  AVG      769.9901  13.4986  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 3.3)

M-  *       (748.0)                     KENNEY    62 HBC  -   1.2 PI-P
M-  *   130 (775.0)                     GUIRAGOSS 63 HBC  -   3.3 PI-P
M-  R       (768.0)   (5.0)             BLIEDEN   65 MMSP -   3-5 PI- P        6/66
M-           772.0    19.0              FIDECARO  66 SPRK -   2.5 PI-,T CUT18 11/66
M-  R       (760.0)   (5.0)             HAGOPIAN1 66 HBC  -   3.0 PI- P        6/66
M-  R       (770.0)   (5.0)             HAGOPIAN2 66 HBC  -   2.14 PI-P        9/67
M-  R       (765.0)   (5.0)             HAGOPIAN2 66 HBC  -   2.14 PI-,TCUT12  9/67
M-  R 6014  (757.6)   (6.6)             JACOBS    66 HBC  -   2-3PI-           6/68*
M-  R 2775  (753.5)  (10.5)             JACOBS    66 HBC  -   2-3PI-,T CUT 20  6/68*
M-  R       (749.0)   (3.0)             WEST      66 HBC  -   2.1 PI- P        0/66
M-           752.0    14.0              BANNER    67 MMS  -   1.8 PI-P,  P+MM  9/67
M-  C       (755.0)   (5.0)             BATON     67 HBC  -   2.8 PI- P        0/67
M-           751.      5.               CLEAR     67 HBC  -   3 PI- P          7/67
M-           764.      4.               EISNER    67 HBC  -   4.2 PI-P         9/67
M-  R       (777.0)   (6.0)             MILLER    67 HBC  -   2.7 PI-,T CUT 5  9/66
M-  R       (775.0)   (5.0)             MILLER    67 HBC  -   2.7 PI-,T CUT10  9/66
M-  R       (768.0)   (5.0)             MILLER    67 HBC  -   2.7 PI-,T CUT20  9/66
M-  R       (781.0)   (2.0)             BATON     68 HBC  -   2.8 PI-,T CUT13  4/68*
M-   12773   764.3     1.9      1.8     PISUT     68 RVUE -   1.7-3.2PI-,CT10  6/68*
M-  A12773  (764.3)  (19.2)    (3.3)    PISUT     68 RVUE -   1.7-3.2PI-,CT10  6/68*
M-  A   ERRORS ARE 2 STD AND INCLUDE SYSTEMATIC UNCERTAINTIES FROM THEORY
M-           . . . . . . . . . . .
M-  AVG      762.8290   2.8006  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.8)

MO  *   190 (750.0)  (20.0)             SAMIOS    62 HBC    0 4.7 PI-P
MO  R   300 (760.0)  (10.0)             ABOLINS   63 HBC    0 3.5 PI+P
MO  *   160 (775.0)                     GUIRAGOSS 63 HBC    0 3.3 PI-P
MO  R   500 (770.0)  (10.0)             GOLDHABER 64 HBC    0 3.7 PI+P
MO  *       (735.0)  (10.0)             ALYEA     65 DBC    0 2.2 K- P         6/66
MO           750.0                      CLARK     65 SPRK   0 1.5 PI-P
MO  N       (736.0)                     CLARK     65 SPRK   0 1.5 PI- P        0/66
MO  N   AT PI PI SCATT.ANGLE OF 90 DEG.WITHOUT INTERFERENCE WITH NONRES.BACK 12/6*
MO  M       (753.0)                     CLARK     65 SPRK   0 1.5 PI- P        0/66
MO  M   AT PI PI SCATT.ANGLE OF 90 DEG. ALLOWING FOR INTERF.WITH NONRES.BACK 12/6*
MO           763.0                      DERADO    65 DBC    0 4.0 PI- P        6/66
MO  S       (750.0)  (15.0)             GUTAY     65 HBC    0 2.0 PI- P        6/66
MO           768.0    14.0              ACCENSI   66 HBC    0 5.7 PBARP        6/66
MO  R       (750.0)   (5.0)             ALFF-STEI 66 HBC    0 2-3 PI+ P        6/66
MO  S       (751.)    (6.)              BALTAY    66 HBC    0 0.0 PBARP        6/66
MO  P       (728.0)   (8.0)             CAMBRIDGE 66 HBC    0 1.0-6.0 GAMMA P  0/66
MO  S       (773.0)  (12.0)             CASON     66 HBC    0 7.0 PI- P        9/66
MO  R       (775.0)   (5.0)             HAGOPIAN1 66 HBC    0 3.0 PI- P        6/66
MO  R       (770.0)   (5.0)             HAGOPIAN2 66 HBC    0 2.14 PI-P        9/67
MO  R       (770.)    (5.)              HAGOPIAN2 66 HBC    0 2.1 PI-,TCUT 12  2/67
MO  R 7760  (763.3)   (6.0)             JACOBS    66 HBC    0 2-3PI-           6/68*
MO  R 4207  (758.0)   (7.5)             JACOBS    66 HBC    0 2-3PI-,T CUT 20  6/68*
MO  R       (765.0)   (8.0)             JAMES     66 HBC    0 2.1 PI+ P        6/66
MO  R       (760.0)   (3.0)             WEST      66 HBC    0 2.1 PI- P        0/66
MO           765.      5.               ASBURY 2  67 CNTR   0 GAMMA + PB       8/67
MO  B       (764.0)  (11.0)             AUSLANDER 67 SPRK   0 E+E- COLL.BEAMS  0/67
MO  B       AUSLENDER 68 IS UPDATING OF AUSLANDER 67
MO  R       (768.0)   (2.0)             BACON     67 HBC    0 1.7 PI-P         9/67
MO           745.      9.               BARLOW    67 HBC    0 1.2 PBAR P      11/66
MO      327  750.     10.               DANYSZ    67 HBC    0 3.0 PB P,6 PI    7/67
MO  W   184 (755.)    (5.)              DANYSZ    67 HBC    0 3.0 PB P,7 PI    7/67
MO  W     WIDTH UNUSUALLY SMALL, SEE BELOW UNDER WIDTH
MO  O   240 (752.)   (10.)              DANYSZ    67 HBC    0 3.0 PB P,7 PI    6/68*
MO  O     SELECTION ON OMEGA.
MO           781.      3.               EISNER    67 HBC    0 4.2 PI-P         9/67
MO  P       (728.0)   (6.0)             ERBE      67 HBC    0 3.5-5.8 GAMMA P  0/66
MO     1500  774.      3.               ERBE      67 HBC    0 1.4-5.8 GAMMA P  7/67
MO  R       (761.)    (3.)              HUWE      67 HBC    0 2.4 PI- P        7/67
MO  Q       (765.0)   (4.0)             MALAMUD   67 RVUE   0 PI+P,SEE NOTE Q  7/67
MO  Q       (767.0)   (2.0)             MALAMUD   67 RVUE   0 PI-P,SEE NOTE Q  7/67
MO  R       (770.0)   (4.0)             MILLER    67 HBC    0 2.7 PI-,T CUT20  9/66
MO  *       (777.0)   (5.0)             POIRIER   67 HBC    0 8.0 PI- P       11/67
MO           770.0     3.0              ABC COLL. 68 HBC    0 8 PI+P TO P+3PI  5/68*
MO  R       (775.0)   (2.0)             ARMENISE  68 DBC    0 5.1 PI+D         6/68*
MO  *       (762.0)   (7.0)             ARMENISE2 68 DBC    0 9.0 PI+ D        9/68*
MO  S       (760.0)   (6.0)             AUGUSTIN  68 SPRK   0 E+E- COLL.BEAMS  9/68*
MO  S       (754.0)   (9.0)             AUSLENDER 68 SPRK   0 E+E- COLL.BEAMS  6/68*
MO           763.     15.               BLECHSCHM 68 HBC    0 GAMMA P (BREMS)  6/68*
MO           745.0     5.0              DONALD    68 HBC    0 1.2 PB P,4 PR.   9/68*
MO           776.      5.               FOSTER    68 HBC    0 PBAR P AT REST   6/68*
MO           775.0     3.0              HYAMS     68 SPRK   011.2 PI- P        9/68*
MO  S       (765.0)   (6.0)             JONES     68 SPRK   0 12PI-, T LT 2.5  5/68*
MO  S       (745.0)  (13.0)             JONES     68 SPRK   0 18PI-, T LT 2.5  5/68*
MO  S       (760.0)   (9.0)             JONES     68 SPRK   0 18PI-,T2.5 TO 5  5/68*
MO  S       (749.0)   (5.0)             JONES     68 SPRK   0 12PI-,T 5 TO 10  5/68*
MO  S       (761.0)   (6.0)             JONES     68 SPRK   0 18PI-,T 5 TO 10  5/68*
MO  S       (750.0)   (8.0)             JONES     68 SPRK   0 12PI-,T10 TO 15  5/68*
MO  S       (780.0)  (10.0)             JONES     68 SPRK   0 18PI-,T10 TO 15  5/68*
MO  S       (760.0)   (5.0)             KEY       68 HBC    0 3.0 PI- P        5/68*
MO           766.      4.               LAMSA     68 HBC    0 8.0 PI-P        11/67
MO  P       (740.0)  (10.0)             LANZEROTT 68 CNTR   0 GAMMA P(BREMS)   0/66
MO  *       (749.0)   (8.0)             MASON     68 HBC    0 2.5 PBAR P       9/68*
MO  *       (755.0)  (15.0)             MOTT      68 HBC    0 4.1-5.5 K- P     9/68*
MO           . . . . . . . . . . .
MO  AVG      770.7016   3.1213  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.5)

M       240  752.0                      ALITTI    63 HBC   -0 1.6 PI-P
M       290  755.0                      CHADWICK  63 HBC  +-0 0.0 PBAR P
M            744.      9.               FRENCH    67 HBC  +-0 3-4 PBAR P       6/67

M   *   ----------NOTES----------

M   C   FROM CHEW-LOW EXTRAPOLATION
M   P   PHOTOPRODUCTION,UNCORRECTED FOR PRODUCTION E-DEPENDENCE
                                         OR BACKGROUND INTERFERENCE
M   Q   FROM PHASE SHIFT ANALYSIS
M   R   INCLUDED IN PISUT 68 RVUE
M   S   S-WAVE BREIT-WIGNER FIT, CANNOT BE COMBINED WITH OTHER VALUES

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            9  RHO(0) - RHO(+-) MASS DIFFERENCE (MEV)

D            2.4       2.1              PISUT     68 RVUE     PI N TO RHO N    6/68*

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            9  RHO  WIDTH (MEV)

W   *   SEE NOTE ON RHO MASS ABOVE

W+            90.0    10.0              SACLAY    63 HBC  +   2.8 PI+P
W+  R        (77.0)  (20.0)             CARMONY   64 HBC  +   3.5 PI+P,TCUT 4
W+           160.     10.               ARMENISE  65 HBC  +   2.8 PI+P
W+  R       (100.0)                     ALFF-STEI 66 HBC  +   2-3 PI+ P        6/66
W+  R       (177.0)  (15.0)             JAMES     66 HBC  +   2.1 PI+ P        7/66
W+  R       (147.0)  (19.0)             JAMES     66 HBC  +   2.1 PI+,TCUT2.5  8/66
W+           149.0    22.0              ABC COLL. 68 HBC  +   8 PI+P TO P+3PI  5/68*
W+           . . . . . . . . . . .
W+  AVG      127.2472  24.0747  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 3.6)

W+  S       (150.0)  (30.0)             BALTAY    66 HBC  +-  0.0 PBARP        6/66
W+  S       (150.0)  (30.0)             BALTAY    66 HBC  +-  0.0 PBARP        6/66
W+           146.     31.               ALLES-BOR 67 HBC  +-  5.7 PBAR P      12/66
W+           130.     25.               BARLOW    67 HBC  +-  1.2 PBAR P      11/66
W+           145.     10.               FOSTER    68 HBC  +-  PBAR P AT REST   6/68*
W+           . . . . . . . . . . .
W+  AVG      143.1837   8.8944  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

W-  *   130 (125.0)                     GUIRAGOSS 63 HBC  -   3.3 PI-P
W-       98  180.0                      BONDAR    64 HBC  -   4.1 PI-P
W-  R       (127.0)   (5.0)             BLIEDEN   66 MMSP -   3-5 PI- P        6/66
W-  R       (150.0)  (20.0)             HAGOPIAN1 66 HBC  -   3.0 PI- P        6/66
W-  R       (130.0)  (20.0)             HAGOPIAN2 66 HBC  -   2.14 PI-P        9/67
W-  R       (135.0)  (20.0)             HAGOPIAN2 66 HBC  -   2.14 PI-,TCUT12  9/67
W-  R 6014  (139.5)  (15.0)             JACOBS    66 HBC  -   2-3PI-           6/68*
W-  R 2775  (137.1)  (20.0)             JACOBS    66 HBC  -   2-3PI-,T CUT 20  6/68*
W-  R       (149.0)  (13.0)             WEST      66 HBC  -   2.1 PI- P        0/66
W-           100.0    30.0              BANNER    67 MMS  -   1.8 PI-P,  P+MM  9/67
W-  C       (110.0)   (9.0)             BATON     67 HBC  -   2.8 PI- P        0/67
W-           133.     11.               EISNER    67 HBC  -   4.2 PI-P         9/67
W-  R       (137.0)  (17.0)             MILLER    67 HBC  -   2.7 PI-,T CUT 5  9/66
W-  R       (145.0)  (12.0)             MILLER    67 HBC  -   2.7 PI-,T CUT10  9/66
W-  R       (153.0)  (13.0)             MILLER    67 HBC  -   2.7 PI-,T CUT20  9/66
W-  R       (132.0)   (3.0)             BATON     68 HBC  -   2.8 PI- P        4/68*
W-   12773   147.3     4.0      3.9     PISUT     68 RVUE -   1.7-3.2PI-,CT10  6/68*
W-           . . . . . . . . . . .
W-  AVG      144.9760   4.5657  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)

WO  *   190 (150.0)  (20.0)             SAMIOS    62 HBC    0 4.7 PI-P
WO  R   300  (90.0)  (10.0)             ABOLINS   63 HBC    0 3.5 PI+P
WO  *   160 (175.[illegible]                     GUIRAGOSS 63 HBC    0 3.3 PI-P
WO  R    96 (210.0)                     BONDAR    64 HBC    0 4.1 PI-P
WO  R   500 (130.0)                     GOLDHABER 64 HBC    0 3.7 PI+P
WO           110.0    20.0              ALYEA     65 DBC    0 2.2 K- P         6/66
WO           130.0                      CLARK     65 SPRK   0 1.5 PI-P
WO           150.0                      DERADO    65 HBC    0 4.0 PI- P        6/66
WO  S        (80.0)  (15.0)             GUTAY     65 HBC    0 2.0 PI- P        6/66
WO            72.0    30.0              ACCENSI   66 HBC    0 5.7 PBARP        6/66
WO  R       (100.0)                     ALFF-STEI 66 HBC    0 2-3 PI+ P        6/66
WO  S       (174.)   (31.)              BALTAY    66 HBC    0 0.0 PBARP        6/66
WO  P       (175.0)                     CAMBRIDGE 66 HBC    0 5-6 GAM P        9/66
WO  S        (57.0)  (25.0)   (15.0)    CASON     66 HBC    0 7.0 PI- P        9/66
WO  R       (120.0)  (10.0)             HAGOPIAN1 66 HBC    0 3.0 PI- P        6/66
WO  R       (130.0)  (20.0)             HAGOPIAN2 66 HBC    0 2.14 PI-P        9/67
WO  R       (135.0)  (20.0)             HAGOPIAN2 66 HBC    0 2.14 PI-P,LOW T  9/67
WO  R 7760  (136.4)  (12.0)             JACOBS    66 HBC    0 2-3PI-           6/68*
WO  R 4207  (122.2)  (15.0)             JACOBS    66 HBC    0 2-3PI-,T CUT 20  6/68*
WO  R       (103.0)  (13.0)             JAMES     66 HBC    0 2.1 PI+ P        6/66
WO  R       (173.0)  (13.0)             WEST      66 HBC    0 2.1 PI- P        0/66
WO           130.      5.               ASBURY 2  67 CNTR   0 GAMMA + PB       8/67
WO  B        (93.0)  (15.0)             AUSLANDER 67 SPRK   0 E+ E- CCLLID.BM  0/67
WO  B       AUSLENDER 68 IS UPDATING OF AUSLANDER 67
WO  R       (148.0)   (8.0)             BACON     67 HBC    0 1.7 PI-P         9/67
WO            92.     42.               BARLOW    67 HBC    0 1.2 PBAR P      11/66
WO      327  135.     25.               DANYSZ    67 HBC    0 3.0 PB P,6 PI    7/67
WO  W   184  (28.)   (15.)              DANYSZ    67 HBC    0 3.0 PB P,7 PI    7/67
WO  W     WIDTH UNUSUALLY SMALL
WO  O   240  (80.)   (30.)              DANYSZ    67 HBC    0 3.0 PB P,7 PI    6/68*
WO  O     SELECTION ON OMEGA.
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Data in parentheses have not been included in our averages.

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WO             166.      11.               EISNER     67 HBC    0 4.2 PI-P          9/67
WO   R        (152.)    (15.)              HUWE       67 HBC    0 2.4 PI- P         7/67
WO   M        (149.0)    (5.0)             MALAMUD    67 RVUE   0 PI-P              7/67
WO   M        (154.0)    (8.0)             MALAMUD    67 RVUE   0 PI+P              7/67
WO   M        SCHLEIN 68 IS UPDATING OF MALAMUD 67
WO   R        (160.0)   (15.0)             MILLER     67 HBC    0 2.7 PI-,T CUT20   9/66
WO   *        (135.0)   (10.0)             POIRIER    67 HBC    0 8.0 PI- P        11/67
WO             165.0     10.0              ABC COLL.  68 HBC    0 8 PI+P TO P+3PI   5/68*
WO   R        (167.0)    (6.0)             ARMENISE   68 DBC    0 5.1 PI+D          6/68*
WO   *        (170.0)   (10.0)             ARMENISE2  68 DBC    0 9.0 PI+ D         9/68*
WO   S        (112.0)   (12.0)             AUGUSTIN   68 SPRK   0 E+E- COLL.BEAMS
WO   S        (105.0)   (20.0)             AUSLENDER  68 SPRK   0 E+E- COLL.BEAMS   6/68*
WO             126.      20.               BLECHSCHM  68 HBC    0 GAMMA P (BREMS)   6/68*
WO             150.0     13.0              DONALD     68 HBC    0 1.2 PB P,4 PR.    9/68*
WO             132.      10.               FOSTER     68 HBC    0 PBAR P AT REST    6/68*
WO             145.0      9.0              HYAMS      68 SPRK   011.2 PI- P         9/68*
WO   S        (129.0)   (19.0)             JONES      68 SPRK   0 12PI-, T LT 2.5   5/68*
WO   S        (169.0)   (41.0)             JONES      68 SPRK   0 18PI-, T LT 2.5   5/68*
WO   S        (175.0)   (30.0)             JONES      68 SPRK   0 18PI-,T2.5 TO 5   5/68*
WO   S        (157.0)   (16.0)             JONES      68 SPRK   0 12PI-,T 5 TO 10   5/68*
WO   S        (157.0)   (19.0)             JONES      68 SPRK   0 18PI-,T 5 TO 10   5/68*
WO   S        (102.0)   (25.0)             JONES      68 SPRK   0 12PI-,T10 TO 15   5/68*
WO   S        (157.0)   (31.0)             JONES      68 SPRK   0 18PI-,T10 TO 15   5/68*
WO   S        (113.0)   (16.0)             KEY        68 HBC    0 3.0 PI- P         5/68*
WO             111.       8.               LAMSA      68 HBC    0 8.0 PI-P         11/67
WO   S        (160.0)   (10.0)             LANZEROTT  68 CNTR   0 GAMMA P           5/68*
WO   C14890   (105.0)   (15.0)             MARATECK   68 HBC    0 1.9-3.0 PI- P     9/68*
WO   *         (67.0)   (12.0)             MASON      68 HBC    0 2.5 PBAR P        9/68*
WO   *        (120.0)   (10.0)             MCCLELLAN  68 SPRK   010.GAM.C (BREMS)   9/68*
WO   *        (130.0)   (40.0)             MOTT       68 HBC    0 4.1-5.5 K- P      9/68*
WO   Q        (135.0)   (10.0)             SCHLEIN    68 RVUE   01.6,4.,8.PI- P     9/68*
WO             . . . . . . . . . .
WO   AVG       134.8554   5.6920  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.9)

W        290  110.0                        CHADWICK   63 HBC  +-0 0.0 PBAR P
W              98.        30.              FRENCH     67 HBC  +-0 3-4 PBAR P        6/67

W    *   ----------NOTES----------

W    C   FROM CHEW-LOW EXTRAPOLATION
W    P   PHOTOPRODUCTION, UNCORRECTED (SEE NOTE P UNDER RHO MASS)
W    Q   FRCM PHASE SHIFT ANALYSIS
W    R   INCLUDED IN PISUT 68 RVUE
W    S   S-WAVE BREIT-WIGNER FIT, CANNOT BE COMBINED WITH CTHER VALUES

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                  9  RHO PARTIAL DECAY MODES

                                                          DECAY MASSES
P1       RHO INTO 2PI                                   139+ 139
P2       RHO INTO 4PI                                   139+ 139+ 139+ 139
P3       RHO INTO PI GAMMA                              139+   0
P4       RHO INTO E+ E-                                  .5+  .5
P5       RHO INTO PI ETA (VIOLATES G)                   139+ 548
P6       RHO INTO MU+ MU-                               105+ 105

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                  9  RHO BRANCHING RATIOS

R1   *   RHU INTO 4PI/2PI

R1   *   RHO+- INTO (PI+- PI+ PI- PI0) / (PI+- PI0)
R1            0.026 OR LESS          BLIEDEN    66 MMSP  -  3-5 PI- P          6/66
R1            0.01 OR LESS           DEUTSCHMA  66 HBC   +  8.0 PI+ P          6/66
R1            0.002 OR LESS          FERBEL     66 HBC  +- PI+- P ABOVE 2.5    0/66
R1            0.0035   0.004         JAMES      66 HBC   +  2.1 PI+P          11/66

R1   *   RHO 0 INTO  (PI+ PI- PI+ PI-) / (PI+ PI-)
R1            0.008 OR LESS          JAMES      66 HBC    0 2.1 PI+P           6/66
R1            0.0015  OR LESS,CL=0.90 LOHRMANN  67 HBC    0 2.5-5.8 GAMMA P    0/67
R1            0.002 OR LESS          CHUNG      68 HBC    0 3.2,4.2 PI-P       7/67

R2   *   RHO INTO PI GAMMA/2PI
R2   M        0.02 OR LESS           LANZEROTT  65 CNTR     GAMMA P(BREMS)    11/66
R2            0.005 OR LESS          FIDECARC   66 SPRK  -  0.97 CCNF LEV      0/66
R2            0.007 OR LESS          HUSON      66 HLBC  -  15 PI-PB           6/66
R2   M        0.004 OR LESS          ERBE       67 HBC   -  3.5-5.5 GAMMA P    0/66
R2   M      ONE PION EXCHANGE MODEL USED IN THIS ESTIMATION

R3   *   RHO INTO(E+ E-)/(PI+PI-)     (UNITS 10**-4)
R3   P        SEE NOTE P ON LEPTONIC DECAY MODES BELOW
R3       94   0.65      0.14         ASBURY 1   67 CNTR     PHOTOPRCDUCTION    9/67
R3   T        ASBURY 1 HAS MASS RESOLUTION OF +-15 MEV.
R3   B       (0.49)    (0.08)        AUSLANDER  67 SPRK     E+E- COLLID.BEAM   0/67
R3   B        FROM SIGMA(RHO)=1.2+-0.2 MICROBARNS. SEE HEIDELB.CONF. P.353
R3   B      AUSLENDER 68 IS UPDATING OF AUSLANDER 67
R3            0.50      0.10         AUSLENDER  68 SPRK     E+E- COLLID.BEAM   9/68*
R3   H       (0.65)    (1.1)   (0.5) HERTZBACH  67 SPRK ASSUME SU(3)+MIXING    0/66
R3   H        NOT SEPARATED FROM OMEGA DECAY.
R3   K   13  (0.39)    (0.12) (0.39) KHACHATUR  67 SPRK ASSUME SU(3)+MIXING    5/67
R3   K        SUPERSEDED BY ASTVACATUROV 68 BELOW
R3            0.65      0.07         AUGUSTIN   68 SPRK     E+E- COLLID.BEAM   9/68*
R3   A   33  (0.53)    (0.11)        ASTVACATU  68 SPRK ASSUME SU(3)+MIXING    6/68*
R3   A        NOT SEPARATED FROM OMEGA DECAY. ERROR STATISTICAL ONLY.
R3          . . . . . . . . . .
R3   AVG        .6078     .0531  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R4   *    RHO INTO (PI ETA)/(2PI)
R4            0.03 OR LESS           DEUTSCHMA  66 HBC   +    8.0 PI+ P        6/66
R4            0.008  OR LESS         FERBEL     66 HBC  +- PI+- P ABOVE 2.5   11/66

R5   *    RHO INTO (MU+ MU-)/(PI+ PI-) (UN 10**-4)
R5   P        SEE NOTE P ON LEPTONIC DECAY MODES BELOW
R5   D       (0.33)    (0.16)  (0.07) DE PAGTER 66 CNTR   0 5.2 GAM P          6/66
R5   D        DE PAGTER 66 SUPERSEDED BY WEINSTEIN 67 BELCW
R5           14.0 OR LESS            HERTZBACH  67 SPRK     3.0 PI-P          10/66
R5            0.97      0.31    0.33 HYAMS      67 SPRK    11 PI- LI H         6/67
R5   H        HYAMS MASS RESOL. IS 20 MEV. THE OMEGA REGION WAS EXCLUDED.
R5   W       (0.51)    (0.12)        WEHMANN    67 SPRK   0 12 PI- CN C,FE     6/67
R5   W        NOT SEPARATED FROM OMEGA DECAY. CORRECTION ASSUMING SU(3).
R5            0.59      0.15         WEINSTEIN  67 CNTR    PHOTOPROCUCTION     0/67
R5   C        DE PAGTER 66 GIVES MASS RESOL.OF THIS EXPT.AS 35 MEV.
R5          . . . . . . . . . .
R5   AVG        .6585     .1460  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

R    P   ---------- NOTE P ON LEPTONIC DECAY MODES ----------
R    P   IN EXTRACTING THE BRANCHING RATIOS, THE POSSIBILITY OF INTERFERENCE
R    P   WITH LEPTONIC DECAYS OF THE OMEGA HAS TC BE TAKEN INTO ACCOUNT.
R    P   SEE, IN PARTICULAR FOR DATA FROM PHOTOPRODUCED RHCS, DAVIER 68 AND
R    P   PARSONS 68 WHERE CORRECTIONS POSSIBLY AS HIGH AS 60 PERCENT ARE
R    P   SUGGESTED.

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REFERENCES FOR RHO


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ANDERSON 61 PRL 6 365          ANDERSON,BANG,BURKE,CARMONY,SCHMITZ   (LRL)
KENNEY   62 PR 126 736         V P KENNEY,W D SHEPHARD,C D GALL (KENTUCKY)
SAMIOS   62 PRL 9 139          SAMIOS,BACHMAN,LEA+   (BNL+CCNY+COLUM+KENT)
XUONG    62 PR 128 1849        NGUYEN HUU XUONG,GERALD R LYNCH       (LRL)

ABOLINS  63 PRL 11 381         ABOLINS,LANDER,MEHLHOP,NGUYEN,YAGER  (UCSD)
ALITTI   63 NC 29 515          ALITTI,BATON,ARMENISE+(SAC+ORSAY+BARI+BOLO)
CHADWICK 63 PRL 10 62          CHADWICK,DAVIES,DERRICK,CRESTI +  (OXF+PAD)
GUIRAGOS 63 PRL 11 85          ZAVEN GUIRAGOSSIAN                    (LRL)
SACLAY   63 SIENA CONF 1 239   SACLAY+ORSAY+BARI + BOLOGNA(COLLABORA(ION))

BATON    64 NC 35 713          BATON,BERTHELOT,ALLES,BORELLI + (CEN+BOLOG)
BONDAR   64 NC 31 729          BONDAR+ (AACHEN+BIRM+BONN+DESY+IMP-COL+MPI)
CARMONY  64 DUBNA CONF 1 486   CARMONY,HOA,LANDER,NG.H.XUONG,YAGER  (UCSD)
GOLDHABE 64 PRL 12 336         GOLDHABER,BROWN,KADYK,SHEN,TRILLING(LRL+UC)

ALYEA    65 PL 15 82           ALYEA,CRITTENDEN,MARTIN,RHODE +   (INDIANA)
ARMENISE 65 NC 37 361          SACLAY+ORSAY+BARI+BOLOGNA (COLLAB(RATION ))
BLIEDEN  65 PL 19 444          CERN MISSING MASS SPECTROMETER GROUP (CERN)
CLARK    65 PR 139 B 1556      A CLARK,CHRISTENSON,CRONIN,TURLAY(PRINCETO)
DERADO   65 PRL 14 872         DERADO,KENNEY,POIRIER,SHEPHARD (NOTRE DAME)
GUTAY    65 NC 39 381          GUTAY,LANNUTTI,TULI               (FLCRIDA)
LANZEROT 65 PRL 15 210         LANZEROTTI,BLUMENTHAL,EHN,FAISSLER +(HARVD)
WOLF     65 PL 19 328          G WOLF                 (             DESY)
ZDANIS   65 PRL 14 721         ZDANIS,MADANSKY,KRAEMER +         (JHU+BNL)

ACCENSI  66 PL 20 557          ACCENSI,ALLES-BORELLI,FRENCH,FRISK+  (CERN)
ALFF-STE 66 PR 145 1072        ALFF-STEINBERGER,BERLEY,BRUGGER+ (COL+RUTG)
BALTAY   66 PR 145 1103        +FRANZINI,LUTJENS,SEVERINS,TYCKO+(COLUMBIA)
BLIEDEN  66 NC 43 71           CERN MISSING MASS SPECTROMETER GROUP (CERN)
CAMBRIDG 66 PR  146  994       CAMBRIDGE BUBBLE CHAMBER GRCUP  (MIT+HARV+)
CASON    66 PR  148  1282      N M CASON                       (WISCONSIN)
DE PAGTE 66 PRL 16 35          DE PAGTER+ (CAM EL ACC+MIT+NORTHEAST+ SLAC)
DEUTSCHM 66 PL 20 82           DEUTSCHMANN,STEINBERG + (AACH+BERLIN+ CERN)
FERBEL   66 PL 21 111          FERBEL                          (ROCHESTER)
FIDECARO 66 PL  23  163        G+M FIDECARO,J POIRIER,P SCHIAVON    (CERN)
HAGOPIA1 66 PR 145 1128        HAGOPIAN,SELOVE,ALITTI,BATCN+ (PENN+SACLAY)
HAGOPIA2 66 PR  152  1183      HAGOPIAN,PAN    (PENNSYLVANIA,LRL-BERKELEY)
HUSON    66 PL 20 91           HUSON,ALLARD,DRIJARD,HENNESSY +  (ORSAY+EP)
JACOBS   66 UCRL-16877         L.D.JACOBS                            (LRL)
JAMES    66 PR 142 896         F E JAMES,KRAYBILL        (YALE+BROOKHAVEN)
WEST     66 PR 149 1089        WEST,BOYD,ERWIN,WALKER          (WISCCNSIN)

ALLES-BO 67 NC 50 A 776        ALLES-BORELLI,FRENCH,FRISK,+    (CERN+BONN)
ASBURY 1 67 PRL 19 869         +BECKER+BERTRAM+JOOS+JORDAN+TING+(DESY+COL)
ASBURY 2 67 PRL 19 865         +BECKER+BERTRAM+JOOS+JORDAN+TING+(DESY+COL)
AUSLANDE 67 PL 25 B 433        AUSLANDER,BUDKER,PESTOV,SIDOROV+(NOVOSIBIR)
BACON    67 PR 157 1263        +FICKINGER,HILL,HOPKINS,ROBINSON+     (BNL)
BANNER   67 PL   25 B  300     +FAYOUX,HAMEL,ZSEMBERY,CHEZE+ (SACLAY+CAEN)
BARLOW   67 NC 50A 701         +LILLESTOL+MONTANET+(CERN+CDF+IR+LIVERPOOL)
BATON    67 PL 25 B 419        J.BATON,G.LAURENS,J.REIGNIER       (SACLAY)
    ALSO 67 NP B 3  349        J.BATON,G.LAURENS,J.REIGNIER       (SACLAY)
CLEAR    67 NC 49A 399         +JOHNSTON+COOPER+MANNER+WALKER+(TO+ANL+WIS)
DANYSZ   67 NC 51 A 801        DANYSZ+FRENCH+SIMAK          (         CERN)
EISNER   67 PR 164 1699        +JOHNSON+KLEIN+PETERS+SAHNI+YEN+   (PURDUE)
ERBE     67 NC 48A 262         +BOTTCHER+MOEBES+HARIGEL+LUKE+    (ABBDHHM)
FRENCH   67 NC 52A 442         +KINSON+MCDONALD+RIDDIFORD+     (CERN+BIRM)
HERTZBAC 67 PR 155  1461       HERTZBACH,KRAEMER,MADANSKI,ZDANIS+(JHU+BNL)
   (SEE ALSO ZDANIS 65)
HUWE     67 PL 24B 252         +MARQUIT+OPPENHEIMER+SCHULTZ+WILSON   (COL)
HYAMS    67 PL 24B 634         +KOCH+PELLETT+POTTER+VONLINCERN+ (CERN+MUN)
KHACHATU 67 PL 24B 349         KHACHATURYAN+AZIMOV+BALDIN+BELOUSOV+(DUBNA)
LOHRMANN 67  SLAC SYMP.P. 199  +HILPERT+ (AACH+BERL+BONN+HAMB+HEID+MUNICH)
MALAMUD  67 PRL 19 1056        E.MALAMUD+P.E.SCHLEIN                (UCLA)
MILLER   67 PR 153 1423        MILLER,GUTAY,JOHNSON,LOEFFLER +    (PURDUE)
POIRIER  67 PR 163 1462        +BISWAS,CASON,DERADO,KENNEY+ (NOTRDAM+PENN)
WEHMANN  67 PRL 18 929         +ENGELS+     (HARVARD+CWRU+SLAC+CORN+MCGILL)
WEINSTEI 67 SLAC SYMPOS.P.424  R.WEINSTEIN,RAP.TALK      (CEA+NORTHEASTERN)

ABC COLL 68 NP B4 501                   (AACHEN+BERLIN+CERN COLLABORATION)
ARMENISE 68 NC 54A 999         +GHIDINI,FORINO+ (BARI+BOLOGN+FIRENZ+CRSAY)
ARMENIS2 68  VIENNA ABS.  412  ARMENISE,FORINO,CARTACCI+  (BARI+BGNA+FIRZ)
ASTVACAT 68 PL 27 B  45        ASTVACATUROV,AZIMOV,BALDIN+    (JINR+MCSCOW)
AUGUSTIN 68 PRL 20 126         +BIZOT+BUON+HAISSINSKI+LALANNE+     (ORSAY)
    ALSO 68  VIENNA CONF.      S. TING, RAPPORTEUR'S TALK          (CRSAY)
AUSLENDE 68  NOVOSIB.PRE. 243  AUSLENDER,BUDKER,PAHTUSOVA,PESTOV+   (NOVO)
   (SEE ALSO AUSLANDER 67)
BATON    68 PL   26B  471      J.P. BATON, G. LAURENS             (SACLAY)
BLECHSCH 68 NC   53 A  1045    BLECHSCHMIDT,DOWD,ELSNER,+     (DESY+MANCH)
  (SEE ALSO NC  52 A  1348 )
CHUNG    68 PR 165 1491        S.U.CHUNG,O.I.DAHL,J.KIRZ,D.H.MILLER  (LRL)
DAVIER   68 PL   27 B  27      M. DAVIER                            (SLAC)
DONALD   68 NP B 6 174         +EDWARDS,FRODESEN,BETTINI+ (LIVP+OSLO+PADO)
FOSTER   68 NP B 6 107         +GAVILLET+LABROSSE+MONTANET+  (CERN+PARIS)
HYAMS    68 NP B 7 1           +KOCH,POTTER,WILSON,VON LINDERN+(CERN+MPIM)
JONES    68 PR 166 1405        +BLEULER,CALDWELL,ELSNER,HARTING+    (CERN)
KEY      68 PR 166 1430        +PRENTICE+COOPER+MANNER+WALKER+(TO+ANL+WIS)
LAMSA    68 PR 166 1395        +CASON+BISWAS+DERADO+GROVES+    (NOTREDAME)
LANZEROT 68 PR 166 1365        LANZEROTTI,BLUMENTHAL,EHN,FAISSLER +(HARVD)
MARATECK 68  VIENNA ABS.  803  +HAGOPIAN,SELOVE             (         PENN)
MASON    68  VIENNA ABS.  275  +MUIRHEAD,POPPLETON,RIGOPOULOS+ (LIVP+ATEN)
MCCLELLA 68  VIENNA ABS.    3  MCCLELLAN,MISTRY,MOSTEK+  (CORNELL+LEBEDEV)
MOTT     68  VIENNA ABS.  351  +AMMAR,DAVIS,KROPAC,SLATE,DAGAN+ (NWES+ANL)
PARSONS  68 PRL  20  1314      RONALD E. PARSONS, ROY WEINSTEIN(NORTHEAST)
PISUT    68 NP B 6 325         J.PISUT,M.ROOS                       (CERN)
SCHLEIN  68  UCLA-1029         PETER E. SCHLEIN             (         UCLA)
   (SEE ALSO MALAMUD 67)
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ω(783)

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1  OMEGA (783,JPG=1--)  I=0

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1  OMEGA  MASS (MEV)

M        400  782.0      1.0         ALFF       62 HBC     2.3-2.9 PI+P
M         64  779.4      1.4         ARMENTERO  62 HBC     0.0 PBAR P
M        650  782.0                  MURRAY     63 HBC     1.5 K-P
M         34  784.0      1.0         ARMENTERC  63 HBC     0.0 PBAR P
M        220  781.0      2.0         KRAEMER    64 DBC     1.2 PI+C
M             785.6      1.2         MILLER D   65 HBC    SEEN WITH K+K-
M    M       (780.8)    (2.0)        MILLER D   65 HBC    SEEN WITH K1 K1      8/66
M    M        DATA INCLUDED IN BARASH 67 BELOW
M        666  786.0      1.0         JAMES      66 HBC     2.1 PI+P            6/66
M       2198  783.4      0.7         BALTAY     67 HBC    0.0 PBAR P           9/66
M        155  779.5      1.5         BARASH     67 HBC    0 PBAR TC K1K1OM    11/66
M    *       (784.0)    (1.0)        BLUMENFEL  68 HBC     3.9 PI- P           9/68*
M    *       (782.3)    (0.5)        DIAZ       68 HBC     0.0 PB P            9/68*
M    *       (783.7)    (1.0)        DONALD     68 HBC     1.2 PB P            9/68*
M             784.8      1.1         KEY        68 HBC     3 PI-P             11/67
M             . . . . . . . . . .
M    AVG      783.4142    .6998  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.0)
                        (SEE IDEOGRAM BELOW )
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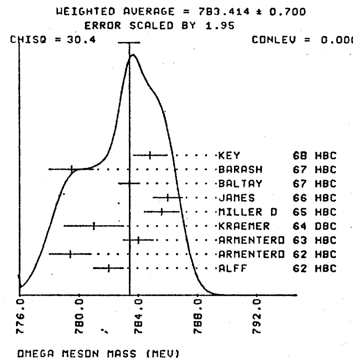
MESON RESONANCES

Data in parentheses have not been included in our averages.

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                  I  OMEGA FULL WIDTH (MEV)

W        34   9.0 .     3.0           ARMENTERC 63 HBC      0.0 PBAR P
W             13.4      2.0           MILLER D  65 HBC    SEEN WITH K+ K-
W    M       (11.6)    (3.0)          MILLER D  65 HBC     SEEN WITH K1 K1   .8/66
W    M        DATA INCLUDED IN BARASH 67 BELOW
W       666   20.0    OR LESS         JAMES     66 HBC      2.1 PI+P          6/66
W       155   12.3      2.0           BARASH    67 HBC     SEEN WITH K1 K1    6/66
W             14.0      2.4           AUGUSTIN  68 SPRK    E+ E- CCLL.BEAMS   9/68*
W             . . . . . . . . .
W    AVG      12.5593   1.1289  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                  I  OMEGA PARTIAL DECAY MODES

                                                           DECAY MASSES
P1        OMEGA INTO PI+ PI- PIO                           139+ 139+ 134
P2        OMEGA INTO PI+ PI- (VIOLATES G)                  139+ 139
P3        OMEGA INTO PI+ PI- GAMMA                         139+ 139+   0
P4        CMEGA INTO PIO GAMMA                             134+   0
P5        OMEGA INTO 2PIO GAMMA                            134+ 134+   0
P6        OMEGA INTO MU+ MU-                               105+ 105
P7        OMEGA INTO E+ E-                                  .5+  .5
P8        CMEGA INTO ETA GAMMA                             548+   0
P9        OMEGA INTO ETA PIO (VIOLATES C)                  548+ 134
P10       OMEGA INTO 3 GAMMA                                 0+   0+   0
P11       OMEGA INTO PIO MU+ MU-                           134+ 105+ 105

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                  I  OMEGA BRANCHING RATIOS

R1   *  OMEGA INTO NEUTRAL/(PI+ PI- PIO)
R1            0.17      0.04              ARMENTERC 63 HBC      0.0 PBAR P
R1      20    0.11      0.02              BUSCHBECK 63 HBC      1.5 K-P
R1      35    0.08      0.03              KRAEMER   64 DBC      1.2 PI+D
R1   *       (0.13)    (0.035)            MILLER D  65 HBC
R1      65    0.10      0.04              ALFF-STEI 66 HBC CCRR.BY SCHULTZ(COL)  9/66
R1     850    0.134     0.026             DIGIUGNO  66 CNTR     1.4 PI-P         9/66
R1     348    0.097     0.016             FLATTE    66 HBC      1.8 K-P          9/66
R1            0.06      0.05      0.02    JAMES     66 HBC      2.1 PI+P         6/66
R1      19    0.10      0.03              BARASH    67 HBC      0.0 PBAR P       7/67
R1          . . . . . . . . .
R1   AVG       .1043     .0091  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R2   *  OMEGA INTO (PI+ PI-)/(PI+ PI- PIO)
R2            0.010 OR LESS               BUTTON    62 HBC      1.6 PBAR P
R2            0.07                        ALITTI    63 HBC      1.6 PI-P
R2            0.05 OR LESS                ARMENTERO 63 HBC      0.0 PBAR P
R2     100    0.05 OR GREATER             FICKINGER 63 HBC      1.7 PI-P
R2            0.05 OR LESS                KRAEMER   64 DBC      1.2 PI+D
R2   *        0.005 OR LESS               LUTJENS   64 RVUE NC INTERFERENCE
R2            0.018     0.012     0.006   WALKER    64 RVUE     2.1 PI-P
R2            0.04 OR GREATER             BATON     65 HBC      2.8 PI-P
R2            0.010 OR LESS               CLARK     65 SPRK     1.5 PI-P         6/66
R2            0.035 OR LESS               MILLER D  65 HBC
R2            0.02 OR LESS                ALFF-STEI 66 HBC      2.9 PI+P        11/66
R2   *       (0.082)   (0.020)            FLATTE    66 HBC  NO INTERFERENCE      9/66
R2            0.029     0.011     0.009   FLATTE    66 HBC  INTERFERENCE         9/66
R2   *   NOT ESTABLISHED WHETHER ANY PI+PI- SIGNAL HAS I=0,SEE PISUT 68.
R2          . . . . . . . . .
R2   AVG       .0229     .0067  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R3   *  OMEGA INTO (PIO GAMMA) / (PI+ PI- PIO)
R3   *        0.125     0.025 OR GRTR.    BARMIN    64 PXBC     2.8 PI-P
R3   N  13   (0.15)    (0.06)             BAGLIN    66 HLBC     2.1 PI+P         9/66
R3   N        BAGLIN 66 SUPERSEDED BY JACQUET 67 BELOW                           0/67
R3            0.13      0.04              JACQUET   67 HLBC                      0/67

R4   *  OMEGA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)
R4            0.05    OR LESS             FLATTE    66 HBC      1.8 K-P          9/66

R6   *  OMEGA INTO (MU+ MU-)/(PI+ PI- PIO)(UNITS 10**-3)
R6            1.2     OR LESS             GALTIERI  65 HBC      2.7 K-P
R6            1.7 OR LESS                 FLATTE    66 HBC      1.8 K-P          9/66

R7   *  CMEGA INTO (2PIO GAMM)/(PIO GAMMA)
R7            0.1     OR LESS             BARMIN    64 PXBC     1.3-2.8 PI-P

R8   *  OMEGA INTO(ETA PIO +ETA GAM)/(PI+PI-PIO)
R8            0.017  OR LESS              FLATTE    66 HBC      1.8 K-P          9/66
R8            0.026 OR LESS               JACQUET   67 HLBC    CL=0.90           0/67

R9   *  OMEGA INTO (NEUTRALS) / (CHARGED)
R9            0.124     0.021             FELDMAN   67 SPRK     1.2 PI- P        3/67

R10  *  CMEGA INTO (2PIO GAMMA)/(PI+PI-PIO)
R10  *        0.1     OR LESS             JACQUET   67 HLBC    CL=0.90           0/67

R11  *  OMEGA INTO (3 GAMMA)/(PIO GAMMA)
R11  *        0.35    OR LESS             KANAREK   67 XEBC     2.34 PI+N       11/67

R12  *  CMEGA INTO (PIO MU+ MU-) / TOTAL  (UNITS 10**-3)
R12           2.      OR LESS             WEHMANN   68 SPRK    12 PI- FE         6/68*

R13  *  OMEGA INTO (E+ E-)/TOTAL   (UNITS 10**-4)
R13      3    2.        1.2               BINNIE    65 SPRK    PI-P NEAR THLD.  6/66
R13  B        MASS RESOLUTION OF BINNIE 65 IS ABOUT 15 MEV.
R13  H       (1.0)     (1.7)     (0.75)   HERTZBACH 67 SPRK ASSUME SU(3)+MIXING  0/66
R13  H        NOT RESOLVED  FROM RHO DECAY.
R13  K  13   (0.48)    (0.15)    (0.48)   KHACHATUR 67 SPRK ASSUME SU(3)+MIXING  5/67
R13  K        SUPERSEDED BY ASTVACATUROV 68 BELOW
R13  A  33   (0.65)    (0.13)             ASTVACATU 68 SPRK ASSUME SU(3)+MIXING  6/68*
R13  A        NOT RESOLVED  FROM  RHO  DECAY. ERROR STATISTICAL ONLY.
R13           0.85      0.16              AUGUSTIN  68 SPRK    E+ E- COLL.BEAMS  9/68*
R13           0.40      0.15              BOLLINI 1 68 CNTR    1.7PI-P,NOTE Z    9/68*
R13  Z        MASS RESOLUTION OF BOLLINI 1 IS +-10 MEV. ABOVE NUMBER IS
R13  Z        WITHOUT RHO-OMEGA INTERFERENCE. COMPLETE INTERFERENCE WOULD
R13  Z        CHANGE IT BY +-35 PER CENT.
R13         . . . . . . . . .
R13  AVG       .6220     .2239  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.1)
                     (SEE IDEOGRAM BELOW )
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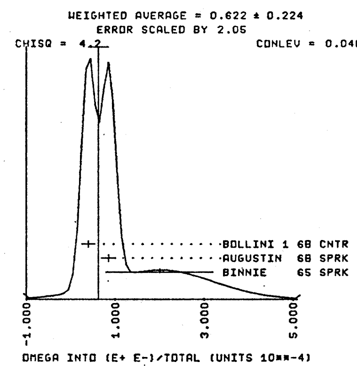


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R14  *  CMEGA INTO NEUTRALS / TOTAL
R14           0.084     0.015             BOLLINI   68 CNTR    2.1 PI- P         6/68*

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                         REFERENCES FOR OMEGA

MAGLIC    61 PRL 7 178            B MAGLIC,ALVAREZ,ROSENFELD,STEVENSON  (LRL)
PEVSNER   61 PRL 7 421            PEVSNER,KRAEMER,NUSSBAUM,RICHARD+  (JHU+NW)
XUONG     61 PRL 7 327            NGUYEN HUU XUONG,GERALD R LYNCH        (LRL)

ALFF      62 PRL 9 325            ALFF,BERLEY,COLLEY,GELFAND + (COLU+RUTGERS)
ARMENTER  62 CERN CONF 90         R ARMENTEROS,R BUDDE +    (CERN+COLL+FRANCE)
BUTTON    62 PR 126 1858          BUTTON,KALBFLEISCH,LYNCH,MAGLIC +      (LRL)
STEVENSO  62 PR 125 687           STEVENSON,ALVAREZ,MAGLIC,RCSENFELD     (LRL)

ALITTI    63 NC 29 515            ALITTI,BATON,BERTHELOT+ (LPCHE+PAR+BARI+BO)
ARMENTER  63 SIENA CONF 1 296     ARMENTEROS,EDWARDS,JACOBSEN+   (CERN+PARIS)
BARMIN    63 SIENA CONF 1 207     BARMIN,DOLGOLENKO,KRESTNIKCV+         (ITEP)
BERTHELO  63 SIENA CONF 2 60      A BERTHELOT                    (CEN-SACLAY)
BUSCHBEC  63 SIENA CONF 1 166     BUSCHBECK,CZAPP+     (VIENNA+CERN+AMSTERDAM)
FICKINGE  63 PRL 10 457           W J FICKINGER,D K ROBINSON,E SALANT   (BNL)
GELFAND   63 PRL 11 436           GELFAND,MILLER,NUSSBAUM,RATAU+ (COLUM+RUTG)
MURRAY    63 PL 7 358             MURRAY,FERROLUZZI,HUWE,SHAFER,SOLMITZ+(LRL)

BARMIN    64 JETP 18 1289         BARMIN,DOLGOLENKO,KRESTNIKOV +        (ITEP)
BEZAGUET  64 PL 12 70             BEZAGUET,NGUYEN KHAC,ROUSSET+ (PAR+BERG+LO)
KRAEMER   64 PR 136 B 496         KRAEMER,MADANSKY,MEER,FIELDS+ (JHU+NW+WOOD)
LUTJENS   64 PRL 12 517           G LUTJENS,J STEINBERGER           (COLUMBIA)
WALKER    64 PL 8 208             WALKER,BOYD,ERWIN,SATTERBLOM +  (WISCONSIN)

BATON     65 NC 35 713            BATON,BERTHELOT,DELER,BENEDETTI+(SAC+BOLOG)
BINNIE    65 PL 18 348            BINNIE,DUANE,JANE,W JONES+ (IC-LOND+MANCHS)
CLARK     65 PR 139 B 1556        CLARK,CHRISTENSON,CRCNIN,TURLAY (PRINCETON)
GALTIERI  65 PRL 14 279           A BARBARO GALTIERI,R D TRIPP           (LRL)
MILLER D  65 CU-237(NEVIS 131)    DAVID C MILLER  (THESIS)          (COLUMBIA)
   MILLER 65 INCLUDES DATA OF     GELFAND 63 ABOVE
ZDANIS    65 PRL 14 721           ZDANIS,MADANSKY,KRAEMER,HERTZBACH+(JHU+BNL)

ALFF-STE  66 PR 145 1072          ALFF-STEINBERGER,BERLEY,BRUGGER+ (COL+RUTG)
BAGLIN    66 PL  23  286          +BEZAGUET,DEGRANGE,HAATUFT +     (EP+BERGEN)
DIGIUGNO  66 NC 44A 1272          DI GIUGNO,PERUZZI,TROISE+  (NAPL+FRAS+TRST)
FLATTE    66 PR  145  1050        +HUWE,MURRAY,BUTTON-SHAFER,SOLMITZ+   (LRL)
JAMES     66 PR 142 896           F E JAMES,KRAYBILL        (YALE+BROOKHAVEN)

BALTAY    67 PRL  18  93          +FRANZINI,SEVERIENS,YEH,ZANELLO  (COLUMBIA)
BARASH    67 PR  156  1399        BARASH,KIRSCH,MILLER,TAN         (COLUMBIA)
FELDMAN   67 PR 159 1219          +FRATI,GLEESON,HALPERN,NUSSBAUM+    (PENNA)
HERTZBAC  67 PR 155, 1461         HERTZBACH,KRAEMER,MADANSKI,ZDANIS+(JHU+BNL)
   (SEE ALSO ZDANIS 65)
JACQUET   67 HEIDBG CONF P.364 +NGUYEN-KHAC,BAGLIN,HAATUFT+    (EPP+BERGEN)
KANAREK   67 YADERN.FIZ.6 786  +LOSKEVICH,MARTYNOV,NICHIPCRUK+      (DUBNA)
KHACHATU  67 PL 24B 349           KHACHATURYAN+AZIMOV+BALDIN+BELOUSOV+(DUBNA)

ASTVACAT  68 PL 27 B  45          ASTVACATUROV,AZIMOV,BALDIN+   (JINR+MOSCOW)
AUGUSTIN  68  VIENNA CONF.        +LEFRANCOIS, LEHMANN, MARIN, +     (CRSAY)
   (SEE S. TING, RAPPORTEURS TALK, DESY F31/4)
BLUMENFE  68  VIENNA ABS.  272 BLUMENFELD,BRUYANT,ABRAMOVITCH+ (CERN+SACL)
BOLLINI   68 NC 56 A 531          +BUHLER,DALPIAZ,MASSAM+    (CERN+BGNA+STRB)
BOLLINI1  68 NC 57 A 404          +BUHLER,DALPIAZ,MASSAM+    (CERN+BGNA+STRB)
DIAZ      68  VIENNA ABS.  676 +GAVILLET,FOSTER,HOLTHUIZEN+    (CERN+CDEF)
DONALD    68  VIENNA ABS.  323 +EDWARDS,BURAN,BETTINI+     (LIVP+OSLO+PADO)
KEY       68 PR 166 1430          +PRENTICE+COOPER+MANNER+WALKER+(TO+ANL+WIS)
PISUT     68 NP B 6 325           J.PISUT,M.ROOS                        (CERN)
WEHMANN   68 PRL 20 748           +ENGELS+ (HARVARD+CASE+SLAC+CORNELL+MCGILL)
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Data in parentheses have not been included in our averages.

η' (958)

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                2   ETA PRIME (958,JPG=0-+)  I=0

                    KNOWN ALSO AS XO
                    (JP = 2- NOT YET EXCLUDED,)
                    (SEE NOTE ON QUANTUM NUMBERS AT END OF LISTING)

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                2   ETA PRIME MASS (MEV)

M      85  957.0                        DAUBER    64 HBC     1.95 K-P
M          958.0      1.0               KALBFLEIS 64 HBC     2.7 K-P        6/66
M          957.0      3.0               BADIER    65 HBC     3.0 K-P
M       8  960.0      2.0               TRILLING  65 HBC     3.65 PI+ P     9/66
M       7  955.0     10.0               COHN      66 DBC     3.3 PI+C       6/66
M          959.0      3.0               LONDON    66 HBC     2.2 K-P        6/66
M   *     (960.0)    (5.0)              MOTT      68 HBC     4.1-5.5 K- P   9/68*
M         . . . . . . . . .
M   AVG    958.3171   .8214  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                2   ETA PRIME WIDTH (MEV)

W      85    4.0 OR LESS                DAUBER    64 HBC     1.95 K-P
W            7.0 OR LESS                KALBFLEIS 64 HBC     2.7 K-P        6/66
W           30.0 OR LESS                BADIER    65 HBC     3.0 K-P
W           15.0 OR LESS                LONDON    66 HBC     2.2 K-P        6/66

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                2   ETA PRIME PARTIAL DECAY MODES

                                                             DECAY MASSES
P1          ETA PRIME INTO  PI+ PI- ETA                      139+ 139+ 548
                 P1(N)  ETAS DECAY INTO ALL NEUTRALS
                 P1(C)  ETAS DECAY CHARGED
P2          ETA PRIME INTO  PIO PIO ETA                      134+ 134+ 548
                 P2(N)  ETAS DECAY INTO ALL NEUTRALS
                 P2(C)  ETAS DECAY CHARGED
P3          ETA PRIME INTO  PI+ PI- GAMMA                    139+ 139+   0
                 (INCLUDING RHOO GAMMA)
P3          ETA PRIME INTO  GAMMA GAMMA                        0+   0
P6          ETA PRIME INTO  RHOO GAMMA                         0+ 770
P10         ETA PRIME INTO  PI+ PI- E+ E-                    139+ 139+  .5+  .5
P11         ETA PRIME INTO  2 PI                             139+ 139
P12         ETA PRIME INTO  3 PI                             139+ 139+ 134
P13         ETA PRIME INTO  4 PI                             139+ 139+ 139+ 139
P14         ETA PRIME INTO  6 PI                             139+ 139+ 139+ 139
P15         ETA PRIME INTO  PIO GAMMA GAMMA                  134+   0+   0
P16         ETA PRIME INTO  PIO E+ E- (VIOLATES C IN         134+  .5+  .5
                                       BORN APPROX.)
P17         ETA PRIME INTO  ETA E+ E- (VIOLATES C IN         548+  .5+  .5
                                       BORN APPROX.)
P18         ETA PRIME INTO  PIO RHO 0 (VIOLATES C)           134+ 770
P19         ETA PRIME INTO  PIO OMEGA (VIOLATES C)           134+ 783

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In our previous calculation of the constrained branching fractions of the $\eta'(958)$ [RMP 40, 77 (1968), see note on η', p. 100], we assumed the following decay modes to exist:

(1) $\eta\pi\pi$ (including $\eta\pi^0\pi^0$, 71% of the η's neutral).

(2) $\pi^+\pi^-\gamma$ (including $\rho^0\gamma$).

(3) Other neutrals, not yet identified.

Since the $\gamma\gamma$ mode now appears to have been directly observed, we redetermine the branching fractions under the assumption that category (3) above consists entirely of $\gamma\gamma$ decays. Note that the $\gamma\gamma$ value measured by BOLLINI 68 ($5.5\ {}^{+3.6}_{-3.0}\ \%$) is slightly different from the result of the overall fit ($6.1 \pm 3.1\%$) because of independent measurements of $\eta' \to$ all neutrals/$\eta' \to$ total. In the fit we do not use the constraint $R = \Gamma(\eta' \to \eta\pi^+\pi^-)/\Gamma(\eta' \to \eta\pi^0\pi^0) = 2$ from I-spin conservation. The result of the fit is in reasonable agreement with it, $R = 1.61 \pm 0.32$.

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                2   ETA PRIME BRANCHING RATIOS

R1   *      ETA PRIME INTO (PI+ PI- ETA (NEUTRAL DEC.))/TOTAL
R1      68   0.36     0.05            KALBFLEIS 64 HBC     2.7 K-P        0/66
R1          . . . . . . . . .
R1   FIT      .308     .025    VALUE FROM CONSTRAINED FIT

R2   *      ETA PRIME INTO (PI+ PI- NEUTRALS, EXCLUDING
R2   *            PI+ PI- GAMMA)/TOTAL
R2      33   0.35     0.06            BADIER    65 HBC     3.0 K-P        0/66
R2      39   0.4      0.1             LONDON    66 HBC     2.2 K-P        0/66
R2          . . . . . . . . .
R2   AVG      .3632    .0514  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R2   FIT      .389     .020    VALUE FROM CONSTRAINED FIT

R3   *      ETA PRIME INTO (PI+ PI- ETA (CHRGD.DECAY))/TOTAL
R3      44   0.12     0.02            KALBFLEIS 64 HBC     2.7 K-P        0/66
R3       7   0.07     0.04            BADIER    65 HBC     3.0 K-P        0/66
R3      10   0.1      0.04            LONDON    66 HBC     2.2 K-P        0/66
R3          . . . . . . . . .
R3   AVG      .1083    .0163  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R3   FIT      .125     .010    VALUE FROM CONSTRAINED FIT

R4   *      ETA PRIME INTO (PI+ PI- NEUTRALS, EXCLUDING PI+ PI- ETA
R4   *               AND PI+ PI- GAMMA)/TOTAL
R4      10   0.05     0.04            KALBFLEIS 64 HBC     2.7 K-P        0/66
R4          . . . . . . . . .
R4   FIT      .082     .015    VALUE FROM CONSTRAINED FIT

R5   *      ETA PRIME INTO (NEUTRALS) / TOTAL
R5      54   0.25     0.05            KALBFLEIS 64 HBC     2.7 K-P        0/66
R5      16   0.24     0.17            BADIER    65 HBC     3.0 K-P        0/66
R5      32   0.3      0.1             LONDON    66 HBC     2.2 K-P        0/66
R5          . . . . . . . . .
R5   AVG      .2587    .0432  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R5   FIT      .263     .029    VALUE FROM CONSTRAINED FIT

R6   *      ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING RHO GAMMA))/TOTAL
R6      42   0.22     0.04            KALBFLEIS 64 HBC     2.7 K-P        0/66
R6   B  35  (0.34)   (0.09)           BADIER    65 HBC     3.0 K-P        0/66
R6   B      CONTROVERSIAL BACKGROUND SUBTRACTION
R6      20   0.2      0.1             LONDON    66 HBC     2.2 K-P        0/66
R6          . . . . . . . . .
R6   AVG      .2172    .0371  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R6   FIT      .223     .028    VALUE FROM CONSTRAINED FIT

R7   *      ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING RHO GAMMA))/(PI PI ETA)
R7           0.25     0.14            DAUBER    64 HBC     1.95 K-P       0/66
R7          . . . . . . . . .
R7   FIT      .312     .051    VALUE FROM CONSTRAINED FIT

R8   *      ETA PRIME INTO (PIO E+ E-)/TOTAL
R8           0.013  OR LESS           RITTENBER 65 HBC          2.7 K-P   0/66

R9   *      ETA PRIME INTO (ETA E+ E-)/TOTAL
R9           0.011  OR LESS           RITTENBER 65 HBC          2.7 K-P   0/66

R10  *      ETA PRIME INTO (PIO RHOO)/TOTAL
R10          0.04   OR LESS           RITTENBER 65 HBC          2.7 K-P   0/66

R11  *      ETA PRIME INTO (PIO OMEGA) /TOTAL
R11          0.08   OR LESS           RITTENBER 65 HBC          2.7 K-P   0/66

R12  *      ETA PRIME INTO (PI+ PI- E+ E-)/TOTAL
R12          0.006  OR LESS           RITTENBER 65 HBC          2.7 K-P   0/66

R13  *      ETA PRIME INTO (2 PI)/TOTAL
R13          0.07   OR LESS  COMP.BY LONDON    66 HBC                     0/66

R14  *      ETA PRIME INTO (3 PI)/TOTAL
R14          0.07   OR LESS  COMP.BY LONDON    66 HBC                     0/66

R15  *      ETA PRIME INTO (4 PI)/TOTAL
R15          0.01   OR LESS  COMP.BY LONDON    66 HBC                     0/66

R16  *      ETA PRIME INTO (6 PI)/TOTAL
R16          0.01   OR LESS  COMP.BY LONDON    66 HBC                     0/66

R17  *      ETA PRIME INTO (PIO GAMMA GAMMA) / TOTAL
R17  *   21 (POSSIBLY SEEN (PRELIM.))  STRÚGALSK 67 HLBC   2.3 PI+ N      7/67

R18  *      ETA PRIME INTO (RHOO GAMMA)/(PI PI ETA)
R18          0.31     0.15            DAVIS     68 HBC     5.5 K- P       9/68*
R18         . . . . . . . . .
R18  FIT      .312     .051    VALUE FROM CONSTRAINED FIT

R19  *      ETA PRIME INTO (2 GAMMA)/TOTAL
R19  *      (0.03)   (0.05)           AZIMOV    68 SPRK    4.0 PI- P      9/68*
R19      5   0.055    0.036    0.030 BOLLINI   68 CNTR    1.9 PI- P      9/68*
R19         . . . . . . . . .
R19  FIT      .062     .031    VALUE FROM CONSTRAINED FIT
 THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

      P1 P2       -.631
      P2 P4       -.652
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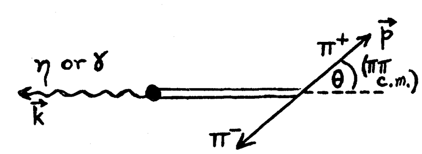
UNCERTAINTY IN THE J^P ASSIGNMENT $\eta'(958)$

The dominant (70%) decay of η' is to $\eta\pi\pi$, but because the Dalitz-plot population is rather flat, exhibiting no significant zeroes, analyses of this mode have not permitted a unique J^P assignment (GOLDBERG 66, DAUBER 64, KALBFLEISCH 64). The flat



Dalitz plot distribution does rule out the J^P = normal series. Thus, using the notation of the sketch, any normal matrix element M needs a factor $\sin\theta$ so as to go to zero at the edge of the Dalitz plot [A. C. Zemach, Phys. Rev. 133, B1201 (1964)].

We must still try to distinguish between $0^-, 1^+, 2^-, \cdots$. In the discussion below, the confidence levels are preliminary values from Alan Rittenberg (LRL) based on fits of 314 $\pi^+\pi^-\eta_{neut}$ decays (see ~100 more in the compilation of LONDON 66) and 184 $\pi^+\pi^-\gamma$ decays (including the 40 in the Letter of KALBFLEISCH 64).

- $J = 0^-$: The simplest M is constant. Conf. level = 15%.
- 1^+ $M = \underline{k}$. This simply does not fit. Of course a strong $\pi\pi$ final-state interaction could help; it seems unlikely but further work is needed.
- 2^- $M = a\underline{k}\underline{k} + b\underline{p}\underline{p}$, where a and b are arbitrary. Here according to London et al., $|M|^2$ gives a good fit to the data with $b \sim 3a$. According to Rittenberg, it gives a poor fit.

Hence, to rule out $J^P = 2^-$, one turns to the 25% mode $\eta' \to \pi^-\pi^+\gamma$, and the usual $J^P = 0^-$ assignment is based primarily on this Dalitz plot (KALBFLEISCH 64). It shows that the decay is mainly $\rho^0\gamma$, and the θ distribution shows a preference for equatorial decays (again, all the figures quoted are from Alan Rittenberg):

$$\frac{d\sigma}{d(\cos\theta)} = (0.5 {}^{+3.0}_{-0.5}) + \sin^2\theta.$$

$J^P = 0^-$ fits well. The only matrix element is magnetic dipole, M_1. $|M_1|^2$ predicts $d\sigma/d\omega \propto \sin^2\theta$, and the confidence level is ≈80%, BUT

$J^P = 2^-$ also fits well. Again the simplest transition is M_1, and this time the predicted distribution is $6 + \sin^2\theta$, with a confidence level of ~40%!

So all available Dalitz-plot data for both modes seem to permit $J^P = 2^-$! London et al. have a qualitative remark that the 2^- hypothesis is inconsistent with the observed 3:1 ratio of $\pi\pi\eta : \pi\pi\gamma$, but if all the evidence against 2^- is to be based on this consideration, it should be checked carefully.

One can return to the $\pi\pi\gamma$ Dalitz plot and ask if it confirms the "ruling out" of $J^P = 1^+$. Rittenberg assumes an E1 matrix element and finds a confidence level of 8%, which on its own would not be enough to rule out 1^+. Further, we should warn that the $\pi\pi\gamma$ decay has a very high Q value ($0 < k < 460$ MeV) with the average experimental value of k about 250 MeV. Hence we must not be too quick to consider only the smallest powers of k/M in matrix elements. Specifically this warning means the following. KALBFLEISCH 64, and we in this note, have considered only the lowest possible electric or magnetic multipole transition. Thus the 8% confidence level just mentioned for the 1^+ hypothesis was based on an E1 matrix element, which has a leading term $\propto (k/M)$. But of course M_2 is also possible, and has an independent coupling which could be large. It has $M \propto (k/M)^2$, and can interfere with E1 to give almost any angular distribution. So the $\pi\pi\gamma$ mode is likely to be unreliable. We want to thank V. I. Ogievetsky and W. Tybor for pointing this out to us. See Zaslavsky, Ogievetsky, and Tybor, JINR Preprint E2-4061, Dubna, 1968.

Since a J = 1 particle cannot decay into $\gamma\gamma$, an observation of a $\gamma\gamma$ decay excludes $J^P = 1^+$. BOLLINI 68 observed 5 events of this kind over a background of only about 1 event. The probability that this is due to a statistical fluctuation of the background is less than 1%, hence at the same level of confidence $J^P = 1^+$ can be excluded.

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REFERENCES FOR ETA PRIME

DAUBER	64 PRL 13 449	DAUBER,SLATER,SMITH,STORK,TICHO (UCLA)JP
ALSO	64 DUBNA CONF 1 418	DAUBER,SLATER,L T SMITH,STORK,TICHO (UCLA)
KALBFLEI	64 PRL 13 349	G.R.KALBFLEISCH,O.DAHL,A.RITTENBERG (LRL)JP
BADIER	65 PL 17 337	BADIER,DEMOULIN,BARLOUTAUD +(PAR+SAC+ZEEMA)
KIENZLE	65 PL 19 438	KIENZLE,MAGLIC,LEVRAT,LEFEBVRES + (CERN)
RITTENBE	65 PRL 15 556	RITTENBERG,KALBFLEISCH (LRL+BNL)
TRILLING	65 PL 19 427	+BROWN,GOLDHABERS,KADYK,SCANIO (LRL)
COHN	66 PL 21 347	COHN,MCCULLOCH,BUGG,CONDO (CRNL+TENN+UNCAR)
LONDON	66 PR 143 1034	LONDON,RAU,SAMIOS,GOLDBERG + (BNL+SYRACUSE)IJP
STRUGALS	67 JINR E1-3100	STRUGALSKI+CHUVILO+IVANOVSKAJA+ (DUBNA)
AZIMOV	68 VIENNA ABS. 772	+HLADKY,KHACHATURYAN,BALDIN+ (JINR+LEBD)
BOLLINI	68 NC 58 A 289	+BUHLER,DALPIAZ,MASSAM+ (CERN+BGNA+STRB)
DAVIS	68 PL 27 B 532	+AMMAR,MOTT,DAGAN,DERRICK,FIELDS (NWES+ANL)
MOTT	68 VIENNA ABS. 351	+AMMAR,DAVIS,KROPAC,SLATE,DAGAN+ (NWES+ANL)

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

MARTIN	66 PL 22,352	MARTIN,CRITTENDEN,SCHROEDER (INDIANA U)I
BARBARO-	68 PRL 20 349	BARBARO-GALTIERI,MATTISON,RITTENBERG+ (LRL)I=0
BARLOUTA	68 PL 26 B 674	BARLOUTAUD+ (SACLAY+AMSTD+BOLOG+WEIZM+E.P.)I=0

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36 DELTA MESON (962,JPG=) I = 1,2

δ(963)

The original $\delta^-(962)$ was seen with the CERN MMS with $\Gamma < 5$ MeV. Several "confirmations" are unconvincing, but as of the 1968 Vienna Conference, three experiments reported peaks in π^- + neutral (probably $\pi^-\eta_{neutral}$) at 970 to 980 MeV, with larger Γ's (25 to 80 MeV). They did not agree as to details. (See B. French's Vienna Rapporteur Talk, and SAMIOS 68).

If we accept that $\delta \to \pi\eta$ by strong decay, then $I^G = 1^-$ and nonobservation of 3π decay can be explained by choosing $J^P = 0^+$, or simply by saying that 3π background is too large to permit detection. These quantum numbers $1^-(0^+)$ are then the same as those

MESON RESONANCES

Data in parentheses have not been included in our averages.

most likely for the $\overline{K}K$ bump called $\pi_N(1016)$, which could then just be the $\overline{K}K$ decay mode of $\delta(962)$. This would require that $\delta(962)$ have a mass ≈ 975 MeV, $\Gamma \approx 50$ MeV (when measured below $\overline{K}K$ threshold), and a strong $\overline{K}K$ coupling, but these possibilities are not ruled out (see DEFOIX 68). Defoix et al. see some evidence for the decay $D^0(1285) \rightarrow \delta^{\mp}\pi^{\pm}$, which also suggests that δ has $I^G = 1^-$.

An unattractive alternative is to believe that δ is really very narrow, and guess that its $\pi\eta$ decay is G-violating electromagnetic. (It is not clear whether there would be competition from $\pi\pi\eta$ decay, which is strong, but has much smaller phase space.) However, in this electromagnetic (em) case, one would also expect slightly faster decay into $\pi\pi$, and we are not sure whether this mode should have been detected. To see why we expect $\pi\pi$ decay, note that these em decays into $\pi^-\pi^0$ or $\pi^-\eta$ involve emission and reabsorption of a photon, with rates proportional to e^4 (also $\pi\pi$ has slightly larger phase space than $\pi\eta$). Neutral em decays (as in the familiar $\eta^0 \rightarrow 3\pi$) have selection rules either

$$\Delta G = \text{Yes}, \quad \Delta|I| = 1$$

$$\text{or} \quad \Delta G = \text{No}, \quad \Delta|I| = 2,$$

but charged decays ($\delta^- - \pi^-\pi^0$ or $\pi^-\eta$) have no such rules (except $\Delta|I| \leq 2$).

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                    36  DELTA (962) MASS (MEV)

M      262  962.0       5.0              KIENZLE   65 MMS   -  3-5 PI- P        9/66
M    B       NOTE THAT BANNER 1 AT 1.8 PI-P DOES NOT SEE IT.
M    O      (966.0)     (8.0)            OOSTENS   66 MMS   +  3.8 PP TC D + MM  9/66
M    O       FOR A CONTRADICTORY RESULT SEE BANNER2 67         3.8 PP TO D + MM 11/67
M    *      (939.)      (15.)            ALLISON   67 HBC   +   6 K-P,(3PI)+...  1/68*
M    *      (913.)      (25.)            ALLISON   67 HBC   -   6 K-P,(3PI)+...  1/68*
M    A      (990.0)                      AMMAR     68 HBC   +-  5.5 K- P,ETA PI  9/68*
M    A       MASS+WIDTH OF THIS PEAK MAKE IDENTIFICATION WITH DELTA DUBIOUS.     9/68*
M    *      (975.0)                      BARNES    68 HBC   -   4.6 K- P,PI MM   9/68*
M    *      (970.0)                      DEFOIX    68 HBC   +-  1.2 PB P,ETA PI  9/68*
M    *
M    V    NOTE THAT THE PI(1016) AS SEEN BY ASTIER 67, IF INTERPRETED AS A      11/67
M    V    VIRTUAL BOUND STATE RESONANCE, WOULD CORRESPOND TO A NARROW RESO-     11/67
M    V    NANCE OF  M = 975 (+15/-10) MEV.                                      11/67

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                    36  DELTA (962) WIDTH (MEV)

W      262     5.0    OR LESS            KIENZLE   65 MMS   -  3-5 PI- P        9/66
W    O        10.0    OR LESS            OOSTENS   66 MMS   +  SEE NOTE O ABOVE 9/66
W             25.     OR LESS            ALLISON   67 HBC   +   6 K-P,(3PI)+...  1/68*
W             30.     OR LESS            ALLISON   67 HBC   -   6 K-P,(3PI)+...  1/68*
W    A      (100.0)                      AMMAR     68 HBC   +-  5.5 K- P,ETA PI  9/68*
W    *       (25.0)                      DEFOIX    68 HBC   +-  1.2 PB P,ETA PI  9/68*

W   NOTES, SEE UNDER MASS LISTING

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                    36  DELTA MESON PARTIAL DECAY MODES

P2          DELTA MESON INTO 3 PI                              134+ 134+ 134
P3          DELTA MESON INTO 4 PI                              134+ 134+ 134+ 134
P5          DELTA MESON INTO ETA PI                            548+ 134

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                    36  DELTA MESON BRANCHING RATIOS

R1          CHARGED DELTA INTO (1 CHARGED) / (3 OR MORE CHARGED)
R1            1.3       0.9       0.7   KIENZLE   65 MMS   -  3-5 PI- P        9/66

R2   *      DELTA MESON INTO (PI ETA) / (PI + MISSING MASS)
R2   *        0.30  OR LESS             BARNES    68 HBC   -  4.6 K- P         9/68*

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                    36  SIGMA(MICROB.) FOR PI- P -- P X-

CS   *      15 +- 5 BRANCH.RATIO ABOVE.KIENZLE   65  MMS  -   3-5 PI-            7/67
CS   * KIENZLE 15. REVISED  TO A FEW...FOCACCI   66  MMS  -   3-5 PI-            7/67
CS          17 OR LESS (2 PRONGS)      JACOBS    66  HBC      3.2  PI-           7/67
CS             3.0 OR LESS /(GEV/C)**2 BANNER 1  67 MMS   -  1.8 PI-P,   P+MM   9/67
CS          3.3 +- 1.7 PI- PI+ PI- ETA CHUNG     68  HBC                         5/68*
CS          .2 OR LESS PI- PI+ PI- MM  CHUNG     68  HBC    3.2-4.2 PI-          5/68*
CS          1.5OR LESS PI- PI+ PI- PIO CHUNG     68  HBC      3.2 PI-            5/68*

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                             REFERENCES FOR DELTA(962)

TURKOT   63 SIENNA CONF 1 661 +COLLINS,FUJII,KEMP+        (BNL+PITTSBURGH)
KIENZLE  65 PL  19  438       + MAGLIC,LEVRAT,LEFEBVRES +           (CERN)
ALLEN D  66 PL 22  543        +GP FISHER,G GODDEN,L MARSHALL,SEARS (COLO)G=+
FOCACCI  66 PL   17  890      + KIENZLE,LEVRAT,MAGLIC,MARTIN        (CERN)
OOSTENS  66 PL   22  708      +CHAVANON,CROZON,TOCQUEVILLE     (SACLAY,CF)I=1
ALLISON  67 PL 25B 619        +CRUZ+     (OXF+MUN+BIRM+RUTH+GLASG+LCN(IC))
ASTIER   67 PL   25 B  294    +MONTANET,BAUBILLIER,DUBOC+  (CDF+CERN+IDR)
AMMAR    68 PRL TO BE PUB     +DAVIS,KROPAC,MOTT,SLATE,WERNER+ (NWES+ANL)
BARNES   68  VIENNA ABS.  259 +DORNAN,GUIDONI,SAMIOS,GOLDBERG+  (BNL+SYR)
DEFOIX   68  VIENNA ABS.  653 +SIAUD,RIVET,SHIVELY,CONFORTO(CDF+IPN+CERN)
JUHALA   68 PL 27 B 257       +LEACOCK,RHODE,KOPELMAN,LIBBY+  (IOWA+COLO)

         . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

                             REFERENCES AGAINST 2PI DECAYS OF DELTA(962)

JACOBS   66 UCRL 16877-THESIS  +O.DAHL, J. KIRZ, D.H.MILLER          (LRL)
WEST     66 PR 149 1089       WEST,BOYD,ERWIN,WALKER           (WISCONSIN)
CLEAR    67 NC 49A 399        +JOHNSTON+PILCHER+COOPER+(TCRONTO+ANL+WISC)
ROOS     67 NP B 2  615       M. ROOS                               (CERN)
FRENCH   68 VIENNA CCNF.  104 RAPPORTEUR
SAMIOS   68  PROC. 1968 UNIV.OF PENN.CONF. ON MESON SPECTROSCOPY

         . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

                             REFERENCES AGAINST DELTA(962)

BANNER 1 67 PL  25 B  300     +FAYOUX,HAMEL,ZSEMBERY,CHEZE+ (SACLAY+CAEN)
BANNER 2 67 PL 25 B 569       +CHEZE,HAMEL,MAREL,TEIGER,CROZON+(CDF+SACL)

CHUNG S  68 PR 165 1491        +O.DAHL, J. KIRZ, D.H.MILLER          (LRL)
GALTIERI 68 PRL 20 349        BARBARO-GALTIERI,MATISON,RITTENBERG+  (LRL)
SABRE CO 68 PL 26B 674        SACL+AMSTDAM+BOLOGNA+REHOVOTH+ECOLE PC(YT.)
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H (990) →

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                  35  H (990, JPG=A -)  I=0

                  IT IS SHOWN BY BARBARO-GALTIERI 68 THAT THE OBSERVED
                  H ENHANCEMENT IS COMPATIBLE WITH BEING ENTIRELY DUE
                  TO MISIDENTIFIED  RHOO-GAMMA DECAYS OF ETA PRIME(958).

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                  35  H  MASS  (MEV)

M        50  975.0     15.0            BARTSCH   64 HBC       4.0 PI+ P         8/66
M        30  975.0    APPROX           GOLDHABER 65 HBC       3.65 PI+P         9/66
M        30  998.      10.             BENSON    66 DBC       3.65 PI+D         9/66
M            980.     APPROX.          COHN      67 DBC       3.3 PI+ D         1/67
M             . . . . . . . . . .
M    AVG     990.9231  10.6154  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)

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                  35  H  WIDTH  (MEV)

W        90  120.0                     BARTSCH   64 HBC       4.0 PI+ P         8/66
W        30   45.0      30.0           BENSON    66 DBC       3.65 PI+ D        0/66
W             60.     OR LESS          COHN      67 DBC       3.3 PI+ D         1/67

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                  35  H  PARTIAL DECAY MODES

                                                           DECAY MASSES
P1          H INTO 3 PI                                 139+ 139+ 134
P2          H INTO RHO PI                               770+ 139

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                  H MESON CROSS SECTION (MICROBARNS)

CS            75.0      15.0           BENSON    66 DBC  3.65 PI+D TC HPP     9/66
CS            50.                      COHN      67 DBC     3.3 PI+D TO HPP   1/67
CS           100.     OR LESS          KIRZ      67    THRESHOLD TO 2.3 PI

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                             REFERENCES ON  H MESON

BARTSCH  64 PL  11  167       AACHEN-ZEUTHEN-BIRM-BONN-HAMB-MUNCHEN (OLL)
GOLDHABE 65 CURAL GABLES P 76 G. GOLDHABER                          (LRL)
BENSON   66 PRL 17 1234       +MARQUIT,ROE,SINCLAIR,VANDER VELDE  (MICH.)IJP
    BENSON 66 ANALYSIS FAVORS JP=1+
GOLDHABE 66  BERKELEY CONF    G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.(ESON RE)IEW
COHN     67 NP B1 57          +MC CULLOCH,BUGG,CONDO   (CAK R.+UNIV.TENN)
ROSENFEL 67 RMP 39 1,APPENDIX  ROSENFELD,BARBARO-GALTIERI+(LRL+CERN+YALE)
ARMENISE 68 PL 26B 336        +GHIDINI,FORINO+ (BARI+BOLCGN+FIRENZ+CRSAY)
BARBARO- 68  UCRL-18271       A.BARBARO-GALTIERI,P.SODING           (LRL)
     AND 68  PROC.1968 UNIV.OF PENN.CONF. ON MESON SPECTROSCOPY
FUNG     68 PRL 21  47        +JACKSON+PU+BROWN+GIDAL    (U.C.RIVERS+LRL)

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π_N (1016)

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                  16 PI(1016,JPG=0+-) I=1

                  STILL NOT DECIDED WHETHER (K KBAR) RESONANCE, VIRTUAL
                  BOUND STATE OR ANTIBOUND STATE.  MAY BE RELATED TO
                  ETA PI MINUS PEAK AT 975-980, SEE NOTE UNDER
                  DELTA (962) ABOVE.

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                  16 PI(1016) MASS  (MEV)

M    *  143 1003.3      7.0+SYSTEMATIC ROSENFELD 65 RVUE +-                     8/66
M            SCAT. LENGTH 2 TO 6 FERMIS.BALTAY    66 HBC       3.7 PBAR P       8/66
M    A  100(1016.)     (10.)             ASTIER    67 HBC  +-  0 PBAR P         7/67
M    A   SCATT.LENGTH ALSO FITS, SEE BELOW
M        SCATT.LENGTH +2.5 +-1. FERMI  ASTIER    67 HBC  +-  0-1.2 PBAR P      7/67
M        OR CMPLX, RE PART=-2.3 F      ......    .. ...  ..  ..... .... .      7/67
M                 IM PART=.5F OR LESS ......    .. ...  ..  ..... .... .      7/67

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MESON RESONANCES

Data in parentheses have not been included in our averages.

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                    16 PI(1016) WIDTH (MEV)

W   *  143   57.0     13.0+SYSTEMATIC ROSENFELC 65 RVUE +-                    8/66
W   A  100   25.  APPROX.             ASTIER    67 HBC  +- SEE NOTE A ABOVE   9/67

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                    16 PI(1016) PARTIAL DECAY MODES

                                                           DECAY MASSES
P1          PI(1016) INTO K KBAR                         493+ 497
P2          PI(1016) INTO ETA PI                         548+ 139

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                    16 PI(1016) BRANCHING RATIOS

R1   *      PI(1016) INTO (ETA PI) / (K KBAR)
R1             5.0   OR LESS          ASTIER    67 HBC      0. PBAR P         9/67

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                         REFERENCES FOR PI(1016)

ARMENTER 65 PL 17 344          ARMENTEROS,EDWARDS,JACOBSEN +  (CERN+PARIS)
BARASH   65 PR  139 B  1659    +FRANZINI,KIRSCH,MILLER,STEINBERGER+(COLUM)
ROSENFEL 65 OXFORD CONF 58     A H ROSENFELD                     (LRL--RVUE)
BALTAY   66 PR  142 B  932     +LACH,SANDWEISS,TAFT,YEH,STONEHILL+  (YALE)
ASTIER   67 PL   25 B  294     +MONTANET,BAUBILLIER,DUBOC+  (CDF+CERN+IDR)
  ASTIER 67 INCLUDES INFORMATION FROM BARLOW 67, CONFORTC 67(, ARMENTEROS)65.
BAILLON  67 NC 50A 393         +EDWARDS+D.ANDLAU+ASTIER+     (CERN+CDF +IR)
BARLOW   67 NC  50 A  701      +MONTANET,D-ANDLAU+(CERN+CDF+IDR+LIVERPOOL)
CONFORTO 67 NP 83 469 ·        CONFORTO,MARECHAL,MONTANET+(CERN+PARIS+LIV)
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ϕ(1019)

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    4  PHI (1019,JPG=1-- ) I=0

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                    4  PHI  MASS (MEV)

M           1017.0      2.0             ARMENTERO 63 HBC      0.0 PBAR P
M           1019.0      2.0             SCHLEIN   63 HBC    2.0 K- P
M           1018.6      0.5             MILLER D  65 HBC      0.0 PBAR P      8/66
M           1020.0      2.0             LONDON    66 HBC      2.2 K-P         6/66
M           1021.5      0.8             ABRAMS    67 HBC     4.2 K- P        11/67
M           1019.       3.              BARLOW    67 HBC      1.2 PBAR P     11/66
M           1021.0      4.0             DAHL      67 HBC      1-4 PI- P       9/66
M    *     (1018.5)    (1.0)            HYAMS     68 SPRK    11.2 PI- P       9/68*
M       165 1022.       1.5             MOSTEK    68 SPRK    1.8 GAMMA + C    6/68*
M    *     (1021.0)    (3.0)            MOTT      68 HBC      4.1-5.5 K- P    9/68*
M           . . . . . . . . . . .
M    AVG    1019.5071   .5799  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)
                       (SEE IDEOGRAM BELOW )
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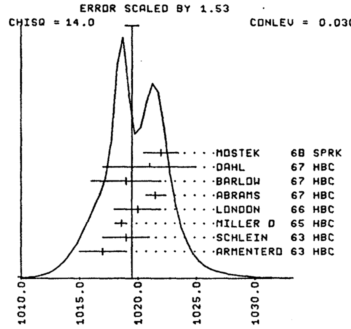
WEIGHTED AVERAGE = 1019.507 ± 0.580
ERROR SCALED BY 1.53
CHISQ = 14.0 CONLEV = 0.030

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                    4  PHI  WIDTH (MEV)

W             3.4       1.7             ARMENTERC 63 HBC      0.0 PBAR P
W       34    5.0  OR LESS              SCHLEIN   63 HBC      2.0 K-P
W             3.5       1.0             MILLER D  65 HBC      0.0 PBAR P      8/66
W             6.0       4.0             LONDON    66 HBC      2.2 K-P         6/66
W             1.8       3.0      1.5    ABRAMS    67 HBC     4.2 K- P        11/67
W            10.   OR LESS              BARLOW    67 HBC      1.2 PBAR P     11/66
W    *  165  (4.5)     (3.0)    (2.0)   MOSTEK    68 SPRK    1.8 GAMMA + C    6/68*
W             4.2       0.9             AUGUSTIN  68 SPRK    E+ E- COLL.BEAMS 0/68*
W          . . . . . . . . .
W    AVG      3.7288    .5933  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    4  PHI PARTIAL DECAY MODES

                                                           DECAY MASSES
P1       PHI INTO K+ K-                                  493+ 493
P2       PHI INTO K01 K02                                497+ 497
P3       PHI INTO PI+ PI- PIO (INCLUDING RHO PI)         139+ 139+ 134
P4       PHI INTO PI+ PI- (VIOLATES G)                   139+ 139
P5       PHI INTO E+  E-                                  .5+  .5
P6       PHI INTO MU+ MU-                                105+ 105
P7       PHI INTO PIO GAMMA                              134+   0
P8       PHI INTO ETA GAMMA                              548+   0
P9       PHI INTO PI+PI-GAMMA                            139+ 139+    0
P10      PHI INTO OMEGA GAMMA (VIOLATES C)               783+   0
P11      PHI INTO ETA PIO (VIOLATES C)                   548+ 134
P12      PHI INTO RHO GAMMA (VIOLATES C)                 770+   0

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                    4  PHI  BRANCHING RATIOS

R1   *       PHI INTO (K+ K-)/TOTAL
R1   B   27   (0.26)    (0.06)          BADIER    65 HBC   (SEE NOTE B BELOW) 0/66
R1      252    0.48      0.04           LINDSEY   66 HBC      2.7 K-P         0/66
R1             0.48      0.024          AUGUSTIN  68 SPRK   E+ E- COLL.BEAMS  0/68*
R1          . . . . . . . . . . .
R1   AVG       .4800     .0206  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1   FIT       .476      .018    VALUE FROM CONSTRAINED FIT
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R2   *       PHI INTO (K1 K2)/TOTAL
R2   B   25   (0.23)    (0.06)          BADIER    65 HBC   (SEE NOTE B BELOW) 0/66
R2      167    0.40      0.04           LINDSEY   66 HBC      2.7 K-P         0/66
R2             0.312     0.016          AUGUSTIN  68 SPRK   E+ E- COLL.BEAMS  0/68*
R2          . . . . . . . . . . .
R2   AVG       .3241     .0303  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.0)
R2   FIT       .328      .018    VALUE FROM CONSTRAINED FIT

R3   *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/TOTAL
R3   B   57   (0.51)    (0.09)          BADIER    65 HBC      3.0 K-P         0/66
R3   B       CONTROVERSIAL BACKGROUND SUBTRACTION
R3       30    0.12      0.08           LINDSEY   66 HBC      2.7 K-P         0/66
R3             0.208     0.04           AUGUSTIN  68 SPRK   E+ E- CCLL.BEAMS  0/68*
R3          . . . . . . . . . . .
R3   AVG       .1904     .0358  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R3   FIT       .196      .023    VALUE FROM CONSTRAINED FIT

R5   *       PHI INTO (K1 K2)/(K KBAR)
R5       10    0.40      0.10           SCHLEIN   63 HBC      2.0 K-P         0/66
R5       52    0.48      0.07           BADIER    65 HBC      3.0 K-P        11/67
R5             0.44      0.07           LONDON    66 HBC      2.2 K-P         0/66
R5          . . . . . . . . . . .
R5   AVG       .4482     .0444  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R5   FIT       .408      .018    VALUE FROM CONSTRAINED FIT

R6   *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/(K KBAR)
R6             0.30      0.15           LONDON    66 HBC      2.2 K-P         0/66
R6          . . . . . . . . . . .
R6   FIT       .244      .034    VALUE FROM CONSTRAINED FIT

R7   *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/(K1 K2)
R7             0.3    OR LESS           BERLEY    65 HBC      2.9 PI+P        0/66

R8   *       PHI INTO (PI+ PI-)/(K KBAR)
R8             0.2    OR LESS           LONDON    66 HBC      2.2 K-P         0/66

R9   *       PHI INTO (E+ E-)/(K+ K-)   (UNITS 10**-4)
R9       40    5.7       1.7            BECKER    68 CNTR        GAMMA C      9/68*

R10  *       PHI INTO (MU+ MU-)/TOTAL (UNITS 10**-4)
R10          53.      OR LESS           GALTIERI  65 HBC    2.7 K- P          0/66
R10           7.4     OR LESS           CHASE     68 CNTR     PHOTOPRCD.      6/68*
R10           3.5       3.5      1.8    WEHMANN   68 SPRK    12 K- C          6/68*

R11  *       PHI INTO (ETA GAMMA)/TOTAL
R11            0.2    OR LESS           BADIER    65 HBC      3.0 K-P         0/66
R11            0.08   OR LESS           LINDSEY   66 HBC      2.7 K-P         0/66

R12  *       PHI INTO (PI+ PI- GAMMA)/(K KBAR)
R12            0.05   OR LESS           LINDSEY   65 HBC      2.7 K-P         0/66

R13  *       PHI INTO (ETA NEUTRALS)/(K KBAR)
R13            0.15   OR LESS           LINDSEY   66 HBC      2.7 K-P         0/66

R14  *       PHI INTO (OMEGA GAMMA) / TOTAL
R14            0.05   OR LESS           LINDSEY   66 HBC      2.7 K-P         0/66

R15  *       PHI INTO (RHO GAMMA) / TOTAL
R15            0.02   OR LESS           LINDSEY   66 HBC      2.7 K-P         0/66

R16  *       PHI INTO (E+ E-)/TOTAL     (UNITS 10**-4)
R16  A    5   (6.6)     (4.4)    (2.8)  ASTVACATU 68 SPRK    4 PI- P          6/68*
R16  A    ERROR OF ASTVACATUROV 68 DOES NOT INCLUDE SIGMA(PHI) UNCERTAINTY.   6/68*
R16      27    7.2       3.9            BINNIE    68 SPRK    1.6 PI- P        6/68*
R16       9    6.1       2.6            BOLLINI   68 CNTR    1.9 PI- P        9/68*
R16            3.9       0.62           AUGUSTIN  68 SPRK   E+ E- COLL.BEAMS  0/68*
R16         . . . . . . . . . . .
R16  AVG       4.0927    .5960  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

  THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

       P1 P3      -.623
       P2 P3      -.634

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                         REFERENCES FOR PHI

BERTANZA 62 PRL 9 180          BERTANZA,BRISSON,CONNOLLY,HART +  (BNL+SYR)
ARMENTER 63 SIENA CONF 2 70    ARMENTEROS,EDWARDS,ASTIER+ (CERN+CDF-PARIS)
GELFAND  63 PRL 11 438         GELFAND,MILLER,NUSSBAUM,KIRSCH+ (COLU+RUTG)
   GELFAND 63 DATA INCLUDED IN MILLER 65 BELOW
SCHLEIN  63 PRL 10 368         SCHLEIN,SLATER,SMITH,STORK,TICHO     (UCLA)

BADIER   65 PL 17 337          BADIER,DEMOULIN,BARLOUTAUD+ (PAR+LPCHE+ZEE)
BERLEY   65 PR 139 B 1097      D BERLEY,N GELFAND           (BNL+COLUMBIA)
GALTIERI 65 PRL 14 279         A BARBARO GALTIERI,R D TRIPP          (LRL)
LINDSEY  65 PRL 15 221         JAMES S LINDSEY,GERALD A SMITH        (LRL)
   LINDSEY 65 DATA INCLUDED IN LINDSEY 66 BELOW
MILLER C 65 CU-237(NEVIS 131) DAVID C MILLER  (THESIS)          (COLUMBIA)

GRAY, L  66 PRL  17  501       +HAGERTY,BIZZARRI,CIAPETTI +   (SYR+ROME)JPG
LINDSEY  66 PR  147  913       JAMES S LINDSEY, GERALD A SMITH       (LRL)
LINDSEY1 66 PL 20 93           J.S.LINDSEY, G.A.SMITH                (LRL)
   LINDSEY 1 66 DATA INCLUDED  IN LINDSEY 66 ABOVE
LCNDCN   66 PR 143 1034        LONDON,RAU,SAMIOS,GOLDBERG + (BNL+SYRACUSE)

ABRAMS   67 MD TECH REP 720    GERALD ABRAMS , THESIS           (MARYLAND)
BARLOW   67 NC 50A 701         +LILLESTOL+MONTANET+(CERN+CDF+IR+LIVERPOOL)
CHASE    67 PRL 18 710         R.C.CHASE,P.ROTHWELL,R.WEINSTEIN(CEA+NEAST)
DAHL     67 PR 163 1377        +HARDY+HESS+KIRZ+MILLER               (LRL)
HERTZBAC 67 PR 155  1461       HERTZBACH,KRAEMER,MADANSKI,ZDANIS+(JHU+BNL)
KHACHATL 67 PL 24B 349         KHACHATURYAN+AZIMOV+BALDIN+BELOUSOV+(CUBNA)

ASTVACAT 68 PL 27 B  45        ASTVACATUROV,AZIMOV,BALDIN+   (JINR+MCSCOW)
AUGUSTIN 68  VIENNA ABS.       +BIZOT,BUON,DELCOURT,HAISSINSKI+    (ORSAY)
    ALSO 68  VIENNA CONF.      S.TING, RAPPORTEURS TALK
BECKER   68  VIENNA ABS.  953 +BERTRAM,BINKLEY,JORDAN,KNASEL+  (DESY+MIT)
    ALSO 67 PRL 19 869         ASBURY,BECKER,BERTRAM,TING+ (DESY+COLUMBIA)
BINNIE   68 PL 27B 106         +DUANE+FARUQI+HORSEY+     (I.C.LON+RUTHERF)
BOLLINI  68 NC 56 A 1171       +BUHLER,DALPIAZ,MASSAM+     (CERN+BGNA+STRB)
HYAMS    68  VIENNA ABS.  765 +KOCH,POTTER,LINDERN,LORENZ+     (CERN+MPIM)
MOSTEK   68 PRL 20 1057        +EISENHANDLER,MCCLELLAN,MISTRY+   (CORNELL)
MOTT     68  VIENNA ABS.  351 +AMMAR,DAVIS,KROPAC,SLATE,DAGAN+ (NWES+ANL)
WEHMANN  68 PRL 20 748         +ENGELS+ (HARVARD+CASE+SLAC+CORNELL+MCGILL)
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η_{0^+}(1070)

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    3 ETA (1070,JPG=0++)I=0

               NAMED S* BY CRENNELL 66.
               THE DISAGREEMENT BETWEEN SOME OF THE OBSERVED WIDTHS IS
RELATED TO AN AMBIGUITY IN INTERPRETATION OF THIS KS KS PEAK EITHER AS A
RESONANCE ABOVE THRESHOLD OR AS A SCATTERING LENGTH EFFECT.  HOANG 68 SHOW
THAT THE SPRK DATA OF BEUSCH 67 AND PHELAN 68 BELOW 1115 MEV CAN BE FITTED
WITH A VIRTUAL KKBAR BOUND STATE.

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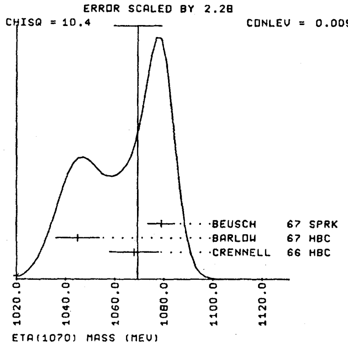
Data in parentheses have not been included in our averages.

3 ETA (1070) MASS (MEV)

M	*		1000.0	APPROX		BINGHAM	62 PBC	6-18 PI-N	
M	*		1000.0	APPROX		BIGI	62 HBC	10.0 PI-P	
M	*		(1000.0)			ERWIN	62 HBC	2.10 PI-P	0/66
M	*	30	1030.0	APPROX.		BALTAY	64 HBC	3.7 PBAR P	
M	*		1025.0	APPROX.		BARMIN	64 HLBC	2.8 PI-P	6/66
M		20	1068.0	10.0		CRENNELL	66 HBC	6.0 PI- P	6/66
M	H	120	SCATT.LENGTH FITS BETTER.			HESS	66 HBC	1.6-4.2 PI- P	0/66
M		35	1045.	9.		BARLOW	67 HBC	1.2 PBAR P	11/66
M		730	1079.0	6.0	5.0	BEUSCH	67 SPRK	5,7,12 PI-P	9/67
M	*		(1030.0)	(7.0)		D.ANDLAU	68 HBC	0.7 PB P,4 BODY	9/68*
M	P		(1050.0)	(10.0)		MILLER	68 HBC	4.0 PI- P	9/68*
M	A		(1065.)	(10.)		PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
M	A		(1045.)	(10.)		PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
M	A		(1035.)	(10.)		PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
M	A	ABOVE 3 VALUES ASSUMING NO 2PI DECAY, 2PI/KKBAR =1, 2PI/KKBAR=2							
M	A	RESPECTIVELY. SCATTERING LENGTH (+-1.1 + 0.2*I) F ALSC FITS.							
M	P	70	(1085.0)	(10.0)		WHITEHEAD	68 SPRK	3.1-3.6 PI-P	0/67
M	P	PI+PI- MODE (NOT CLEAR IF THIS IS THE S*. J=0 IS NOT FAVORED.)'							
M	*	NOTE THAT IN A COMPILATION OF PI N HBC DATA WITH TWICE THE STATISTICS							
M	*	OF WHITEHEADS COMPILATION, NO PI+ PI- PEAK IS SEEN. (P.SCHLEIN 68)							
M		. . . .							
M	AVG		1069.4383	9.6955	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.3) (SEE IDEOGRAM BELOW)				

WEIGHTED AVERAGE = 1069.44 ± 9.70
ERROR SCALED BY 2.28
CHISQ = 10.4 CONLEV = 0.005



3 ETA (1070) WIDTH (MEV)

W		20	80.0	15.0		CRENNELL	66 HBC	6.0 PI-P	6/66
W		35	50.	24.		BARLOW	67 HBC	1.2 PBAR P	11/66
W	S		(168.0)	(21.0)	(19.0)	BEUSCH	67 SPRK	5,7,12 PI-P	9/67
W	S	ASSUME NO S WAVE SCATTERING LENGTH.WITH S WAVE THE WIDTH IS NARROWER							
W	*		(50.0)	(15.0)		D.ANDLAU	68 HBC	0.7 PB P,4 BODY	9/68*
W	P		40.0	OR LESS		MILLER	68 HBC	4.0 PI- P	9/68*
W	A		(170.)	(40.)		PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
W	A		(140.)	(50.)	(30.)	PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
W	A		(140.)	(40.)		PHELAN	68 SPRK	4 PI-P - KS KS N	6/68*
W	A	SEE NOTE A UNDER MASS ABOVE.							
W	P		25.0	OR LESS		WHITEHEAD	68 SPRK	3.1-3.6 PI-P	0/67
W	P	PI+PI- MODE (NOT CLEAR IF THIS IS THE S*. J=0 IS NOT FAVORED.)							
W		. . . .							
W	AVG		71.5730	13.4831	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)				

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3 ETA (1070) PARTIAL DECAY MODES

		DECAY MASSES
P1	ETA (1070) INTO KKBAR	493+ 497
P2	ETA (1070) INTO PIPI	139+ 134

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3 ETA (1070) BRANCHING RATIOS

R1	*	ETA (1070) INTO (PI PI)/(K KBAR)						
R1		2.5	OR LESS		CRENNELL	66 HBC	90 PCT CONF LEV	7/66
R1	I	(0.92)	(0.57)	(0.34)	WHITEHEAD	68 RVUE		6/68*
R1	I	NOT CLEAR IF THE OBSERVED PI+PI- PEAK IS A MODE OF THE						6/68*
R1	I	ETA(1070). NOTE THE SMALL WIDTH AND THE PREFERENCE OF J.GT.0						6/68*
R1	I	(1.0)	(0.6)	(0.3)	LAI	68 HBC	6 PI- P	11/68*

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REFERENCES FOR ETA(1070)

BIGI	62 CERN CONF 247	A BIGI,S BRANDT, R CARRARA +	(CERN)
BINGHAM	62 CERN CONF 240	H H BINGHAM,M BLOCH +	(PARIS+EC POLY+CERN)
ERWIN	62 PRL 9 34	ERWIN,HOYER,MARCH,WALKER,WANGLER	(WIS+BNL)
BALTAY	64 DUBNA CONF 1 409	BALTAY,LACH,CRENNELL,OREN,STUMP +	(YALE+BNL)
BARMIN	64 DUBNA CONF 1 433	BARMIN,DOLGOLENKO,YEROFEEV,KRESTNI+	(ITEP)
CRENNELL	66 PRL 16 1025	CRENNELL,KALBFLEISCH,LAI,SCARR,SCHU+	(BNL)
HESS	66 PRL 17 1109	+DAHL+HARDY+KIRZ+MILLER	(LRL)
HESS REPLACES	PRL 9 460	ALEXANDER,DAHL,JACOBS,KALBFLEISCH +	(LRL)
BARLOW	67 NC 50A 701	+LILLESTOL+MONTANET+	(CERN+CDF+IR+LIVERPOOL)
BEUSCH	67 PL 25 B 357	+FISCHER,GOBBI,ASTBURY,MICHELINI+	(ETH+CERN)
DAHL	67 PR 163 1377	+HARDY+HESS+KIRZ+MILLER	(LRL)
D.ANDLAU	68 VIENNA ABS. 626	+ASTIER,COHEN,AGUILAR-BENITEZ+	(CDEF+CERN)
HOANG	68 PREPRINT	T.F.HOANG	(ANL)
LAI	68 PHILADEL.CONF.	KWAN WU LAI	(BNL)
MILLER	68 VIENNA ABS. 804	+GUTAY,JOHNSON,KENNEY+	(PURDUE+NDAME+SLAC)
PHELAN	68 THESIS	JAMES J. PHELAN	(ANL+ST.LOUIS UNIV)
ALSO	68 PRL 21 316	HOANG,EARTLY,PHELAN,ROBERTS+	(ANL+CHIC+NDAM)
SCHLEIN	68 PRIV. COMM.	P.SCHLEIN	(UCLA)
WHITEHEA	68 NC 53 A 817	C.WHITEHEAD +	(HARWELL+STHAMPT+U.C.LON)

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10 A1 MESON (1070, JPG=1+-) I=1

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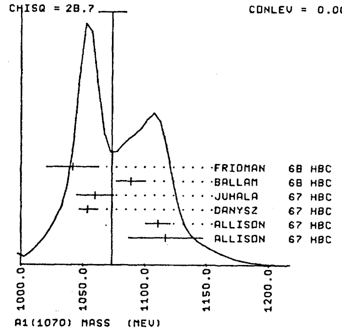
A1(1080)

10 A1 MESON MASS (MEV)

M	*	MASS AND WIDTH MIGHT HAVE LARGE SYSTEMATIC								
M	*	ERRORS DUE TO COMPLICATED BEHAVIOR OF BACKGROUND.								
M			1080.0		ADERHOLZ	64 HBC		4.0 PI+P		
M			1117.	30.	ALLISON	67 HBC	+	6 K-P,LAM +4 PI		1/68*
M			1111.	10.	ALLISON	67 HBC	+	6 K-P,LAM +5 PI		1/68*
M			1054.	7.	DANYSZ	67 HBC	+-	3,3.6 PBAR P		7/67
M			1060.	15.	JUHALA	67 HBC	0	4.6-5 K-P,5BODY		1/68*
M	*	306	(1066.0)	(12.0)	ABBCH COL	68 HBC	-	16.0 PI- P(3 PI)		9/68*
M	*		(1058.0)	(7.0)	ABBCH COL	68 HBC	-	16.0 PI- P,5 PI		9/68*
M			1060.		ASCOLI	68 HBC	-0	5 PI-P		6/68*
M			1089.0	12.0	BALLAM	68 HBC	-	16.0 PI- P		9/68*
M			1080.	APPROX.	BOESEBECK	68 HBC	+	8 PI+ P		6/68*
M	*		(1073.0)	(7.0)	CASON	68 HBC	+	18.5 PI+P,P+3PI		9/68*
M			1080.	APPROX.	CASO	68 HBC	-	11 PI- P		6/68*
M			1090.	APPROX.	CHUNG	68 HBC	-	3.2,4.2 PI-P		2/67
M			1042.	21.	FRIDMAN	68 HBC	+-	5.7 PBAR P		6/68*
M	K		(1119.)	(30.)	KEY	68 HBC	-	3 PI-P		9/68*
M	K	SHOULDER ON A2 ONLY								
M		. . . .								
M	AVG		1073.5351	11.2629	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.4) (SEE IDEOGRAM BELOW)					

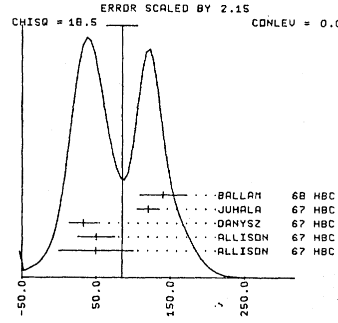
WEIGHTED AVERAGE = 1073.5 ± 11.3
ERROR SCALED BY 2.39
CHISQ = 28.7 CONLEV = 0.000



10 A1 MESON WIDTH (MEV)

W	*	SEE NOTE UNDER A1 MESON MASS.								
W			80.0			ADERHOLZ	64 HBC		4.0 PI+P	
W			50.	50.		ALLISON	67 HBC	+	6 K-P,LAM +4 PI	1/68*
W			50.	25.		ALLISON	67 HBC	+	6 K-P,LAM +5 PI	1/68*
W			33.	19.		DANYSZ	67 HBC	+-	3,3.6 PBAR P	7/67
W			120.	15.		JUHALA	67 HBC	0	4.6-5 K-P,5BODY	1/68*
W	*	306	(146.0)	(18.0)		ABBCH COL	68 HBC	-	16.0 PI- P(3 PI)	9/68*
W			140.0	31.0		BALLAM	68 HBC	-	16.0 PI- P	9/68*
W			130.	APPROX.		BOESEBECK	68 HBC	+	8 PI+ P	6/68*
W			100.	APPROX.		CASO	68 HBC	-	11 PI- P	6/68*
W	*		(41.0)	(32.0)	(16.0)	CASON	68 HBC	+	18.5 PI+P,P+3PI	9/68*
W			125.	APPROX.		CHUNG	68 HBC	-	3.2,4.2 PI-P	2/67
W			130.	APPROX.		FRIDMAN	68 HBC	+-	5.7 PBAR P	6/68*
W	K		(76.)	(46.)		KEY	68 HBC	-	3.0 PI- P	11/67
W	K	SHOULDER ON A2 ONLY								
W		. . . .								
W	AVG		84.8775	21.2552	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.2) (SEE IDEOGRAM BELOW)					

WEIGHTED AVERAGE = 84.9 ± 21.3
ERROR SCALED BY 2.15
CHISQ = 18.5 CONLEV = 0.001



10 A1 PARTIAL DECAY MODES

		DECAY MASSES
P1	A1 INTO RHO PI	770+ 139
P2	A1 INTO KBAR K	493+ 497
P3	A1 INTO ETA PI	548+ 139
P4	A1 INTO ETA PRIME PI	958+ 139
P5	A1 INTO 3 PI	139+ 139+ 139

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MESON RESONANCES

Data in parentheses have not been included in our averages.

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                        10  A1 BRANCHING RATIOS

R1  *   A1 INTO (KBAR K)/(RHO PI)
R1           0.0025 OR LESS          DAHL      67 HBC   -  4.0 PI- P        0/66
R1  *   A1 INTO (KBAR K)/(RHO PI)

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                              REFERENCES FOR A1

ADERHOLZ 64 PL 10 226           AACH+BERL+BIRM+BO(N+DESY+HAMB+IMP.COL+ MPI)

ALLISON  67 PL 25B 619          +CRUZ+    (OXF+MUN+BIRM+RUTH+GLASG+LON(IC))
DAHL     67 PR 163 1377         +HARDY+HESS+KIRZ+MILLER                (LRL)
DANYSZ   67 NC 51 A 801         DANYSZ+FRENCH+SIMAK                   (CERN)
JUHALA   67 PRL 19 1355         +LEACOCK+RHODE+KOPELMAN+         (IOWA+COLO)

ABBCH CO 68  VIENNA ABS.   466 COLLABORATION AACHEN-BERLIN+BON(+CERN+HEID)
ASCOLI   68  COO-1195-121       +CRAWLEY,KRUSE,MORTARA,SCHAFER,+ (ILLINOIS)
BALLAM   68 PRL 21 934          +BRODY,CHADWICK,FRIES,GUIRAGOSSIAN+  (SLAC)JP
BOESEBEC 68 NP B 4 501          BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO     68 NC 54 A 983         +CONTE+CORDS+DIAZ+    (GENOVA+HAMB+MIL+SACL)
CASON    68  VIENNA ABS.    24 +HONES,MCGAHAN,BISWAS,JOHNSON,KENNEY+(NDAM)
CHUNG    68 PR 165 1491         S.U.CHUNG,O.DAHL,J.KIRZ,D.H.MILLER    (LRL)
CNOPS    68  VIENNA ABS.   210 +HOUGH,COHN,BUGG+ (BNL+ORNL+ORUC+TENN+PENN)
FRIDMAN  68 PR 167 1268         +MAURER,MICHALON,OUDET+(HEIDELB+STRASBOURG)
KEY      68 PR 166 1430         +PRENTICE+COOPER+MANNER+WALKER+(TO+ANL+WIS)

                     PAPERS NOT REFERRED TO IN DATA CARDS

BELLINI  63 NC 29 896           BELLINI,FIORINI,HERZ,NEGRI,RATTI     (MILAN)
GOLDHABE 64 PRL 12 336          GOLDHABER,BROWN,KADYK,SHEN,TRILLING(LRL+UC)
LANDER   64 PRL 13 346 A        LANDER,ABOLINS,CARMONY,HENDRICKS +   (UCSD) JP
ABOLINS  65 ATHENS(OHIO)CONF.  +CARMONY,LANDER,XUONG,YAGER      (LA JOLLA)I=1
ALITTI   65 PL 15 69            ALITTI,BATON,DELER,CRUSSARD+      (SAC+BOL)
ALLARD   66 NC 46A 737          +DRIJARD+HENNESSY+    (ORSAY+MILAN+SAC+BERK)
   ALLARD+ 66 GET GOOD FIT TO M(PI RHO) ONLY WHEN (SSUMING ADDITIONAL RES)-
   NANCES BETWEEN 940 AND 1315 MEV
HESS     66 UCRL-16832          R I HESS (THESIS, BERKELEY)            (LRL)
SLATTERY 67 NC 50A 377          +KRAYBILL+FORMAN+FERBEL        (YALE+ROCH)  JP
ARMENISE 68 PL 26 B  336        +FORINO+CARTACCI+        (BARI+BOL+FIR+CRSAY)

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$A_{1.5}$(1170)

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44  A 1.5  (1170, JPG=  -) I=1

BUMP IN 3 PI AND RHO PI MASS SPECTRA BETWEEN A1 AND A2.
EVIDENCE FOR RESONANCE NOT COMPELLING. OMITTED FROM
TABLE.

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                        44  MASS (MEV)

M    *     (1190.)      (4.)              CASON      67 HBC   -  8 PI-P           6/68*
M    *     (1190.0)     (8.0)             ABBCH COL 68 HBC   - 16.0 PI- P,5 PI    9/68*
M    D  111(1194.0)     (9.0)             ABBCH COL 68 HBC   - 16.0 PI- P(3 PI)   9/68*
M    D     FROM FIT WHERE THE A2 IS FIXED AT MASS 1305 MEV, WIDTH 90 MEV
M          1170.                          ASCOLI     68 HBC   -0 5 PI-P           6/68*
M    A     (1250.0)     (21.0)            CASON      68 HBC   + 18.5 PI+P,P+4PI   9/68*
M    A     (1231.0)     (11.0)            CASON      68 HBC   + 18.5 PI+P,P+3PI   9/68*
M    A     NO A2 MESON PEAK,IS SEEN
M    *     (1195.0)     (15.0)            VON KROGH 68 HBC   -  6.7 PI- P         9/68*

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                        44  WIDTH (MEV)

W    *      (17.)       (12.)      (6.)   CASON      67 HBC   -  8 PI-P           6/68*
W    D  111 (52.0)      (20.0)            ABBCH COL 68 HBC   - 16.0 PI- P(3 PI)   9/68*
W    D     FROM FIT WHERE THE A2 IS FIXED AT MASS 1305 MEV, WIDTH 90 MEV
W           45.         15.               ASCOLI     68 HBC   -0 5 PI-P           6/68*
W    A     (132.0)      (60.0)    (36.0)  CASON      68 HBC   + 18.5 PI+P,P+4PI   9/68*
W    A      (63.0)      (12.0)            CASON      68 HBC   + 18.5 PI+P,P+3PI   9/68*
W    A     NO A2 MESON PEAK IS SEEN
W    *      (20.0)      (10.0)            VON KROGH 68 HBC   -  6.7 PI- P         9/68*

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                         REFERENCES  ON  A 1.5 (117C)

BUTTERWO 67 HEIDELB.CONF.P.28 REVIEW TALK ON MESONS (AT HEIDELBERG CONF.)
CASON    67 PRL 18  880         +LAMSA,BISWAS,DERADO,GROVES,+    (NOTREDAME)
ABBCH CO 68  VIENNA ABS.   466 COLLABORATION AACHEN-BERLIN+BON(+CERN+HEID)
ASCOLI   68 PRL 21 113          +CRAWLEY,KRUSE,MORTARA,SCHAFER,+ (ILLINOIS)
CASON    68  VIENNA ABS.    24 +HONES,MCGAHAN,BISWAS,JOHNSON,KENNEY+(NDAM)
DONALD   68 PL 26 B  327        +FRODESEN,BETTINI,+  (LIVERPOOL,OSLO,PADUA)
VONKROGH 68 PL 27B 253          +MIYASHITA,KOPELMAN,MARSHALL LIBBY   (COLO)

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B(1210)

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11  B MESON (1220,JPG=1++) I=1

ASCOLI 68 FIND JP EITHER =1+, OR = 2+,3-,...
THE SERIES JP=3-,5-,...SEEMS UNLIKELY BECAUSE 2PI AND
K KBAR  DECAYS ARE NOT OBSERVED.

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                        11  B MESON  MASS (MEV)

M        60 1220.0                      ABOLINS    63 HBC  +   3.5 PI+P
M           1220.0                      GOLDHABER 65 HBC       3.7 PI+,PI-P
M    B     (1320.)                      BALLAM     67 HBC  -   16 PI- P          11/67
M    B      BALLAM 68 IS UPDATING OF BALLAM 67
M       376 1200.       20.             BALTAY     67 HBC  +- 0.0 PBAR P          2/67
M    *     (1270.)                      BISWAS     67 HBC  -   8. PI- P          11/67
M        25 1250.    ESTIMATED          LEE        67 HBC  -   3.6 PI- P          1/68*
M    *     (1250.0)    (35.0)           BALLAM     68 HBC  - 16.0 PI- P           9/68*
M           1259.0      27.0            BOESEBECK 68 HBC  +   8.0 PI+ P           0/67
M           1250.    APPROX.            CASO       68 HBC  -   11 PI- P           6/68*
M           1220.       20.             CHUNG      68 HBC  - 3.2,4.2 PI- P        9/67
M    *  IN THE 3-4 PI-P DATA,THE B ENHANCEMENT MAY BE DECK EFFECT (CHUNG 68)
M       150 1230.    APPROX.            GIDAL      68 HBC  +   3-4 PI+ P          6/68*
M           . . . . . . . . . . .
M    AVG    1220.5490  15.5578  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)

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                        11  B MESON  WIDTH (MEV)

W        60  100.0      20.0            ABOLINS    63 HBC  +   3.5 PI+P
W             80.0                      GOLDHABER 65 HBC       3.7 PI+,PI-P
W       376  100.       30.             BALTAY     67 HBC  +- 0.0 PBAR P          2/67
W    *      (250.)                      BISWAS     67 HBC  -   8. PI- P          11/67
W        25  100.    ESTIMATED          LEE        67 HBC  -   3.6 PI- P          1/68*
W    *      (200.0)    (50.0)           BALLAM     68 HBC  - 16.0 PI- P           9/68*
W            203.       75.             BOESEBECK 68 HBC  +   8. PI+ P           11/67
W            150.       20.             CHUNG      68 HBC  - 3.2,4.2 PI- P        9/67
W           . . . . . . . . . . .
W    AVG     122.7880  16.0668  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                        (SEE IDEOGRAM BELOW )
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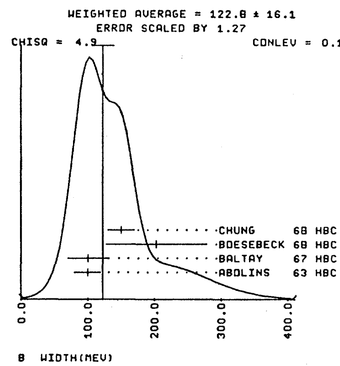


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                     11  B MESON PARTIAL DECAY MODES

                                                              DECAY MASSES
P1      B MESON INTO OMEGA+PI                                 783+ 139
P2      B MESON INTO 2PI+ 2PI-                                139+ 139+ 139+ 139
P3      B MESON INTO K KBAR                                   493+ 493
P4      B MESON INTO PI PI                                    139+ 139
P5      B MESON INTO PI PHI                                   134+1019
P6      B MESON INTO ETA PI (FORBIDDEN BY G)                  548+ 139
P7      B MESON INTO K KBAR PI                                493+ 493+ 139

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                     11  B MESON  BRANCHING RATIOS

R1   *   B INTO  4PI/(OMEGA PI)
R1             0.5   OR LESS            ABOLINS    63 HBC  +   3.5 PI+P

R2   *   B MESON INTO (K KBAR)/(OMEGA PI)
R2             0.02  OR LESS            DAHL       67 HBC  -   1.6-4.2 PI- P     0/66
R2             0.10  OR LESS (CL 90)    BALTAY     67 HBC  +-  0.0 PBAR P        2/67

R3   *   B MESON INTO (PI PI)/(PI OMEGA)
R3             0.3   OR LESS            ADERHOLZ   64 HBC      4.0 PI+P          7/66

R4   *   B MESON INTO (PI PHI) / (PI OMEGA)
R4             0.015 OR LESS            DAHL       67 HBC      1.6-4.2 PI- P     0/66

R5   *   B MESON INTO (ETA PI) / (PI OMEGA)
R5             0.25  OR LESS (CL 90)    BALTAY     67 HBC  +-  0.0 PBAR P        2/67

R6   *   B+- INTO ((K KBAR)+- PI0) / (PI OMEGA)
R6             0.08  OR LESS (CL 90)    BALTAY     67 HBC  +-  0.0 PBAR P        2/67

R6   *   B+- INTO (KS KS PI+-) / (PI OMEGA)
R6             0.02  OR LESS (CL 90)    BALTAY     67 HBC  +-  0.0 PBAR P        2/67

R6   *   B+- INTO (KS KL PI+-) / (PI CMEGA)
R6             0.06  OR LESS (CL 90)    BALTAY     67 HBC  +-  0.0 PBAR P        2/67

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                           REFERENCES FOR B MESCN

ABOLINS  63 PRL 11 381          ABOLINS,LANDER,MEHLHOP,XUCNG,YAGER   (UCSD)
ADERHOLZ 64 PL 10 240           AACHEN+BERLIN+BIRM+BONN+HAMBUR+IC-LO(D+MPI)
GOLDHABE 65 PRL 15 118          G GOLDHABER,S GOLDHABER,KADYK,SHEN    (LRL)

BALLAM   67 HEIDBG CONF P.33    +BRODY,CHADWICK,FRIES,GUIRAGOSSIAN+  (SLAC)
BALTAY   67 PRL 18 93           +SEVERIENS+YEH+ZANELLO             (COL+BNL)
BISWAS   67 HEIDBG CONF P.33    +GROVES,CASON,KENNEY,POIRIER+  (NCTRE DAME)
DAHL     67 PR 163 1377         +HARDY+HESS+KIRZ+MILLER                (LRL)
FOSTER   67 HEIDELB.CONF.P 33 +GAVILLET,LABROSSE,MONTANET+  (CERN+C.DE F)
LEE      67 PR 159 1156         +MOEBS,ROE,SINCLAIR,VANDERVELDE  (MICHIGAN)

ASCOLI   68 PRL 20 1411         +CRAWLEY,MORTARA,SHAPIRO          (URBANA)  JP
BOESEBEC 68 NP B 4 501          BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO     68 NC 54 A 983         +CONTE+CORDS+DIAZ+    (GENOVA+HAMB+MIL+SACL)
CHUNG    68 PR 165 1491         S.U.CHUNG,O.DAHL,J.KIRZ,D.H.MILLER    (LRL)
GIDAL    68  UCRL-17984         +BROWN,BIRGE,BACASTOW,FUNG+(LRL+U.C.RIVERS)

                     PAPERS NOT REFERRED TO IN DATA CARDS

BONDAR   63 PL 5 209            BONDAR,DODD+ (AACHEN+BIRM+HAMB+IC-LOND+MPI)
CARMONY  64 PRL 12 254          CARMONY,LANDER,RINDFLEISCH,XUONG,YAGER (UC) JP
SLATTERY 67 NC 50A 377          +KRAYBILL+FORMAN+FERBEL         (YALE+ROCH)
BALLAM   68  VIENNA ABS.   919 +BRODY,CHADWICK,GUIRAGOSSIAN,LEITH+  (SLAC)

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Data in parentheses have not been included in our averages.

f(1260)

5 F (1260,JPG=2++) I=0

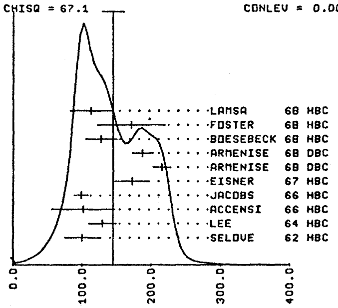
5 F MASS (MEV)

M		1250.0	25.0	SELOVE	62	HBC	3.0 PI-P	
M	*	5(1260.0)		BONDAR	63	HBC	4.0 PI-P	
M		1260.0	35.0	VEILLET	63	FBC	6.1 PI-P	
M		5 1250.0		GUIRAGOSS	63	HBC	3.3 PI-P	
M		1250.0		LEE	64	HBC	3.7 PI-P	
M		1270.0		DERADO	65	HBC	4.0 PI- P	6/66
M		1240.0	20.0	ACCENSI	66	HBC	5.7 PBAR P	6/66
M		1416 1267.0	10.0	JACOBS	66	HBC	2-3 PI-P,T CUT20	0/67
M		1275.0	25.0	WAHLIG	66	SPRK	10.0 PI-P	6/66
M	*	(1255.)	(13.)	BARLOW	67	HBC	(K01 K01 MODE)	11/66
M	*	(1271.)	(9.)	EISNER	67	HBC	4.2 PI-P (ALL T)	9/67
M		1264.	7.	EISNER	67	HBC	4.2 PI-P (T CUT 20)	9/67
M	*	(1262.0)	(7.0)	POIRIER	67	HBC	8.0 PI- P	11/67
M	S	(1276.)	(11.)	RABIN	67	HBC	8.5 PI+ P	9/67
M	S	S-WAVE BREIT-WIGNER FIT						
M		1261.	4.	ARMENISE	68	DBC	5.1 PI+N,P PI+ -	6/68*
M		1270.	5.	ARMENISE	68	DBC	5.1 PI+N,P PI0 0	6/68*
M	*	(1267.0)	(9.0)	ARMENISE2	68	DBC	9.0 PI+ D	9/68*
M		1265.	8.	BOESEBECK	68	HBC	8 PI+ P	6/68*
M		1241.	38.	FOSTER	68	HBC	PBAR P AT REST	6/68*
M		1267.	15.	LAMSA	68	HBC	8 PI-P	0/67
M	*	(1291.0)	(35.0)	MASON	68	HBC	2.5 PBAR P	9/68*
M	*	(1270.0)	(15.0)	WHITEHEAD	68	SPRK	3.2 PI-P,PI+PI-N	6/68*
M		. . . .						
M	AVG	1264.1715	2.4985	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)				

5 F WIDTH (MEV)

W		100.0	25.0	SELOVE	62	HBC	3.0 PI-P	
W	*	85 (160.0)		BONDAR	63	HBC	4.0 PI-P	
W		200.0	OR LESS	VEILLET	63	FBC	6.1 PI-P	
W		130.0	20.0	LEE	64	HBC	3.7 PI-P	
W		150.0		DERADO	65	HBC	4.0 PI- P	6/66
W		102.0	46.0	ACCENSI	66	HBC	5.7 PBAR P	6/66
W		1416 99.0	10.0	JACOBS	66	HBC	2-3 PI-P,T CUT20	0/67
W		100.		WAHLIG	66	SPRK	10.0 PI-P	11/66
W	*	(82.)	(34.)	BARLOW	67	HBC	(K01 K01 MODE)	11/66
W	*	(219.)	(39.)	EISNER	67	HBC	4.2 PI-P (ALL T)	9/67
W		173.	25.	EISNER	67	HBC	4.2 PI-P (T CUT 20)	9/67
W	*	(163.0)	(16.0)	POIRIER	67	HBC	8.0 PI- P	11/67
W	S	(155.)	(17.)	RABIN	67	HBC	8.5 PI+ P	9/67
W	S	S-WAVE BREIT-WIGNER FIT						
W		216.	13.	ARMENISE	68	DBC	5.1 PI+N,P PI+ -	6/68*
W		188.	15.	ARMENISE	68	DBC	5.1 PI+N,P PI0 0	6/68*
W	*	(272.0)	(20.0)	ARMENISE2	68	DBC	9.0 PI+ D	9/68*
W		128.	23.	BOESEBECK	68	HBC	8 PI+ P	6/68*
W		172.	49.	FOSTER	68	HBC	PBAR P AT REST	6/68*
W		113.	30.	LAMSA	68	HBC	8 PI-P	0/67
W	*	(181.0)	(40.0)	MASON	68	HBC	2.5 PBAR P	9/68*
W	*	(160.0)	(20.0)	WHITEHEAD	68	SPRK	3.2 PI-P,PI+PI-N	6/68*
W		. . . .						
W	AVG	145.3259	15.7796	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.7) (SEE IDEOGRAM BELOW)				

WEIGHTED AVERAGE = 145.3 ± 15.8
ERROR SCALED BY 2.73
CHISQ = 67.1   CONLEV = 0.000



F WIDTH (MEV)

5 F PARTIAL DECAY MODES

			DECAY MASSES
P1	F	INTO PI+ PI-	139+ 139
P2	F	INTO 2PI+ 2PI-	139+ 139+ 139+ 139
P3	F	INTO K KBAR	497+ 497

5 F BRANCHING RATIOS

R1	*	F INTO (2PI+ 2PI-) / TOTAL						
R1		0.08	0.06	BONDAR	63	HBC	4.0 PI-P	
R1		0.04	OR LESS	CHUNG	65	HBC	3.2 PI-P	
R1	*	0.01	APPROX.	FERBEL	68	HBC	5 PI- P	6/68*
R2	*	F INTO (K KBAR)/(PI PI)						
R2	*	DETERMINATION DIFFICULT BECAUSE PROXIMITY OF A2 WHICH HAS SAME						
R2	*	NEUTRAL (K KBAR) MODES						
R2		0.09	OR LESS	BARMIN	65	HLBC	2.8 PI-	0/66
R2		0.16	OR LESS	WANGLER	65	HBC	3.0 PI-P	
R2	B	PROBABLY SEEN		BARLOW	67	HBC	1.2 PBAR P--K1K1	11/66
R2	N	0.047	0.012 + SYST.	BEUSCH	67	SPRK	5,7,12 PI-P	9/67
R2	N	PEAK UNRESOLVED FROM A2						
R2		0.025	OR LESS	DAHL	67	HBC	1.6-4.2 PI- P	0/66
R2	A	(0.055)	(0.038)	ABCCW COL	68	HBC	8.0 PI+ P	9/68*
R2	A	K+K- PEAK IS AT ABOUT 1260 MEV WHILE (KKBAR)+ PEAKS AT 1320.						

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REFERENCES FOR F

SELOVE	62 PRL 9 272	SELOVE,HAGOPIAN,BRODY,BAKER,LEBOY	(PENNA)
BONDAR	63 PL 5 153	BONDAR+ (AACHEN+BIRM+BONN+DESY+IC-LOND+MPI)	
GUIRAGOS	63 PRL 11 85	Z.G.T. GUIRAGOSSIAN	(LRL)
VEILLET	63 PRL 10 29	VEILLET,HENNESSY,BINGHAM,BLOCH+	(PAR+MILAN)
LEE	64 PRL 12 342	LEE,ROE,SINCLAIR,VANDERVELDE	(MICHIGAN)
BARMIN	65 SJNP 1 623	+DOLGOLENKO+EROFEEV+KRESTNIKOV+	(ITEP MOSC)
CHUNG	65 PRL 15 325	CHUNG,DAHL,HARDY,HESS,JACOBS,KIRZ	(LRL)
DERADO	65 PRL 14 872	DERADO,KENNEY,POIRIER,SHEPHARD	(NOTRE DAME)
GUIRAGOS	65 PRL 11 85	Z G T GUIRAGOSSIAN	(LRL)
WANGLER	65 PR 137 B 414	T P WANGLER,A R ERWIN,W WALKER	(WISCONSIN)
ACCENSI	66 PL 20 557	ACCENSI,ALLES-BORELLI,FRENCH,FRISK+	(CERN)
JACOBS	66 UCRL-16877	L.D.JACOBS,THESIS	(LRL)
WAHLIG	66 PR 147 941	+SHIBATA,GORDON,FRISCH,MANNELLI	(MIT+PISA) J
BARLOW	67 NC 50A 701	+LILLESTOL+MONTANET+(CERN+CDF+IR+LIVERPOOL)	
BEUSCH	67 PL 25 B 357	+FISCHER,GOBBI,ASTBURY,MICHELINI+(ETH+CERN)	
DAHL	67 PR 163 1377	+HARDY+HESS+KIRZ+MILLER	(LRL)
EISNER	67 PR 164 1699	+JOHNSON+KLEIN+PETERS+SAHNI+YEN+	(PURDUE)
POIRIER	67 PR 163 1462	+BISWAS,CASON,DERADO,KENNEY+	(NOTRDAM+PENN)
RABIN	67 THESIS	M. RABIN	(RUTGERS)
ABCCW CO	68 VIENNA ABS. 454	COLLABORATION AACHEN-BERLIN+CERN+(RAK+WARS)	
ARMENISE	68 NC 54 A 999	+FORINO+CARTACCI+(BARI+BOLOG+FIRENZE+ORSAY)	
ARMENIS2	68 VIENNA ABS. 412	ARMENISE,FORINO,CARTACCI+	(BARI+BGNA+FIRZ)
BOESEBIC	68 NP B 4 501	BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)	
FERBEL	68 PREP.-PHILA.CONF	T.FERBEL,QUOT.RES.OF MORTARA+(ILL.)	(ROCH)
FOSTER	68 NP B 6 107	+GAVILLET+LABROSSE+MONTANET+	(CERN+PARIS)
LAMSA	68 PR 166 1395	+CASON+BISWAS+DERADO+GROVES+	(NOTREDAME)
MASON	68 VIENNA ABS. 275	+MUIRHEAD,POPPLETON,RIGOPCULOS+	(LIVP+ATEN)
WHITEHEA	68 NC 53A 817	+MCEWEN,OTT,AITKEN+	(AERE+SHAMPT+UC.LOND)

PAPERS NOT REFERRED TO IN DATA CARDS

HAGOPIAN	63 PRL 10 533	V HAGOPIAN,W SELOVE	(PENNA)	
ADERHOLZ	64 PL 10 240	AACHEN+BERLIN+BIRM+BONN+HAMBUR+IC-L(ND+MPI)		IJ
BRUYANT	64 PL 10 232	BRUYANT,GOLDBERG,HOLDER,FLEURY,HUC(CERN+PA)		I
SODICKSO	64 PRL 12 485	SODICKSON,WAHLIG,MANNELLI,FRISCH+	(MIT)	I
BARMIN	65 SJNP 1 230	+COLGOLENKO,ELENSKY,EROFEEV+	(ITEP MOSCOW)	JP
STRUGALS	67 JINR E1-3100	STRUGALSKI+CHUVILO+IVANOVSKAJA+	(DUBNA)	

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D(1285)

8 D MESON (1285,JPG= +) I=0

(JP=0-,1+,2- WITH 1+ FAVORED.)

8 D MESON MASS (MEV)

M		1290.	APPROX.	BARLOW	67	HBC	1.2 PBAR P,4BODY	5/67
M		1283.0	5.0	DAHL	67	HBC	1.6-4.2 PI- P	0/66
M		1290.	7.	D.ANDLAU	68	HBC	1.2 PBAR P, 5-6BODY	6/68*
M	*	46(1270.0)	(10.0)	D.ANDLAU2	68	HBC	0.7 PB P,5 BODY	9/68*
M	*	(1300.0)		DEFOIX	68	HBC	1.2 PB P,7 PI	9/68*
M		. . . .						
M	AVG	1285.3649	4.0687	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)				

8 D MESON WIDTH (MEV)

W		35.0	10.0	DAHL	67	HBC	1.6-4.2 PI- P	0/66
W		30.	5.	D.ANDLAU	68	HBC	1.2 PBAR P, 5-6 PFS	6/68*
W	*	46 (65.0)	(20.0)	D.ANDLAU2	68	HBC	0.7 PB P,5 BODY	9/68*
W	*	(40.0)		DEFOIX	68	HBC	1.2 PB P,7 PI	9/68*
W		. . . .						
W	AVG	31.0000	4.4721	AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)				

8 D MESON PARTIAL DECAY MODES

		DECAY MASSES
P1	D MESON INTO K KBAR PI	497+ 497+ 134
P2	D MESON INTO PI PI RHO	134+ 134+ 770
P3	D MESCN INTO ETA PI PI	548+ 134+ 134
P4	D MESON INTO DELTA(962) PI	962+ 134

8 D MESON BRANCHING RATIOS

R1	*	D MESON INTO (PI PI RHO) / (K KBAR PI)						
R1	*	2.0	OR LESS	DAHL	67	HBC	CHARGED PI ONLY	0/66
R1	D	4.0	OR LESS	DONALD	68	HBC	1.2 PB P,5 PI	9/68*
R1	D	THIS IS FOR (RHO0 PI+ PI-)/(K KBAR PI0)						
R2	*	D MESON INTO (K KBAR PI)/(ETA PI PI)						
R2	*	(0.142)	(0.035)	DEFOIX	68	HBC	1.2 PB P,7 PI	9/68*
R3	*	D MESON INTO (DELTA PI)/(ETA PI PI)						
R3	*	POSSIBLY SEEN		DEFOIX	68	HBC	1.2 PB P,7 PI	9/68*

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REFERENCES FOR D MESON

BARLOW	67 NC 50 A 701	+MONTANET,D-ANDLAU+(CERN+CDF+IDR+LIVERPOOL)		
DAHL	67 PR 163 1377	+HARDY+HESS+KIRZ+MILLER	(LRL)	I JP
SEE ALSO	65 PRL 14 1074	MILLER,CHUNG,DAHL,HESS,HARDY,KIRZ+	(LRL+UC)	
D.ANDLAU	68 NP B 5 693	+ASTIER,BARLOW,MONTANET+	(CDF+CERN+RAD+LIV)	I JP
D.ANDLA2	68 VIENNA ABS. 626	D'ANDLAU,ASTIER,COHEN-GANOUNA+	(CDEF+CERN)	
DEFOIX	68 VIENNA ABS. 653	+SIAUD,RIVET,SHIVELY,CONFORTO(CDF+IPN+CERN)		
DONALD	68 VIENNA ABS. 323	+EDWARDS,BURAN,BETTINI+	(LIVP+OSLC+PADO)	

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A2(1300)

12 A2 MESON (1300,JPG=2+-) I=1

THE MASS ANC WIDTH DATA ARE SEPARATEC INTO 4 GRCUPS
A2L CONTAINS INFORMATION ON THE LOWER PEAK
A2H CONTAINS INFORMATION ON THE HIGHER PEAK
A2K CONTAINS INFORMATION CN K KBAR (YET UNDECIDED WHETHER SPLIT)
A2 CONTAINS THE REMAINING INFORMATION (NO SEPARATION)

MESON RESONANCES

Data in parentheses have not been included in our averages.

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                  12  A2L MESON MASS (MEV)

ML          1274.       16.             CHIKOVANI 67 MMS   -  6,7 PI- P        6/68*
ML          1269.0      5.0             CRENNELL  68 HBC   -  6.0 PI-P,X-      6/68*
ML    *     (1266.)     (8.)            KIENZLE   68 MMS   -  2.65 PI- P       6/68*
ML          . . . . . . . . . .
ML   AVG    1269.4448   4.7724  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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                  12  A2H MESON MASS (MEV)

MH          1320.       16.             CHIKOVANI 67 MMS   -  6,7 PI- P        6/68*
MH          1315.0      5.0             CRENNELL  68 HBC   -  6.0 PI-P,X-      6/68*
MH    *     (1319.)     (8.)            KIENZLE   68 MMS   -  2.65 PI- P       6/68*
MH          . . . . . . . . . .
MH   AVG    1315.4448   4.7724  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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                  12  A2  MESON MASS (MEV), K KBAR MODE

MK       80 1317.0      3.0             BARLOW    67 HBC  +-  1.2 PBAR P, KK   9/67
MK       60 1333.0      13.0            BARLOW    67 HBC  +-  1.2 PBAR P, KK   9/67
MK    N     (1344.0)    (7.)     (6.)   BEUSCH    67 SPRK   0 5-12 PI- P       7/67
MK    N     K01 K01 MODE. PEAK UNRESOLVED FROM F.
MK      130 1280.0      12.0            CONFORTO  67 HBC  +-  0. PBAR P IN KK  9/67
MK          1317.2      4.0             DAHL      67 HBC   -  2.7-4.5 PI- P    8/67
MK          1315.7      10.8            DAHL      67 HBC   0 2.7-4.5 PI- P     8/67
MK          1311.0      5.0             CRENNELL  68 HBC   -  6.0 PI-P,K1K1    6/68*
MK          . . . . . . . . . .
MK   AVG    1315.2943   3.1680  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)
                        (SEE IDEOGRAM BELOW )
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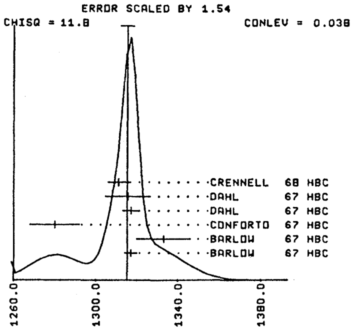
WEIGHTED AVERAGE = 1315.29 ± 3.17
ERROR SCALED BY 1.54

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                  12  A2 MESON MASS (MEV),3PI MODE,SPLITTING UNRESOLVED

M           1320.0                      ADERHOLZ  64 HBC      4.0 PI+P
M           1335.0      10.0            GOLDHABER 64 HBC  +-  3.7 PI+- P
M       130 1310.0                      FORINO    65 DBC  + 0 4.5 PI+ D       0/66
M      1425 1290.0      5.0             LEFEBVRES 65 MMSP  -  5.6,6.0 PI-P    6/66
M           1300.0                      SEIDLITZ  65 DBC   -  3.2 PI-D        6/66
M           1290.0      10.0            BARNES    66 HBC   -  6.0 PI-P        6/66
M           1310.0      10.0            BENSON    66 DBC    0 3.65 PI+D       6/66
M     * 1800 1310.0     10.0   COMP.BY FERBEL    66       +-  PI+- P         10/66
M      1060 1286.       8.              LEVRAT    66 MMS   -   6-7 PI- P      2/67
M       137 1285.       20.             BALTAY    67 HBC    0 8.5 PI+ P       7/67
M     A     (1288.)     (14.)           CASON     67 HBC   -  8 PI- P         5/67
M     A     ANALYSIS COMPLICATED BY NEARBY PEAK (A1.5) AT 1190 MEV
M      4000 1307.       16.             CHIKOVANI 67 MMS   -  7 PI- P         8/67
M           1269.       9.              DANYSZ    67 HBC  +-  3,3.6 PBAR P    7/67
M     *     (1306.0)    (7.0)           ABBCH COL 68 HBC   - 16.0 PI- P,5 PI  9/68*
M           1311.0      6.0             ARMENISE  68 DBC    0 5.1 PI+D        9/67
M     *     (1306.0)    (10.0)          ASCOLI 2  68 HBC   -  5.0 PI- P       9/68*
M           1282.0      15.0            BALLAM    68 HBC   - 16.0 PI- P       9/68*
M     *     (1315.0)    (15.0)          BLUMENFEL 68 HBC   -  3.9 PI- P       9/68*
M           1320.       10.             BOESEBECK 68 HBC    0 8 PI+ P         6/68*
M     B     (1280.)     (10.)           BOESEBECK 68 HBC   +  8 PI+ P         6/68*
M     B     ASSUMING A1 AND A1.5 MESONS OF FIXED MASS AND WIDTH
M           1300.       APPROX.         CASO      68 HBC   - 11 PI- P         6/68*
M           1310.       20.             CHUNG     68 HBC   -  2.7-4.5 PI- P   5/68*
M           1287.0      10.0            CRENNELL  68 HBC   -  6.0 PI-P,X-     6/68*
M           1275.       17.             FRIDMAN   68 HBC  +-  5.7 PBAR P      6/68*
M           1280.       12.             KEY       68 HBC   -  3 PI-P         11/67
M     *     (1301.0)    (8.0)           VON KROGH 68 HBC   -  6.7 PI- P       9/68*
M           . . . . . . . . . .
M    AVG    1296.6581   4.4843  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.8)
                        (SEE IDEOGRAM BELOW )
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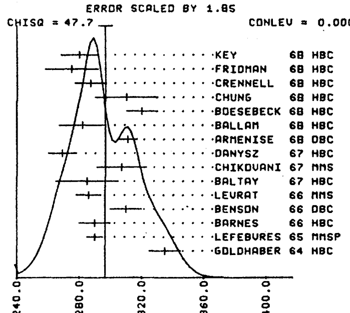
WEIGHTED AVERAGE = 1296.66 ± 4.48
ERROR SCALED BY 1.85

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                  12  A2L MESON WIDTH (MEV)

WL          29.         10.             CHIKOVANI 67 MMS   -  6,7 PI- P        6/68*
WL          24.0        10.0            CRENNELL  68 HBC   -  6.0 PI-P,X-      6/68*
WL    *     (28.)       (5.)            KIENZLE   68 MMS   -  2.65 PI- P       6/68*
WL          . . . . . . . . . .
WL   AVG    26.5000     7.0711  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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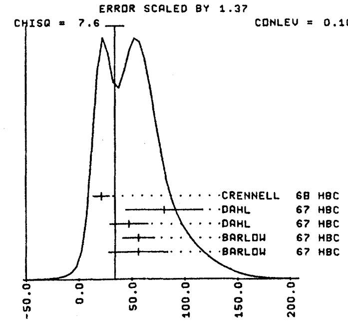
                  12  A2H MESON WIDTH (MEV)

WH          35.         10.             CHIKOVANI 67 MMS   -  6,7 PI- P        6/68*
WH          12.0        10.0            CRENNELL  68 HBC   -  6.0 PI-P,X-      6/68*
WH    *     (28.)       (5.)            KIENZLE   68 MMS   -  2.65 PI- P       6/68*
WH          . . . . . . . . . .
WH   AVG    23.5000     11.5000 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)
------ --------- --------- --------- --------- --------- --------- --------

                  12  A2  MESON WIDTH (MEV), K KBAR MODE

WK       60 56.0        28.0            BARLOW    67 HBC  +-  1.2 PBAR P, KK   9/67
WK       80 56.0        15.0            BARLOW    67 HBC  +-  1.2 PBAR P, KK   9/67
WK    N     (88.)       (23.)    (22.)  BEUSCH    67 SPRK   0 5-12 PI- P       7/67
WK    N     K01 K01 MODE. PEAK UNRESOLVED FROM F.
WK      130 90.0                        CONFORTO  67 HBC  +-  0. PBAR P IN KK  9/67
WK          47.         18.             DAHL      67 HBC   -  2.7-4.5 PI- P    8/67
WK          80.5        36.5            DAHL      67 HBC   0 2.7-4.5 PI- P     8/67
WK          21.0        10.0     6.0    CRENNELL  68 HBC   -  6.0 PI-P,K1K1    6/68*
WK          . . . . . . . . . .
WK   AVG    33.9103     8.6596  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
                        (SEE IDEOGRAM BELOW )
```

WEIGHTED AVERAGE = 33.91 ± 8.66
ERROR SCALED BY 1.37

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                  12  A2 MESON  WIDTH (MEV)

W           100.0                       ADERHOLZ  64 HBC      4.0 PI+P
W           90.0        10.0            GOLDHABER 64 HBC  +-  3.7 PI+- P
W      1425 99.0        15.0            LEFEBVRES 65 MMSP  -  6.0 PI-P        6/66
W           140.0                       SEIDLITZ  65 DBC   -  3.2 PI-D        6/66
W           70.0        10.0            BARNES    66 HBC   -  6.0 PI-P        6/66
W     N     (110.0)     (45.0)          BENSON    66 DBC    0 3.65 PI+D       6/66
W     N     SUPERSEDED BY BENSON 1 66
W           100.        15.             BENSON 1  66 DBC    0 3.65 PI+D       1/67
W     * 1800 80.0       10.0   COMP.BY FERBEL    66       +-  PI+- P         10/66
W      1060 98.         5.              LEVRAT    66 MMS   -  6,7 PI- P       2/67
W       137 100.        25.             BALTAY    67 HBC    0 8.5 PI+ P       7/67
W     A     (84.)       (30.)    (20.)  CASON     67 HBC   -  8 PI- P         5/67
W     A     ANALYSIS COMPLICATED BY NEARBY PEAK (A1.5) AT 1190 MEV
W      4000 90.         15.             CHIKOVANI 67 MMS   -  7 PI- P         8/67
W           45.         22.             DANYSZ    67 HBC  +-  3,3.6 PBAR P    7/67
W           96.0        16.0            ARMENISE  68 DBC    0 5.1 PI+D        9/67
W     *     (108.0)     (10.0)          ASCOLI 2  68 HBC   -  5.0 PI- P       9/68*
W           125.0       40.0            BALLAM    68 HBC   - 16.0 PI- P       9/68*
W           90.         APPROX.         BOESEBECK 68 HBC   +  8 PI+ P         6/68*
W           56.         21.             BOESEBECK 68 HBC    0 8 PI+ P         6/68*
W           80.         APPROX.         CASO      68 HBC   - 11 PI- P         6/68*
W           80.         20.             CHUNG     68 HBC   -  2.7-4.5 PI- P   5/68*
W           94.0        30.0     20.0   CRENNELL  68 HBC   -  6.0 PI-P,X-     6/68*
W           80.         APPROX.         FRIDMAN   68 HBC  +-  5.7 PBAR P      6/68*
W           91.         18.             KEY       68 HBC   -  3 PI-P         11/67
W     *     (40.0)      (25.0)          VON KROGH 68 HBC   -  6.7 PI- P       9/68*
W           . . . . . . . . . .
W    AVG    90.8811     3.6713  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)
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                  12  A2 MESON PARTIAL DECAY MODES

                                                          DECAY MASSES
P1      A2 MESCN INTO RHO PI                              770+ 139
P2      A2 MESCN INTO KBAR K                              493+ 497
P3      A2 MESCN INTC ETA PI                              548+ 139
P4      A2 MESON INTO ETA PRIME PI                        958+ 139
P5      A2 MESON INTO PI+ PI- PIO                         139+ 139+ 134
------ --------- --------- --------- --------- --------- --------- --------

                  12  A2 MESON  BRANCHING RATIOS

R1  *   A2 MESON  INTO (K KBAR) / (RHO PI)
R1  *       0.08  OR LESS               LANDER    64 HBC  +   3.5 PI+P        0/66
R1  N      (0.13)    (0.03)             BEUSCH    67 SPRK   0 5,7,12 PI-+     9/67
R1  N       K01 K01 MODE. UNRESOLVED FROM F.
R1  *      (0.15)    (0.05)             BOCKMANN  67 HBC    0 5.0 PI+P        9/67
R1  *      (0.09)    (0.05)             BOCKMANN  67 HBC  +   5.0 PI+P        9/67
R1      11  0.09      0.06     0.09     ASCOLI    68 HBC  -   5 PI-P          6/68*
R1          0.022     0.008             BOESEBECK 68 HBC  +   8 PI+ P         6/68*
R1          0.054     0.022             CHUNG     68 HBC  -   3.2 PI-P        1/67
R1          0.03      0.012             DONALD    68 HBC  +-  1.2 PBAR P      6/68*
R1        . . . . . . . . . .
R1  AVG     .0274     .0063  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT     .027      .006    VALUE FROM CONSTRAINED FIT

R2  *   A2 MESON INTO (ETA PI)/TOTAL
R2          0.084     0.023             BOESEBECK 68 HBC  +   8 PI+ P         6/68*
R2        . . . . . . . . . .
R2  FIT     .108      .021    VALUE FROM CONSTRAINED FIT
```

Data in parentheses have not been included in our averages.

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R3  *   A2 MESON INTO (ETA PI) / (RHO PI)
R3          0.3        0.2              ADERHOLZ  64 HBC      4.0 PI+P
R3  D      (0.24)     (0.08)            DUBOVIKOV 66 HBC   -  3.3 PI-P         11/66
R3  D     VETLITSKY 68 IS UPDATING OF DUBOVIKOV 66
R3  *   15 (0.24)     (0.08)            BOCKMANN  67 HBC   +  5.0 PI+P          9/67
R3          0.22       0.09             CONTE     67 HBC   -  11.0 PI-P         8/67
R3      22  0.23       0.08             ASCOLI    68 HBC   -  5 PI-P            6/68*
R3          0.12       0.08             CHUNG     68 HBC   -  3.2 PI-P         12/66
R3  *       0.072 OR LESS               DONALD    68 HBC   +- 1.2 PBAR P        6/68*
R3          0.16       0.10             KEY       68 HBC   -  3 PI-P           11/67
R3  *      (0.18)     (0.06)            VETLITSKY 68 HBC   -  3.3 PI- P         9/68*
R3        . . . . . . . . . .
R3  AVG      .1878     .0422  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R3  FIT      .126      .027    VALUE FROM CONSTRAINED FIT

R4  *   A2 MESON INTO (ETA PRIME PI) / TOTAL
R4          0.1    OR LESS              CHUNG     65 HBC   -  3.2 PI-P
R4          0.004      0.004            BOESEBECK 68 HBC   +  8 PI+ P           6/68*
R4        . . . . . . . . . .
R4  FIT      .005      .004    VALUE FROM CONSTRAINED FIT

R5  *   A2 MESON INTO (ETA PRIME PI)/(RHO PI)
R5      14  0.07       0.03             ASCOLI    68 HBC   -  5.0 PI-P          6/68*
R5        . . . . . . . . . .
R5  FIT      .006      .005    VALUE FROM CONSTRAINED FIT

R6  *   A2 MESON INTO (PI+ PI- PIO) / (RHO PI)
R6          0.17   OR LESS              BENSON    66 DBC    0 3.7 PI+D

 THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

     P1 P3      -.950

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REFERENCES FOR A2


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ADERHOLZ 64 PL 10 248          AACHEN+BERLIN+BIRM+BONN+HA(B+IC-LONDON+MPI)
GOLDHABE 64 DUBNA CONF  1 480 G GOLDHABER,S GOLDHABER,OHALLORAN,SHEN(LRL)
LANDER   64 PRL 13 346         +ABOLINS,CARMONY,HENDRIKS,XUONG+ (LA JOLLA)

ABOLINS  65 ATHENS(OHIO)CONF. +CARMONY,LANDER,XUONG,YAGER     (LA JOLLA)I=1
CHUNG    65 PRL  15  325       +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER   (LRL)
FORINO   65 PL 19 68           +GESSAROLI+LENDINARA+(BOL+BARI+FIR+ORS+SAC)
LEFEBVRE 65 PL 19 434          CERN MISSING MASS SPECTROMETER GROUP (CERN)
SEIDLITZ 65 PRL 15 217         L SEIDLITZ,O I DAHL,D H MILLER        (LRL)

BARNES   66 PRL 16 41          BARNES,FOWLER,LAI,ORENSTEIN +    (BNL+CCNY)
BENSON   66 PRL 16 1177        G BENSON,LOVELL,MARQUIT,ROE  +   (MICHIGAN)
BENSON 1 66 MICH COO-1112-4    G.C.BENSON, THESIS               (MICHIGAN)
DUBOVIKC 66 PL 23 716+PRIV.C. DUBOVIKOV,GRIGORIEV,VLADIMIRSKY +    (ITEP)
EHRLICH  66 PR 152 1194        R. EHRLICH,W.SELOVE,H.YUTA   (PENNSYLVANIA)
FERBEL   66 PL 21 111          FERBEL                          (ROCHESTER)
LEVRAT   66 PL  22  714        CERN MISSING MASS SPECTROMETER GROUP (CERN)

ARMENISE 67 PL 25B 53          ARMENISE,FORINO,+       (BARI+BOL+FIR+CRSAY)
BALTAY   67 PL 25B 160         +KIRSCH+KUNG+YEH+RABIN  (COLUM+BNL+RUTGERS)
BARLOW   67 NC 50A 701         +LILLESTOL+MONTANET+(CERN+CDF+IR+LIVERPOOL)
BARTSCH  67 PL 25B 48          +DEUTSCHMANN+GROTE+COCCONI+(AACH+BERL+CERN)
BEUSCH   67 PL 25 B 357        +FISCHER,GOBBI,ASTBURY,MICHELINI+(ETH+CERN)
BOCKMANN 67 HEIDBG CONF P.20   +KOBE,ROST,POLS+ (BONN+DURH+NIJM+EPP+TURIN)
CASON    67 PRL 18 880         +LAMSA,BISWAS,DERADO,GROVES,+   (NOTREDAME)
CHIKOVAN 67 PL 25B 44          CERN MISSING MASS SPECTROMETER GROUP (CERN)
CHUNG    67 PRL 18 100         +DAHL,HARDY,HESS,KIRZ,MILLER          (LRL)
   ALSO  66 UCRL-16832         RICHARD I HESS--THESIS,BERKELEY       (LRL)
COHN     67 NP B1 57           +MCCULLOCH+BUGG+CONDO      (ORNL+UNIV.TENN.)
CONFORTO 67 NP B3 469          +MARECHAL,MONTANET+ (CERN+CF+IPN+LIVERPOOL)
CONTE    67 NC  51 A  175      +TOMASINI,CORDS+ (GENOVA+HAM+MILANO+SACLAY)
DAHL     67 PR 163 1377        +HARDY+HESS+KIRZ+MILLER               (LRL)
DANYSZ   67 NC 51 A 801        DANYSZ+FRENCH+SIMAK                  (CERN)

ABBCH CO 68  VIENNA ABS.  466 COLLABORATION AACHEN-BERLIN+BONN+CER(+HEID)
ARMENISE 68 PL 26B 336         ARMENISE,FORINO,+       (BARI+BOL+FIR+CRSAY)
ASCOLI   68 PRL 20  1321       +CRAWLEY,MORTARA,SHAPIRO,BRIDGES+(ILLINOIS)  JP
ASCOLI 2 68  VIENNA ABS.  509 +BRIDGES,CRAWLEY,EISENSTEIN,HANFT+     (ILL)
BALLAM   68 PRL 21 934         +BRODY,CHADWICK,FRIES,GUIRAGOSSIAN+  (SLAC)
BLUMENFE 68  VIENNA ABS.  272 BLUMENFELD,BRUYANT,ABRAMOVITCH+ (CERN+SACL)
BOESEBEC 68 NP B 4 501         BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO     68 NC 54 A 983        +CONTE+CORDS+DIAZ+   (GENOVA+HAMB+MIL+SACL)
CHUNG    68 PR 165 1491        S.U.CHUNG,O.DAHL,J.KIRZ,D.H.MILLER    (LRL)
CRENNELL 68 PRL 20 1318        +KARSHON+KWAN LAI,SCARR,SKILLICORN    (BNL)
DONALD   68 PL 26 B  327       +FRODESEN+BETTINI+   (LIVERPOOL+OSLO+PADUA)
FRIDMAN  68 PR 167 1268        +MAURER,MICHALON,OUDET+(HEIDELB+STRASBOURG)
KEY      68 PR 166 1430        +PRENTICE+COOPER+MANNER+WALKER+(TO+ANL+WIS)
KIENZLE  68  PHILADELPH.CONF. REVIEW GIVEN AT PH.C. ON MESON SPECT.(CERN)
VETLITSK 68  VIENNA ABS.  928 VETLITSKY,GRIGOREYEV,GRISHIN,GUZHAVIN+(ITEP)
VONKROGH 68 PL 27 B 253        +MIYASHITA,KOPELMAN,MARSHALL LIBBY   (COLO)
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PAPERS NOT REFERRED TO IN DATA CARDS

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LANDER   64 PRL 13 346 A       LANDER,ABOLINS,CARMONY,HENDRICKS +   (UCSD)  JP
ADERHOLZ 65 PR 138 B 897       AACHEN+BERLIN+BIRM+BONN+HAMB+LOND+MU(NCHEN)
ALITTI   65 PL 15 69           ALITTI,BATON,DELER,CRUSSARD+ (SACLAY+BOLOG)  JP
GOLDHABE 66 BERKELEY CONF.     G. GOLDHABER, MESON REVIEW            (LRL)
SLATTERY 67 NC 50A 377         +KRAYBILL+FORMAN+FERBEL         (YALE+ROCH)  JP
LAMSA    68 PR 166 1395        +CASON+BISWAS+DERADO+GROVES+    (NOTREDAME)
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A2 I=2 (1320)

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37  A2,2 (1320) I=2 OR GREATER

    SEEN AS A BUMP IN RHO- PI- MASS SPECTRUM.
    EVIDENCE NOT COMPELLING. OMITTED FROM TABLE.
    FOR A DISCUSSICN SEE ROSENFELD 68

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                    37 MASS (MEV)

M       34 1320.      25.              VANDERHAG 67 DBC  -- 5 PI-D          5/67

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                    37 WIDTH (MEV)

W       34  150.    APPROX.            VANDERHAG 67 DBC  -- 5 PI-D          5/67

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                    37 CROSS SECTICN (MICROBARNS)

CS      34   15.       5.              VANDERHAG 67 DBC  -- 5 PI-D          5/67

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REFERENCES FOR A2,2


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VANDERHA 67 PL 24B 493         VANDERHAGEN+HUC+FLEURY+ (EP+IPN+BARI+BOLOG)
ROSENFEL 68 UCRL-18266         A.H.ROSENFELD (PHILAD.CONF. MESON SP.)(LRL)
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E (1420)

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6  E MESON  (1420,JPG=A +)  I=0

   BAILLON 67 FAVOR JP=0-, DAHL 67 FAVCR 1+ BUT DO NOT
   EXCLUDE 2-, 0-.

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                    6 E MESON MASS (MEV)

M          1425.       7.          BAILLON   67 HBC     0. PBAR P          11/66
M          1420.0     20.0         DAHL      67 HBC     1.6-4.2 PI- P       0/66
M          1423.      10.          FRENCH    67 HBC     3-4 PBAR P          6/67
M   *    84(1415.0)  (10.0)        D.ANDLAU  68 HBC     0.7 PB P,4 BODY     9/68*
M   *   105(1428.0)  (15.0)        D.ANDLAU  68 HBC     0.7 PB P,5 BODY     9/68*
M   *    35(1401.0)  (18.0)        HODGE     68 HBC   0 5.5 K- P            9/68*
M         . . . . . . . . . .
M   AVG    1424.0124   5.5125  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    6 E MESON WIDTH (MEV)

W            80.       10.         BAILLON   67 HBC     0. PBAR P          11/66
W            60.0      20.0        DAHL      67 HBC     1.6-4.2 PI- P       0/66
W            45.       20.         FRENCH    67 HBC     3-4 PBAR P          6/67
W   *    84  (50.0)   (20.0)       D.ANDLAU  68 HBC     0.7 PB P,4 BODY     9/68*
W   *   105 (105.0)   (25.0)       D.ANDLAU  68 HBC     0.7 PB P,5 BODY     9/68*
W   *    35  (75.0)   (10.0)       HODGE     68 HBC     5.5 K- P            9/68*
W         . . . . . . . . . .
W   AVG      70.8333   9.6645  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)

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                    6 E MESON PARTIAL DECAY MODES

                                                         DECAY MASSES
P1          E INTO K K*(890)                             493+ 892
P2          E INTO K KBAR PI                             497+ 497+ 139
P3          E MESON INTO PI PI RHO                       134+ 134+ 770
P4          E INTO PI(1016) PI                          1016+ 139
P5          E INTO ETA PI PI                             548+ 139+ 139

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                    6  E MESON BRANCHING RATIOS

R1  *       E INTO K K*(890)/((K K*)+(PI(1016) PI))
R1             .50       .10       BAILLON   67 HBC      0.0 PBAR P        11/66

R2  *       E MESON INTO (PI PI RHO) / (K KBAR PI)
R2  *         2.0    OR LESS       CAHL      67 HBC    0 CHARGEO PI ONLY   0/66

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REFERENCES FOR E MESON


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BAILLON  67 NC 50A  393        +EDWARDS+D.ANDLAU+ASTIER+      (CERN+CDF+IR)
BARASH   67 PR 156  1399       BARASH,KIRSCH,MILLER,TAN          (COLUMBIA)
DAHL     67 PR 163 1377        +HARDY+HESS+KIRZ+MILLER               (LRL)I JP
   SEE ALSO 65 PRL 14 1074     MILLER,CHUNG,DAHL,HESS,HARCY,KIRZ+ (LRL+UC)
FRENCH   67 NC 52A 442         +KINSON+MCDONALD+RIDDIFORD+      (CERN+BIRM)
D.ANDLAU 68  VIENNA ABS.  626 +ASTIER,COHEN,AGUILAR-BENITEZ+  (CDEF+CERN)
HODGE    68  VIENNA ABS.  291 HODGE,KRAUSS,REEDER                (WISCONSIN)
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$K_S K_S$ (1440) / $\rho\rho$ (1410)

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29  KSKS(1440) AND RHORHO(1410) (JPG=N +) I GTE 0

    EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE
    IF RHOO RHOO AND KS KS ARE MODES OF THE SAME RESONANCE
    THEN I=0.

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                    29  KSKS AND RHORHO MASS  (MEV)

M     -------RHOO RHOO MODE-------
M         1410.0                   BETTINI   66 DBC   0  0. PBARP TO 5PR   9/66

M     -------KS KS MODE ----------
M   B     POSSIBLY SEEN            ABRAMS    67 HBC     4.25 K- P           5/67
M   B     THE AUTHORS ASSOCIATE THE PEAK WITH THE F PRIME, BUT BACKGROUND
M   B     ESTIMATION IS DIFFICULT
M         1412.       23.          BARLOW    67 HBC     1.2 PBAR P          5/67
M         1439.0       5.0    6.0  BEUSCH    67 SPRK    5,7,12 PI-P         9/67
M         . . . . . . . . . .
M   AVG   1437.5396    5.3492  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    29  KSKS AND RHORHO WIDTH (MEV)

W     -------RHOO RHOO MODE-------
W           90.0                   BETTINI   66 DBC   C 0. PBAR P TO 5PR   9/66

W     -------KS KS MODE ----------
W          100.       70.          BARLOW    67 HBC     1.2 PBAR P          5/67
W           43.0      17.0   18.0  BEUSCH    67 SPRK    5,7,12 PI-P         9/67
W         . . . . . . . . . .
W   AVG      46.3529  16.9775  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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REFERENCES FOR KSKS(1440) AND RHO RHO(1410)


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BETTINI  66 NC 42A 695         +CRESTI,LIMENTANI,LORIA,PERUZZO+ (PAD+PISA)
ABRAMS   67 PRL 18 620         +KEHOE,GLASSER,SECHI-ZORN,WCLSKY (MARYLAND)
BARLCW   67 NC  50 A  701      +MONTANET,D-ANDLAU+(CERN+CDF+IDR+LIVERPOOL)
BEUSCH   67 PL 25 B 357        +FISCHER,GOBBI,ASTBURY,MICHELINI+(ETH+CERN)
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f′(1515)

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13  F PRIME (1515,JPG=2++)  I=0

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                    13  F PRIME(1515) MASS (MEV)

M        14 1480.0                 CRENNELL  66 HBC     6.0 PI- P           8/66
M   B     5(1460.)    (10.)        ABRAMS    67 HBC    4.25 K- P            5/67
M   B   BACKGROUND ESTIMATION DIFFICULT.                                    5/67
M           1515.0     7.0         AMMAR     67 HBC     5.5 K-P             9/67
M        70 1513.0     7.0         BARNES    67 HBC     4.6, 5. K- P        0/67
M   *    20(1500.0)   (10.0)       D.ANDLAU  68 HBC     0.7 PB P,3 BODY     9/68*
M         . . . . . . . . . .
M   AVG   1514.0000    4.9497  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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MESON RESONANCES

Data in parentheses have not been included in our averages.

13 F PRIME(1515) WIDTH (MEV)

W B 5 (53.) (18.) ABRAMS 67 HBC 4.25 K- P 5/67
W B BACKGROUND ESTIMATION DIFFICULT. 5/67
W 35.0 25.0 AMMAR 67 HBC 5.5 K-P 9/67
W 70 87.0 15.0 BARNES 67 HBC 4.6, 5. K- P 0/67
W * 20 (50.0) (10.0) D.ANDLAU 68 HBC 0.7 PB P,3 BODY 9/68*
W . . . .
W AVG 73.2353 22.9412 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.8)

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13 F PRIME PARTIAL DECAY MODES

DECAY MASSES
P1 F PRIME INTO PI+ PI- 139+ 139
P2 F PRIME INTO K KBAR 497+ 497
P3 F PRIME INTO K K*(890) 493+ 892
P4 F PRIME INTO ETA ETA 548+ 548
P5 F PRIME INTO PI PI ETA 139+ 139+ 548
P6 F PRIME INTO PI K KBAR 139+ 497+ 497

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13 F PRIME BRANCHING RATIOS

R1 * F PRIME INTO (PI+ PI-)/(K KBAR)
R1 0.2 OR LESS AMMAR 67 HBC 5.5 K-P ,CL=.67 9/67
R1 0.18 OR LESS BARNES 67 HBC 4.6, 5.0 K- P 0/67
R1 N .03 ESTIMATE FROM SU3 GLASHOW 65 SU3

R3 * F PRIME INTO (ETA ETA)/(K KBAR)
R3 0.50 OR LESS BARNES 67 HBC 4.6, 5.0 K- P 0/67

R4 * F PRIME INTO (PI PI ETA)/(K KBAR)
R4 0.3 OR LESS AMMAR 67 HBC CL=0.67 0/67
R4 0.25 0.13 BARNES 67 HBC 4.6, 5.0 K- P 0/67

R5 * F PRIME INTO (PI K KBAR + K K*(890))/(K KBAR)
R5 0.4 OR LESS AMMAR 67 HBC CL=0.67 0/67
R5 0.14 OR LESS BARNES 67 HBC 4.6, 5.0 K- P 0/67
R5 B OR AS 0.14 0.14 BARNES 67 HBC 4.6, 5.0 K- P 0/67

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REFERENCES FOR F PRIME

CRENNELL 66 PRL 16 1025 + KALBFLEISCH,LAI,SCARR,SCHLMANN + (BNL)I
ABRAMS 67 PRL 18 620 +KEHOE,GLASSER,SECHI-ZORN,WOLSKY (MARYLAND)
AMMAR 67 PRL 19 1071 +DAVIS,HWANG,DAGAN,DERRICK + (NWU+ANL) JP
BARNES 67 PRL 19 964 +DORNAN,GOLDBERG,LEITNER + (BNL+SYRACUSE)ICJP
D.ANDLAU 68 VIENNA ABS. 626 +ASTIER,COHEN,AGUILAR-BENITEZ+ (CDEF+CERN)

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$\pi/\rho(1550)$ $\to K\bar{K}\pi$

47 PI/RHO (1550,JPG=) I=1
PRELIMINARY EVIDENCE,OMITTED FROM TABLE

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47 PI/RHO (1550) MASS (MEV)

M * 1550.0 APPROX. AGUILAR 68 HBC 0.7 PB P 9/68*

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47 PI/RHO (1550) WIDTH (MEV)

W * 40.0 APPROX. AGUILAR 68 HBC 0.7 PB P 9/68*

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47 PI/RHO (1550) PARTIAL DECAY MODES

DECAY MASSES
P1 PI/RHO (1550) INTO K KBAR PI 134+ 497+ 497
P2 PI/RHO (1550) INTO K*(890) KBAR 892+ 497

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REFERENCES FOR PI/RHO (1550)

AGUILAR 68 VIENNA ABS. 760 +BARLOW,JACOBS,MALECKI,MONTANET+(CERN+CDEF)

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$\pi(1640)$

34 PI (1640, JPG= -) I = 1
(ALSO CALLED A3.)
THIS ENTRY CONTAINS G=-1 PEAKS AND THE R1 PEAK

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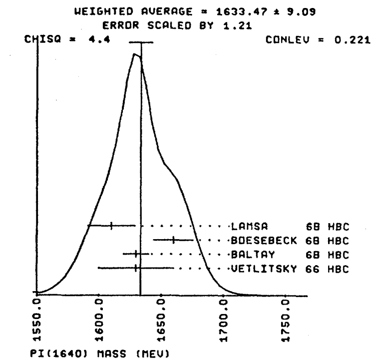
34 PI (1640) MASS (MEV)

M 30 1600.0 FORINO 65 DBC 04.5 PI+ D 0/66
M 20 1630.0 30.0 VETLITSKY 66 HBC - 4.7 PI- P
M O (1689.) (10.) DANYSZ 67 HBC 0 3,3.6 PBAR P 7/67
M O OBSERVED IN (OMEGA PI+ PI-) (AND POSSIBLY (OMEGA RHO(0))) MODE
M O NOTE THAT THE WIDTH OF THIS PEAK IS SMALL
M R (1630.) (15.) DUBAL 67 MMS - 7,11.5,12PI- P 7/67
M R R1 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
M R NOTE THAT THE R1 HAS SMALLER WIDTH THAN THE OTHER ENTRIES.
M * 218(1659.0) (32.0) ABBCH COL 68 HBC - 16.0 PI- P(3 PI) 9/68*
M 1630. 10. BALTAY 68 HBC + 7, 8.5 PI+ P 6/68*
M * (1708.) (10.) BISWAS 68 HBC 0 8 PI- P 6/68*
M 1660. 16. BOESEBECK 68 HBC + 8 PI+ P 6/68*
M * (1700.0) (16.0) BOESEBECK 68 HBC + 8.0 PI+ P,PI+F 0/67
M 1660. CASO 1 68 HBC - 11 PI- P 6/68*
M * (1680.0) CASO 1 68 HBC - 11 PI-P, PI-F 6/68*
M * (1710.0) (22.0) CNOPS 68 DBC + 8.0 PI+D,3 PI 9/68*
M 1650.0 IOFFREDO 68 HBC - 13-20 PI-P,PI-F. 9/68*
M 1610. 19. LAMSA 68 HBC - 8.0 PI-P, PI-F 11/67
M Q (1670.0) (18.0) YOST 68 HBC 04.3 K-P,LMBD.5PI 9/68*
M Q OBSERVED IN (OMEGA PI+ PI-) BUT NOT IN (OMEGA RHO 0)
M . . . .
M AVG 1633.4736 9.0898 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)
(SEE IDEOGRAM BELOW)



34 PI (1640) WIDTH (MEV)

W R 21. OR LESS LEVRAT 66 MMS - 7,12 PI- P 7/67
W R R1 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
W 20 100. VETLITSKY 66 HBC - 4.7 PI-P 6/66
W O (38.) (18.) DANYSZ 67 HBC 0 3,3.6 PBAR P 7/67
W O OBSERVED IN (OMEGA PI+ PI-) (AND POSSIBLY (OMEGA RHO(0))) MODE
W * 218 (278.0) (70.0) ABBCH COL 68 HBC - 16.0 PI- P(3 PI) 9/68*
W 70. 40. BALTAY 68 HBC + 7, 8.5 PI+ P 6/68*
W * (116.) (30.) (23.) BISWAS 68 HBC 0 8 PI- P 6/68*
W 115. 45. BOESEBECK 68 HBC + 8 PI+ P 6/68*
W * (152.0) (51.0) BOESEBECK 68 HBC + 8.0 PI+ P,PI+F 5/68*
W 130. CASO 1 68 HBC - 11 PI- P 6/68*
W * (150.0) CASO 1 68 HBC - 11.0 PI-P,PI- F 6/68*
W * (170.0) (50.0) CNOPS 68 DBC + 8.0 PI+D,3 PI 9/68*
W 100. 50. 30. LAMSA 68 HBC - 8.0 PI-P PI-F 11/67
W Q (50.0) (15.0) YOST 68 HBC 04.3 K-P,LMBD.5PI 9/68*
W Q OBSERVED IN (OMEGA PI+ PI-) BUT NOT IN (OMEGA RHO 0)
W . . . .
W AVG 93.4956 23.9468 AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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34 PI (1640) PARTIAL DECAY MODES

DECAY MASSES
P1 PI(1640) INTO 3 PI 134+ 134+ 134
P2 PI(1640) INTO RHO PI 134+ 770
P3 PI(1640) INTO ETA PI 134+ 548
P4 PI(1640) INTO 5 PI
P5 PI(1640) INTO K K*(890) 497+ 892
P6 PI(1640) INTO K KBAR PI 497+ 497+ 134
P7 PI(1640) INTO K KBAR 497+ 497
P8 PI(1640) INTO F PI 1263+ 134

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34 PI (1640) BRANCHING RATIOS

R1 * PI(1640) INTO (K KBAR) / (ALL 3 PI)

R2 * PI(1640)+- INTO (PI+- RHO0)/(ALL PI+- PI+ PI-)
R2 * 0.2 OR LESS BALTAY 68 HBC + 7-8.5 PI+P 5/68*
R2 * BUT COMPILED AS 0.4 OR LESS BY FERBEL 68.
R2 C 0.35 OR LESS CASO 1 68 HBC - 11.0 PI-P 6/68*
R2 C CASO 2 68 IS UPDATING OF CASO 1 68
R2 * (0.03) (0.36) (0.03) CASO 2 68 HBC - 11.0 PI- P 9/68*
R2 * CONSISTENT WITH 0.0 IOFFREDO 68 HBC - 13-20 PI-P 9/68*

R3 * PI(1640)+- INTO (PI+- F)/(ALL PI+- PI+ PI-)
R3 * (WITH F INTO PI+ PI-)
R3 INDICATION SEEN LUBATTI 66 HLBC 16 PI- 11/66
R3 0.35 0.20 BALTAY 68 HBC + 7-8.5 PI+P 5/68*
R3 SEEN BOESEBECK 68 HBC + 8 PI+ P 6/68*
R3 C CONSISTENT WITH 1.0 CASO 1' 68 HBC - 11 PI- P 6/68*
R3 C CASO 2 68 IS UPDATING OF CASO 1 68
R3 * (0.94) (0.06) (0.29) CASO 2 68 HBC - 11.0 PI- P 9/68*
R3 * SEEN IOFFREDO 68 HBC - 13-20 PI-P,PI-F 9/68*

R4 * R1 MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R4 * 0.37 / 0.59 / 0.04 FOCACCI 66 MMS - 3-12 PI-P 0/66

R5 * PI(1640) +- INTO (PI+- ETA)/(ALL PI+- PI+ PI-)
R5 * (ALL ETA DECAYS)
R5 0.09 OR LESS BALTAY 68 HBC + 7-8.5 PI+P 5/68*

R6 * PI(1640)+- INTO (PI+- 2PI+ 2PI-)/(ALL PI+- PI+ PI-)
R6 0.1 OR LESS BALTAY 68 HBC + 7,8.5 PI+ P 6/68*

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REFERENCES FOR PI(1640)

FORINO 65 PL 19 68 +GESSAROLI+LENDINARA+(BOL+BARI+FIR+ORS+SAC)
FERBEL 66 BERK.CONF.P 131 SEE G. GOLDHABER, REVIEW ON MESONS (LRL)
FOCACCI 66 PRL 17 890 CERN MISSING MASS SPECTROMETER GROUP (CERN)
LEVRAT 66 PL 22 714 CERN MISSING MASS SPECTROMETER GROUP (CERN)
LUBATTI 66 THESIS BERKELEY H.J.LUBATTI (LRL)1-2-
VETLITSK 66 PL 21 579 VETLITSKY,GUSZAVIN,KLIGER,ZOLGANOV+ (ITEP)

DANYSZ 67 NC 51 A 801 DANYSZ+FRENCH+SIMAK (CERN)
DUBAL 67 NP B3 435 CERN MISSING MASS SPECTROMETER GROUP (CERN)
ALSO 68 THESIS 1456 L.DUBAL (GENEVE)

ABBCH CO 68 VIENNA ABS. 466 COLLABORATION AACHEN-BERLIN+BONN+CERN+HEID)
BALTAY 68 PRL 20 887 +KUNG+YEH+FERBEL+ (COLMB+ROCH+RUTG+YALE)I=1
BARTSCH 68 CERN 68-10 --NP +KEPPEL,GROTE,BOTTCHER,+ (AACH+BERL+CERN)JP
BISWAS 68 PREPRINT -ATHENS +CASON,GROVES,KENNEY,POIRIER+ (NTRDAME)
BOESEBEC 68 NP B 4 501 BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO 1 68 NC 54 A 983 +CONTE+CORDS+DIAZ+ (GENOVA+HAMB+MIL+SACL)
CASO 2 68 VIENNA ABS. 325 +CONTE,CORDS,RATTI+ (GENOA+HAMB+MILAN+SACL)
CNOPS 68 VIENNA ABS. 210 +HOUGH,COHN,BUGG+ (BNL+ORNL+ORUC+TENN+PENN)
FERBEL 68 PREP.-PHILA.CONF T.FERBEL (ROCHESTER)
IOFFREDO 68 PRL 21 1212 +BRANDENBURG,BRENNER,EISENSTEIN+ (HARVARD)
LAMSA 68 PR 166 1395 +CASON+BISWAS+DERADO+GROVES+ (NOTREDAME)
YOST 68 VIENNA ABS. 65 +YODH,EINSCHLAG,CAY,GLASSER (MARYLAND)

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MESON RESONANCES

Data in parentheses have not been included in our averages.

φ(1650) → $\rho^0\pi^0$

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              45  PHI (1650,JPG=  -) I=0

              PRELIMINARY EVIDENCE,OMITTED FROM TABLE
              THIS ENTRY CONTAINS NEUTRAL 3 PI ENHANCEMENTS FOR WHICH
              A (RHO O PI O) DECAY MODE HAS BEEN SUGGESTED. IF TRUE,
              I=0 SO THAT IT CANNOT BE THE RHO(1650).  HOWEVER, THE
              EXISTENCE OF THE (RHO O PI O) MODE HAS NOT BEEN PROVEN.

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              45  PHI (1650)   MASS (MEV)

M          1636.0     20.0              ARMENISE  68 DBC    0 5.1 PI+D        9/68*
M   *     (1667.0)   (16.0)             CNOPS     68 DBC    0 8.0 PI+D,PI RHO 9/68*

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              45  PHI (1650)  WIDTH (MEV)

W           112.0     60.0              ARMENISE  68 DBC    0 5.1 PI+D        9/68*
W   *      (118.0)   (39.0)             CNOPS     68 DBC    0 8.0 PI+D,PI RHO 9/68*

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              45  PHI (1650)  PARTIAL DECAY MODES

                                                          DECAY MASSES
P1          PHI (1650) INTO RHO PI                       139+ 770
P2          PHI (1650) INTO RHOO PIO                     134+ 770

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              45  PHI (1650)  BRANCHING RATIOS

R1  *       PHI (1650) INTO(RHOO PIO)/(RHO PI)
R1  *         (0.35)   (0.08)           CNOPS     68 DBC    0 8.0 PI+D        9/68*

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                                REFERENCES FOR PHI (1650)

ARMENISE 68 PL 26B 336       +GHIDINI,FORINO+ (BARI+BOLOGN+FIRENZ+ORSAY)
CNOPS    68  VIENNA ABS.  210 +HOUGH,COHN,BUGG+ (BNL+ORNL+ORUC+TENN+PENN)

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ρ_N (1650)
g″ → 2π

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              15  RHO (1650, JPG= N+) I=1

              THIS ENTRY CONTAINS THE R1,G(2 PI) AND K KBAR PEAKS.
              FOR POSSIBLE 4 PI MODES SEE RHO(1700)
          CRENNELL 67 SUGGEST JP=3- FROM THE PI PI SCATTERING ANGLE DISTR.

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              15  RHO (1650)  MASS (MEV)

M          1700.0    100.0              BELLINI   65 HLBC   0 6.1 PI-P        6/66
M          1640.0                       FORINO    65 DBC    0 4.5 PI+D        6/66
M          1670.0     30.0              GOLDBERG  65 HBC    0 6 PI+D, 8 PI-P
M   C   50(1630.)                       CRENNELL  67 HBC  -   6.0 PI-P        3/67
M   C   70(1700.)                       CRENNELL  67 HBC'   0 6.0 PI-P        3/67
M   C     CRENNELL 68 IS UPDATING OF CRENNELL 67
M   R     (1630.)    (15.)              DUBAL     67 MMS  -   7,11.5,12PI- P  7/67
M   R     R1 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
M   R     NOTE THAT THE R1 HAS MUCH SMALLER WIDTH THAN THE OTHER ENTRIES.
M   *     (1680.0)   (20.0)             POIRIER   67 HBC    0 8.0 PI- P      11/67
M          1683.      13.               ARMENISE  68 DBC    0 5.1 PI+ D       6/68*
M   *     (1737.0)   (35.0)             ARMENISE2 68 DBC    0 9.0 PI+ D       9/68*
M          1620.      20.               BOESEBECK 68 HBC  +   8 PI+ P         6/68*
M   *     (1750.0)                      CASO      68 HBC    011.0 PI-P,2 PI   9/68*
M   *     (1707.0)   (16.0)             CNOPS     68 DBC    0 8.0 PI+D,PI+PI- 9/68*
M   *     (1720.0)   (20.0)             CRENNELL  68 HBC    0 6.0 PI- P       9/68*
M   *     (1640.0)   (25.0)             CRENNELL  68 HBC  -   6.0 PI- P       9/68*
M   *     (1640.0)   (20.0)   (25.0)    CRENNELL  68 HBC  +-  6.0 PI-P,KBAR K 9/68*
M          1655.0     10.0              JOHNSTON  68 HBC    0 7.0PI-P         6/68*
M         . . . . . . . . .
M   AVG    1660.0614  11.2795  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)
                              (SEE IDEOGRAM BELOW )
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                    WEIGHTED AVERAGE = 1660.1 ± 11.3
                          ERROR SCALED BY 1.58
             CHISQ = 7.5                    CONLEV = 0.058
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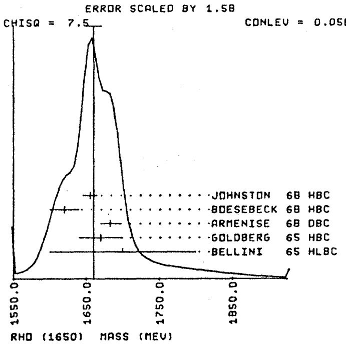


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              15  RHO (1650) WIDTH (MEV)

W            40.0                       FORINO    65 DBC    0 4.5 PI+D        6/66
W           180.0     40.0              GOLDBERG  65 HBC    0 6 PI+D, 8 PI-P
W   R        21.    OR LESS             LEVRAT    66 MMS  -   7,12 PI- P      7/67
W   R       R1 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
W   C   50 (100.)                       CRENNELL  67 HBC  -   6.0 PI-P        3/67
W   C   70 (200.)                       CRENNELL  67 HBC    0 6.0 PI-P        3/67
W   C      CRENNELL 68 IS UPDATING OF CRENNELL 67
W   *      (226.0)   (68.0)   (46.0)    POIRIER   67 HBC    0 8.0 PI- P      11/67
W           188.      49.               ARMENISE  68 DBC    0 5.1 PI+ D       6/68*
W   *      (131.0)   (20.0)             ARMENISE2 68 DBC    0 9.0 PI+ D       9/68*
W           108.      40.               BOESEBECK 68 HBC  +   8 PI+ P         6/68*
W   *      (200.0)                      CASO      68 HBC    011.0 PI-P,2 PI   9/68*
W   *      (173.0)   (65.0)             CNOPS     68 DBC    0 8.0 PI+D,PI+PI- 9/68*
W   *      (200.0)   (00.0)             CRENNELL  68 HBC  -   6.0 PI- P       9/68*
W   *      (200.0)   (00.0)             CRENNELL  68 HBC    0 6.0 PI- P       9/68*
W   *       (79.0)   (70.0)   (25.0)    CRENNELL  68 HBC  +-  6.0 PI-P,KBAR K 9/68*
W            80.0     20.0              JOHNSTON  68 HBC    0 7.0 PI- P       6/68*
W          . . . . . . . . .
W   AVG     109.9968  25.0588  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)
                              (SEE IDEOGRAM BELOW )
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                    WEIGHTED AVERAGE = 110.0 ± 25.1
                          ERROR SCALED BY 1.62
             CHISQ = 7.8                    CONLEV = 0.049
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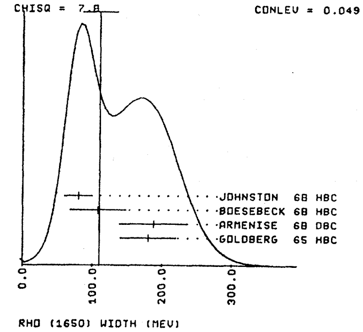


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              15  RHO (1650)      PARTIAL DECAY MODES

                                                          DECAY MASSES
P1          RHO (1650) INTO PI PI                         139+ 139
P2  *       RHO (1650) INTO  4PI                          139+ 139
P5          RHO (1650) INTO K KBAR                        497+ 497

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              15  RHO (1650)  BRANCHING RATIOS

R1  *       R1 MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R1            0.37 /    0.59 /    0.04  FOCACCI   66 MMS  -                   0/66

R3  *       RHO(1650) INTO (K KBAR) / (2 PI)
R3             INDICATION SEEN          EHRLICH   66 HBC  +-0 7.9 PI- P       3/67
R3             PROBABLY SEEN            ABRAMS    67 HBC    0 4.25 K- P       6/67
R3  C          0.10  OR LESS            CRENNEL   67 HBC      6.0 PI-P        4/67
R3  C       CRENNELL 68 IS UPDATING OF CRENNELL 67
R3  *         (0.08)    (0.08)    (0.03) CRENNELL  68 HBC      6.0 PI- P       9/68*

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                                REFERENCES FOR RHO(1650)

BELLINI  65 NC 40 A 948       BELLINI,DI CORATO,DUIMINO,FIORINI  (MILANO)
FORINO   65 PL 19 65          FORINO,GESSAROLI +   (BOLOGNA+ORSAY+SACLAY)
GOLDBERG 65 PL 17 354         GOLDBERG+(CERN+PARIS+ORSAY+MILANO+CEA-SACL)
EHRLICH  66 PR 152 1194       R. EHRLICH,W.SELOVE,H.YUTA   (PENNSYLVANIA)
FOCACCI  66 PRL  17  890      CERN MISSING MASS SPECTROMETER GROUP (CERN)
LEVRAT   66 PL  22  714       CERN MISSING MASS SPECTROMETER GROUP (CERN)
ABRAMS   67 PRL 18 620        +KEHOE+GLASSER+SECHI-ZORN+WOLSKY (MARYLAND)
CRENNELL 67 PRL 18 323        +HOUGH,KALBFLEISCH,LAI,BACHMAN+  (BNL,CCNY)I JP
DUBAL    67 NP B3 435         CERN MISSING MASS SPECTROMETER GROUP (CERN)
   ALSO  68 THESIS 1456       L.DUBAL                            (GENEVE)
POIRIER  67 PR 163 1462       +BISWAS,CASON,DERADO,KENNEY+ (NOTRDAM+PENN)
ARMENISE 68 NC 54 A 999       +FORINO+CARTACCI+(BARI+BOLOG+FIRENZE+ORSAY)I
ARMENIS2 68  VIENNA ABS.  412 ARMENISE,FORINO,CARTACCI+  (BARI+BGNA+FIRZ)
BOESEBEC 68 NP B 4 501        BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO     68  VIENNA ABS.  907 +CONTE,BENZ,CORDS+  (GENOVA+HAMB+MILA+SACL)
CNOPS    68  VIENNA ABS.  210 +HOUGH,COHN,BUGG+ (BNL+ORNL+ORUC+TENN+PENN)
CRENNELL 68  VIENNA ABS.  148 +KARSHON,LAI,SCARR,SKILLICORN          (BNL)
JOHNSTON 68 PRL 20 1414       +PRENTICE,STEENBERG,YOON      (TORONTO+WISC)

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ρ(1700)

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              38  RHO(1700,JPG=  +) I = 1 OR 2

              THIS ENTRY CONTAINS 4PI, RHO 2PI, 2RHO, OMEGA PI, AND K*KBAR
              ENHANCEMENTS, AND THE R2.

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              38  MASS (MEV)

M       80 1717.      7.                DANYSZ    67 HBC      OSEE NOTE R BELOW 5/67
M   R     SEEN IN 2.5-3 PBAR P. 2PI+2PI-,WITH 0,1,2 PI+PI- PAIRS IN RHOO BAND
M   M     (1700.)    (15.)              DUBAL     67 MMS  -   7,11.5,12PI- P  7/67
M   M     R2 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
M   K     (1700.)                       FRENCH    67 HBC    0 3,3.6 PBAR P    7/67
M   K     OBSERVED IN NEUTRAL(K* KBAR) MODE  (G-PARITY UNKNOWN)
M   *     (1700.0)   (35.0)             BALLAM    68 HBC  - 16.0 PI- P        9/68*
M          1720.      15.               BALTAY    68 HBC  +   7, 8.5 PI+ P    6/68*
M   *     (1710.)    (23.)              BISWAS    68 HBC  -   8 PI- P         6/68*
M   C     (1720.0)                      CASO 1    68 HBC  - 11.0PI-P,RHO 2PI  6/68*
M   C     (1670.0)                      CASO 1    68 HBC  - 11.0 PI-P, 4PI    6/68*
M   C     (1700.0)                      CASO 2    68 HBC  - 11.0 PI- P        9/68*
M   C       SEEN IN RHO- PI- PI+ AND RHO- RHOO (OMEGA ANTISELECTED)
M   C     CASO 2 68 IS UPDATING OF CASO 1 68
M   O   18(1630.0)                      CASO 2    68 HBC  - 11.0 PI- P        9/68*
M   O       SEEN IN THE OMEGA PI- SYSTEM
M   J     (1675.0)   (10.0)             JOHNSTON  68 HBC  -   7.0 PI- P       6/68*
M   J     NOT SEPARATED FROM 2 PI DECAY
M          . . . . . . . . .
M   AVG    1717.5365  6.3433  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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MESON RESONANCES

Data in parentheses have not been included in our averages.

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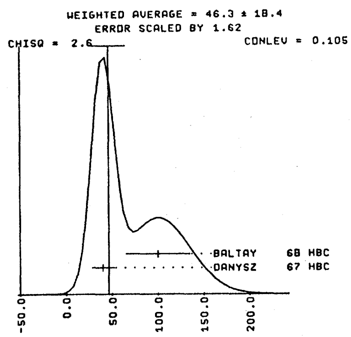
                    38  WIDTH (MEV)

W   M       30.    OR LESS           LEVRAT    66 MMS   -  7-12 PI- P        7/67
W   M   R2 PEAK FROM CERN MMS EXPT. DECAY MODES AND G PARITY UNKNOWN.
W       80   40.      12.            DANYSZ    67 HBC    OSEE NOTE R BELOW  5/67
W   R   SEEN IN 2.5-3 PBAR P. 2PI+2PI-,WITH 0,1,2 PI+PI- PAIRS IN RHOO BAND
W   *      (180.0)   (50.0)          BALLAM    68 HBC   - 16.0 PI- P       9/68*
W           100.      35.            BALTAY    68 HBC  +   7, 8.5 PI+ P    6/68*
W   *      (162.)    (58.)   (40.)   BISWAS    68 HBC   -  8 PI- P         6/68*
W   C      (120.0)                   CASO 1    68 HBC   - 11.0 PI-P, 4PI   6/68*
W   C      (100.0)                   CASO 1    68 HBC   - 11.0PI-P,RHO 2PI 6/68*
W   C      (200.0)                   CASO 2    68 HBC   - 11.0 PI- P       9/68*
W   C      SEEN IN RHO- PI- PI+ AND RHO- RHOO (OMEGA ANTISELECTED)
W   C    CASO 2 68 IS UPDATING OF CASO 1 68
W   O   18 (60.0)                    CASO 2    68 HBC   - 11.0 PI- P       9/68*
W   O      SEEN IN THE OMEGA PI- SYSTEM
W   J       (90.0)   (20.0)          JOHNSTON  68 HBC   -  7.0 PI- P       6/68*
W   J      NOT SEPARATED FROM 2 PI DECAY
W          . . . . . . . . .
W   AVG      46.3112  18.4076  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.6)
                          (SEE IDEOGRAM BELOW )
```



RHO(1700) WIDTH

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                    38  RHO (1700) PARTIAL DECAY MODES

                                                        DECAY MASSES
P1          RHO(1700) INTO 4 PI                         139+ 139+ 139+ 139
P2          RHO(1700) INTO A2 PI                        139+1305
P3          RHO(1700) INTO OMEGA PI                     139+ 783
P4          RHO(1700) INTO PHI PI                      1019+ 139
P5          RHO(1700) INTO 2 RHO                        770+ 770

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                    38  RHO(1700) BRANCHING RATIOS

R1  *       R2 MESCN FRACTION INTO ONE / THREE / FIVE OR MCRE CHARGEC TRACKS
R1            0.42 /    0.56 /    0.01  FOCACCI   66 MMS   -                0/66

R2  *       RHO(1720)+- INTO (PI+- A20)/(ALL PI+- PI+ PI- PIO)
R2  *                      (WITH A20 INTO (PI+ PI- PIO))
R2  *         NOT SEEN                  BALLAM    68 HBC   - 16.0 PI- P      9/68*
R2            0.40      0.20            BALTAY    68 HBC  +   7,8.5 PI+P     6/68*
R2            NOT SEEN                  JOHNSTON  68 HBC   -  7 PI- P        6/68*

R3  *       RHO(1720)+- INTO (PI OMEGA)/(ALL PI+- PI+ PI- PIO)
R3  *                      (WITH OMEGA INTO(PI+ PI- PIO))
R3  *        (0.17)    (0.30)           BALLAM    68 HBC   - 16.0 PI- P      9/68*
R3            0.25      0.10            BALTAY    68 HBC  +   7-8.5 PI+P     5/68*
R3             .25      0.10            JOHNSTON  68 HBC   -  7.0 PI- P      6/68*
R3            . . . . . . . . . .
R3  AVG        .2500     .0707  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R4  *       RHO(1720)+- INTO (PI PHI)/(ALL PI+- PI+ PI- PIO)
R4  *         0.11  OR LESS             EHRLICH   68 HBC  +   7,8.5 PI+P     6/68*

R5  *       RHO(1720)+- INTO (RHO 2PI)/(ALL 4PI)
R5  *         CONSISTENT WITH 1.        CASO 1    68 HBC   -  11 PI- P       6/68*

R6  *       RHO(1720)+- INTO (RHO+- RHOO)/(ALL RHO 2PI)
R6  *        (0.48)    (0.16)           CASO 1    68 HBC   -  11 PI- P       6/68*

R7  *       RHO(1720)    INTO (2 RHO) / (ALL 4PI)
R7  *         SEEN                      DANYSZ    67 HBC    0 3-4 PBAR P     5/68*
R7  *   33   (0.83)    (0.30)           BALLAM    68 HBC   - 16.0 PI- P      9/68*
R7  *         SEEN                      BALTAY    68 HBC  +   7,8.5 PI+ P    6/68*
R7  *         SEEN                      JOHNSTON  68 HBC   -  7 PI-P         6/68*

R8  *       RHO(1720)+- INTO (PI+- 2PI+ 2PI- PIO)/(ALL PI+- PI+ PI- PIO)
R8            0.15  OR LESS             BALTAY    68 HBC  +   7,8.5 PI+ P    6/68*

R9  *       RHO(1720)+- INTO (PI+- PIO) / (ALL PI+- PI+ PI- PIO)
R9  D         0.08  OR LESS             BALTAY    68 HBC  +   7-8.5 PI+ P    6/68*
R9  D         USING DATA OF DEUTSCHMANN 65 ON PI+P TO PI+ PIO P              6/68*

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                    REFERENCES FOR RHO(1700)
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DEUTSCHM 65 PL 18 351          M.DEUTSCHMANN ET AL     (AACHEN+BERLIN+CERN)
FOCACCI  66 PRL  17  890       CERN MISSING MASS SPECTROMETER GROUP (CERN)
LEVRAT   66 PL   22  714       CERN MISSING MASS SPECTROMETER GROUP (CERN)
DANYSZ   67 PL 24B 309         +FRENCH+KINSON+SIMAK+        (CERN+LIVERPOOL)
DUBAL    67 NP B3 435          +FOCACCI+KIENZLE+LECHANOINE+LEVRAT+  (CERN)
   ALSO  68 THESIS 1456        L.DUBAL                             (GENEVE)
FRENCH   67 NC 52A 442         +KINSON+MCDONALD+RIDDIFORD+      (CERN+BIRM)

BALLAM   68  VIENNA ABS.  919 +BRODY,CHADWICK,GUIRAGOSSIAN,LEITH+  (SLAC)
BALTAY   68 PRL 20 887         +KUNG+YEH+FERBEL+   (COLMB+ROCH+RUTG+YALE)I=1
BISWAS   68  PREPRINT          +CASON,GROVES,KENNEY,POIRIER+      (NTRDAME)
CASO 1   68 NC 54 A 983        +CONTE+CORDS+DIAZ+    (GENOVA+HAMB+MIL+SACL)
CASO 2   68  VIENNA ABS.  325 +CONTE,CORDS,RATTI+ (GENOA+HAMB+MILAN+SACL)
EHRLICH  68  QUT.BY BALTAY 68 R.EHRLICH                           (RUTGERS)
JOHNSTON 68 PRL 20 1414        +PRENTICE,STEENBERG,YOON    (TORCNTO+WISC)IJP
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R (1750)

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        39   R(1750) I=1

------>  THIS ENTRY CONTAINS I=1 PEAKS AND THE R3 PEAK
         NOT A FIRMLY ESTABLISHED RESONANCE - OMITTED FROM TABLE

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                    39   R(1750) MASS(MEV)

M          1748.      16.            DUBAL     67 MMS   -  7,11.5,12 PI- P  7/67
M   F     (1740.)                    FRENCH    67 HBC  (KO K+-) 3-4 PBAR P  7/67
M   F      SEE FIG. 9 OF FRENCH 67

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                    39   R(1750) WIDTH (MEV)

W            38.    OR LESS          LEVRAT    66 MMS   -  7,12 PI- P       7/67

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                    39  R(1750) BRANCHING RATIOS

R3  *      R3 MESON FRACTION INTO ONE / THREE / FIVE OR MCRE CHARGEC TRACKS
R3  C         0.14 /    0.80 /    0.05  FOCACCI   66 MMS   -                0/66
R3  C    FRACTION INTO ONE CHARGED PROB.LARGER THAN GIVEN ABCVE. CF.DUBAL+67

****** ********* ********* ********* ********* ********* ********* ********

                    REFERENCES FOR R (1750)
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FOCACCI  66 PRL  17  890       CERN MISSING MASS SPECTROMETER GROUP (CERN)
LEVRAT   66 PL   22  714       CERN MISSING MASS SPECTROMETER GROUP (CERN)
DUBAL    67 NP B3 435          CERN MISSING MASS SPECTROMETER GROUP (CERN)
FRENCH   67 NC 52A 442         +KINSON+MCDONALD+RIDDIFORD+      (CERN+BIRM)
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****** ********* ********* ********* ********* ********* ********* ********
                              **** ********* ********* ********* ********
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$\eta_{A,I\geq 0}(1830) \rightarrow 4\pi, K^*\bar{K}$

```
ETA OR RHO (1830)  G=+1 (JPG=  +)  I=0 OR GREATER

------>  THIS ENTRY CONTAINS 4 PI AND K PI KBAR AND THE R4 MMS PEAK.
         R4 IS ONLY A 3 STANDARD DEVIATIONS EFFECT.
         OMITTEC FROM TABLE.

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                    42 MASS (MEV)

M      110 1832.       6.            DANYSZ    67 HBC    OSEE NOTE R BELOW  5/67
M   R   SEEN IN 2.5-3 PBAR P. 2PI+2PI-,WITH 0,1,2 PI+PI- PAIRS IN RHOO BAND
M   M     (1830.)    (15.)           DUBAL     67 MMS   -  7,11.5,12.PI- P  6/68*
M   M      MISSING MASS R4 PEAK,FINAL STATE UNKNOWN
M          1820.      12.            FRENCH    67 HBC    OSEE NOTE K BELCW  7/67
M   K   SEEN IN 3.-3.6 PBAR P TO (KS KO PIO...). G PARITY UNKNOWN
M          . . . . . . . . .
M   AVG    1829.6000   5.3666  AVERAGE (ERROR INCLUDES SCALE FACTCR OF 1.0)

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                    42 WIDTH (MEV)

W      110   42.      11.            DANYSZ    67 HBC    OSEE NOTE R BELOW  5/67
W   R   SEEN IN 2.5-3 PBAR P. 2PI+2PI-,WITH 0,1,2 PI+PI- PAIRS IN RHOO BAND
W   M        30.0  OR LESS           DUBAL     67 MMS   - 7,11.5,12 PI-P    6/68*
W   M      MISSING MASS R4 PEAK,FINAL STATE UNKNOWN
W            50.      23.            FRENCH    67 HBC    OSEE NOTE K BELCW  7/67
W   K   SEEN IN 3.-3.6 PBAR P TO (KS KC PIO...). G PARITY UNKNOWN
W          . . . . . . . . .
W   AVG       43.4892   9.9235  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    42 PARTIAL DECAY MODES

                                                        DECAY MASSES
P1          ETA OR RHO (1830) INTO 4 PI                 139+ 139+ 139+ 139
P2          ETA OR RHO (1830) INTO RHO PI PI            139+ 139+ 770
P3          ETA OR RHO (1830) INTO RHO RHO              770+ 770
P4          ETA OR RHO (1830) INTO K KBAR PI            134+ 497+ 497

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                    REFERENCES
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```
DANYSZ   67 PL 24B 309         +FRENCH+KINSON+SIMAK+        (CERN+LIVERPOOL)
DUBAL    67 NP B3 435          CERN MISSING MASS SPECTROMETER GROUP (CERN)
   ALSO  68 THESIS 1456        L.DUBAL                             (GENEVE)
FRENCH   67 NC 52A 442         +KINSON+MCDONALD+RIDDIFORD+      (CERN+BIRM)
```


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****** ********* ********* ********* ********* ********* ********* ********
                              **** ********* ********* ********* ********
```

$\phi_{A,I\geq 0}(1830) \rightarrow 5\pi, K^*\bar{K}$

```
PHI OR PI (1830)  G=-1 (JPG=  -) I=0 OR GREATER

------>  THIS ENTRY CONTAINS OMEGA PI PI AND K PI KBAR AND THE R4 PEAK.
         R4 IS ONLY A 3 STANDARD DEVIATIONS EFFECT.
                  I=1 IF (OMEGA RHO) MODE EXISTS.
                  OMITTED FROM TABLE.

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                    43  MASS (MEV)

M   C     (1848.)    (11.)           DANYSZ    67 HBC    0 3,3.6 PBAR P     7/67
M   O   OBSERVED IN (OMEGA PI+ PI-) (AND POSSIBLY (OMEGA RHO(0))) MCDE
M   K     (1820.)    (12.)           FRENCH    67 HBC    0 3,3.6 PBAR P     7/67
M   K   OBSERVED IN (KS KO PIO...) MODE  (G-PARITY UNKNOWN)
M   M     (1830.)    (15.)           DUBAL     67 MMS   -  7,11.5,12.PI- P  6/68*
M   M      MISSING MASS R4 PEAK,FINAL STATE UNKNOWN

------ --------- --------- --------- --------- --------- --------- --------

                    43  WIDTH (MEV)

W   O      (67.)     (27.)           DANYSZ    67 HBC    0 3,3.6 PBAR P     7/67
W   O   OBSERVED IN (OMEGA PI+ PI-) (AND POSSIBLY (OMEGA RHO(0))) MCDE
W   K      (50.)     (20.)           FRENCH    67 HBC    0 3-4 PBAR P       7/67
W   K   ORSERVED IN (KS KO PIO...) MODE (G PARITY UNKNOWN)
W   M        30.0  OR LESS           DUBAL     67 MMS   - 7,11.5,12 PI-P    6/68*
W   M      MISSING MASS R4 PEAK,FINAL STATE UNKNOWN

------ --------- --------- --------- --------- --------- --------- --------

                    43 PARTIAL DECAY MODES

                                                        DECAY MASSES
P1          PHI (1830) INTO 5 PI                        139+ 139+ 139+ 139
P2          PHI (1830) INTO OMEGA PI PI                 139+ 139+ 783
P3          PHI (1830) INTO OMEGA RHO                   783+ 770
P4          PHI (1830) INTO K KBAR PI                   134+ 497+ 497

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MESON RESONANCES

Data in parentheses have not been included in our averages.

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                    REFERENCES

DANYSZ  67 NC 51A 801       DANYSZ+FRENCH+SIMAK                (CERN)
DUBAL   67 NP B3 435        CERN MISSING MASS SPECTROMETER GROUP (CERN)
  ALSO  68 THESIS 1456      L.DUBAL                           (GENEVE)
FRENCH  67 NC 52A 442       +KINSON+MCDONALD+RIDDIFORD+     (CERN+BIRM)
```

S(1930)

```
31 S(1930,JPG=   ) I=1 OR 2

THIS ENTRY CONTAINS, BESIDES THE S(1930) SEEN BY
CHIKOVANI 66 WITH A MMS, VARIOUS OTHER PEAKS NEARBY.

              31  S (1930)  MASS (MEV)

M         1929.0     14.0       CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
M         1900.      40.        BOESEBECK 68 HBC  +   8 PI+ P,PI+ PIO  6/68*
M   C    (1985.0)               CASO      68 HBC  - 11.0 PI- P         9/68*
M   C    SEEN IN RHO- PI+ PI- (OMEGA ANTISELECTED)
M         1945.0                CLINE     68 HBC     .3-.7 PB P ELAST  9/68*
M         1925.0                CLINE     68 HBC     .3-.7 PB P ELAST  9/68*
M         . . . . . . . .
M   AVG   1925.8352  13.2140  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

              31  S (1930)  WIDTH (MEV)

W           35.0   OR LESS      CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
W          216.      105.       BOESEBECK 68 HBC  +   8 PI+ P,PI+ PIO  6/68*
W   C     (100.0)               CASO      68 HBC  - 11.0 PI- P         9/68*
W   C    SEEN IN RHO- PI+ PI- (OMEGA ANTISELECTED)
W           22.0                CLINE     68 HBC     .3-.7 PB P ELAST  9/68*
W           10.0                CLINE     68 HBC     .3-.7 PB P ELAST  9/68*

              31  D(SIGMA)/D(T)  ( MICROBARNS/(GEV/C)**2 )

CS          35.0     12.0       FOCACCI    66 MMS  .22 LTE T LTE .36   9/66

              REFERENCES FOR S(1930)

CHIKOVAN 66 PL  22  233       CERN MISSING MASS SPECTROMETER GROUP (CERN)
FOCACCI  66 PRL  17  890      CERN MISSING MASS SPECTROMETER GROUP (CERN)
BOESEBEC 68 NP B 4 501        BOESEBECK,DEUTSCHMANN,+(AACHEN+BERLIN+CERN)
CASO     68  VIENNA ABS.  325 +CONTE,CORDS,RATTI+ (GENOA+HAMB+MILAN+SACL)
CLINE    68 PRL 21 1268       +ENGLISH,REEDER,TERRELL,TWITTY  (WISCONSIN)
```

T(2195)

```
32 T(2200,JPG=   ) I=1 OR 2

THIS ENTRY CONTAINS, BESIDES THE T(2200) SEEN BY
CHIKOVANI 66 WITH A MMS, VARIOUS OTHER PEAKS NEARBY.

              32  T(2200)  MASS (MEV)

M         2195.0     15.0       CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
M   B    (2190.)     (5.)       ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67
M   B    SEEN AS BUMP IN I=1 STATE. WIDTH MUCH LARGER THAN IN THE MMSP EXPT.
M   B    SEE ALSO COOPER 68.
M         2207.      13.        ALLES-BOR 67 HBC    0 5.7 PBAR P      12/66
M   A    ALLES-BORELLI 67 SEE NEUTRAL MODE ONLY (PI+PI-PIO)
M         2190.0     10.0       CLAYTON   67 HBC  +- 2.5PBAR,A2+OMEGA  0/67
M   C    (2200.0)               CASO      68 HBC  - 11.0 PI- P         9/68*
M   C    SEEN IN RHO- PI+ PI- (OMEGA ANTISELECTED)
M         . . . . . . . .
M   AVG   2196.0316   7.0080  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

              32  T(2200)  WIDTH (MEV)

W           13.0   OR LESS      CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
W   B      (85.)                ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67
W   B    SEE NOTE B UNDER T(2200) MASS ABOVE.
W           62.      52.        ALLES-BOR 67 HBC    0 5.7 PBAR P      12/66
W   C     (130.0)               CASO      68 HBC  - 11.0 PI- P         9/68*
W   C    SEEN IN RHO- PI+ PI- (OMEGA ANTISELECTED)

              32  D(SIGMA)/D(T)  ( MICROBARNS/(GEV/C)**2 )

CS          29.0     10.0       FOCACCI    66 MMS  .22 LTE T LTE .36   9/66

              32  SIGMA (MB) FOR FORMATION BY NUCLEON ANTINUCLEON

CS           6.                 ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67

              REFERENCES FOR T(2200)

CHIKOVAN 66 PL  22  233       CERN MISSING MASS SPECTROMETER GROUP (CERN)
FOCACCI  66 PRL  17  890      CERN MISSING MASS SPECTROMETER GROUP (CERN)
ABRAMS   67 PRL 18 1209       +COOL+GIACOMELLI+KYCIA+LEONTIC+LI+    (BNL)
ALLES-BO 67 NC 50 A 776       ALLES-BORELLI,FRENCH,FRISK,+    (CERN+BONN)G=-
CASO     68  VIENNA ABS.  325 +CONTE,CORDS,RATTI+ (GENOA+HAMB+MILAN+SACL)
CLAYTON  67 HEIDBG.CONF.P.57  +MASON,MUIRHEAD,FILIPPAS+  (LIVPOOL+ATHENS)
COOPER   68 PRL 20 1059       +HYMAN,MANNER,MUSGRAVE,VOYVODIC       (ANL)
```

$N\bar{N}_{I=0}$(2380)

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N NBAR (2380) (I=0)

EVIDENCE FOR RESONANCE PRELIMINARY,
OMITTED FROM TABLE.

              41 MASS

M          2380.     10.        ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67

              41 WIDTH

W           140.                ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67

              41 SIGMA (MB) FOR FORMATION BY NUCLEON ANTINUCLEON

CS  *        (2.)               ABRAMS    67 CNTR                      7/67

              REFERENCES FOR N NBAR (2380)

ABRAMS   67 PRL 18 1209       +COOL+GIACOMELLI+KYCIA+LEONTIC+LI+    (BNL)
```

U(2380)

```
33 U(2380,JPG=   ) I=1 OR 2

THIS ENTRY CONTAINS (A2 OMEGA), N NBAR (I=1), AND
THE U (MMS) PEAK.

              33 U(2380)  MASS (MEV)

M         2382.0     24.0       CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
M   B    (2345.)    (10.)       ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67
M   B    SEEN AS BUMP IN I=1 STATE. WIDTH MUCH LARGER THAN IN THE MMSP EXPT.
M         2380.0     10.0       CLAYTON   67 HBC  +- 2.5PBAR,A2+OMEGA  0/67
M         . . . . . . . .
M   AVG   2380.2959   9.2308  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

              33 U(2380)  WIDTH (MEV)

W           30.0   OR LESS      CHIKOVANI 66 MMSP  -  12.0 PI-P        8/66
W   B     (140.)                ABRAMS    67 CNTR   S CHANNEL PBAR N   7/67
W   B    SEEN AS BUMP IN I=1 STATE. WIDTH MUCH LARGER THAN IN THE MMSP EXPT.

              33 D(SIGMA)/D(T)  ( MICROBARNS/(GEV/C)**2 )

CS          42.0     14.0       FOCACCI    66 MMS  .28 LTE T LTE .36   9/66

              33 SIGMA (MB) FOR FORMATION BY NUCLEON ANTINUCLEON

CS  *        (3.)               ABRAMS    67 CNTR   S CHANNEL NBAR N   7/67

              33  U MESON BRANCHING RATIOS

R1  *     U- MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R1          0.30 /    0.45 /   0.25  FOCACCI   66 MMS   -              0/66

              REFERENCES FOR U(2380)

CHIKOVAN 66 PL  22  233       CERN MISSING MASS SPECTROMETER GROUP (CERN)
FOCACCI  66 PRL  17  890      CERN MISSING MASS SPECTROMETER GROUP (CERN)
ABRAMS   67 PRL 18 1209       +COOL+GIACOMELLI+KYCIA+LEONTIC+LI+    (BNL)
CLAYTON  67 HEIDBG.CONF.P.57  +MASON,MUIRHEAD,FILIPPAS+  (LIVPOOL+ATHENS)
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K

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K MESON  (JP=0-)  I = 1/2

SEE LISTINGS OF STABLE PARTICLES
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K(725)

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17  KAPPA (725,JP=  )  I=1/2

EVIDENCE NOT COMPELLING. OMITTED FROM TABLE.
FOR A COMPILATION, SEE APPENDIX A OF JAN 67 EDITION
(RMP 39, 1) OF THIS DATA SUMMARY.
SEE ALSO ROSENFELD, PROC.1968 UNIV.OF PENN.CONF.ON MESON SPECTROSCOPY
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K*(892)

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18  K*  (890,JP =1-  )  I=1/2

              18  K* (890) MASS (MEV)

M           898.0     5.0       CHADWICK  63 HBC  +   1.5 K+P
M           891.0     3.0       FERRO-LUZ 65 HBC  +   3.0 K+P
M           895.      3.        BOMSE     67 HBC  +  2.3 K+P            7/67
M           891.      2.        DE BAERE  67 HBC  +  3.5 K+P (KO PI+)   7/67
M           892.5     2.5       DE BAERE  67 HBC  +  3.5 K+P (K+ PIO)   7/67
M           898.      4.        SALLSTROM 67 HBC  +  3. K+ P (KO PI+)   7/67
M           883.      5.        SALLSTROM 67 HBC  +  3. K+ P (K+ PIO)   7/67
M           890.      2.        BARLOW    67 HBC  +-  1.2 PBAR P       11/66
M           889.      3.        BARLOW    67 HBC  +-  1.2 PBAR P       11/66
M           896.0     5.0       CONFORTO  67 HBC  +-  0. PBAR P         9/67
M      3870 891.0     1.0       WOJCICKI  64 HBC  -   1.7 K-P
M           889.5     2.5       ADELMAN   65 HBC  -   1.5 K-P           6/66
M           895.0     3.0       GELSEMA   65 HBC  -   1.5 K-P
M           893.      4.        ADERHOLZ  68 HBC  -   10 K- P           6/68
M           891.      4.        FICENEC   68 HBC  -   1.3 K-P (K-PIO)   9/67
M           887.      3.        FICENEC   68 HBC  -   1.3 K-P (KOPI-)   9/67
M           896.0     4.0       SCHWEINGR 68 HBC  -   4.1 K-P           9/67
M           892.0     2.0       SCHWEINGR 68 HBC  -   5.5 K-P           9/67
M           . . . . . . . .
M   AVG     891.4197   .5778  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
M       200 880.0               ALEXANDER 62 HBC  + 0 2.2 PI-P
M           895.0     2.0       FERRO-LUZ 65 HBC  + 0 3.0 K+P.          6/66
M           895.0               WANGLER   65 HBC  + 0 3.0 PI- P         6/66
M           894.      5.        FRENCH    67 HBC  +-0 3-4 PBAR P        6/67
M           . . . . . . . .
M   AVG     894.8621  1.8570  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
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MESON RESONANCES

Data in parentheses have not been included in our averages.

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M        70  897.0     10.0              COLLEY    62 HBC     0 2.0 PI-P
M       200  892.0      2.0              KRAEMER   63 HBC     0 2.3 K+P
M       150  885.0                       SMITH     63 HBC     0 2.3 PI-P
M            899.       4.               BARLOW    67 HBC     0 1.2 PBAR P        11/66
M            897.       4.               BARLOW    67 HBC     0 1.2 PBAR P        11/66
M            889.0      5.0              CONFORTO  67 HBC     0 0. PBAR P          9/67
M            894.7      1.3              DAUBER    67 HBC     0  2.0 K- P         12/66
M            892.0      4.0              GEORGE    67 HBC     0 5.0 K+ P          11/67
M            895.       2.               FICENEC   68 HBC     0 1.3 K-P (K-PI+)    9/67
M            896.0      4.0              SCHWEINGR 68 HBC     0 4.1 K-P            9/67
M            903.0      4.0              SCHWEINGR 68 HBC     0 5.5 K-P            9/67
M            . . . . . . . . . .
M   AVG      894.7266   .9036  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

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                 18  K*(0) - K*(+) MASS DIFF. (MEV)

D              6.3      4.1              BARASH    67 HBC      0 PBAR P            8/67

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                 18  K* (890) WIDTH (MEV)

W             46.0      8.0              CHADWICK  63 HBC  +   1.5 K+P
W.            47.0      4.0              FERRO-LUZ 65 HBC  +   3.0 K+P
W             50.       5.               BOMSE     67 HBC  +  2.3 K+P              7/67
W             56.       4.5              DE BAERE  67 HBC  +  3.5 K+P (KO PI+)     7/67
W             53.       8.               DE BAERE  67 HBC  +  3.5 K+P (K+ PIO)     7/67
W             68.      10.               SALLSTROM 67 HBC  +  3. K+ P (KO PI+)     7/67
W             47.      10.               SALLSTROM 67 HBC  +  3. K+ P (K+ PIO)     7/67
W             44.       7.               BARLOW    67 HBC  +-  1.2 PBAR P         11/66
W             43.       9.               BARLOW    67 HBC  +- 1.2 PBAR P          11/66
W             53.       7.               BARLOW    67 HBC  +-  1.2 PBAR P         11/66
W             43.                        CONFORTO  67 HBC  +-  0. PBAR P           9/67
W      3870   46.0      3.0              WOJCICKI1 64 HBC   -  1.7 K-P
W             51.0      3.0              ADELMAN   65 HBC   -  1.5 K-P             6/66
W             50.0     15.0              GELSEMA   65 HBC   -  1.5 K-P
W             58.       7.               ADERHOLZ  68 HBC   -  10 K- P             6/68*
W             58.      16.               FICENEC   68 HBC   -  1.3 K-P (K-PIO)     9/67
W             44.      13.               FICENEC   68 HBC   -  1.3 K-P (KOPI-)     9/67
W             41.0      8.0              SCHWEINGR 68 HBC   -  4.1 K-P             9/67
W             47.0      4.0              SCHWEINGR 68 HBC   -  5.5 K-P             9/67
W
W       200   60.0      5.0              ALEXANDER 62 HBC  + 0 2.2 PI-P
W             51.8      3.5              FERRO-LUZ 65 HBC  + 0 3.0 K+P             6/66
W             40.0                       WANGLER   65 HBC  + 0 3.0 PI- P           6/66
W             60.      10.               FRENCH    67 HBC  +-0 3-4 PBAR P          6/67
W
W        70   60.0     10.0              COLLEY    62 HBC    0 2.0 PI-P
W       200   50.0      5.0              KRAEMER   63 HBC    0 2.3 K+P
W       150   50.0                       SMITH     63 HBC    0 2.3 PI-P
W             53.      13.               BARLOW    67 HBC    0 1.2 PBAR P         11/66
W             34.       8.               BARLOW    67 HBC    0 1.2 PBAR P         11/66
W             43.                        CONFORTO  67 HBC    0 0. PBAR P           9/67
W             44.       4.               DAUBER    67 HBC    0  2.0 K- P          12/66
W             52.      12.               FICENEC   68 HBC    0 1.3 K-P (K-PI+)     9/67
W             51.0     11.0              SCHWEINGR 68 HBC    0 5.5 K-P             9/67
W             53.0     11.0              SCHWEINGR 68 HBC    0 4.1 K-P             9/67
W            . . . . . . . . . .
W   AVG       49.7498   1.0657  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                 18  K* (890) PARTIAL DECAY MODES

                                                               DECAY MASSES
P1     K* INTO K PI                                          493+ 139
P2     K*(890) INTO (K PI PI)                                493+ 139+ 139

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                 18  K* (890) BRANCHING RATIOS

R1  *  K*(890) INTO (K PI PI)/(K PI)
R1       0    0.002 OR LESS              WOJCICKI2 64 HBC   -  1.7 K-P

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REFERENCES FOR K*


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ALSTON    61 PRL 6 300           ALSTCN,ALVAREZ,EBERHARD,GOCD,GRAZIANC+(LRL)
ALEXANDE 62 PRL 8 447            ALEXANDER,KALBFLEISCH,MILLER,G SMITH  (LRL)
COLLEY    62 CERN CONF 315       D COLLEY,N GELFAND +      (CCLUMBIA+RUTGERS)

CHADWICK 63 PL 6 309             CHADWICK,CRENNELL,DAVIES,BETTINI+(OXF+PADU)
GOLDHABE 63 ATHENS CONF 92       SULAMITH GOLDHABER                     (LRL)
KRAEMER   63 ATHENS CONF 130     R KRAEMER L MADANSKY +      (JOHNS HOPKINS)
SMITH     63 PRL 10 138          SMITH,SCHWARTZ,MILLER,KALBFLEISCH,HUF+(LRL)

WOJCICK1 64 PR 135 B 484         STANLEY G WOJCICKI                     (LRL)
WOJCICK2 64 PR 135 B 495         S WOJCICKI,M ALSTON,G KALBFLEISCH      (LRL)

ADELMAN   65 ATHENS 527          STUART LEE ADELMAN              (CAVENDISH)
FERRO-LU 65 NC 36 1101           FERRO-LUZZI,GEORGE,HENRI,JONGEJANS   (CERN)
FERRO-LU 65 NC 39 417            FERRO-LUZZI,GEORGE,GOLDSCHMIDT-CLER+ (CERN)
GELSEMA   65 THESIS              E.S.GELSEMA (SEE ALSC PL 10 341)  (AMSTERD)
WANGLER   65 PR 137 B 414        WANGLER,ERWIN,WALKER            (WISCONSIN)

BARASH    67 PR  156  1399       BARASH,KIRSCH,MILLER,TAN         (COLUMBIA)
BARLOW    67 NC   50 A  701      +MONTANET,D-ANDLAU+(CERN+CDF+IDR+LIVERPOOL)
BOMSE     67 PR 158 1298         +BORENSTEIN+COLE+GILLESPIE+  (JOHN HOPKINS)
CONFORTO 67 NP B3 469            +MARECHAL,MONTANET+ (CERN+CF+IPN+LIVERPOOL)
DAUBER    67 PR 153 1403         +SCHLEIN,SLATER,TICHO                 (UCLA)
DE BAERE 67 NC 51 A 401          +GOLDSCHMIDT-CLERMONT,HENRI+    (BRUX+CERN)
FRENCH    67 NC 42A 442          +KINSON+MCDONALD+RIDDIFORD+     (CERN+BIRM)
GEORGE    67 NC 49A 9            +GOLDSCHMIDT-CLERMONT+HENRI+    (CERN+BRUX)
SALLSTRO 67 NC 49A 348           SALLSTROM+OTTER+EKSPCNG         (STOCKHOLM)

ADERHOLZ 68 NP B 5  567          +CEUTSCHMANN+  (AACH+BERL+CERN+I.C.+VIENNA)
FICENEC   68 PR 169 1034         +HULSIZER+SWANSON+TROWER           (URBANA)
SCHWEING 68 PR 166 1317          SCHWEINGRUBER,DERRICK,FIELDS,AMMAR+(ANL+NW)
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K_N (1100-1200)

$\rightarrow K\pi$

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19  KN(1100-1200)

OMITTED FROM TABLE.
FROM A STUDY OF  K P ---  K PI (DELTA)++, TRIPPE 68
FIND THAT THE I=1/2 S-WAVE (K PI) PHASE SHIFT INCREASES SM JTH(Y FROM)
THRESHOLD AND REACHES ABOUT 90 DEG IN THE REGION 1100 - 12C0 M(V.  THE)
WIDTH OF THIS OBJECT, IF A TRUE RESONANCE, IS ABOUT 400 MEV  H(S MAKIN)
IT UNLIKELY THAT IT HAS ANYTHING TO DO WITH THE NARROW (K PI) (ASS ENH)NCE
MENT AT 1080 MEV REPORTED EARLIER BY DE BAERE 67.
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REFERENCES


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DE BAERE 67 NC 51 A  401        +DEBAISIEUX,GOLDSCHMIDT-CLERM.+ (CERN+BRUX)
TRIPPE    68  UCLA-1024          +CHIEN,MALAMUD,MELLEMA,SCHLEIN,SLATER(UCLA)  0+
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$K_{3/2}$ (1175)

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24 KA 3/2 (1175,JP=  ) I = 3/2

EVIDENCE NOT COMPELLING, OMITTED FROM TABLE.
FOR A DISCUSSION SEE ROSENFELD 68
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REFERENCES FOR KA3/2(1175)


```
WANGLER   64 PL 9 71             T P WANGLER,A R ERWIN,W D WALKER  (WISCONS)
MILLER    65 PL 15 74            MILLER,KOVACS,MCILWAIN,PALFREY +   (PURDUE)
ROSENFEL 68 UCRL-18266           A.H.ROSENFELD (PHILAD.CONF. MESON SP.)(LRL)
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$K_{3/2}$ (1270)

```
25  KA3/2(1265,JP=     )  I=3/2

EVIDENCE NOT COMPELLING, OMITTED FROM TABLE.
FOR A DISCUSSICN SEE ROSENFELD 68
```

REFERENCES FOR K*3/2 (1265)


```
FRENCH    67 NC 52A 442          +KINSON+MCDONALD+RIDDIFORD+     (CERN+BIRM)
ROSENFEL 68 UCRL-18266           A.H.ROSENFELD (PHILAD.CONF. MESON SP.)(LRL)
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    THERE EXIST MANY PAPERS REPORTING A BROAD I=1/2 (K PI PI) ENHANCEMENT
    IN THE MASS REGION 1.23-1.36 GEV.  IT IS PROBABLY DUE TO SOME
    COMBINATION OF DECK EFFECT AND ONE, TWO, OR THREE REAL RESONANCES.
    FOR CONVENIENCE OF PRESENTATION, WE HAVE GROUPED THE CATA UNDER THE NAM
    OF THREE PARTICLES AND ONE PSEUDO-PARTICLE, RESPECTIVELY KA(123C),
    KA(1280), KA(1320), AND KA(1200-1350).  UNDER THE LAST CATEGORY WE
    HAVE LISTED ALL EXPERIMENTS THAT REPORT A BROAD PEAK, WITH A WIDTH
    GREATER THAN 100 MEV.

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K_A (1200-1350)

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KA(1200-1350)  I=1/2

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                 28  KA(1200-1350) MASS  (MEV)

M       200 1280.      20.              BERLINGHI 67 HBC  +   12.7 K+ P         7/67
M   BERLINGHIERI VALUE IS FROM (K* PI) MODE. THE (K RHO) MASS PEAKS AT 1320
M   AN EFFECT THAT THEY ATTRIBUTE TO KINEMATICS NEAR (K RHO) THRESHCLD.
M           1270.     APPROX.           DE BAERE  67 HBC  +  3.5 K+ P           7/67
M    *     (1325.0)    (6.0)            ABCLV COL 68 HBC   - 10.0 K- P(K 2PI)   9/68*
M    *     (1335.0)    (6.0)            ABCLV CCL 68 HBC   - 10.0 K- P(K NPI)   9/68*

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                 28  KA(1200-1350) WIDTH (MEV)

W       200  130.      15.              BERLINGHI 67 HBC  +   12.7 K+ P         7/67
W            200.    APPROX.            DE BAERE  67 HBC  +  3.5 K+ P           7/67
W    *     (186.0)   (15.0)             ABCLV CCL 68 HBC   - 10.0 K- P(K 2PI)   9/68*
W    *     (196.0)   (16.0)             ABCLV COL 68 HBC   - 10.0 K- P(K NPI)   9/68*

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                 28  KA(1200-1350) PARTIAL DECAY MODES

                                                               DECAY MASSES
P1  *     KA(1200-1350) INTO K*(890) PI                      493+ 139+ 139
P2  *     KA(1200-1350) INTO K RHO                           493+ 139+ 139
P3  *     KA(1200-1350) INTO K PI                            493+ 139+ 139
P4  *     KA(1200-1350) INTO K ETA                           493+ 139+ 139
P5  *     KA(1200-1350) INTO K OMEGA                         493+ 139+ 139
P6        KA(1200-1350) INTO K PI PI                         497+ 139+ 139

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                 28  KA(1200-1350) BRANCHING RATIOS

R1        KA(1200-1350) INTO K*(890) PI AND K RHO (OVERLAPPING BANDS)
R1      200   1.0                       BERLINGHI 67 HBC  +   12.7 K+ P         7/67

R2.       KA(1200-1350) INTO (K PI) / TOTAL
R2           0.02  OR LESS              BERLINGHI 67 HBC  +   12.7 K+ P        11/67
R2  *        0.02  OR LESS, C.L.=.95 ABCLV COL 68 HBC    - 10.0 K- P           9/68*

R3        KA(1200-1350) INTO (K ETA) / TOTAL
R3           0.02  OR LESS              BERLINGHI 67 HBC  +   12.7 K+ P        11/67

R4        KA(1200-1350) INTO (K OMEGA) / TOTAL
R4           0.02  OR LESS              BERLINGHI 67 HBC  +   12.7 K+ P        11/67
R4  *   12  (0.01)   (0.005)            ABCLV COL 68 HBC   - 10.0 K- P          9/68*

R5        KA(1200-1350) INTO (K RHO) / (K*(890) PI)
R5           0.91      0.25             BERLINGHI 67 HBC  +   12.7 K+ P        11/67
R5  *  701  (0.4)    (0.1)              ABCLV COL 68 HBC   - 10.0 K- P          9/68*

R6        KA(1200-1350) INTO (K PI) / (K*(890) PI)
R6           0.21  OR LESS              DE BAERE  67 HBC  +   3.5 K+ P         11/66

R7  *     KA(1200-1350) INTO (K PI PI) / TOTAL
R7  *  201  (0.22)   (0.08)             ABCLV COL 68 HBC   - 10.0 K- P          9/68*

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REFERENCES FOR KA (1200-135C)


```
BERLINGH 67 PRL 18 1087          BERLINGHIERI+FARBER+FERBEL+FCRMAN+   (ROCH)IJP
DE BAERE 67 NC 49A 374           +DERAISIEUX+FAST+FILIPPAS+      (CERN+BRUX)
   AND PRIVATE COMMUNICATION BY B. JONGEJANS
ABCLV CO 68  VIENNA ABS.  464 COLLABORATION AACHEN-BERLIN+CER(+LOIC+WIEN)
ANTICH    68  VIENNA ABS.  493 +BOSCO,CALLAHAN,COX,DENEGRI+(JOHNS HOPKINS)I JP
BOMSE     68 PRL 20 1519         +BORENSTEIN,CALLAHAN,COLE,CCX,+  (JOHNHOPK)  1+
DENEGRI   68 PRL 20 1194         +CALLAHAN+ETTLINGER+GILLESPIE+   (JOHNHOPK)  1+
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Data in parentheses have not been included in our averages.

$K_A(1230)$

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                    20  KA (1230,JP=   )  I=1/2

                    FORMERLY CALLED C MESON
                    (JP = 1+ FAVORED)

                    SEE NOTE PRECEDING KA(1200-1350)

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                    20  KA (1230)  MASS (MEV)

M            1230.0     15.0                BASSOMPIE 67 HBC  +   5. K+ P          11/67
M            1250.0     10.0                GOLDHABER 67 HBC      9.0 K+ P          0/67
M    *       1250  APPROX.                  BGO COLL. 68 HBC  +  10.0 K+ P          9/68*
M            1242.        9.       10.      ASTIER    68 HBC  +-0 0 PBAR P          6/68*
M    M      (1277.)     (9.)     (10.)      ASTIER    68 HBC  +-0 0 PBAR P          6/68*
M    M               FROM FIT WITH A  KA(1320).
M            . . . . . . . . . .
M    AVG     1243.0447   6.2592  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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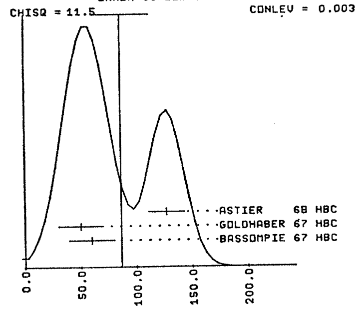
                    20  KA (1230) WIDTH (MEV)

W              60.0     20.0                BASSOMPIE 67 HBC  +   5. K+ P          11/67
W              50.0     20.0                GOLDHABER 67 HBC      9.0 K+ P          0/67
W             127.        7.       25.      ASTIER    68 HBC  +-0 0 PBAR P          6/68*
W    M       (83.)     (20.)                ASTIER    68 HBC  +-0 0 PBAR P          6/68*
W    M      SEE NOTE M UNDER MASS ABOVE.
W            . . . . . . . . . .
W    AVG       86.5789  25.4017  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.4)
                             (SEE IDEOGRAM BELOW )
```

WEIGHTED AVERAGE = 86.6 ± 25.4
ERROR SCALED BY 2.40
CHISQ = 11.5   CONLEV = 0.003



K*A(1230) WIDTH (MEV)

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                    20  KA (1230) PARTIAL DECAY MODES

                                                         DECAY MASSES
P1       KC INTO K RHO                                   493+ 770
P2       KC INTO K* PI                                   892+ 139
P3       KC INTO K PI PI                                 497+ 139+ 139

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                    20  KA (1230) BRANCHING RATIOS

R1   *   KA(1230) INTO (K RHO)/TOTAL   (UNITS OF 10**-2)
R1            75.0      10.0             ARMENTERO 64 HBC     0.0 PBAR P      6/66

R2   *   KA(1230) INTO (K* PI)/TOTAL   (UNITS OF 10**-2)
R2            25.0      10.0             ARMENTERO 64 HBC     0.0 PBAR P      6/66

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REFERENCES FOR KA (1230)


```
ARMENTER 64 DUBNA CONF 1 577  ARMENTEROS,EDWARDS,D-ANDLAU +     (CERN+CDF)
                          SEE ALSO PL 9, 207
    ALSO     DUBNA CONF 1 617  R ARMENTEROS (RAPPORTEUR)
SEE ALSO 66 PR   145 1095      BARASH,KIRSCH,MILLER,TAN          (COLUMBIA)

BASSOMPI 67 PL 26B 30          BASSOMPIERRE,GOLDSCHMIDT+  (CERN+BRUX+BIRM)IJP
GOLDHABER67 PRL 19  972        G.GOLDHABER,FIRESTONE,SHEN               (LRL)
ASTIER   68  VIENNA ABS.  501 +MARECHAL,MONTANET+(CDEF+CERN+IPN(P)+LPOOL)
BGO COLL 68  VIENNA ABS.  217                // BIRMINGHAM+GLASGOW+OXFORD
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$K_A(1280)$

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                    26  KA(1280,JP=   ) I=1/2

                    SEE NOTE PRECEDING KA(1200-1350)

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                    26  KA(1280) MASS  (MEV)

M    S      (1280.0)                        SHEN      66 HBC  + 0 4.6 K+P          11/67
M    S    SEEN IN FIVE-BODY FINAL STATE. MAY BE ASSOCIATED WITH KA(1320).
M          35 1280.0     10.0               BASSOMPIE 67 HBC  +   5. K+ P          11/67
M    N     45(1300.)                        CRENNELL  67 HBC    0 6 PI- P           7/67
M    N    THESE PEAKS MAY BETTER BE ASSOCIATED WITH THE KA(1320).
M    G      (1250.0)    (10.0)              GOLDHABER 67 HBC      9.0 K+ P          0/67
M    G    THIS PEAK MAY BETTER BE ASSOCIATED WITH THE KA(1230).

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                    26  KA(1280) WIDTH (MEV)

W    S       (100.0)   (20.0)               SHEN      66 HBC  + 0 4.6 K+ P         11/67
W    S    SEEN IN FIVE-BODY FINAL STATE. MAY BE ASSOCIATED WITH KA(1320).
W          35   80.0     20.0               BASSOMPIE 67 HBC  +   5. K+ P          11/67
W    N     45  (60.)                        CRENNELL  67 HBC    0 6 PI- P           7/67
W    N    THESE PEAKS MAY BETTER BE ASSOCIATED WITH THE KA(1320).
W    G        (50.0)   (20.0)               GOLDHABER 67 HBC      9.0 K+ P          0/67
W    G    THIS PEAK MAY BETTER BE ASSOCIATED WITH THE KA(1230).

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                    26  KA (1280) PARTIAL DECAY MODES

                                                         DECAY MASSES
P1       KA INTO K*(890) PI                              892+ 139
P2       KA INTO K RHO                                   497+ 770
P3       KA INTO K OMEGA                                 497+ 783
P4       KA INTC K PI                                    493+ 139
P5       KA INTO K ETA                                   493+ 548

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                    26  KA (1280) BRANCHING RATIOS

R1   *      KA(1280) INTO (K PI) / (K*(890) PI)
R1   S         0.8    OR LESS          SHEN      66 HBC     4.6 K+P          11/67
R1   S    SEEN IN FIVE-BODY FINAL STATE. MAY BE ASSOCIATED WITH KA(1320).

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REFERENCES FOR KA(1280)


```
SHEN     66 PRL  17  726      +BUTTERWORTH,FU,GOLDHABERS,TRILLING   (LRL)
BASSOMPI 67 PL 26B 30         BASSOMPIERRE,GOLDSCHMIDT+  (CERN+BRUX+BIRM)IJP
CRENNELL 67 PRL 19  44        +KALBFLEISCH,LAI,SCARR,SCHUMANN       (BNL)I
GOLDHABER67 PRL 19  972       G.GOLDHABER,FIRESTONE,SHEN            (LRL)
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$K_A(1320)$

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                    21  KA (1320,JP= ) I=1/2

                    (JP = 1+ FAVORED)
                    SEE NOTE PRECEDING KA(1200-1350)

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                    21  KA (1320) MASS (MEV)

M        12 1320.0     25.0                ALMEIDA   65 HBC  +   3-5 K+  P          8/66
M        70 1320.0     10.0                SHEN      66 HBC  +   4.6 K+  P          8/66
M    S     (1280.0)                        SHEN      66 HBC  + 0 4.6 K+P           11/67
M    S   SEEN IN FIVE-BODY FINAL STATE. MAY BE ASSOCIATED WITH KA(1280).
M           1320.0     15.0                BASSOMPIE 67 HBC  +   5. K+ P           11/67
M    N   45(1300.)                         CRENNELL  67 HBC    0 6 PI- P            7/67
M    N   THESE PEAKS MAY POSSIBLY BE ASSOCIATED WITH THE KA(1280).
M           1360.0     10.0                GOLDHABER 67 HBC      9.0 K+ P           0/67
M    *     (1330.)    (12.)                ASTIER    68 HBC  +-0 0 PBAR P           6/68*
M           . . . . . . . . . .
M    AVG    1335.3584  11.2317  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.8)
                             (SEE IDEOGRAM BELOW )
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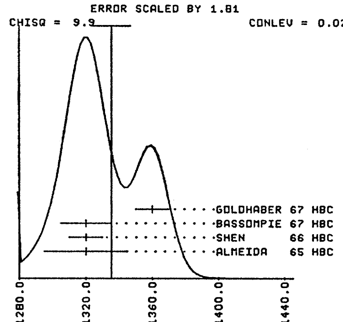
WEIGHTED AVERAGE = 1335.4 ± 11.2
ERROR SCALED BY 1.81
CHISQ = 9.9   CONLEV = 0.020



KA (1320) MASS (MEV)

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                    21  KA (1320) WIDTH (MEV)

W        12   60.0     20.0                ALMEIDA   65 HBC  +   3-5 K+P            8/66
W        70   80.0     20.0                SHEN      66 HBC  +   4.6 K+P            8/66
W    S       (100.0)   (20.0)              SHEN      66 HBC  + 0 4.6 K+ P          11/67
W    S   SEEN IN FIVE-BODY FINAL STATE. MAY BE ASSOCIATED WITH KA(1280).
W              60.0     20.0               BASSOMPIE 67 HBC  +   5. K+ P           11/67
W    N   45  (60.)                         CRENNELL  67 HBC    0 6 PI- P            7/67
W    N   THESE PEAKS MAY POSSIBLY BE ASSOCIATED WITH THE KA(1280).
W              80.0     20.0               GOLDHABER 67 HBC      9.0 K+ P           0/67
W    *       (120.)    (20.)     (30.)     ASTIER    68 HBC  +-0 0 PBAR P           6/68*
W           . . . . . . . . . .
W    AVG       70.0000  10.0000  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                    21  KA (1320) PARTIAL DECAY MODES

                                                         DECAY MASSES
P1          KA INTO K*(890) PI                           892+ 139
P2          KA INTO K RHO                                497+ 770
P3          KA INTO K OMEGA                              497+ 783
P4          KA INTO K PI                                 493+ 139
P5          KA INTO K ETA                                493+ 548

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                    21  KA (1320) BRANCHING RATIOS

1R1  *      KA INTO K*(890) PI AND K RHO (OVERLAPPING BANDS)
R1      70    1.0                       SHEN      66 HBC  +   4.6 K+P            8/66

R2   *     KA INTO(K OMEGA)/(K*(890) PI)
R2            0.1    OR LESS            SHEN      66 HBC  +   4.6 K+P            0/66

R8   *     KA (1320) INTO (K PI) / (K*(890) PI)
R8            0.30   OR LESS            SHEN      66 HBC  +   4.6 K+P            0/66

R9   *     KA (1320) INTO (K+ PI-) / (K+0 PIO+ PI-)
R9            0.2    OR LESS (CL=.90)   CRENNELL  67 HBC    0 6.0 PI-P           7/67

R10  *     KA (1320) INTO (KO PI+ PI- PIO) / (K+0 PIO+ PI-)
R10           0.1    OR LESS (CL=.90)   CRENNELL  67 HBC    0 6.0 PI-P           7/67

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Data in parentheses have not been included in our averages.


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                         REFERENCES FOR KA(1320)

ALMEIDA  65 PL 16 184         ALMEIDA,ATHERTON,BYER,DORNAN,FORSON+(CAMBR)
SHEN     66 PRL  17  726      +BUTTERWORTH,FU,GOLDHABERS,TRILLING   (LRL)
   ALSO 66  (PRIVATE COMMUN)GERSON GOLDHABER                        (LRL)

BASSOMPI 67 PL 26B 30         BASSOMPIERRE,GOLDSCHMIDT+  (CERN+BRUX+BIRM)IJP
CRENNELL 67 PRL 19  44        +KALBFLEISCH,LAI,SCARR,SCHUMANN       (BNL)I
GOLDHABER67 PRL 19  972       G.GOLDHABER,FIRESTONE,SHEN            (LRL)
ASTIER   68  VIENNA ABS.  501 +MARECHAL,MONTANET+(CDEF+CERN+IPN(P)+LPOOL)

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$K_N(1420)$

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22  KN (1420,JP=2+) I=1/2

JP = 3- IS UNLIKELY BUT NOT YET COMPLETELY RULED OUT.

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                         22 KN(1420) MASS (MEV)

M        1404.0     15.0             FOCARDI   65 HBC   -0 3.  K- P (K PI)  0/66
M        1390.0     30.0             SHEN      66 HBC  + 0 4.6 K+ P (K PI)  0/66
M        1446.0      7.9             DAHL      67 HBC    0 4.PI- P (KPI)    0/66
M        1427.      15.0             DE BAERE  67 HBC  +  3.5 K+P (KO PI+)  0/66
M        1440.      24.0     40.     DE BAERE  67 HBC  +  3.5 K+P (K+ PIO)  0/66
M   V   (1430.0)   (20.0)            GEORGE    67 HBC    0 5.  K+ P (K PI)  0/66
M        1423.      21.              ADERHOLZ  68 HBC  -  10 K- P (K PI)    6/68*
M   *   (1396.0)   (8.0)             BASSOMPIE 68 HBC  +   5.0 K+ P (K PI)  9/68*
M        1405.0     18.0             SCHWEINGR 68 HBC    0 4.1 K- P (K PI)  9/67
M        1401.0      8.0             SCHWEINGR 68 HBC  -   4.1 K- P (K PI)  9/67
M        1397.0     19.0             SCHWEINGR 68 HBC    0 5.5 K- P (K PI)  9/67
M        1427.0      9.0             SCHWEINGR 68 HBC  -   5.5 K- P (K PI)  9/67
M
M        1400.0     20.0             BADIER    65 HBC  -   3.  K- P (K*PI)  0/66
M        1430.0     10.0             SHEN      66 HBC  + 0 4.6 K+ P (K*PI)  0/66
M   V   (1420.0)   (10.0)            BASSOMPIE 67 HBC  +   5. K+ P (K 2PI) 11/67
M   V   BASSOMPIERRE 68 IS UPDATING OF BASSCMPIERRE 67 AND GEORGE 67
M        1440.                       CRENNELL  67 HBC    0 6 PI- P (K 2PI)  7/67
M        1420.0     10.0             GOLDHABER 67 HBC      9.0 K+ P(K 2PI)  0/67
M   *   (1396.0)   (5.0)             BASSOMPIE 68 HBC  +   5.0 K+ P(K 2PI)  9/68*
M   *   (1422.0)   (5.0)             BASSOMPIE 68 HBC    0 5.0 K+ P(K 2PI)  9/68*
M
M   *   THE FOLLOWING VALUES ARE FROM BOTH (K PI) AND (K 2PI) MODES
M        1425.0     10.0             BISHOP    66 HBC  +   3.5 K+ P         0/66
M        1423.0      7.0             BASSANO   67 HBC   -0 4.6, 5.C K- P    0/67
M     20 1440.0     20.0             DUBAL     68 MMS  -   11.5 K- P        6/68*
M        . . . . . . . . . .
M   AVG  1422.1971   3.7401  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
                     (SEE IDEOGRAM BELOW )
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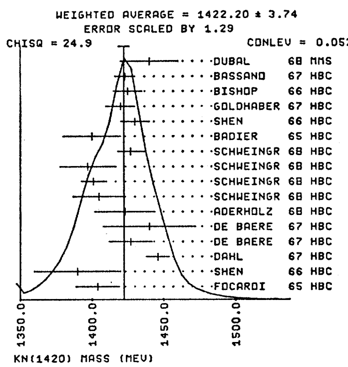


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                         22  KN(1420) WIDTH (MEV)

W         92.0      14.0             FOCARDI   65 HBC   -0 3.0 K- P (K PI)
W         75.0      25.0             SHEN      66 HBC     4.6 K+ P          8/66
W         61.0      24.0             DAHL      67 HBC    0 3.8-4.2 PI- P    9/66
W         90.0      28.0             DE BAERE  67 HBC  +   3.5 K+ P         0/66
W   V    (110.0)   (40.0)            GEORGE    67 HBC    0 5.0 K+ P         0/66
W        175.       57.              ADERHOLZ  68 HBC  -   10 K- P (K PI)   6/68*
W   *    (123.0)   (25.0)            BASSOMPIE 68 HBC  +   5.0 K+ P(K  PI)  9/68*
W        107.0      20.0             SCHWEINGR 68 HBC   -0 4.1+5.5 K-P      9/67
W
W        105.0      30.0             BADIER    65 HBC  -   3.0 K-P          6/66
W   V    (80.0)    (20.0)            BASSOMPIE 67 HBC  +   5. K+ P (K* PI) 11/67
W   V    BASSCMPIERRE 68 IS UPDATING OF BASSCMPIERRE 67 AND GEORGE 67
W         80.0      20.0             GOLDHABER 67 HBC      9.0 K+ P(K 2PI)  0/67
W   *    (110.0)   (10.0)            BASSOMPIE 68 HBC  +   5.0 K+ P(K 2PI)  9/68*
W   *    (110.0)   (10.0)            BASSOMPIE 68 HBC    0 5.0 K+ P(K 2PI)  9/68*
W
W         96.0      10.0             BISHOP    66 HBC  +   3.5 K+ P         6/66
W         65.0      20.0             BASSANO   67 HBC   -0 4.6, 5.C K- P    0/67
W         . . . . . . . . . .
W   AVG   89.7795    5.9098  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

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                         22  KN (1420) PARTIAL DECAY MODES

                                                       DECAY MASSES
P1         KN(1420) INTO K PI                          493+ 139
P2         KN(1420) INTO K*(890) PI                    892+ 139
P3         KN(1420) INTO K RHO                         493+ 770
P4         KN(1420) INTO K OMEGA                       493+ 783
P5         KN(1420) INTO K ETA                         493+ 548

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                         22  KN(1420) BRANCHING RATIOS

R1  *   KN(1420) INTO (K PI)/TOTAL
R1  R      (0.37)   (0.19)           BADIER    65 HBC      3.0 K-P          6/66
R1  R      (0.33)   (0.07)           BISHOP    66 HBC      3.5 K+P          6/66
R1  R      (0.39)   (0.11)           BASSANO   67 HBC  -   4.6, 5.0 K- P    0/67
R1  R   THIS BRANCHING RATIO CONTAINS REDUNDANT INFORMATICN, SINCE WE
R1  R   CONSTRAIN THE SUM OF ALL BRANCHING RATIOS TO BE 1.0
R1         . . . . . . . . . .
R1  FIT     .507     .047     VALUE FROM CONSTRAINED FIT

R2  *   KN(1420) INTO (K*(890) PI) / TOTAL
R2          .41      0.14            BADIER    65 HBC      3.0 K-P          6/66
R2         0.56      0.10            BISHOP    66 HBC      3.5 K+P          6/66
R2         0.47      0.10            BASSANO   67 HBC  -   4.6, 5.0 K- P    0/67
R2         . . . . . . . . . .
R2  AVG     .4937    .0631  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R2  FIT     .330     .034    VALUE FROM CONSTRAINED FIT

R3  *   KN(1420) INTO (K RHO)/TOTAL
R3         0.14      0.05            BADIER    65 HBC      3.0 K-P          6/66
R3         0.10      0.05            BISHOP    66 HBC      3.5 K+P          6/66
R3         0.14      0.10            BASSANO   67 HBC    0 4.6, 5.0 K- P    0/67
R3         . . . . . . . . . .
R3  AVG     .1222    .0333  AVERAGE (ERROR INCLUDES SCALF FACTOR OF 1.0)
R3  FIT     .109     .031    VALUE FROM CONSTRAINED FIT

R4  *   KN(1420) INTO (K OMEGA)/TOTAL
R4         0.07      0.04            BADIER    65 HBC      3.0 K-P          6/66
R4         . . . . . . . . . .
R4  FIT     .034     .012    VALUE FROM CONSTRAINED FIT

R5  *   KN(1420) INTO (K ETA)/TOTAL
R5         0.02      0.02            BADIER    65 HBC      3.0 K-P          6/66
R5         . . . . . . . . . .
R5  FIT     .020     .016    VALUE FROM CONSTRAINED FIT

R6  *   KN(1420) INTO (K*(890) PI) / (K PI)
R6      6  0.33      0.33            CHUNG     65 HBC  + 0  3.9-4.2 PI- P   8/66
R6         0.65      0.20            SHEN      66 HBC    0  N* PRCDUCED     0/66
R6  .      0.63      0.20            SHEN      66 HBC  +    NO N* PRODUCED  0/66
R6  *     (1.1)     (0.3)            BASSOMPIE 68 HBC  +-  5.0 K+ P         9/68*
R6  *     (1.5)     (0.3)            BASSCMPIE 68 HBC    0 5.0 K+ P         9/68*
R6         0.52      0.12            SCHWEINGR 68 HBC    0 4.1+5.5 K- P     0/67
R6         . . . . . . . . . .
R6  AVG     .5531    .0882  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R6  FIT     .652     .115    VALUE FROM CONSTRAINED FIT

R7  *   KN(1420) INTO (K OMEGA) / K PI
R7  *      0.08  OR LESS             SHEN      66 HBC      4.6 K+P          8/66
R7  *      0.1   OR LESS             BASSOMPIE 68 HBC  +   5.0 K+ P         9/68*
R7  *      0.03  OR LESS             BASSOMPIE 68 HBC    0 5.0 K+ P         9/68*
R7         . . . . . . . . . .
R7  FIT     .068     .026    VALUE FROM CONSTRAINED FIT

R8  *   KN(1420) INTO (K RHO) / (K PI)
R8         0.09  OR LESS             CHUNG     65 HBC  + 0  3.9-4.2 PI- P   8/66
R8  *      0.2   OR LESS             BASSOMPIE 68 HBC    0 5.0 K+ P         9/68*
R8  *      0.2   OR LESS             BASSOMPIE 68 HBC  +   5.0 K+ P         9/68*
R8         0.26      0.16            SCHWEINGR 68 HBC    0 4.1+5.5 K- P     0/67
R8         . . . . . . . . . .
R8  FIT     .215     .072    VALUE FROM CONSTRAINED FIT

R9  *   KN(1420) INTO (K RHO) / (K*(890) PI)
R9         0.39  OR LESS             BASSOMPIE 67 HBC  +   5. K+ P          9/67
R9         0.4C  OR LESS  (CL=.90) FIELD       67 HBC  - 3.8 K- P           6/67
R9         . . . . . . . . . .
R9  FIT     .329     .112    VALUE FROM CONSTRAINED FIT

R10 *   KN(1420) INTO (K OMEGA) / (K*(890) PI)
R10        0.10      0.04            FIELD     67 HBC  -- 3.8 K- P          6/67
R10        . . . . . . . . . .
R10 FIT     .104     .036    VALUE FROM CONSTRAINED FIT

R11 *   KN(1420) INTO (K ETA) / (K*(890) PI)
R11        0.07      0.04            FIELD     67 HBC  - 3.8 K- P           6/67
R11        . . . . . . . . . .
R11 FIT     .061     .046    VALUE FROM CONSTRAINED FIT

R12 *   KN(1420) INTO (K ETA) / (K PI)
R12 *      0.025 OR LESS             BASSOMPIE 68 HBC      5.0 K+ P         9/68*
R12        . . . . . . . . . .
R12 FIT     .040     .033    VALUE FROM CONSTRAINED FIT

 THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

      P1 P2      -.584

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                         REFERENCES FOR KN(1420)

BADIER   65 PL 19 612         BADIER,DEMOULIN,GOLDBERG+ (EP+SACLY+ZEEMAN)
CHUNG    65 PRL  15  325      +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER   (LRL)
FOCARDI  65 PL 16 351         FOCARDI,MINGUZZI RANZI,SERRA+ (BOLOGNA+CEN)

BISHOP   66 PRL 16 1069       BISHOP,GOSHAW,ERWIN,THOMPSCN+   (WISCONSIN)
SHEN     66 PRL  17  726      +BUTTERWORTH,FU,GOLDHABERS,TRILLING   (LRL)
   ALSO 66  (PRIVATE COMMUN)GERSON GOLDHABER                        (LRL)

BASSANO  67 PRL  19  968      +GOLDBERG,GOZ,BARNES,LEITNER+(BNL+SYRACUSE)
BASSOMPI 67 PL 26B 30         BASSOMPIERRE,GOLDSCHMIDT+  (CERN+BRUX+BIRM)IJP
CRENNELL 67 PRL 19  44        +KALBFLEISCH,LAI,SCARR,SCHUMANN       (BNL)
DAHL     67 PR 163 1377       +HARDY+HESS+KIRZ+MILLER               (LRL)
SEE ALSO 65 PRL 14 401        HARDY,CHUNG,DAHL,HESS,KIRZ,MILLER     (LRL)
DE BAERE 67 NC 51 A 401       +GOLDSCHMIDT-CLERMONT,HENRI+     (BRUX+CERN)
FIELD    67 PL 24B 638        +HENDRICKS+PICCIONI+YAGER          (LAJOLLA)
GEORGE   67 NC 49A 9          +GOLDSCHMIDT-CLERMONT+HENRI+     (CERN+BRUX)
GOLDHABER67 PRL 19  972       G.GOLDHABER,FIRESTONE,SHEN            (LRL)

ADERHOLZ 68 NP B 5  567       +DEUTSCHMANN+  (AACH+BERL+CERN+I.C.+VIENNA)
BASSOMPI 68  VIENNA ABS.  446 BASSOMPIERRE,GOLDSCHMIDT-CLERM.+(CERN+BRUX)
SEE ALSO 66 PL 22 357         BARTSCH,DEUTSCHMANN,MORRISCN+    (ABCL(IC)V)
DUBAL    68 THESIS  1456      L.DUBAL                            (GENEVE)
SCHWEING 68 PR 166 1317       SCHWEINGRUBER,DERRICK,FIELDS,AMMAR+(ANL+NW)
   ALSO  67  THESIS           F.L.SCHWEINGRUBER   (NORTHWESTERN,EVANSTON)

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$K_N(1660)$

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27  KN (1660, JP=  )  I = 1/2

-------->EVIDENCE NOT COMPELLING, OMITTED FROM TABLE

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                         27  KN (1660) MASS  (MEV)

M          1660.0                    CARMONY   67 HBC  -  3.8 K-P,OMEGA K 11/67
M          1660.0     10.0           JOBES     67 HBC  +  5. K+ P         11/67
M    J   CLAIMED BY JOBES IN (K PI), (K*(890) PI), AND (K*(1420) PI) MODES.  11/67
M    J   JOBES 67 SEES THE K PI BUMP MOSTLY IN INTERFERENCE WITH N*(1236).   11/67

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                         27  KN (1660) WIDTH (MEV)

W          60.0      20.0            JOBES     67 HBC  +  5. K+ P         11/67

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Data in parentheses have not been included in our averages.

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                   27  KN (1660) PARTIAL DECAY MODES

                                                        DECAY MASSES
P1      KN*(1660) INTO K PI                            493+ 139
P2      KN*(1660) INTO K PI PI                         493+ 139+ 139
P3      KN*(1660) INTO K*(890) PI                      892+ 139
P4      KN*(1660) INTO KN*(1430) PI                   1420+ 139

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                      REFERENCES FOR KN(1660)

CARMONY  67 PRL  18  615       D.CARMONY,T.HENDRICKS,L.LANDER    (LA JOLLA)
JOBES    67 PL 26B 49          +BASSOMPIERRE,DE BAERE +   (BIRM+CERN+BRUX)

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K_A (1780)

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23    KA (1780, JP=  )  I = 1/2

(ALSO CALLED L MESON)
(JP = 1+, 2- SEEM MOST LIKELY)

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                   23   KA (1780) MASS (MEV)

M   V     (1785.0)   (12.0)         ABCLV COL 67 HBC   - 10.0 K- P(K 2PI)  6/68*
M   V      ABCLV COL 68 IS UPDATING OF ABCLV COL 67
M       20 1780.                    BERLINGHI 67 HBC   +  12.7 K+P           7/67
M          1760.0      15.0         JOBES     67 HBC   +  5. K+ P           11/67
M   *     (1789.0)    (8.0)         ABCLV COL 68 HBC   - 10.0 K- P(K NPI)  9/68*

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                   23   KA (1780) WIDTH (MEV)

W   V     (127.0)    (43.0)         ABCLV COL 67 HBC   - 10.0 K- P(K 2PI)  6/68*
W   V      ABCLV COL 68 IS UPDATING OF ABCLV COL 67
W       20  80.                     BERLINGHI 67 HBC   +  12.7 K+P           7/67
W           60.0      20.0          JOBES     67 HBC   +  5. K+ P           11/67
W   *     (132.0)    (28.0)         ABCLV COL 68 HBC   - 10.0 K- P(K NPI)  9/68*

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                   23   KA (1780) PARTIAL DECAY MODES

                                                        DECAY MASSES
P1      KA    INTO K PI                                497+ 134
P2      KA    INTO K RHO                               497+ 770
P3      KA    INTO K*(890) PI                          134+ 892
P4      KA    INTO K OMEGA                             497+ 783
P5      KA    INTO K PI PI                             497+ 134+ 134
P6      KA    INTO K*(1420) PI                         134+1420
P7      KA    INTO K ETA                               497+ 548
P8      KA    INTO K PHI                               497+1019
P9      KA    INTO K*(890) ETA                         548+ 892

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                   23   KA (1780) BRANCHING RATIOS

R1  *  KA   INTO (K PI)/TOTAL
R1  V         0.023 OR LESS              ABCLV COL 67 HBC   - 10.0 K- P        0/67
R1  V       ABCLV COL 68 IS UPDATING OF ABCLV CCL 67
R1  *         0.06  OR LESS, C.L.=.95 ABCLV COL 68 HBC   - 10.0 K- P        9/68*
R1  *         0.1   OR LESS              ANTICH     68 DBC   - 12.6 K- D        9/68*

R2  *  KA   INTO (K RHO)/TOTAL
R2  V        (0.099)  (0.06)             ABCLV COL 67 HBC   - 10.0 K- P        0/67
R2  V       ABCLV COL 68 IS UPDATING OF ABCLV CCL 67
R2  *   31   (0.11)    (0.09)            ABCLV COL 68 HBC   - 10.0 K- P        9/68*
R2  *        (0.2)     (0.15)    (0.2)   ANTICH     68 DBC   - 12.6 K- D        9/68*

R3  *  KA   INTO (K*(890) PI)/TOTAL
R3  V        (0.244)  (0.08)             ABCLV COL 67 HBC   - 10.0 K- P        0/67
R3  V       ABCLV COL 68 IS UPDATING OF ABCLV CCL 67
R3  *   92   (0.34)    (0.12)            ABCLV COL 68 HBC   - 10.0 K- P        9/68*
R3  *        (0.29)    (0.09)    (0.14)  ANTICH     68 DBC   - 12.6 K- D        9/68*

R4  *  KA   INTO (K OMEGA)/TOTAL
R4  V        (0.048)  (0.02)             ABCLV COL 67 HBC   - 10.0 K- P        0/67
R4  V       ABCLV COL 68 IS UPDATING OF ABCLV COL 67
R4  *   25   (0.08)    (0.05)            ABCLV COL 68 HBC   - 10.0 K- P        9/68*

R5  *  KA   INTO (K*(890) ETA)/TOTAL
R5  *         0.05  OR LESS, C.L.=.95 ABCLV COL 68 HBC   - 10.0 K- P        9/68*

R6  *  KA   INTO (K PI PI)/(TOTAL)
R6  V        (0.445)  (0.15)             ABCLV COL 67 HBC   - 10.0 K- P        0/67
R6  V       ABCLV COL 68 IS UPDATING OF ABCLV COL 67
R6  R   77   (0.28)    (0.13)            ABCLV COL 68 HBC   - 10.0 K- P        9/68*
R6  R        (0.31)    (0.30)    (0.15)  ANTICH     68 DBC   - 12.6 K- D        9/68*
R6  R   THIS BRANCHING RATIO CONTAINS REDUNDANT INFORMATION, SINCE WE
R6  R   CONSTRAIN THE SUM OF ALL BRANCHING RATIOS TO BE 1.0

R7  *  KA   INTO (K*(1420) PI) / TOTAL
R7  V        (0.164)  (0.08)             ABCLV COL 67 HBC   - 10.0 K- P        0/67
R7  V       ABCLV COL 68 IS UPDATING OF ABCLV COL 67
R7  *   51   (0.19)    (0.05)            ABCLV COL 68 HBC   - 10.0 K- P        9/68*
R7  *        (0.20)    (0.09)    (0.15)  ANTICH     68 DBC   - 12.6 K- D        9/68*

R8  *  KA   INTO (K ETA)/TOTAL
R8            0.01  OR LESS              ABCLV COL 67 HBC   - 10.0 K- P        0/67

R9  *  KA   INTO (K PHI)/TOTAL
R9  *         0.05  OR LESS, C.L.=.95 ABCLV COL 68 HBC   - 10.0 K- P        9/68*

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                      REFERENCES FOR KA(1780)

ABCLV CO 67 HEIDBG CONF P.43   AACHEN+BERLIN+CERN+LONDON (C+VIENNA COLLAB)
SEE ALSO 66 PL 22 357          BARTSCH,DEUTSCHMANN,MORRISCN+   (ABCL(IC)V)
BERLINCH 67 PRL 18 1087        BERLINGHIERI+FARBER+FERBEL+FORMAN+   (ROCH)I
JOBES    67 PL 26B 49          +BASSOMPIERRE,DE BAERE +   (BIRM+CERN+BRUX)
ABCLV CO 68  VIENNA CONF. 464 COLLABORATION AACHEN-BERLI(+CERN+LOIC+WIEN)
ANTICH   68  VIENNA CONF. 493 +BOSCO,CALLAHAN,COX,DENEGRI+(JOHNS HOPKINS)I JP
BGO COL. 68  VIENNA CONF. 500 COLLABORATION BIRMINGHAM +GL(SGOW + OXFORD)
DENEGRI  68 PRL 20 1194        +CALLAHAN+ETTLINGER+GILLESPIE+   (JOHNHOPK)  2-

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K^* (2240)

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40    K* (2240, JP=  )  I=1/2

------>  ENHANCEMENT SEEN IN (ANTIHYPERON+NUCLEON) MASS.
         EVIDENCE NOT COMPELLING, OMITTED FROM TABLE.

------ --------- --------- --------- --------- --------- --------- --------

                   40   K* (2240)  MASS (MEV)

M      15 2240.      20.               ALEXANDER 68 HBC   + 0 9 K+P,YBAR+N+..  6/68*

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                   40   K* (2240)  WIDTH (MEV)

W      15   70.      20.               ALEXANDER 68 HBC   + 0 9 K+P,YBAR+N+..  6/68*

****** ********* ********* ********* ********* ********* ********* ********

                      REFERENCES FOR K*(2240)

ALEXANDE 68 PRL 20 755         ALEXANDER,FIRESTCNE,GOLDHABER,SHEN    (LRL)

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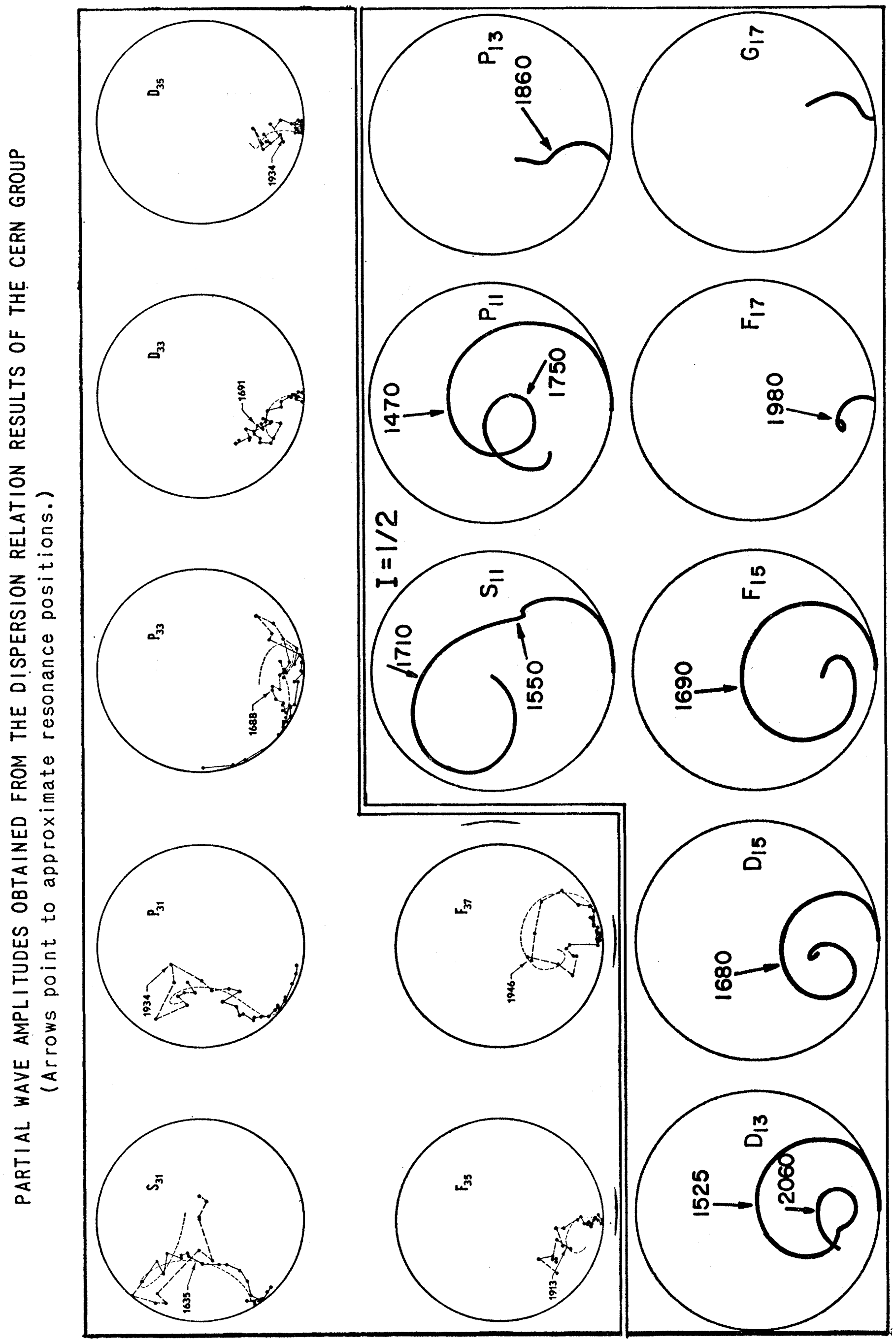
BARYON RESONANCES

Note on Nucleon Resonances

There are five "modern" phase-shift analyses of πN elastic scattering, made by groups at Saclay,[1] CERN (Paper I),[2] Berkeley,[3] Glasgow,[4] and CERN (Paper II)[5]—the last a reanalysis of the isospin-3/2 phase shifts using different methods than CERN (I). Our only source for the Glasgow and CERN (II) results—and for much of the rest of the last year's work on nucleon resonances—is the 1968 Vienna Conference rapporteur talk by Donnachie,[6] which, together with a talk by Rushbrooke,[7] should be read by anyone interested in this field. Here we reproduce (slightly modified) some tables from Donnachie, and add the CERN (II) phase-shift solutions to our previous Argand diagrams. We have not seen the Glasgow or recent Berkeley diagrams. We have added a column to the first table giving our evaluation of the status of the resonances. Those listed "good" or "fair" are included in the Baryon Table. Those listed "poor" are not. In two or three cases, our evaluation is based in part on the results of a phase-shift analysis of the reaction $\pi^- p \rightarrow K^0 \Lambda$ made by Lovelace et al.[8] Their Argand diagrams may be found in Donnachie.[6]



Partial-wave amplitudes obtained by the CERN analyses.[2,5] The CERN (I) results are the smooth curves (light lines in the isospin-3/2 diagrams). This analysis used dispersion relations to join and smooth the solutions found at different energies. The isospin-3/2 analysis was redone using a "shortest-path" method, devised by the Berkeley group,[3] to join the solutions at different energies (jagged lines). Arrows point to approximate positions of resonances claimed by the CERN group.

PARTIAL WAVE AMPLITUDES OBTAINED BY THE SACLAY PHASE SHIFT ANALYSIS (BAREYRE et al)

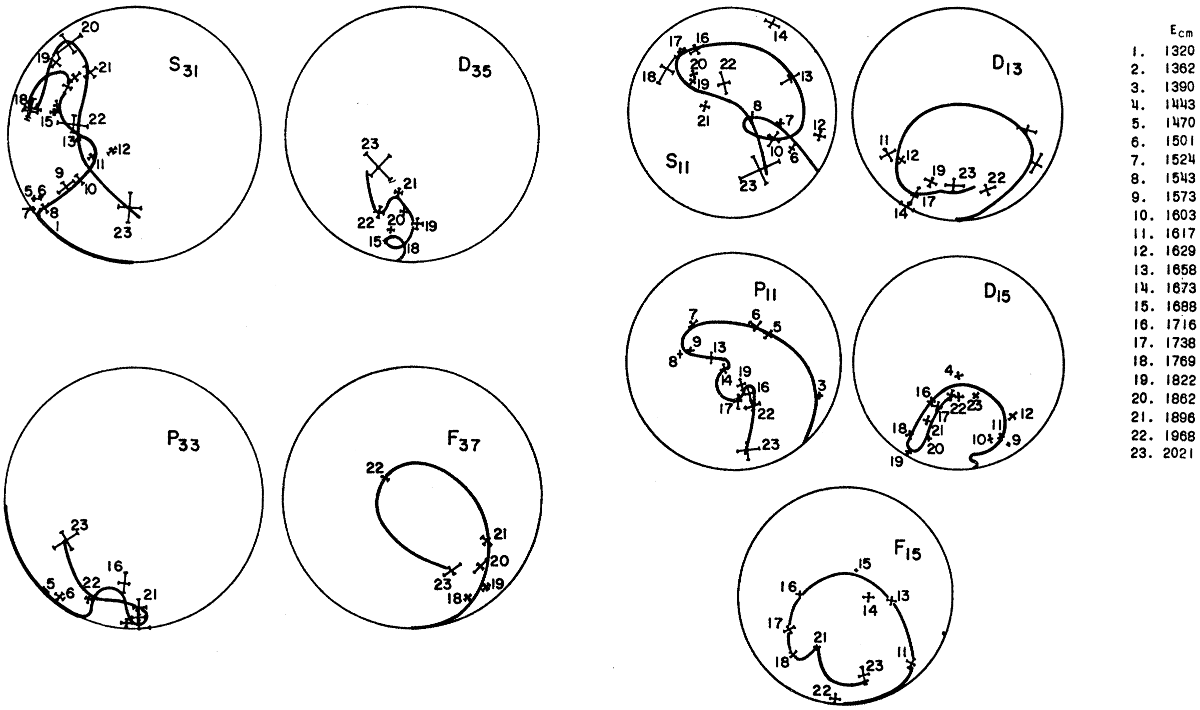


Table I. The status of nucleon resonances as seen in various phase-shift analyses and inelastic channels (there D means definite and P means probable or possible). The CERN I and II and Saclay phase-shift diagrams are shown in accompanying figures. See A. Donnachie,[6] from whom this table is adapted, for a discussion. We have added a column giving our evaluation of the status of the resonances.

Possible resonances	Berkeley	CERN I	Saclay	Glasgow	CERN II	Our evaluation	ηN	$K\Lambda$	$K\Sigma$	$\pi\Delta$	ρN	γN
$P_{33}(1236)$			We will not argue about this one			Good						D
$S_{31}(1640)$	Definite	Definite	Definite	Definite	Definite	Good				P		
$D_{33}(1690)$	Possible	Possible	Ambiguous	Definite	Definite	Fair				P		
$P_{33}(1690)$	Probable	Probable	Ambiguous	Possible	Definite	Poor				P		
$F_{35}(1910)$	Probable	Probable	Ambiguous	Definite	Definite	Fair						
$P_{31}(1930)$	Probable	Probable	Ambiguous	Definite	Definite	Good						
$F_{37}(1950)$	Definite	Definite	Definite	Definite	Definite	Good			P	D	D	D
$D_{35}(1950)$	Doubtful	Doubtful	Ambiguous	No	Possible	Poor						
$P_{11}(1470)$	Definite	Definite	Definite	Definite	--	Good				D		P
$D_{13}(1520)$	Definite	Definite	Definite	Definite	--	Good				D		D
$S_{11}(1550)$	Definite	Definite	Definite	Definite	--	Good	D					D
$D_{15}(1680)$	Definite	Definite	Definite	Definite	--	Good				P		
$F_{15}(1690)$	Definite	Definite	Definite	Definite	--	Good				P		D
$S_{11}(1710)$	Definite	Definite	Definite	Definite	--	Good ($K\Lambda$)	P	P				
$D_{13}(\sim1730)$	No	Use imagination	No	No	--	Poor		P				
$P_{11}(1750)$	No	Possible	No	Definite	--	Fair ($K\Lambda$)	P	P		P		
$P_{13}(1860)$	No	Possible	No	Definite	--	Poor						
$F_{17}(1980)$	No	Doubtful	No	Transferred to G_{17}	--	Poor						
$D_{13}(\sim2030)$	No	Probable	No	No	--	Poor						
$G_{17}(2190)$	Ambiguous	Definite	--	--	--	Good						P

Table II. Resonances observed in pion-nucleon scattering with a mass of less than 2.2 GeV. The masses, widths, and elasticities conjectured in the CERN I[2] analysis and the two results of the Glasgow analysis[4] are shown, together with the "average." In forming this "average," the two Glasgow results were first combined, and then taken with the CERN I analysis. The differences in the resonance parameters give some guide to the uncertainty in extracting these numbers from Argand diagrams.

Partial wave	CERN I			Glasgow (A)			Glasgow (B)			Composite		
	Mass	Γ_{tot}	Γ_{el}/Γ_{tot}	Mass	Γ_{tot}	Γ_{el}/Γ_{tot}	Mass	Γ_{tot}	Γ_{el}/Γ_{tot}	Mass	Γ_{tot}	Γ_{el}/Γ_{tot}
P_{33}	1236	125	1.00	1238	120	1.00	1238	120	1.00	1237	122.5	1.00
S_{31}	1640	177	0.28	1617	141	0.28	1623	140	0.25	1630	160	0.27
D_{33}	1690	269	0.14	1649	188	0.12	1650	174	0.13	1670	225	0.13
P_{33}	1690	281	0.10	-	-	-	-	-	-	1690	280	0.10
F_{35}	1910	350	0.16	1841	136	0.20	1852	150	0.19	1880	250	0.18
P_{31}	1930	339	0.30	1914	290	0.18	1843	231	0.24	1905	300	0.25
F_{37}	1950	221	0.39	1935	196	0.51	1935	212	0.39	1940	210	0.42
P_{11}	1470	211	0.66	1462	391	0.49	1436	224	0.46	1460	260	0.57
D_{13}	1520	114	0.57	1512	106	0.45	1512	125	0.49	1515	115	0.52
S_{11}	1550	116	0.33	1502	36	0.36	1499	53	0.35	1525	80	0.34
D_{15}	1680	173	0.39	1669	115	0.50	1667	115	0.43	1675	145	0.43
F_{15}	1690	132	0.68	1685	104	0.54	1684	123	0.54	1690	125	0.61
S_{11}	1710	300	0.79	1766	404	0.56	1671	121	0.51	1715	280	0.66
D_{13}	1730?	?	?	-	-	-	-	-	-	1730?	?	?
P_{11}	1750	327	0.32	1770	445	0.43	1867	525	0.30	1785	405	0.34
P_{13}	1860	296	0.21	1844	449	0.40	1854	307	0.26	1855	335	0.27
D_{13}	2030?	290	0.26	-	-	-	-	-	-	2030?	290?	0.26?
G_{17}	2190	300	0.35	-	-	-	-	-	-	2190	300	0.35

REFERENCES AND FOOTNOTES

1. P. Bareyre, C. Bricman, and G. Villet, Phys. Rev. 165, 1730 (1968).
2. A. Donnachie, R. G. Kirsopp, and C. Lovelace, Phys. Letters 26 B, 161 (1968).
3. C. H. Johnson, P. D. Grannis, M. J. Hansroul, O. Chamberlain, G. Shapiro, and H. M. Steiner, communication to Intern. Conf. on Elementary Particles, Heidelberg, 1967;
C. H. Johnson and H. M. Steiner, UCRL-18001, presented at the Conf. on πN Scattering, University of California, Irvine, 1967;
C. H. Johnson, UCRL-17683, 1967.
4. A. T. Davies and R. G. Moorhouse, communication to Intern. Conf. on High-Energy Physics, Vienna, 1968.
5. C. Lovelace and F. Wagner, communica-

Data in parentheses have not been included in our averages.

tion to Intern. Conf. on High-Energy Physics, Vienna, 1968.

6. A. Donnachie, 14th Intern. Conf. on High-Energy Physics, Vienna, 1968 (CERN, Geneva, 1968), p. 139.
7. J. G. Rushbrooke, 14th Intern. Conf. on High-Energy Physics, Vienna, 1968 (CERN, Geneva, 1968), p. 158.
8. C. Lovelace, F. Wagner, and J. Iliopoulos, communication to Intern. Conf. on High-Energy Physics, Vienna, 1968.

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CODE EVENTS QUANTITY  ERROR+  ERROR-  REFERENCE YR TECN SIGN COMMENTS  DATE
     ABOVE                                                          PUNCHED
   BACKGROUND
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p

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                    16  PROTON  (938, J=1/2)  I=1/2

                    SEE LISTINGS OF STABLE PARTICLES

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n

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                    17  NEUTRON  (939, J=1/2)  I=1/2

                    SEE LISTINGS OF STABLE PARTICLES

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Δ(1236) P33

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                    81  N*3/2(1236, JP=3/2+) I=3/2

                     THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
                     THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                     CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                     THE N*3/2(1236).

                    81  N*3/2(1236) MASS (MEV)      ----------------------

M    *     (1234.0)                ROPER     65 RVUE 0++PHASE-SHIFT ANAL
M    *     (1235.8)                DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
M++         1236.0     0.55        OLSSON    65 RVUE ++ TOTAL-SIGMA DATA
M++  *     (1232.0)   (6.0)        FERRO-LUZ 65 HBC  ++ K+P TO KO P PI+
M++  *     (1233.4)   (4.4)        GIDAL     66 DBC  ++ D D TO NN(NN) PI  7/66
M++         1236.0                 DEANS     66 RVUE ++ PI+P TOTAL        7/66
MO          1236.45    0.65        OLSSON    65 RVUE 0
M-   *     (1241.3)   (5.1)        GIDAL     66 DBC  -                    7/66

----------------  81  N*(0) - N*(++) MASS DIFFERENCE (MEV)    ----------

D    R       (0.45)   (0.85)       OLSSON    65 RVUE
D    R     REDUNDANT WITH DATA IN MASS LISTING.

----------------  81  N*(-) - N*(++) MASS DIFFERENCE (MEV)    ----------

D               7.9    6.8         GIDAL     66 DBC

----------------  81  N*3/2(1236) WIDTH (MEV)    ----------------------

W    *     (125.1)                 DONNACHIE 68 RVUE                      6/68*
W++         120.0      2.0         OLSSON    65 RVUE ++
W++  *     (125.0)   (30.0)        FERRO-LUZ 65 HBC  ++
W++  *     (124.0)   (14.0)        GIDAL     66 DBC  ++                   7/66
W++         121.0                  DEANS     66 RVUE ++                   7/66
WO          119.6      2.4         OLSSON    65 RVUE 0
W-   *     (149.0)   (18.0)        GIDAL     66 DBC  -                    7/66

----------------  81  N*3/2(1236) PARTIAL DECAY MODES    ---------------

                                                       DECAY MASSES
P1         N*3/2(1236) INTO PI N                      139+ 938
P2     N*3/2(1236) INTO N GAMMA                         0+ 938

----------------  81  N*3/2(1236) BRANCHING RATIOS  ---------------------

R1     N*3/2(1236) INTO (N GAMMA)/TOTAL    (PERCENT)     (P2)/(P1)
R1              0.55     0.02      DALITZ    66 RVUE                      7/68*

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                            REFERENCES -- N*3/2(1236)

OLSSON   65 PRL 14 118      M G OLSSON                          (WISC)
FERRO-LU 65 NC 36 1101      FERRO-LUZZI,GEORGE, +               (CERN)
ROPER    65 PR 138 B190     L D ROPER, R M WRIGHT, B T FELD  (LRL,MIT) JP
DALITZ   66 PR 146 1180     DALITZ,SUTHERLAND                 (OXFORD)
DEANS    66 PREPRINT        S R DEANS, W G HOLLADAY        (VANDERBILT)
GIDAL    66 PR 141 1261     G GIDAL, A KERNAN, S KIM             (LRL)
DONNACHI 68 PL 26B 161      A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

       FOR EXTENSIVE REFERENCES TO DATA AND PHASE-SHIFT ANALYSES TILL 1965,
       SEE ROPER 65, ESPECIALLY APPENDIX II.
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N(1470) P11

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                    61  N*1/2(1470, JP=1/2+) I=1/2

                     THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
                     THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                     CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                     THE N*3/2(1236).

    THE MASS AND WIDTH ARE BEST DETERMINED FROM PHASE-SHIFT ANALYSES.  WE
    NO LONGER LIST THEM AS DETERMINED FROM PRODUCTION EXPERIMENTS.  SEE THE
    PREVIOUS EDITION (RMP 40, 77, 1968) FOR SUCH A LIST.

----------------  61  N*1/2(1470) MASS (MEV)    ------------------------

M    *     (1380.0)                ROPER     65 RVUE    PHASE-SHIFT ANAL  9/66
M    *     (1370.0)                BRANDSEN  65 RVUE    PHASE-SHIFT ANAL  9/66
M    1     (1470.0)                BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     1     WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M    2     (1505.0)                BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     2     WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
     2     IS GREATEST.
M    3     (1466.0)                DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
     3     WHERE THE ABSORPTION IS GREATEST.

----------------  61  N*1/2(1470) WIDTH (MEV)    -----------------------

W    1     (255.0)                 BAREYRE   68 RVUE                     11/67
W    2     (205.0)                 BAREYRE   68 RVUE                     11/67
W    3     (211.0)                 DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

----------------  61  N*1/2(1470) PARTIAL DECAY MODES    ---------------

                                                      DECAY MASSES
P1         N*1/2(1470) INTO PI N                     139+ 938
P2         N*1/2(1470) INTO N SIGMA (SIGMA MESCN)    938+ 400
P3         N*1/2(1470) INTO N*3/2(1236) PI          1236+ 139
P4         N*1/2(1470) INTO N PI PI                  938+ 139+ 139

----------------  61  N*1/2(1470) BRANCHING RATIOS    ------------------

RI         N*1/2(1470) INTO (PI N)/TOTAL             (P1)/TOTAL
R1   1       (0.68)                BAREYRE   68 RVUE                     11/67
R1   3       (0.658)               DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

R2         N*1/2(1470) INTO (N SIGMA)/TOTAL          (P2)/TOTAL
R2         DOMINANT INELASTIC DECAY   THURNAUER 65 RVUE  -               11/67
R2         DOMINANT INELASTIC DECAY   NAMYSLOWS 66 RVUE  -               11/67
R2         DOMINANT INELASTIC DECAY   ROSENFELD 67 RVUE  -               11/67
R2         DOMINANT INELASTIC DECAY   MORGAN    68 RVUE   ISOBAR MODEL    6/68*

R3         N*1/2(1470) INTO (N*3/2(1236) PI)/TOTAL   (P3)/TOTAL
R3             PROBABLY SEEN          LAMSA     68 HBC    PI-P 8 BEV/C   11/68*
R3             PROBABLY SEEN          JESPERSEN 68 HBC    PP 22 BEV/C    11/68*

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                            REFERENCES -- N*1/2(1470)

ROPER    65 PR 138 B190     LD ROPER,RM WRIGHT,BT FELD   (LRL-LVMR,MIT)IJP
BRANDSEN 65 PR 139 B1566    +ODONNELL, MOORHOUSE         (DURHAM,RTHFD)IJP
THURNAUE 65 PRL 14 985      P G THURNAUER                          (ROCH)
NAMYSLOW 66 PR 157 1328     NAMYSLOWSKI,RAZMI,ROBERTS    (STAN,EDINB,IC)
ROSENFEL 67 IRVINE CONF     A H ROSENFELD, P SODING                 (LRL)
BAREYRE  68 PR 165 1731     P BAREYRE, C BRICMAN, G VILLET     (SACLAY)IJP
DONNACHI 68 PL 26B 161      A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP
LAMSA    68 PR 166 1395     +CASON,BISWAS,DERADO,GROVES,+  (NOTRE DAME)
MORGAN   68 PR 166 1731     D MORGAN                              (RTHFD)
JESPERSE 68 PRL 21 1368     JESPERSEN,KANG,KERNAN, +        (IOWA STATE)

                    PAPERS NOT REFERRED TO IN DATA CARDS.

BAREYRE  64 PL 8 137        +BRICMAN,VALLADAS,VILLET, +   (SACLAY,CAEN) IJ
ADELMAN  65 PRL 14 1043     S L ADELMAN               (CAMBRIDGE(CERN))
DALITZ   65 PL 14 159       R H DALITZ, R G MOORHOUSE        (OXF,RTHFD)
BAREYRE  65 PL 18 342       +BRICMAN, STIRLING, VILLET         (SACLAY)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                          (LRL)
     THE FOLLOWING ARE THEORETICAL PAPERS CONCERNING THE N*1/2(147C) --
RESNICK  66 PR 150 1292     L RESNICK                       (NIELS BOHR)
SCHWARZ  66 PR 152 1325     J H SCHWARZ                             (LRL)
GOLDBERG 67 PR 154 1558     H GOLDBERG                          (CORNELL)
BALL     67 PR 155 1725     JS BALL, GL SHAW, DY WONG    (UCLA,UCI,UCSD)
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N(1518) D13

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                    62  N*1/2(1518, JP=3/2-) I=1/2

                     THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
                     THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                     CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                     THE N*3/2(1236).

----------------  62  N*1/2(1518) MASS (MEV)    ------------------------

M    *     (1536.0)                ROPER     65 RVUE    PHASE-SHIFT ANAL  9/66
M    *     (1530.0)                BRANDSEN  65 RVUE    PHASE-SHIFT ANAL  9/66
M    1     (1510.0)                BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     1     WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M    2     (1515.0)                BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     2     WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
     2     IS GREATEST.
M    3     (1541.0)                DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
     3     WHERE THE ABSORPTION IS GREATEST.

----------------  62  N*1/2(1518) WIDTH (MEV)    -----------------------

W    1     (125.0)                 BAREYRE   68 RVUE                     11/67
W    2     (110.0)                 BAREYRE   68 RVUE                     11/67
W    3     (149.0)                 DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

----------------  62  N*1/2(1518) PARTIAL DECAY MODES    ---------------

                                                      DECAY MASSES
P1         N*1/2(1518) INTO PI N                     139+ 938
P2         N*1/2(1518) INTO N*3/2(1236) PI          1236+ 139
P3         N*1/2(1518) INTO N PI PI                  938+ 139+ 139
P4         N*1/2(1518)+ INTO NEUTRON PI+             939+ 139
P5         N*1/2(1518)+ INTO PROTON PI+ PI-          938+ 139+ 139
P6         N*1/2(1518) INTO N ETA                    939+ 548
P7         N*1/2(1518) INTO N SIGMA (SIGMA MESON)    939+ 400
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BARYON RESONANCES

Data in parentheses have not been included in our averages.

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-----------------   62  N*1/2(1518) BRANCHING RATIOS    -------------------

R1         N*1/2(1518) INTO (PI N)/TOTAL                    (P1)/TOTAL
R1  1        (0.54)                BAREYRE   68 RVUE                      11/67
R1  3        (0.509)               DONNACHIE 68 RVUE                       6/68*
      SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

    ALMOST THE ENTIRE INELASTICITY IS IN N PI PI (ONLY N ETA COULD COMPETE,
    AND IT DOESNT).  THE N PI PI SEEMS TO BE MAINLY N*3/2(1236) PI, IN BOTH
    S AND D WAVES.

R2         N*1/2(1518) INTO (N*3/2(1236) PI)/TOTAL          (P4)/TOTAL
R2            DOMINANT INEL DECAY      OLSSON    66 RVUE     PI P TO PI PI N   9/66
R2            0.20      0.05           KIRZ      66 HBC   0  ASSUMING R1=0.72  9/66

R3         N*1/2(1518) INTO (N PI)/(N PI PI)                (P1)/(P3)
R3            1.25      0.44      0.71 A-BORELLI 67 HBC   0  PBAR P 5.7 BEV/C  9/66

R4         N*1/2(1518) INTO (N*3/2(1236) PI)/(N PI PI)      (P2)/(P3)
R4            0.00      0.09           A-BORELLI 67 HBC                        9/66
R4             LARGE                   THURNAUER 65 RVUE  -                   11/67
R4             LARGE                   NAMYSLOWS 66 RVUE  -                   11/67
R4             LARGE                   ROBERTS   67 RVUE  -                   11/67
R4             LARGE                   ROSENFELD 67 RVUE  -                   11/67
R2           LARGE                     MORGAN    68 RVUE     ISOBAR MODEL      6/68*

R5         N*1/2(1518) INTO (NEUTRON PI+)/(P PI+ PI-)       (P4)/(P5)
R5            0.77      0.45           ALEXANDER 67 HBC   +  PP 5.5 BEV/C      9/66

R6         N*1/2(1518) INTO (PI N)/(PI N*3/2(1236))         (P1)/(P2)
R6            0.42     OR LESS         LEE       67 HBC                       11/67

R7         N*1/2(1518) INTO (N ETA)/TOTAL                   (P6)/TOTAL
R7            0.006     APPROX         DAVIES    67 RVUE                      11/67
     DAVIES 67 GIVES SEVERAL VALUES DEPENDING ON INPUT DATA.  ALL ARE SMALL

R8         N*1/2(1518) INTO (N SIGMA)/TOTAL                 (P7)/TOTAL
R8           PROBABLY PRESENT          MORGAN    68 RVUE     ISOBAR MCDEL      6/68*

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                          REFERENCES -- N*1/2(1518)

       SEE A PREVIOUS EDITION (RMP 37, 633, 1965) FOR EARLIER REFERENCES.

ROPER    65 PR 138 B190         LD ROPER,RM WRIGHT,BT FELD   (LRL-LVMR,MIT)IJP
BRANDSEN 65 PR 139 B1566        +ODONNELL, MOORHOUSE         (DURHAM,RTHFD)IJP
THURNAUE 65 PRL 14 985          P G THURNAUER                        (ROCH)
NAMYSLOW 66 PR 157 1328         NAMYSLOWSKI,RAZMI,ROBERTS   (STAN,EDINB,IC)
KIRZ     66 PRIVATE COMM        J KIRZ                                (LRL)
     --  NUMBER EXTRACTED FROM DATA DISCUSSED IN KIRZ 63.
OLSSON   66 PR 145 1309         M G OLSSON, G B YODH                (WISC,MD)
A-BORREL 67 NC 47 232           ALLES-BORELLI,FRENCH,FRISK,MICHEJDA  (CERN)
ALEXANDE 67 PR 154 1284         ALEXANDER,BENARY,CZAPEK,+  (WEIZMANN(CERN))
LEE      67 PR 159 1156         +MOEBS,ROE,SINCLAIR,VANDER VELDE     (MICH)
ROBERTS  67 PREPRINT            R G ROBERTS                         (DURHAM)
ROSENFEL 67 IRVINE CONF         A H ROSENFELD, P SODING                (LRL)
DAVIES   67 NC 52A 1112         A T DAVIES, R G MOORHOUSE   (GLASGOW,RTHFD)

MORGAN   68 PR 166 1731         D MORGAN                             (RTHFD)
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET    (SACLAY)IJP
DONNACHI 68 PL 26B 161          A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

                     PAPERS NOT REFERRED TO IN DATA CARDS.

KIRZ     63 PR 130 2481         J KIRZ, J SCHWARTZ, R D TRIPP          (LRL)
CROUCH   65 DESY CONF II 21   +   (BROWN,CEA,HARVARD,MIT,PADOVA,WEIZMANN)
DERADO   65 ATHENS CONF 244   +KENNEY,LAMSA, +      (NOTRE DAME,KENTUCKY)
BAREYRE  65 PL 18 342         + BRICMAN, STIRLING, VILLET         (SACLAY)IJP
MERLO    66 P ROY SOC 289 489 J P MERLO, G VALLADAS                 (SACLAY)
    -- THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE RESONANCE.
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)

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N(1550)   63 N*1/2(1550, JP=1/2-) I=1/2 S_{11}

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               THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
               THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
               CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
               THE N*3/2(1236).

               63  N*1/2(1550) MASS (MEV)    -------------------------

M    *      (1519.0)                   HENDRY    65 RVUE    ETA N + S11 PI N  9/66
M            1570.0                    MICHAEL   66 RVUE    FITS BAREYRE S11  7/66
M    N       1557.0  OR  1565.0        UCHIYAMA- 66 RVUE    FITS N ETA DATA   9/66
M    N      FITTING GIVES TWO SOLUTIONS.  PROBLEMS MATCHING PI P PHASE SHIFT
M    1      (1535.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     1      WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M    2      (1515.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     2      WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
     2      IS GREATEST.
M    3      (1591.0)                   DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
     3      WHERE THE ABSORPTION IS GREATEST.

----------------   63  N*1/2(1550) WIDTH (MEV)    -------------------------

W    *      (130.0)                    HENDRY    65 RVUE                      9/66
W            130.0                     MICHAEL   66 RVUE                      7/66
W    N       156.0  OR  144.0          UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66
W    1      (155.0)                    BAREYRE   68 RVUE                     11/67
W    2      (105.0)                    BAREYRE   68 RVUE                     11/67
W    3       268.0     APPROX          DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

----------------   63  N*1/2(1550) PARTIAL DECAY MODES    ----------------

                                                          DECAY MASSES
P1          N*1/2(1550) INTO PI N                        139+ 938
P2          N*1/2(1550) INTO N ETA                       939+ 548
P3          N*1/2(1550) INTO N PI PI                     938+ 139+ 139

----------------   63  N*1/2(1550) BRANCHING RATIOS    -------------------

R1          N*1/2(1550) INTO (PI N)/TOTAL                   (P1)/TOTAL
R1   *        (0.69)                   HENDRY    65 RVUE                      9/66
R1   *        (0.32)                   MICHAEL   66 RVUE                      9/66
R1   N         0.71  OR  0.28          UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66
R1             0.78      0.24          BASSOMPIE 67 HBC  +  K+P TO K* N*     11/68*
R1             0.31   OR   0.43        DAVIES    67 RVUE    SOLUT. B OR C    11/67
R1   3        (0.696)                  DONNACHIE 68 RVUE                      6/68*

R2          N*1/2(1550) INTO (N ETA)/TOTAL                  (P2)/TOTAL
R2             DOMINANT INEL DECAY     HENDRY    65 RVUE                      9/66
R2             0.68                    MICHAEL   66 RVUE                      9/66
R2   N         0.29  OR  0.71          UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66
R2             0.22      0.14          BASSOMPIE 67 HBC  +  K+P TO K* N*     11/68*
R2             0.69   OR   0.45        DAVIES    67 RVUE    SOLUT. B OR C    11/67

R3          N*1/2(1550) INTO (N PI PI)/TOTAL                (P3)/TOTAL
R3             0.08     OR LESS        BASSOMPIE 67 HBC  +  K+P TO K* N*     11/68*

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                          REFERENCES -- N*1/2(1550)

HENDRY   65 PL 18 171           A W HENDRY, R G MOORHOUSE            (RTHFD)
      -- REVIEWS EARLY PHASE-SHIFT-ANALYSIS RESULTS AND PI- P TO ETA N
         EXPERIMENTS.  WE TAKE NUMBERS FROM THE SOLUTION USING BRANDSEN 65.
BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET       (SACLAY)IJP
MICHAEL  66 PL 21 93            C MICHAEL                              (OXF)
UCHIYAMA 66 PR 149 1220         F UCHIYAMA-CAMPBELL, R K LOGAN       (ILL)IJP
BASSOMPI 67 PL 25B 440          BASSOMPIERRE, +             (CERN,BRUXELLES)
DAVIES   67 NC 52A 1112         A T DAVIES, R G MOORHOUSE   (GLASGOW,RTHFD)
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET    (SACLAY)IJP
DONNACHI 68 PL 26B 161          A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

                     PAPERS NOT REFERRED TO IN DATA CARDS.

BRANDSEN 65 PR 139 B1566        +ODONNELL, MOORHOUSE         (DURHAM,RTHFD)IJP
      -- BASIS OF NUMBERS WE QUOTE FROM HENDRY 65.
LOVELACE 67 HEIDELBERG C. 79  C LOVELACE                             (CERN)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)

        THERE IS GETTING TO BE A WHOLE LITERATURE ON THE REACTIONS PI- P TO
        ETA N AND GAMMA P TO ETA P NEAR THRESHOLD AND THEIR CONNECTION WITH
        THE BEHAVIOR OF THE S11 AMPLITUDE AS DETERMINED IN PI P PHASE-SHIFT
        ANALYSIS.  THE READER IS INVITED TO PERUSE THE FOLLOWING RATHER IN-
        DIGESTIBLE COLLECTION.  FURTHER REFERENCES MAY BE FOUND IN THESE.

         MAINLY EXPERIMENTAL --
BULOS    64 PRL 13 486          +          (BROWN,BRANDEIS,HARVARD,MIT,PADOVA) I
RICHARDS 66 PRL 16 1221         +CHIU,EANDI,HELMHOLZ,KENNEY,+  (LRL,HAWAII) IJ
JONES    66 PL 23 597           +BINNIE,DUANE,HORSEY,MASON,+ (IMPCOL,RTHFD)
BACCI    66 NC 45A 983          +PENSO,SALVINI,MENCUCCINI,+ (ROME,FRASCATI)IJP
PREPOST  67 PRL 18 82           R PREPOST, D LUNDQUIST, D QUINN  (STANFORD)
BLOOM    68 PRL 21 1100         +HEUSCH, PRESCOTT, ROCHESTER       (CALTECH)
         MAINLY THEORETICAL --
DOBSON   66 PR 146 1022         P N DOBSON                          (HAWAII)
MINAMI   66 PR 147 1123         S MINAMI                             (OSAKA)
BALL     66 PR 149 1191         J S BALL                              (UCLA)

LOGAN    67 PR 153 1634         R K LOGAN, F UCHIYAMA-CAMPBELL         (ILL)
MENCUCCI 67 NC 48A 579          C MENCUCCINI, A REALE             (FRASCATI)
DEANS    67 PR 161 1466         S R DEANS, W G HOLLADAY         (VANDEFBILT)
MINAMI   67 PR 162 1619         S MINAMI                             (OSAKA)
MOSS     67 PR 163 1785         T A MOSS                               (LSU)
DEANS    68 PR 165 1886         S R DEANS, W G HOLLADAY         (VANDERBILT)
PAL      68 PR 167 1350         B K PAL                      (NPL NEW DELHI)

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Δ(1640)   82 N*3/2(1640, JP=1/2-) I=3/2 S_{31}

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               THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
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               CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
               THE N*3/2(1236).

               82  N*3/2(1640) MASS (MEV)    -------------------------

M    *      (1648.0)   (12.0)          DEVLIN    65 CNTR    PI+- P TOTAL
M    1      (1695.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     1      WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M    2      (1650.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     2      WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
     2      IS GREATEST.
M    3      (1635.0)                   DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
     3      WHERE THE ABSORPTION IS GREATEST.

-----------------   82  N*3/2(1640) WIDTH (MEV)    -------------------------

W    1      (250.0)                    BAREYRE   68 RVUE                     11/67
W    2      (130.0)                    BAREYRE   68 RVUE                     11/67
W    3      (177.0)                    DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

-----------------   82  N*3/2(1640) PARTIAL DECAY MODES    ----------------

                                                          DECAY MASSES
P1          N*3/2(1640) INTO PI N                        139+ 938

-----------------   82  N*3/2(1640) BRANCHING RATIOS    -------------------

R1          N*3/2(1640) INTO (PI N)/TOTAL                   (P1)/TOTAL
R1   3        (0.284)                  DONNACHIE 68 RVUE                      6/68*

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                          REFERENCES -- N*3/2(1640)

DEVLIN   65 PRL 14 1031         T J DEVLIN,J SOLOMON,G BERTSCH  (PRINCETON) I
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET    (SACLAY)IJP
DONNACHI 68 PL 26B 161          A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

                     PAPERS NOT REFERRED TO IN DATA CARDS.

CARRUTHE 60 PRL 4 303           P CARRUTHERS                      (CORNELL) I
DEVLIN   62 PR 125 690          T J DEVLIN, B J MOYER, V PEREZ-MENDEZ (LRL) I
HELLAND  64 PR 134 B1062        +DEVLIN,HAGGE,LONGO,MOYER,WOOD        (LRL) I
BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET       (SACLAY)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)

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N(1680)   64 N*1/2(1680, JP=5/2-) I=1/2 D_{15}

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               THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
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               THE N*3/2(1236).

-----------------   64  N*1/2(1680) MASS (MEV)    -------------------------

M    *       1650.0       APPROX       BRANDSEN  65 RVUE    PHASE-SHIFT ANAL  7/66
M    *      (1674.0)                   DUKE      68 CNTR    PI-P EL + POL     6/68*
M    1      (1680.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     1      WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M    2      (1655.0)                   BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
     2      WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
     2      IS GREATEST.
M    3      (1678.0)                   DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
     3      WHERE THE ABSORPTION IS GREATEST.

-----------------   64  N*1/2(1680) WIDTH (MEV)    -------------------------

W    1      (135.0)                    BAREYRE   68 RVUE                     11/67
W    2      (105.0)                    BAREYRE   68 RVUE                     11/67
W    3      (173.0)                    DONNACHIE 68 RVUE                      6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.
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Data in parentheses have not been included in our averages.

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----------------  64  N*1/2(1680) PARTIAL DECAY MODES   ---------------

                                                           DECAY MASSES
P1         N*1/2(1680) INTO  PI N                         139+ 938
P2         N*1/2(1680) INTO  N ETA                        939+ 548
P3         N*1/2(1680) INTO  LAMBDA K                    1115+ 497
P4         N*1/2(1680) INTO N*3/2(1236) PI               1236+ 139

----------------  64  N*1/2(1680) BRANCHING RATIOS   -----------------

R1         N*1/2(1680) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1  1        (0.41)                BAREYRE   68 RVUE                    11/67
R1  3        (0.391)               DONNACHIE 68 RVUE                    6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

R2         N*1/2(1680) INTO (N ETA)/TOTAL                (P2)/TOTAL
R2           0.025      OR LESS    TRIPP     67 RVUE                     8/67

R3         N*1/2(1680) INTO (LAMBDA K)/TOTAL             (P3)/TOTAL
R3           0.016      OR LESS    TRIPP     67 RVUE                     8/67

    SEE NOTE PRECEDING THE N*1/2(1688) INELASTIC DECAY MODE MEASUREMENTS.

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                          REFERENCES -- N*1/2(1680)

DUKE     65 PRL 15 468          +JONES,KEMP,MURPHY,PRENTICE, +  (RTHFD,OXF)IJP
BRANDSEN 65 PL 19 420           +ODONNELL, MOORHCUSE          (DURHAM,RTHFD)IJP
TRIPP    67 NP B3 10            + LEITH, +     (LRL,SLAC,CERN,HEIDEL,SACLAY)
DUKE     68 PR 166 1448         +JONES,KEMP,MURPHY,THRESHER, +  (RTHFD,OXF)IJP
      --  INSIGHTFUL QUALITATIVE ARGUMENTS CONCERNING EXISTENCE AND IJP.
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET     (SACLAY)IJP
DONNACHI 68 PL 26B 161          A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

                       PAPER NOT REFERRED TO IN DATA CARDS.

BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET        (SACLAY)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)

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N(1688)

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                   65  N*1/2(1688, JP=5/2+) I=1/2      F15

                   THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
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                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

----------------  65  N*1/2(1688) MASS (MEV)   ------------------------

M   *     (1680.0)                 BRANDSEN  65 RVUE    PHASE SHIFT ANAL  7/66
M   *     (1682.0)                 DUKE      68 CNTR    PI-P EL + POL    6/68*
M   1     (1690.0)                 BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
    1      WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M   2     (1680.0)                 BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
    2      WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
    2      IS GREATEST.
M   3     (1687.0)                 DONNACHIE 68 RVUE    PHASE-SHIFT ANAL  6/68*
    3      WHERE THE ABSORPTION IS GREATEST.

----------------  65  N*1/2(1688) WIDTH (MEV)   -----------------------

W   1     (110.0)                  BAREYRE   68 RVUE                    11/67
W   2     (105.0)                  BAREYRE   68 RVUE                    11/67
W   3     (177.0)                  DONNACHIE 68 RVUE                    6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

----------------  65  N*1/2(1688) PARTIAL DECAY MODES   ---------------

                                                           DECAY MASSES
P1         N*1/2(1688) INTO  PI N                         139+ 938
P2         N*1/2(1688) INTO  N ETA                        939+ 548
P3         N*1/2(1688) INTO  LAMBDA K                    1115+ 497
P4         N*1/2(1688) INTO N*3/2(1236) PI               1236+ 139
P5         N*1/2(1688) INTO N PI                          938+ 139+ 139
P6         N*1/2(1688)+ INTO NEUTRON PI+                  939+ 139
P7         N*1/2(1688)+ INTO PROTON PI+ PI-               938+ 139+ 139
P8         N*1/2(1688)+ INTO N*3/2(1236)++ PI-           1236+ 139

----------------  65  N*1/2(1688) BRANCHING RATIOS   -----------------

R1         N*1/2(1688) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1  1        (0.64)                BAREYRE   68 RVUE                    11/67
R1  3        (0.560)               DONNACHIE 68 RVUE                    6/68*
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

    WE LIST MEASUREMENTS OF THE INELASTIC DECAY MODES OF THE 1688 MEV BUMP.
    SUCH MEASUREMENTS HAVE NOT UNTANGLED THE D15 AND F15 (AND POSSIBLE S11)
    COMPONENTS.  IT IS CLEAR THAT BOTH D15 AND F15 DECAY ALOT INTO N PI PI.
    MERLO 66 FINDS SOME N*3/2(1236) PI (SLIGHTLY MORE THAN PHASE SPACE).
    ROBERTS 67 SUGGESTS THAT THE DOMINANT MODE IS N*1/2(1518).

R2         N*1/2(1688) INTO (N ETA)/TOTAL                (P2)/TOTAL
R2           0.025      OR LESS    KRAEMER   64 DBC  +  PI+D 1.23 BEV/C   9/66
R2           0.042 OR LESS (95PC CL) A-BORELLI 67 HBC  +  PBAR P 5.7 BEV/C  8/67
R2           0.015                 TRIPP     67 RVUE                     8/67

R3         N*1/2(1688) INTO (N ETA)/(PI N)               (P2)/(P1)
R3           0.027      OR LESS    HEUSCH    66 RVUE +  PIO, ETA PHOTO    9/66

R4         N*1/2(1688) INTO (LAMBDA K)/TOTAL             (P3)/TOTAL
R4           0.013 OR LESS (95PC CL) A-BORELLI 67 HBC  +                    8/67
R4           0.0013                TRIPP     67 RVUE                     8/67
R4            SEEN                 CHINOWSKY 68 HBC     PP TO K+ Y N    6/68*

R5         N*1/2(1688) INTO (N PI)/(N PI PI)             (P1)/(P5)
R5           1.26 OR LESS (95PC CL)  A-BORELLI 67 HBC  +                    8/67

R6         N*1/2(1688) INTO (N*3/2(1236) PI)/(N PI PI)   (P4)/(P5)
R6           NO EVIDENCE           A-BORELLI 67 HBC  +                    8/67
R6         SEE MERLO 66 FOR A REVIEW.

R7         N*1/2(1688) INTO (NEUTRON PI+)/(P PI+ PI-)    (P6)/(P7)
R7           0.67       0.40       ALEXANDER 67 HBC  +  PP 5.5 BEV/C     11/67

R8         N*1/2(1688) INTO (N*(1236)++ PI-)/(P PI+ PI-) (P8)/(P7)
R8           0.74       0.14       ALEXANDER 67 HBC  +  PP 5.5 BEV/C     11/67
R8           1.0              0.3  ALMEIDA   66 HBC  +  PP 10 BEV/C       9/66
R8           0.83                  KAYAS     68         PP 8.1 BEV/C    11/68*

R9         N*1/2(1688) INTO (LAMBDA K)/(P PI+ PI-)       (P3)/(P7)
R9           0.034      OR LESS    ALEXANDER 67 HBC  +  PP 5.5 BEV/C     11/67

R10        N*1/2(1688) INTO (PI N)/(PI N*3/2(1236))      (P1)/(P4)
R10          0.77     OR LESS      LEE       67 HBC                      11/67

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                          REFERENCES -- N*1/2(1688)

         SEE A PREVIOUS EDITION (RMP 37, 633, 1965) FOR EARLIER REFERENCES.

KRAEMER  64 PR 136 B496         +MADANSKY,+  (J HOPKINS,NWESTERN,WOODSTOCK) I
DUKE     65 PRL 15 468          +JONES,KEMP,MURPHY,PRENTICE, +  (RTHFC,UXF)IJP
BRANDSEN 65 PL 19 420           +ODONNELL, MOORHOUSE          (DURHAM,RTHFD)IJP
HEUSCH   66 PRL 17 1019         C A HEUSCH, C Y PRESCOTT, R F DASHEN  (CIT)
ALMEIDA  66 BERKELEY CONF       +RUSHBROOKE, +            (CAVNDSH,DESY(CERN))
MERLO    66 P ROY SOC 289 489 J P MERLO, G VALLADAS                 (SACLAY)

ALEXANDE 67 PR 154 1284         ALEXANDER,BENARY,CZAPEK,+  (WEIZMANN(CERN))
A-BORREL 67 NC 47 232           ALLES-BORELLI,FRENCH,FRISK,MICHEJDA  (CERN)
LEE      67 PR 159 1156         +MOEBS,ROE,SINCLAIR,VANDER VELDE      (MICH)
TRIPP    67 NP B3 10            + LEITH, +     (LRL,SLAC,CERN,HEIDEL,SACLAY)
CHINOWSK 68 PR 165 1466         CHINOWSKY,KINSEY,KLEIN, +         (LRL,SLAC)
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET     (SACLAY)IJP
DUKE     68 PR 166 1448         +JONES,KEMP,MURPHY,THRESHER, +  (RTHFD,OXF)IJP
DONNACHI 68 PL 26B 161          A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP
KAYAS    68 NP B5 169           +GUYADER,SENE,YIOU,ALITTI,+  (ORSAY,SACLAY)

                       PAPERS NOT REFERRED TO IN DATA CARDS.

CROUCH   65 DESY CONF II 21   +    (BROWN,CEA,HARVARD,MIT,PADOVA,WEIZMANN)
DERADO   65 ATHENS CONF 244   +KENNEY,LAMSA, +       (NOTRE DAME,KENTUCKY)
ROBERTS  67 PREPRINT          R G ROBERTS                         (DURHAM)
BANNER   68 PR 166 1347       +DETOEUF,FAYOUX,HAMEL, +       (SACLAY,CAEN)
      --  THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE BUMP.
BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET        (SACLAY)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)

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Δ(1690)

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                       N*3/2(1690, JP=3/2-) I=3/2       D33

                   THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
                   THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

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                       N*3/2(1690, JP=3/2+) I=3/2       P33

                   THE LATEST RESULTS ON NUCLEON RESCNANCES, PRESENTED AT
                   THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

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N(1710)

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                   66  N*1/2(1710, JP=1/2-) I=1/2      S11

                   THE LATEST RESULTS ON NUCLEON RESCNANCES, PRESENTED AT
                   THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

                   66  N*1/2(1710) MASS (MEV)   -----------------------

M   *     (1695.0)                 BRANDSEN  65 RVUE    PHASE-SHIFT ANAL  9/66
M   *     (1700.0)                 MICHAEL   66 RVUE    FITS BAREYRE S11  7/66
M   1     (1710.0)                 BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
    1      WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M   2     (1665.0)                 BAREYRE   68 RVUE    PHASE-SHIFT ANAL 11/67
    2      WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
    2      IS GREATEST.
M   3     (1709.0)                 LOVELACE  67 RVUE    PHASE-SHIFT ANAL 11/67
    3      WHERE THE ABSORPTION IS GREATEST.

----------------  66  N*1/2(1710) WIDTH (MEV)   -----------------------

W   *     (240.0)                  MICHAEL   66 RVUE                     7/66
W   1     (260.0)                  BAREYRE   68 RVUE                    11/67
W   2     (110.0)                  BAREYRE   68 RVUE                    11/67
W   3     (300.0)                  LOVELACE  67 RVUE    PHASE-SHIFT ANAL 11/67
       SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

----------------  66  N*1/2(1710) PARTIAL DECAY MODES  ----------------

                                                           DECAY MASSES
P1         N*1/2(1710) INTO PI N                          139+ 938
P2         N*1/2(1710) INTO N ETA                         939+ 548
P3         N*1/2(1710) INTO LAMBDA K                     1115+ 497

----------------  66. N*1/2(1710)  BRANCHING RATIOS  ------------------

R1         N*1/2(1710) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1  *        1.0          APPROX   MICHAEL   66 RVUE                     7/66
R1  3        (0.786)               LOVELACE  67 RVUE    PHASE-SHIFT ANAL 11/67

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                          REFERENCES -- N*1/2(1710)

BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET        (SACLAY)IJP
BRANDSEN 65 PL 19 420           +ODONNELL, MOORHOUSE          (DURHAM,RTHFD)IJP
MICHAEL  66 PL 21 93            C MICHAEL                               (OXF)
JOHNSCN  67 UCRL-17683 THESIS C H JOHNSON                              (LRL)
BAREYRE  68 PR 165 1731         P BAREYRE, C BRICMAN, G VILLET     (SACLAY)IJP

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N(1730) →

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                       N*1/2(1730, JP=3/2-) I=1/2       D13

                   THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
                   THE 1968 VIENNA CCNFERENCE, ARE NOT INCLUDED IN THE
                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

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N(1750)

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                       N*1/2(1750, JP=1/2+) I=1/2       P11

                   THE LATEST RESULTS ON NUCLEON RESCNANCES, PRESENTED AT
                   THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
                   CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
                   THE N*3/2(1236).

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BARYON RESONANCES

Data in parentheses have not been included in our averages.

N(1860)

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         N*1/2(1860, JP=3/2+) I=1/2          P13

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
         THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
  -----> CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

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Δ(1910)

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         N*3/2(1910, JP=5/2+) I=3/2          F35

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
         THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
         CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

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Δ(1930)

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         N*3/2(1930, JP=1/2+) I=3/2          P31

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
         THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
         CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

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Δ(1950)

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       83  N*3/2(1950, JP=7/2+) I=3/2

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
         THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
         CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

       83  N*3/2(1950) MASS (MEV)      ------------------------

M  *    1922.0       APPROX     COOL      56 CNTR   PI+ P TOTAL       7/66
M  *   (1912.0)  (15.0)         BRISSON   61 CNTR   PI+ P TOTAL       7/66
M  N   (1956.0)                 LAYSON    63 RVUE   PI P TOTAL, EL    7/66
M  N    ASSUMES AN N*3/2(1855).
M  *   (1920.0)                 HOHLER    64 RVUE   DATA + DISP REL   7/66
M  *   (1900.0)   (9.0)         DEVLIN    65 CNTR   PI+ P TOTAL
M  *    1950.0       APPROX     YOKOSAWA  66 CNTR   PI- P DSIG + POL  7/66
M  *   (1920.0)                 DUKE      68 CNTR   PI-P EL + POL     6/68*
M  1   (1975.0)                 BAREYRE   68 RVUE   PHASE-SHIFT ANAL 11/67
   1    WHERE THE PARTIAL-WAVE TOTAL CROSS SECTION IS GREATEST.
M  2   (1980.0)                 BAREYRE   68 RVUE   PHASE-SHIFT ANAL 11/67
   2    WHERE THE VELOCITY OF THE AMPLITUDE ACROSS THE ARGAND DIAGRAM
   2    IS GREATEST.
M  3   (1946.0)                 DONNACHIE 68 RVUE   PHASE-SHIFT ANAL  6/68*
   3    WHERE THE ABSORPTION IS GREATEST.

-----------------  83  N*3/2(1950) WIDTH (MEV)     -----------------------

W  *   (170.0)                  HOHLER    64 RVUE                     7/66
W  *   (256.0)   (39.0)         DEVLIN    65 CNTR
W  *   (170.0)                  DUKE      65 CNTR                     7/66
W  *    200.0        APPROX     YOKOSAWA  66 CNTR                     7/66
W  1   (180.0)                  BAREYRE   68 RVUE                    11/67
W  2   (140.0)                  BAREYRE   68 RVUE                    11/67
W  3   (221.0)                  DONNACHIE 68 RVUE                     6/68*
    SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

-----------------  83  N*3/2(1950) PARTIAL DECAY MODES   ----------------

                                                     DECAY MASSES
P1         N*3/2(1950) INTO PI N                     139+ 938
P2         N*3/2(1950) INTO SIGMA K                 1189+ 493
P3         N*3/2(1950) INTO N*3/2(1236) PI          1236+ 139
P4         N*3/2(1950) INTO Y*1(1385) K             1385+ 493
P5         N*3/2(1950) INTO N*3/2(1236) RHO         1236+ 770
P6         N*3/2(1950) INTO NEUTRON PI+ PI+          939+ 139+ 139
P7         N*3/2(1950) INTO N*3/2(1236) PI PI (NOT RHO)  1236+ 139+ 139

-----------------  83  N*3/2(1950) BRANCHING RATIOS    ------------------

R1         N*3/2(1920) INTO (PI N)/TOTAL                (P1)/TOTAL
R1  N       (0.33)              LAYSON    63 RVUE                     7/66
R1  N      ASSUMES AN N*3/2(1855).
R1  *        0.73     OR LESS   HOHLER    63 RVUE   DATA + DISP REL   7/66
R1  *       (0.57)  (0.12)      DEVLIN    65 CNTR
R1  *       (0.41)              DUKE      65 CNTR   VERY ENERGY DEP   7/66
R1  *        0.4     APPROX     YOKOSAWA  66 CNTR                     7/66
R1  1       (0.57)              BAREYRE   68 RVUE                    11/67
R1  3       (0.386)             DONNACHIE 68 RVUE                     6/68*
    SEE THE NOTES ACCOMPANYING THE MASSES QUOTED.

R2         N*3/2(1950) INTO (SIGMA K)/(PI N)            (P2)/(P1)
R2           0.059    0.024     CHINOWSKY 68 HBC  ++ PP TO P SIG K   11/68*

R3     N*3/2(1950) INTO ((PI N)*(N*3/2(1236) PI))/TOTAL   (P1*P3)/TOTAL
R3           0.23     0.04      FUNG      68 HBC  ++ PI+P TO PI+PIO P 11/68*

R4         N*3/2(1950) INTO (PI N)/(N*3/2(1236) PI)     (P1)/(P3)
R4          LESS THAN 0.55      LEE       67 HBC    PI-P 3.63 BEV/C  11/67

R5     N*3/2(1950) INTO ((PI N)*(NEUTRON PI+ PI+))/TOTAL  (P1*P6)/TOTAL
R5           0.05     0.013     GALLOWAY  68 RVUE ++ PI+P TO N 2PI+    6/68*

R6         N*3/2(1950) INTO (Y*1(1385) K)/(PI N)        (P4)/(P1)
R6           0.035    0.015     CHINOWSKY 68 HBC  ++ PP TO P LAM K PI 11/68*

R7         N*3/2(1950) INTO (N*3/2(1236) RHO)/(PI N)    (P5)/(P1)
R7           0.45     APPROX    CHINOWSKY 68 HBC  ++ PP TO (P 3PI) N  11/68*
    THIS INCLUDES CURRECTION FOR UNSEEN DECAY (ISPIN FACTOR 5/3).

R8         N*3/2(1950) INTO N*3/2(1236) PI PI (NOT RHO)  (P7)/(P1)
R8           SEEN               CHINOWSKY 68 HBC  ++ PP TO (P 3PI) N  11/68*

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                       REFERENCES -- N*3/2(1950)

COOL     56 PR 103 1082    R COOL, O PICCIONI, D CLARK             (BNL) I
BRISSON  61 NC 19 210      +DETOEUF,FALK-VAIRANT,VAN ROSSUM,+ (SACLAY) I
LAYSON   63 NC 27 724      W M LAYSON                             (CERN) IJ
HOHLER   63 NP 48 470      G HOHLER, G EBEL                  (KARLSRUHE) I
HOHLER   64 PL 12 149      G HOHLER, J GIESECKE              (KARLSRUHE) I
DEVLIN   65 PRL 14 1031    T J DEVLIN,J SOLOMON,G BERTSCH   (PRINCETON) I
DUKE     65 PRL 15 468     +JONES,KEMP,MURPHY,PRENTICE, +  (RTHFC,OXF)IJP
HOLLADAY 65 PR 139 B1348   W G HOLLADAY                     (VANDERBILT)
YOKOSAWA 66 PRL 16 714     +SUWA, HILL, ESTERLING, BOOTH     (ARG,CHI)IJP
LEE      67 PR 159 1156    +MOEBS,ROE,SINCLAIR,VANDER VELDE       (MICH)
GALLOWAY 68 PL 26B 334     K F GALLOWAY                        (INDIANA) I
BAREYRE  68 PR 165 1731    P BAREYRE, C BRICMAN, G VILLET     (SACLAY)IJP
DONNACHI 68 PL 26B 161     A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP
CHINOWSK 68 PR 171 1421    CHINOWSKY,CONDON,KINSEY,KLEIN,+  (LRL,SLAC)
FUNG     68 VIENNA CONF.   FUNG, KERNAN, KALMUS, BIRGE (RIVERSIDE,LRL)
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                   PAPERS NOT REFERRED TO IN DATA CARDS.

HELLAND  64 PR 134 B1062    +DEVLIN,HAGGE,LONGO,MOYER,WOOD      (LRL) IJ
AUVIL    64 NC 33 473       P AUVIL, C LOVELACE               (IMPCOL)IJP
JOHNSON  67 UCRL-17683 THESIS C H JOHNSON                      (LRL)

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N(1980)

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         N*1/2(1980, JP=3/2-) I=1/2          D13

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
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  -----> CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

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N(2080)

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       70  N*   (2080, JP=    ) I=

       YOON 67 SEE A NARROW BUMP IN THE INVARIANT MASS OF
  ---> (P PI+ PI- PIO) FROM 3 BEV/C PI- P TO (PI- P PI+ PI-
   RHO-.  AT 3.2 BEV/C, WITH APPROXIMATELY FOUR  TIMES THE NUMBER CF
   EVENTS, THE EFFECT IS NOT SEEN (    CHUNG 68      ) .  OMITTED FROM
   TABLE.

-----------------  70  N*   (2080) MASS (MEV)    ------------------------

M        2080.0    12.0          YOON      67 HBC  +  3 BEV/C PI-P      8/67

-----------------  70  N*   (2080) WIDTH (MEV)    -----------------------

W          40.0    20.0          YOON      67 HBC  +                    8/67

-----------------  70  N*   (2080) PARTIAL DECAY MODES   ----------------

                                                     DECAY MASSES
P1       N*   (2080) INTO PI N
P2       N*   (2080) INTO N*3/2(1236) RHO

-----------------  70  N*   (2080) BRANCHING RATIOS      ----------------

R1       N*   (2080) INTO (N*3/2(1236) RHO)/TOTAL     (P2)/TOTAL
R1              SEEN             YOON      67 HBC  +                    8/67

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                       REFERENCES -- N*   (2080)

YOON     67 PL 24B 307      +BERENYI,KEY,PRENTICE, +      (TORONTC,WISC)
CHUNG    68 PR 165 1491     S U CHUNG,DAHL,KIRZ,MILLER              (LRL)

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N(2190)

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       71  N*1/2(2190, JP=7/2-) I=1/2

         THE LATEST RESULTS ON NUCLEON RESONANCES, PRESENTED AT
         THE 1968 VIENNA CONFERENCE, ARE NOT INCLUDED IN THE
         CARD LISTINGS, BUT ARE DISCUSSED IN A NOTE PRECEDING
         THE N*3/2(1236).

       71  N*1/2(2190) MASS (MEV)      ------------------------

M        2190.0                  DIDDENS   63 CNTR   PI+- P TOTAL
M        2210.0                  HOHLER    64 RVUE   DATA + DISP REL
M        2190.0      APPROX      YOKOSAWA  66 CNTR   PI- P DSIG + POL  7/66
M        2265.0                  DONNACHIE 68 RVUE   PHASE-SHIFT ANAL  6/68*

-----------------  71  N*1/2(2190) WIDTH (MEV)     ----------------------

W         200.0                  DIDDENS   63 CNTR
W         200.0                  HOHLER    64 RVUE                     7/66
W         220.0      APPROX      YOKOSAWA  66 CNTR                     7/66
W         298.0                  DONNACHIE 68 RVUE                     6/68*

-----------------  71  N*1/2(2190) PARTIAL DECAY MODES    ---------------

                                                     DECAY MASSES
P1       N*1/2(2190) INTO PI N                       139+ 938
P2       N*1/2(2190) INTO LAMBDA K                  1115+ 497

-----------------  71  N*1/2(2190) BRANCHING RATIOS     -----------------

R1       N*1/2(2190) INTO (PI N)/TOTAL                (P1)/TOTAL
R1          0.3      APPROX      DIDDENS   63 CNTR                     7/66
R1          0.3      APPROX      YOKOSAWA  66 CNTR                     7/66
R1          0.349                DONNACHIE 68 RVUE                     6/68*

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                       REFERENCES -- N*1/2(2190)

DIDDENS  63 PRL 10 262      +JENKINS, KYCIA, RILEY                 (BNL) I
HOHLER   64 PL 12 149       G HOHLER, J GIESECKE             (KARLSRUHE) I
YOKOSAWA 66 PRL 16 714      +SUWA,HILL,ESTERLING,BOOTH          (ARG,CHI) JP
DONNACII 68 PL 26B 161      A DONNACHIE, R G KIRSOPP, C LOVELACE (CERN)IJP

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

CARROLL  66 PRL 16 288      +CORBETT,DAMERELL,MIDDLEMAS, +  (RTHFD,OXF)J-L
CARROLL  66 PRL 17 1274     +CORBETT,DAMERELL,MIDDLEMAS, +  (RTHFD,OXF)J-L
    --  ERRATUM CHANGING THE RATHER WEAK DETERMINATICN OF J-L TO +1/2.
KORMANYO 66 PRL 16 709      KORMANYOS,KRISCH,OFALLON, +      (MICH,ARG) P
BARGER   66 PRL 16 913      V BARGER, D CLINE                     (WISC) P
BUSZA    67 NC 52A 331      +DAVIS,DUFF,HEYMANN, +   (UNICOL,WESTFIELD)

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Δ(2420)

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       84  N*3/2(2420, JP=11/2+) I=3/2

       PARTIAL WAVE ANALYSIS OF BELLAMY 67 SUGGESTS J=11/2

  ---> 84  N*3/2(2420) MASS (MEV)      ------------------------

M  *   (2360.0)                  DIDDENS   63 CNTR   PI+ P TOTAL
M  *   (2520.0)   (40.0)         ALVAREZ   64 CNTR   PI PHOTOPROD      7/66
M  *    2400.0       APPROX      WAHLIG    64 SPRK O PI-P CH EX
M  *   (2440.0)                  HOHLER    64 RVUE   DATA + DISP REL
M       2423.0    10.0           CITRON    66 CNTR   PI+ P TOTAL       7/66
M  B   (2452.0)                  BARGER    66 RVUE   TOTAL + CH EX    11/67

-----------------  84  N*3/2(2420) WIDTH (MEV)     ----------------------

W  *   (200.0)                   DIDDENS   63 CNTR
W  *   (245.0)                   HOHLER    64 RVUE                     7/66
W       310.0     20.0           CITRON    66 CNTR                     7/66
W  B   (275.0)                   BARGER    66 RVUE   TOTAL + CH EX    11/67
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Data in parentheses have not been included in our averages.

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----------------  84  N*3/2(2420) PARTIAL DECAY MODES    ---------------

                                                          DECAY MASSES
P1          N*3/2(2420) INTO PI N                        139+ 938
P2          N*3/2(2420) INTO SIGMA K                     1197+ 493
P3          N*3/2(2420) INTO N*3/2(1236) PI              1236+ 139
P4          N*3/2(2420) INTO NEUTRON PI+ PI+              939+ 139+ 139

----------------  84  N*3/2(2420) BRANCHING RATIOS  --------------------

R1          N*3/2(2420) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1   *          0.067      APPROX       DIDDENS    63 CNTR    ASSUMING J=11/2   7/66
R1              0.113    0.0036         CITRON     66 CNTR    ASSUMING J=11/2   7/66
R1   B         (0.12)                   BARGER     67 FIT     ASSUMING J=11/2  11/67
     B  USES REGGE AMP.+RESON. TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGRE
     B  FOR CRITICISM OF THIS METHOD, SEE DOLEN 68.
R1   D         (0.163)                  DIKMEN     67 FIT     ASSUMING J=11/2  11/67
     D  USES ONLY RESONANCES TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGREES
R1              0.06                    KORMANYOS 67 CNTR     ASSUMING J=11/2  11/67

R2  N*3/2(2420) INTO (PI N)*(NEUTRON PI+ PI+)/(TOTAL**2)  (P1*P4)/TOTAL**2
R2              0.0195   0.0048         GALLOWAY  68 RVUE                       6/68*

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                       REFERENCES -- N*3/2(2420)

DIDDENS  63 PRL 10 262         +JENKINS, KYCIA, RILEY                (BNL) I
ALVAREZ  64 PRL 12 710         +BAR-YAM,KERN,LUCKEY,OSBORNE, +   (MIT,CEA)
WAHLIG   64 PRL 13 103         +MANNELLI,SODICKSON,FACKLER,WARD, +   (MIT)
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE            (KARLSRUHE) I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, +  (BNL) I
BARGER   66 PR 151 1123        V BARGER, M OLSSON                   (WISC)

BARGER   67 PR 155 1792        V BARGER, D CLINE                    (WISC) P
DIKMEN   67 PRL 18 798         F N DIKMEN                           (MICH)
KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLON, +    (MICH,ARG) P
DOLEN    68 PR 166 1768        R DOLEN, D HORN, C SCHMID        (CAL TECH)
GALLOWAY 68 PL 26B 334         K F GALLOWAY                     (INDIANA) I

                  PAPERS NOT REFERRED TO IN DATA CARDS.

DOBROWOL 67 PL 24B 203         DOBROWOLSKI,GUSKOV,LIKHACHEV, +     (DUBNA) P
BELLAMY  67 PRL 19 476         +BUCKLEY,DOBINSON, +      (WESTFIELD,UNICOL) JP
BAACKE   67 NC 51A 761         J BAACKE, M YVERT         (KARLSRUHE,CRSAY)J-L
WAHLIG   68 PR 168 1515        M A WAHLIG, I MANNELLI             (MIT,PISA)
     --  FINAL VERSION OF DATA USED IN WAHLIG 64.  IN CONJUNCTION WITH
         CITRON 66 TOTAL CROSS SECTIONS, THIS CHARGE EXCHANGE DATA GIVES
         COMPLEX ELASTIC SCATTERING AMPLITUDE AT 0 DEGREES.

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N(2650)

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                  72  N*1/2(2650, JP=    -) I=1/2

                  72  N*1/2(2650) MASS (MEV)    ------------------------

M    *    (2700.0)                      ALVAREZ   64 CNTR    PI PHOTOPROD
M    *     2600.0      APPROX           WAHLIG    64 SPRK 0  PI-P CH EX
M    *    (2660.0)                      HOHLER    64 RVUE    DATA + DISP REL
M          2649.0    10.0               CITRON    66 CNTR    PI+- P TOTAL       7/66
M    *    (2633.0)                      BARGER    66 FIT     TOTAL + CH EX     11/67

----------------  72  N*1/2(2650) WIDTH (MEV)    -----------------------

W    *     (100.0)                      ALVAREZ   64 CNTR
W    *     (200.0)                      HOHLER    64 RVUE                       7/66
W           360.0    20.0               CITRON    66 CNTR                       7/66
W    *     (425.0)                      BARGER    66 FIT     TOTAL + CH EX     11/67

----------------  72  N*1/2(2650) PARTIAL DECAY MODES    ---------------

                                                          DECAY MASSES
P1          N*1/2(2650) INTO PI N                        139+ 938
P2          N*1/2(2650) INTO LAMBDA K                    1115+ 497

----------------  72  N*1/2(2650) BRANCHING RATIOS   -------------------

R1          N*1/2(2650) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1     ONLY (J+1/2)*( PI N/TOTAL) MEASURED FOR THIS STATE
R1              0.436    0.028          CITRON    66 CNTR    TOTAL CRCSS-SEC. 11/67
R1   B         (0.456)  (0.018)         BARGER    66 RVUE    TOTAL + CH EXC.  11/67
R1   B         (0.30)                   BARGER    67 RVUE    USES KORMANYOS67 11/67
     B  USES REGGE AMP.+RESON. TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGRE
     B  FOR CRITICISM OF THIS METHOD, SEE DOLEN 68.
R1   D         (0.24)                   DIKMEN    67 RVUE    USES KORMANYOS66 11/67
     D  USES ONLY RESONANCES TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGREES
R1              0.06                    KORMANYOS 67 CNTR    PI-P AT 180 DEG. 11/67

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                       REFERENCES -- N*1/2(2650)

ALVAREZ  64 PRL 12 710         +BAR-YAM,KERN,LUCKEY,OSBORNE, +   (MIT,CEA)
WAHLIG   64 PRL 13 103         +MANNELLI,SODICKSON,FACKLER,WARD, +   (MIT)
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE            (KARLSRUHE) I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, +  (BNL) I
BARGER   66 PR 151 1123        V BARGER, M OLSSCN                   (WISC)
BARGER   67 PR 155 1792        V BARGER, D CLINE                    (WISC) P
DIKMEN   67 PRL 18 798         F N DIKMEN                           (MICH)
KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLON, +    (MICH,ARG) P
DOLEN    68 PR 166 1768        R DOLEN, D HORN, C SCHMID        (CAL TECH)

                  PAPER NOT REFERRED TO IN DATA CARDS.

BAACKE   67 NC 51A 761         J BAACKE, M YVERT         (KARLSRUHE,CRSAY)J-L
WAHLIG   68 PR 168 1515        M A WAHLIG, I MANNELLI             (MIT,PISA)
     --  FINAL VERSION OF DATA USED IN WAHLIG 64.  IN CCNJUNCTION WITH
         CITRON 66 TOTAL CROSS SECTIONS, THIS CHARGE EXCHANGE DATA GIVES
         COMPLEX ELASTIC SCATTERING AMPLITUDE AT 0 DEGREES.

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Δ(2850)

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                  85  N*3/2(2850, JP=    +) I=3/2

                  85  N*3/2(2850) MASS (MEV)    ------------------------

M    *     2700.0      APPROX           WAHLIG    64 SPRK 0  PI-P CH EX
M    *    (2870.0)                      HOHLER    64 RVUE    DATA + DISP REL
M          2850.0    12.0               CITRON    66 CNTR    PI+ P TOTAL        7/66
M    *    (2850.0)                      BARDADIN  66 HBC  ++ N* TO P + 3 PIS    7/66

----------------  85  N*3/2(2850) WIDTH (MEV)    -----------------------

W           400.0    40.0               CITRON    66 CNTR                       7/66
W    *     (150.0)                      BARDADIN  66 HBC  ++                    7/66

----------------  85  N*3/2(2850) PARTIAL DECAY MODES    ---------------

                                                          DECAY MASSES
P1          N*3/2(2850) INTO PI N                        139+ 938
P2          N*3/2(2850) INTO P PI PI PI                  938+ 139+ 139+ 139

----------------  85  N*3/2(2850) BRANCHING RATIOS    ------------------

R1          N*3/2(2850) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1     ONLY (J+1/2)*( PI N/TOTAL) MEASURED FOR THIS STATE
R1              0.261    0.048          CITRON    66 CNTR    TOTAL CRCSS.SEC. 11/67
R1   B         (0.224)  (0.016)         BARGER    66 RVUE    TOTAL + CH EXC.  11/67
R1   B         (0.40)                   BARGER    67 RVUE    USES KORMANYOS66 11/67
     B  USES REGGE AMP.+RESON. TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGRE
     B  FOR CRITICISM OF THIS METHOD, SEE DOLEN 68.
R1   D         (0.49)                   DIKMEN    67 RVUE    USES KORMANYOS67 11/67
     D  USES ONLY RESONANCES TO CALCULATE DIF. CROSS SECTICNS AT 180 DEGREES
R1              0.10                    KORMANYOS 67 CNTR    PI-P AT 180 DEG. 11/67
R1              0.39                    DOBROWOLS 67 CNTR    PI+P AT 180 DEG

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                       REFERENCES -- N*3/2(2850)

WAHLIG   64 PRL 13 103         +MANNELLI,SODICKSON,FACKLER,WARD, +   (MIT)
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE            (KARLSRUHE) I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, +  (BNL) I
BARDADIN 66 PL 21 357          BARDADIN-OTWINOWSKA,DANYSZ, +       (WARSAW)
BARGER   66 PR 151 1123        V BARGER, M OLSSCN                   (WISC)
BARGER   67 PR 155 1792        V BARGER, D CLINE                    (WISC) P
DIKMEN   67 PRL 18 798         F N DIKMEN                           (MICH)
DOBROWOL 67 PL 24B 203         DOBROWOLSKI,GUSKOV,LIKHACHEV, +     (DUBNA) P
KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLCN, +    (MICH,ARG) P
DOLEN    68 PR 166 1768        R DOLEN, D HORN, C SCHMID        (CAL TECH)

                  PAPERS NOT REFERRED TO IN DATA CARDS.

BAACKE   67 NC 51A 761         J BAACKE, M YVERT         (KARLSRUHE,CRSAY)J-L
WAHLIG   68 PR 168 1515        M A WAHLIG, I MANNELLI             (MIT,PISA)
     --  FINAL VERSION OF DATA USED IN WAHLIG 64.  IN CONJUNCTION WITH
         CITRCN 66 TOTAL CROSS SECTIONS, THIS CHARGE EXCHANGE DATA GIVES
         COMPLEX ELASTIC SCATTERING AMPLITUDE AT 0 DEGREES.

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N(3030)

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                  73  N*1/2(3030, JP=     ) I=1/2

                  73  N*1/2(3030) MASS (MEV)    ------------------------

M    *    (3080.0)                      HOHLER    64 RVUE    DATA + DISP REL    7/66
M          3030.0                       CITRON    66 CNTR    PI+- P TCTAL       7/66

----------------  73  N*1/2(3030) WIDTH (MEV)    -----------------------

W           400.0                       CITRON    66 CNTR                       7/66

----------------  73  N*1/2(3030) PARTIAL DECAY MODES    ---------------

                                                          DECAY MASSES
P1          N*1/2(3030) INTO PI N                        139+ 938

----------------  73  N*1/2(3030) BRANCHING RATIOS    ------------------

R1          N*1/2(3030) INTO (PI N)/TOTAL                 (P1)/TOTAL
R1     ONLY (J+1/2)*( PI N/TOTAL) MEASURED FOR THIS STATE
R1              0.048                   CITRON    66 CNTR    TOTAL CRCS.SEC.  11/67
R1   B         (0.088)  (0.016)         BARGER    66 RVUE    TOTAL + CH EXC.  11/67
R1   B         (0.12)                   BARGER    67 CNTR    USES KORMANYOS66 11/67
     B  USES REGGE AMP.+RESON. TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGRE
     B  FOR CRITICISM OF THIS METHOD, SEE DOLEN 68.
R1   D         (0.016)                  DIKMEN    67 RVUE    USES KORMANYOS67 11/67
     D  USES ONLY RESONANCES TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGREES

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                       REFERENCES -- N*1/2(3030)

HOHLER   64 PL 12 149          G HOHLER, J GIESECKE            (KARLSRUHE) I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, +  (BNL) I
BARGER   66 PR 151 1123        V BARGER, M OLSSON                   (WISC)
KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLCN, +    (MICH,ARG) P
BARGER   67 PR 155 1792        V BARGER, D CLINE                    (WISC) P
DIKMEN   67 PRL 18 798         F N DIKMEN                           (MICH)
DOLEN    68 PR 166 1768        R DOLEN, D HORN, C SCHMID        (CAL TECH)

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Δ(3230)

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                  86  N*3/2(3230, JP=     ) I=3/2
----------------  86  N*3/2(3230) MASS (MEV)    ------------------------

M          3230.0                       CITRON    66 CNTR    PI+ P TOTAL        7/66

----------------  86  N*3/2(3230) WIDTH (MEV)    -----------------------

W           440.0                       CITRON    66 CNTR                       7/66

----------------  86  N*3/2(3230) PARTIAL DECAY MODES    ---------------

                                                          DECAY MASSES
P1          N*3/2(3230) INTO PI N                        139+ 938

----------------  86  N*3/2(3230) BRANCHING RATIOS    ------------------

R1     ONLY (J+1/2)*( PI N/TOTAL) MEASURED FOR THIS STATE
R1              0.06                    CITRON    66 CNTR    TOTAL CRCS. SEC. 11/67
R1   B         (0.03)   (0.01)          BARGER    66 RVUE    TOTAL + CH EXC.  11/67
R1   B          0.03   TO  0.1          BARGER    67 CNTR    USES KORMANYOS66 11/67
     B  USES REGGE AMP.+RESON. TO CALCULATE DIF. CROSS SECTIONS AT 180 DEGRE
     B  FOR CRITICISM OF THIS METHOD, SEE DOLEN 68.
R1   D         (0.25)                   DIKMEN    67 RVUE    USES KORMANYOS67 11/67
     D  USES ONLY RESONANCES TO CALCULATE DIF. CROSS SECTICNS AT 180 DEGREES

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                       REFERENCES -- N*3/2(3230)

CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, +  (BNL) I
BARGER   66 PR 151 1123        V BARGER, M OLSSON                   (WISC)
KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLON, +    (MICH,ARG) P
BARGER   67 PR 155 1792        V BARGER, D CLINE                    (WISC) P
DIKMEN   67 PRL 18 798         F N DIKMEN                           (MICH)
DOLEN    68 PR 166 1768        R DOLEN, D HORN, C SCHMID        (CAL TECH)

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BARYON RESONANCES

Data in parentheses have not been included in our averages.

$N_?$ (3245)

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                  74  N*   (3245, JP=     +)

                      EXISTENCE NOT CONCLUSIVELY ESTABLISHED.  I-SPIN
                      NOT DETERMINED, BUT THE NARROW WIDTH PRECLUDES
                      IDENTIFICATION WITH THE N*3/2(3230).  OMITTED
                      FROM TABLE.

----------------- 74  N* /2(3245) MASS (MEV)     ------------------------

M        3245.0     10.0           KORMANYOS 67 CNTR    PI-P 180 DEG EL   6/68*

----------------- 74  N* /2(3245) WIDTH (MEV)    ------------------------

W          35.0     OR LESS        KORMANYOS 67 CNTR                      6/68*

----------------- 74  N* /2(3245) PARTIAL DECAY MODES     ----------------

                                                        DECAY MASSES
P1          N* /2(3245) INTO PI N                      139+ 938
      J IS NOT KNOWN.  FOLLOWING IS (J+1/2)*(PI N)/TOTAL
R1            0.37                 KORMANYOS 67 CNTR                      6/68*

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                          REFERENCES -- N* /2(3245)

KORMANYO 67 PR 164 1661        KORMANYOS, KRISCH, OFALLON, +    (MICH,ARG) P

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N (3690)

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                  75  N*1/2(3690, JP=      ) I=1/2

                      A BUMP SEEN IN THE INVARIANT MASS OF A VERY COMPLI-
                      CATED STATE (N + SEVEN PIS), SO AS EVIDENCE FOR
                      A NEW RESONANCE IT IS NOT CONCLUSIVE.  NOT INCLUDED
                      IN TABLE.

----------------- 75  N*1/2(3690) MASS (MEV)     ------------------------

M        3690.0     10.0           BARTKE    67 HBC   + PI+P 8 PRONGS     8/67

----------------- 75  N*1/2(3690) WIDTH (MEV)    ------------------------

W          50.0     30.0           BARTKE    67 HBC   +                   8/67

----------------- 75  N*1/2(3690) PARTIAL DECAY MODES     ----------------

                                                        DECAY MASSES
P1          N*1/2(3690) INTO N + 7 PIS                 1420

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                          REFERENCES -- N*1/2(3690)

BARTKE   67 PL 24B 118         +CZYZEWSKI,DANYSZ, +    (CRACOW,ORSAY(CERN)) I

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$N_?$ (3755)

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                  76  N* /2(3755, JP=      )

                      A SMALL PEAK IN THE (P P PBAR) INVARIANT MASS FROM
                      8.4 BEV/C PI+ P TO PI+ P P PBAR EVENTS.  AS EVIDENCE
                      FOR A NEW RESONANCE IT IS NOT CONCLUSIVE.  OMITTED
                      FROM TABLE.

                  76  N* /2(3755) MASS (MEV)     ------------------------

M        3755.0      8.0           EHRLICH   68 HBC  +  PI+ P P PBAR      6/68*

----------------- 76  N* /2(3755) WIDTH (MEV)    ------------------------

W          40.0     20.0           EHRLICH   68 HBC  +                    6/68*

----------------- 76  N* /2(3755) PARTIAL DECAY MODES     ----------------

                                                        DECAY MASSES
P1          N* /2(3755) INTO PI+ P P PBAR

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                          REFERENCES -- N* /2(3755)

EHRLICH  68 PRL 20 686         R EHRLICH,R J PLANO,J B WHITTAKER (RUTGERS)

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$N^*_{5/2}$ (1560)

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                  91  N*5/2(1560, JP=     ) I=5/2

                      IT HAS BEEN SUSPECTED ALMOST FROM THE BEGINNING THAT
                      THIS IS A KINEMATIC EFFECT AND NOT A RESONANCE.  RE-
                      CENT EVIDENCE STRONGLY SUPPORTING THIS INTERPRETATION
    IS GIVEN BY GOLDHABER 67.  A THEORETICAL APPROACH TO KINEMATIC PEAKS
    IS GIVEN BY KRAMER 67.  OMITTED FROM TABLE.

----------------- 91  N*5/2(1560) MASS (MEV)     ------------------------

M        1560.0     20.0           GOLDHABER 64 HBC  +++3.65 BEV/C PI+ P  7/66
M        1570.0                    ALEXANDER 67 HBC  +++PP 4PI 5.5 BEV/C  9/66
M        1562.0     18.0           CAMBRIDGE 68 HBC  +++GAMMA P TO 6 BEV  6/68*
M        . . . . . . . . . .
M  AVG   1561.1050  13.3793  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------- 91  N*5/2(1560) WIDTH (MEV)    ------------------------

W         220.0     20.0           GOLDHABER 64 HBC  +++                  7/66
W         140.0                    ALEXANDER 67 HBC  +++                  9/66
W         200.0     54.0           CAMBRIDGE 68 HBC  +++GAMMA P TO 6 BEV  6/68*
W        . . . . . . . . . .
W  AVG    217.5875  18.7550  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------- 91  N*5/2(1560) PARTIAL DECAY MODES     ----------------

                                                        DECAY MASSES
P1          N*5/2(1560) INTO N PI PI                    938+ 139+ 139
P2          N*5/2(1560) INTO N*3/2(1236) PI            1236+ 139

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                          REFERENCES -- N*5/2(1560)

GOLDHABE 64 DUBNA CONF I 480   G+S GOLDHABER,OHALLORAN,SHEN     (LRL(BNL)) I
DASH     65 LRL UCID-2752      J DASH, G GOLDHABER, J SWIHART          (LRL)
CONTE    66 BERKELEY CONF      +DAMERI,RATTI,RUSSO, +  (GENOVA,MILANC,OXF)
ALEXANDE 67 PR 154 1284        ALEXANDER,BENARY,CZAPEK,+  (WEIZMANN(CERN))
GOLDHABE 67 CORAL GABLES 190   G GOLDHABER                             (LRL)
KRAMER   67 PR 164 1887        I KRAMER                                (LRL)
CAMBRIDG 68 PR 169 1081        BROWN, CEA, HARVARD, MIT, PADOVA, WEIZ(ANN) I

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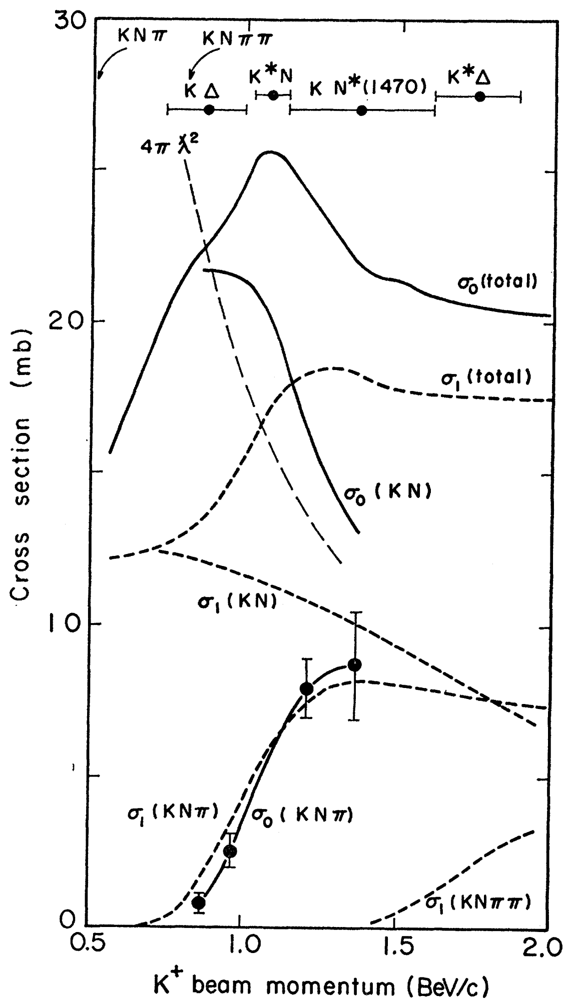
Note on Possible KN Resonances (Z's)

The K^+p and K^+d total cross sections have been accurately measured by COOL 66 and BUGG 68. They show similarly shaped asymmetric peaks near 1 BeV/c incident K^+ momentum. The K^+p is a direct measurement of the isospin-1 KN cross section. The isospin-0 KN cross section is extracted from the K^+d cross section. To do this, it is necessary to correct for the shielding and motion of the nucleons within the deuteron, which requires making approximations the validity and effect of which are not fully understood. For a discussion and references, see TRIPP 68. The isospin-0 cross section so deduced has a peak, also near 1 BeV/c, that is higher, narrower, and more symmetric than the isospin-1 peak. This is shown in the accompanying figure. Peaks in πN and $\overline{K}N$ cross sections are nearly always attributed to resonances. However, the consequences of the existence of KN resonances are severe. In particular, all well-established strongly interacting particles and resonances have quantum numbers that permit their classification as quark-antiquark (for meson) or triple-quark (for baryon) states, and KN resonances will not fit into this scheme. States that will not are called exotic or "far-out." The only s-channel experiment one can arrange for seeking exotic resonances is KN scattering.

CARTER 67 used the total-cross-section data in a dispersion-relation analysis, and found that the Argand diagram for the isospin-0 forward scattering amplitude has the behavior of a resonance-like circle added to a smoothly varying background. This merely reflects the fact that there is a large, narrow peak in the cross section. The crucial question is whether it is a single partial wave or some general coordinated behavior of several of them that is responsible for the rapidly varying part of the full amplitude.



KN total and partial cross sections. Subscripts indicate isospin. Total cross sections are from CARTER 68, which uses data from COOL 66 and BUGG 68. Isospin-1 partial cross sections are adapted from a compilation made by BLAND 68. Isospin-0 partial cross sections are from HIRATA 68. Thresholds for various processes are indicated at the top.

Only a few channels are open in KN scattering at low energies. The thresholds and final-state-particle cross sections are shown in the figure. BLAND 67 (for the isospin-1 channel) and HIRATA 68 (for the isospin-0 channel) have shown that the only important inelastic process (up to momenta well above the peaks) is KN → KNπ. Even this channel does not become important until the thresholds for the quasi-two-body channels KN → KΔ (forbidden to the isospin-0 channel) and KN → K^*N are reached; in the region of the peaks, 70 to 90% of the KNπ final state is KΔ or K^*N. It is clear from the figure that the structure in the total cross sections is associated with the rise of the KN → KNπ cross section at the thresholds of the quasi-two-body reactions. Furthermore, the production and decay angular distributions for these reactions are qualitatively consistent with simple t-channel exchange models. Once upon a time, these threshold and t-channel characteristics of the reactions that can be most closely associated with the structure in the total cross sections would probably have been enough to discourage a resonance interpretation. However, since Schmid has shown that a decomposition of t-channel Regge-exchange amplitudes may lead to resonance-like circles in the s-channel partial-wave amplitudes, the question is no longer either-or between s- and t-channel interpretations. See Sec. IV of the introduction to this Review for further brief comments, and HARARI 68 for an extended discussion and references on the twofold interpretation of amplitudes. In summary, the simple characteristics of the reaction channels are not sufficient to answer the question whether KN resonances exist.

No further analysis has yet been performed with the isospin-0 channel, but the much more accessible isospin-1 channel has been studied in greater detail, and no evidence

Data in parentheses have not been included in our averages.

has been found for resonant behavior of any partial wave in the region of the peak in the total cross section. BLAND 67 made a partial-wave analysis of the reaction $K^+p \rightarrow K\Delta$ and found no rapid variation of any phase. HITE 67 made a K-matrix analysis of K^+p reactions, which reproduced the main features (though not the details) of the data without invoking a resonance. LEA 68 made a partial-wave analysis of total and elastic-scattering data and found some suggestion that the $P_{1/2}$ wave resonates near 2 BeV ($\approx$ 1.5 BeV/c), rather far above the peak in the total cross section. However, this analysis has severe limitations, forced by lack of polarization data. In particular, the favored solution keeps the $P_{3/2}$ wave completely elastic, whereas BLAND 67 showed this to be the largest of the amplitudes feeding the reaction $K^+p \rightarrow K\Delta$. MARTIN 68 extended the work of LEA 68, and again found that the $P_{1/2}$ wave might be resonating, but the analysis is subject to the same limitations as was that of Lea et al. Phase-shift analyses of the elastic-scattering data can be no more than suggestive until there are accurate polarization data.

In production experiments, there is no solid evidence for KN resonances. BASSOMPIERRE 68 found no structure in mass spectra of systems recoiling against a pion in the reactions $K^+p \rightarrow KN\pi$, $KN\pi\pi$, and $KN\pi\pi\pi$. TYSON 67 and MORI 68 found some structure in mass spectra in the reaction $\gamma p \rightarrow K^-(MM)^{++}$, but the interpretation of this as due to KN resonances is indirect and, at best, no more than suggestive. BIRNBAUM 67 found some structure in the mass spectra in the reaction $\pi^- p \rightarrow K^-(MM)^+$, but it was later found that the position of the structure varied with incident π^- momentum.

The approximate parameters of the cross-section structure, if interpreted as resonant, are given in the data-card listings. In addition, ABRAMS 67 extended the total-cross-section measurements and found very small bumps in the isospin-1 channel at 2190 and 2505 MeV, and borderline indications of structure in the isospin-0 channel. We do not include the possible Z's in the BARYON TABLE.

Z_0(1865)

```
         96  Z*0(1865, JP=    ) I=0
              SEE THE PRECEDING NOTE.
---------------- 96  Z*0(1865) MASS (MEV)   --------------------------
M         1868.0     10.0         KYCIA     67 CNTR   K+P, D TCTAL       8/67
M         1860.0     15.0         CARTER    67 THEO   DISPERSION REL.    8/67
M         . . . . . . . . .
M   AVG   1865.5385   8.3205  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
---------------- 96  Z*0(1865) WIDTH (MEV)   -------------------------
W          160.0     30.0         KYCIA     67 CNTR                      8/67
W          200.0     50.0         CARTER    67 THEO                      8/67
W         . . . . . . . . .
W   AVG    170.5882  25.7248  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
---------------- 96  Z*0(1865) PARTIAL DECAY MODES   -----------------
                                                   DECAY MASSES
P1        Z*0(1865) INTO K N                      493+ 939
P2        Z*0(1865) INTO N K*(890)                938+ 892
---------------- 96  Z*0(1865) BRANCHING RATIOS   --------------------
R1        Z*0(1865) INTO (K N)/TOTAL                (P1)/TOTAL
R1           0.40      0.05       KYCIA     67 CNTR    IF J=1/2          8/67
R1           0.31      0.05       CARTER    67 THEO    IF J=1/2          8/67
R1        . . . . . . . . .
R1  AVG       .3550     .0450  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
R2        Z*0(1865) INTO N K*(890)                  (P2)
R2           MAIN INELASTIC DECAY     HIRATA    68 HBC                   11/68*
****** ********* ********* ********* ********* ********* ********* ********
                     REFERENCES -- Z*0(1865)
                SEE REFERENCES FOR THE Z*1(1900)
****** ********* ********* ********* ********* ********* ********* ********
****** ********* ********* ********* ********* ********* ********* ********
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Z_1(1910)

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         97  Z*1(1900, JP=    ) I=1
              SEE THE NOTE PRECEDING THE Z*0(1865).
---------------- 97  Z*1(1900) MASS (MEV)   --------------------------
M         1900.0     10.0         KYCIA     67 CNTR ++ K+P TOTAL         8/67
---------------- 97  Z*1(1900) WIDTH (MEV)   -------------------------
W          260.0     50.0         KYCIA     67 CNTR ++                   8/67
---------------- 97  Z*1(1900) PARTIAL DECAY MODES   -----------------
                                                   DECAY MASSES
P1        Z*1(1900) INTO K N                      493+ 938
P2        Z*1(1900) INTO N*3/2(1236) K            1236+ 493
---------------- 97  Z*1(1900) BRANCHING RATIOS   --------------------
R1        Z*1(1900) INTO (K N)/TOTAL                (P1)/TOTAL
R1           0.25      0.06       KYCIA     67 CNTR ++ IF J=1/2          8/67
R1           0.10         OR LESS CARTER    67 THEO    DISPERSICN REL.   8/67
R2        Z*1(1900) INTO K N*3/2(1236)              (P2)
R2           MAIN INELASTIC DECAY     BLAND·    67 HBC ++                8/67
****** ********* ********* ********* ********* ********* ********* ********
                     REFERENCES -- Z*1(1900)
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     TOTAL-CROSS-SECTION EXPERIMENTS  ---
COOL     66 PRL 17 102       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+ (BNL) I
     --  SLIGHTLY REVISED RESULTS FROM KYCIA 67 REPLACE COOL 66 --
KYCIA    67 PRIVATE COMM.    T F KYCIA                             (BNL) I
ABRAMS   67 PRL 19 259       +COOL,GIACOMELLI,KYCIA,LECNTIC,LI, +  (BNL)
BUGG     68 PR 168 1466      +GILMORE,KNIGHT, +    (RTHFD,BRMGHM,CVNDSH) I

     DISPERSION-RELATION CALCULATION USING TOTAL-CROSS-SECTION DATA  ---
CARTER   67 PRL 18 801       A A CARTER                       (CAVENDISH)
CARTER   68 PREPRINT         A A CARTER                       (CAVENDISH)

     PARTIAL-CROSS-SECTION EXPERIMENTS  ---
BLAND    67 PRL 18 1077      +BOWLER,BROWN,G+S GOLDHABER,SEEGER,+  (LRL)
     --  BLAND 68 IS MORE COMPLETE THAN BLAND 67 --
BLAND    68 UCRL-18131 THESIS R W BLAND                            (LRL)
HIRATA   68 PRL 21 1485      HIRATA, WOHL, GOLDHABER, TRILLING     (LRL)

     K-MATRIX (HITE 67) AND ELASTIC-SCATTERING PHASE-SHIFT ANALYSES  ---
HITE     67 THESIS           G E HITE                          (ILLINOIS)
LEA      68 PR 165 1770      LEA, MARTIN, OADES           (RTHFD,BNL,CERN)
MARTIN   68 PRL 21 1287      B R MARTIN                            (BNL)

     PRODUCTION EXPERIMENTS  ---
TYSON    67 PRL 19 255       +GREENBERG,HUGHES,LU,MINEHART,MORI,  (YALE)
MORI     68 PL 28B 152       +GREENBERG,HUGHES,LU,ROTHBERG, +     (YALE)
BIRNBAUM 67 HEIDELBERG CONF. +EDELSTEIN,HEIN,MCMAHON, +   (CARNEGIE,BNL)
BASSOMPI 68 PL 27B 468       BASSOMPIERRE, +           (CERN,BRUXELLES)

     LATEST RELEVANT RAPPORTEUR TALKS  ---
TRIPP    68 VIENNA CONF 173  R D TRIPP                             (LRL)
HARARI   68 VIENNA CONF 195  H HARARI                    (WEIZMANN,SLAC)
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Data in parentheses have not been included in our averages.

Λ

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              18  LAMBDA  (1115,JP=1/2+)  I=0

                  SEE LISTINGS OF STABLE PARTICLES
****** ********* ********* ********* ********* ********* ********* ********
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Λ (1320)

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              87  Y*0(1327,JP=    )  I=0

  ------->        A PEAK IN THE LAMBDA GAMMA INVARIANT MASS IS BE-
                  LIEVED TO BE EVIDENCE FOR A NEW RESCNANCE- A SI-
                  MILAR PEAK WAS PREVIOUSLY INTERPRETED AS A MANI-
                  FESTATION OF Y*0(1670)- SEE NOTE B CN MASS AND
                  WIDTH OF THIS STATE -
                  CONTRADICTORY EVIDENCE ON THE RESONANCE INTERPRE-
                  TATION OF THIS PEAK CAN BE FOUND IN THE DATA OF
                  DAHL 67 - SEE TRIPP 68 FOR A DETAILED DISCUSSICN

                  87  Y*0(1327)  MASS (MEV)     -------------------------

M          1327                   BUGACHEV  68 PBC   0 PI- AT 5.1 GEV/C 12/68*

----------------  87  Y*0(1327) WIDTH (MEV)     -------------------------

W            25.   OR LESS        BUGACHEV  68 PBC   0 PI- AT 5.1 GEV/C 12/68*

----------------  87  Y*0(1327) PARTIAL DECAYS  -------------------------

                                                       DECAY MASSES
P1      Y*0(1327) INTO LAMBDA GAMMA                   1115+   0

----------------  87  Y*0(1327) BRANCHING RATIOS -------------------------

R1      Y*0(1327) INTO (LAMBDA GAMMA)/TOTAL             (P1)/TOTAL
R1  *    36   MAIN  DECAY  MODE   BUGACHEV  68 PBC     PI- AT 5.1 GEV/C 12/68*

****** ********* ********* ********* ********* ********* ********* ********

                           REFERENCES -- Y*0(1327)

BUGACHEV 68  VIENNA ABS. 87   N P BUGACHEV +                        ( CUBNA)
DAHL     67 PR 163 1377       DAHL,HARDY,HESS,KIRZ,MILLER             (LRL)
TRIPP    68 VIENNA CONF 173   RAPPORTEUR S TALK                       (LRL)

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Λ(1405)

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              37  Y*0(1405, JP=1/2-) I=0  S01

                  THIS RESONANCE CAN BE IDENTIFIED WITH THE VIRTUAL
                  BOUND STATE IN THE KBAR-N SYSTEM THAT IS DEDUCED
                  FROM THE I=0 SCATTERING LENGTH DETERMINED FROM LOW
  ENERGY K-P INTERACTIONS.  THE DIFFICULTIES IN EXTRAPOLATING FROM THE
  PHYSICAL REGION TO THE RESONANCE LOCATION ARE DISCUSSED BY DALITZ 67.
  THE NUMBERS WE USE IN AVERAGING ARE FROM PRODUCTION EXPERIMENTS ONLY.

----------------  37  Y*0(1405) MASS (MEV)      -------------------------

M          1405.C                 ALSTON    61 HBC    K-P 1.15 BEV/C
M          1410.0                 ALEXANDER 62 HBC    PI-P 2.1 BEV/C
M          1405.0                 ALSTON    62 HBC    K-P 1.2-.5 BEV/C
M          1400.0    24.0         MUSGRAVE  65 HBC    PBAR P 3-4 BEV/C  7/66
M   *     (1382.0)   (8.0)        ENGLER    65 HDBC   PI-P, PI+D 1.68   7/66
M   *     (1410.7)   (1.0)        KIM       65 HBC    0-EFF-RANGE FIT   7/66
M   N     (1409.6)   (1.7)        SAKITT    65 HBC    0-EFF-RANGE FIT   7/66
M   N       DATA OF SAKITT ARE USED IN FIT BY KITTEL.
M   *     (1407.5)   (1.2)        KITTEL    66 HBC    0-EFF-RANGE FIT   7/66
M      67 1400.0      5.0         BIRMINGHA 66 HBC     3.5 K- P         9/67
M   *     (1403.0)   (3.0)        KIM       67 HBC    K MATRIX FIT(KP)  8/67
M     120 1405.0      5.0         GALTIERI  68 DBC    K-D 2.1-2.7BEV/C  6/68*
M          . . . . . . . . . .
M   AVG    1402.4469   3.4978  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  37  Y*0(1405) WIDTH (MEV)     -------------------------

W            20.0                 ALSTON    61 HBC                      7/66
W            35.0     5.0         ALEXANDER 62 HBC
W            50.0                 ALSTON    62 HBC
W            60.0    20.0         MUSGRAVE  65 HBC                      7/66
W   *       (89.0)  (20.0)        ENGLER    65 HDBC                     7/66
W   *       (37.0)   (3.2)        KIM       65 HBC                      7/66
W   N       (28.2)   (4.1)        SAKITT    65 HBC                      7/66
W   N       DATA OF SAKITT ARE USED IN FIT BY KITTEL.
W   *       (34.1)   (4.1)        KITTEL    66 HBC                      7/66
W      67    50.0    10.0         BIRMINGHA 66 HBC     3.5 K- P         9/67
W   *       (50.0)   (5.0)        KIM       67 HBC    K MATRIX FIT(KP)  8/67
W     120    35.0     8.0         GALTIERI  68 DBC    K-D 2.1-2.7BEV/C  6/68*
W          . . . . . . . . . .
W   AVG      38.1193   3.9257  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  37  Y*0(1405) PARTIAL DECAY MODES     -----------------

                                                       DECAY MASSES
P1          Y*0(1405) INTO SIGMA PI                   1197+ 139

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                           REFERENCES -- Y*0(1405)

ALSTON    61 PRL 6 698          +ALVAREZ,EBERHARD,GOOD,GRAZIANO, +    (LRL) I
ALEXANDE  62 PRL 8 447          ALEXANDER,KALBFLEISCH,MILLER,SMITH    (LRL) I
ALSTON    62 CERN CONF 311      +ALVAREZ,FERRO-LUZZI,ROSENFELD, +     (LRL) I
MUSGRAVE  65 NC 35 735          +PETMEZAS,+ (BIRMGHM,CERN,EP,IMPCOL,SACLAY)
ENGLER    65 PRL 15 224         +FISK,KRAEMER,MELTZER,WESTGARD,+ (CRNG,BNL) IJ
KIM       65 PRL 14 29          J K KIM                        (COLUMBIA)IJP
SAKITT    65 PR 139 B719        +DAY,GLASSER,SEEMAN,FRIEDMAN, +   (MD,LRL)IJP

KITTEL    66 PL 21 349          W KITTEL, G OTTER, I WACEK        (VIENNA)IJP
BIRMINGH  66 PR  152  1148      BIRMINGHAM,GLASGOW,I.C., OXFORD,RUT(ERFORD)
DALITZ    67 PR 153 1617        DALITZ, WONG, RAJASEKARAN   (OXFORD,BOMBAY)
KIM       67 PRL 19 1074        J KIM                               (YALE)JP
GALTIERI  68 PRL 21 573         BARBARO-GALTIERI,CHADWICK +       (LRL,SLAC)

                    PAPERS NOT REFERRED TO IN DATA CARDS.

ABRAMS    65 PR 139 B454        G S ABRAMS, B SECHI-ZORN               (MD)IJP
KADYK     66 PRL 17 599         +OREN, G+S GOLDHABER, TRILLING        (LRL)IJP
DONALD    66 PL 22 711          + EDWARDS, LYS, NISAR, MOORE    (LIVERPOOL)
     --  ABRAMS 65, KADYK 66, AND DONALD 66 SUPPORT THOSE EFFECTIVE-RANGE-
         FIT SOLUTIONS GIVING AN I=0 S1/2 RESONANCE.

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Λ(1520)

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              38  Y*0(1520, JP=3/2-) I=0  D03

              38  Y*0(1520) MASS (MEV)      -------------------------

M          1519.4     2.0         WATSON    63 HBC    K-P ALL CHANNELS
M      145 1517.2     3.0         GALTIERI  63 DBC    K-D 1.51 BEV/C
M       29 1520.0     4.0         ALMEIDA   64 HBC    K-P 1.45 BEV/C
M          1511.0    15.0         MUSGRAVE  65 HBC    PBAR P 3-4 BEV/C  7/66
M   *   30(1510.0)   (2.0)        BIRMINGHA 66 HBC     3.5 K- P         9/67
M          . . . . . . . . . .
M   AVG    1518.8293   1.5284  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

W   ------------  38  Y*0(1520) WIDTH (MEV)   ---------------------------
W            16.4     2.0         WATSON    63 HBC
W   *       (19.0)  (19.0)        MUSGRAVE  65 HBC                      7/66
W   *   30  (50.0)  (10.0)        BIRMINGHA 66 HBC     3.5 K- P         9/67
W            18.0      OR LESS    DAHL      68 HBC                      9/66
W          . . . . . . . . . .
W   FIT      13.207    2.292   VALUE FROM CONSTRAINED FIT

----------------  38  Y*0(1520) PARTIAL DECAY MODES   -----------------

                                                       DECAY MASSES
P1          Y*0(1520) INTO KBAR N                      497+ 939
P2          Y*0(1520) INTO SIGMA PI                   1197+ 139
P3          Y*0(1520) INTO LAMBDA PI PI               1115+ 139+ 139
P4          Y*0(1520) INTO LAMBDA GAMMA               1115+   0

----------------  38  Y*0(1520) PARTIAL WIDTHS (MEV)    ----------------

W1          Y*0(1520) INTO KBAR N                      (P1)
W1            4.8     0.5         WATSON    63 HBC
W1         . . . . . . . . . .
W1  FIT       6.002    1.078   VALUE FROM CONSTRAINED FIT

W2          Y*0(1520) INTO SIGMA PI                    (P2)
W2            9.0     1.0         WATSON    63 HBC
W2         . . . . . . . . . .
W2  FIT       5.890    1.131   VALUE FROM CONSTRAINED FIT

----------------  38  Y*0(1520) BRANCHING RATIOS    --------------------

R1      Y*0(1520) INTO (SIGMA PI)/(KBAR N)               (P2)/(P1)
R1            1.72     .78        MUSGRAVE  65 HBC                      8/67
R1            0.73    0.11        DAUBER    67 HBC    K-P AT 2.GEV/C    8/67
R1            0.96    0.20        DAHL      68 HBC    PI-P 1.6-4 GEV/C  9/66
R1         . . . . . . . . . .
R1  AVG       .7975   .0974  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT       .981    .210     VALUE FROM CONSTRAINED FIT

R2      Y*0(1520) INTO (LAMBDA PI PI)/(KBAR N)           (P3)/(P1)
R2            0.21    0.18        DAUBER    67 HBC    K-P AT 2.GEV/C    8/67
R2            0.17    0.05        DAHL      68 HBC    PI-P 1.6-4 GEV/C  9/66
R2         . . . . . . . . . .
R2  AVG       .1729   .0482  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R2  FIT       .219    .052     VALUE FROM CONSTRAINED FIT

R3     Y*0(1520) INTO (SIGMA PI)/(LAMBDA PI PI)          (P2)/(P3)
R3            4.5     1.0         ARMENTERO 65 HBC                      7/66
R3            3.3     1.1         BIRMINGHA 66 HBC     3.5 K- P         9/67
R3            4.8     1.2         UHLIG     67 HBC    K-P .9-1.0 BEV/C  9/66
R3         . . . . . . . . . .
R3  AVG       4.1892  .6298  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R3  FIT       4.481   .559     VALUE FROM CONSTRAINED FIT

R4      Y*0(1520) INTO (LAMBDA GAMMA)/TOTAL  (PERCENT)   (P4)/TOTAL
R4      238    0.86     0.14          MAST      68 HBC    0 K-P TO LAM.GAMMA 11/68*
  THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

        P1 P2      -.951


****** ********* ********* ********* ********* ********* ********* ********

                           REFERENCES -- Y*0(1520)

WATSON    63 PR 131 2248        M B WATSON, M FERRO-LUZZI, R D TRIPP  (LRL)IJP
GALTIERI  63 PL 6 296           A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP (LRL)
ALMEIDA   64 PL 9 204           S P ALMEIDA, G R LYNCH                 (CERN)
MUSGRAVE  65 NC 35 735          +PETMEZAS,+ (BIRMGHM,CERN,EP,IMPCOL,SACLAY)
ARMENTER  65 PL 19 338          ARMENTEROS,F-LUZZI, +  (CERN,HEIDEL,SACLAY)

BIRMINGH  66 PR  152  1148      BIRMINGHAM,GLASGOW,I.C.,(OXFORD,RUTHERFORD)
DAUBER    67 PL 24B 525         +MALAMUD,SCHLEIN,SLATER,STORK          (UCLA)
UHLIG     67 PR 155 1448        +CHARLTON,CONDON,GLASSER,YCDH,+  (MD,USNRL)
DAHL      68 PR 163 1377        DAHL,HARDY,HESS,KIRZ,MILLER             (LRL)
MAST      68 PRL TO BE PUBL.    MAST,ALSTON,BANGERTER,GALTIERI+         (LRL)

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Y^*'s in the region 1600 to 1900 MeV

There is much information from production and formation experiments in this energy region; however, a consistent picture of what is going on in this energy region is not yet possible. The states with J > 3/2 are adequately treated in the listings and the table. The lower J states are badly entangled and require discussion here.

Production experiments show evidence for Σ(1610), Σ(1660), and Σ(1690), but cannot give information on the I = 0 states, since it is very difficult to disentangle them from the neutral production of the I = 1 states. The separation of Σ(1660) and Σ(1690) is not very clear; it is based only on the evidence that in the reaction $K^-p \to Y^{*+}\pi^-$ the branching fractions for the decay $Y^{*+}(\approx 1660)$ into $\Lambda\pi$ and $\Sigma\pi$

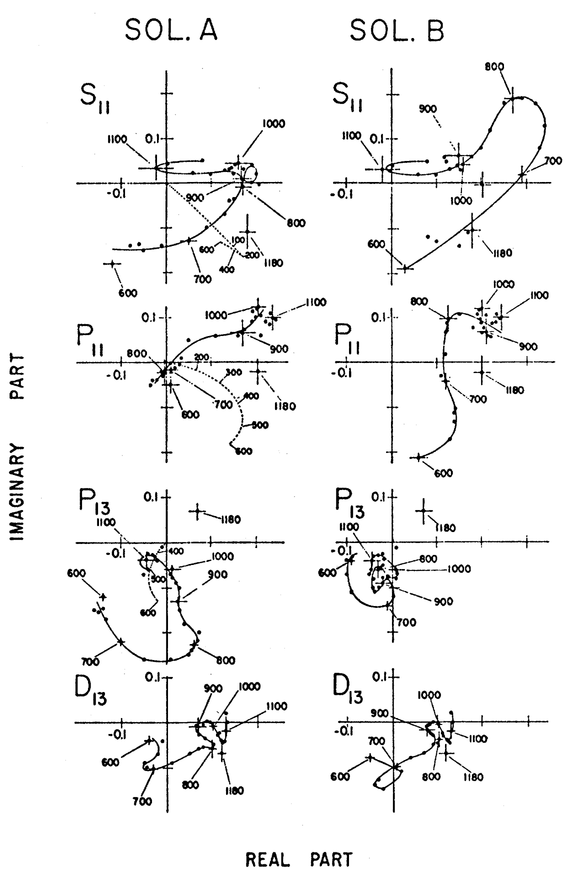
change with incident K^- momentum. As for $\Sigma(1616)$, it has been detected in only one experiment (CRENNELL 68), and needs further confirmation.

Formation experiments. Partial-wave analyses in almost all channels are now available throughout this energy region. Recent results on the two-body final states $K^-p \to \bar{K}N, \Lambda\pi, \Sigma\pi$ have been reported by:

CHS	(ARMENTEROS 68) on $\bar{K}N$ E_{cm} = 1.61 to 1.98 GeV
	(ARMENTEROS1 68) on $\Lambda\pi$ E_{cm} = 1.61 to 1.98 GeV
	(ARMENTEROS2 68) on $\Sigma\pi$ E_{cm} = 1.61 to 1.80 GeV
Chicago-Heid	(CONFORTO 68) and (CONFORTO1 68) on K^-p E_{cm} = 1.69 to 1.89 GeV
LRL	(SMART 68) on $\Lambda\pi$ E_{cm} = 1.6 to 1.9 GeV
PI-BNL-Yale	(BERTANZA 68) on $\bar{K}N$ E_{cm} = 1.65 to 1.71 GeV
BNL	(BERLEY 68) on $\Sigma\pi$ E_{cm} = 1.61 to 1.71 GeV

All partial-wave analyses are energy dependent (except CHS's $\Lambda\pi$) and treat each channel independently; hence each channel gives a slightly different mass and width for a given resonance. All parameterize the resonances as Breit-Wigner amplitudes, and use assorted parameterizations for the backgrounds.

The first attempt to perform an energy-independent analysis has been reported by the CHS collaboration in the $\Lambda\pi$ channel, where differential cross sections and polarizations have been measured. As expected, this type of analysis has shown a lot of structure, although better statistics are required to draw final conclusions. Four states with $J < 3/2$ show a resonant behavior between 1610 and 1670 MeV. The $\Sigma(1610)$ seen here could be identified with the one seen in production experiments by Crennell et al. This identification should still be taken with some caution: 1610 MeV is right at the bottom of the CHS mass range, and only one of the two CHS solutions requires a $\Sigma(1610)$ resonance. We reproduce their Argand diagrams, to show the statistical uncertainties present in such experiments.



Amplitudes of the two solutions of the CHS energy independent partial-wave analysis.

We present here the table of R. D. Tripp in his rapporteur talk at the Vienna Conference, with his evaluation of the significance of the various states. The $\Lambda\pi$ enhancement at 1680 MeV, which we had in our earlier tables as $\Sigma(1690)$, can be either the S_{11} or the P_{13} seen by the CHS collaboration. There is no information from production experiments on this point, so no choice can be made. Of the four new states we list in the Baryon Table only $\Sigma(1610)$; for the others we wait for confirmation.

In conclusion, in the 1600- to 1700-MeV region with $J \leq 3/2$, there are now established two I = 0 states and three I = 1 states, with one more awaiting confirmation. In the 1700- to 1800-MeV region there await confirmation one state with I = 1 and two I = 0 states. Above 1800 MeV there is one tentative state.

Summary of evidence for Y^*'s of $J \leq 3/2$ in the 1600- to 1900-MeV mass region.
(Table from R. D. Tripp, Proceedings of Vienna Conference, 173, 1968.)

$L_{I, 2J}(J^P)$			New status Mass (MeV)	Width (MeV)	Br. fract. (%)	Laboratory	Quality[a]	Old states RMP 40, 77 (68)	New states
$S_{01}(1/2^-)$	$\Lambda\eta$ resonance at ≈ 1670 MeV	$\bar{K}N$	1663	26	14	CHS	A	$\Lambda(1670)$[c]	
		$\Sigma\pi$	1678	26	45				
		$\Lambda\eta$	1670	18	28	BNL			
	--	$\bar{K}N$	1750	110	20	Ch+H	C		$\Lambda(1750)$
$S_{11}(1/2^-)$	$\Lambda\pi$ enhancement[b] at ≈ 1680 MeV	$\bar{K}N$	--	--	7-10	CHS	B		$\Sigma(1650)$
		$\Lambda\pi$	1650	100	70-100				
		$\Sigma\pi$	--	--	--				
	$\Sigma\eta$ threshold effect at ≈ 1750 MeV	$\bar{K}N$	1769	123	12	Ch+H	B	$\Sigma(1780)$	
$P_{01}(1/2^+)$	--	$\bar{K}N$	1745	147	40	CHS	C		$\Lambda(1745)$
		$\Sigma\pi$	--		--				
$P_{11}(1/2^+)$	--	$\bar{K}N$	--	--	2-10	CHS			$\Sigma(1610)$[c]
		$\Lambda\pi$	1610	60	20-100				
		$\Sigma\pi$	--	--	--				
		$\Lambda\pi$ prod.	1616	60	--	BNL (no J^P dat.)	B		
	--	$\Lambda\pi$	1882	222	--	LRL	C	$\Sigma(1880)$	
$P_{03}(3/2^+)$	--	--	--	--	--	--			
$P_{13}(3/2^+)$	See footnote b	$\bar{K}N$	--	--	4-10	CHS	C	$\Sigma(1690)$[c]	
		$\Lambda\pi$	1660	80	40-100				
		$\Sigma\pi$	--	--	--				
$D_{03}(3/2^-)$	$\Lambda(1690)$	$\bar{K}N$	1696	35	18	CHS	A	$\Lambda(1700)$[c]	
		$\Sigma\pi$	1681	85	60				
		$\Sigma\pi\pi$	--	--	20				
$D_{13}(3/2^-)$	$\Sigma(1660)$	$\bar{K}N$	1668	56	9	CHS	A	$\Sigma(1660)$[c]	
		$\Lambda\pi$	1667	50	29				
		$\Sigma\pi$	1661	44	49				
		$\Lambda(1405)\pi$	--	--	~8				
		$\Lambda\pi\pi$	--	--	~10				

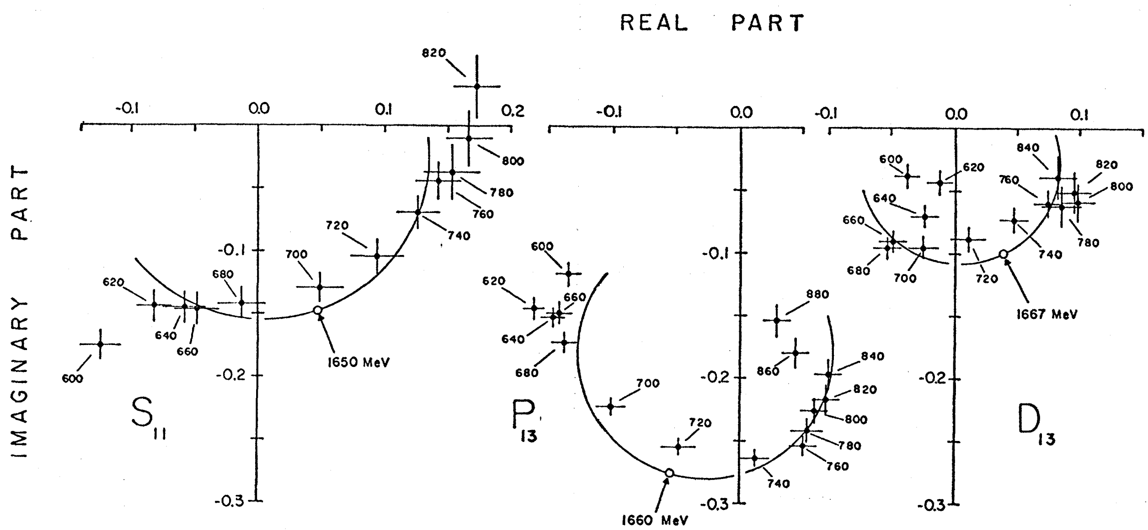
a. A stands for "well established," B for "good evidence but in need of confirmation," C for "shaky evidence."

b. It is not clear if $\Sigma(1690)$ seen in production experiments corresponds to the S_{11} or to the P_{13} state detected by the CHS collaboration in their $\Lambda\pi$ energy-independent partial-wave analysis. We temporarily list $\Sigma(1690)$ as the P_{13} state.

c. This state is included in the Baryon Table.

BARYON RESONANCES

Data in parentheses have not been included in our averages.



S_{11}, P_{13}, and D_{13} of solution A in the resonant region. Arrows indicate positions of resonance.

Λ(1670) S_{01}

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40  Y*0(1670, JP=1/2-) I=0   S01
SEE NOTE ABOVE

SEE ALSO NOTE IN Y*0(1327) LISTINGS

40  Y*0(1670) MASS (MEV)    --------------------------

M  B     (1680.0)                 Y-CHANG    64 PBC     PI-PRP 7-8 BEV/C   7/66
M         1670.0                  BERLEY     65 HBC     K-P TO LAM ETA     7/66
M  N  50(1645.0)    (6.0)         BIRMINGHA  66 HBC  +  K-P AT 3.5 GEV/C 11/67
M  B     (1680.)                  BUBELEV    67 PBC     PI-PRP AT 4GEV/C   8/67
M  S      1663.      3.           ARMENTERO  68 HBC   C K-P ELAST.+CEXC.  11/68*
M  S      1678.      2.           ARMENTER2  68 HBC   0 K-P TO SIGMA PI   11/68*
M  N  AUTHORS SEE A SIGNAL IN NEUTRAL (SIG PI)  BUT NOT IN CHARGED. IT IS
M  NOT CLEAR THAT IT CORRESPONCS TO THIS STATE
M  S    SYSTEMATIC ERRORS NOT INCLUDED. ONLY INDETERM. IN FIT QUOTED
M  B    THESE TWO EXPERIMENTS HAVE DETECTED A PEAK IN THE LAMBDA GAMMA MASS
M  B    PLOT.  A NEW SIMILAR EXPERIMENT IN A LARGER CHAMBER SUGGESTS THAT
M  B    THIS PEAK SHOULD NOT BE ASSIGNED TO Y*0(1670)-SEE NOTE FOR Y*0(1327
M         . . . . . . . . .
M  AVG    1673.3846   6.9231  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 4.2)

----------------  40  Y*0(1670) WIDTH (MEV)   --------------------------

W  B        20.0       OR LESS     Y-CHANG    64 PBC                       7/66
W           18.0                   BERLEY     65 HBC                       7/66
W  N   50  (40.0)   (10.0)         BIRMINGHA  66 HBC  +  K-P AT 3.5 GEV/C 11/67
W  B        20.   OR  LESS         BUBELEV    67 PBC     PI-PRP AT 4GEV/C  8/67
W  S        26.      8.            ARMENTERO  68 HBC   0 K-P ELAST.+CEXC. 11/68*
W  S        26.      5.            ARMENTER2  68 HBC   0 K-P TO SIGMA PI  11/68*
W  N  AUTHORS SEE A SIGNAL IN NEUTRAL (SIG PI)  BUT NOT IN CHARGED. IT IS
W  NOT CLEAR THAT IT CORRESPONDS TO THIS STATE
W  S    SYSTEMATIC ERRORS NOT INCLUDED. ONLY INDETERM. IN FIT QUOTED
W  B    SEE NOTE IN MASS ABOVE
W         . . . . . . . . .
W  AVG      26.0000   4.2400  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  40  Y*0(1670) PARTIAL DECAY MODES   ----------------

                                                        DECAY MASSES
P1        Y*0(1670) INTO KBAR N                          497+ 939
P2        Y*0(1670) INTO LAMBDA ETA                     1115+ 548
P3        Y*0(1670) INTO SIGMA PI                       1197+ 139

----------------  40  Y*0(1670) BRANCHING RATIOS   -------------------

R1     Y*0(1670) INTO (KBAR N)/TOTAL                    (P1)/TOTAL
R1          0.14      0.04         ARMENTERC 68 HBC   0 K-P ELAST.+CEXC. 11/68*

R2     Y*0(1670) INTO ((SIGMA PI)*(KBARN))/TOTAL**2     (P3*P1)/TOTAL**2
R2          0.063     0.03         ARMENTER2 68 HBC   0 K-P TO SIGMA PI  11/68*

R3  *     Y*0(1670) INTO ((KBAR N)(LAM ETA))/TOTAL**2   (P1*P2)/TOTAL**2
R3          0.046                  BERLEY    65 HBC                       7/66

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                        REFERENCES -- Y*0(1670)

Y-CHANG  64 DUBNA CONF I 615  YUNG-CHANG, IN, KLADNITSKAYA, +    (DUBNA) I
BERLEY   65 PRL 15 641        +CONNOLLY,HART,RAHM,STONEHILL, +      (BNL)IJP
BIRMINGH 66 PR  152  1148     BIRMINGHAM,GLASGOW,I.C., OXFORD,RUTHER(ORD)
BUBELEV  67 PL 248 246        +CHADRAA,CHUVILO,HI IN+      (JINR,BUC,CERN)
ARMENTER 68 NP TO BE PUBLIS.  ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
ARMENTE2 68 PREPRINT          ARMENTEROS+BAILLCN +    (CERN+HEIDE+SACLAY)IJP

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Λ(1700) D_{03}

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55  Y*0(1700, JP=3/2-) I=0   D03
SEE NOTE PRECEDING Y*0(1670) LISTINGS

55  Y*0(1700) MASS (MEV)   --------------------------

M  *     (1698.0)               DAVIES    67 CNTR    K-P, D TCTAL      11/66
M  S      1696.      3.         ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
M  S      1681.0     2.0        ARMENTER2 68 HBC   0 K-P TO SIGMA PI  11/68*
M         1681.0     8.0        BARTLEY   68 DBC   0 K-P AND K-D DATA 11/68*
M  S      1701.      2.0        BERTANZA  68 HBC    0 KP ELAS.+CH.EX. 11/68*
M         1695.0     4.0        BUGG      68 CNTR    K-P,D TOTAL        7/68*
M   C    (1697.)    (2.)        CONFORTO  68 HBC   0  K-P ELASTIC     11/68*
M   C   FIT TO K-P ELAS. DIFFER. CROSS SECTIONS (PART OF DATA INCLUDED IN
M   C   ARMENTEROS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)
M  S   SYSTEMATIC ERRORS NOT INCLUDED. ONLY INDETERM. IN FIT QUOTED      11/67
M         . . . . . . . . .
M  AVG    1691.9421   4.4555  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 3.7)

----------------  55  Y*0(1700) WIDTH (MEV)   --------------------------

W  S        35.      7.         ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
W   S      (85.0)   (7.0)       ARMENTER2 68 HBC   0 K-P TO SIGMA PI  11/68*
W           48.0    15.0        BARTLEY   68 DBC   0 K-P AND K-D DATA 11/68*
W  S        24.      3.0        BERTANZA  68 HBC    0 KP ELAS.+CH.EX. 11/68*
W           40.0    10.0        BUGG      68 CNTR   TOTAL CRCSS SECT  11/66
W   C      (27.)    (5.)        CONFORTO  68 HBC   0 NOTE C IN MASS   11/68*
W  S   SYSTEMATIC ERRORS NOT INCLUDED. ONLY INDETERM. IN FIT QUOTED      11/67
W         . . . . . . . . .
W  AVG      27.3649   3.6820  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)

----------------  55  Y*0(1700) PARTIAL DECAY MODES   ----------------

                                                        DECAY MASSES
P1     Y*0(1690) INTO KBAR N                             497+ 939
P2     Y*0(1690) INTO SIGMA PI                          1197+ 139
P3     Y*0(1690) INTO SIGMA PI PI                       1197+ 139+ 139
P4     Y*0(1670) INTO LAMBDA PI PI                      1115+ 139+ 139

----------------  55  Y*0(1700) BRANCHING RATIOS   -------------------

R1        Y*0(1700) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1          0.24                DAVIES    67 CNTR    ASSUMING J=3/2   11/66
R1          0.18      0.03      ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
R1          0.28      0.02      BERTANZA  68 HBC    0 KP ELAS.+CH.EX. 11/68*
R1  C      (0.22)    (0.03)     CONFORTO  68 HBC   0 NOTE C IN MASS   11/68*
R1        . . . . . . . . .
R1  AVG      .2492     .0462  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.8)

R2     Y*0(1700) INTO (SIGMA PI)*(KBAR N)/TOTAL**2     (P2*P1)/TOTAL**2    8/67
R2          0.096     0.013     ARMENTE2  68 HBC   0 K-P TO SIGMA PI  11/68*
R2          0.073               BERLEY    68 HBC   0 K-P .6-.82 BEV/C 11/68*

R3     Y*0(1700) INTO (LAMBDA PI PI)*(KBAR N)/TOTAL**2  (P4*P1)/TOTAL**2
R3          0.06      0.01      BARTLEY   68 DBC   0 K-P ANC K-D DATA 11/68*

R4     Y*0(1700) INTO (SIGMA PI PI)/TOTAL               (P3)/TOTAL
R4       ABOUT   0.25           ARMENTE3  68 HBC     K-P AND K-D      11/68*

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                        REFERENCES -- Y*0(1690)

DAVIES   67 PRL 18 62         +DOWELL,HATTERSLEY,HOMER+ (BIRMI,CAMB,RUTH)I
ARMENTER 68 NP TO BE PUBLIS.  ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
   ALSO  67 NP 83 592         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)JP
ARMENTE2 68 PREPRINT          ARMENTEROS+BAILLCN +    (CERN+HEIDE+SACLAY)IJP
   ALSO2 67 PL 248 198        ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAYI)P
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Data in parentheses have not been included in our averages.


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ARMENTE3 68  VIENNA CONF       ARMENTEROS,BAILLON +      (CERN+HEID+SACLAY)I
BARTLEY  68 PRL 21 1111        BARTLEY,CHU,DOWD,SIMS,MEER+ (TUFTS+FLO+BRA)
BERLEY   68  VIENNA CONF       BERLEY,HART,RAHM,WILLIS,YAMAMOTO        (BNL)
BERTANZA 68 PR TO BE PUBLIS.   BERTANZA,BIGI+BERLEY,HART+  (PISA+BNL+YALE) JP
BUGG     68 PR 168 1466        +GILMORE,KNIGHT,DAVIES+    (BIRMI,CAMB,RUTH)I
CONFORTO 68 EFI 68-62 NP TBP.  B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)
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Λ (1745) 77 Y*0(1745,JP=1/2+) I=0 P_{01}

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                  SEE NOTE PRECEDING Y*0(1670) LISTINGS

      ------->    PARTIAL WAVE ANALYSIS OF CHS COLLABORATION INDICATES
                  PRESENCE OF THIS STATE ONLY IN KBAR N -

                  77  Y*0(1745)  MASS (MEV)    ------------------------

M         1745.                     ARMENTER  68 HBC   0 K-P .6-1.2 GEV/C 11/68*

----------------  77  Y*0(1745) WIDTH (MEV)    ------------------------

W          147.                     ARMENTER  68 HBC    K-P ELAST.+CH.EX 11/68*

----------------  77  Y*0(1745) PARTIAL DECAY MODE -------------------

                                                     DECAY MASSES
P1      Y*0(1745) INTO KBAR N                         497+ 939
P2      Y*0(1745) INTO SIGMA PI                      1197+ 139

----------------  77  Y*0(1745) BRANCHING RATIOS   -------------------

R1      Y*0(1745) INTO (KBAR N)/TOTAL                (P1)/TOTAL
R1           0.40                   ARMENTER  68 HBC   0 K-P .6-1.2 GEV/C 11/68*

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                          REFERENCES -- Y*0(1745)
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ARMENTER 68 NP TO BE PUBLIS.  ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
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Λ(1750) 76 Y*0(1750,JP=1/2-) I=0 P_{01}

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                  SEE NOTE PRECEDING Y*0(1670) LISTINGS

      ------->    PARTIAL WAVE ANALYSIS OF K-P DATA (PART OF WHICH
                  ARE INCLUDED IN CHS ANALYSIS) INDICATES THE PRESENCE
                  OF SUCH STATE

                  76  Y*0(1750)  MASS (MEV)

M         1750.                     CONFORT1  68 HBC   C K-P ELASTIC      11/68*

----------------  76  Y*0(1750) WIDTH (MEV)    ------------------------

W          110.                     CONFORT1  68 HBC   0 K-P ELASTIC      11/68*

----------------  76  Y*0(1750) PARTIAL DECAY MODES   -----------------

                                                     DECAY MASSES
P1      Y*0(1750)  INTC KBAR N                        497+ 939

----------------  76  Y*0(1750) BRANCHING RATIOS   -------------------

R1      Y*0(1750)  INTO (KBAR N)/TOTAL               (P1)/TOTAL
R1            0.2                   CONFORT1  68 HBC   0 K-P ELASTIC      11/68*

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                          REFERENCES -- Y*0(1750)
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CONFORT1 68  VIENNA CONF      CONFORTO,LEVI-SETTI,KLUGE+   (CHICAGO+HEID)
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Λ(1815) 39 Y*0(1815, JP=5/2+) I=0 F_{05}

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                  39  Y*0(1815) MASS (MEV)    -------------------------

M   *     (1815.0)                 GALTIERI  63        K-P RVUE          7/66
M          1815.0                  BIRGE     65 HBC    KBAR N,LAM PI PI  7/66
M       50 1810.0      20.0        BIRMINGHA 66 HBC     3.5 K- P         9/67
M   N     (1811.0)     (4.0)       GELFAND   66 HBC   0 K-P ELASTIC      8/67
M   N      RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 68 FITS TO
M  S       1813.0       2.0        ARMENTERO 67 HBC   0 K-P TO SIGMA PI   8/67
M  S       1816.0       4.0        BELL      67 HDBC   OKP,KD TO SIG PI  11/67
M  S       1817.        2.         ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
M          1819.0       4.0        BUGG      68 CNTR   K-P, D TOTAL       6/68*
M   C     (1816.)      (2.)        CONFORTO  68 HBC   0  K-P ELASTIC     11/68*
M   C    FIT TO K-P ELAS. DIFFER. CROSS SECTICNS (PART OF DATA INCLUDED IN
M   C    ARMENTEROS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)
M  S   SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED      6/68*
M          . . . . . . . . . .
M   AVG    1815.4781   1.2624  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  39  Y*0(1815) WIDTH (MEV)    ------------------------

W   *       (70.0)                 GALTIERI  63
W            60.0                  BIRGE     65 HBC                      7/66
W       50  110.0      50.0        BIRMINGHA 66 HBC      3.5 K- P        9/67
W   N      RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 68 FITS TO
W   N      (73.0)     (10.0)       GELFAND   66 HBC   C K-P ELASTIC      8/67
W            87.0      15.0        ARMENTERO 67 HBC   0 K-P TO SIGMA PI  8/67
W            64.0      12.0        BELL      67 HDBC   OKP,KD TO SIG PI 11/67
W  S         71.        4.         ARMENTERC 68 HBC   0 K-P ELAST.+CH.EX 11/68*
W            75.0       7.0        BUGG      68 CNTR   K-P, D TOTAL      6/68*
W   C       (72.)      (7.)        CONFORTO  68 HBC   0 NOTE C IN MASS  11/68*
W  S   SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED      6/68*
W          . . . . . . . . . .
W   AVG      72.2644   3.2496  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  39  Y*0(1815) PARTIAL DECAY MODES   -----------------

                                                     DECAY MASSES
P1          Y*0(1815) INTO KBAR N                     497+ 939
P2          Y*0(1815) INTO SIGMA PI                  1197+ 139
P3          Y*0(1815) INTO Y*1(1385) PI              1385+ 139
P4          Y*0(1815) INTO LAMBDA ETA                1115+ 548
P5          Y*0(1815) INTO SIGMA PI PI               1197+ 139+ 139

----------------  39   Y*0(1815) BRANCHING RATIOS  -------------------

R1     Y*0(1815) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1  *        (0.8)                 GALTIERI  63        K-P RVUE
R1  N       (0.67)    (0.08)       GELFAND   66 HBC   0 K-P ELASTIC      8/67
R1           0.80                  KYCIA     67 CNTR   TOTAL CRCSS-SEC.  8/67
R1           0.62      0.02        ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
R1           0.72                  BUGG      68 CNTR                     6/68*
R1  C       (0.65)    (0.01)       CONFORTO  68 HBC   0 NOTE C IN MASS  11/68*
R1  N      RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 68 FITS TO

R2     Y*0(1815) INTO (SIGMA PI)*(KBAR N)/TOTAL**2    (P2*P1)/TOTAL**2
R2          0.073     0.005        ARMENTERC 67 HBC   0                  8/67
R2          0.054     0.012        BELL      67 HDBC   OKP,KD TO SIG PI 11/67
R2         . . . . . . . . . .
R2  AVG      .0702     .0067  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)

R3     Y*0(1820) INTO (Y*1(1385) PI)*(KBAR N)/TOTAL**2  (P3*P1)/TOTAL**2
R3          0.057     0.013        ARMENTE2  67 HBC   0 K-P TO LAM.PI PI  8/67

R4     Y*0(1815) INTO (Y*1(1385) PI)/TOTAL                (P3)/TOTAL
R4          0.20      0.05         BIRGE     65 HBC                      7/66

R5     Y*0(1815) INTO (SIGMA PI PI)/TOTAL                 (P5)/TOTAL
R5  C    ABOUT   0.03              ARMENTE3  68 HBC    K-P AND K-D      11/68*
R5  C  CONSISTENT WITH SIG 2PI MODE OF THE Y*1(1385)+PI DECAY            11/68*

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                          REFERENCES -- Y*0(1815)
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GALTIERI 63 PL 6 296           A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP (LRL)IJ
BIRGE    65 ATHENS CONF 296    +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA, +  (LRL)IJP
BIRMINGH 66 PR  152  1148      BIRMINGHAM,GLASCOW,I.C., OXFORD,RUTHER(ORD)
GELFAND  66 PRL 17 1224        +HARMSEN,LEVI-SETTI,PREDAZZI+ (EFINS,ARGON)
ALSO     68 PR 163 1792        LASINSKI,LEVI-SETTI,PREDAZZI          (EFINS)JP

ARMENTER 67 PL 24B 198         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)IJP
ARMENTE2 67 ZEIT.PHYS.202,486  ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)
BELL     67 PRL 19 936         R B BELL                              (L R L)
KYCIA    67 PRIVATE COMM.      T F KYCIA                             (BNL) I
ARMENTER 68 NP TO BE PUBLIS.   ARMENTEROS,BAILLCN +     (CERN+HEID+SACLAY)IJP
   ALSO  67 NP B3 592          ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)P
ARMENTE3 68  VIENNA CONF       ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)I
BUGG     68 PR 168 1466        +GILMORE,KNIGHT,DAVIES+   (BIRMI,CAMB,RUTH)I
CONFORTO 68 EFI 68-62 NP TBP.  B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)

                     PAPERS NOT REFERRED TO IN DATA CARDS.

CHAMBERL 62 PR 125 1696        CHAMBERLAIN,CROWE,KEEFE,KERTH, +     (LRL) I
     --  FIRST SEEN IN CHAMBERLAIN 62 TOTAL CROSS SECTION MEASUREMENTS.
SODICKSO 64 PR 133 B757        SODICKSON,MANNELLI,FRISCH,WAHLIG (MIT(BNL)) J
HOLLEY   65 UCRL-16274 THESIS W R HOLLEY                             (LRL) J
     --  SODICKSON 64 AND HOLLEY 65 ELASTIC SCATTERING WCRK INDICATED J=5/2.
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Λ (1830) 56 Y*0(1830, JP=5/2-) I=0 D_{05}

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                  56  Y*0(1830) MASS (MEV)

M  S       1827.0       3.0        ARMENTERO 67 HBC   0 K-P TO SIGMA PI   8/67
M  S       1837.       11.         BELL      67 HDBC   OKP,KD TO SIG PI  11/67
M  S       1807.       10.         ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
M   C     (1840.)      (5.)        CONFORTO  68 HBC   0  K-P ELASTIC     11/68*
M   C    FIT TO K-P ELAS. DIFFER. CROSS SECTIONS (PART OF DATA INCLUDED IN
M   C    ARMENTEROS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)
M  S   SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED      6/68*
M          . . . . . . . . . .
M   AVG    1826.0929   4.2710  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)

                  56  Y*0(1830) WIDTH (MEV)

W  S       (75.0)      (9.0)       ARMENTERC 67 HBC   0 K-P TO SIGMA PI   8/67
W  S       (74.0)     (18.0)       BELL      67 HDBC   OKP,KD TO SIG PI  11/67
W  S      (123.)      (32.)        ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
W   C      (66.)      (25.)        CONFORTO  68 HBC   0 NOTE C IN MASS   11/68*
W  S   SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED      6/68*

                  56  Y*0(1830) PARTIAL DECAY MODES

                                                     DECAY MASSES
P1      Y*0(1830) INTO KBAR N                         497+ 939
P2      Y*0(1830) INTO SIGMA PI                      1197+ 139

                  56  Y*0(1830) BRANCHING RATIOS

R1      Y*0(1830) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1           0.09      0.01        ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
R1  C       (0.10)    (0.01)       CONFORTO  68 HBC   0 NOTE C IN MASS   11/68*

R2      Y*0(1830) INTO (SIGMA PI)*(KBAR N)/TOTAL**2   (P2*P1)/TOTAL**2
R2          0.0225    0.006        ARMENTERO 67 HBC   0 K-P TO SIG PI     8/67
R2          0.037     0.003        BELL      67 HDBC  0 KP,KD TO SIG PI  11/67
R2         . . . . . . . . . .
R2  AVG      .0341     .0058  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.2)

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                          REFERENCES -- Y*0(1830)
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ARMENTER 67 PL 24B 198         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)P
BELL     67 PRL 19 936         R B BELL                              (L R L)
ARMENTER 68 NP TO BE PUBLIS.   ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
  ALSO   67 NP B3 592          ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)IJP
CONFORTO 68 EFI 68-62 NP TBP.  B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)
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Λ(1860) 60 Y*0(1860, JP=7/2+) I=0 F_{07}

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      ------->    PARTIAL WAVE ANALYSIS OF ELASTIC AND CHARGE EXCHANGE
                  DATA REQUIRE A RESONANT F07 AMPLITUDE. EXISTENCE NOT
                  CONCLUSIVELY ESTABLISHED. SEEN ALSO IN FORMATION
                  EXPERIMENT. FIT TO TOTAL CROSS SECTION DATA
                  IMPROVES IF THIS STATE IS ACCEPTED.

---------------       Y*0(1860)  MASS (MEV)   ---------------------------

M  S       1864.        2.         ARMENTERC 68 HBC   0 K-P ELAST.+CH.EX 11/68*
M          1870.0       5.0        BUGG      68 CNTR   K-P,D TOTAL        7/68*
M   C     (1865.)      (2.)        CONFORTO  68 HBC   0  K-P ELASTIC     11/68*
M   N     (1840.0)    (10.0)       GALTIERI  68 DBC    K-D 2.1-2.7BEV/C   6/68*
M   S  SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED      6/68*
M   N  SIGNAL SEEN ONLY IN NEUTRAL STATE--NARRCW WIDTH SUGGESTS THIS ASSIG.
M   C    FIT TO K-P ELAS. DIFFER. CROSS SECTIONS (PART OF DATA INCLUDED IN
M   C    ARMENTERCS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)
M          . . . . . . . . . .
M   AVG    1864.8276   2.0690  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)
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BARYON RESONANCES

Data in parentheses have not been included in our averages.

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---------------     Y*0(1860)  WIDTH (MEV)  ------------------------------

W  S        39.      7.              ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
W           40.      10.             BUGG      68 CNTR    K-P,D TOTAL       7/68*
W   C      (49.)     (9.)            CONFORTO  68 HBC   0  NOTE C IN MASS  11/68*
W   N      (35.0)   (10.0)           GALTIERI  68 DBC     K-D 2.1-2.7BEV/C  6/68*
W   S  SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED         6/68*
W          . . . . . . . . . .
W   AVG    39.3289   5.7346  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
M   N  SIGNAL SEEN ONLY IN NEUTRAL STATE--NARRCW WIDTH SUGGESTS THIS ASSIG.

---------------     Y*0(1860) PARTIAL DECAY MODES  -----------------------

                                                       DECAY MASSES
P1     Y*0(1860) INTO KBAR N                          497+ 939
P2     Y*0(1860) INTO SIGMA PI                       1197+ 139

---------------     Y*0(1860)  BRANCHING RATIOS  ------------------------

R1     Y*0(1860) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1          0.12      0.02           ARMENTERO 68 HBC   0 K-P ELAST.+CH.EX 11/68*
R1          0.10                     BUGG      68 CNTR    K-P,D TOTAL       7/68*
R1  C      (0.10)    (0.04)          CONFORTO  68 HBC   0  NOTE C IN MASS  11/68*

R2     Y*0(1860) INTO SIGMA PI/ TOTAL                (P2)/TOTAL

R2  *  SEEN - NO RATIO GIVEN         GALTIERI  68 DBC                       6/68*

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                          REFERENCES -- Y*0(1860)

ARMENTER 68 NP TO BE PUBLIS.  ARMENTEROS,BAILLON +      (CERN+HEID+SACLAY)IJP
  ALSO   67 NP B3 592         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)IJP
BUGG     68 PR 168 1466       +GILMORE,KNIGHT,DAVIES+    (BIRMI,CAMB,RUTH)I
CONFORTO 68 EFI 68-62 NP TBP. B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)
GALTIERI 68 PRL 21 573        BARBARO-GALTIERI,CHADWICK +      (LRL,SLAC)

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Λ(2100)

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41  Y*0(2100, JP=7/2-) I=0

    WOHL 66 AND DAUM 68 FIND JP=7/2-.

                   41  Y*0(2100) MASS (MEV)     ---------------------------

M   *    (2097.0)     (6.0)          BOCK      65 HBC    PBAR P 5.7 BEV/C  7/66
M   *    (2120.0)                    WOHL      66 HBC    K-P CH EX         7/66
M         2103.0      10.0           KYCIA     67 CNTR   K-P, D TCTAL      8/67
M         2100.0       7.0           BUGG      68 CNTR   K-P, D TOTAL      6/68*
M        . . . . . . . . . .
M   AVG   2100.9866   5.7346  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------   41  Y*0(2100) WIDTH (MEV)    ---------------------------

W   *     (24.0)    (14.0)   (24.0)  BOCK      65 HBC     INTO KBAR N (PI) 7/66
W   *    (145.0)                     WOHL      66 HBC                      7/66
W         143.0     10.0             KYCIA     67 CNTR                     8/67
W         140.0     15.0             BUGG      68 CNTR                     6/68*
W        . . . . . . . . . .
W   AVG   142.0769   8.3205   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------   41  Y*0(2100) PARTIAL DECAY MODES    -------------------

                                                      DECAY MASSES
P1        Y*0(2100) INTO KBAR N                        497+ 939
P2        Y*0(2100) INTO SIGMA PI                     1197+ 139
P3        Y*0(2100) INTO LAMBDA ETA                   1115+ 548
P4        Y*0(2100) INTO XI K                         1321+ 497
P5        Y*0(2100) INTO LAMBDA OMEGA                 1115+ 783
P6        Y*0(2100) INTO KBAR N PI                     497+ 939+ 139

----------------   41  Y*0(2100) BRANCHING RATIOS     ----------------------

R1        Y*0(2100) INTO (KBAR N)/TOTAL               (P1)/TOTAL
R1  *       (0.25)                   WOHL      66 HBC                      7/66
R1          0.333     0.013          KYCIA     67 CNTR                     8/67
R1          0.305                    BUGG      68 CNTR                     6/68*

R2        Y*0(2100) INTO SIGMA PI                     (P2)
R2             SEEN                  GALTIERI  68 HBC    K-P TO SIGMA PI  11/68*

R3     Y*0(2100) INTO (LAMBDA ETA)*(KBAR N)/TOTAL**2  (P3)*(P1)/TOTAL**2
R3          0.0087  OR LESS          FLATTE 2  67 HBC    K-P TO LAM ETA    6/68*

R4     Y*0(2100) INTO (XI K)*(KBAR N)/TOTAL**2        (P4)*(P1)/TOTAL**2
R4          0.0029                   TRIPP     67 RVUE                     8/67
R4           MAYBE SEEN              BURGUN    68 HBC    K-P TO XI K      11/68*

R5        Y*0(2100) INTO (LAMBDA OMEGA)/TOTAL         (P5)/TOTAL
R5          0.1         OR LESS      FLATTE 1  67 HBC                      8/67

R6        Y*0(2100) INTO (KBAR N PI)/TOTAL            (P6)/TOTAL
R6             SEEN                  BOCK      65 HBC

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                          REFERENCES -- Y*0(2100)

BOCK     65 PL 17 166         +COOPER,FRENCH,KINSON, +      (CERN,SACLAY)
COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+ (BNL) I
    --  SLIGHTLY REVISED RESULTS FROM KYCIA 67 REPLACE COOL 66 --
KYCIA    67 PRIVATE COMM.     T F KYCIA                           (BNL) I
WOHL     66 PRL 17 107        C G WOHL, F T SOLMITZ, M L STEVENSON  (LRL)IJP
FLATTE 1 67 PR 155 1517       S M FLATTE                          (LRL)
TRIPP    67 NP B3 10          + LEITH, +    (LRL,SLAC,CERN,HEIDEL,SACLAY)
FLATTE 2 67 PR 163 1441       S M FLATTE, C G WOHL                (LRL)
BUGG     68 PR 168 1466       +GILMORE,KNIGHT, +    (RTHFD,BRMGHM,CVNDSH) I
DAUM     68 NP B7 19          +ERNE, LAGNAUX, SENS, STEUER, UDO    (CERN)JP
GALTIERI 68 PRIVATE COMM.     L BARBARO-GALTIERI                  (LRL)
BURGUN   68 PREPRINT          +MEYER,PAULI, +    (SACLAY,COLFRANCE,RTHFD)
    --  A RESONANCE-LIKE EFFECT IS SEEN IN THIS REGICN IN THE REACTION
        K-P TO XI K, BUT A PERHAPS MORE LIKELY EXPLANATION OF THE DATA IS
        IN TERMS OF A SO FAR OTHERWISE UNOBSERVED RESONANCE HAVING SPIN
        LESS THAN 7/2.  THE SITUATION REMAINS TO BE CLARIFIED.

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Λ(2350)

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42  Y*0(2350, JP=    ) I=0

    DAUM 68 FAVORS JP=7/2- OR 9/2+.

                   42  Y*0(2350) MASS (MEV)     ---------------------------

M         2352.0      11.0           KYCIA     67 CNTR   K-P, D TCTAL      8/67
M         2340.0       7.0           BUGG      68 CNTR   K-P, D TOTAL      6/68*
M        . . . . . . . . . .
M   AVG   2343.4588   5.9056  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------   42  Y*0(2350) WIDTH (MEV)    ---------------------------

W          210.0     50.0            KYCIA     67 CNTR                     8/67
W          140.0     20.0            BUGG      68 CNTR                     6/68*
W        . . . . . . . . . .
W   AVG    149.6552  24.1379  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)

----------------   42  Y*0(2350) PARTIAL DECAY MODES     ------------------

                                                      DECAY MASSES
P1        Y*0(2350) INTO KBAR N                        497+ 939

----------------   42  Y*0(2350) BRANCHING RATIOS     ---------------------

R1        Y*0(2350) INTO (KBAR N)/TOTAL               (P1)/TOTAL
     J IS NOT KNOWN.  FOLLOWING IS (J+1/2)*(KBAR N)/TOTAL
R1          0.68      0.10           KYCIA     67 CNTR                     8/67
R1          0.57                     BUGG      68 CNTR                     6/68*

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                          REFERENCES -- Y*0(2350)

COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LECNTIC,LI,LUNDBY,+ (BNL) I
    --  SLIGHTLY REVISED RESULTS FROM KYCIA 67 REPLACE COOL 66 --
KYCIA    67 PRIVATE COMM.     T F KYCIA                           (BNL) I
BUGG     68 PR 168 1466       +GILMORE,KNIGHT, +    (RTHFD,BRMGHM,CVNDSH) I
DAUM     68 NP B7 19          +ERNE, LAGNAUX, SENS, STEUER, UDO    (CERN)JP

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Σ^+

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19  SIGMA +   (1189,JP=1/2+)  I=1

    SEE LISTINGS OF STABLE PARTICLES

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Σ^-

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20  SIGMA -   (1198,JP=1/2+)  I=1

    SEE LISTINGS OF STABLE PARTICLES

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Σ^0

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21  SIGMA 0   (1193,JP=1/2+)  I=1

    SEE LISTINGS OF STABLE PARTICLES

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Σ(1385)

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43  Y*1(1385, JP=3/2+) I=1

                    FOR THE TABLES WE USE ONLY THE UNSTARRED DATA, WHICH
                    ATTEMPTS TO OBTAIN THE SEPARATE CHARGE-STATE MASSES AN
                    WIDTHS.  SEE HOWEVER THE IDEOGRAMS INSERTED IN LISTING
   THESE INDICATE SERIOUS SYSTEMATICS, PERHAPS ARISING FROM INTERFERENCE E
   FECTS THAT CHANGE WITH PRODUCTION MECHANISM AND BEAM MOMENTUM.

----------------   43  Y*1(1385) MASS (MEV)     ---------------------------

M   *  141(1384.0)                   ALSTON    60 HBC  +- K-P 1.15 BEV/C
M   *   38(1384.0)                   MARTIN    61 HBC  O+ K20 P .98 BEV/C
M   *     (1385.0)                   BERGE     61 HBC  +- K-P .4-.85 BEV/C
M   *     (1392.0)     (7.0)         COLLEY    62 PBC  O- PI- PRP 2. BEV/C
MO  *  106(1381.0)     (4.0)         CURTIS    63 SPRK O  PI-P 1.5 BEV/C
M   *     (1392.0)    (10.0)         MUSGRAVE  65 HBC  +-OPBAR P 3-4 BEV/C  7/66
M   *     (1389.0)     (3.0)         BALTAY    65 HBC  +- PBAR P 3.7 BEV/C  7/66

M+     154 1376.0      3.0           ELY       61 PBC  +  K-P 1.11 BEV/C
M+     170 1375.0      3.9           COOPER    64 HBC  +  K-P 1.45 BEV/C
M+     859 1381.0      1.6           HUWE      64 HBC  +  K-P 1.22 BEV/C
M+         1382.0      1.0           ARMENTERO 65 HBC  +  K-P .9-1.2 BEV/C
M+         1382.6      1.4           SMITH     65 HBC  +  K-P 1.95 BEV/C    9/66
M+         1384.3      1.1           SMITH     65 HBC  +  K-P 1.8 BEV/C     9/66
M+      40 1383.0      2.0           BIRMINGHA 66 HBC  +   3.5 K- P         9/67
M+         1378.0      5.0           LONDON    66 HBC  +  K-P 2.24 BEV/C    7/66
M+        . . . . . . . . . .
M+  AVG    1382.2440   .7961  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
                  (SEE IDEOGRAM BELOW )
M-      93 1382.0      3.0           DAHL      61 DBC  -  K-D 0.45 BEV/C
M-     224 1376.0      3.0           ELY       61 PBC  -
M-     200 1392.0      6.2           COOPER    64 HBC  -
M-    1086 1385.3      1.5           HUWE      64 HBC  -
M-         1384.0      1.0           ARMENTERO 65 HBC  -
M-         1391.5      1.8           SMITH     65 HBC  -  K-P 1.8 BEV/C     9/66
M-         1399.8      1.4           SMITH     65 HBC  -  K-P 1.95 BEV/C    9/66
M-         1389.0      9.0           LONDON    66 HBC  -                    7/66
M-        . . . . . . . . . .
M-  AVG    1388.0068  3.0064  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 4.8)
                  (SEE IDEOGRAM BELOW )

----------------   43  Y*(-) - Y*(+) MASS DIFFERENCE (MEV)   -------------

D    R      (0.0)     (4.2)          ELY       61 PBC  +- K-P 1.11 BEV/C    8/66
D    R      (4.3)     (2.2)          HUWE      64 HBC  +- K-P 1.22 BEV/C    8/66
D    R      (2.0)     (1.5)          ARMENTERO 65 HBC  +- K-P .9-1.2 BEV/C  8/66
D    R      (7.2)     (2.1)          SMITH     65 HBC  +- K-P 1.8 BEV/C     9/66
D    R     (17.2)     (2.0)          SMITH     65 HBC  +- K-P 1.95 BEV/C    9/66
     R    REDUNDANT WITH DATA IN MASS LISTING.
D    R     (11.0)     (9.0)          LONDON    66 HBC  +- K-P 2.24 BEV/C    8/66
D            9.0       6.0           LONDON    66 HBC  +- LAMBDA 3 PI EVTS  7/66

----------------   43  Y*1(1385) WIDTH (MEV)    ---------------------------

W   *      (64.0)                    ALSTON    60 HBC  +-
W   *       20.0       OR LESS       MARTIN    61 HBC  O+
W   *      (40.0)                    BERGE     61 HBC  +-
W   *      (80.0)     (10.0)         COLLEY    62 PBC  O-
W   *      (30.0)      (9.0)         CURTIS    63 SPRK C
W   *      (38.0)      (9.0)         MUSGRAVE  65 HBC  +-0                  7/66
W   *      (26.0)      (5.0)         BALTAY    65 HBC  +-                   7/66

W+          48.0       8.0           ELY       61 PBC  +
W+          51.0      10.0           COOPER    64 HBC  +
W+          46.5       3.0           HUWE      64 HBC  +
W+          32.0       3.0           ARMENTERO 65 HBC  +
W+          30.3       3.1           SMITH     65 HBC  +  K-P 1.8 BEV/C     9/66
W+          33.1       3.8           SMITH     65 HBC  +  K-P 1.95 BEV/C    9/66
W+      40  25.0       6.0           BIRMINGHA 66 HBC  +   3.5 K- P         9/67
W+        . . . . . . . . . .
W+  AVG     35.9114   3.0978  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.1)
                  (SEE IDEOGRAM BELOW )
W           40.0                     DAHL      61 DBC  -
W-          66.0      10.0           ELY       61 PBC  -
W-          88.0      10.0           COOPER    64 HBC  -
W-          62.0       7.0           HUWE      64 HBC  -
W-          38.0       3.0           ARMENTERO 65 HBC  -
W-          29.2       5.7           SMITH     65 HBC  -  K-P 1.80 BEV/C    9/66
W-          17.1       4.4           SMITH     65 HBC  -  K-P 1.95 BEV/C    9/66
W-        . . . . . . . . . .
W-  AVG     37.6555   7.7088  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 3.7)
                  (SEE IDEOGRAM BELOW )
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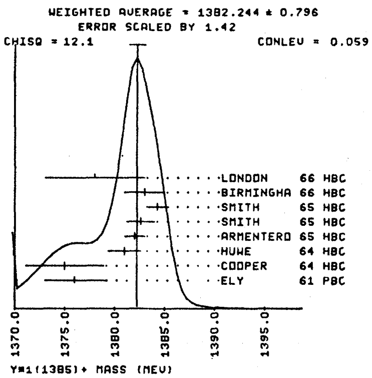
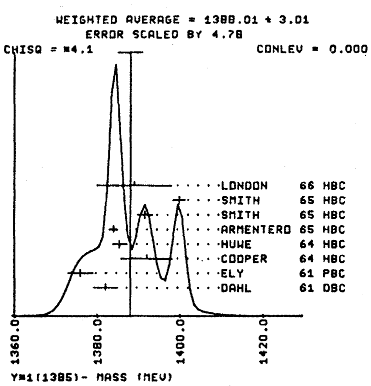
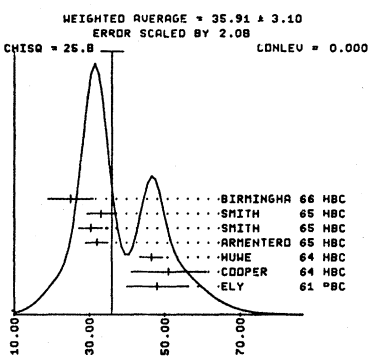
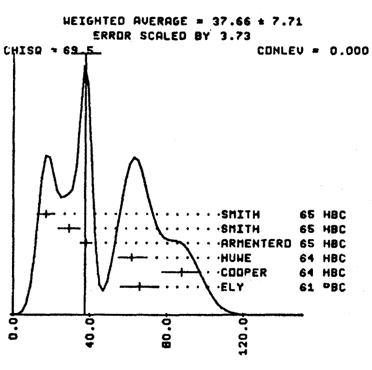
Data in parentheses have not been included in our averages.







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-----------------   43  Y*1(1385) PARTIAL DECAY MODES    ------------------

                                                              DECAY MASSES
P1        Y*1(1385) INTO LAMBDA PI                           1115+ 139
P2        Y*1(1385) INTO SIGMA PI                            1197+ 139

-----------------   43  Y*1(1385) BRANCHING RATIOS   ---------------------

R1        Y*1(1385) INTO (SIGMA PI)/(LAMBDA PI)              (P2)/(P1)
R1           0.04      0.04          BASTIEN   61 HBC  +-
R1   *       0.04        OR LESS     ALSTON    62 HBC  +-0
R1           0.09      0.04          HUWE      64 HBC  +-
R1           0.163     0.035         ARMENTERO 65 HBC  +-                  7/66
R1           0.08      0.06          LONDON    66 HBC  +                   7/66
R1        . . . . . . . . .
R1   AVG      .1009     .0284  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.4)
                       (SEE IDEOGRAM BELOW )

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                              REFERENCES -- Y*1(1385)

ALSTON   60 PRL 5 520         +ALVAREZ,EBERHARD,GOOD,GRAZIANO, +    (LRL) I
DAHL     61 PRL 6 142         +HORWITZ,MILLER,MURRAY,WHITE          (LRL)
MARTIN   61 PRL 6 283         +LEIPUNER,CHINOWSKY,SHIVELY, +   (BNL,YALE)
BERGE    61 PRL 6 557         +BASTIEN,DAHL,FERRO-LUZZI,KIRZ, +     (LRL)
BASTIEN  61 PRL 6 702         P BASTIEN,M FERRO-LUZZI,A H ROSENFELD (LRL)
ELY      61 PRL 7 461         +FUNG,GIDAL,PAN,POWELL,WHITE          (LRL) J

ALSTON   62 CERN CONF 311     +ALVAREZ,FERRO-LUZZI,ROSENFELD, +     (LRL)
COLLEY   62 PR 128 1930       +GELFAND,NAUENBERG, +    (CCLUMBIA,RUTGERS) JP
CURTIS   63 PR 132 1771       +COFFIN,MEYER,TERWILLIGER            (MICH) J
COOPER   64 PL 8 365          +FILTHUTH,FRIDMAN,MALAMUD, +   (CERN,AMSTR)
HUWE     64 UCRL-11291 THESIS D O HUWE                              (LRL) JP

MUSGRAVE 65 NC 35 735         +PETMEZAS,+ (BIRMGHM,CERN,EP,IMPCOL,SACLAY)
ARMENTER 65 PL 19 75          ARMENTEROS, +          (CERN,HEIDEL,SACLAY)
BALTAY   65 PR 140 B1027      +SANDWEISS,TAFT,CULWICK,KOPP, +  (YALE,BNL)
SMITH    65 THESIS (UCLA)     L T SMITH                            ( UCLA)

BIRMINGH 66 PR  152  1148     BIRMINGHAM,GLASGOW,I.C., O(FORDYRUTHERFORD)
LONDON   66 PR 143 1034       +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+  (BNL,SYCR) J

             QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

SHAFER   64 PR 134 B1372      J B SHAFER, D O HUWE                  (LRL) JP
MALAMUD  64 PL 10 145         E MALAMUD, P E SCHLEIN          (CERN,UCLA) JP

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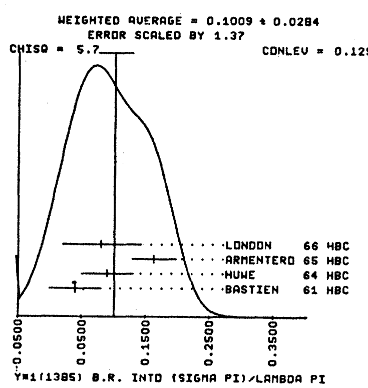

$\Lambda\pi$ Enhancement at 1440 MeV

The most plausible explanation of this enhancement is a kinematical effect. A Monte Carlo calculation of a double reaction process involving both nucleons of the deuteron generates a peak in the $\Lambda\pi$ mass plot at this value without invoking a $\Lambda\pi$ resonant state (ALEXANDER 68). The possibility of the kinematical origin of this peak was also pointed out by CLINE 68.

We omit this enhancement from the table until it is detected in an experiment other than K^-d.

BARYON RESONANCES

Data in parentheses have not been included in our averages.

Σ (1440)

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80  Y*1(1440,JP=    )  I=1

   EFFECT BEING A RESONANCE VERY MUCH IN DOUBT- SEE PRECEDING NOTE       11/68*

                    80  Y*1(1440)  MASS (MEV)

M        1440.                      CLINE     68 DBC    K-D TO LAM.PI P  11/68*

                    80  Y*1(1440)  WIDTH (MEV)

W          30.                      CLINE     68 DBC    K-D TO LAM.PI P  11/68*

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                         REFERENCES -- Y*1(1440)
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ALEXANDE 68 TO BE PUBLIS.     ALEXANDER,HALL,JEW,KALMUS,KERNAN  (LRL+UCR)
CLINE    68 PRL 21 1372       CLINE,LAUMANN,MAPP               (WISCONSIN)
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Σ (1610)

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78  Y*1(1610,JP=   -)  I=1   P11
    SEE NOTE PRECEDING Y*0(1670) LISTINGS

                    78  Y*1(1610) MASS  (MEV)   ---------------------------

M        66 1616.       8.           CRENNELL  68 HBC    OKP TO LAMBDA PI  11/68*
M    B     (1610.)                   ARMENTER1 68 HBC    OKP TO LAMBDA PI  11/68*
M    B   SOLUTION B OF THE ENERGY INDIPEND. ANALYSIS INCLUDES THIS STATE

-------------------    Y*1(1610) WIDTH (MEV)    ---------------------------

W    B      (60.)                    ARMENTER1 68 HBC    OK-P TO LAMBDA PI 11/68*
W        66  66.        16.          CRENNELL  68 HBC    OKP TO LAMBDA PI  11/68*
W    B   SOLUTICN B OF THE ENERGY INDIPEND. ANALYSIS INCLUDES THIS STATE

-------------------    Y*1(1610) PARTIAL DECAY NODES  ---------------------

                                                         DECAY MASSES
P1     Y*1(1610)   INTO KBAR N                            497+ 939
P2     Y*1(1610)   INTO LAMBDA PI                        1115+ 139
P3     Y*1(1610)   INTO Y*1(1385) PI                     1385+ 139

-------------------    Y*1(1610) BRANCHING RATIOS    ----------------------

R1     Y*1(1610) INTO (LAMBDA PI)/TOTAL                 (P2)/TOTAL
R1   *   66      DOMTNANT  MODE          CRENNELL  68 HBC    0                 11/68*

R2     Y*1(1610) INTO (KOBAR-P)/(LAMBDA PI)             (P1)/(P2)
R2          0.0       0.1                CRENNELL  68 HBC    0                 11/68*

R3     Y*1(1610) INTO (Y*1(1385) PI)/(LAMBDA PI)        (P3)/(P2)
R3          0.2       0.1                CRENNELL  68 HBC    0                 11/68*

R4      Y*1(1616) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2    (P2*P1)/TOTAL**2
R4          0.025                        ARMENTER1 68 HBC   OSOLUTION B        11/68*

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                         REFERENCES -- Y*1(1610)
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ARMENTE1 68 NP TOBE PUBLIS.   ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
CRENNELL 68 PRL 21 648        CRENNELL,DELANEY,FLAMINIO +      (BNL+CCNY)
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Σ (1650)

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79  Y*1(1650,JP=1/2-)  I=1  S11
    SEE NOTE PRECEDING Y*0(1670) LISTINGS

        ENERGY INDEPENDENT ANALYSIS OF LAPBDA PI CHANNEL BY
        CHS COLLABORATION INDICATES THE PRESENCE OF THIS .
        POSSIBLE STATE.

----------------       79 Y*1(1650)  MASS (MEV)    ------------------------

M        1650.                      ARMENTE1  68 HBC    0                 11/68*

----------------       79 Y*1(1650) WIDTH (MEV)    ------------------------

W         100.                      ARMENTE1  68 HBC    0 K-P TO LAMBDAPI 11/68*

----------------       79 Y*1(1650) PARTIAL DECAY MODES     ---------------

                                                         DECAY MASSES
P1      Y*1(1650) INTO KBAR N                             497+ 939
P2      Y*1(1650) INTO LAMBDA PI                         1115+ 139

                       Y*1(1650) BRANCHING RATIOS

R1      Y*1(1650) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2    (P2*P1)/TOTAL**2
R1            0.0676                ARMENTE1  68 HBC    0 K-P TO LAMBDAPI 11/68*

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                         REFERENCES -- Y*1(1650)
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ARMENTE1 68 NP TOBE PUBLIS.   ARMENTEROS,BAILLON +     (CERN+HEID+SACLAY)IJP
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Σ(1660)

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44  Y*1(1660, JP=3/2-) I=1   D13
    SEE NOTE PRECEDING Y*0(1670) LISTINGS

          THE Y*1(1660) HAS APPEARED IN BOTH FORMATION AND PRO-
          DUCTION EXPERIMENTS. THE PRESENT DATA ON FORMATION EX-
          PERIMENTS IS NOT SUFFICENT TO CLARIFY THE SITUATION OF
   THE I=1 STATE. PRODUCTION EXPERIMENTS HAVE SHOWN LARGE INCONSISTENCIES
   IN THE BRANCHING RATIOS (CHANGING WITH INCIDENT ENERGY). THE Y*(1690)
   MIGHT BE A SECOND I=1 STATE IN THIS ENERGY REGION. BRANCHING  RATIOS
   HOWEVER ARE NOT YET DISENTANGLED.
        AS FOR THE QUANTUM NUMBERS, THE ANALYSES OF LAMBDA PI CHANNEL (IN
   FORMATION EXP.) AND Y*0(1405)+PI CHANNEL (IN PROD. EXP.) ARE CONSISTENT
   WITH JP=3/2-. JP OF Y*1(1690) NOT YET KNOWN.

----------------    44  Y*1(1660) MASS (MEV)    ---------------------------

M           1685.0                    ALEXANDER 62 HBC  0- PI-P 2-2.2 BEV/C
M           1660.0     10.0           ALVAREZ   63 HBC  +  K-P 1.51 BEV/C
M           1660.0                    BERLEY    64 HBC  0  K-P TO LAM PIO    7/66
M           1645.0      7.0           LEVEQUE   65 HBC  +  K-P TO Y*1660 PI  7/66
M    S     (1668.)     (5.)           ARMENTER  68 HBC   0 K-P ELAS.+CH.EX  11/68*
M           1667.                     ARMENTE1  68 HBC    0 K-P TO LAMB.PI  11/68*
M    S     (1661.0)    (2.0)          ARMENTE2  68 HBC  0  K-P TO SIGMA PI  11/68*
M           1680.     10.             ARMENTE4  68 DBC     K-N TO SIG- PIO  12/68*
M           1665.0      5.0           BUGG      68 CNTR    K-P, D TCTAL C.S
M        70 1661.       9.            PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
M    S  SYSTEMATIC ERROR NOT INCLUDED . ONLY INCETERM. IN FIT QUOTED         6/68*
M           . . . . . . . . . .
M    AVG    1661.1452   5.0555   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)

----------------    44  Y*1(1660) WIDTH (MEV)    --------------------------

W            45.0                     ALEXANDER 62 HBC  0-
W            40.0      10.0           ALVAREZ   63 HBC  +
W            60.0                     BERLEY    64 HBC  0                    7/66
W            55.0      10.0           LEVEQUE   65 HBC  +                    7/66
W            56.       18.            ARMENTER  68 HBC   0 K-P ELAS.+CH.EX  11/68*
W            50.                      ARMENTE1  68 HBC    0 K-P TO LAMB.PI  11/68*
W    S      (44.0)     (4.0)          ARMENTE2  68 HBC   0 K-P TO SIGMA PI  11/68*
W            65.       20.0           ARMENTE4  68 DBC     K-N TO SIG- PIO  12/68*
W            30.0      15.0           BUGG      68 CNTR                     11/66
W        70  60.       20.            PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
W    S  SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED         6/68*
W           . . . . . . . . . .
W    AVG     48.2211    5.5444   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------    44  Y*1(1660) PARTIAL DECAY MODES    ------------------

                                                         DECAY MASSES
P1          Y*1(1660) INTO KBAR N                         497+ 939
P2          Y*1(1660) INTO LAMBDA PI                     1115+ 139
P3          Y*1(1660) INTO SIGMA PI                      1197+ 139
P4          Y*1(1660) INTO LAMBDA PI PI                  1115+ 139+ 139
P5          Y*1(1660) INTO SIGMA PI PI                   1197+ 139+ 139
P6          Y*1(1660) INTO Y*1(1385) PI                  1385+ 139
P7          Y*1(1660) INTO Y*0(1405) PI                  1405+ 139

----------------    44  Y*1(1660) BRANCHING RATIOS    ---------------------

R1          Y*1(1660) INTO (KBAR N)/TOTAL                (P1)/TOTAL
R1             0.05         OR LESS      ALVAREZ   63 HBC  + K-P AT 1.15 BEV/C
R1   B         0.16         OR MORE      BASTIEN 2 63 HBC  0
R1   B   ANALYSIS DID NOT INCLUDE I=0 RESONANT STATE Y*0(1690)             11/67
R1             0.2          OR LESS      LONDON    66 HBC  + K-P AT 2.25 BEV/C  7/66
R1             0.025                     BUGG      68 CNTR 0  ASSUMING J=3/2   11/66
R1             0.15    OR  LESS          PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*

R2          Y*1(1660) INTO (LAMBDA PI)/TOTAL             (P2)/TOTAL
R2             0.32                      ALVAREZ   63 HBC  + K-P AT 1.15 BEV/C
R2   B         0.09         OR LESS      BASTIEN 2 63 HBC  0 K-P TO LAP. PI
R2   B   ANALYSIS DID NOT INCLUDE I=0 RESONANT STATE Y*0(1690)             11/67
R2             0.2          OR LESS      LONDON    66 HBC  + K-P AT 2.25 BEV/C  7/66
R2             0.06      0.06            SMART     66 DBC  -  ASSUMING R1=0.15  7/66

R3          Y*1(1660) INTO (SIGMA PI)/TOTAL              (P3)/TOTAL
R3             0.27                      ALVAREZ   63 HBC  + K-P AT 1.15 BEV/C
R3   B        (0.22)    (0.06)           BASTIEN 2 63 HBC  0 K-P TO SIGMA PI
R3   B   ANALYSIS DID NOT INCLUDE I=0 RESONANT STATE Y*0(1690)             11/67
R3             0.25      0.15            LONDON    66 HBC  + K-P AT 2.25 BEV/C  7/66
R3   A    53  (0.63)    (0.20)           PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
R3   A      ASSUMING THAT P3 AND P7 ARE THE ONLY DECAY MODES OF Y*1(1660)      7/68*

R4          Y*1(1660) INTO (LAMBDA PI PI)/TOTAL          (P4)/TOTAL
R4             0.18                      ALVAREZ   63 HBC  + K-P AT 1.15 BEV/C
R4   B        (0.16)    (0.05)           BASTIEN 2 63 HBC  0
R4   B   ANALYSIS DID NOT INCLUDE I=0 RESONANT STATE Y*0(1690)             11/67
R4             0.2          OR LESS      LONDON    66 HBC  + K-P AT 2.25 BEV/C  7/66

R5          Y*1(1660) INTO (SIGMA PI PI)/TOTAL           (P5)/TOTAL
R5             0.18                      ALVAREZ   63 HBC  + K-P AT 1.15 BEV/C
R5   B        (0.25)    (0.06)           BASTIEN 2 63 HBC  0 K-P TO SIG PI PI
R5   A         0.14     OR  LESS         ARMENTE3  68 HBC     K-P AND D-P1=.09 11/68*
R5   A    RATIO ONLY FOR (SIG PI) SYSTEM IN I=1, WHICH CANNOT BE Y*1(1385)    11/68*
R5   B   ANALYSIS DID NOT INCLUDE I=0 RESONANT STATE Y*0(1690)             11/67

R6          Y*1(1660) INTO (Y*0(1405) PI)/TOTAL          (P7)/TOTAL
R6             0.75      0.25            LONDON    66 HBC  + K-P AT 2.25 BEV/C  7/66
R6             0.06     OR  LESS         ARMENTE3  68 HBC     K-P AND D-P1=.09 11/68*
R6   A    17  (0.37)    (0.15)           PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
R6   A      ASSUMING THAT P3 AND P7 ARE THE ONLY DECAY MODES OF Y*1(1660)      7/68*

R7          Y*1(1660) INTO (KBAR N)/(LAMBDA PI)          (P1)/(P2)
R7             0.43         OR MORE      SMITH     63 HBC  0-

R8          Y*1(1660) INTO (SIGMA PI)/(LAMBDA PI)        (P3)/(P2)
R8             0.86                      SMITH     63 HBC  0-
R8             6.8       3.0             HUWE      64 HBC  +

R9          Y*1(1660) INTO (LAMBDA PI PI)/(LAMBDA PI)    (P4)/(P2)
R9             0.14                      SMITH     63 HBC  0-

R10         Y*1(1660) INTO-(Y*0(1405) PI)/(SIGMA PI PI)  (P7)/(P5)
R10            0.90      0.10      0.16  EBERHARD  65      + K-P AT 2.45 BEV/C  7/66

R11         Y*1(1660) INTO (Y*0(1405) PI)/(Y*1(1385) PI)  (P7)/(P6)
R11            0.8          OR MORE      EBERHARD  65      + K-P AT 2.45 BEV/C  7/66

R12     Y*1(1660) IN  (LAMBDA PI PI)/(SIGMA PI PI)       (P4)/(P5)
R12            0.35      0.2             BIRMINGHA 66 HBC  +  K-P AT 3.5 GEV/C 11/67

R13     Y*1(1660) INTO (LAMBDA PI)/(SIGMA PI PI)         (P2)/(P5)
R13             .2    OR LESS            BIRMINGHA 66 HBC  +  K-P AT 3.5 GEV/C 11/67

R14     Y*1(1660) INTO (SIGMA PI)/(SIGMA PI PI)          (P3)/(P5)
R14             .4    OR LESS            BIRMINGHA 66 HBC  +  K-P AT 3.5 GEV/C 11/67

R15     Y*1(1660) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2     (P2*P1)/TOTAL**2
R15            0.0256                    ARMENTE1  68 HBC    0 K-P TO LAMB.PI  11/68*

R16     Y*1(1660) INTO (SIGMA PI)*(DBAR N)/TOTAL**2      (P3*P1)/TOTAL**2
R16            0.044      .004           ARMENTE2  68 HBC   0 K-P TO SIGMA PI  11/68*
R16            0.029                     BERLEY    68 HBC   0 K-P .6-.82 BEV/C 11/68*

R17     Y*1(1660) INTO Y*1(1385)*(KBAR N)/TOTAL**2       (P6*P1)/TOTAL**2
R17            0.031     0.006           SIMS      68 DBC   -                  11/68*

R18     Y*1(1660) INTO (Y*0(1405) PI)/(SIG PI)           (P7)/(P3)
R18            0.5     OR LESS           BERLEY    68 HBC   0 K-P .6-.82 BEV/C 11/68*

                  44  QUANTUM NUMBERS DETERMINATION

Q1   *               JP=3/2+             LEVEQUE   65 HBC     INTO Y*(1405)+PI 11/68*
Q1   *               JP=3/2-             SCHLEIN   66 DBC   0 INTO LAMBDA+PI   11/68*
Q1   *               JP=3/2-             EBERHARD  67 HBC  +  INTO Y*(1405)+PI 11/68*
Q1   *   400         JP=3/2-             BUTTON-SH 68 HBC  +- INTO SIGZERO+PI  11/68*

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                         REFERENCES -- Y*1(1660)
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ALEXANDE 62 CERN CONF 320      ALEXANDER,JACOBS,KALBFLEISCH,MILLER,+ (LRL) I
ALVAREZ  63 PRL 10 184         +ALSTON,FERRO-LUZZI,HUWE, +           (LRL) I
BASTIEN2 63 UCRL-10779 THESIS  P L BASTIEN                           (LRL) IJ
SMITH    63 ATHENS CONF 67     G A SMITH                             (LRL)
HUWE     64 UCRL-11291 THESIS  D O HUWE                              (LRL)
BERLEY   64 DUBNA CONF I 565   +CONNOLLY,HART,RAHM,STONEHILL, +      (BNL)IJP

EBERHARD 65 PRL 14 466         +SHIVELY,ROSS,SIEGAL,FICENEC, +   (LRL,ILL) I
LEVEQUE  65 PL 18 69            +       (SACLAY,EP,GLASGOW,IPPCOL,OXF,RTHFD) JP
BIRMINGH 66 PR  152  1148      BIRMING(AM,GLASGOW,I.C.Y OXFORDYRUOHERFORD)
LONDON   66 PR 143 1034        +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+  (BNL,SYCR) IJ
SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY (LRL)IJP
EBERHARD 67 PR 163 1446        +PRIPSTEIN,SHIVELY,KRUSE,SWANSON  (LRL,ILL)IJP
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Data in parentheses have not been included in our averages.


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ARMENTER 68 NP TO BE PUBLIS.   ARMENTEROS,BAILLCN +       (CERN+HEID+SACLAY)IJP
ARMENTE1 68 NP TOBE PUBLIS.    ARMENTEROS,BAILLON +       (CERN+HEID+SACLAY)IJP
  ALSO   67 NP 83 592          ARMENTEROS,FERRO-LUZZI+    (CERN,HEID,SACLAY)
ARMENTE2 68 PREPRINT           ARMENTEROS+BAILLCN +      (CERN+HEIDE+SACLAY)IJP
  ALSO 2 67 PL 24B 198         ARMENTEROS,FERRO-LUZZI+    (CERN,HEID,SACLAY)JP
ARMENTE3 68  VIENNA CONF       ARMENTEROS,BAILLON +       (CERN+HEID+SACLAY)I
ARMENTE4 68 VIENNA ABST 523    ARMENTEROS,BAILLON,MINTEN +    (CERN+SACLAY) J

BERLEY   68  VIENNA CONF       BERLEY,HART,RAHM,WILLIS,YAMAMOTO        (BNL)
BUGG     68 PR 168 1466        +GILMORE,KNIGHT,DAVIES+    (BIRMI,CAMB,RUTH)I
BUTTON-S 68 PRL 21 1123        J BUTTON SHAFER             (UNIV.MAS+LRL) JP
PRIMER   68 PRL 20 610         +GOLDBERG,JAEGER,BARNES,DORNAN +  (SYR,BNL)
SIMS     68 PRL 21 1413        SIMS,ALBRIGHT,BARTLEY,MEER+ (FLO+TAFTS+BRA)

                    PAPERS NOT REFERRED TO IN DATA CARDS.

BASTIEN1 63 PRL 10 188         P L BASTIEN, J P BERGE                (LRL) IJ
      -- REPLACED BY BASTIEN 2, BUT SIMILAR AND MORE READILY AVAILABLE.
T-ZADEH  63 PRL 11 470         TAHER-ZADEH,PROWSE,SCHLEIN,SLATER,+  (UCLA) JP
      -- SEE NOTE FOLLOWING SCHLEIN 66.
LEE      66 PRL 17 45          Y Y LEE, D D REEDER, R W HARTUNG     (WISC) JP
SCHLEIN  66 UCLA-1016          P E SCHLEIN, T G TRIPPE              (UCLA) JP
      -- REANALYZES DATA OF TAHER-ZADEH 63 AND BASTIEN 63 AND ALL PUBLISHED
         LAMBDA PI CROSS SECTION DATA IN THE LIGHT OF THE NOW KNOWN
         Y*1(1765) AND REVERSES THE MODEL-DEPENDENT CONCLUSION OF TAHER-
         ZADEH ON THE PREFERRED JP ASSIGNMENT (FROM 3/2+ TO 3/2-).

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Σ(1690)

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U58  Y*1(1690, JP=   ) I=1

SEE NOTE PRECEDING Y*1(1660) LISTINGS

    ENERGY INDEPENDENT PARTIAL WAVE ANALYSIS BY CHS COL
    LABORATION INDICATES THE PRESENCE OF A P13 STATE AT
    THIS ENERGY -WHETHER OR NOT  IT  HAS TO BE IDENTI-
    FIED WITH THE Y*1(1690) SEEN IN PRODUCTION EXPERI-
    MENTS IS NOT CLEAR YET.

                 58  Y*1(1690) MASS (MEV)    --------------------------

M       30 1715.0     12.0         COLLEY    67 HBC  +  K-P AT 6.0 GEV/C  8/67
M       53 1683.0     15.0         DERRICK   67 HBC  +  K-P AT 5.5 GEV/C  8/67
M          1660.                   ARMENTE1  68 HBC    OK-P TO LAMBDA PI 11/68*
M       60 1694.      24.          PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
M   S     (1700.)     (.           SIMS      68 DBC  -  INTO Y*1(1385)PI 11/68*
M   S  SIMS 68 SUGGEST JP=5/2+ FOR THIS STATE -NEEDS CONFIRMATION-        11/68*
M          . . . . . . . . . . .
M   AVG    1701.3862  10.4821  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)

---------------  58  Y*1(1690) WIDTH (MEV)   --------------------------

W       30  100.0     35.0         COLLEY    67 HBC  +  K-P AT 6.0 GEV/C  8/67
W       53  120.      30.          DERRICK   67 HBC  +  K-P AT 5.5 GEV/C  8/67
W            80.                   ARMENTE1  68 HBC    OK-P TO LAMBDA PI 11/68*
W       60  105.      35.          PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
W   S       (62.)     1(.          SIMS      68 DBC  -  INTO Y*1(1385)PI 11/68*
W   S  SIMS 68 SUGGEST JP=5/2+ FOR THIS STATE -NEEDS CONFIRMATION-        11/68*
W          . . . . . . . . . . .
W   AVG     109.5868  19.0909  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

---------------  58  Y*1(1690) PARTIAL DECAY MODES    -----------------

                                                      DECAY MASSES
P1   Y*1(1690) INTO KBAR N                           497+ 939
P2   Y*1(1690) INTO LAMBDA PI                       1115+ 134
P3   Y*1(1690) INTO SIGMA  PI                       1197+ 139
P4   Y*1(1690) INTO Y*1(1385) PI                    1385+ 139

----------------  58  Y*1(1690) BRANCHING RATIOS  --------------------

R1   Y*1(1690) INTO (LAMBDA PI)/(KBAR N)                (P2)/(P1)
R1     18    0.80      0.50        COLLEY    67 HBC  +  KO BAR FIN.STATE  8/67
R1     15    0.6       0.40        DERRICK   67 HBC  +  KO BAR FIN.STATE  8/67
R1  *     MAIN  DECAY  MODE        PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*
R1         . . . . . . . . . . .
R1  AVG         .6780     .3123  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

R2   Y*1(1690) INTO (SIGMA PI)/(LAMBDA PI)              (P3)/(P2)
R2           0.3       0.3         COLLEY    67 HBC  +  CHARG.SIGMA F.S.  8/67
R2           0.25   OR  LESS       DERRICK   67 HBC  +  NEUTR. SIGMA F.S  8/67

R3   Y*1(1690) INTO (Y*1(1385) PI)/(LAMBDA PI)          (P4)/(P2)
R3     14    1.0       0.3         DERRICK   67 HBC  +  LAMBDA 2PI F.S.   8/67
R3           0.49      0.29        COLLEY    67 HBC  +  LAMBDA 2PI F.S.   8/67
R3         . . . . . . . . . . .
R3  AVG         .7364     .2549  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.2)

R4    Y*1(1690) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2      (P2*P1)/TOTAL**2
R4           0.04                  ARMENTE1  68 HBC    OK-P TO LAMBDA PI 11/68*

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                         REFERENCES -- Y*1(1690)

COLLEY   67 PL 24B 489         +MACDONALD,MUSGRAVE+(BI,UG,IC,MPI,OXF,RUTH)
DERRICK  67 PRL 18 266         +FIELDS,LOKEN,AMMAR,DAVIS (ARGONNE,NORTHWE)
ARMENTE1 68 NP TOBE PUBLIS.    ARMENTEROS,BAILLCN +      (CERN+HEID+SACLAY)IJP
PRIMER   68 PRL 20 610         +GOLDBERG,JAEGER,BARNES,DORNAN +  (SYR,BNL)
SIMS     68 PRL 21 1413        SIMS,ALBRIGHT,BARTLEY,MEER+ (FLO+TAFTS+BRA)

                    PAPERS NOT REFERRED TO IN DATA CARDS

MEYER    67 HEIDELBERG CONF.  J MEYER - RAPPORTEUR ON BARYON RES.(SACLAY)

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Σ(1765)

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45  Y*1(1765, JP=5/2-) I=1  D15

45  Y*1(1765) MASS (MEV)    ---------------------------

M          1765.0      10.0         GALTIERI  63 DBC  O  K-D 1.51 BEV/C
M          1755.0      10.0         ARMENTER  65 HBC  O  K-P TO Y*1520 PI  7/66
M          1760.0      10.0         BELL 1    66 DBC  -  K-N TO Y*1520 PI  7/66
M          1746.0       8.0         FENSTER   66 HBC  O  K-P TO Y*1520 PI  9/66
M    N    (1758.0)    (11.0)        GELFAND   66 HBC   O K-P ELASTIC       8/67
M  S       1768.        2.          ARMENTER  68 HBC   O K-P ELAS.+CH.EX  11/68*
M          1768.0       4.0         BUGG      68 CNTR    K-P, D TCTAL     11/66
M    C    (1765.)      (3.)         CONFORTO  68 HBC   O  K-P ELASTIC     11/68*
M    S    (1775.0)     (7.0)        SMART     68 DBC   - K-N TO LAM.PI-    7/68*
M    C    FIT TO K-P ELAS. DIFFER. CROSS SECTICNS (PART OF DATA INCLUDED IN
M    C    ARMENTEROS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)
M    N       RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 68 FITS TO
M  S    SYSTEMATIC ERROR NOT INCLUDED -ONLY INDETERMINATICN OF FIT INCLUDED   7/68*
M          . . . . . . . . . . .
M   AVG    1766.3700    2.2458  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
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-----------------  45  Y*1(1765) WIDTH (MEV)   --------------------------

W            60.0      10.0            GALTIERI  63 DBC  O
W            70.0      20.0            BELL 2    66 DBC  -                   7/66
W            70.0      20.0            FENSTER   66 HBC  O                   9/66
W   N      (113.0)    (25.0)           GELFAND   66 HBC   O K-P ELASTIC      8/67
W           128.        8.             ARMENTER  68 HBC   O K-P ELAS.+CH.EX 11/68*
W           110.0       7.0            BUGG      68 CNTR    K-P,D TOTAL      7/68*
W   C      (112.)      (5.)            CONFORTO  68 HBC   O NOTE C IN MASS  11/68*
W   S      (146.0)     (9.0)           SMART     68 DBC   - K-N TO LAM.PI-   7/68*
W   S  SYSTEMATIC ERROR NOT INCLUDED . ONLY INDETERM. IN FIT QUOTED          6/68*
W   N       RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 67 FITS TO
W           . . . . . . . . . .
W   AVG     101.7946  13.0241  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.9)
                      (SEE IDEOGRAM BELOW )
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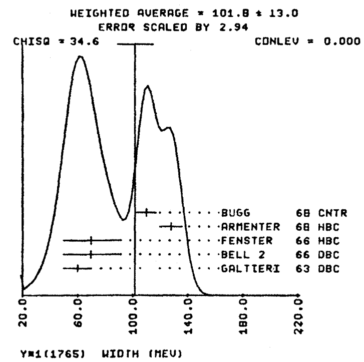


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-----------------  45  Y*1(1765) PARTIAL DECAY MODES  -------------------

                                                         DECAY MASSES
P1       Y*1(1765) INTO KBAR N                          497+ 939
P2       Y*1(1765) INTO LAMBDA PI                      1115+ 134
P3       Y*1(1765) INTO SIGMA PI                       1197+ 139
P4       Y*1(1765) INTO SIGMA ETA                      1192+ 548
P5       Y*1(1765) INTO Y*1(1385) PI                   1385+ 139
P6       Y*1(1765) INTO Y*0(1520) PI                   1518+ 139
P7       Y*1(1765) INTO SIGMA PI PI                    1197+ 139+ 139

-----------------  45  Y*1(1765) BRANCHING RATIOS   ---------------------

R1    Y*1(1765) INTO (KBAR N)/TCTAL                       (P1)/TOTAL
R1  *       (0.6)                   GALTIERI  63 HBC  O  K-P RVUE
R1  N       (0.46)    (0.05)        GELFAND   66 HBC   O K-P ELASTIC        8/67
R1           0.34                   KYCIA     67 CNTR    TOTAL CRCSS-SEC.   8/67
R1           0.53      0.09         UHLIG     67 HBC  O                     9/66
R1           0.45      0.01         ARMENTER  68 HBC   O K-P ELAS.+CH.EX   11/68*
R1           0.37                   BUGG      68 CNTR                      11/66
R1  C       (0.44)    (0.03)        CONFORTO  68 HBC   O NOTE C IN MASS    11/68*
R1  N     RES + DIFFRACTIVE BGD FOR K-P EL-- DATA ARE IN ARMENT 67 FITS TO
R1          . . . . . . . . . . .
R1  AVG       .4510     .0099  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R1  FIT       .455      .010    VALUE FROM CONSTRAINED FIT

R2    Y*1(1765) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2       (P2*P1)/TCTAL**2
R2           0.07      0.01         SMART     68 DBC                        7/68*
R2          . . . . . . . . . . .
R2  FIT       .069      .007    VALUE FROM CONSTRAINED FIT

R3    Y*1(1765) INTO (Y*0(1520) PI)*(KBAR N)/TOTAL**2   (P3*P1)/TOTAL**2
R3           0.075     0.015        ARMENTERC 65 HBC    OHYPERONS FIN.ST.  9/66
R3           0.12      0.03         FENSTER   66 HBC    OKBAR N  FIN. ST.  9/66
R3          . . . . . . . . . . .
R3  AVG       .0840     .0180  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.3)
R3  FIT       .068      .010    VALUE FROM CONSTRAINED FIT

R4    Y*1(1765) INTO (Y*1(1385) PI)*(KBAR N)/TOTAL**2   (P4*P1)/TOTAL**2
R4           0.09      0.03         ARMENTE2  67 HBC   O K-P TO LAM.PI PI   8/67
R4           0.105     0.040        SIMS      68 DBC   - K-N TO LAM.PI PI  11/68*
R4          . . . . . . . . . . .
R4  AVG       .0954     .0240  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)
R4  FIT       .068      .015    VALUE FROM CONSTRAINED FIT

R5    Y*1(1765) INTO (SIGMA PI)*(KBAR N)/TOTAL **2      (P5*P1)/TOTAL**2
R5           0.005     0.003        ARMENTERO 67 HBC   O K-P TO SIGMA PI    8/67
R5          . . . . . . . . . . .
R5  FIT       .005      .003    VALUE FROM CONSTRAINED FIT

R6    Y*1(1765) INTO (LAMBDA PI)/(KBAR N)                (P2)/(P1)
R6           0.33      0.05         UHLIG     67 HBC   O K-P,.9 GEV/C       9/66
R6          . . . . . . . . . . .
R6  FIT       .334      .035    VALUE FROM CONSTRAINED FIT

R7    Y*1(1765) INTO (Y*0(1520)/(KBAR N)                 (P3)/(P1)
R7           0.28      0.05         UHLIG     67 HBC   O K-P,.9 GEV/C       9/66
R7          . . . . . . . . . . .
R7  FIT       .327      .047    VALUE FROM CONSTRAINED FIT

R8    Y*1(1765) INTO (Y*1(1385)/(KBAR N)                 (P4)/(P1)
R8           0.25      0.09         UHLIG     67 HBC   O K-P,.9 GEV/C       9/66
R8          . . . . . . . . . . .
R8  FIT       .329      .071    VALUE FROM CONSTRAINED FIT

R9     Y*1(1765) INTO (SIGMA PI PI)/TOTAL                 (P7)/TOTAL
R9  C    ABOUT      0.12            ARMENTE3  68 HBC     K-P AND K-D       11/68*
R9  C    CCNSISTENT WITH (SIG 2PI) MODE OF Y*1(1385)+PI AND Y*0(1520)+PI

R9    Y*1(1765) INTO(SIGMA ETA)/TOTAL                    (P6)/TOTAL
R9          . . . . . . . . . . .
R9  FIT       .083      .044    VALUE FROM CONSTRAINED FIT
R9  FIT       .083      .044    VALUE FROM CONSTRAINED FIT

 THE FOLLOWING BRANCHING FRACTIONS HAVE CORRELATED ERRORS GREATER THAN .5

       P4 P6      -.756

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BARYON RESONANCES

Data in parentheses have not been included in our averages.

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                         REFERENCES -- Y*1(1765)

GALTIERI 63 PL 6 296.          A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP (LRL)IJ
ARMENTER 65 PL 19 338          ARMENTEROS, +       (CERN,HEIDELBERG,SACLAY)IJP
BELL 1   66 PRL 16 203         R B BELL, R W BIRGE, Y-L PAN, R T PU  (LRL)IJP
BELL 2   66 UCRL-16936 THESIS R B BELL                               (LRL)IJP
FENSTER  66 PRL 17 841         +GELFAND,HARMSEN,L-SETTI,+  (CHI,ARG(CERN))IJP
GELFAND  66 PRL 17 1224        +HARMSEN,LEVI-SETTI,PREDAZZI+ (EFINS,ARGON)
ALSO     68 PR 163 1792        LASINSKI,LEVI-SETTI,PREDAZZI         (EFINS)JP

ARMENTER 67 PL 248 198         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAYI)P
ARMENTE2 67 ZEIT.PHYS.202,486 ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)
KYCIA    67 PRIVATE COMM.      T F KYCIA                              (BNL) I
UHLIG    67 PR 155 1448        +CHARLTCN,CONDON,GLASSER,YCOH,+  (MD,USNRL)
ARMENTER 68 NP TO BE PUBLIS.  ARMENTEROS,BAILLON +      (CERN+HEID+SACLAY)IJP
    ALSO 67 NP B3 592          ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)IJP
ARMENTI3 68  VIENNA CONF       ARMENTEROS,BAILLON +      (CERN+HEID+SACLAY)I
BUGG     68 PR 168 1466        +GILMORE,KNIGHT,DAVIES+    (BIRMI,CAMB,RUTH)I
CONFORTO 68 EFI 68-62 NP TBP. B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)
SIMS     68 PRL 21 1413        SIMS,ALBRIGHT,BARTLEY,MEER+ (FLO+TAFTS+BRA)
SMART    68 PR 169 1330        W M SMART                             ( LRL)IJP
    ALSO 66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY (LRL)IJP

                PAPERS NOT REFERRED TO IN DATA CARDS.

YODH     65 ATHENS CONF 269   G B YODH                          (MARYLAND)IJ
BIRGE    65 ATHENS CONF 296   +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA, +  (LRL)IJP
    --  YODH 65 AND BIRGE 65 ARE PRECURSORS OF UHLIG 66 AND BELL 66.

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Σ (1780)

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                57  Y*1(1780, JP=    ) I=1

                SEE NOTE PRECEDING Y*0(1670) LISTINGS

                 A SIGMA ETA THRESHOLD EFFECT.  INTERPRETATION AS A
                 RESONANCE IS NOT CONCLUSIVE.  OMITTED FROM TABLE.
                 SEE FERRO-LUZZI 66.

-----------------  57  Y*1(1780) MASS (MEV)   --------------------------

M        1780.0                  CLINE      67 DBC  -  K-N TO SIG- ETA   9/66
M        1769.                   CONFORTI   68 HBC   0 K-P ELASTIC      11/68*

-----------------  57  Y*1(1780) WIDTH (MEV)  --------------------------

W         100.0                  CLINE      67 DBC  -                    9/66
W         123.                   CONFORTI   68 HBC   0 K-P ELASTIC      11/68*

-----------------  57  Y*1(1780) PARTIAL DECAY MODES   -----------------

                                                     DECAY MASSES
P1        Y*1(1780) INTO KBAR N                     497+ 939
P2        Y*1(1780) INTO SIGMA ETA                  1197+ 548

                 Y*1(1780) BRANCHING RATIOS

R1     Y*1(1780) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1          0.12                 CONFORTI   68 HBC   0 K-P ELASTIC      11/68*


                         REFERENCES -- Y*1(1780)

CLINE    67 PL 258 41         CLINE,OLSSON                      (WISCCNSIN)
CONFORT1 68  VIENNA CONF      CONFORTO,LEVI-SETTI,KLUGE+    (CHICAGO+HEID)

                 PAPERS NOT REFERRED TO IN DATA CARDS

FERRO-LU 66 BERKELEY 183      ARMENTEROS+FERRO-LUZZI+ (CERN,HEIDE,SACLAY)
MEYER    67 HEIDELBERG C. 117 J MEYER - RAPPORTEUR ON BARYON RES.(SACLAY)

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Σ (1880) P_{11}

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                67  Y*1(1880,JP=1/2+)  I=1
                SEE NOTE PRECEDING Y*0(1670) LISTINGS

                   PARTIAL WAVE ANALYSIS OF K-P TO LAMBDA PI DATA
                   REQUIRE A P11 AMPLITUDE AT THIS MASS. EXISTENCE
                   NOT CONCLUSIVELY ESTABLISHED.

----------------------  Y*1(1880)  MASS  (MEV)   -----------------------

M         1882.      40.          SMART      68 RVUE  -0 K-N TO LAM.PI    7/68*

----------------------  Y*1(1880)  WIDTH (MEV)   -----------------------

W          222.      150.         SMART      68 RVUE  -0 K-N TO LAM.PI    7/68*

----------------------  Y*1(1880)  PARTIAL DECAY MODES ------------------

                                                    . DECAY MASSES
P1    Y*1(1880) INTO KBAR N                           497+ 939
P2    Y*1(1880) INTO LAMBDA PI                        1197+ 139

----------------------  Y*1(1880)  BRANCHING RATIOS  --------------------

R1    Y*1(1880) INTO (LAMBDA PI)*(KBAR N)/ TOTAL**2     (P2)*(P1)/TCTAL**2
R1           0.012    0.007       SMART      68 RVUE  -0 K-N TO LAM.PI    7/68*

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                         REFERENCES -- Y*1(1880)

SMART    68 PR 169 1330       W M SMART                            (LRL)IJP

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Σ(1915) F_{15}

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               46  Y*1(1915, JP=5/2+) I=1

               SOME RESERVATION SHOULD BE HELD AGAINST COMPLETE
               ACCEPTANCE OF THE INTERPRETATION OF THIS EFFECT

-----------------  46  Y*1(1915) MASS (MEV)   --------------------------

M   *    (1942.0)    (9.0)        BOCK       65 HBC     PBAR P 5.7 BEV/C
M         1915.0     20.0         COOL       66 CNTR 0- K-P, D TOTAL      7/66
M         1905.0      5.0         BUGG       68 CNTR    K-P, D TOTAL     11/66
M         1902.0     11.0         SMART      68 RVUE  -0 K-N TO LAM.PI    7/68*
M         . . . . . . . . . .
M   AVG   1905.0041   4.4383   AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

-----------------  46  Y*1(1915) WIDTH (MEV)   -------------------------

W   *       (36.0)    (20.0)    (36.0)  BOCK      65 HBC
W            65.0                       COOL      66 CNTR 0-                     7/66
W            60.0      10.0             BUGG      68 CNTR                       11/66
W   C       (50.0)    (20.0)            ARMENTER1 67 HBC    OK-P EL. +CH.EXC.  11/67
W   C LACK OF DATA PREVENTS AUTHORS FROM DETERMINING UNAMBIG  THIS AMPLITU.  11/67
W            52.0      25.0             SMART     68 RVUE  -0 K-N TO LAM.PI     7/68*
W         . . . . . . . . . .
W   AVG     58.8966    9.2848  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

-----------------  46  Y*1(1915) PARTIAL DECAY MODES   -----------------

                                                         DECAY MASSES
P1        Y*1(1915) INTO KBAR N                         497+ 939
P2        Y*1(1915) INTO LAMBDA PI                      1115+ 139
P3        Y*1(1915) INTO SIGMA PI                       1197+ 139

-----------------  46  Y*1(1915) BRANCHING RATIOS   --------------------

R1         Y*1(1915) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1  *        (0.103)                    COOL      66 CNTR    ASSUMING J=5/2    7/66
R1            0.09                      KYCIA     67 CNTR    TOTAL CROSS-SEC.  8/67
R1  A        (0.12)     (.01)           ARMENTER1 67 HBC  0  K-P EL. +CH.EXC. 11/67
R1  A LACK OF DATA PREVENTS AUTHORS FROM DETERMINING UNAMBIG  THIS AMPLITU.  11/67
R1            0.06                      BUGG      68 CNTR    ASSUMING J=5/2    6/68*
R1  C        (0.10)    (0.01)           CONFORTO  68 HBC  0  K-P ELASTIC      11/68*
R1  C    FIT TO K-P ELAS. DIFFER. CROSS SECTIONS (PART OF DATA INCLUDED IN
R1  C    ARMENTEROS 68 WHICH FIT LEGEN. POLYN. COEFFICENTS)


R2      Y*1(1915) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2     (P1*P2)/TOTAL**2
R2  A        (0.006)                    ARMENTER1 67 HBC     OK-P TO LAM.PI   11/67
R2  A LACK OF DATA PREVENTS AUTHORS FROM DETERMINING UNAMBIG  THIS AMPLITU.  11/67
R2            0.006     0.003           SMART     68 RVUE  -0 K-N TO LAM.PI     7/68*

R3      Y*1(1915) INTO (SIGMA PI)*(KBAR N)/TOTAL**2      (P1*P3)/TOTAL**2
R3  C        (0.00)    (0.01)           ARMENTERO 67 HBC     K-P TO SIG+-PI-+ 11/67
R3  C LACK OF DATA PREVENTS AUTHORS FROM DETERMINING UNAMBIG  THIS AMPLITU.  11/67

R4      Y*1(1915)  INTO (LAMBDA PI)/TOTAL                 (P2)/TOTAL
R4  *   50     SEEN                     PRIMER    68 HBC  +  K-P 4.6-5. GEV/C  7/68*

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                        REFERENCES -- Y*1(1915)

BOCK     65 PL 17 166          +COOPER,FRENCH,KINSON, +       (CERN,SACLAY) I
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+ (BNL) I
SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY (LRL)IJP
ARMENTER 67 PL 248 198         ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)
ARMENTE1 67 NP B3 592          ARMENTEROS,FERRO-LUZZI+  (CERN,HEID,SACLAY)
KYCIA    67 PRIVATE COMM.      T F KYCIA                              (BNL) I

BUGG     68 PR 168 1466        +GILMORE,KNIGHT,DAVIES+    (BIRMI,CAMB,RUTH)I
CONFORTO 68 EFI 68-62 NP TBP. B.CONFORTO,HARMSEN+BURKHARDT+  (EFINS+HEID)
PRIMER   68 PRL 20 610         +GOLDBERG,JAEGER,BARNES,DORNAN +  (SYR,BNL)
SMART    68 PR 169 1330        W M SMART                              (LRL)

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Σ (2030)

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                 47  Y*1(2030, JP=7/2+) I=1

                 WOHL 66, SMART 68, AND DAUM 68 FIND JP=7/2+.

                 47  Y*1(2030) MÅSS (MEV)   .-------------------------

M   *    (2022.0)    (20.0)          BLANPIED  65 CNTR 0  GAMMA P TO K+ Y*
M   *    (2030.0)    (20.0)          WOHL      66 HBC  0  K-P TO LAM PIO     7/66
M         2026.0      19.0           KYCIA     67 CNTR    K-P, D TOTAL       8/67
M         2020.0       7.0           BUGG      68 CNTR    K-P, D TOTAL       6/68*
M         2032.0       6.0           SMART     68 RVUE    K-N TO LAM PI      6/68*
M         . . . . . . . . . .
M   AVG   2026.8678    4.4300  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  47  Y*1(2030) WIDTH (MEV)   --------------------------

W   *    (120.0)     (20.0)          BLANPIED  65 CNTR 0
W   *    (170.0)                     WOHL      66 HBC  0                     7/66
W         120.0       10.0           KYCIA     67 CNTR.                      8/67
W         130.0       10.0           BUGG      68 CNTR                       6/68*
W         160.0       16.0           SMART     68 RVUE    INCLUDES WOHL 66   6/68*
W         . . . . . . . . . .
W   AVG    130.7190    9.7049  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.5)

----------------  47  Y*1(2030) PARTIAL DECAY MODES   ------------------

                                                      DECAY MASSES
P1        Y*1(2030) INTO KBAR N                      497+ 939
P2        Y*1(2030) INTO LAMBDA PI                   1115+ 134
P3        Y*1(2030) INTO SIGMA PI                    1197+ 139
P4        Y*1(2030) INTO XI K                        1321+ 497

----------------  47  Y*1(2030) BRANCHING RATIOS   ---------------------

R1        Y*1(2030) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1  *      (0.25)                    WOHL      66 HBC  0  K-P CH EX          7/66
R1          0.105      0.005         KYCIA     67 CNTR                       8/67
R1          0.131                    BUGG      68 CNTR                       6/68*

R2    Y*1(2030) INTO (LAMBDA PI)*(KBAR N)/TOTAL**2       (P2)*(P1)/TOTAL**2
R2  *      (0.040)                   WOHL      66 HBC     K-P TO LAM PIO     7/66
R2          0.045      0.004         SMART     68 RVUE    INCLUDES WOHL      6/68*

R3        Y*1(2030) INTO SIGMA PI                        (P3)
R3            SEEN                   GALTIERI  68 HBC     K-P TO SIGMA PI  11/68*

R4    Y*1(2030) INTO (XI K)*(KBAR N)/TOTAL**2            (P4)*(P1)/TOTAL**2
R4          0.00256   OR LESS        TRIPP     67 RVUE                       8/67

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                       REFERENCES°-- Y*1(2030)

BLANPIED 65 PRL 14 741         +GREENBERG,HUGHES,KITCHING,LU,+ (YALE(CEA))
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+ (BNL) I
      --  SLIGHTLY REVISED RESULTS FROM KYCIA 67 REPLACE COOL 66 --
KYCIA    67 PRIVATE COMM.      T F KYCIA                             (BNL) I
WOHL     66 PRL 17 107         C G WOHL, F T SOLMITZ, M L STEVENSON  (LRL)IJP
TRIPP    67 NP B3 10           + LEITH, +     (LRL,SLAC,CERN,HEIDEL,SACLAY)
BUGG     68 PR 168 1466        +GILMORE,KNIGHT, +     (RTHFD,BRMGHM,CVNDSH) I
SMART    68 PR 169 1336        W M SMART                             (LRL)IJP
DAUM     68 NP B7 19           +ERNE, LAGNAUX, SENS, STEUER, UDO    (CERN)JP
GALTIERI 68 PRIVATE COMM.      L BARBARO-GALTIERI                    (LRL)

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Data in parentheses have not been included in our averages.

Σ (2250)

```
48  Y*1(2250, JP=    ) I=1
----------------- 48  Y*1(2250) MASS (MEV)   ---------------------------
M   *     (2245.0)                        BLANPIED  65 CNTR   GAMMA P TO K+ Y*
M   *     (2299.0)    (6.0)               BOCK      65 HBC    PBAR P 5.7 BEV/C
M          2252.0     10.0                KYCIA     67 CNTR   K-P, D TCTAL       8/67
M          2250.0      7.0                BUGG      68 CNTR   K-P, D TOTAL       6/68*
M          . . . . . . . . . .
M   AVG    2250.6577   5.7346  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------- 48  Y*1(2250) WIDTH (MEV)   --------------------------

W   *      (150.0)                        BLANPIED  65 CNTR
W   *       (21.0)    (17.0)    (21.0)    BOCK      65 HBC
W           200.0      20.0               KYCIA     67 CNTR                      8/67
W           230.0      20.0               BUGG      68 CNTR                      6/68*
W          . . . . . . . . . .
W   AVG     215.0000  15.0000  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

----------------- 48  Y*1(2250) PARTIAL DECAY MODES   ------------------

                                                        DECAY MASSES
P1         Y*1(2250) INTO KBAR N                      497+ 939
P2         Y*1(2250) INTO KBAR N PI                   497+ 939+ 139

----------------- 48  Y*1(2250) BRANCHING RATIOS   ---------------------

R1         Y*1(2250) INTO (KBAR N)/TOTAL                   (P1)/TOTAL
     J IS NOT KNOWN.  FOLLOWING IS (J+1/2)*(KBAR N)/TOTAL
R1            0.31      0.02              KYCIA     67 CNTR                      8/67
R1            0.47                        BUGG      68 CNTR                      6/68*

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                       REFERENCES -- Y*1(2250)

BLANPIED 65 PRL 14 741        +GREENBERG,HUGHES,KITCHING, +   (YALE(CEA))
BOCK     65 PL 17 166         +COOPER,FRENCH,KINSON, +      (CERN,SACLAY)
COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+ (BNL) I
     --  SLIGHTLY REVISED RESULTS FROM KYCIA 67 REPLACE COOL 66 --
KYCIA    67 PRIVATE COMM.     T F KYCIA                           (BNL) I
BUGG     68 PR 168 1466       +GILMORE,KNIGHT, +    (RTHFD,BRMGHM,CVNDSH) I

                 PAPER NOT REFERRED TO IN DATA CARDS.

DAUBER   66 PL 23 154         +SCHLEIN, SLATER, STORK, TICHO  (UCLA(LRL)) J
     --  SUGGESTS J=9/2 RESONANT BEHAVIOR IN SIGMA- PI+, BUT APPEARS
         INCONSISTENT WITH PARAMETERS OF COOL 66.

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Σ (2455)

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53  Y*1(2455, JP=    ) I=1

               ONE OF TWO NEW SMALL BUMPS IN THE I=1 TOTAL CRCSS
               SECTION (SEE THE Y*1(2595)). IT IS REASONABLE TO
               INTERPRET THEM AS RESONANCES, THOUGH THAT IS NOT
   CERTAIN.  THERE IS ALSO LESSER EVIDENCE FOR NEW STRUCTURE IN THE I=0
   CROSS SECTION -- SEE ABRAMS 67.
               THERE IS ALSO SOME SLIGHT EVIDENCE FCR Y* STATES IN
   THIS MASS REGION FROM THE REACTION GAMMA + P TO K+ + MISSING MASS --
   SEE GREENBERG 68.

                  53  Y*1(2455) MASS (MEV)   ---------------------------

M          2455.0     10.0                ABRAMS    67 CNTR   K-P, D TOTAL      11/67
M          2455.0      7.0                BUGG      68 CNTR   K-P, D TOTAL       6/68*
M          . . . . . . . . . .
M   AVG    2455.0000   5.7346  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------- 53  Y*1(2455) WIDTH (MEV)   --------------------------

W           140.0  APPROXIMATELY          ABRAMS    67 CNTR                     11/67
W           100.0     20.0                BUGG      68 CNTR                      6/68*

----------------- 53  Y*1(2455) PARTIAL DECAY MODES   ------------------

                                                        DECAY MASSES
P1         Y*1(2455) INTO KBAR N                      497+ 939

----------------- 53  Y*1(2455) BRANCHING RATIOS   ---------------------

R1         Y*1(2455) INTO (KBAR N)/TOTAL                   (P1)/TOTAL
     J IS NOT KNOWN.  FOLLOWING IS (J+1/2)*(KBAR N)/TOTAL
R1            0.26                        ABRAMS    67 CNTR                     11/67
R1            0.3                         BUGG      68 CNTR                      6/68*

****** ********* ********* ********* ********* ********* ********* ********

                       REFERENCES -- Y*1(2455)

ABRAMS   67 PRL 19 678        +COOL,GIACOMELLI,KYCIA,LECNTIC,LI, +  (BNL)
BUGG     68 PR 168 1466       +GILMORE,KNIGHT, +    (RTHFD,BRMGHM,CVNDSH) I
GREENBER 68 PRL 20 221        GREENBERG, HUGHES, LU, MINEHART, +   (YALE)

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Σ (2595)

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54  Y*1(2595, JP=    ) I=1
                  SEE NOTE UNDER THE Y*1(2455).

                  54  Y*1(2595) MASS (MEV)   ---------------------------

M          2595.0     10.0                ABRAMS    67 CNTR   K-P, D TOTAL      11/67

----------------- 54  Y*1(2595) WIDTH (MEV)   --------------------------

W           140.0  APPROXIMATELY          ABRAMS    67 CNTR                     11/67

----------------- 54  Y*1(2595) PARTIAL DECAY MODES   ------------------

                                                        DECAY MASSES
P1         Y*1(2595) INTO KBAR N                      497+ 939

----------------- 54  Y*1(2595) BRANCHING RATIOS   ---------------------

R1         Y*1(2595) INTO (KBAR N)/TOTAL                   (P1)/TOTAL
     J IS NOT KNOWN.  FOLLOWING IS (J+1/2)*(KBAR N)/TOTAL
R1            0.26                        ABRAMS    67 CNTR                     11/67

****** ********* ********* ********* ********* ********* ********* ********

                       REFERENCES -- Y*1(2595)

ABRAMS   67 PRL 19 678        +COOL,GIACOMELLI,KYCIA,LECNTIC,LI, +  (BNL)

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Σ (3000)

→

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59  Y*1(3000, JP=    ) I=1
    ENHANCEMENT IN LAMBDA PI AND KBAR N INVARIANT MASS
    SPECTRA AND IN MISSING MASS OF NEUTRALS RECOILING
    AGAINST K0.  EVIDENCE NOT CONCLUSIVE.  OMITTED FROM
    TABLE.

----------------- 59  Y*1(3000) MASS (MEV)   ---------------------------

M          3000.0                       EHRLICH   66 HBC  0  PI-P 7.91 BEV/C   9/66

----------------- 59  Y*1(3000) PARTIAL DECAY MODES   ------------------

                                                       DECAY MASSES
P1         Y*1(3000) INTO KBAR N                     497+ 939
P2         Y*1(3000) INTO LAMBDA PI                 1115+ 139

****** ********* ********* ********* ********* ********* ********* ********

                       REFERENCES -- Y*1(3000)

EHRLICH  66 PR 152 1194       R EHRLICH, W SELCVE, H YUTA     (PENN(BNL)) I

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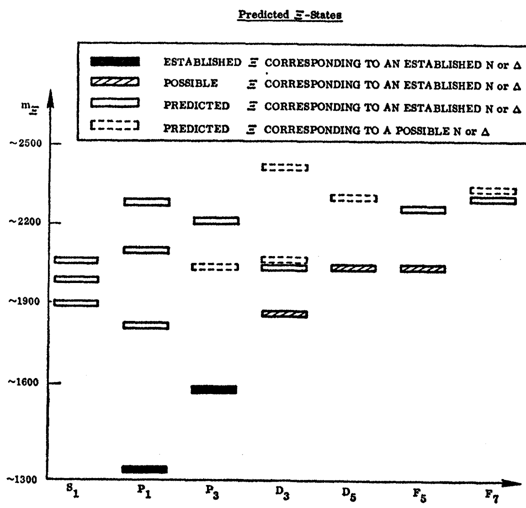
Note on Ξ's

This year, for the first time since 1966, there is significant new information on Ξ's. ALITTI 68 have given new information on the Ξ(1820), have confirmed the Ξ(1930), and have discovered a Ξ(2030). New information on the Ξ(1930) also has come from DAUBER 68. However, for none of these resonances is the spin-parity known, nor is there more than semiquantitative information on branching ratios. Only the other (and lowest-mass) Ξ resonance, the Ξ(1530), can be said to be well understood. The reason for this scarcity of information is of course that Ξ's cannot be produced in attainable s-channel formation experiments, and their production cross sections are very small.

SU(3) symmetry predicts that for each N and Δ there is a Ξ. We here reproduce a figure given by H. Harari, which shows the approximate spectrum to be expected from the known or suspected N and Δ states. The retarded state of information on Ξ's is evident; moreover Ξ's are so inaccessible that no rapid improvement is foreseen. Furthermore, when apparent discrepancies among experiments occur [for example, see the Ξ(1820) → Σ$\bar{K}$ decay branching ratio], it may mean only that the different experiments are seeing different Ξ's (or different mixtures of them) having about the same mass, and not that one or another of the experiments is wrong.

BARYON RESONANCES

Data in parentheses have not been included in our averages.



The predicted Ξ spectrum. The approximate mass scale is based on adding 300 to 350 MeV to the mass of the corresponding N or Δ state. This figure is taken from H. Harari (rapporteur talk, 1968 Vienna Conference, p. 195).

Ξ⁻

```
22  XI -     (1321,JP=1/2 )  I=1/2
SEE LISTINGS OF STABLE PARTICLES

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Ξ⁰

```
23  XI 0     (1314, JP=1/2 )  I=1/2
SEE LISTINGS OF STABLE PARTICLES

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Ξ(1530)

```
49  XI*1/2(1530, JP=3/2+) I=1/2

49  XI*1/2(1530) MASS (MEV)        -----------------------

M   *   (1529.0)   (5.0)          PJERROU   62 HBC  0- K-P 1.8 BEV/C
M   *   (1532.0)   (2.0)          BADIER    64 HBC  0- K-P 3 BEV/C
M-       1535.7     3.2           LONDON    66 HBC  -  K-P 2.24 BEV/C     7/66
MO       1528.7     1.1           LONDON    66 HBC  0                     7/66

----------------  49  XI*(-)-XI*(0) MASS DIFFERENCE (MEV)  ------------

D         5.7      3.0            PJERROU   65 HBC  0- K-P 1.8-1.95 B/C  7/66
D   R    (7.0)    (4.0)           LONDON    66 HBC  0-                    7/66
D   R   REDUNDANT WITH DATA IN MASS LISTING.
D         2.0      3.2            MERRILL   66 HBC  0- K-P 1.7-2.7 BE/C  7/66
D       . . . . . . . . . . .
D   AVG   3.9692   2.1886  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  49  XI*1/2(1530) WIDTH (MEV)  ---------------------

W         7.0      2.0            SCHLEIN   63 HBC  C  K-P 1.8-1.95 B/C
W         8.5      3.5            LONDON    66 HBC  0                     7/66
W         7.0      7.0            BERGE     66 HBC  0  K-P 1.5-1.7 BE/C  7/66
W       . . . . . . . . . . .
W   AVG   7.3478   1.6854  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  49  XI*1/2(1530) PARTIAL DECAY MODES  --------------

                                                   DECAY MASSES
P1        XI*1/2(1530) INTO XI PI                1321+ 139

****** ********* ********* ********* ********* ********* ********* ********

                       REFERENCES -- XI*1/2(1530)

PJERROU  62 PRL 9 114         +PROWSE,SCHLEIN,SLATER,STORK,TICHO   (UCLA) I
SCHLEIN  63 PRL 11 167        +CARMONY,PJERROU,SLATER,STORK,TICHO  (UCLA)IJP
BADIER   64 DUBNA I 593       +DEMOULIN,GOLDBERG, +     (EP,SACLAY,AMSTR) I
PJERROU  65 PRL 14 275        +SCHLEIN,SLATER,SMITH,STORK,TICHO    (UCLA)
LONDON   66 PR 143 1034       +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+  (BNL,SYCR) IJ
BERGE    66 PR 147 945        +EBERHARD,HUBBARD,MERRILL,B-SHAFER,+  (LRL) I
MERRILL  66 UCRL-16455 THESIS D W MERRILL                           (LRL) JP
SHAFER   66 PR 142 883        BUTTON-SHAFER,LINDSEY,MURRAY,SMITH    (LRL) JP
    --  A SPIN-PARITY DETERMINATION.

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Ξ(1700)

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51  XI*1/2(1700, JP=    ) I=1/2
EVIDENCE NOT COMPELLING.  OMITTED FROM TABLE.
——→
51  XI*1/2(1700) MASS (MEV)        ------------------------

M        1705.0        APPROX     SMITH    65 HBC  0- K-P 2.1-.7 BEV/C

----------------  51  XI*1/2(1700) WIDTH (MEV)  ------------------------

W          20.0        APPROX     SMITH    65 HBC  0-

----------------  51  XI*1/2(1700) PARTIAL DECAY MODES  ----------------

                                                      DECAY MASSES
P1        XI*1/2(1700) INTO XI PI                   1321+ 139
P2        XI*1/2(1700) INTO LAMBDA KBAR             1115+ 497

****** ********* ********* ********* ********* ********* ********* ********

                       REFERENCES -- XI*1/2(1700)

SMITH    65 ATHENS CONF 251   G A SMITH, J S LINDSEY              (LRL) I

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Ξ(1820)

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50  XI*1/2(1820, JP=    ) I=1/2

50  XI*1/2(1820) MASS (MEV)        -----------------------

M   *   (1770.0)                  HALSTEINS 63 FBC  C- K-FR 3.5 BEV/C
M        1817.0      7.0          SMITH 1   65 HBC  0- K-P 2.4-.7 BEV/C
M        1814.0      4.0          BADIER    65 HBC  0  K-P 3 BEV/C
M        1830.0     10.0          ALITTI    68 HBC  -  K-P 3.9-5 BEV/C  11/68*
M       . . . . . . . . . . .
M   AVG  1816.3811   3.4541  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

----------------  50  XI*1/2(1820) WIDTH (MEV)  ---------------------

W   *     80.0         OR LESS    HALSTEINS 63 FBC  0-
W         12.0     4.0            BADIER    65 HBC  0
W         30.0     7.0            SMITH 2   65 HBC  0-
W         60.0    35.0     20.0   ALITTI    68 HBC  -                  11/68*
W       . . . . . . . . . . .
W   AVG   17.1148  7.7226  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 2.2)

----------------  50  XI*1/2(1820) PARTIAL DECAY MODES  --------------

                                                    DECAY MASSES
P1        XI*1/2(1820) INTO LAMBDA KBAR           1115+ 497
P2        XI*1/2(1820) INTO XI PI                 1321+ 139
P3        XI*1/2(1820) INTO SIGMA KBAR            1197+ 497
P4        XI*1/2(1820) INTO XI*1/2(1530) PI       1530+ 139
P5        XI*(1820) INTO XI PI PI (XI PI NOT XI*(1530)) 1321+ 139+ 139

----------------  50  XI*1/2(1820) BRANCHING RATIOS  -----------------

R1        XI*1/2(1820) INTO (LAMBDA KBAR)/TOTAL       (P1)/TOTAL
R1          LARGE                 BADIER    65 HBC                       7/66
R1          LARGE                 SMITH 2   65 HBC                       7/66
R1           0.6                  ALITTI    68 HBC  -                  11/68*

R2        XI*1/2(1820) INTO (XI PI)/(LAMBDA KBAR)     (P2)/(P1)
R2          0.20     0.20         BADIER    65 HBC        .              7/66
R2          SMALL                 SMITH 2   65 HBC    IF XI*1933 EXIST  7/66
R2          SMALL                 ALITTI    68 HBC  -                  11/68*

R3        XI*1/2(1820) INTO (SIGMA KBAR)/TOTAL        (P3)/TOTAL
R3          0.02       OR LESS    TRIPP     67 RVUE                      8/67
R3          0.3                   ALITTI    68 HBC  -                  11/68*

R4        XI*1/2(1820) INTO (XI*(1530) PI)/(LAM KBAR)  (P4)/(P1)
R4          0.26     0.13         SMITH 1   65 HBC
R4          SMALL                 BADIER    65 HBC                       7/66

R5        XI*1/2(1820) INTO (XI PI PI)/(LAMBDA KBAR)  (P5)/(P1)
R5          0.1        OR MORE    SMITH 1   65 HBC
R5          SMALL                 BADIER    65 HBC                       7/66

R6        XI*1/2(1820) INTO (XI*1/2(1530) PI)/TOTAL   (P4)/TOTAL
R6          0.1                   ALITTI    68 HBC  -                  11/68*

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                       REFERENCES -- XI*1/2(1820)

HALSTEIN 63 SIENA CONF 173    HALSTEINSLID,+ (BERGEN,CERN,EP,RTHF,UNICOL) I
SMITH 1  65 PRL 14 25         +LINDSEY,BUTTON-SHAFER,MURRAY         (LRL)IJP
BADIER   65 PL 16 171         +DEMOULIN,GOLDBERG, +     (EP,SACLAY,AMSTR) I
SMITH 2  65 ATHENS CONF 251   G A SMITH, J S LINDSEY                (LRL)
TRIPP    67 NP B3 10          + LEITH, +   (LRL,SLAC,CERN,HEIDEL,SACLAY)
    --  USES DATA OF SMITH 1.
MERRILL  68 PR 167 1202       D W MERRILL, J BUTTON-SHAFER          (LRL)
    --  WEAK EVIDENCE CONCERNING JP.
ALITTI   68 VIENNA CONFERENCE +FLAMINIO,METZGER,RADOJICIC,+(BNL,SYRACUSE) I

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Ξ(1930)

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52  XI*1/2(1930, JP=    ) I=1/2

52  XI*1/2(1930) MASS (MEV)        -----------------------

M        35 1933.0     16.0          BADIER    65 HBC  0  K-P 3 BEV/C
M        19 1930.0     20.0          ALITTI    68 HBC  0  K-P 4.6-5 BEV/C  11/68*
M   *    66(1894.0)   (18.0)         DAUBER    68 HBC  -  K-P 2.7 BEV/C    11/68*
M          . . . . . . . . . . .
M   AVG     1931.8293  12.4939  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.0)

----------------  52  XI*1/2(1930) WIDTH (MEV)  ---------------------

W        35  140.0     35.0          BADIER    65 HBC  0
W        19   80.0     40.0          ALITTI    68 HBC  0                   11/68*
W   *    66  (98.0)   (23.0)         DAUBER    68 HBC  -                   11/68*
W          . . . . . . . . . . .
W   AVG      113.9823  29.7345  AVERAGE (ERROR INCLUDES SCALE FACTOR OF 1.1)

----------------  52  XI*1/2(1930) PARTIAL DECAY MODES  --------------

                                                      DECAY MASSES
P1        XI*1/2(1930) INTO XI PI                   1321+ 139
P2        XI*1/2(1930) INTO LAMBDA KBAR             1115+ 497

----------------  52  XI*1/2(1930) BRANCHING RATIOS  -----------------

R1        XI*1/2(1930) INTO XI PI                   (P1)
R1             SEEN                  BADIER    65 HBC  0
R1             SEEN                  ALITTI    68 HBC  0                   11/68*
R1             SEEN                  DAUBER    68 HBC  -                   11/68*

        LOOKED FOR BUT NOT SEEN IN OTHER CHANNELS.  SEE ALITTI 68.

****** ********* ********* ********* ********* ********* ********* ********
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BARYON RESONANCES

Data in parentheses have not been included in our averages.


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                                REFERENCES -- XI*1/2(1930)

BADIER   65 PL 16 171         +DEMOULIN,GOLDBERG, +       (EP,SACLAY,AMST) I
ALITTI   68 PRL 21 1119       +FLAMINIO,METZGER,RADOJICIC,+(BNL,SYRACUSE) I
DAUBER   68 PR (SUBMITTED)    +BERGE, HUBBARD, MERRILL, MULLER      (LRL) I
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Ξ (2030)

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                       68  XI*1/2(2030, JP=   ) I=1/2

                       68  XI*1/2(2030) MASS (MEV)     ------------------------

M         2030.0     10.0             ALITTI    68 HBC  -  K-P 3.9-5 BEV/C  11/68*

-----------------      68  XI*1/2(2030) WIDTH (MEV)     ----------------------

W           50.0     25.0     20.0    ALITTI    68 HBC  -                  11/68*

-----------------      68  XI*1/2(2030) PARTIAL DECAY MODES     ---------------

                                                         DECAY MASSES
P1        XI*1/2(2030) INTO XI PI                       1321+ 139
P2        XI*1/2(2030) INTO LAMBDA KBAR                 1115+ 497
P3        XI*1/2(2030) INTO SIGMA KBAR                  1197+ 497
P4        XI*1/2(2030) INTO XI*1/2(1530) PI             1530+ 139

-----------------      68  XI*1/2(2030) BRANCHING RATIOS     -----------------

R1        XI*1/2(2030) INTO (XI PI)/TOTAL               (P1)/TOTAL
R1          SMALL                     ALITTI    68 HBC  -                  11/68*

R2        XI*1/2(2030) INTO (LAMBDA KBAR)/TOTAL         (P2)/TOTAL
R2            0.5                     ALITTI    68 HBC  -                  11/68*

R3        XI*1/2(2030) INTO (SIGMA KBAR)/TOTAL          (P3)/TOTAL
R3            0.5                     ALITTI    68 HBC  -                  11/68*

R4        XI*1/2(2030) INTO (XI*1/2(1530) PI)/TOTAL     (P4)/TOTAL
R4          SMALL                     ALITTI    68 HBC  -                  11/68*

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                                REFERENCES -- XI*1/2(2030)

ALITTI   68 VIENNA CONFERENCE +FLAMINIO,METZGER,RADOJICIC,+(BNL,SYRACUSE) I
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Ω^-

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                       24  OMEGA -  (1675, JP=3/2+)  I=0

                       SEE LISTINGS OF STABLE PARTICLES

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APPENDIX I. Test of $\Delta I = 1/2$ Rule for K Decays

The quantities of interest for making tests of theoretical predictions regarding K decay are usually partial decay rates for single channels or special sums of channels. It is not possible to compute the errors on sums, difference, and ratios of partial decay rates from the information given in Table S because of the presence of off-diagonal terms in the error matrix. For this reason we give some of these quantities below.

Table I.

$\Gamma_{K^+_{\ell 3}} = \Gamma_{K^+_{e3}} + \Gamma_{K^+_{\mu 3}}$	$= (6.51 \pm .15) \times 10^6\ \text{sec}^{-1}$
$\Gamma_{K^+_\tau} - \Gamma_{K^+_{\tau'}}$	$= (3.14 \pm .05) \times 10^6\ \text{sec}^{-1}$
$\Gamma_{K^+_{\mu 3}} / \Gamma_{K^+_{e3}}$	$= 0.66 \pm .02$
$\Gamma_{K^+_\tau} / \Gamma_{K^+_{\tau'}}$	$= 3.28 \pm .09$
$\Gamma_{K^0_{\ell 3}} = \Gamma_{K^0_{e3}} + \Gamma_{K^0_{\mu 3}}$	$= (12.24 \pm 0.46) \times 10^6\ \text{sec}^{-1}$
$\Gamma_{K^0_{\mu 3}} / \Gamma_{K^0_{e3}}$	$= 0.75 \pm 0.04$
$\Gamma_{K^0_{\pi^0\pi^0\pi^0}} / \Gamma_{K^0_{\pi^+\pi^-\pi^0}}$	$= 1.70 \pm 0.07$

The $\Gamma_{K_{\ell 3}}$ rates are useful in testing the leptonic $\Delta I = 1/2$ rule in the way suggested by Trilling.[1] The predictions are

$$\Gamma_{K^0_{\ell 3}} / 2\Gamma_{K^+_{\ell 3}} = 1.01, \text{ a phase-space factor,}^{2}$$

and

$$\Gamma_{K^0_{\mu 3}} / \Gamma_{K^0_{e3}} = \Gamma_{K^+_{\mu 3}} / \Gamma_{K^+_{e3}} .$$

From Table I,

$$\Gamma_{K^0_{\ell 3}} / 2\Gamma_{K^+_{\ell 3}} = 0.94 \pm 0.04$$

and

$$\frac{\Gamma_{K^0_{\mu 3}}}{\Gamma_{K^0_{e3}}} \left[\frac{\Gamma_{K^+_{\mu 3}}}{\Gamma_{K^+_{e3}}} \right]^{-1} = 1.14 \pm 0.07.$$

These results seem to show a less than 2σ disagreement with the predictions, but the errors should be regarded with caution in view of the internal disagreements in the data. (Note the ideograms in the data listing for the charged K meson.)

The three pion ratios may be used in the following tests of the $\Delta I = 1/2$ rule:

$$R_1 = \frac{2}{3} \frac{\Gamma_{K^0_{\pi^0\pi^0\pi^0}}}{\phi_1} \left[\frac{\Gamma_{K^0_{\pi^+\pi^-\pi^0}}}{\phi_2} \right]^{-1} = 1,$$

$$R_2 = \frac{1}{4} \frac{\Gamma_{K^+_\tau}}{\phi_3} \left[\frac{\Gamma_{K^+_{\tau'}}}{\phi_4} \right]^{-1} = 1,$$

$$R_3 = \frac{1}{2} \frac{\Gamma_{K^0_{\pi^+\pi^-\pi^0}}}{\phi_2} \left[\frac{\Gamma_{K^+_{\tau'}}}{\phi_4} \right]^{-1} = 1,$$

$$R_4 = \frac{\Gamma_{K^0_{\pi^0\pi^0\pi^0}}}{\phi_1} \left[\frac{\Gamma_{K^+_\tau}}{\phi_3} - \frac{\Gamma_{K^+_{\tau'}}}{\phi_4} \right]^{-1} = 1,$$

where the ϕ_i are phase-space factors. They have been calculated by Trilling (UDP),[1] assuming uniform Dalitz plot distributions for the three pions, and by Devlin and Barshay (NUDP),[3] including the mass differences between the pions and the observed slopes for the Dalitz plot distributions. These values are

	Method	
	UDP	NUDP
ϕ_1	1.495	1.480
ϕ_2	1.225	1.310
ϕ_3	1.000	1.000
ϕ_4	1.248	1.210

The corresponding values of the ratios are

	Method	
	UDP	NUDP
R_1	0.93 ± 0.04	1.00 ± 0.04
R_2	1.02 ± 0.03	0.99 ± 0.03
R_3	0.87 ± 0.04	0.79 ± 0.04
R_4	0.79 ± 0.04	0.80 ± 0.04

For the first two ratios there seems to be good agreement with the predictions of the $\Delta I = 1/2$ rule. For R_3 and R_4 the disagreement seems to be significant. This would indicate that a $\Delta I = 3/2$ transition is present in $K \to 3\pi$ decay.

FOOTNOTES

1. G. Trilling, K-Meson Decays, UCRL-16473 (updated from Argonne Conference Proceedings, 1965, p. 115).
2. N. Brene (CERN), private communication. In our Jan. 1968 edition we had erroneously used 1.04.
3. T. Devlin and S. Barshay, Phys. Rev. Letters 19, 881 (1967).

APPENDIX II. (C. Zemach)

Selection Rules for Meson Decays

Some considerations related to quantum number assignments are sketched here with emphasis on points that sometimes cause uncertainty.

A1. C, P, and G for Decays into Particle-Antiparticle

The reasoning behind Eqs. (8) through (12) of the text is presented here in more detail.

First consider boson-antiboson ($\bar{b}b$) and fermion-antifermion ($\bar{f}f$) states, where $\bar{b}$ and $\bar{f}$ are the antiparticles of the b and f respectively. Later, as in Section A4, we suppose that b, f are members of isotopic multiplets, and that $\bar{b}, \bar{f}$ are any members of the antiparticle multiplets.

The properties C and P for particle-antiparticle states are determined by the relation of states to the field operators that create the particles out of the vacuum, and to their commutation properties.

Any state may be represented as a superposition of free particle states. Let $\psi_\alpha^N(\underset{\sim}{x})$ be the field operator which, acting upon the vacuum state Ψ_{vac}, creates a free particle at position $\underset{\sim}{x}$ with spin component α and particle number N (where N = +1 for particle, N = -1 for antiparticle). The state Ψ containing, among other things, two particles of this field is given by

$$\Psi = \left[\sum_{\alpha,\beta} \int d\underset{\sim}{x} d\underset{\sim}{y} \int f_{\alpha,\beta}^{N,M}(\underset{\sim}{x}, \underset{\sim}{y}, \cdots) \times \psi_\alpha^N(\underset{\sim}{x}) \psi_\beta^M(\underset{\sim}{y}) \cdots \right] \Psi_{vac} + \cdots . \quad (A1)$$

(The dots inside the bracket refer to other particles and the dots outside the brackets refer to possible admixture of states with other numbers of particles of the ψ field. For simplicity, ignore these notational complications.) The wave function f, by its dependence on $\underset{\sim}{x}, \underset{\sim}{y}$ and α, β may specify a definite orbital angular momentum ℓ, with orbital parity $(-1)^\ell$, and total spin S. The behavior of Ψ under particle exchange X, parity P, and charge conjugation C is determined by the behavior of the field operators.

For spin zero,

(a) $\psi^{-1}(\underset{\sim}{x}) = (\psi^{+1}(\underset{\sim}{x}))^\dagger$ ($\dagger$ = adjoint),

(b) $\psi^N(\underset{\sim}{x})$ and $\psi^M(\underset{\sim}{y})$ commute*,

(c) $P\psi^N(\underset{\sim}{x}) = \eta_P \psi^N(-\underset{\sim}{x})$ ($\eta_P = \pm 1$ = intrinsic parity),

(d) $C\psi^N(\underset{\sim}{x}) = \eta_C \psi^{-N}(\underset{\sim}{x})$ ($\eta_C = \pm 1$ = intrinsic charge-conjugation number)

*In the commutation or anticommutation of ψ^{+1} and ψ^{-1}, a δ function of $\underset{\sim}{x}-\underset{\sim}{y}$ also enters, but this will not affect the explicitly written parts of Eq. (A1), and we ignore it.

For spin 1/2, we use the following representation of the Dirac γ matrices

$$\gamma_0 = \begin{vmatrix} \underset{\sim}{1} & 0 \\ 0 & -\underset{\sim}{1} \end{vmatrix}, \quad \gamma_k = \begin{vmatrix} 0 & \underset{\sim}{\sigma}_k \\ -\underset{\sim}{\sigma}_k & 0 \end{vmatrix}, \qquad (A2)$$

and, also

$$\overline{\psi} = \psi^\dagger\gamma_0 = \gamma_0\psi^\dagger. \qquad (A3)$$

If ψ^{+1} is the field operator for a particle, and ψ^{-1} is the field operator for its antiparticle, then ψ^{-1} is charge conjugation upon ψ^{+1} and with representation (A2),

(a') $\psi^{-1} = i\gamma_0\gamma_2\overline{\psi^{+1}}$,

which, by (A3), is equivalent to

(a'') $\psi^{-1} = -i\gamma_2(\psi^{+1})^\dagger$.

(b') $\psi^N(\underset{\sim}{x})$ and $\psi^M(\underset{\sim}{y})$ anticommute.*

Under parity, $\psi(\underset{\sim}{x})$ transforms into $\gamma_0\psi(-\underset{\sim}{x})$,
$\overline{\psi}(x)$ transforms into $\gamma_0\overline{\psi}(-\underset{\sim}{x})$.

Introducing an intrinsic parity $\eta_P = \pm 1$ for particles, we write

(c') $P\psi^{+1}(\underset{\sim}{x}) = \eta_P\gamma_0\psi^{+1}(-\underset{\sim}{x})$,

but the equivalent expression (c'') for antiparticles has a factor of -1.§ In fact, operating with P on (a'), and using (c'), then (A3), then $\gamma_0^2 = 1$, then (a''), we have

(c'') $P\psi^{-1}(\underset{\sim}{x}) = -\eta_P\gamma_0\psi^{-1}(-\underset{\sim}{x})$.

Next consider charge conjugation. Again there is an intrinsic charge conjugation number $\eta_C = \pm 1$, so we write

(d') $C\psi^{+1}(\underset{\sim}{x}) = \eta_C\psi^{-1}(\underset{\sim}{x})$.

Unlike the parity case there is no factor of -1 in Eq. (d'') for antiparticles, but simply

(d'') $C\psi^{-1}(\underset{\sim}{x}) = \eta_C\psi^{+1}(\underset{\sim}{x})$.

(To get d'' from d' use $\gamma_2^2 = -1$, $\gamma_2^\dagger = -\gamma_2$, $\gamma_2^{\text{transpose}} = +\gamma_2$.)

For spin > 1/2, we assert that the conclusions below for spin 0 are valid for bosons in general, and the conclusions for spin 1/2 are valid for fermions.

With Eqs. (a) through (d), or their primed equivalents, the effects of P and C operations on a particle-antiparticle state in Eq. (A1) are easily computed when the state carries definite ℓ and S. Interchanging space coordinates in the center of mass yields

$$f(\underset{\sim}{y}, \underset{\sim}{x}) = f(-\underset{\sim}{x}, -\underset{\sim}{y}) = (-1)^\ell f(\underset{\sim}{x}, \underset{\sim}{y}).$$

Exchanging spins introduces a sign X_S,

$$f_{\alpha\beta} = X_S f_{\beta\alpha},$$

with $X_S = (-1)^S$ for integral spins (A4)
and $\quad = (-1)^{S+1}$ for half-integral spins. (A5)

Operating with C, we get

$$C\Psi_{f\bar{f}} = \int d\underset{\sim}{x}d\underset{\sim}{y}\, f^{+1,-1}_{\alpha\beta}(\underset{\sim}{x},\underset{\sim}{y})C\psi^{+1}_\alpha(\underset{\sim}{x})C\psi^{-1}_\beta(\underset{\sim}{y})\Psi_{vac}$$
$$= \int d\underset{\sim}{x}d\underset{\sim}{y}\, f^{+1,-1}_{\alpha\beta}(\underset{\sim}{x},\underset{\sim}{y})\psi^{-1}_\alpha(\underset{\sim}{x})\psi^{+1}_\beta(\underset{\sim}{y})\Psi_{vac}.$$

Commuting the ψ's for fermions yields the crucial factor of -1, i.e.

$$= -\int d\underset{\sim}{x}d\underset{\sim}{y}\, f^{+1,-1}_{\alpha\beta}(\underset{\sim}{x},\underset{\sim}{y})\psi^{+1}_\beta(\underset{\sim}{y})\psi^{-1}_\alpha(\underset{\sim}{x})\Psi_{vac}.$$

We can then interchange the variables $\underset{\sim}{x}, \underset{\sim}{y}$ and α, β to relabel the ψ's as in (A1),

$$= -\int d\underset{\sim}{y}d\underset{\sim}{x}\, f^{+1,-1}_{\beta\alpha}(\underset{\sim}{y},\underset{\sim}{x})\psi^{+1}_\alpha(\underset{\sim}{x})\psi^{-1}_\beta(\underset{\sim}{y})\Psi_{vac}.$$

Thus the net effect of C on $f_{\alpha\beta}(\underset{\sim}{x},\underset{\sim}{y})$ is equivalent to space and spin exchange times minus one. Using (A4) and (A5) we get text Eq. (11a),

$$C(f\bar{f}) = (-1)^{\ell+S}(f\bar{f}). \qquad (A6)$$

Similarly we can get Eq. (12),

$$P(f\bar{f}) = -(-1)^\ell (f\bar{f}). \qquad (A7)$$

Once we have worked through the above for $f\bar{f}$, we can even more easily see that for $b\bar{b}$ we get the same equation, numbered (8a) in the text,

$$C(b\bar{b}) = (-1)^{\ell+S}(b\bar{b}), \qquad (A8)$$

and for parity,

$$P(b\bar{b}) = (-1)^\ell (b\bar{b}). \qquad (A9)$$

§This point has been verified experimentally in the $\gamma\gamma$ decay of $^1S_0$ positronium; see C. S. Wu and I. Shaknow, Phys. Rev. 77, 136 (1950).

In summary we can restate the words above (A6) as follows. By using commutation for bosons (or anticommutation for fermions) we have generalized to particle-antiparticle pairs the familiar rules for the exchange of bosons,

$$X = X_r C X_s = +1, \tag{7}$$

and fermions,

$$X = X_r C X_s = -1. \tag{10}$$

A2. Extended Statistics

A state of N different particles can be described by a wave function $\phi(x_1, x_2, x_3, \cdots)$ supplemented by an ordering convention that the first coordinate stands for particle 1, the second for particle 2, etc. Alternatively, we may introduce a type variable t, which takes on discrete values labeling the different particles, and consider functions $\phi(x_1, t_1; x_2, t_2; \cdots)$ in the enlarged set of variables. Then there is no need for an ordering convention. Each physical state is described by N! different functions, obtained by the N! permutations of the arguments (x_i, t_i), $i = 1, 2, \cdots N$. To remove the ambiguity, we may require that only the function completely symmetric (or antisymmetric) under interchange of x and t be used to represent a state. If the particles are all bosons (fermions) and the restriction that the particles are all different is dropped, then clearly the choice of symmetry (antisymmetry) is appropriate, as the requirement of ordinary Bose (Fermi) statistics is imposed when, and only when, it is applicable.

So far, this procedure is purely formal. It becomes useful if the interaction among the particles is symmetric. Then an initially symmetric or antisymmetric state remains so automatically, even if the dynamics transforms one type of particle into another. Thus, e.g., the combined implications of statistics and isospin invariance for a multipion state can be most efficiently realized when the state is regarded as completely symmetric under simultaneous interchange of space and isospin coordinates.

A3. On Isotopic Spin

The incorporation of sets of elementary particles into isotopic multiplets with definite phase relationships follows from, by now, standard expressions for the interactions, e.g., $\overline{N}\gamma_5 \underline{\tau} N \cdot \pi$, $\overline{N}_\alpha \gamma_5 \Lambda K_\alpha$, etc. Let the proton and neutron operators transform under C like $C\,p = i\gamma_0\gamma_2\overline{p}$ and $C\,n = i\gamma_0\gamma_2\overline{n}$, i.e., same intrinsic C for p and n assumed. Then, under C, $\overline{N}\tau_i N$ transforms into itself for $i = 1, 3$ and into its own negative for $i = 2$. Thus (π_1, π_2, π_3) is an isovector in (Cartesian) three-space and for C invariance of the interaction, must have the C properties

$$C(\pi_1) = +\pi_1,\ C(\pi_2) = -\pi_2,\ C(\pi_3) = +\pi_3.$$

In terms of the convention for charged pions,

$$\pi^+ = (\pi_1 + i\pi_2)/\sqrt{2},\ \pi^0 = \pi_3,\ \pi^- = (\pi_1 - i\pi_2)/\sqrt{2},$$

we have

$$C(\pi^+) = +\pi^-,\ C(\pi^0) = +\pi^0,\ C(\pi^-) = +\pi^+,$$

and the triplet $(-\pi^+, \pi^0, \pi^-)$ transforms like an $I = 1$ multiplet with $I_z = +1, 0, -1$, respectively according to the usual (Condon-Shortly) conventions. (Note the minus sign in fron of π^+.)

Let $\{a_m\}$ be an isotopic multiplet of particles of isotopic spin I, where $m = I, I-1, \cdots, -I$ labels the z component of isospin. Then for any isospin rotation, there exists a matrix D_{mn} and a transformation law

$$a'_m = \sum_n D_{mn} a_n. \tag{A10}$$

Now let $\overline{a}_m$ be a member of the antiparticle multiplet, again with m labeling the z component of isospin. Then $\overline{a}_m$ is the charge conjugate of a_{-m}. That is, $\overline{a}_m = \overline{(a_{-m})}$. Under a rotation, the $\overline{a}_m$ do not follow the same transformation law (A10) as the a_m. But the correct law for transformation of the $\bar{a}_m$ is inferred from the requirement that $\sum_m \overline{(a_m)} a_m$ be invariant. In fact (see, e.g., A. R. Edmonds, Angular Momentum) the quantity $(-1)^{I+m}\, \bar{a}_{-m}$ does follow the same law as a_m. Thus, if (K^+, K^0) and (p, n) are K meson and nucleon doublets transforming, respectively, like the $I_z = +1/2$ and the $I_z = -1/2$ members of an isospinor, then $(-\overline{K}^0, K^-)$ and $(-\bar{n}, \bar{p})$ transform likewise. It is instructive to compare the isoscalar and isovector states formed (a) from a KK state and (b) from a $K\overline{K}$ state:

	KK	$K\overline{K}$
I = 0:	$(K^+K^0 - K^0K^+)/\sqrt{2}$	$(K^+K^- + K^0\overline{K}^0)/\sqrt{2}$
I = 1:	K^+K^+	$-K^+\overline{K}^0$
	$(K^+K^0 + K^0K^+)/\sqrt{2}$	$(K^+K^- - K^0\overline{K}^0)/\sqrt{2}$
	K^0K^0	K^0K^-

A4. G Parity

The G-conjugation operator is defined by

$$G = C\, e^{i\pi I_y} \qquad \text{(A11)}$$

and is conserved in strong interactions. The factor $e^{i\pi I_y}$ represents rotation by π around the y axis of isospin space. A useful fact about this rotation is

$$e^{i\pi I_y} |I, I_z\rangle = (-1)^{I+I_z} |I, -I_z\rangle. \qquad \text{(A12)}$$

Let $\{a_m\}$ be an isotopic multiplet of definite I, with $m \equiv I_z$, which is closed to C, that is, the charge conjugate (= antiparticle) of each member of the multiplet is also a member of the multiplet. Since C reverses I_z, charge, baryon number, hypercharge, etc., such a multiplet has baryon number zero, hypercharge zero, and the neutral member has $I_z = 0$. The pion triplet and any multiplet of particle-antiparticle pairs are examples.

We now show that all members of such a multiplet are eigenstates of G with the same eigenvalue. This eigenvalue is called the G parity of the multiplet and is either +1 or -1. The previous section told us that the quantities

$$(-1)^{I+m}\overline{(a_{-m})}, \quad m = I, I-1, \cdots, -I$$

transform under isospin rotations just like the quantities a_m. Then, for this multiplet closed to C,

$$(-1)^{I+m} C(a_{-m}) \equiv (-1)^{I+m}\overline{(a_{-m})}$$
$$= a_m \times \text{coefficient independent of m.}$$

Therefore, by Eqs. (A11) and (A12),

$$G(a_m) = (-1)^{I+m} C(a_{-m})$$
$$= a_m \times \text{coefficient independent of m,}$$

as asserted.

The unknown coefficient is determined by comparison with the m = 0 (neutral) case. Let $Ca_0 = C_n a_0$ where the constant C_n is the C parity of the neutral member. Then

$$G(a_0) = C_n e^{i\pi I_y}(a_0) = C_n(-1)^I a_0;$$

that is,

$$G \text{ parity} = C_n(-1)^I.$$

The G parity of a particle-antiparticle $(p\bar{p})$ multiplet is then derived from the C properties of the neutral member, as given in Eqs. (A6) and (A8),

$$G(p\bar{p}) = (-1)^{\ell+S+I}(p\bar{p}),$$

giving both text equations (8b) for $b\bar{b}$ and (11b) for $f\bar{f}$.

Finally, we note the action of G on some familiar particles. For isospinors,

$$e^{i\pi I_y} = e^{i(\pi/2)\sigma_2} = i\sigma_2 = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix},$$

so that

$$G\begin{pmatrix} K^+ \\ K^0 \end{pmatrix} = \begin{pmatrix} \overline{K}^0 \\ -K^- \end{pmatrix}, \quad G\begin{pmatrix} \overline{K}^0 \\ -K^- \end{pmatrix} = \begin{pmatrix} -K^+ \\ -K^0 \end{pmatrix}$$

and

$$G\begin{pmatrix} p \\ n \end{pmatrix} = \begin{pmatrix} \bar{n} \\ -\bar{p} \end{pmatrix}, \quad G\begin{pmatrix} \bar{n} \\ -\bar{p} \end{pmatrix} = \begin{pmatrix} -p \\ -n \end{pmatrix}.$$

For a single pion, the rotation $e^{i\pi I_y}$ changes the sign of π_1 and π_3, and C changes the sign of π_2. Hence

$$G(\pi_i) = (-1)\pi_i \text{ for } i = 1, 2, 3.$$

Thus for an n-pion state, regardless of the charges, $G = (-1)^n$.