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Data on Particles and Resonant States*

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Data on the properties of leptons, mesons, and baryons are listed, referenced, averaged, and summarized in tables and wallet cards. This is an updating of the *Reviews of Modern Physics* article of October 1965.

This data survey is an updating of that of October 1965.[1] An intermediate version was distributed at the XIII International Conference on High Energy Physics held at Berkeley in August 1966. This time a large number of early data and references have been deleted from the listings; these pioneer works can be found in any earlier edition.[1]

As always, we make two requests of our readers:

(1) Please inform us of mistakes and omissions. We cannot do an adequate job without this help.

(2) We wish to emphasize that it is not appropriate to refer to this compilation instead of the original published work; nor is it necessary, since we provide complete listings of references!

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.

(1) Table S covers all stable particles (leptons, mesons, and baryons), i.e., those states which are immune to decay via the strong interaction;

(2) Meson Resonances, and (3) Baryon Resonances. For convenience, these tables include basic information on stable mesons and baryons.

Each table is of slightly different form; thus Table S 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 sheets. These are the new "wallet cards": the paper is now thinner and more durable, and the reader can fold them according to his needs.

Of course most of our work involves deciding how to handle data. Often it is best not to average a result, either because it is already incorporated in a later paper or because we have some reservations about the experiment. (We then punch any character in Col. 8 of our data cards, thereby instructing the averaging programs to ignore the result.) When the data for an *individual* particle received special treatment, this is noted either in the listings or in a special note following them.

NOTES ON THE TABLES

Quoted errors represent standard deviations. Inequalities are also standard deviations or $1/e$ confidence levels.

The quantum number C stands for the eigenvalue of the charge-conjugation operator applied to a neutral particle. The notation C_n (n for neutral) means the eigenvalue of C applied to the *neutral member* of a nonstrange triplet, like the pion. Thus for all members of the $SU(3)$ 0^- nonet, $C_n=+1$.

Well-established quantum numbers are underlined (except in Table S, where most of the quantum num-

* Work performed under the auspices of the U.S. Atomic Energy Commission.

[1] A. H. Rosenfeld, A. Barbaro-Galtieri, W. H. Barkas, P. L. Bastien, J. Kirz, and M. Roos, Rev. Mod. Phys. 37, 633 (1965).

bers 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.

We define antiparticles as the result of operating with CPT on particles, so both share the same spins, masses, and mean lives.[2–4]

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 $N_{3/2}^*(1236)$ or $Y_0^*(1520)$, 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. [For $N_{3/2}^*(1236)$ this corresponds to 1236 MeV, but for further discussion of this point see the note following the baryon listings.] 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. Thus the peak in the πp cross section near 1236 MeV actually occurs at 1223 MeV. Nevertheless, it is conventional simply to report the energy of the peak in the observed cross section. For well-studied resonances, we have protected the averaging programs (by putting a star in the eighth column of the data cards) from masses and widths obtained without the proper kinematical factors or the proper background treatment. For the others, we have used whatever data was available.

NOTES ON TABLE S

The quantum numbers of all the stable particles seem well established, with the exceptions of Ξ and Ω^-. Of course if we accept the normal $SU(3)$ assignments, then Ξ becomes $1/2^+$ and Ω^- must be $3/2^+$.

Hyperon Decay Asymmetries

We adopt the following conventions for the decay asymmetries:

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

where s is the parity-changing amplitude and p is *minus* the parity-conserving amplitude. (Here we use the Condon–Shortley conventions for spherical harmonics and Clebsch–Gordan coefficients. They are repeated in more detail on our wallet cards.) Then α is equal to the helicity of the decay baryon from unpolarized hyperon decay, and the polarization $\mathbf{P}_N$ of the decay baryon from hyperons with polarization $\mathbf{P}_Y$ is[5] (in the Y rest frame)

$$\mathbf{P}_N = (1+\alpha P_Y\cos\theta)^{-1} \times\{[\alpha+P_Y\cos\theta(1-\gamma)]\hat{N}+\gamma\mathbf{P}_Y+\beta(\hat{P}_Y\times\hat{N})\},$$

where $\hat{N}$ is a unit vector along the direction of emission of the decay baryon, and θ is the angle between $\mathbf{P}_Y$ and $\hat{N}$. This convention for α and γ is the same as that of Cronin and Overseth,[6] except that they defined β with the opposite sign in its relation to s and p; nevertheless, the experimental value of β that they quote *is in agreement* with the convention used here.

In practice, the value of α is usually known much more accurately than those of β and γ. Since

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

there is really only one other parameter to be determined. A quantity, ϕ, which has a more nearly Gaussian distribution than β or γ, is defined by

$$\left.\begin{aligned}\beta &= (1-\alpha^2)^{1/2}\sin\phi\\ \gamma &= (1-\alpha^2)^{1/2}\cos\phi\end{aligned}\right\}\ \tan\phi=\beta/\gamma.$$

On the other hand, in discussing time-reversal invariance, the quantity of interest is Δ, defined by

$$\tan\Delta = -\beta/\alpha.$$

Under time-reversal invariance, one should have

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

the difference between pion–nucleon scattering phase shifts at the correct energy and in the appropriate isospin state. For Λ decay, if we assume the $\Delta|I|=\frac{1}{2}$ rule,

$$\delta_s-\delta_p \approx 7°.$$[7]

On the data cards, we list α and ϕ for each decay, since these are the most closely related to the experiment, and are essentially uncorrelated. 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.

NOTES ON THE MESON TABLE

The Symbol-Minded Approach

In addition to the colloquial names for particles, we have used the names suggested by Chew, Gell-Mann, and Rosenfeld[8,9]: atomic mass number A, hypercharge Y, and isospin I have been grouped into a single symbol. For mesons, $A=0$, Matts Roos has

[2] T. D. Lee, R. Oehme, and C. Yang, Phys. Rev. **106**, 340 (1957).
[3] S. Okubo, Phys. Rev. **109**, 984 (1958).
[4] A. Pais, Phys. Rev. Letters **3**, 342 (1959).
[5] T. D. Lee and C. N. Yang, Phys. Rev. **108**, 1645 (1957).
[6] J. W. Cronin and O. E. Overseth, Phys. Rev. **129**, 1795 (1963).
[7] S. W. Barnes, B. Rose, G. Giacomelli, J. Ring, K. Miyake, and K. Kinsey, Phys. Rev. **117**, 226 (1960).
[8] A. H. Rosenfeld, in *Proceedings of 1962 International Conference on High-Energy Physics at CERN* (CERN, Geneva, 1962), p. 325.
[9] G. F. Chew, M. Gell-Mann, and A. H. Rosenfeld, Sci. Am. **210**, 74 (1964).

suggested that the name should also reflect G, and sometimes J^P, so we now use

$Y=0$, $I=0$, η for $G=+1$, ϕ for $G=-1$,

$Y=0$, $I=1$, ρ for $G=+1$, π for $G=-1$,

$Y=1$, $I=\frac{1}{2}$, K (called K_V if $K\rightarrow K\pi$, K_A if $\nrightarrow K\pi$),

$Y=1$, $I=\frac{3}{2}$, (if ever firmly established), L.

Hence a nonet with charge-conjugation quantum number $C_n=+1$ will have members η, π, K, $\bar{K}$, and η'. If $C=-1$, the members will be ϕ, ρ, K^*, $\bar{K}^*$, and ϕ'.

In older editions, we used subscripts α, β, γ, and δ for J^P:

α for 0^+, 2^+, $\cdots$ mesons or $1/2^+$, $5/2^+$, $\cdots$ baryons.

β for 0^-, 2^-, $\cdots$ mesons or $1/2^-$, $5/2^-$, $\cdots$ baryons.

γ for 1^-, 3^-, $\cdots$ mesons or $3/2^-$, $7/2^-$, $\cdots$ baryons.

δ for 1^+, 3^+, $\cdots$ mesons or $3/2^+$, $7/2^+$, $\cdots$ baryons.

This has been accepted by many authors for baryons, but has not been popular for mesons, for which no Regge recurrences are yet known. Hence we now just give J^P, unless it is unknown. In that case, depending on whether 2π, $\bar{K}K$, or $K\pi$ decays are seen, we guess whether J^P belongs to the normal $(0^+, 1^- \cdots)$ or to the abnormal series $(0^-, 1^+, \cdots)$. In the former case, we write $J^P=V$ (for *V*acuum, *V*ector, etc.) or A for (*A*bnormal, *A*xial, etc.)

When two states have identical quantum numbers, we call one of them "prime," e.g., η, η', f, f', N, N' (1400, $1/2^+$). Note that $\eta(0^-)$ and $\eta(2^+)=f'$ are both the "mainly octet" members of their respective nonets. Then for our meson symbol for $I^G=0^-$, we must choose either ω or ϕ. We chose ϕ, since it is the ϕ (1019), not the ω (783), which is mainly octet.

We were tempted to go further and use names that also reflect the J^P series, A vs V, but that would require four more names and there are not four more mesons with simple names and really established quantum numbers. We would rather leave open the later possibility of doubling the names via the use of capital vs lower case letters, subscripts, $\cdots$.

Quantum Numbers and the Symbol C_n

For nonstrange mesons we list the eigenvalue of the G parity operator [10,11]

$$G=C\exp(\pi i I_y). \tag{1}$$

For neutral mesons, C has the eigenvalue ± 1, and it turns out that we can write[7]

$$G=C(-1)^I. \tag{2}$$

Now G and I have eigenvalues, of course, for all members of a charge multiplet, but C only for the neutral member. So to generalize Eq. (2) we define C_n as the eigenvalue of C for the neutral member of the multiplet, and then write for any member of the multiplet

$$G=C_n(-1)^I. \tag{3}$$

Meson Decays into 2π or $\bar{K}K$

In this discussion we use $\bar{K}K$ as an example. If the $\bar{K}K$ system is in a state with orbital angular momentum l, Bose statistics require that for a neutral pair

$$C=(-1)^l; \tag{4}$$

for a charged pair C has no eigenvalue, but G does,[12] namely,

$$G=(-1)^{l+I}. \tag{5}$$

Thus consider the $A2$ meson $\pi(1310)$. Its main decay mode is $\pi\rho$, hence $G=-1$. It is also seen to go to $K^-K_S^0$, so $I=1$. Then, by (5), observation of this mode establishes that l is even.

Next consider the isospin $I=1$ $A1$ meson $\pi(1090)$. Its main decay is again $\pi\rho$, so again $G=-1$, then again $l(\bar{K}K)$ must be even. Of course, if $A1$ has $J^P=0^-$, 1^+, or 2^-, we never expect to see $\bar{K}K$.

Finally consider the B meson $\pi(1220)$. Its main decay mode is $\pi\omega$, so $G=+1$, $I=1$. This time (5) forces $l(\bar{K}K)$ to be odd. Hence non-observation of $\bar{K}K$ is evidence against a 1^- interpretation of B.

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.[13]

s-Wave Bumps Near Threshold—$\eta_V(1050)\rightarrow\bar{K}K$, $\pi_V(1003)\rightarrow\bar{K}K$, $N(1560)$, $\Lambda(1405)$, $\Lambda(1670)$, $\Sigma(1780)$.

Peaks in cross sections near threshold pose special difficulties in interpretation, particularly for s-wave states. It is often uncertain which of the following causes the peak.

1. A Breit–Wigner resonance occurring just above or below threshold. In the complex energy plane, this is represented by a pole adjacent to the physical region but with a small negative imaginary displacement. See Fig. 1.
2. A pole near threshold but on or adjacent to the real axis of an *unphysical* sheet of the energy surface. See Fig. 2. This is often called an "antibound state."
3. Finally, the effect of non-threshold branch points in the energy plane often can be parameterized by a single pole whose position depends on the range of the nuclear force. With data of finite accuracy, such a parameterization may yield an adequate fit even though no pole really exists at the position indicated, but a "fake pole" cannot produce a scattering length larger than the dominant force range.

[10] T. D. Lee and C. N. Yang, Nuovo Cimento **3**, 749 (1956).
[11] L. Michel, Nuovo Cimento **10**, 319 (1953).
[12] A. H. Rosenfeld, in *Proceedings of the Varenna Summer School, Course 26, 1962* (Academic Press Inc., New York, 1963).
[13] M. Goldhaber, T. D. Lee, and C. N. Yang, Phys. Rev. **112**, 1796 (1958); D. R. Inglis, Rev. Mod. Phys. **33**, 1 (1961).

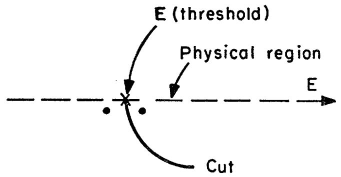

FIG. 1. The complex energy plane near threshold, showing possible poles (dots) corresponding to two ordinary Breit-Wigner resonances. The cut attached to the threshold branch point has been drawn so as to expose both the pole positions and the physical region.

Clearly we do not want to list in this compilation threshold bumps which are most probably effects of type 3. We do intend to list those in which some kind of pole seems to be present, though it may not be clear whether it is of type 1 or 2. Roughly speaking, a true pole is indicated whenever the measured scattering length has a real part of the order of 1 Fermi or more.

Careful experimental analysis can distinguish between poles of type 1 and type 2, but in most of the cases we are considering, the data are not yet sufficient for us to make this distinction with certainty. Even when type 2 is firmly indicated, as in the singlet deuteron, we still wish to list the state. Arguments have been given by Chew[14] to support calling such states "particles."

Of the cases listed at the head of this note, the $Y_0^*(1405)$ is well established as a type 1 pole, as is also the $N_{1/2}^*(1560, 1/2^-)$. The status of the other cases is less clear.

NOTES ON THE BARYON TABLE

S-Wave Bumps Near Threshold

This matter was discussed under Mesons.

Symbol-Minded Approach for Baryons (cf. Mesons)

Again we use familiar symbols to denote baryons with various values of hypercharge and isospin: namely, N for $N_{1/2}^*$, Λ for Y_0^*, Σ for Y_1^*, Ξ for $\Xi_{1/2}^*$, and Ω^-. For $N_{3/2}^*$ we have invented Δ, and for hypercharge $Y=+2$ we have recently added Z.

PROCEDURES FOR TREATING THE DATA

Except for trivial cases, all branching ratios and rate measurements are analyzed by computer program

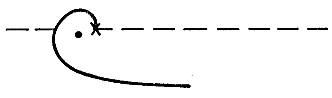

FIG. 2. The complex energy plane near threshold, showing the possible position of a pole corresponding to an "antibound state." Notice that in order to expose the pole in the figure the physical region just below threshold has been obscured from view.

[14] G. F. Chew, "Resonances, Particles, and Poles from the Experimenter's Point of View," Lawrence Radiation Laboratory Report UCRL-16983, July 1966.

AHR. This program makes a simultaneous, least-squares fit to all the data, and outputs the partial decay fractions, $\bar{f}_i$, and their errors, $\delta(\bar{f}_i)$. It is these values which we report in our tables (except that some errors have been "scaled"—see following section on χ^2 Scale Factor).

Program AHR uses the constraints that the sum of all of the partial decay fractions must total 100%, and that the sum of the partial rates must equal the total decay rate. AHR was written by this project's perennial friend, J. Peter Berge, and is documented in the 8030 Programming Memo.

When inequalities are reported from a particular experiment, we have on the first iteration ignored

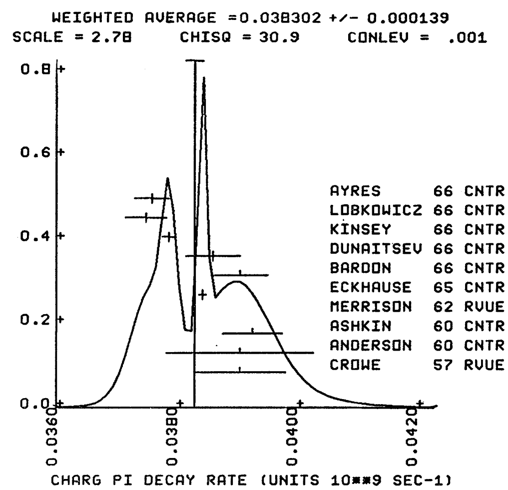

FIG. 3. Typical ideogram: $\pi^\pm$ decay rates. Results are usually published as mean lives τ, but we average *rates*, $\Gamma=1/\tau$ because rates are more normally distributed. The rms average $\bar{\Gamma}=(38.33\pm0.05)10^6$ sec^{-1} is drawn as a vertical line, with an error flag at the top scaled up by a scale factor $S=3.5$. (It is easily seen that even after scaling, this final result is not a satisfactory statement of the situation.) Only five experiments, indicated by $+$ error flags, were precise enough to satisfy Eq. (6) 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.

that experiment; we then checked to see if the weighted average of the others violates the inequality. If so, we change the input data: $<x\to0\pm x$, or $>x\to2x\pm x$, and iterate once more. If there are cases of small statistics, we weight them according to the prescription of maximum likelihood. When no errors are reported, we merely list the data for inspection.

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* (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, $[\chi^2/(N-1)]^{1/2}\equiv$ SCALE). If this were true, then we could correct the calculated error of the mean simply by multiplying each of the reported errors by SCALE, and then recalculating the error of $\bar{x}$. Multiplying the original $\delta(\bar{x})$ by SCALE would obviously also give the same final result.

In fact, this is exactly *what we have done*. (This is a NEW CONVENTION, started August 1966. In the older editions we listed the SCALE factor but did not enlarge the errors. We made this change because we discovered that few people paid any attention to SCALE.) 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 of the disadvantages of penalizing a whole class of students because of one naughtly 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 which 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

$$\delta_0=3N^{1/2}\delta(\bar{x}). \qquad (6)$$

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 in no way affect the value of $\bar{x}$. 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. Program AHR calculates not only the best simultaneous fit to all of the partial decay fractions, f_i, but also the contribution to χ^2 for each of the input ratios. If any of these individual contributions to χ^2 is considerably greater than the average expected χ^2 (a "ceiling" of $\chi^2=2.0$ is used at present), *all* of the measurements of that particular ratio have their errors increased by SCALE, with SCALE defined as before. (N and χ^2 are now, of course, the number, and the total contribution to χ^2, of only those experiments measuring that particular ratio.) Now, because of the many correlations induced by the constraint, it is not possible to merely multiply the output $\delta(\bar{f}_i)$'s by SCALE. Instead, one must actually rerun the program AHR on all of the data—those with errors unchanged as well as those with errors increased. We then get new values for $\delta(\bar{f}_i)$, i.e., the *errors* of the partial decay modes. These errors are the values given in our tables. (We list only the *largest* SCALE factor used for a particular particle. Thus it is not possible to recover the unscaled $\delta(\bar{f}_i)$'s from our reported values for particles which have constrained fits.) However, in line with our policy of not letting SCALE affect the central values, we give the values of $\bar{f}_i$ obtained from the original (unscaled) fits. (In all data processed so far, the differences between the $\bar{f}_i$'s calculated with either the scaled or the unscaled errors have been within the scaled errors, $\delta\bar{f}_i$).

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

$$\tau=\sum t_i/N,$$

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, 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.

NOTES ON THE DATA CARDS

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.

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.

Partial Decay Modes: 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. The numbers S_- or U_- in the far right-hand fields are simply the the mass codes of the decay products for this program.

Cross-Sections Cards (Coded CS)

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 information in that paper.

Note added in proof. Overseth *et al.* have called our attention to a mistake in sign in the Λ phi-parameter card in the data listings. On Table S the Λ decay parameter angles should be changed to read: $\phi = (-6\pm7)°$, $\Delta = (7\pm8)°$.

Other mistakes are:

Table S: The entry for $c\tau$ for the η meson should read $(2<c\tau<20)10^{-9}$ cm.

Meson Table: In the expression for the octet–singlet mixing angle in the lower right corner, the symbols η, m_8, ··· should all be squared. The value of

$$\Gamma(A2\rightarrow\eta\pi)/\Gamma(A2\rightarrow\rho\pi)$$

given by Chung +66 has been changed to 0.12+0.08. Hence in the table, the following fractions should be changed: $A2\rightarrow\rho\pi = (91\pm8)\%$, $A2\rightarrow\eta\pi = (5\pm8)\%$, $S=2.9$.

Baryon Table: We omitted an important entry for $\Xi^*(1815)$, namely a $\Sigma\bar{K}$ fraction of $<3\%$ from Smith 1 65.

Wallet Sheets: *Clesbsch–Gordan Coefficients*. In the note under the title, extend the top of the $\surd$ sign to read $\sqrt{\frac{8}{15}}$.

Table of Atomic and Nuclear Properties of Materials. A warning about the radiation length of hydrogen: The $L_{\rm rad}$ entries incorporate a correction for the incoherent scattering from atomic electrons, based on the Thomas–Fermi model. This is a poor approximation, especially for hydrogen, and the actual pair production and bremsstrahlung cross sections for hydrogen probably differ by as much as 10% from the values expected on the basis of the tabulated value of $L_{\rm rad}$. In addition there is an effect of the molecular binding on $L_{\rm rad}$ [see Bernstein and Panofsky, Phys. Rev. **102,** 522 (1956)]. We shall try to give an improved result in our next revision, so we solicit relevant information.

EXPLANATION OF SYMBOLS USED ON DATA CARDS

The following abbreviations have been used:

1. *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

2. *Journals*

ADVP	Advances in Physics
ANP	Annals of Physics
ARNS	Annual Reviews of Nuclear Science
BAPS	Bulletin of the American Physical Society

Data on Particles and Resonant States: Table S, Stable Particles. Rev. Mod. Phys., January 1967

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	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) $c\tau$ (cm)	Mass^2 (GeV)^2	Decays: Partial mode	Decays: Fraction	Q (MeV)	p or p_{max} (MeV/c)	Magnetic moment ($e\hbar/2m_pc$)	Decay Parameters[†] Measured α	Measured Φ(degree)	Derived γ	Derived Δ(degree)
γ	$0, 1(1^-)^-$	0		stable	0	stable								
ν_e	$J = \frac{1}{2}$	0(<0.2 keV)		stable	0	stable								
ν_μ		0(<2.1 MeV)												
$e^\mp$	$J = \frac{1}{2}$	0.511006		stable	0.000	stable	$\mu_e = \frac{1.001159622}{\pm.000000027} \frac{e\hbar}{2m_ec}$							
		±.000002		$(> 2\times10^{21}y)$										
$\mu^\mp$	$J = \frac{1}{2}$	105.659		2.199×10^{-6}	0.011	$e\nu\bar{\nu}$	100 %	105	53					
		±.002		±.001, S=1.3[*]		$e\gamma\gamma$	(< 1.6)10^{-5}	105	53					
				$c\tau = 6.592\times10^4$		3e	(< 1.3)10^{-7}	104	53					
	μ_μ = 1.001164 ±.000003 $\frac{e\hbar}{2m_\mu c}$					$e\gamma$	(< 6)10^{-9}	105	53					
			-33.920 ±.014											
$\pi^\pm$	$1^-(0^-)^+$	139.579		2.608×10^{-8}	0.019	$\mu\nu$	100 %	34	30					
		±.014		±.015, S=3.5[*]		$e\nu$	(1.24± 0.03)10^{-4}	139	70					
				$c\tau$ = 782		$\mu\nu\gamma$	(1.24± 0.25)10^{-4}	34	30					
			4.6041	$(\tau^+-\tau^-)/\bar{\tau}$ = (.4±.2)%		$\pi^0 e\nu$	(1.01± 0.09)10^{-8}	4	5					
			±.0037	(test of CPT)		$e\nu\gamma$	(3.0 ±0.5)10^{-8}	139	70					
π^0	$1^-(0^-)^+$	134.975		[b] 0.89×10^{-16}	0.018	$\gamma\gamma$	[c](98.8)%	135	67					
		±.014		±.18, S=1.6[*]		γe^+e^-	(1.169)%	134	67					
				$c\tau = 2.67\times10^{-6}$		$\gamma\gamma\gamma$	[c](< 5)10^{-6}	135	67					
						$e^+e^-e^+e^-$	(3.47)10^{-5}	133	67					
$K^\pm$	$\frac{1}{2}(0^-)$	493.82		1.235×10^{-8}	0.244	$\mu\nu$	[b](63.4 ±0.5)% S=1.5[*]	388	236					
		±.11		±.006, S=2.4[*]		$\pi\pi^0$	(21.0 ±0.3)% S=1.5[*]	219	205					
				$c\tau$ = 3.70		$\pi\pi^-\pi^+$	(5.6 ±0.1)% S=1.5[*]	75	126					
				$(\tau^+-\tau^-)/\bar{\tau}$ = (.09±.08)%		$\pi\pi^0\pi^0$	(1.71± 0.08)%, S=1.5[*]	84	133					
				(test of CPT)		$\mu\pi^0\nu$	(3.41± 0.22)%, S=1.9[*]	253	215					
						$e\pi^0\nu$	(4.79± 0.18)%, S=2.1[*]	358	229					
						$\pi\pi^\mp e^\pm\nu$	(3.8 ±0.8)10^{-5}	214	204					
			-4.05			$\pi\pi^\pm e^\mp\nu$	(< 2)10^{-6}	214	204					
			±.12			$\pi\pi^\mp\mu^\pm\nu$	(≤ 1.4)10^{-5}	109	151					
						$\pi\pi^\pm\mu^\mp\nu$	(< 3)10^{-6}	109	151					
						$e\nu$	(1.9 ±1.2)10^{-5}	493	247					
						$\pi\pi^0\gamma$	(2.2 ±0.7)10^{-4}	219	205					
						$\pi\pi^+\pi^-\gamma$	(10 ±4)10^{-5}	75	126					
						πe^+e^-	(< 1.1)10^{-6}	353	227					
						$\pi\mu^+\mu^-$	(< 3)10^{-6}	143	172					
K^0	$\frac{1}{2}(0^-)$	497.87		50% K_{Short}, 50% K_{Long}										
		±0.16												
K_{Short}	$\frac{1}{2}(0^-)$			0.87×10^{-10}	0.248	$\pi^+\pi^-$	(69.3 ±1.2)% S=1.25[*]	219	206					
				±.009, S=1.3[*]		$\pi^0\pi^0$	(30.7 ±1.2)% S=1.25[*]	228	209					
			$-0.48\times\frac{1}{\tau_S}$	$c\tau$ = 2.61										
			±.02											
K_{Long}	$\frac{1}{2}(0^-)$			5.68×10^{-8}	0.248	$\pi^0\pi^0\pi^0$	(23.5 ±2.1)%	93	139					
				±.26		$\pi^+\pi^-\pi^0$	(11.5 ± .4)%	84	133					
				$c\tau$ = 1703		$\pi\mu\nu$	(27.5 ±1.8)%	253	216					
						$\pi e\nu$	(37.4 ±1.8)%	358	229					
						$\pi^+\pi^-$	(.153 ±.007)%	219	206					
						$\pi^+\pi^-\gamma$	(< 0.3)%	219	206					
						$\pi^0\pi^0$	(< 2.7)10^{-3}	228	209					
						$e\mu$	(< 4)10^{-5}	392	238					
						$\gamma\gamma$	(1.3 ±0.6)10^{-4}	498	249					
						$\mu^+\mu^-$	(< 4)10^{-6}	287	225					
						e^+e^-	(< 4)10^{-5}	497	249					
η	$0^+(0^-)^+$	548.6		1<Γ<10 keV		Neutral decays 72.9%: $\gamma\gamma$	(31.4 ±2.2)%	549	274					
		±0.4		$(2<c\tau<20)10^{-10}$		$\pi^0\gamma\gamma$	(20.5 ±3.5)% S=1.3[*]	414	258					
						$3\pi^0$	(21.0 ±3.2)% S=1.5[*]	144	179					
						Charged decays 27.1%: $\pi^+\pi^-\pi^0$	(22.4 ±1.8)%	135	174					
						$\pi^+\pi^-\gamma$	(4.6 ±0.8)% S=1.1[*]	269	236					
						$\pi^0e^+e^-$	(< 0.2)%	413	258					
						$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	268	236					
p	$\frac{1}{2}(\frac{1}{2}^+)$	938.256		stable	0.880					2.792763				
		±0.005	-1.2933	$(> 6\times10^{27}y)$						±.000030				
n	$\frac{1}{2}(\frac{1}{2}^+)$	939.550	±.0001	$(1.01\pm.03)10^3$	0.882	$pe^-\nu$	100 %	1	1	-1.913148				
		±0.005		$c\tau = 3.03\times10^{13}$						±.000066				
Λ	$0(\frac{1}{2}^+)$	1115.58		2.51×10^{-10}	1.245	$p\pi^-$	(66.4 ±1.1)% S=1.1[*]	38	100	-0.73	.663±.022	(7±7)°	.74	(-8±8)°
		±0.10		±.04, S=1.4[*]		$n\pi^0$	(33.6 ±1.1)% S=1.1[*]	41	104	±.16	.73 ±.18			
				$c\tau$ = 7.52		$pe\nu$	(0.88± 0.15)10^{-3}	177	163		.06 ±.19			
						$p\mu\nu$	(1.35± 0.60)10^{-4}	72	131					
Σ^+	$1(\frac{1}{2}^+)$	1189.47		0.810×10^{-10}	1.412	$p\pi^0$	(52.8 ±1.5)%	116	189	2.3	-.960±.067			
		±0.08		±.013		$n\pi^+$	(47.2 ±1.5)%	110	185	±.6	+.008±.037	(180±30)°	-1.0	(0±85)°
				$c\tau$ = 2.43		$p\gamma$	(1.9 ±0.4)10^{-3}	251	225					
						$n\pi^+\gamma$	(≈ 0.2)10^{-4}	110	185					
						$\Lambda e^+\nu$	(1.5 ±0.9)10^{-5}	73	72					
						$n\mu^+\nu$	(< 1.1)10^{-4}	144	202					
			-7.97			$ne^+\nu$	(< 5)10^{-5}	249	224					
			±.11											
Σ^0	$1(\frac{1}{2}^+)$	1192.56		$<1.0\times10^{-14}$	1.422	$\Lambda\gamma$	[c]100 %	77	75					
		±0.11	-4.88	$c\tau<3\times10^{-4}$		Λe^+e^-	(5.45)10^{-3}							
Σ^-	$1(\frac{1}{2}^+)$	1197.44	±.06	1.65×10^{-10}	1.434	$n\pi^-$	100 %	118	193		-.010±.043			
		±0.09		±.03, S=1.4[*]		$ne^-\nu$	(1.25± 0.17)10^{-3}	257	230					
				$c\tau$ = 4.95		$n\mu^-\nu$	(0.62± 0.12)10^{-3}	152	210					
						$\Lambda e^-\nu$	(0.61± 0.16)10^{-4}	81	79					
						$n\pi^-\gamma$	(≈ 1)10^{-5}	118	193					
Ξ^0	$\frac{1}{2}(\frac{1}{2}^+)$	1314.7		3.0×10^{-10}	1.728	$\Lambda\pi^0$	100 %	64	135		-.33 ±.10			
	?	±1.0		±.5, S=1.3[*]		$p\pi^-$	(< .5)%	237	299					
				$c\tau$ = 8.99		$pe^-\nu$	(< .6)%	376	323					
						$\Sigma^+e^-\nu$	(< .7)%	125	119					
						$\Sigma^-e^+\nu$	(< .6)%	117	112					
			-6.5			$\Sigma^+\mu^-\nu$	(< .7)%	20	64					
			±.2			$\Sigma^-\mu^+\nu$	(< .6)%	12	49					
						$p\mu^-\nu$	(< .6)%	271	309					
Ξ^-	$\frac{1}{2}(\frac{1}{2}^+)$	1321.2		1.74×10^{-10}	1.746	$\Lambda\pi^-$	100 %	66	139		-.391±.032	(6±8)°	.92	(14±15)°
	?	±0.2		±.05		$\Lambda e^-\nu$	(2.5 ±1.8)10^{-3}	205	190					
				$c\tau$ = 5.22		$n\pi^-$	(< 5)10^{-3}	242	303					
						$\Lambda\mu^-\nu$	(< 1.2)%	100	163					
						$\Sigma^0e^-\nu$	(< 0.3)%	128	122					
						$\Sigma^0\mu^-\nu$	(< 0.5)%	23	70					
						$ne^-\nu$	(< 1)%	381	327					
Ω^-	$0(3/2^+)$	1674		1.5×10^{-10}	2.802	$\Xi\pi$	(~50)%	221	296					
	? ?	±3		±.5, $c\tau$ = 4.5		$\Lambda\bar{K}$	(~50)%	66	216					

[†] The definition of these quantities is as follows

$$\alpha = \frac{2\,\mathrm{Re}(S^*P)}{|S|^2+|P|^2};\quad \beta = \frac{2\,\mathrm{Im}(S^*P)}{|S|^2+|P|^2};\quad \gamma = \frac{|S|^2-|P|^2}{|S|^2+|P|^2}$$

$$\tan\Phi = \frac{\beta}{\gamma},\quad \tan\Delta = \frac{-\beta}{\alpha}.$$

General Atomic and Nuclear Constants[a]

- N = 6.02252×10^{23} mole^{-1} (based on A_{C12} = 12)
- c = 2.997925×10^{10} cm sec^{-1}
- e = 4.80298×10^{-10} esu = 1.60210×10^{-19} coulomb
- 1 MeV = 1.60210×10^{-6} erg
- ħ = 6.5819×10^{-22} MeV sec
- = 1.05449×10^{-27} erg sec
- ħc = 1.9732×10^{-11} MeV cm = 197.32 MeV fermi
- k = 8.6171×10^{-11} MeV deg^{-1} (Boltzmann const.)
- α = $e^2/\hbar c$ = 1/137.0388
- m_e = 0.511006 MeV/c^2 = 1/1836.10 m_p
- m_p = 938.256 MeV/c^2 = 1836.10 m_e = 6.721 $m_{\pi\pm}$
- = 1.00727663 m_1 (where m_1 = 1 amu = $\frac{1}{12}$ m_{C12} = 931.478 MeV/c^2)
- r_e = e^2/m_ec^2 = 2.81777 fermi (1 fermi = 10^{-13} cm)
- $\lambda\!\!\!^{-}_e$ = $\hbar/m_ec$ = $r_e\alpha^{-1}$ = 3.86144×10^{-11} cm
- a_∞ Bohr = $\hbar^2/m_ee^2$ = $r_e\alpha^{-2}$ = 0.529167 A (1 A = 10^{-8} cm)
- $\sigma_{Thompson}$ = $\frac{8}{3}\pi r_e^2$ = 0.66516×10^{-24} cm^2 = 0.66516 barn
- R_∞ = $m_ee^4/2\hbar^2$ = $m_ec^2\alpha^2/2$ = 13.60535 eV (Rydberg)

Hydrogen-like atom (non-rel., μ = reduced mass)

$$E_n = \frac{\mu z^2e^4}{2(n\hbar)^2};\quad a_{n=1} = \frac{\hbar^2}{\mu ze^2};\quad \left.\frac{v}{c}\right)_{rms} = \frac{ze^2}{n\hbar c}$$

- μ_{Bohr} = $e\hbar/2m_ec$ = 0.578817×10^{-14} MeV gauss^{-1}
- μ_{nucl} = $e\hbar/2m_pc$ = 3.1524×10^{-18} MeV gauss^{-1}
- $\frac{1}{2}\omega_{cyclotron}$ = $e/2m_ec$ = 8.79404×10^6 rad sec^{-1} gauss^{-1}
- = $e/2m_pc$ = 4.7895×10^3 rad sec^{-1} gauss^{-1}.
- $\sigma_{natural}$ = $\pi(\hbar/m_{\pi\pm}c)^2$ = 62.768 mb

Other Physical Constants

- 1 year = 3.1536×10^7 sec (≈ $\pi\times10^7$ sec)
- density of air = 1.205 mg cm^{-3} (at 20°C)
- acceleration by gravity = 980.67 cm sec^{-2}
- gravitational constant = 6.670×10^{-8} cm^{3}g^{-1} sec^{-2}
- 1 calorie = 4.184 joules
- 1 atmosphere = 1033.2 g cm^{-2}
- 1 eV per particle = 11604.9°K (from E = kT)

Numerical Constants

1 rad	= 57.29578 deg	e	= 2.71828
C	= 0.577216	1/e	= 0.367879
ln 2	= 0.69315	$\log_{10}e$	= 0.43429
ln 10	= 2.30259	$\log_{10}2$	= 0.30103

[a] Based mainly on E. R. Cohen and J. W. M. DuMond, Rev. Mod. Phys. 37, 537 (1965).

[*] 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., δx → S δx. This new convention, is still inadequate, since if S > 1, the real uncertainty is probably even greater than Sδx. See text.

a. See notes on Stable Particles in text. b. See notes in data card listings. c. Theoretical value. See also data card listings.

‡ In decays with more than two bodies, $\bar{p}_{max}$ is the maximum momentum that any particle can have.

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Particle	Symbol(J^P)	$I^G(J^P)C_n$ (underline = estab.)	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)	Nonets (CP=−1: 0^-; CP=+1: 0^+, 1^-, 1^+, 2^+)
$\eta(549)$	$\eta(0^-)$	$0^+(0^-)+$	548.6 ±0.4	<0.01	0.301 <.000005	all neutral	73	} See Table S		(0^-) η
						$\pi^+\pi^-\pi^0+\pi^+\pi^-\gamma$	27			
σ, ϵ §										
$\omega(783)$	$\phi'(1^-)$	$0^-(1^-)-$	783.4 ±0.7* S=1.8*	11.9 ±1.5	0.614 ±.009	$\pi^+\pi^-\pi^0$	≈ 90	369	328	(1^-) ω
						$\pi^+\pi^-$	seen (c)	504	366	
						$\pi^0\gamma$	9.7±0.8	648	380	
						η + neutral	< 1.5	234	199	
						$\pi^+\pi^-\gamma$	< 5	504	366	
						e^+e^-	0.012±.003	782	392	
						$\mu^+\mu^-$	< 0.10	572	377	
$\eta'(958)$ or X^0	$\eta'(0^-)$	$0^+(0^-)+$	958.3 ±0.8	<4	0.918 <.004	$\eta\pi\pi$	75 ± 3 S=1.8*	131	232	(0^-) η'
						$\pi^+\pi^-\gamma$(incl. $\rho^0\gamma$)	25 ± 3	679	458	
						for upper limits see footnote (f)				
H §										
$\phi(1019)$	$\phi(1^-)$	$0^-(1^-)-$	1018.6 ±0.5	4.0 ±1.0 S=1.2*	1.039 ±.004	K^+K^-	48 ± 3	31	125	(1^-) φ
						K_LK_S	40 ± 3	23	107	
						$\pi^+\pi^-\pi^0$ (incl. ρπ)	12 ± 4	604	461	
						for upper limits see footnote (g)				
$\eta_V(1050)$ → K_SK_S	$\eta(0^+)$	$0^+(0^+)+$	1050	50	1.10 ±.05	ππ	< 70	780	507	(0^+) η_V
	Some data still favor large scattering length					$K\bar{K}$	> 30	54	167	
$f(1250)$	$\eta'(2^+)$	$0^+(2^+)+$	1254 ±12	117 ±15	1.57 ±.15	ππ	large	975	611	(2^+) f
						$2\pi^+2\pi^-$	< 4	696	547	
						$K\bar{K}$	2.3±0.6	258	381	
$D(1285)$	$\eta'(A)$	$0^+(1^+)+$	1285 ±4	32 ±8	1.65 ±.04	$K\bar{K}\pi$ (mainly $\pi_V(1003)\pi$) only mode seen		154	304	(1^+) D
						$K^*\bar{K}+\bar{K}^*K$		-100		
						ππρ	not seen	256	356	
$E(1420)$	$\eta(A)$	$0^+(0^-)+$	1424 ±7	76 ±9	2.03 ±.11	$K^*\bar{K}+\bar{K}^*K$	50 ±10	38	157	(0^-) ?; (1^+) E?
						$\pi_V(1003)\pi$	50 ±10	284	338	
						ππρ	not seen	395	462	
K_sK_s §, ρρ										
$f'(1500)$	$\eta(2^+)$	$0^+(2^+)+$	1514 ±16	86 ±23	2.29 ±.13	ππ	< 14	1235	744	(2^+) f'
						$K\bar{K}$	> 60	518	570	
						$K^*\bar{K}+\bar{K}^*K$	< 40	128	294	
						ηη	not seen	417	522	
$\pi^\pm(140)$, $\pi^0(135)$	$\pi(0^-)$	$1^-(0^-)+$	139.58, 134.98		0.019, 0.018	See Table S				(0^-) π
$\rho^\pm(760)$	$\rho(1^-)$	$1^+(1^-)-$	778 (h)	160 (h)	0.605 ±.124	ππ	≈100	480	353	(1^-) ρ
						$\pi^\pm\pi^+\pi^-\pi^0$	< 0.2	206	243	
						$\pi^+\pi^-\pi^+\pi^-$	< 0.6	199	238	
						$\pi^0\gamma$	< 0.4	619	367	
$\rho^0(760)$			770 (h)	140 (h)	0.593 ±.108	$\eta\pi^\pm$	< 0.8	71	135	
						e^+e^-	$.0065^{+.011}_{-.005}$	759	380	
						$\mu^+\mu^-$	$.0033^{+.0016}_{-.0007}$	549	365	
$\delta(965)$	?( )	1( )	963.1 ±4.2	<5	0.927 <.005	$\delta^\pm$ → 1 charged+neutral(s)	≈ 60			
						$\delta^\pm$ → ≥3 charged+neutral(s)	≈ 40			
$\pi_V(1003)$ → $K\bar{K}$	$\pi(0^+)$	$1^-(0^+)+$	1003	70 ±15	1.006 ±.057	$K^\pm K^0$	large	11	75	(0^+) π_V
	may also be interpreted as due to large scattering length					ηπ	see note in data listings	315	333	
$A1(1080)$	$\pi(1^+)$	$1^-(1^+)+$	1079 ±8	130 ±40	1.16 ±.14	ρπ	≈100	181	245	(1^+) A_1
	unresolved mixture of resonance and "Deck effect"					$K\bar{K}$	< 0.25, $G=(-1)^{\ell+I}$ forbids this (Eq. 5)			
						ηπ	< 1.5	391	385	
						η'π	< 1.5	-19		
$B(1210)$	ρ(A ?)	$1^+(1^+)-$??	1208 ±12	119 ±24 S=1.6*	1.46 ±.14	ωπ	≈100	297	339	
						ππ	< 30	941	594	
						$K\bar{K}$	< 2	232	358	
						4π	< 50	662	528	
						φπ	< 1.5	66	137	
$A2(1300)$	$\pi(2^+)$	$1^-(2^+)+$ (d)	1306 ±8 S=2.6*	81 ±8 S=1.4*	1.70 ±.11	ρπ	93 ±3	408	417	(2^+) A_2
						$K\bar{K}$	3.8±1.3	314	425	
						ηπ	2.9±2.4 S=1.5*	618	527	
						η'π	< 1.5	208	276	
						$\pi^+\pi^-\pi^0$(excl. ρπ)	< 17	892	616	
$\pi(1640)$ → 3π	π(A) ?	≥1^-(A)+ ?	1640 ±20	100 ±20	2.69 ±.16	3π	appears dominant	1235	792	
						[ρπ	< 40]	746	636	
						[fπ	?]	251	319	
						$K\bar{K}$	< 40	644	652	
$\rho(1650)$ g→2π	ρ(V)	1^+(V)− S=1.4* →	1637 ±23	150 ±50	2.68 ±.24	2π	observed	1358	807	
	$R_1R_2R_3$ bumps suggest more structure in this peak					4π }	probably observed	1079	758	
						ρππ }		599	605	
$R_1R_2R_3$ §										
$S(1930)$ X^-	?(V) ? (e)	≥ 1^+( ) ?	1929 ±14	⩽35	3.72 ⩽.07	1 charged } +neutral(s)	6(+15/-6)			
						3 charged } +neutral(s)	92(+ 8/-20)			
						>3 charged } +neutral(s)	2(+13/-2)			
$T(2200)$ X^-	?( )	≥ 1	2195 ±15	⩽13	4.82 ⩽.03.	1 charged } +neutral(s)	4(+11/-4)			
						3 charged } +neutral(s)	94(+ 6/-19)			
						>3 charged } +neutral(s)	2(+13/-2)			
$U(2380)$ X^-	?( )	≥ 1	2382 ±24	⩽30	5.67 ⩽.07	1 charged } +neutral(s)	30 ±10			
						3 charged } +neutral(s)	45 ±15			
						>3 charged } +neutral(s)	25 ±10			
$K^+(494)$, $K^0(498)$	$K(0^-)$	$1/2(0^-)$	493.78, 497.7		0.244, 0.248	See Table S				(0^-) K
$K^*(890)$	$K(1^-)$	$1/2(1^-)$	892.4 ±0.8	49.8 ±1.7 S=1.1*	0.796 ±.044	Kπ	≈100	259	288	(1^-) K^*
	$m_0-m_\pm = 3.5\pm1.8$ S=1.2*					Kππ	< 0.2	119	216	
κ(725) §, $K_V(1080)$ §, $K_c(1215)$ §										
$K_A(1320)$	K(A) ?	1/2(A) ?	1320 ±10	80 ± 20	1.742 ±.106	$K^*\pi$ } overlap	large	288	338	(1^+) K_A
						Kρ } overlap		63	198	
	m and Γ values taken from Shen+. Appreciable discrepancies with other experiments. See note in data listings.					Kω	probably seen, < 10	39	155	
						Kπ	< 30	687	558	
						Kη	< 10	278	405	
$K_V(1420)$	$K(2^+)$	$1/2(2^+)$	1411 ±5 S=1.8*	92 ±7 S=1.2*	1.991 ±.130	Kπ	52 ± 5 } S=2.2*!	778	610	(2^+) K_V
						$K^*\pi$	36 ± 6	379	407	
						Kρ	9 ± 5	158	319	
						Kω	1.0±1.7	134	293	
						Kη	2.1±3.0	368	475	
$K_A(1800)$	K(A)	1/2(A)	1789 ±10	80 ±20	3.20 ±.14	Kπ	< 10	1156	819	
						$K^*\pi$	35 ±12	762	664	
						$K_V(1420)\pi$	8 ± 5	243	315	
						Kρ	7 ± 5	532	630	
						Remaining Kππ	40 ±15	1021	801	
						Kω	10 ± 3	508	616	
$K^*_{3/2}(1175)$ §, $K^*_?(1270)$ §										(0^+) tentative; (1^+) tentative

Nonet quantity	(0^-)	(0^+)	(1^-)	(1^+)	(2^+)
$m_8 = \sqrt{K^2 + \frac{K^2-\pi^2}{3}}$ =	566.8 ±0.2		928.4 (i)±3.0	1391. ±13.	1444.3 ±6.9
$\sin^2\theta = \frac{\eta - m_8}{\eta - \eta'}$ =	0.033 ±0.001		0.414 (i)±0.013	0.25 ±0.10	0.29 ±0.06
θ =	10.4°		40.1°	29.7°	32.4°

§ The following bumps, excluded above, are listed among the data cards: σ(410), ε(700), H(975), K_SK_S(1440) and ρρ(1410), R_1, R_2, R_3(≈1700), κ(725) $K_V(1080)$, $K_c(1215)$, $K^*_{3/2}(1175)$, $K^*_?(1270)$.

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

Footnotes continued in right margin.

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

(d) If A2 → both ρπ and $K\bar{K}$, then $J^P = 2^+$.

(e) S is ρ(V) if identified with $\pi^+\pi^-$ bump at 1910 MeV. See note on mesons.

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

(g) Empirical limits on fractions for other decay modes of φ(1019): $\pi^+\pi^- < 20\%$, $\eta\gamma < 8\%$, η + neutrals < 13%, $\pi^+\pi^-\gamma < 4\%$, $e^+e^- < 0.2\%$, $\mu^+\mu^- < 0.5\%$, $\omega\gamma < 5\%$, $\rho\gamma < 2\%$.

(h) m_ρ, Γ_ρ from p-wave fit to compiled spectrum of 2-4 GeV/c $\pi^+p \to \Delta^{++}\rho^0$, $|t| < 10\ m_\pi^2$, and comparison of $\rho^\pm$ - ρ^0 in similar reactions. Results depend on background and t-cut, hence real errors unknown, but larger than statistical errors ~ 5 MeV. (See Matts Roos, Phys. Letters, to be publ.) Note contrast between Roos' p-wave fit vs. weighted average of published results (see listings). m(±) 778 vs. 757; m(0) 770 vs. 760, Γ(±) 160 vs. 132, Γ(0) 140 vs. 116. This demonstrates present uncertainty.

(i) Error on m_ρ taken to be 10 MeV.

BARYONS - January 1967

Group	Particle or resonance	I(J^P) (⊢⊣ = estab.)	Beam π,K (BeV) (BeV/c)	Mass (MeV)	Γ (MeV)	$M^2 \pm \Gamma M$ (BeV^2)	Mode	Fraction (%)	Q (MeV)	p or p_{max}‡ (MeV/c)	$4\pi\lambda\!\!\!^{-2}$ (mb)
$N^*_{1/2}$	p n	1/2(1/2⁺)		938.3 939.6		0.880 0.883	See Table S				
	N′(1400)	1/2(1/2⁺) P_{11}	T=0.43πp p=0.55	~1400[a]	~200	1.96 ±0.28	Nπ	70	322	367	36.3
	N(1525)	1/2(3/2⁻) D_{13}	T=0.62 p=0.75	1525[a]	105	2.33 ±0.16	Nπ Nππ [Δ(1236)π][e]	65 35 [~ 20]	447 308 149	460 414 229	23.2
	N(1570)	1/2(1/2⁻) S_{11}	T=0.69 p=0.82	1570[a]	130	2.46 ±0.20	Nπ Nη	~ 30 ~ 70	492 82	491 242	20.3
	N(1670)	1/2(5/2⁻) D_{15}	T=0.87 p=1.00	1670[a]	140	2.79 ±0.23	Nπ Nππ [Δ(1236)π][e] ΛK Nη	40 dominant[a] [?] small small	592 453 294 57 182	560 526 357 200 368	15.6
	N(1688)	1/2(5/2⁺) F_{15}	T=0.90 p=1.03	1688[a]	110	2.85 ±0.19	Nπ Nππ [Δ(1236)π][e] ΛK Nη	65 dominant[a] [?] small small	610 471 312 75 200	572 538 372 231 388	14.9
	N′(1700)[c]	1/2(1/2⁻) S_{11}	T=0.92 p=1.05	1700[a]	240	2.89 ±0.41	Nπ	100	622	580	14.5
	N(2190)	1/2(7/2⁻)	T=1.94 p=2.07	2190	200	4.80 ±0.44	Nπ ΛK	30 ?	1112 577	888 710	6.21
	N(2650)	1/2(11/2⁻)[b]	T=3.12 p=3.26	2650 ± 10	~300	7.02 ±0.80	Nπ ΛK	7 ?	1572 1037	1154 1022	3.67
	⇉ N(3030)[c]	1/2(15/2⁻)[b]	T=4.26 p=4.40	3030	400	9.18 ±1.21	Nπ	0.7	1972	1377	2.62
$N^*_{3/2}$	Δ(1236)	3/2(3/2⁺) P_{33}	T=0.195 p=0.304	(++) 1236.0 ±0.6	120 ±2	1.53 ±0.15	Nπ $N\pi^+\pi^-$	100 0	158 18	231 89	91.9
		$m_0 - m_{++} = 0.45 \pm 0.85$		$m_- - m_{++} = 7.9 \pm 6.8$							
	Δ(1670)	3/2(1/2⁻) S_{31}	T=0.87 p=1.00	1670[a]	~180	2.79 ±0.30	Nπ Nππ	40 ?	592 453	560 526	15.6
	Δ(1920)	3/2(7/2⁺)	T=1.35 p=1.48	1920	200	3.69 ±0.38	Nπ ΣK	50 seen	842 229	722 423	9.37
	Δ(2420)	3/2(11/2⁺)[b]	T=2.51 p=2.65	2423 ±10	~275	5.87 ±0.67	Nπ ΣK	10 ?	1345 732	1024 830	4.66
	Δ(2850)	3/2(15/2⁺)[b]	T=3.71 p=3.85	2850 ±12	~300	8.12 ±0.86	Nπ	3	1772	1266	3.05
	→ Δ(3230)[c]	3/2(19/2⁺)[b]	T=4.94 p=5.08	3230	440	10.4 ±1.4	Nπ	0.6	2152	1475	2.24
Z^*_0	→ Z_0(1865)[c]	0(?)	p=1.15 K^+p	1863	150	3.47 ±0.28	NK	55 (if J = 1/2)	432	579	14.6
Y^*_0	Λ	0(1/2⁺)		1115.6		1.24	See Table S				
	Λ(1405)[d]	0(1/2⁻)	p<0 K^-p	1405	35	1.97 ±0.05	Σπ	100	68	142	
	Λ(1520)	0(3/2⁻)	p=0.392	1518.8 ±1.5	16 ±2	2.31 ±0.02	$N\bar{K}$ Σπ S=1.7*→ Λππ	{39±5 51±6 10±2	81 182 124	235 258 251	83.6
	Λ(1670)[a]	0(1/2⁻)	p=0.74	1670	18	2.79 ±0.03	Λη $N\bar{K}$	$K^-p \to \Lambda\eta$ seen	6 233	66 410	28.5
	Λ(1700)	0(3/2⁻)	p=0.80	1700 ±10	40 ±10	2.89 ±0.07	$N\bar{K}$ Σπ	20 seen	263 363	438 411	25.0
	Λ(1820)	0(5/2⁺)	p=1.06	1819.5 ±3.5	83 ± 8	3.31 ±0.15	$N\bar{K}$ Σπ Σ(1385)π Λη	70 11 18 ~ 1	382 482 295 155	541 502 362 349	16.5
	Λ(2100)	0(7/2⁻)	p=1.68	2100	160	4.41 ±0.34	$N\bar{K}$ Σπ	29 seen	663 763	748 699	8.68
	Λ(2340)	0(?)	p=2.27	2340 ±20	105	5.48 ±0.25	$N\bar{K}$ seen in σ(total)	10 ↳ if J = 9/2	903	907	5.92
Y^*_1	Σ	1(1/2⁺)		(+)1189.5 (0)1192.6 (-)1197.4		1.41 1.42 1.43	See Table S				
	Σ(1385)	1(3/2⁺)	p<0 K^-p	(+)1382.2±0.9 S=1.6* S=4.8*←(-)1388.0±3.0	(+)37±3 S=2.1* (-)38±8, S=3.7*	1.92 ±0.05	Λπ Σπ	91±3 9±3 S=1.4*	130 48	208 117	
	Σ(1660)[a]	1(3/2⁻)	p=0.72	1660	50	2.76 ±0.08	Λ(1405)π Σπ Λπ $N\bar{K}$	large ? ? small	115 323 405 223	197 379 439 400	29.9
		Large contradictions among measured branching ratios.									
	→ Σ(1770)	1(5/2⁻)	p=0.95	1768 ±4 S=1.5*	89 ±12 S=2.0*	3.13 ±0.16	$N\bar{K}$ Λπ Λ(1520)π Σ(1385)π Ση Σπ	49 17 19 12 2 < 1	331 517 110 243 27 431	498 520 192 318 143 463	19.4
	Σ(1910)[c]	1(5/2⁺)	p=1.25	1910 ±10	60	3.65 ±0.11	$N\bar{K}$ Λπ Σπ	8 10 3	473 655 573	612 619 568	12.9
	Σ(2035)	1(7/2⁺)	p=1.53	2035 ±15	160	4.14 ±0.33	$N\bar{K}$ Λπ Σπ	16 25 seen	598 784 698	703 703 655	9.83
	→ Σ(2260)[c]	1(?)	p=2.06	2260 ±20	180	5.11 ±0.41	$N\bar{K}$ seen in σ(total)	14 ↳ if J = 9/2	823	855	6.66
$\Xi^*_{1/2}$	Ξ	1/2(1/2⁺)		(0)1314.7 (-)1321.2		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	69	145	
	Ξ(1815)	1/2(?)		1815 ±3	16 ±8 S=2.2*	3.29 ±0.03	$\Lambda\bar{K}$ Ξπ Ξππ [Ξ(1530)π][e]	~ 65 ~ 10 ~ 25 [~ 20]	202 354 215 145	391 409 351 229	
		Branching ratios poorly known									
	→ Ξ(1930)	1/2(?)		1933 ±16	140 ±35	3.74 ±0.27	Ξπ $\Lambda\bar{K}$	seen seen	472 320	501 504	
Ω^-	Ω^-	0(3/2⁺)		1674		2.80	See Table S				

a. See note in data listings.
b. J^P assignment based on straight-line Regge-trajectory-recurrence hypothesis and supported by fits to πp elastic scattering at 180°. See note following data listings.
c. Evidence for the existence of the effect and/or for its interpretation as a resonance is open to some question.
d. A virtual bound state of the $\bar{K}N$ system with negative scattering length [$a_0 = (-1.6 + 0.6i)F$]; i.e., a pole in the S matrix below the elastic threshold. See notes in main text and data listings.
e. Square brackets indicate a sub-reaction of the previous unbracketed decay mode.

→ at left of 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: $N_?(3245)$, N(3695), $N^*_{5/2}(1560)$, $Z^*_1(1910)$, Σ(1780), Σ(3000), Ξ(1705), and $\Xi_?(2270)$.
* 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.

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

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, Balatonvilaeos, 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 Elementary Particles, 1963
STANFORD	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.

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Alan Rittenberg has generously provided us with the nice routines which plot histograms and ideograms, and J. Peter Berge has as always been more than helpful with our fitting programs. Professor Gaurang Yodh helped us with the baryon table and the summary Chew–Frautschi plot for the baryons. This whole work is probably still littered with mistakes and omissions, but it would be far worse were it not for the help of many friends who have carefully read our listings and tables and tried to set us right.

DATA FOR TABLES ON STABLE PARTICLES

STABLE MEANING IMMUNE TO STRONG DECAY

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

    N  ANY SYMBOL IN COLUMN 8 INDICATES DATA IGNORED BY AVERAGING PROGRAMS

        1         2         3         4         5         6         7         8
*4567890123456789012345678901234567890123456789012345678901234567890123456789012345678
```

γ

```
                    0 GAMMA (0,J=1)
****** ********* ********* ********* ********* ********* ********* *********
```

ν_e

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

                    1  E-NFUTRINO  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

****** ********* ********* ********* ********* ********* ********* *********

                          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

****** ********* ********* ********* ********* ********* ********* *********

                          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

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****** ********* ********* ********* ********* ********* ********* *********
```

e

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

                    3  ELECTRON  MASS (MEV)

M          0.511006 0.000002         COHEN     65 RVUE

------ --------- --------- --------- --------- --------- --------- ---------

                3  ELECTRON LIFETIME (UNITS 10**21 YR)

T    *     OVER                 2.0   MOE       65 CNTR                      6/66

------ --------- --------- --------- --------- --------- --------- ---------

                    3  ELECTRON MAGNETIC MOMENT(E/2ME)

MM   *     1.0011609 .0000024        SCHUPP    61 CNTR  -
MM         1.001159622  +-(27)*10**-9 WILKINSON 63 CNTR -                    8/66
MM   *     1.001168 0.000011         RICH      66 CNTR +  POSITRON           8/66

****** ********* ********* ********* ********* ********* ********* *********

                          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

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μ

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                    4  MUON  (106,J=1/2)

                    4  MUON  MASS (MEV)

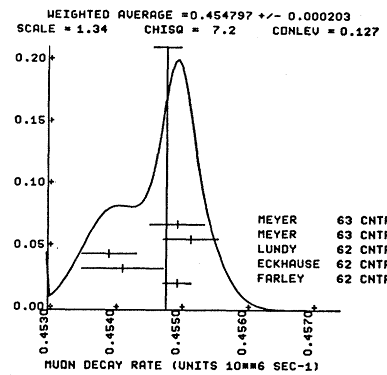
M          105.659    0.002          FEINBERG  63 RVUE

------ --------- --------- --------- --------- --------- --------- ---------

                    4  MUON LIFETIME (UNITS 10**-6)

T    N        2.200    0.015    0.015 FISHER    59 CNTR
T    N        2.225    0.006    0.006 ASTBURY   60 CNTR
T    N        2.211    0.003    0.003 REITER    60 CNTR
T    N        2.208    0.004    0.004 TELEGDI   60 CNTR
T    N  OLD DATA NEGLECTED FOLLOWING SUGGESTION OF V.TELEGDI

T             2.198    0.001    0.C01 FARLEY    62 CNTR
T             2.202    0.003    0.003 ECKHAUSE  62 CNTR
T             2.203    0.002          LUNDY     62 CNTR CONV. FROM CL=;98    9/66
T             2.197    0.002    0.002 MEYER     63 CNTR +
T             2.198    0.002    0.002 MEYER     63 CNTR -                    7/66
                               (Ideogram below)
------ --------- --------- --------- --------- --------- --------- ---------
```

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                    4  RATIO OF LIFETIME OF MU+ TO MU-

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

------ --------- --------- --------- --------- --------- --------- ---------

                    4  MUON PARTIAL DECAY MODES

P1      MUON INTO E (E-NEU) (MU-NEU)                     S 3S 1S 2
P2      MUON INTO E 2GAMMA                               S 3S 0S 0
P3      MUON INTO 3ELECTRONS                             S 3S 3S 3
P4      MUON INTO E GAMMA                                S 3S 0

------ --------- --------- --------- --------- --------- --------- ---------

                    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

------ --------- --------- --------- --------- --------- --------- ---------

                    4  MUON  MAGNETIC MOMENT (IN E/(2*MUON MASS)

MM          1.001162 0.000005        CHARPAK   62 CNTR +
MM          1.001165 0.000003        FARLEY    66      - STORAGE RINGS    11/66

****** ********* ********* ********* ********* ********* ********* *********

                          REFERENCES
                          4  MUON  (106,J=1/2)

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

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,ANDERSON,BLESER,LEDERMAN+//COLUM
PARKER    64 PR 133B 768        S PARKER,H L ANDERSON,C REY //////// EFINS
FARLEY    66  BERKELEY CONF.    FARLEY,BAILEY,BROWN,GIESCH +       // CERN

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$\pi^{\pm}$

```
                    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    0.014         SHAFER    65 CNTR                       6/66

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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

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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/  6/66
T                25.6      0.3             BARDON     66 CNTR                  6/66
T                25.9      0.3             DUNAITSEV  66 CNTR                  9/66
T                26.40     0.08            KINSEY     66 CNTR +                6/66
T                26.67     0.24            LOBKOWICZ  66 CNTR                  9/66
T                26.6      0.2             AYRES      66 CNTR                 10/66
                           (Ideogram below)
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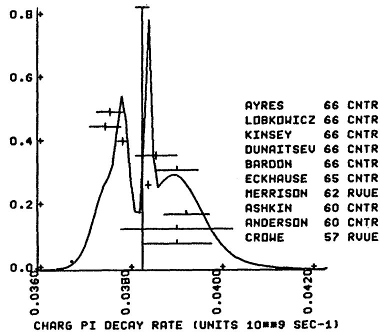
WEIGHTED AVERAGE =0.038302 +/- 0.000139
SCALE = 2.78   CHISQ = 30.9   CONLEV = .001

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

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

LR           0.56      0.28            AYRES     66 CNTR                   10/66
LR           0.23      0.40            LOBKOWICZ 66 CNTR     SEE NOTE L     9/66
LR  L    ABOVE IS THE MOST CONSERVATIVE VALUE QUOTED BY AUTHORS             9/66
LR           0.4       0.7             BARDON    66 CNTR                    7/66

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                      8  CHARGED PION PARTIAL DECAY MODES

P1      CHAR.PION INTO MU (MU-NEU)                          S 4S 2
P2      CHAR.PION INTO E (E-NEU)                            S 3S 1
P3      CHAR.PION INTO MU (MU-NEU) GAMMA                    S 4S 2S 0
P4      CHAR.PION INTO PIO E (E-NEU)                        S 9S 3S 1
P5        CHAR.PION INTO E NEU GAMMA                        S 3S 1S 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

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

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            1.01      0.08      0.10 DEPOMMIER 66 CNTR                    6/66

R4  *   CHAR.PION INTO E NEU GAMMA (UNITS 10**-8)       (P5)/(P1)
R4     143    3.0       0.5            DEPOMMIER 63 CNTR                    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,RCSEN ///// 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
SHAFER   65 UCRL 16365 THESIS ROBERT E SHAFER ///////////////////////// LRL
REPLACES 65 PRL 14 923            R E SHAFER,K M CROWE,D A JENKINS ///// LRL

AYRES    66  PREPRINT             D.S.AYRES,CALDWELL,GREENBERG,KURZ+  // LRL
BARDON   66 PRL 16 775            BARDON,DORE,DORFAN,KRIEGER + //// COLUMBIA
DEPOMMIE 66   PRIV COMM           DEPOMMIER,SOERGEL //////////////////// CERN
DUNAITSE 66 PL  23  283           DUNAITSEV,KUTYIN,PROKOSHKIN + // SERPUKHOV
KINSEY   66 PR 144   1132         KINSEY,LOBKOWICZ,NORDBERG //ROCHESTER UNIV
LOBKOWIC 66 PRL  17  548          LOBKOWICZ,MELISSINOS,NAGASHIMA+ //ROCH+BNL

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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

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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
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       EMULSION MEASUREMENTS NOT USED BECAUSE OF POSSIBLE SYSTEMATIC
T   N       SHIFT TO LARGER LIFETIME VALUES

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                      9  NEUTRAL PION PARTIAL DECAY MODES

P1      PIO INTO 2GAMMA                                     S 0S 0
P2      PIO INTO E+ E- GAMMA                                S 3S 3S 0
P3      PIO INTO 4ELECTRONS                                 S 3S 3S 3S 3
P4        PIO INTO 3 GAMMA                                  S 0S 0S 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

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

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                    6/66
R3  N       ABOVE VALUE USES PANOFSKY RATIO=1.62

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                                  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+NRL
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
PETRUKHI 63 SIENA CONF 208        V I PETRUKHIN,YU D PROKOSHKIN /////// JINR
VONCARDE 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

VASILEVS 66 PL   23  281          VASILEVSKY,VISHNYAKOV,DUNAITSEV + // DUBNA

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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  -

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M           493.78     0.17               GREINER   65 EMUL +   VIA TAU DECAY   7/66

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                      10  CHAR.K  LIFETIME (UNITS 10**-8)

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  BOYARSKY  62 CNTR +
T              1.2443    0.0038           FITCH     65 CNTR +                   6/66
T              1.2265    0.0036           LOBKOWICZ 66 CNTR +                   9/66
                         (Ideograms on next page)
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                      10 LIFETIME DIFFERENCE,(+)-(-)/AVGE. (PERCENT)

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

LR             0.049     0.097            LOBKOWICZ 66 CNRT      SEE NOTE L     9/66
LR  L    ABOVE IS THE MOST CONSERVATIVE VALUE QUOTED BY AUTHORS                 9/66

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                    10  CHARGED K PARTIAL DECAY MODES

P1      CHAR. K INTO MU (NEU)                 K MU          S 4S 2
P2      CHAR. K INTO PI PIO                   K PI          S 8S 9
P3      CHAR. K INTO PI PI+ PI-               TAU           S 8S 8S 8
P4      CHAR. K INTO PI 2PIO                  TAU PRIME     S 8S 9S 9
P5      CHAR. K INTO MU PIO NEU               K MU          S 4S 9S 2
P6      CHAR. K INTO E PIO NEU                K E           S 3S 9S 1
P7      POSIT.K INTO PI+ PI- E+NEU            K E+          S 8S 8S 3S 1
P8      POSIT.K INTO PI+ PI+ E-NEU            K E-          S 8S 8S 3S 1
P9       POSIT.K INTO PI+ PI- MU+ NEU         K+MU+ 4       S 8S 8S 4S 2
P10      POSIT.K INTO PI+ PI+ MU- NEU         K+MU- 4       S 8S 8S 4S 2
P11      CHAR. K INTO E NEU                   K E 2         S 3S 1
P12      CHAR. K INTO MU NEU GAMMA            K MU RAD      S 4S 2S 0
P13      CHAR. K INTO PI PIO GAMMA            K PI RAD      S 8S 9S 0
P14      CHAR. K INTO PI PI+ PI- GAMMA        TAU RAD       S 8S 8S 8S 0
P15      CHAR. K INTO PI E+ E-                PI E E        S 8S 3S 3
P16      CHAR. K INTO PI MU+ MU-              PI MU MU      S 8S 4S 4

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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 +

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
R2  *        21.6       0.6             TRILLING  65 RVUE                   6/66

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            5.1       0.2             SHAKLEE    64 XBC  +                9/66
R3            5.71      0.15            DE MARCO  '65 HBC                   6/66
R3            6.0       0.4             YOUNG      65 EMUL +                6/66
                          (Ideogram on next page)
R4  *  CHAR. K INTO PI 2PIO (TAU PRIME)(UNITS 10**-2)      (P4)/TOTAL
R4  O    '    2.1       0.5             BIRGE      56 EMUL +
R4  O         2.2       0.4             ALEXANDER 57 EMUL +
R4  O         1.5       0.2             TAYLOR     59 EMUL +

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

R6  *  CHAR. K INTO E PIO NEU (E3)     (UNITS 10**-2)      (P6)/TOTAL
R6  O         3.2       1.3             BIRGE      56.EMUL +
R6  O         5.1       1.3             ALEXANDER 57 EMUL +

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

R8  *  POSIT.K INTO PI+ PI+ E- NEU     (UNITS 10**-5)      (P8)/TOTAL
R8            0.2     OR LESS           BIRGE      65 FBC  + 95 PER CT CONF 8/66
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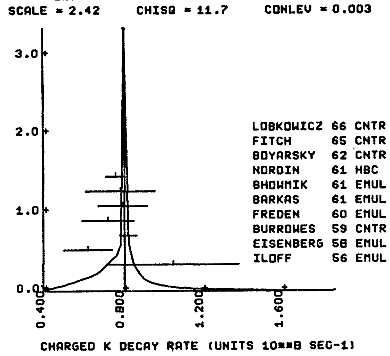
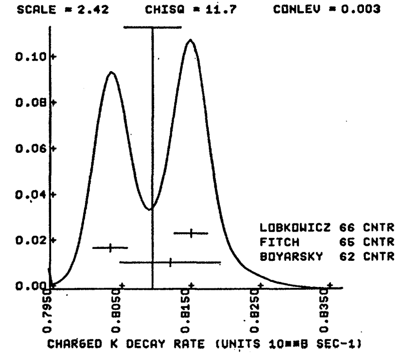
WEIGHTED AVERAGE =0.80971 +/- 0.00403
SCALE = 2.42   CHISQ = 11.7   CONLEV = 0.003



NOTE: Ideogram above contains all the data. Ideogram below contains only those in the central peak.

WEIGHTED AVERAGE =0.80979 +/- 0.00403
SCALE = 2.42   CHISQ = 11.7   CONLEV = 0.003

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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 *         16.0   OR LESS           BORREANI   64 HBC  +                 8/66
R11 *     4    1.9       1.2           BOWEN      66 SPRK +                 8/66

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 55-90 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

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

R17 *   CHAR. K INTO (PI PIO)/TAU                       (P2)/(P3)
R17 N          3.26      0.23          ROE        61 XBC  +                 8/66
R17 N   KMU RAD VS KMU3 SORTING DIFFICULTIES SUSPECTED BY AUTHORS           9/66
R17            4.40      0.23          SHAKLEE    64 XBC  +                 8/66
R17     134    3.24      0.34          YOUNG      65 EMUL +                 8/66
R17    1045    3.96      0.15          CALLAHAN   66 FBC                    9/66
                    (Ideogram on next page)
R18 *   CHAR. K INTO (PI 2PIO)/TAU                      (P4)/(P3)
R18            0.30      0.04          ROE        61 XBC  +                 8/66
R18            0.35      0.04          SHAKLEE    64 XBC  +
R18    2027    0.303     0.009         BISI       65 H+HL +                 8/66
R18      17    0.393     0.099         YOUNG      65 EMUL +                 8/66

R19 *   CHAR. K INTO (MU PIO NEU)/TAU                   (P5)/(P3)
R19 N          0.84      0.14          ROE        61 XBC  +                 8/66
R19 N   KMU RAD VS KMU3 SORTING DIFFICULTIES SUSPECTED BY AUTHORS           9/66
R19            0.59      0.10          SHAKLEE    64 XBC  +                 8/66
R19    2175    0.632     0.035         BISI       65 H+HL +                 8/66
R19      38    0.90      0.16          YOUNG      65 EMUL +                 8/66
R19     650    0.525     0.032         CALLAHAN   66 FBC                    9/66
                    (Ideogram on next page)
R20 *   CHAR. K INTO (E PIO NEU)/TAU                    (P6)/(P3)
R20            0.88      0.11          ROE        61 XBC  +                 8/66
R20     230    0.90      0.06          BORREANI   64 HBC  +                 8/66
R20            0.92      0.08          SHAKLEE    64 XBC  +
R20      37    0.90      0.16          YOUNG      65 EMUL +                 8/66
R20     864    0.727     0.028         CALLAHAN   66 FBC                    9/66
                    (Ideogram on next page)
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

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

R23 *   CHAR. K INTO (E PIO NEU)/(M2 + P2)(UNITS 10**-2)(P6)/(P1+P2)
R23    1679    5.89      0.16          CESTER     66 SPRK +                 8/66

R24 *   CHAR. K INTO (PI PIO)/(MU NEU)                  (P2)/(P1)
R24            0.3253    0.0062        AUERBACH   66 SPRK +                 8/66

R25 *   CHAR. K INTO (E PIO NEU)/(MU NEU)               (P6)/(P1)
R25            0.0796    0.0054        AUERBACH   66 SPRK +                 8/66

R26 *   CHAR. K INTO (MU PIO NEU)/(MU NEU)              (P5)/(P1)
R26            0.0602    0.0043        AUERBACH   66 SPRK +                 8/66
R26            0.059     0.004         TSIPIS     66 SPRK +                 9/66

R27 *   CHAR. K INTO (MU NEU)/(TAU)                     (P1)/(P3)
R27 R   427   10.38      0.82          YOUNG      65 EMUL +                 9/66
R27 R ONLY YOUNG MEASURED MU2 DIRECTLY. SEE NOTE PRECEDING THE K+ BRANCHING
        RATIOS LISTINGS

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1. In a number of experiments, the Kμ2 branching ratio is not determined from kinematically identified events, but essentially by subtracting the sum of other branching ratios from one. Since our averaging program applies this constraint, we omit those unmeasured branching ratios from the input.

2. The tau branching ratios are not all in agreement within the stated errors. Since one would expect the number of taus to be reliably determined in each case, we take this to indicate a systematic error in the total number of K-decays, which would be reflected in errors in the other branching ratios.

Since there are some recent and precise measurements of the tau branching ratio, the following method has been devised. The ratio of the other modes to the number of taus is taken whenever appropriate (of course, in a number of experiments this is the quantity actually measured, with some value of the tau branching ratio being used to convert this measurement to an absolute branching ratio). All the recent measurements of the tau branching ratio are used, and together with the ratios of other modes to taus, are entered in the averaging program.

If there is, as suspected, a large correlation between the tau branching ratio and the other branching ratios, in the presence of certain kinds of systematic errors, this method takes advantage of it, with an unimportant increase in the quoted errors.

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

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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,JOHNSTON,OCEALLAIGH//DUBLIN INST
COHEN    57 FUND.CONS.PHYS.    E R COHEN,K M CROWE,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
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,RITSON ////////// MIT

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
BORREANI 64 PL   12 123        G BORREANI,G RINAUDO,A WERBROUCK /// TURIN
CALLAHAN 64 PR   136 B 1463    A CALLAHAN,R MARCH,R STARK ///// WISCONSIN
CAMERINI 64 PRL  13 318        CAMERINI,CLINE,FRY,POWELL // WISCONSIN+LRL
CLINE    64 PRL  13 101        D CLINE, W F FRY /////////////// WISCONSIN
GREINER  64 PRL  13 284        D GREINER, W OSBORNE, W BARKAS /////// LRL
SHAKLEE  64 PR   136 B 1423    SHAKLEE,JENSEN,ROE,SINCLAIR ///// MICHIGAN

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
CALLAHAN 65 PRL   15  129      A CALLAHAN,D CLINE ///////////// WISCONSIN
CAMERINI 65 NC    37 1795      CAMERINI,CLINE,GIDAL,KALMUS,KERNAN/WIS+LRL
CLINE    65 PL    15  293      A CLINE,W F FRY //////////////// WISCONSIN
DE MARCO 65 PR 140 B 1430      DE MARCO,GROSSO,RINAUDO ////// TURINO+CERN
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 AN UPDATE OF HIS REPORT AT THE 1965 ARGONNE CONF, P 115)
YOUNG    65 UCRL 16362         POH-SHIEN YOUNG (THESIS,BERKELEY) //// LRL

AUERBACH 66  BERKELEY 28       AUERBACH,MANN,WHITE,YOUNT+//PENN-PRINCETON
BOWEN    66  BERKELEY 28       BOWEN,MANN,MCFARLANE,HUGHES+/PENN-PRINCETO
CALLAHAN 66 NC 44A 90          A C CALLAHAN                   // WISCONSIN
CESTER   66 PL 21 343          CESTER,ESCHSTRUTH,ONEILL+ //PRINCETON-PENN
LOBKOWIC 66 PRL  17  548       LOBKOWICZ,MELISSINOS,NAGASHIMA+ //ROCH+BNL
TSIPIS   66  BERKELEY CONF     +MEYER,ROSEN+ //COLUMBIA+RUTGERS+ROCH+WISC

     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

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 FRCM PBAR P   6/66
M    4500  498.9    0.5           BALTAY    66 HBC    KO FROM PBAR P   6/66
```

(Ideogram below)

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     17   4.18    0.18         ENGELMANN 65 HBC                       6/66
D     25   3.71    0.35         KIM       65 HBC  -  K- P TO KO N      6/66

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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
ENGELMAN 65    PRI COMM        ENGLEMAN,FILTHUTH ///////////// HEIDELBERG
KIM      65 PR 140 B 1334      J K KIM,L KIRSCH,D MILLER /////// COLUMBIA
BALTAY   66 PR 142    932      BALTAY,SANDWEISS,STONEHILL +    //YALE+BNL

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K^0_1

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

12 KO1 LIFETIME (UNITS 10**-10)

```
T        90    1.07     0.13     0.13  BOLDT      58 CC
T   U    62    0.81     0.23     0.15  BROWN      58 PBC
T   U    29    0.84     0.35     0.19  COOPER     58 CC
T   U    39    1.15     0.40     0.25  BLUMENFEL  58 CC
T   U   259    1.06     0.08     0.06  EISLER     58 PBC
T   U   UNPUBLISHED DATA EXCLUDED

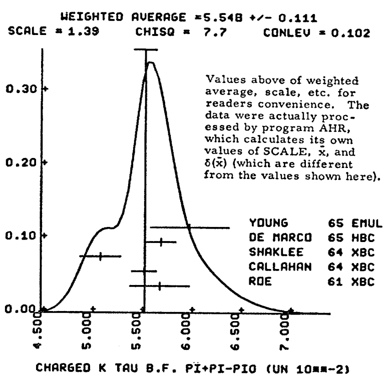
T       512    0.94     0.05     0.05  CRAWFORD   59 HBC
T        63    1.09     0.18     0.15  BOWEN      60 CC
T       378    0.94     0.05     0.05  BERTANZA   62 HBC
T       503    0.87     0.05           CHRETIEN   63 PBC
T       545    0.86     0.04           KREISLER   64 SPRK

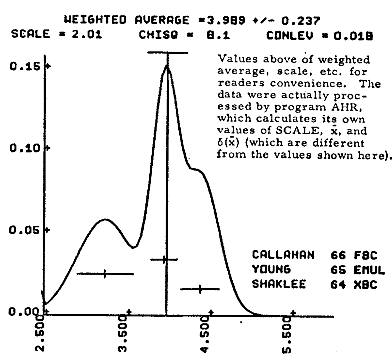
T       572    0.91     0.04           AUERBACH   65 SPRK                 6/66
T              0.866    0.016          ALFF-STEI  66 SPRK                 9/66
T      4500    0.92     0.04           BALTAY     66 HBC                  6/66
T              0.904    0.024          BOTT-BODE  66 SPRK                 9/66
T              0.858    0.014          HILL       66 DBC                  9/66
T      5000    0.843    0.013          KIRSCH     66 HBC                  6/66
```

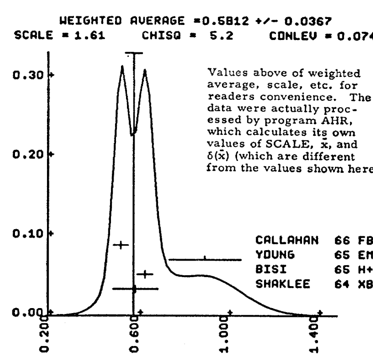
(Ideogram below)

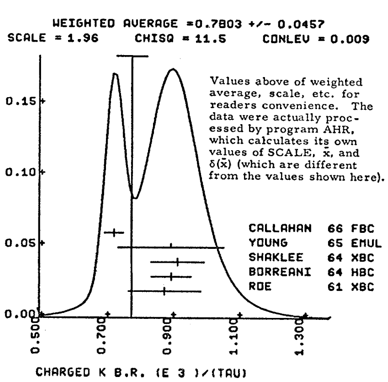
12 KO1 PARTIAL DECAY MODES

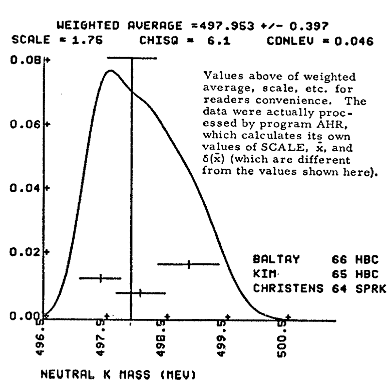
```
P1     KO1 INTO PI+ PI-                                    S 8S 8
P2     KO1 INTO PIO PIO                                    S 9S 9
```

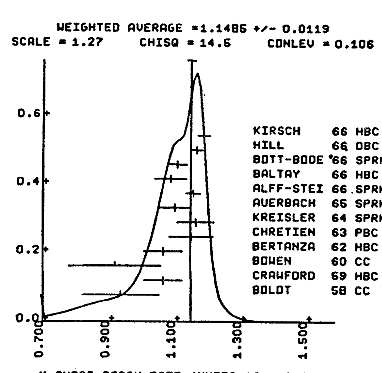












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                    12  K01  BRANCHING RATIOS

R1  *  K01 INTO (PI+ PI-)/TOTAL                              (P1)/TOTAL
R1          0.68      0.04          CRAWFORD  59 HBC
R1          0.70      0.08          COLUMBIA  60 HBC
R1          0.740     0.024         ANDERSON  62 HBC

R2  *  K01 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
                          (Ideogram below)
R3  *   (K01 INTO PI+ PI- PIO)/(K02 INTO PI+ PI- PIO)
R3          0.45  OR LESS           BEHR      66 HLBC   90 PER CT CONF    8/66

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

BLUMENFE 58 CERN CONF 272      H BLUMENFELD,W CHINCNSKY,L LEDERMAN//COLUM
BOLDT    58 PRL   1  150       E BOLDT,D O CALDWELL,Y PAL /////////// MIT
BROWN    58 CERN CONF 272      J BROWN,D GLASER + /////////////// MICHIGAN
COOPER   58 CERN CONF 272      W A COOPER,H FILTHUTH + ///// JUNGFRAUJUCH
EISLER   58 CERN CONF 272      F EISLER,R PLANO + // BNL+COL+BOLOGNA+PISA
CRAWFORD 59 PRL   2  266       CRAWFORD,CRESTI,DOUGLASS,GOOD,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+WISCONSIN
BOWEN    60 PR  119 2030       BOWEN,HARDY,REYNOLDS,SUN,MCORE+/PRINCE+BNL
COLUMBIA 60 ROCH CONF 727      M SCHWARTZ + //////////////////// COLUMBIA
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 AUTHORS,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+BROWN+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
  (THIS IS AN UPDATED VERSION OF REPORT AT 1965 ARGONNE CONF, PAGE 115)

ALFF-STE 66 PL 21 595          ALFF-STEINBERGER,HEUER,KLEINKNECHT +//CERN
BALTAY   66 PR 142   932       BALTAY,SANDWEISS,STONEHILL + /// YALE+BNL
BOTT-BOD 66      BERKELEY CONF. BOTT-BODENHAUSEN,DE BOUARD +       // CERN
HILL     66      BERKELEY CONF. HILL,ROBINSON,SAKITT +       // BNL+CARNEGIE
KIRSCH   66 PR  147  939       L KIRSCH,P SCHMIDT ////////////// COLUMBIA

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K^0_2

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

               13  K02-K01  MASS DIFFERENCE (UNITS OF INVERSE K01 LIFE)

D  *          1.9       0.3            FITCH     61 CNTR
D             0.84      0.29      0.21 GOOD      61 PBC
D  *          1.5       0.2            CAMERINI  62 PBC
D             0.5       0.1            CHRISTENS 63 SPRK

D             0.47      0.21           AUBERT    65 PBC                     6/66
D             0.26      0.36      0.26 BALDO-CEO 65 PBC     ASS.CP CONS.
D  *          0.60  OR LESS            FITCH     65 SPRK    CF. MEISNER 56  7/66

D             0.445     0.034          ALFF-STEI 66 SPRK                    6/66
D             0.52      0.15      0.16 BALATZ    66 SPRK                    9/66
D             0.480     0.024          BOTT-BODE 66 SPRK                    9/66
D        72 + 0.64      0.18           CANTER    66 DBC     KO SCATTER IN D2 11/66
D             0.55      0.1            CHRISTENS 66 SPRK                    6/66
D             0.72      0.15           FUJII     66 SPRK    IRON REGENERATOR 9/66

D           + 0.62      0.16           HILL      66 DBC     KO+D INTO HYPER.  9/66
D            +0.35      0.15           JOVANOVIC 66 SPRK    C+URANIUM REGEN. 11/66
D           + 0.44      0.06           MEHLHOP   66 SPRK                    9/66
D        59   0.65      0.30           MEISNER 1 66 HBC     SEE NOTE A      6/66
D  M        + SIGN FAVORED             MEISNER 2 66 HBC                     9/66
D             0.59      0.07           MISCHKE   66 SPRK                    9/66
                          (Ideogram below)
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               13  K02 LIFETIME (NANOSEC)       (MICROSEC)

T  *   ASSUMED DS=DQ AND DELTA I=1/2 CRAWFORQ  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             0.054     0.06            FUJI      64 SPRK
T    1700     0.061     0.015     6.0   ASTBURY 3 65 CC
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                    13  K02 PARTIAL DECAY MODES

P1      K02 INTO 3PIO                                        S 9S 9S 9
P2      K02 INTO PI+ PI- PIO                                 S 8S 8S 9
P3      K02 INTO PI MU NEUTRINO                              S 8S 4S 2
P4      K02 INTO PI E NEUTRINO                               S 8S 3S 1
P5      K02 INTO PI+ PI-                                     S 8S 8
P6      K02 INTO MU+ MU-                                     S 4S 4
P7        K02 INTO E+ E-                                     S 3S 3
P8        K02 INTO E MU                                      S 3S 4
P9        K02 INTO TWO GAMMAS                                S 0S 0
P10       K02 INTO PI+ PI- GAMMA                             S 8S 8S 0
P11       K02 INTO PIO PIO                                   S 9S 9

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                    13  K02 DECAY RATES

W1  *  K02 INTO PIO PIO PIO        (UNITS 10**6 SEC-1)  (P1)
W1      54    5.22   1.03      C.84  BEHR      66 HLBC    ASSUMES CP      8/66

W2  *  K02 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
                        (Ideogram below)
W3  *  K02 INTO PI E NEUTRINO      (UNITS 10**6 SEC-1)  (P4)
W3            8.1       1.0          AUBERT    65 HLBC                    8/66

W4  *  K02 INTO CHARGED (3-BODY)   (UNITS 10**6 SEC-1)  (P2+P3+P4)
W4     107   14.7       1.8          AUERBACH  65 SPRK USING NEW K1 LIFE  6/66

W5  *  K02 INTO LEPTONIC (KMU3+KE3) (UNITS 10**6 SEC-1) (P3+P4)
W5     109    9.4       1.3          FRANZINI  65 HBC                     6/66
W5     204   10.3       0.8          CHO       66 DBC                     9/66
W5      54   11.3       1.9          GOLDEN    66 HBC                     9/66

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                    13  K02 BRANCHING RATIOS

R1  *  K02 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

R2  *  K02 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.C4  ASTBURY 1 65 CC                      8/66
R2     326    0.159     0.015        ASTBURY 2 65 CC                      6/66
R2     566    0.178     0.017        GUIDONI   65 HBC                     6/66
R2    1729    0.144     0.004        HOPKINS   65 HBC                     6/66
R2     126    0.162     0.015        HAWKINS   66 HBC                     6/66
R2     180    0.17      0.03         KULYUKINA 66 CC                      9/66

R3  *  K02 INTO (PI MU NEUTRINO)/CHARGED                (P3)/(P2+P3+P4)
R3     479    0.356     0.07         LUERS     64 HBC
R3            0.39      0.08   0.10  ASTBURY 1 65 CC                      7/66
R3     330    0.32      0.07         KULYUKINA 66 CC                      9/66

R4  *  K02 INTO (PI E NEUTRINO)/CHARGED                 (P4)/(P2+P3+P4)
R4     479    0.487     0.05         LUERS     64 HBC
R4            0.46      0.08   0.10  ASTBURY 1 65 CC                      7/66
R4     500    0.51      0.06         KULYUKINA 66 CC                      9/66

R5  *  K02 INTO (PI E NEU)/((PI E NEU)+(PI MU NEU))     (P4)/(P3+P4)
R5     320    0.415     0.120        ASTIER    61 CC

R6  *  K02 INTO(PI+ PI- PIO)/TOTAL                      (P2)/TCTAL
R6      16    0.18      0.05         STERN     64 HBC

R7  *  K02 INTO(LEPTON PI NEUTRINO)/TOTAL               (P3+P4)/TOTAL
R7      14    0.58      0.17         ALEXANDER 62 HBC

R8  *    K02 INTO (2 GAMMA)/TOTAL    (UN. 10**-4)       (P9)/TOTAL
R8            1.3       0.6          CRIEGEE   66 SPRK                    8/66

R9  *  K02 INTO (PI+ PI-)/CHARGED    (UNIT 10**-3)      (P5)/(P2+P3+P4)
R9      45    2.0       0.4          CHRISTENS 64 SPRK
R9      54    2.08      0.35         GALBRAITH 65 SPRK
R9            1.97      0.18         CRONIN    65 SPRK                    6/66
R9            1.93      0.26         BASILE    66 SPRK                    9/66
R9            1.993     0.080        BOTT-BODE 66 SPRK                    9/66
R9            2.22      0.27         DEKKERS   66 CNTR                    6/66

R10 *  K02 INTO (PI MU NEU)/(PI E NEU)                  (P3)/(P4)
R10           0.81      0.19         ADAIR     64 HBC                     6/66
R10           0.78      0.15         DE BOUARD 65 CNTR

R11 *  K02 INTO (MU+MU-)/CHARGED   (UNITS 10**-4)       (P6)/(P2+P3+P4)
R11 *         1.0 OR LESS            ANIKINA   65 CC                      6/66
R11 *         2.     OR LESS         DE BOUARD 65 SPRK                    8/66
R11 *         0.5    OR LESS         ABASHIAN  66 SPRK   90 PER CT CONF   8/66
R11 *         2.5   OR LESS          ALFF      66 SPRK   0.90 CONF. LEVEL 9/66
R11 *         0.05  OR LESS          BOTT-BODE 66 SPRK   0.70 CONF.LIMIT  9/66
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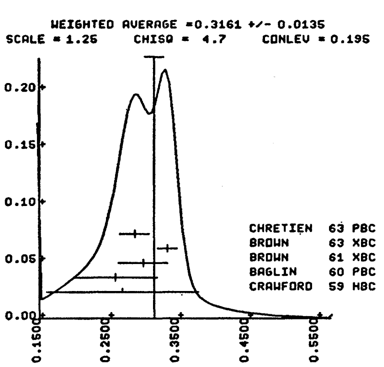

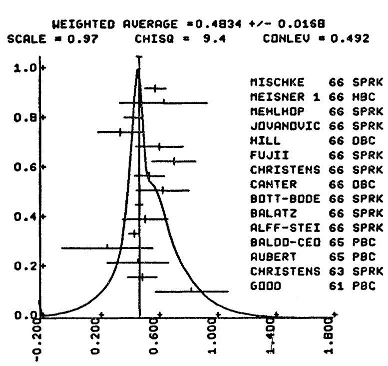

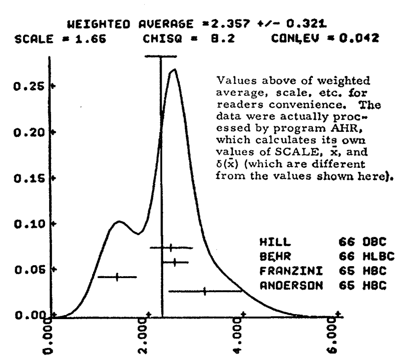

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R12 *     K02 INTO (PI+ PI- GAMMA)/TOTAL (UNITS 10**-3)  (P10)/TOTAL
R12 *          15.0 OR LESS                 ANIKINA   65 CC                       6/66
R12 *           3.0 OR LESS                 NEFKENS   66 SPRK                     6/66

R13 *     K02 INTO (E+ E-)/CHARGED      (UNITS 10**-4)     (P7)/(P2+P3+P4)
R13 *          10.0 OR LESS                 ANIKINA   65 CC                       6/66
R13 *           1.     OR LESS              DE BOUARD 65 SPRK                     8/66
R13 *           0.5    OR LESS              ABASHIAN  66 SPRK   90 PER CT CONF    8/66
R13 *           2.0   OR LESS               ALFF      66 SPRK   0.90 CONF. LEVEL  9/66
R13 *           0.3   OR LESS               BOTT-BODE 66 SPRK   0.70 CONF.LIMIT   9/66

R14 *     K02 INTO (E MU)/CHARGED       (UNITS 10**-4)     (P8)/(P2+P3+P4)
R14 *          10.0 OR LESS                 ANIKINA   65 CC                       6/66
R14 *           0.5    OR LESS              ABASHIAN  66 SPRK   90 PER CT CONF    8/66

R15 *    K02 INTO(E+ PI- NEU)/(E- PI+ NEU)
R15     97     0.90      0.18               NEAGU     61 CC
R15            1.01      0.16               LUERS     64 HBC                      8/66
R15   2500     1.06      0.05               ABASHIAN  66 SPRK                     8/66
R15    894     0.99      0.023              KULYUKINA 66 CC                       9/66

R16 *    K02 INTO(MU+ PI- NEU)/(MU- PI+ NEU)
R16   3200     1.02    0.04                 ABASHIAN  66 SPRK                     8/66

R17 *      K02 INTO (PI0 PI0)/TOTAL  (UNITS 10**-3)     (P11)/TOTAL
R17      7     1.2       1.5       1.2      CRIEGEE   66 SPRK                     7/66

R18 *     K02 INTO (3PI0)/(PI+PI-PI0)                   (P1)/(P2)
R18    188     2.0       0.6                ALEKSANYA 64 FBC                      9/66

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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 PIRQUE,R PERKINS ///// PRINCETON
GOOD     61 PR 124 1223        GOOD,MATSEN,MULLER,PICCIONI,POWELL +// LRL

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 PRL 13 253         FUJII,JOVANOVICH,TURKOT,ZORN //BNL+MARYLND
LUERS    64 PR 133 B 1276      LUERS,MITTRA,WILLIS,YAMAMOTO ///////// 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
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
AUERBACH 65 PRL 14 192         AUERBACH,LANDE,MANN,SCIULLI + ////// PENNA
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, FOOTNOTE)

CRONIN   65   ARGONNE CONF 17 FITCH,ROTH,RUSS,VERNON-TO BE PUB/PRINCETON
DE BOUAR 65 PL  15  58         DE BOUARD,DEKKERS,SCHARFF+//CERN+ORSAY+MPI
FITCH    65 PRL 15 73          FITCH,ROTH,RUSS,VERNON ///////// 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
MESTVIRI 65 JINR P 2449        MESTVIRISHVILI,NYAGU,PETROV,RUSAKOV+//JINR
TRILLING 65 UCRL 16473         GEORGE H TRILLING //////////////////// LRL
   (THIS IS AN UPDATED VERSION OF REPORT AT 1965 ARGONNE CONF, PAGE 115)

ALFF     66 PL 21 595          ALFF-STEINBERGER,HEUER,RUBBIA +     // CERN
BALATZ   66     BERKELEY CONF. BALATZ,BEREZIN +                    // ITEP
BASILE   66  BALATON CONF      BASILE,CRONIN,THEVENET +          // SACLAY
BEHR     66  BERKELEY 2B       BEHR,BRISSON,BALDO CEOLIN,AUBERT+/PADUA,EP
BOTT-BOD 66 PL  23  277        BOTT-BODENHAUSEN,DE BOUARD,CASSEL+ // CERN

CANTER   66 PRL 17 942         +CHO,ENGLER,FISK,HILL +    // CARNEGIE+BNL
CHO      66  BERKELEY CONF     CHO,CANTER,DRALLE,ENGLER,FISK+ // CARN+BNL
CRIEGEE  66 PRL 17 150         +FOX,FRAUENFELDER,HANSON,MOSCAT+//ILLINOIS
DEKKERS  66 THESIS BRUSSELS    D DEKKERS + ////////////////////////// CERN
FUJII    66 PRL 13 253         FUJII,JOVANOVICH,TURKOT,ZORN//BNL+MARYLAND
  (FUJII 66 IS THE CORRECTED VALUE GIVEN BY JOVANOVICH+ 66)

GOLDEN   66  BERKELEY 2B       R.GOLDEN,F.CRAWFORD,D.STERN           // LRL
HAWKINS  66 PL 21 238          C J B HAWKINS ///////////////////////// YALE
HILL     66     BERKELEY CONF. HILL,ROBINSON,SAKITT +     // BNL+CARNEGIE
JOVANOVI 66 PRL 17 1075        JOVANOVICH,FUJII,TURKOT,ZORN +//BNL+MD+MIT
KULYUKIN 66  BERKELEY 2B       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
MISCHKE  66     BERKELEY CONF. + ABASHIAN,ABRAMS,CARPENTER +  // ILLINOIS
NEFKENS  66 PL 19 706          NEFKENS,ABASHIAN,ABRAMS,CARPENTER+ /// ILL

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

                    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  552.0     4.0           JAMES     66 HBC                          6/66

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                    14  ETA  WIDTH (MEV)

W    *   91   10.0   OR LESS              ALFF      62 HBC
W    *  325   16.0   OR LESS              KRAMER    64 DBC
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

W1   *  ETA INTO TWO GAMMAS, PARTIAL WIDTH
W1   *     BETWEEN 0.3 AND 3.0 KEV    LUEBBELSM 66 SPRK                    9/66

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                    14  ETA PARTIAL DECAY MODES

P1      ETA INTO 2GAMMA                                   S 0S 0
P2      ETA INTO 3PI0                                     S 9S 9S 9
P3      ETA INTO PI+ PI- PI0                              S 8S 8S 9
P4      ETA INTO PI+ PI- GAMMA                            S 8S 8S 0
P5      ETA INTO   E+E-PI0         VIOLATES C IN E.M.I.   S 9S 3S 3
P6      ETA INTO E+E-PI+PI-                               S 8S 8S 3S 3
P7      ETA INTO PI0 2GAMMA                               S 9S 0S 0
P8      ETA INTO E+E-GAMMA                                S 3S 3S 0
P9      ETA INTO 2PI0 GAMMA        VIOLATES C             S 9S 9S 0

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                    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
     N    THIS EXPERIMENT HAS NOT BEEN USED IN COMPUTING THE AVERAGES
     N  AS IT WAS UNABLE TO CLEARLY SEPARATE PARTIAL MODES (3) AND (4)
     N  FROM EACH OTHER.  THE REPORTED VALUE THUS PROBABLY CONTAINS
     N  SOME (UNKNOWN) FRACTION OF MODE (4), AS POINTED OUT BY E.C. FOWLER

R2   *  ETA INTO 2GAMMA/CHARGED                          (P1)/(P3+P4)
R2              0.99      0.48          CRAWFORD  63 HBC

R3   *    ETA INTO PI0 2GAMMA/NEUTRALS                   (P7)/(P1+P2+P7)
R3              0.375     0.072         DI GIUGNO 66 CNTR    ERROR DOUBLED  6/66
     *    THE ERRORS OF DIGIUGNO+ 66 HAVE BEEN INCREASED BY A FACTOR
     *  OF TWO, TO TAKE INTO ACCOUNT POSSIBLE SYSTEMATIC ERRORS, AS
     *  SUGGESTED BY THE AUTHORS.
R3               .19       .08          GRUNHAUS  66 SPRK                  7/66

R4   *  ETA INTO (PI+ PI- GAMMA)/(PI+ PI- PI0)           (P4)/(P3)
R4              0.14      0.08          FOELSCHE  64 HBC
R4   M   24     0.73      0.25          PAULI     64 DBC
     M    THIS EXPERIMENT HAS NOT BEEN INCLUDED IN THE AVERAGES SINCE
     M  IT IS NOT CLEAR THAT THEIR CLASS B EVENTS ARE ACTUALLY FROM ETAS.
R4              0.30      0.06          CRAWFORD1 66 HBC                   6/66
R4   N    9     0.27      0.10          PAULI     64 DBC                   6/66
R4   N THE PAULI VALUE BASED ON ONLY 9 EVENTS IS DUE TO CRAWFORD1 66
R4               .10       .10          KRAEMER   64 DBC                   7/66
R4               .196      .041         FOSTER3   65 HBC                   7/66

R5   *  ETA INTO 3PI0/(PI+ PI- PI0)                      (P2)/(P3)
     S  FOR THIS RATIO, SEE NOTES ON TABLE S FOLLOWING THIS LISTING
R5   S          0.83      0.32          CRAWFORD  63 HBC     ASSUM.P7/P2 = 0   7/66
R5   S          2.0       1.0           FOELSCHE  64 HBC     ASSUM.P7/P2 = 0   7/66
R5   S          0.90      0.24          FOSTER1   65 HBC     ASSUM.P7/P2 = 0   7/66
R5   N          0.38      0.15          CRAWFORD2 66 HBC  ASSUM.(P7)/(P2)=1.8  6/66
R5   N          0.41      0.11          FOSTER1   65 HBC  ASSUM.(P7)/(P2)=1.8  6/66
     N      GIVEN BY CRAWFORD2 66

R6   *  ETA INTO 2GAMMA/3PI0                             (P1)/(P2)
R6   *          1.1       0.3 OR LESS   CHRETIEN  62 PBC
R6   S          1.10      0.5           MULLER    63 DBC     ASSUM.P7/P2 = 0   7/66
 .   S      FOR PRECEDING CARD, SEE NOTES ON TABEL S FOLLOWING THIS LISTING.
R6   *          2.38 OR MORE            STRUGALSKI 66 HLBC                 9/66

R7   *  ETA INTO 2GAMMA/(PI+ PI- P0)                     (P1)/(P3)
R7              1.61      0.39          FOSTER    64 HBC

R8   *    ETA INTO NEUTRAL/(PI+ PI- PI0)                 (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

R9   *  ETA INTO  (E+E-PI0)/(PI+PI-PI0)  (UNITS 10**-2) (P5)/(P3)
R9   *  LESS THAN    1.1        1.1     PRICE     65 HBC
R9   *    0     0.77  OR LESS           FOSTER2   65 HBC
R9   *          0.45  OR LESS           BAGLIN    66 HLBC    0.9 CONF LEVEL  9/66

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             0.416     0.044         DI GIUGNO 66 CNTR    ERRCR DOUBLED  6/66
R12              .47       .06          GRUNHAUS  66 SPRK                  7/66

R13 *     ETA INTO 3PI0/NEUTRALS                         (P2)/(P1+P2+P7)
R13             0.209     0.054         DI GIUGNO 66 CNTR    ERROR DOUBLED  6/66
R13              .34       .04          GRUNHAUS  66 SPRK                  7/66

R14 *      ETA INTO PI0 2GAMMA/2GAMMA                    (P7)/(P1)         7/66
R14 *            .5   OR LESS           WAHLIG    66 SPRK    .9 CONF LEVL   7/66
R14             0.86      0.47          STRUGALSK 66 HLBC                  9/66

R15 *      ETA INTO (E+E-PI0)/TOTAL                      (P5)/TOTAL        7/66
R15 *           0.7 OR LESS             RITTENBER 65 HBC                   6/66

R16 *     ETA INTO 2GAMMA/(3PI0 + PI0 2GAMMA)            (P1)/(P2+P7)
R16             0.80       .25          BACCI     63 CNTR                  7/66

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                14  ETA C-NONCONSERVING DECAY PARAMETER

A    DECAY ASYMMETRY PARAMETER FOR PI+ PI- PI0
A      1351    7.2       2.8            BALTAY    66 DBC                   8/66
A       565    4.1       4.1            FOWLER    66 HBC                   8/66
A       705   -6.0       4.0            RUTH-SACL 66 HBC                   8/66
A     10665    0.3       1.0            FINOCCHIA 66 SPRK                  8/66
A      1300    5.8       3.4            OTHERS    66 HBC                   8/66
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(Ideogram on next page)

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B    DECAY ASYMMETRY PARAMETER FOR PI+ PI- GAMMA
B        33   -0.02      0.17           CRAWFORD1 66 HBC                  11/66

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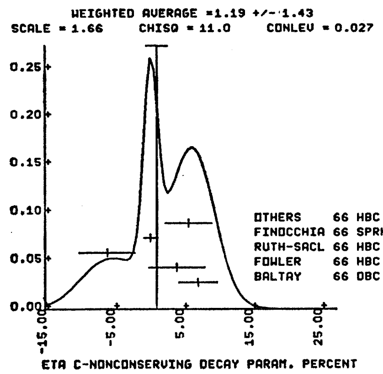

REFERENCES
14 ETA(549,JPG=0-+)I=0

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,FOWLER /////// LRL+DUKE
DELCOURT	63 PL 7 215	DELCOURT,LEFRANCCIS,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
PRICE	65 PRL 15 123	L.R.PRICE,F.S.CRAWFORD //LRL
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 //WISCONSIN
RITTENBE	65 PRL 15 556	RITTENBERG,KALBFLEISCH /////////// LRL+BNL
ALFF-STE	66 PR 145 1072	ALFF-STEINBERGER,BERLEY+//COLUMBIA+RUTGERS
BAGLIN	66 BERKELEY CONF	BAGLIN,BEZAGUET,DEGRANGE+ // EC.POLYT+LRL
ALSO	66 PL 22 219	BAGLIN,BEZAGUET,DEGRANGE+ // EC.POLYT+LRL
BALTAY	66 PRL 16 1224	+FRANZINI,KIM,KIRSCH+/COLUMBIA+STONY BROOK
CRAWFRD1	66 PRL 16 333	F.S.CRAWFORD,L.R.PRICE //LRL
CRAWFRD2	66 PRL 16 907	F S CRAWFORD,L LLOYD,E FOWLER //LRL+DUKE
DIGIUGNO	66 PRL 16 767	DIGIUGNO,GIORGI,SILVESTRI+//NAP+TRST+FRASC
JAMES	66 PR 142 896	F E JAMES,H L KRAYBILL ////////// YALE+BNL
GROSSMAN	66 PR 146 993	R GROSSMAN,L PRICE,F CRAWFORD //////// LRL
GRUNHAUS	66 THESIS	J.GRUNHAUS //COLUMBIA
LUEBBELS	66 BERKELEY 8A	LUEBBELSMEYER+ // BONN+
STRUGALS	66 BERK CONF	STRUGALSKI,CHUVILE,IVANOVSKAJA,+ //DUBNA
WAHLIG	66 PRL 17 221	WAHLIG,SHIBATA,MANNELLI //MIT+PISA

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
CRAWFRD1	66 PRL 16 333	F.S.CRAWFORD,L.R.PRICE //LRL
OTHERS	66 PR 149 1044	COLUMBIA,LRL,PURDUE,WISCONSIN,YALE
FOWLER	66 BAPS 11 380	E.C.FOWLER //DUKE
FINOCCHI	66 BERKELEY CONF	FINOCCHIARO,CNOPS,MULLER+//CERN+ZUR+SACLAY
RUTH-SAC	66 BERKELEY CONF	RUTHEFORD-SACLAY COLLABORATION

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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

16 PROTON LIFETIME (UNITS 10**26 YR)

T	*	OVER	1.5	BACKENSTO	60 CNTR	
T	*	OVER	60.0	KROPP	65 CNTR	6/66

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

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

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n

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

17 NEUTRON LIFETIME (UNITS 10**3 SEC)

T	1.01	0.03	0.03	SOSNOVSKI	59 PILE

17 NEUTRON MAGNETIC MOMENT (MAGNETONS,938.2 MEV)

MM	-1.913148	0.000066	COHEN	56 SPECIAL	7/66

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

COHEN	56 PR 104 283	V W COHEN, CORNGOLD, RAMSEY // BNL+HARVARD
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

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Λ

18 LAMBDA (1115,JP=1/2+) I=0

Hyperon Masses

For the Λ mass, there is a large discrepancy between the measurement of SCHMIDT 65 and the emulsion measurements reviewed by BHOWMIK 63. The former determination used range measurements in a hydrogen bubble chamber.

The Σ^- mass of SCHMIDT 65 (1196.53 ± 0.24 MeV) also obtained using HBC range measurements, is also in disagreement with previous emulsion determinations and with the one, by the same author, which does not use range measurements. Therefore, as a temporary procedure, we do not include any determinations of absolute masses which use range measurements in HBC. BURNSTEIN 64 has two sorts of measurements: absolute masses which again depend on HBC ranges, and mass differences; we have used only the latter. Both authors, P. Schmidt and G. Snow (representing Burnstein et al.) agree with this procedure.

18 LAMBDA MASS (MEV)

M	*	25	1115.06	0.41	ARMENTERO	62 HBC	ERROR IS STATIS.	
M	*		1115.27	0.36	BALTAY	62 HBC	ERROR IS STATIS.	
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						
	L	INCREASE IN PROTON MASS AND 11 KEV DECREASE IN CHARGED PION MASS.						
M	*		1115.4	0.2	BADIER	64 HBC	ERROR IS STATIS.	6/66
M	*	635	1115.86	0.09	BALTAY	65 HBC	ERROR IS STATIS.	6/66
M	N		1115.61	0.07	SCHMIDT	65 HBC		9/66
M	N	SEE NOTE PRECEDING LAMBDA MASS LISTINGS						
M			1115.6	0.4	LONDON	66 HBC		6/66

18 LAMBDA LIFETIME (UNITS 10**-10)

T	U	74	2.75	0.45	0.38	BLUMENFEL	58 CC	
T		188	2.63	0.21	0.21	BOLDT	58 CC	
T	U	61	2.08	0.46	0.31	BROWN	58 PBC	
T	U	40	3.04	0.78	0.51	COOPER	58 CC	
T	U	454	2.29	0.15	0.13	EISLER	58 HBC	
T		825	2.72	0.16	0.16	CRAWFORD	59 HBC	
T		140	2.72	0.29	0.27	BOWEN	60 CC	
T	U	748	2.58	0.11	0.11	BERTANZA	62 HBC	
T		186	2.60	0.28	0.20	C-C CHANG	62 HBC	
T	U	3447	2.52	0.08		FUNG	62 PBC	6/66
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		2213	2.452	0.056	0.054	ENGELMANN	66 HBC	9/66
T	U	UNPUBLISHED MEASUREMENTS (EXCEPT THESES) NOT INCLUDED IN AVERAGE						7/66

(Ideogram on next page)

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	-1.37	0.72	ANDERSON	64 HBC	
MM	151	-0.5	0.28	CHARRIERE	65 EMUL	
MM		-0.75	0.19	HILL	66 SPRK	9/66

18 LAMBDA PARTIAL DECAY MODES

P1	LAMBDA INTO PROTON PI-	S16S 8
P2	LAMBDA INTO NEUTRON PI0	S17S 9
P3	LAMBDA INTO PROTON MU- NEUTRINO	S16S 4S 2
P4	LAMBDA INTO PROTON E- NEUTRINO	S16S 3S 1

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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      903     0.643     0.016           HUMPHREY  62 HBC
R1              0.685     0.017           ANDERSON  62 HBC
                              (Ideogram below)
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

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
                              (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

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                        18  LAMBDA DECAY PARAMETERS

A-   *  ALPHA LAMBDA- (LAMBDA INTO PI- PROTON)
A-              0.62      0.05            CRONIN    63 CNTR                       6/66
A-     2529     0.747     0.086           MERRILL   66 HBC     FROM XI- DECAY     6/69
A-     4660     0.655     0.025           OVERSETH  66 SPRK    LAMBDA FROM PI-P   9/66
A-   *          0.663     0.022           BERGE     66 RVUE  INCLUDES ALL ABOVE   9/66

A0   *  ALPHA0 /ALPHA- FOR LAMBDA (L INTO PI0 N/L INTO PI- P)
A0              1.10      0.27            CORK      60 CNTR

AE         ALPHA LAMBDA E- (LAMBDA INTO PROTON E- NEUTRINO)
AE              0.06      0.19            BARLOW    65 SPRK                       7/66

F-   *   PHI ANGLE (TAN(PHI)=BETA/GAMMA)   (DEGREE)
F-             13.0      17.0             CRONIN    63 SPRK    LAMBDA FROM PI-P
F-     4660     6.0       7.5             OVERSETH  66 SPRK    LAMBDA FROM PI-P   9/66

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                                 REFERENCES
                                 18 LAMBDA (1115,JP=1/2+) I=0

EISLER    57 NC      5 1700      EISLER,PLANO,SAMIOS,SCHWARTZ + //COLUM+BNL
BLUMENFE  58 CERN CONF 270       H BLUMENFELD,W CHINOWSKY,L LEDERMAN//COLUM
BOLDT     58 PRL     1  148      E BOLDT,D O CALDWELL,Y PAL /////////// MIT
BROWN     58 CERN CONF 270       BROWN,GLASER,GRAVES,PERL,CRONIN + //  MICH
COOPER    58 CERN CONF 270       W A COOPER,H FILTHUTH + ///// JUNGFRAUJOCH
EISLER    58 CERN CONF 270       F EISLER,PLANO,BASSI + // BNL+COLUM+BOL+PI
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,REYNOLDS,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

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
BERTANZA  62 PREPRINT D105       BERTANZA,CONNOLLY,CULWICK,EISLER + /// BNL
CHANG     62 THESIS DUKE         CHUEN CHUEN CHANG /////////////////// DUKE
COOL      62 PR    127 2223      COOL,HILL,MARSHALL + ///// BNL+MIT+NYU+ANL
FUNG      62 BAPS    7  619      SUN YIU FUNG ////////////////////////// LRL
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

BALTAY    65 PR 140 B 1027       BALTAY,SANDWEISS,CULWICK,KOPP + //YALE+BNL
BARLOW    65 PL   18   64        J BARLOW,BLAIR,DUKE,MANN+//CERN+RUTH+PENNA
CHARRIER  65 PL    15    66      CHARRIERE,GIBSON+ //// EPUL+BRIST+CERN+MPI
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
ENGELMAN  66     BERKELEY CONF.  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
MERRILL   66  BERKELEY CONF      MERRILL,SHAFER,BERGE                 // LRL
     CF.  66 UCRL 16455          DEANE MERRILL (THESIS, BERKELEY) ///// LRL
OVERSETH  66  BERKELEY CONF      O.E OVERSETH, R F ROTH//MICHIGAN+PRINCETON
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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
     S  INCREASE IN PROTON MASS AND 21 KEV DECREASE IN PION MASS
M           1189.59      0.11             SCHMIDT   65 HBC                      9/66

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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            CARAYANNO 65 HBC                      6/66
T               0.83      0.018           CHANG     65 HBC                      6/66
T       381     0.80      0.07            COOK      66 SPRK                     7/66

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                     19  SIGMA+ MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

MM       43     1.2       1.5             BRISTOL   66 EMUL                     9/66
MM      381     1.5       1.1             COOK      66 SPRK                     7/66
MM              3.2       1.1             GOZA      66 EMUL        K- P         9/66
MM       44     3.1       1.4             SULLIVAN  66 EMUL    PHOTOPROD        9/66

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                     19  SIGMA+ PARTIAL DECAY MODES

P1      SIGMA + INTO PROTON PIO                           S16S 9
P2      SIGMA + INTO NEUTRON PI+                          S17S 8
P3      SIGMA + INTO NEUTRON PI+ GAMMA                    S17S 8S 0
P4      SIGMA + INTO LAMBDA E+ NEU                        S18S 3S 0
P5      SIGMA + INTO PROTON GAMMA                         S16S 0
P6      SIGMA + INTO NEUTRON MU+ NEUTRINO                 S17S 4S 2
P7      SIGMA + INTO NEUTRON E+ NEUTRINO                  S17S 3S 1

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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              0.46      0.02            CHANG     65 HBC                      6/66

R2   *  SIGMA+ INTO (NEUT PI+ GAM)/(PI+N) (UNITS 10**-4) (P3)/(P2)
R2      ABOUT                     0.4     COURANT   63 HBC

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        3     1.5       0.9             BAGGETT   66 RVUE    SEE NOTE B BELOW 9/66
R3   B  ABOVE EXP. CONTAINS 1 EVENT OF WILLIS + ASSUMES  S20R3=.00006            9/66

R4   *  SIGMA+  INTO (N MU+ NEU)/(PI+N)    (UNITS 10**-4) (P6)/(P2)
R4   *    1 EVENT SEEN,NO RATIO GIVEN. GALTIERI 62 EMUL
R4   *    0  LESS THAN             2.3  BURNSTEIN 63 HBC
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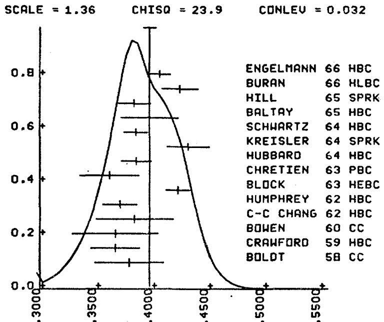
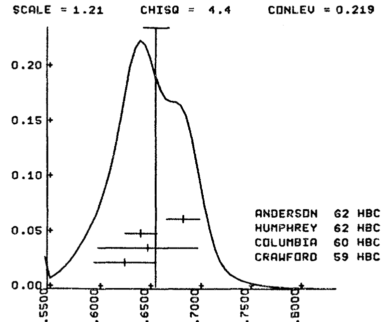
WEIGHTED AVERAGE =0.39844 +/- 0.00561
SCALE = 1.36   CHISQ = 23.9   CONLEV = 0.032



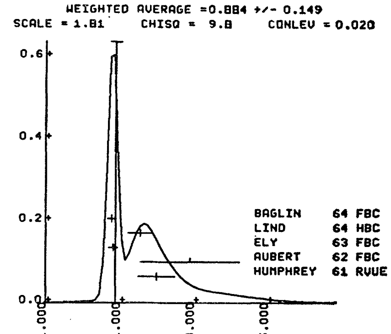
LAMBDA DECAY RATE (UNITS 10**10 SEC -1)

WEIGHTED AVERAGE =0.6579 +/- 0.0129
SCALE = 1.21   CHISQ = 4.4   CONLEV = 0.219



LAMBDA B.F. INTO P PI-

WEIGHTED AVERAGE =0.884 +/- 0.149
SCALE = 1.81   CHISQ = 9.8   CONLEV = 0.020



LAMBDA B.F. INTO P E- NEUTRINO

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R5  *  SIGMA+  INTO (N E+ NEU)/(N PI+)  (UNITS 10**-4)  (P7)/(P2)
R5  *    0 LESS THAN             2.6 BURNSTEIN 63 HBC
R5  *      LESS THAN         4.0     MURPHY    64 PBC
R5  *    1 LESS THAN            1.03 NAUENBERG 64 HBC

R6  *  SIGMA+  INTO (P GAMMA)/(P PIO)  (UNITS 10**-2)   (P5)/(P1)
R6  *    1    0.68  OR LESS          CARRARA   64 HBC
R6      24    0.37     0.08          BAZIN     65 HBC
R6       4    0.17                   QUARENI   65 EMUL                   6/66

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19 SIGMA+ DECAY PARAMETERS

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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

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 BANGER
AO    5200   -0.986    0.072         BANGERTER 66 HBC    K-P TO SIG+ PI-  7/66

F   *      PHI ANGLE (TAN(PHI)=BETA/GAMMA)  (DEGREE)
F      370  180.       30.           BERLEY    66 HBC  + NEUTRON RESCATT. 9/66

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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
PUSCHELL 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
COURANT  63 SIENA CONF  1 15  COURANT,FILTHUTH,BURNSTEIN+ // CERN+MD+NRL

BHOWMIK  64 NP 53 22          B BHOWMIK,P JAIN,P MATHUR,LAKSHMI // DELHI
BURNSTEI 64 PRL 13 66         BURNSTEIN,DAY,KEHOE,SECHI ZORN,SNOW /MARYL
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
CARAYAN  65 PR 138 B 433      CARAYANNOPOULOS,TAUTFEST,WILLMANN// PURDUE
CHANG    65 NEVIS 145  THESIS CHUNG YUN CHANG ////////////////// COLUMBIA
QUARENI  65 NC 40 A 928       QUARENI,CARTACCI + //////BOL+FIR+GEN+PARMA
SCHMIDT  65 PR 140 B 1328     P SCHMIDT ///////////////////////// COLUMBIA

BAGGETT  66        (PREPRINT) BAGGETT,DAY,GLASSER +            // MARYLAND
BANGERTE 66 PRL  17  495      BANGERTER,GALTIERI,BERGE,MURRAY+   // LRL
BERLEY   66 PRL 17 1071       +HERZBACH,KOFLER,YAMAMOTO +//BNL+MASS+YALE
BRISTOL  66  BERKELEY CONF    BRISTOL-CERN-LAUSANNE-MUNICH-ROME COLLABOR
COOK     66 PRL  17  223      V COOK,EWART,MASEK,ORR,PLATNER//WASHINGTON
GOZA     66  BERKELEY CONF    GOZA,KOTELCHUCK,ROOS,SULLIVAN //VANDERBILT
SULLIVAN 66  BERKELEY CONF    SULLIVAN,KOTELCHUCH,MCINTURFF,ROOS//VANDER
   ALSO  64 PRL 13 246        A D MCINTURFF,C E ROOS           // VANDERBILT

         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)

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M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M   *      1197.47     0.11          SCHMIDT   65 HBC                    9/66

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

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D        87   8.25     0.40          BARKAS    63 EMUL  -
D      2500   8.25     0.25          DOSCH     65 HBC

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

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M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

DL            81.70     0.19          BURNSTEIN 64 HBC                    9/66

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

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T             1.67     0.40      0.28 BROWN     58 PBC
T             1.89     0.33      0.25 EISLER    58 PBC
T             1.45     0.12      0.12 CRAWFORD  59 HBC
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             1.666    0.026          CHANG     65 HBC                    6/66
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(Ideogram below)

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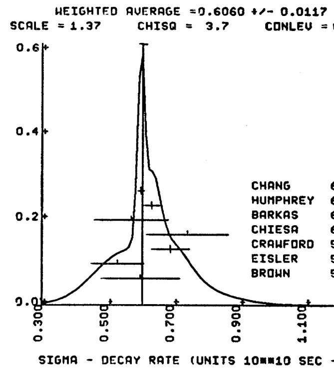

20 SIGMA- PARTIAL DECAY MODES

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P1     SIGMA - INTO  NEUTRON PI-                              S17S 8
P2     SIGMA - INTO  NEUTRON PI- GAMMA                        S17S 8S 0
P3     SIGMA - INTO  NEUTRON MU- NEUTRINO                     S17S 4S 2
P4     SIGMA - INTO  NEUTRON E- NEUTRINO                      S17S 3S 1
P5     SIGMA - INTO  LAMBDA E- NEUTRINO                       S18S 3S 1

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20 SIGMA- BRANCHING RATIOS

```
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 STOP. K-   6/66

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

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      12    0.50                   BAGGETT   66 HBC  - STOP. K-         9/66
R3  *   23    0.61     0.16          BAGGETT   66 RVUE - AVER. ABOVE 2 EX 9/66

R4  *  SIGMA - INTO (N PI- GAMMA)/(N PI-) (UNITS 10**-4)(P2)/(P1)
R4  *  ABOUT                     0.1 COURANT   63 HBC

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20 SIGMA- DECAY PARAMETERS

```
A-  *  ALPHA SIGMA-
A-  *        -0.16     0.21          TRIPP     62 HBC    REPL.BY BANGERTER
A-    6500   -0.010    0.043         BANGERTER 66 HBC    K-P TO SIG- PI+  7/66

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REFERENCES

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


```
BROWN    58 CERN CONF 270     BROWN,GLASER,GRAVES,PERL,CRONIN + /// 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,MASON,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
COURANT  63 SIENA 1 15        COURANT,FILTHUTH,BURNSTEIN+/// CERN+MD+NRL
BURNSTEI 64 PRL 13 66         BURNSTEIN,DAY,KEHOE,SECHI ZORN,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 ////////////// WISCONSIN
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
SCHMIDT  65 PR 140 B 1328     P SCHMIDT ///////////////////////// COLUMBIA
BAGGETT  66        (PREPRINT) BAGGETT,DAY,GLASSER +            // MARYLAND
BANGERTE 66 PRL  17  495      BANGERTER,GALTIERI,BERGE,MURRAY+   // LRL
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21 SIGMA 0 (1193,JP=1/2+) I=1

21 (SIGMA-) - (SIGMAO) MASS DIFFERENCE (MEV)

```
D1       18   4.75     0.1           BURNSTEIN 64 HBC      SEE NOTE IN TEXT
D1       37   4.87     0.12          DOSCH     65 HBC
D1            4.99     0.12          SCHMIDT   65 HBC      SEE NOTE IN TEXT 6/66

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

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M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

DL            76.61     0.28          SCHMIDT   65          SEE NOTE IN TEXT 9/66

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21 SIGMAO LIFETIME (UNITS 10**-14)

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T   *     1.0 OR LESS                DAVIS     62 EMUL

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                    21  SIGMA O PARTIAL DECAY MODES

P1        SIGMA O INTO LAMBDA GAMMA                        S18S 0
P2        SIGMA O INTO LAMBDA E+ E-                        S18S 3S 3

R1  *   SIGMA O 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 O(1193,JP=1/2+)I=1

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
BURNSTEI 64 PRL 13 66           BURNSTEIN,DAY,KEHOE,SECHI ZORN,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 B1105        ALFF,GELFAND,NAUENBERG+//COLUMBIA+RUTG+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       62 1321.1      0.65             SCHNEIDER 63 HBC
M      517 1321.4      0.4              .JANEAU    63 FBC
M      241 1321.1      0.3              BADIER     64 HBC
M   *  ALL MASSES ABOVE MUST BE RAISED 0.09 MEV BECAUSE LAMBDA MASS RAISED
M      299 1321.4      1.1              LONDON     66 HBC                      6/66

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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
T      794     1.69     0.07           HUBBARD    64 HBC
T      299     1.80     0.16           LONDON     66 HBC                       6/66

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                  22  XI- PARTIAL DECAY MODES

P1      XI- INTO LAMBDA PI-                                  S18S 8
P2      XI- INTO LAMBDA E- NEUTRINO                          S18S 3S 1
P3      XI- INTO NEUTRON PI-                                 S17S 8
P4          XI- INTO LAMBDA MU- NEUTRINO                     S18S 4S 2
P5          XI- INTO SIGMAO E- NEUTRINO                      S21S 3S 1
P6          XI- INTO SIGMAO MU- NEUTRINO                     S21S 4S 2
P7          XI- INTO NEUTRON E- NEUTRINO                     S17S 3S 1

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                  22  XI- BRANCHING RATIOS

R1  * XI- INTO (LAMBDA E- NEU)/(LAMBDA PI-)                (P2)/(P1)
```

We have arrived at a new world average using the following input:

Leptonic events	Efficiency	Nonleptonic events	Effective denominator	Reference
1	0.8	194	155	CARMONY 63
1	0.5	310	155	LONDON 66
0	0.4	551	220	BERGE 66
0	0.8	326	260	H. Bingham, priv. comm. EP + CERN
2			790	Total

The resulting branching ratio is $(2.5 \pm 1.8)10^{-3}$

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R2  *  XI- INTO (NEUTRON PI-)/(LAMBDA PI-)                (P3)/(P1)
R2  *          0.005   OR LESS          FERRO-LUZ 63 HBC

R3  *       XI- INTO (LAMBDA MU- NEUTRINO)/TOTAL            (P4)/TOTAL
R3  *          0.012   OR LESS          BERGE      66 HBC                      7/66

R4  *       XI- INTO (SIGMAO E- NEUTRINO)/TOTAL            (P5)/TOTAL
R4  *          0.003   OR LESS          BERGE      66 HBC                      7/66

R5  *       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

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                  22  XI- DECAY PARAMETERS

A   *   ALPHA XI-
A            -0.44       0.11           JAUNEAU    63 FBC
A      240   -0.5        0.35           BADIER     64 HBC                      7/66
A      356   -0.62       0.12           CARMONY    64 HBC
A       62   -0.73       0.21           SCHNEIDER 64 HBC
A   * 1004   -0.368      0.057          BERGE      66 HBC   - REPL. BY MERRILL  7/66
A     2529   -0.342      0.044          MERRILL    66 HBC     USED ALPHAL=.747  9/66
A      364   -0.47       0.12           LONDON     66 HBC  USING A-LAMB =0.62   6/66
A   *        -0.391      0.032          BERGE 2    66 RVUE  INCLUDES ALL ABOVE  9/66
```

```
F   *  PHI ANGLE (TAN(PHI)=BETA/GAMMA)   (DEGREE)
F          -16.       37.               JAUNEAU    63 FBC
F      356   54.0      25.0             CARMONY    64 HBC
F       62   45.0      30.0             SCHNEIDER 64 HBC
F   * 1004    0.45     10.7             BERGE      66 HBC   - REPL. BY MERRILL  7/66
F      364    0.0      17.0             LONDON     66 HBC     USED ALPHAL=.62   9/66
F     2529    1.2       7.5             MERRILL    66 HBC     USED ALPHAL=.747  9/66

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                                 REFERENCES

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

FOWLER   61 PRL 6 134           FOWLER,BIRGE,EBERHARD,ELY,GOOD,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,GAILLOUD +///BNL+YALE

CARMONY  63 PRL  10  381        CARMONY,PJERROU                       // UCLA
FERROLUZ 63 PR 130 1568         FERRO-LUZZI,ALSTON,ROSENFELD,WOJCICKI//LRL
JAUNEAU  63 SIENA CONF 4        JAUNEAU+ ///// PARIS+CERN+LOND+RUTH+BERGEN
    ALSO 63 PL 4 49             JAUNEAU+ ///// PARIS+CERN+LOND+RUTH+BERGEN
SCHNEIDE 63 PL 4 360            H SCHNEIDER ///////////////////////// CERN

CARMONY  64 PRL 12 482          CARMONY,PJERROU,SCHLEIN,SLATER,STORK+/UCLA
BADIER   64 DUBNA CONF          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

BERGE    66 PR  147  945        BERGE,EBERHARD,HUBBARD,MERRILL + ///// LRL
BERGE 2  66    BERKELEY CONF.   BERGE,CABIBBO                         // RVUE
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

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

CARMONY  64 PRL 12 482          CARMONY,PJERROU,SCHLEIN,SLATER,STORK+/UCLA  J
SHAFER   65 UCRL 11884          J BUTTON SHAFER, DEANE MERRILL  /////  LRL  J
MERRILL  66 UCRL 16455          DEANE MERRILL (THESIS, BERKELEY)  ///  LRL  J

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

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

D        23    6.8       1.6              JAUNEAU    63 FBC
D        45    6.1       1.6              CARMONY    64 HBC
D        29    6.9       2.2              LONDON     66 HBC                      6/66

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

T        24    3.9       1.4       0.80  JAUNEAU    63 FBC
T        45    3.5       1.0        0.8  CARMONY    63 HBC
T       101    2.5       0.4        0.3  HUBBARD    63 HBC
                              (Ideogram below)
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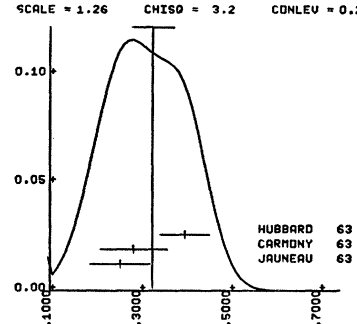
```

WEIGHTED AVERAGE =0.3283 +/- 0.0465
SCALE = 1.26   CHISQ = 3.2   CONLEV = 0.203



XIO DECAY RATE (UNITS 10**10 SEC -1)

```
                  23  XI O  PARTIAL DECAY MODES

P1      XI O INTO LAMBDA PIO                                 S18S 9
P2      XI O INTO PROTON PI-                                 S16S 8
P3      XI O INTO PROTON E- NEU                              S16S 3S 1
P4      XI O INTO SIGMA+ E- NEU                              S19S 3S 1
P5      XI O INTO SIGMA- E+ NEU                              S20S 3S 1
P6          XI O INTO SIGMA+ MU- NEUTRINO                    S19S 4S 2
P7          XI O INTO SIGMA- MU+ NEUTRINO                    S20S 4S 2
P8          XI O INTO PROTON MU- NEUTRINO                    S16S 4S 2

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                  23  XI O  BRANCHING RATIOS

R1  *  XI O INTO(PROTON PI-)/(LAMBDA PIO)                  (P2)/(P1)
R1  *    0    0.027  OR LESS         TICHO      63 HBC
R1  *    0    0.005  OR LESS         HUBBARD    66 HBC                         7/66

R2  *  XI O INTO(PROTON E- NEU)/(LAMBDA PIO)               (P3)/(P1)
R2  *    0    0.027  OR LESS         TICHO      63 HBC
R2       0    0.006 OR LESS          HUBBARD    66 HBC                         7/66

R3  *  XI O INTO(SIGMA+ E- NEU)/(LAMBDA PIO)               (P4)/(P1)
R3  *    0    0.013  OR LESS         TICHO      63 HBC
R3       0    0.007 OR LESS          HUBBARD    66 HBC                         7/66

R4  *      XI O INTO (SIGMA- E+ NEUTRINO)/TOTAL             (P5)/TOTAL
R4  *    0    0.006  OR LESS         HUBBARD    66 HBC                         7/66
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R5  *      X1 O INTO (SIGMA+ MU- NEUTRINO)/TOTAL          (P6)/TOTAL
R5  *   0     0.007  OR LESS          HUBBARD   66 HBC                    7/66

R6  *      X1 O INTO (SIGMA- MU+ NEUTRINO)/TOTAL          (P7)/TOTAL
R6  *   0     0.006  OR LESS          HUBBARD   66 HBC                    7/66

R7  *      X1 O INTO (PROTON MU- NEUTRINO)/TOTAL          (P8)/TOTAL
R7  *   0     0.006  OR LESS          HUBBARD   66 HBC                    7/66
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                 23  XI O DECAY PARAMETER

A   *  ALPHA XI O
A            -0.09     0.42          PJERROU   65 HBC
A   *        -0.149    0.154         BERGE     66 HBC                     7/66
A       46   -0.2      0.4           LONDON    66 HBC  USING A-LAMB=0.62  6/66
A      490   -0.33     0.10          MERRILL   66 HBC  A-LAM=0.690+-.048  8/66

F   *  PHI ANGLE XIO  (TAN(PHI)=BETA/GAMMA)  (DEGREE)
F   N  146   -2.9      23.5          BERGE     66 HBC                     7/66
F   N  490  107.0      38.0          MERRILL   66 HBC  USING A-LAMB=0.642 8/66
F   N  THE LIKELIHOOD FUNCTION FOR COMBINED DATA IS VERY NON-GAUSSIAN. THE 7/66
F   N    DATA ARE CONSISTENT (2.2 S.D.) WITH PHI BETWEEN -25 AND +225 DEG.  7/66

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                           REFERENCES

                           23 XI O(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+LOND+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

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

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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   S   1 1673.0     8.0          ABRAMS    64 HBC     INTO XI- PI0      7/66
M   S   1 1686.0    12.0          BARNES 1  64 HBC     INTO XIO PI-      7/66
M   S   1 1674.0     3.0          BARNES 2  64 HBC     INTO LAMBDA K-    7/66
M   S   1 1666.0     8.0          COLLEY    65 HBC     INTO XIO PI-      6/66
M   S   1 1671.0     5.0          RICHARDSO 65 HBC     INTC LAMBDA K-    7/66
M   S     ABOVE EVENTS INCLUDED IN SAMIOS RVUE                           7/66
M       6 1674.0     3.0          SAMIOS    65 RVUE                      6/66
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                 24  OMEGA- LIFETIME  (UNITS 10**-10 SEC)

T   S   1    1.63                 ABRAMS    64 HBC                       7/66
T   S   1    0.7                  BARNES 1  64 HBC                       7/66
T   S   1    1.4                  BARNES 2  64 HBC                       7/66
T   S   1    1.85                 COLLEY    65 HBC                       7/66
T   S   1    1.5                  RICHARDSO 65 HBC                       7/66
T   S     ABOVE EVENTS INCLUDED IN SAMIOS RVUE                           7/66
T       6    1.5       0.5        SAMIOS    65 RVUE                      6/66

                 24 OMEGA- PARTIAL DECAY MODES

P1  OMEGA- INTO LAMBDA K-                               S18S10
P2  OMEGA- INTO XI O PI-                                S23S 8

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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,CONNOLLY,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
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DATA ON MESON RESONANCES

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

   N  ANY SYMBOL IN COLUMN 8 INDICATES DATA IGNORED BY AVERAGING PROGRAMS

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σ (410)

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

   *            NO COMPELLING EVIDENCE FOR NARROW RESONANCE.
   *            OMITTED FROM TABLE.
```

There are four kinds of information concerning a $\pi\pi$, $T = 0$, $J^P = 0^+$ interaction at about 400 MeV invariant mass, called σ in each case:

I) direct evidence of a narrow peak (50-140 MeV) in experiments of limited statistics (SAMIOS 62, DEL FABRO 64, KOPELMANN 66);
II) indirect model-dependent evidence (width 90-100 MeV, but consistent with larger width) from η and K^+ decay (CRAWFORD 64, KALMUS 64, BROWN 65);
III) indirect evidence for a broad resonance (about 400 MeV) via πN (and NN) dispersion relations (LOVELACE 66); and
IV) indirect evidence for a broad resonance from the existence of a peak near the upper limit of phase space in the reaction

$$\pi^- p \to \pi^+ \pi^- n$$

at low energies (KIRZ 63, BLOKINTSEVA 63, BARISH 64, and perhaps others).

It is almost certain that the σ of types I and III cannot be the same object, unless the broad type III turns out to be in fact two narrower resonances, one of which is seen as type I. More experiments of better statistics and smaller background would be needed, in particular to exhibit the broad type III σ more directly.

There is good evidence from numerous peripheral experiments for a large S-wave at the ρ mass, which could be the tail of type III. Some such experiments have claimed to see a narrow resonance at about 720 MeV, but this is still controversial.


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                         REFERENCES FOR SIGMA

SAMICS   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+       FRASCATI
KALMUS   64 PRL 13  99         +KERNAN,PU,POWELL,DOWD ///// LRL+WISCONSIN
BROWN    65 CORAL GABLES 219   BROWN+FAIER ///////////////// NORTHWESTERN
ANDERSON 66  BERKELEY CONF.    +FUKUI,KESSLER+ // CHIC+ARG+OTT+MCGILL+QMC
KOPELMAN 66 PL  22  118        +ALLEN,GOODEN,MARSHALL +  // COLORADO+IOWA
LOVELACE 66 PL  22  332        LOVELACE,HEINZ,DONNACHIE            // CERN

    FOR NEGATIVE EVIDENCE FROM PI PI PHASE SHIFT DETERMINATIONS, SEE
BIRGE    65 PR 139 B 1600      +ELY+GIDAL+KALMUS+CAMERINI+ ///// LRL+WISC
WOLF     65 PL 19 328          WOLF ///////////////////////////////  DESY
BIRGE    66  BERKELEY CONF     +ELY+GIDAL+HAGOPIAN+ / LRL+LONDON(UC)+WISC
JACCBS   66 PRL 16 669         +SELOVE //////////////////////////// LRL
JONES    66 BERKELEY CONF      +CALDWELL+ZACHAROV+HARTING+BLEULER+ / CERN

    SEE ALSC DISCUSSION BY G. GOLDHABER, BERKELEY CONF. 1966, MESCN REVIEW

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ϵ (700)

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              14     EPSILON (700,JPG=0++)  I=0

   *                 EVICENCE NOT YET COMPELLING, OMITTED FROM TABLE.
   *                 FOR NEGATIVE EVIDENCE AND COMPILATION
   *                 SEE REVIEW BY G. GOLDHABER, 1966 BERKELEY CONFERENCE.

              14     EPSILON (700)  MASS (MEV)

M          700.0                       FELDMAN   65 SPRK
M       20 710.                        FORINO    65 DBC     4.5 PI+ D    10/66
M          720.0                       HAGOPIAN  65 HBC
M   *      740.0                       WOLF      65 RVUE                  6/66
M        SEE GCLDHABER MESCN REVIEW, 1966 BERKELEY CCNF
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              14     EPSILON (700)  WIDTH (MEV)

W           50.0                       FELCMAN   65 SPRK
W           50.0                       HAGOPIAN  65 HBC
W   *       90.0                       WOLF      65 RVUE                  6/66
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                         REFERENCES FOR EPSILON

COHN     65 PRL 15 906         H O COHN,BUGG+//ORNL+TENN+UNCAR+COLU+EFINS
CORBETT  65 NC 39 979          CORBETT,DAMERELL,MIDDLEMAS,CLEG+//OXF+RHEL
DURAND   65 PRL 14 329         L. DURAND AND Y.T. CHIU ///////////// YALE
FELDMAN  65 PRL 14 869         FELDMAN,FRATI,HALPERN,CHOLDRY+/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     G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
GUTAY    66  PURDUE COO-1428   L.J.GUTAY,JOHNSON,CSONKA+ //// PURDUE+UCRL
OLSSCN   66  PREPRINT          MARTIN G. OLSSON /////////////// WISCONSIN

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ω (783)

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

1  OMEGA  MASS (MEV)

M    400  782.0    1.0          ALFF       62 HBC
M     64  779.4    1.4          ARMENTERO  62 HBC
M    650  782.0                 MURRAY     63 HBC
M     34  784.0    1.0          ARMENTERO  63 HBC
M    220  781.0    2.0          KRAEMER    64 DBC
M         785.6    1.2          MILLER D   65 HBC     SEEN WITH K+K-
M         780.8    2.0          MILLER D   65 HBC     SEEN WITH K1 K2    8/66
M    333  786.0    1.0          JAMES      66 HBC                        6/66
M   2198  783.4    0.7          BALTAY     66 HBC      0.0 PBAR P        9/66
M    155  779.5    1.5          BARASH     66 HBC  0 PBAR P TO K1K2 OM  11/66
                      (Ideogram below)
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WEIGHTED AVERAGE =783.164 +/- 0.723
SCALE = 1.94     CHISQ = 30.1     CONLEV =  .001
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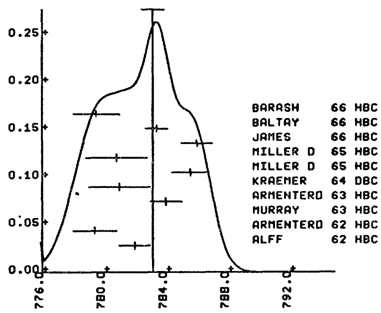

OMEGA MESON MASS (MEV)

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1  OMEGA FULL WIDTH (MEV)

W      34   9.0    3.0          ARMENTERO 63 HBC
W          13.4    2.0          MILLER D  65 HBC     SEEN WITH K+ K-
W          11.6    3.0          MILLER D  65 HBC     SEEN WITH K1 K2     8/66
W     155  12.3    2.0          BARASH    66 HBC
W  *  333  20.0  OR LESS        JAMES     66 HBC                         6/66
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1  OMEGA PARTIAL DECAY MODES

P1     OMEGA INTO PI+ PI- PIO                             S 8S 8S 9
P2     OMEGA INTO PI+ PI- (VIOLATES G)
P3     OMEGA INTO PI+ PI- GAMMA                           S 8S 8S 0
P4     OMEGA INTO PIO GAMMA                               S 9S 0
P5     OMEGA INTO 2PIO GAMMA                              S 9S 9S 0
P6     OMEGA INTO MU+ MU-                                 S 4S 4
P7     OMEGA INTO E+ E-                                   S 3S 3
P8     OMEGA INTO ETA GAMMA                               S14S 0
P9     OMEGA INTO ETA PIO (VIOLATES C)
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1  OMEGA  BRANCHING RATIOS

R1  *  OMEGA INTO NEUTRAL/(PI+ PI- PIO)                  (P4+P5)/(P1)
R1          0.17      0.04            ARMENTERO 63 HBC
R1     20   0.11      0.02            BUSCHBECK 63 HBC
R1     35   0.08      0.03            KRAEMER   64 DBC
R1  *       0.13      0.035           MILLER D  65 HBC
R1     65   0.10      0.04            ALFF-STEI 66 HBC CORR.BY SCHULTZ(COL)  9/66
R1     19   0.10      0.03            BARASH    66 HBC                      11/66
R1    850   0.134     0.026           DI GIUGNO 66 CNTR                      9/66
R1    348   0.097     0.016           FLATTE    66 HBC                       9/66
R1          0.06      0.05      0.02  JAMES     66 HBC                       6/66

R2  *  OMEGA INTO (PI+ PI-)/(PI+ PI- PIO)                (P2)/(P1)
R2  *       0.010 OR LESS             BUTTON    61 HBC
R2  *       0.07                      ALITTI    63 HBC
R2  *       0.05 OR LESS              ARMENTERO 63 HBC
R2  *  100  0.05 OR GREATER           FICKINGER 63 HBC
R2  *       0.02                      JAMES     63 HBC

R2  *       0.05 OR LESS              KRAEMER   64 DBC
R2  *       0.005 OR LESS             LUTJENS   64 RVUE NO INTERFERENCE
R2  *       0.018     0.012    0.006  WALKER    64 RVUE

R2  *       0.04 OR GREATER           BATON     65 HBC
R2  *       0.010 OR LESS             CLARK     65 SPRK                      6/66
R2  *       0.035 OR LESS             MILLER D  65 HBC
R2  *       0.02 OR LESS              ALFF-STEI 66 HBC                      11/66
R2  *       0.029     0.011    0.009  FLATTE    66 HBC  INTERFERENCE         9/66
R2  *       0.082     0.020           FLATTE    66 HBC  NO INTERFERENCE      9/66

R3  *  OMEGA INTO (PIO GAMMA) / (PI+ PI- PIO)             (P4)/(P1)
R3  *       0.125     0.025           BARMIN    64 PXBC
R3          0.10      0.03            BELYAKOV  64 PXBC
R3     13   0.15      0.06            BAGLIN    66 HLBC                      9/66

R4  *  OMEGA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)          (P3)/(P1)
R4  *       0.05   OR LESS            FLATTE    66 HBC                       9/66

R5  *  OMEGA INTO(E+ E-)/(PI+ PI- PIO)  (UNITS 10**-3)  (P7)/(P1)
R5  *       3.9       1.5    OR LESS  BARMIN    63 PBC
R5  *   1   2.8   OR LESS             BEZAGUET  64 FBC
R5      3   0.20      0.12            BINNIE    65 SPRK                      6/66
R5  *       1.4   OR LESS             GALTIERI  65 HBC
R5     20   0.11      0.03            AZIMOV    66 SPRK   MAY CONTAIN RHCS   9/66
R5          0.3 OR LESS               FLATTE    66 HBC                       9/66
R5          0.11      0.19     0.08   HERTZBACH 66 SPRK ASSUME SU(3)+MIXING 10/66

R6  *  OMEGA INTO (MU+ MU-)/(PI+ PI- PIO)(UNITS 10**-3) (P6)/(P1)
R6  *       1.2   OR LESS             GALTIERI  65 HBC
R6          1.7 OR LESS               FLATTE    66 HBC                       9/66

R7  *  OMEGA INTO (2PIO GAMM)/(PIO GAMMA)                (P5)/(P4)
R7  *       0.1   OR LESS             BARMIN    64 PXBC

R8  *  OMEGA INTO(ETA PIO +ETA GAM)/(PI+PI-PIO)          (P8+P9)/(P1)
R8  *       0.017  OR LESS            FLATTE    66 HBC                       9/66

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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,ROSENFELD /// 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,KRESTNIKOV+ ////// 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
JAMES    63 PREPR. TID-19082   F E JAMES, H L KRAYBILL ////////////// YALE
MURRAY   63 PL 7 358           MURRAY,FERROLUZZI,HUWE,SHAFER,SOLMITZ+/LRL

BARMIN   64 JETP 18 1289       BARMIN,DOLGOLENKO,KRESTNIKOV + ///// ITEP
BELYAKOV 64 DUBNA CONF         BELYAKOV + //////////////// DUBNA+BUCHAREST
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,CRONIN,TURLAY//PRINCETON
GALTIERI 65 PRL 14 279         A BARBARO GALTIERI,R D TRIPP ///////// LRL
MILLER   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
AZIMOV   66  BERKELEY CONF.    AZIMOV,BALDIN,BELOUSOV,CHUVILO +  // DUBNA
BAGLIN   66 PL  23  286        +BEZAGUET,DEGRANGE,HAATUFT +  // EP+BERGEN
BALTAY C 66  BERKELEY CONF     +FRANZINI,SEVERIENS,YEH,ZANELLO //BNL,CCNY
BARASH   66  CU258(NEVIS 154)  BARASH,KIRSCH,MILLER,TAN //////// COLUMBIA
DIGIUGNO 66 NC 44A 1272        DI GIUGNO,PERUZZI,TROISE+ //NAPL+FRAS+TRST
FLATTE   66 PR  145  1050      +HUWE,MURRAY,BUTTON-SHAFER,SOLMITZ+ // LRL
HERTZBAC 66  PREPRINT          HERTZBACH,KRAEMER,MADANSKI,ZDANIS+/JHU+BNL
   (SEE ALSO ZDANIS 65)
JAMES    66 PR 142 896         F E JAMES,KRAYBILL //////  YALE+BROOKHAVEN
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η′ (958)

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2  ETA PRIME (958,JPG=0-+)  I=0
   KNOWN EARLIER AS XO OR ETA*

2  ETA PRIME MASS (MEV)

M       85  957.0                 DAUBER    64 HBC
M           958.0     1.0         KALBFLEIS 64 HBC                    6/66
M           957.0     3.0         BADIER    65 HBC
M        8  960.0     2.0         TRILLING  65 HBC     3.65 PI+ P     9/66
M        7  955.0    10.0         COHN      66 DBC                    6/66
M           959.0     3.0         LONDON    66 HBC                    6/66
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2  ETA PRIME WIDTH (MEV)

W   *   85   4.0 OR LESS          DAUBER    64 HBC
W   *        7.0 OR LESS          KALBFLEIS 64 HBC                    6/66
W   *       30.0 OR LESS          BADIER    65 HBC
W   *       15.0 OR LESS          LONDON    66 HBC                    6/66
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2  ETA PRIME PARTIAL DECAY MODES

P1         ETA PRIME INTO  PI+ PI- ETA(NEUTRAL DECAY)    S 8S 8S14
P2         ETA PRIME INTO  PI+ PI- ETA(CHARGED DECAY)    S 8S 8S14
P3         ETA PRIME INTO  PI+ PI- NEUTRALS
                           (EXCLUDING  PI+ PI- ETA(NEUTRAL DECAY))
P4         ETA PRIME INTO  NEUTRALS
P5         ETA PRIME INTO  PI+ PI- GAMMA (INCL. RHO GAM) S 8S 8S 0
P6         ETA PRIME INTO  PIO E+ E- (VIOLATES C IN      S 9S 3S 3
                                      BORN APPROX.)
P7         ETA PRIME INTO  ETA E+ E- (VIOLATES C IN      S14S 3S 3
                                      BORN APPROX.)
P8         ETA PRIME INTO  PIO RHO 0 (VIOLATES C)        S 9U 9
P9         ETA PRIME INTO  PIO OMEGA (VIOLATES C)        S 9U 1
P10        ETA PRIME INTO  PI+ PI- E+ E-                 S 8S 8S 3S 3
P11        ETA PRIME INTO  2 PI                          S 8S 8
P12        ETA PRIME INTO  3 PI                          S 8S 8S 9
P13        ETA PRIME INTO  4 PI                          S 8S 8S 8S 8
P14        ETA PRIME INTO  6 PI                          S 8S 8S 8S 8S 8S 8
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2  ETA PRIME BRANCHING RATIOS

PARTIAL MODES  ADJUSTED BY PROGRAM  AHR=12345

R1  *      ETA PRIME INTO (PI+ PI- ETA (NEUTRAL DEC.))  NUM 1
R1  *                   / TOTAL                         DEN 12345
R1     68   0.36     0.05        KALBFLEIS 64 HBC                       10/66

R2  *      ETA PRIME INTO (PI+ PI- NEUTRALS) / TOTAL    NUM 1 3
R2  *                                                   DEN 12345
R2     39   0.4      0.1         LONDON    66 HBC                       10/66
R2     33   0.35     0.06        BADIER    65 HBC                       10/66

R3  *      ETA PRIME INTO (PI+ PI- ETA (CHRGD.DECAY))   NUM  2
R3  *                   / TOTAL                         DEN 12345
R3     10   0.1      0.04        LONDON    66 HBC                       10/66
R3      7   0.07     0.04        BADIER    65 HBC                       10/66
R3     44   0.12     0.02        KALBFLEIS 64 HBC                       10/66

R4  *      ETA PRIME INTO (PI+ PI- NEUTRALS (EXCLUDING  NUM   3
R4  *      PI+ PI- ETA (NEUTR.DEC.))) / TOTAL           DEN 12345
R4     10   0.05     0.04        KALBFLEIS 64 HBC                       10/66

R5  *      ETA PRIME INTO (NEUTRALS) / TOTAL            NUM   4
R5  *                                                   DEN 12345
R5     32   0.3      0.1         LONDON    66 HBC                       10/66
R5     16   0.24     0.17        BADIER    65 HBC                       10/66
R5     54   0.25     0.05        KALBFLEIS 64 HBC                       10/66

R6  *      ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING     NUM     5
R6  *                   RHO GAMMA)) / TOTAL             DEN 12345
R6  *      THIS MODE SEEMS TO BE CONSISTENT WITH BEING ENTIRELY RHO GAMMA
R6     20   0.2      0.1         LONDON    66 HBC                       10/66
R6     42   0.22     0.04        KALBFLEIS 64 HBC                       10/66
R6  B  35   0.34     0.09        BADIER    65 HBC                       10/66
R6  B      CONTROVERSIAL BACKGROUND SUBTRACTION
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R7   *     ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING     NLM     5
R7   *                    RHO GAMMA)) /(PI PI ETA)      DEN 1234
R7          0.25     0.14          DAUBER    64 HBC                    10/66

R8   *     ETA PRIME INTO (PIO E+ E-)/TOTAL             NLM      6
R8   *      0.013  OR LESS         RITTENBER 65 HBC    DEN 12345       10/66

R9   *     ETA PRIME INTO (ETA E+ E-)/TOTAL             NUM       7
R9   *      0.011  OR LESS         RITTENBER 65 HBC    DEN 12345       10/66

R10  *     ETA PRIME INTO (PIO RHOO)/TOTAL              NUM        8
R10  *      0.04   OR LESS         RITTENBER 65 HBC    DEN 12345       10/66

R11  *     ETA PRIME INTO (PIO OMEGA) /TOTAL            NUM         9
R11  *      0.08   OR LESS         RITTENBER 65 HBC    DEN 12345       10/66

R12  *     ETA PRIME INTO (PI+ PI- E+ E-)/TOTAL         NUM          0
R12  *      0.006  OR LESS         RITTENBER 65 HBC    DEN 12345       10/66

R13  *     ETA PRIME INTO (2 PI)/TOTAL                  NLM           1
R13  *      0.07   OR LESS  COMP.BY LONDON    66 HBC   DEN 12345       10/66

R14  *     ETA PRIME INTO (3 PI)/TOTAL                  NLM            2
R14  *      0.07   OR LESS  COMP.BY LONDON    66 HBC   DEN 12345       10/66

R15  *     ETA PRIME INTO (4 PI)/TOTAL                  NLM             3
R15  *      0.01   OR LESS  COMP.BY LONDON    66 HBC   DEN 12345       10/66

R16  *     ETA PRIME INTO (6 PI)/TOTAL                  NLM              4
R16  *      0.01   OR LESS  COMP.BY LONDON    66 HBC   DEN 12345       10/66
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η' Branching Ratios

There is evidence for only two η' partial modes, $\eta 2\pi$ and $\pi^+\pi^-\gamma$. (This electromagnetic mode may be mainly $\rho^0\gamma$.) In the $\eta 2\pi$ mode, the two pions, in an I = 0 state, will appear as $2/3\ \pi^+\pi^-$, $1/3\ \pi^0\pi^0$. The η then decays into 27% visible decay products, 73% invisible, yielding the following four distinguishable configurations:

$$\eta' \to \pi\pi\eta = \begin{cases} \frac{2}{3}(\pi^+\pi^-\eta) \to \begin{cases} \frac{2}{3}\times 0.27\ \pi^+\pi^-\pi^+\pi^- \begin{cases}\gamma \\ \pi^0\end{cases} \\ \frac{2}{3}\times 0.73\ \pi^+\pi^- + (\eta \text{ decaying into neutrals}) \end{cases} \\ \frac{1}{3}(\pi^0\pi^0\eta) \to \begin{cases} \frac{1}{3}\times 0.27\ \pi^0\pi^0\pi^+\pi^- \begin{cases}\gamma \\ \pi^0\end{cases} \\ \frac{1}{3}\times 0.73 \text{ all neutrals} \end{cases} \end{cases}$$

A measurement of the rate of <u>any</u> of these final states is therefore equivalent to a measurement of the rate of $\eta' \to \pi\pi\eta$ (provided the decay is I-conserving). Of course for the final states arising from $\eta' \to \pi^0\pi^0\eta$, the presence of an η as an intermediate particle cannot be proved experimentally, at least in a bubble chamber. Our branching ratios for the η' have been calculated using the additional assumption that the only strong decay mode of the η' is $\eta' \to \pi\pi\eta$. This is based on the experimental result that the observed decay $\eta' \to \pi^+\pi^-\pi^+\pi^-\pi^0$ always proceeds via an intermediate $\pi^+\pi^-\eta$ state, and further on the fact that η' decay into $\pi^+\pi^-$, $\pi^+\pi^-\pi^0$, or $\pi^+\pi^-\pi^+\pi^-$ has not been observed.

(Since the strong decay and the $\pi^+\pi^-\gamma$ decay of the η' have comparable rates, one might worry about a possible I-nonconserving admixture in the $\eta' \to \pi\pi\eta$ decay amplitude. One may, however, expect such an amplitude to be considerably smaller than the amplitude for $\eta' \to \rho^0\gamma$, (a) because of the much smaller phase space, and (b) because such an amplitude would be either of the order e^2, or would represent an I-nonconserving part of the strong interaction, which is known to be very small.)


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                       REFERENCES FOR ETA PRIME

DAUBER   64 DUBNA CCNF 1 418  DAUBER,SLATER,L T SMITH,STORK,TICHO //UCLA
DAUBER 2 64 PRL 13 449        CAUBER,SLATER,SMITH,STORK,TICHO ///// UCLA
KALBFLEI 64 PRL 13 349        G.R.KALBFLEISCH,O.DAHL,A.RITTENBERG // LRL

BADIER   65 PL 17 337         BADIER,DEMOULIN,BARLOUTALD +/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,SCANIU       // LRL

COHN     66 PL 21 347         COHN,MCCULLUCH,BUGG,CONDO//ORNL+TENN+LNCAR
LONDCN   66 PR 143 1034       LONDON,RAU,SAMIOS,GOLDBERG +//BNL+SYRACUSE

      QUANTUM NUMBER DETERMINATICNS NOT REFERRED TO IN THE DATA CARDS

GALTIERI 65 OXF.VCL.2,P.10    + RITTENBERG,IN ROSENFELD MESON REVIEW/LRL I=0
GALTIERI 66  BERKELEY CONF    +RITTENBERG, IN GOLDHABER MESON REVIEW/LRL I=0
MARTIN   66 PL 22,352         MARTIN,CRITTENDEN,SCHROEDER   // INDIANA U I

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H (975)

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            35  H (975, JPG=  -)  I=0
    *       EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE
    *       FOR COMPILATION SEE GOLDHABER MESON REVIEW
    *       1966 BERKELEY CONFERENCE
    *       ALSO COMPILED IN APPENDIX A.

            35  H (975)  MASS  (MEV)

M  C  50  975.0    15.0              BARTSCH   64 HBC    4.0 PI+ P       8/66
M  C  30  975.0   APPROX             GOLDHABER 65 HBC    3.65 PI+P       9/66
M  C  30  998.     10.               BENSON    66 DBC    3.65 PI+D       9/66
M  C  EXPERIMENTS ABOVE COMPILED IN GOLDHABER 66 MESON REVIEW
M     50 1000.    APPROX.   COMP.BY GOLDHABER 66 RVUE  C  SEE ABOVE    P 9/66
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            35  H (975) WIDTH  (MEV)

W  C  90  120.0                      BARTSCH   64 HBC    4.0 PI+ P       8/66
W  C  30   45.0    30.0              BENSON    66 DBC    3.65 PI+ D     10/66
W     50   80.0   COMPILED BY        GOLDHABER 66 RVUE  C ONLY 3.65,4 PI P 9/66
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            H MESON CROSS SECTION (MICROBARNS)

CS  *       75.0    15.0             BENSON    66 DBC  3.65 PI+D TO HPP  9/66

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                  REFERENCES FOR H MESON

BARTSCH  64 PL  11  167      AACHEN-ZEUTHEN-BIRM-BONN-HAMB-MUNCHEN COLL
GOLDHABE 65 CORAL GABLES P 76 G. GOLDHABER                        // LRL
BENSCN H 66  BERK.CONF - PRL  +MARQUIT,ROE,SINCLAIR,VANDER VELDE// MICH.
GOLDHABE 66  BERKELEY CONF    G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW

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ϕ (1019)

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            4  PHI (1019,JPG=1-- ) I=C

            4  PHI  MASS (MEV)

M           1017.0     2.0           ARMENTERO 63 HBC
M           1019.0     2.0           SCHLEIN   63 HBC   2.0 K- P
M           1018.6     0.5           MILLER    65 HBC                     8/66
M           1019.      3.            BARLOW    66 HBC    1.2 PBAR P      11/66
M           1021.0     4.0           HESS      66 HBC    1-4 PI- P        9/66
M           1020.0     .2.0          LONDON    66 HBC                     6/66
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            4  PHI  WIDTH (MEV)

W              3.4     1.7           ARMENTERO 63 HBC
W    *   34    5.0  OR LESS          SCHLEIN   63 HBC
W              3.5     1.0           MILLER D  65 HBC                     8/66
W             10.      3.            BARLOW    66 HBC    1.2 PBAR P      11/66
W             10.0     3.0           HESS      66 HBC    1-4 PI- P        9/66
W              6.0     4.0           LONDON    66 HBC                     6/66
                         (Ideogram below)
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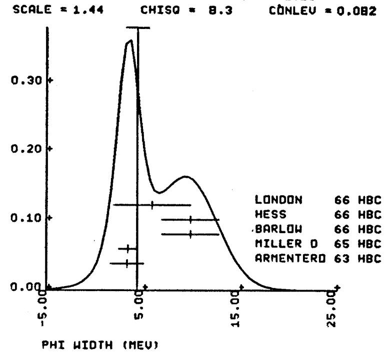
WEIGHTED AVERAGE =4.46 +/- 1.13
SCALE = 1.44   CHISQ = 8.3   CONLEV = 0.082

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            4  PHI PARTIAL CECAY MODES

P1      PHI INTO K+ K-                                        S1CS10
P2      PHI INTO K01 K02                                      S11S11
P3      PHI INTO PI+ PI- PIO (INCLUDING RHO PI)               S 8S 8S 9
P4      PHI INTO PI+ PI- (VIOLATES G)                         S 8S 8
P5      PHI INTO E+  E-                                       S 3S 3
P6      PHI INTO MU+ MU-                                      S 4S 4
P7      PHI INTO PIO GAMMA                                    S 9S 0
P8      PHI INTO ETA GAMMA                                    S14S 0
P9      PHI INTO PI+PI-GAMMA                                  S 8S 8S 0
P10     PHI INTO OMEGA GAMMA (VIOLATES C)                     C 1S 0
P11     PHI INTO ETA PIO (VIOLATES C)                         S14S 9
P12     PHI INTO RHO GAMMA (VIOLATES C)                       C 9S 0
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            4  PHI  BRANCHING RATIOS

            PARTIAL MODES ADJUSTED BY PROGRAM   AHR=123

R1  *       PHI INTO (K+ K-)/TOTAL                          NLM 1
R1  *                                                       DEN 123
R1  B   27    0.26     0.06        BADIER    65 HBC                   10/66
R1  B       CCNTROVERSIAL BACKGROUNC SUBTRACTION
R1     252    0.48     0.04        LINDSEY   66 HBC                   10/66

R2  *       PHI INTO (K1 K2)/TOTAL                          NLM  2
R2  *                                                       DEN 123
R2  B   25    0.23     0.06        BADIER    65 HBC                   10/66
R2  B       CCNTROVERSIAL BACKGROUND SUBTRACTION
R2     167    0.40     0.04        LINDSEY   66 HBC                   10/66
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R3  *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/TOTAL      NUM   3
R3  *                                                       DEN 123
R3  B   57    0.51      0.09            BADIER    65 HBC                           10/66
R3  B       CONTROVERSIAL BACKGROUND SUBTRACTION
R3      30    0.12      0.08            LINDSEY   66 HBC                           10/66

R4  *       PHI INTO (K+ K-)/(K KBAR)                       NUM 1
R4  *                                                       DEN 12

R5  *       PHI INTO (K1 K2)/(K KBAR)                       NUM  2
R5  *                                                       DEN 12
R5            0.44      0.07            LONDON    66 HBC                           10/66
R5      10    0.40      0.10            SCHLEIN   63 HBC                           10/66

R6  *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/(K KBAR)NUM   3
R6  *                                                       DEN 12
R6            0.30      0.15            LONDON    66 HBC                           10/66

R7  *       PHI INTO (PI+ PI- PIO (INCL.RHO PI))/(K1 K2) NUM   3
R7  *                                                       DEN  2
R7  *         0.3     OR LESS           BERLEY    65 HBC                           10/66

R8  *       PHI INTO (PI+ PI-)/(K KBAR)                     NUM    4
R8  *                                                       DEN 12
R8  *         0.2     OR LESS           LONDON    66 HBC                           10/66

R9  *       PHI INTO (L+ E-)/(K KBAR)                       NUM     5
R9  *                                                       DEN 12
R9  *         0.0036 OR LESS            GALTIERI  65 HBC                           10/66
R9  *         0.002  OR LESS            AZIMOV    66 SPRK                          10/66

R10 *       PHI INTO (MU+ MU-)/(K KBAR)                     NUM      6
R10 *                                                       DEN 12
R10 *         0.0053 OR LESS            GALTIERI  65 HBC                           10/66

R11 *       PHI INTO (ETA GAMMA)/TOTAL                      NUM        8
R11 *                                                       DEN 123
R11 *         0.2     OR LESS           BADIER    65 HBC                           10/66
R11 *         0.08    OR LESS           LINDSEY   66 HBC                           10/66

R12 *       PHI INTO (PI+ PI- GAMMA)/(K KBAR)               NUM         9
R12 *                                                       DEN 12
R12 *         0.05    OR LESS           LINDSEY   65 HBC                           10/66

R13 *       PHI INTO (ETA NEUTRALS)/(K KBAR)                NUM        8  1
R13 *                                                       DEN 12
R13 *         0.15    OR LESS           LINDSEY   66 HBC                           10/66

R14 *       PHI INTO (OMEGA GAMMA) / TOTAL                  NUM          0
R14 *                                                       DEN 123
R14 *         0.05    OR LESS           LINDSEY   66 HBC                           10/66

R15 *       PHI INTO (RHO GAMMA) / TOTAL                    NUM            2
R15 *                                                       DEN 123
R15 *         0.02    OR LESS           LINDSEY   66 HBC                           10/66

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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
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
MILLER   65 CU-237 (NEVIS 131)DAVID C MILLER  (THESIS) //////// COLUMBIA
   MILLER 65 INCLUDES DATA OF GELFAND 63 BELOW
GELFAND  63 PRL 11 438         GELFAND,MILLER,NUSSBAUM,KIRSCH+//COLU+RUTG

AZIMOV   66  BERKELEY CONF.    AZIMOV,BALDIN,BELOUSOV,CHUVILO +  // DUBNA
BARLOW   66  CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
HESS     66  BERKELEY CONF.    +DAHL,HARDY,KIRZ,D.H.MILLER          // LRL
LINDSEY  66 PR  147  913       JAMES S LINDSEY, GERALD A SMITH  ////  LRL
   LINDSEY 66 INCLUDES DATA OF LINDSEY 65 AND 66 BELOW
LINDSEY  65 PRL 15 221         JAMES S LINDSEY,GERALD A SMITH /////// LRL
LINDSEY  66 PL 20 93           J S LINDSEY,G A SMITH //////////////// LRL
LONDON   66 PR 143 1034        LONDON,RAU,SAMIOS,GOLDBERG +//BNL+SYRACUSE

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

GRAY, L  66 PRL  17  501      +HAGERTY,BIZZARRI,CIAPETTI +   // SYR+ROME JPG
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η_V (1050) $\rightarrow K_S K_S$

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               3 ETA (1050,JPG=0++)I=0

               NAMED S* BY CRENNELL ET AL.
               MAY BE JUST LARGE S-WAVE SCATTERING LENGTH

               3 ETA (1050) MASS (MEV)

M   *       1000.0     APPROX           BINGHAM   62 PBC
M   *       1000.0     APPROX           BIGI      62 HBC
M   *       1000.0                      ERWIN     62 HBC                           10/66
M   *    30 1030.0     APPROX.          BALTAY    64 HBC
M   *       1025.0     APPROX.          BARMIN    64 HLBC                           6/66
M        35 1045.        9.             BARLOW    66 HBC        1.2 PBAR P         11/66
M       135 1056.0                      BEUSCH    66 SPRK                           9/66
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      10/66

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               3 ETA (1050) WIDTH (MEV)

W        35   50.       24.             BARLOW    66 HBC        1.2 PBAR P         11/66
W             50.0                      BEUSCH    66 SPRK                           9/66
W        20   80.0      15.0            CRENNELL  66 HBC                            6/66

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               3 ETA (1050) PARTIAL DECAY MODES

P1          ETA (1050) INTO KKBAR
P2          ETA (1050) INTO PIPI

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               3 ETA (1050) BRANCHING RATIOS.

R1  *       ETA (1050) INTO (PI PI)/(K KBAR)               (P1)/(P2)
R1  *          2.5    OR LESS           CRENNELL  66 HBC     90 PCT CONF LEV    7/66

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                           REFERENCES FOR ETA(1050)

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
BARLOW   66  CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BEUSCH   66  BERKELEY CONF     BEUSCH,FISCHER,ASTBURY,MICHELINI+/ETH+CERN
CRENNELL 66 PRL 16 1025        CRENNELL,KALBFLEISCH,LAI,SCARR,SCHU+ //BNL
CRENNEL2 66  BERKELEY CONF     +KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL I,JP
   CRENNELL 2 HAS MORE DATA THAN CRENNELL  BUT SAME CONCLUSIONS
HESS     66 UCRL-16832         R I HESS (THESIS, BERKELEY)         // LRL
  HESS REPLACES  PRL 9 460     ALEXANDER,DAHL,JACOBS,KALBFLEISCH + // LRL
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f (1250)

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               5  F  (1250,JPG=2++)  I=0

               5  F   MASS (MEV)

M           1250.0     25.0             SELOVE    62 HBC
M           1260.0     35.0             VEILLET   63 FBC
M         5 1250.0                      GUIRAGOSS 63 HBC
M         5 1260.0                      BONDAR    63 HBC
M           1250.0                      LEE       64 HBC
M           1240.0     20.0             ACCENSI   66 HBC                            6/66
M   *       1255.      13.              BARLOW    66 HBC    (K01 K01 MODE)        11/66
M           1275.0     25.0             WAHLIG    66 SPRK                           6/66

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               5  F   WIDTH (MEV)

W            100.0     25.0             SELOVE    62 HBC
W   *        200.0    OR LESS           VEILLET   63 FBC
W        85  160.0                      BONDAR    63 HBC
W            130.0     20.0             LEE       64 HBC
W            102.0     46.0             ACCENSI   66 HBC                            6/66
W   *         82.      34.              BARLOW    66 HBC    (K01 K01 MODE)        11/66
W            100.                       WAHLIG    66 SPRK                          11/66

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               5  F  PARTIAL DECAY MODES

P1      F  INTO PI+ PI-                                         S 8S 8
P2      F  INTO 2PI+ 2PI-                                       S 8S 8S 8S 8
P3      F  INTO K KBAR                                          S12S12

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               5  F   BRANCHING RATIOS

R1  *  F  INTO (4PI)/(2PI)                                   (P2)/(P1)
R1           0.08      0.06             BONDAR    63 HBC
R1  *        0.04   OR LESS             CHUNG     65 HBC

R2  *  F INTO (K KBAR)/(PI PI)                               (P3)/(P1)
R2           0.09   OR LESS             BARMIN    65                               10/66
R2  *        0.16   OR LESS             WANGLER   65 HBC
R2  *        0.06   OR LESS             BRANDT    66 HBC     CONF.LIMIT 0.95        9/66
R2  *        0.05 OR LESS               DEUTSCHMA 66 HBC                            6/66
R2           0.023     0.006            FISCHER   66 SPRK                           9/66
R2  *        0.025 OR LESS              HESS      66 HBC   -  1.6-4.2 PI- P        10/66

R   *FOR 2+ NONET SU3 RATES SEE E.G. GLASHOW,SOCOLOW; PRL 15,329(65)

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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
VEILLET  63 PRL 10 29          VEILLET,HENNESSY,BINGHAM,BLOCH+//PAR+MILAN
LEE      64 PRL 12 342         LEE,ROE,SINCLAIR,VANDERVELDE //// MICHIGAN

BARMIN   65 SJNP 1 870         +DOLGOLENKO+EROFEEV+KRESTNIKOV+/ ITEP MOSC
CHUNG    65 PRL 15 325         CHUNG,DAHL,HARDY,HESS,JACOBS,KIRZ //// LRL
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
BARLOW   66  CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BEUSCH   66   (PREPRINT)       BEUSCH,FISCHER,ASTBURY,MICHELINI+/ETH+CERN
BRANDT   66  BERKELEY CONF.    BRANDT,COCCONI,CZYZEWSKI+ //CERN+CRAC+WARS
DEUTSCHM 66 PL 20 82           DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
FISCHER  66  PRIVATE COMMUN.   W E FISCHER (BASED ON BEUSCH 66)//ETH+CERN
HESS     66 UCRL-16832         R I HESS (THESIS, BERKELEY)         // LRL
WAHLIG   66 PR  147  941       +SHIBATA,GORDON,FRISCH,MANNELLI //MIT+PISA  J

      QUANTUM NUMBER DETERMINATIONS 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-LOND+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         +DOLGOLENKO,ELENSKY,EROFEEV+ / ITEP MOSCOW   JP
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D (1285)

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               8  D MESON (1285,JPG=  +) I=0

               JPG DISCUSSED AT OXFORD, SEE ROSENFELD 65

               8  D MESON  MASS (MEV)

M           1290.0      8.0             D.ANDLAU  65 HBC
M           1283.0      5.0             HESS      66 HBC       1.6-4.2 PI- P   10/66

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               8  D MESON WIDTH (MEV)

W             25.0     15.0             D.ANDLAU  65 HBC                            9/66
W             35.0     10.0             HESS      66 HBC       1.6-4.2 PI- P   10/66

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               8  D MESON PARTIAL DECAY MODES

P1          D MESON INTO K KBAR PI                              S11S11S 9
P2          D MESON INTO PI PI RHO                              S 9S 9U 9

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                 8  D MESON BRANCHING RATIOS

R1  *     D MESCN INTO (PI PI RHO) / (K KBAR PI)        NUM  2
R1  *                                                   DEN 1
R1  *        2.0   OR LESS            HESS      66 HBC    C CHARGED PI ONLY 10/66

R   *FOR 1+ NONET SU3 RATES SEE E.G. GOLDHABER, REVIEW BERKELEY CONF.1966

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                           REFERENCES FOR D MESON

D.ANDLAU 65 PL 17 347          D.ANDLAU,ASTIER,BARLOW +//CDF+CERN+RAD+LIV
HESS     66 UCRL-16832         R I HESS (THESIS, BERKELEY)         // LRL
SEE ALSO 65 PRL 14 1074        MILLER,CHUNG,DAHL,HESS,HARDY,KIRZ+//LRL+UC

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E (1420)

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                 6  E MESON  (1420,JPG=  +)  I=0

                 6 E MESON MASS (MEV)

M           1425.       7.               BAILLON   66 HBC     O. PBAR P       11/66
M           1420.0     20.0              HESS      66 HBC      1.6-4.2 PI- P  10/66

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                 6 E MESCN WIDTH (MEV)

W            80.       10.              .BAILLON   66 HBC     O. PBAR P       11/66
W            60.0      20.0              HESS    . 66 HBC      1.6-4.2 PI- P  10/66

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                 6 E MESON PARTIAL DECAY MODES

P1          E INTO K K*(890)                                S10U18
P2          E INTO K KBAR PI                                S12S12S 8
P3          E MESON INTO PI PI RHO                          S 9S 9U 9
P4          E INTO PI(1003) PI                              U16S 8

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                 6  E MESON BRANCHING RATIOS

R1  *       E INTO K K*(890)/((K K*)+(PI(1003) PI))         NUM 1
R1  *                                                       DEN 1  4
R1  *          .50      .10             BAILLON   66 HBC                      11/66

R2  *       E MESCN INTO (PI PI RHO) / (K KBAR PI)          NUM   3
R2  *                                                       DEN  2
R2  *        2.0    OR LESS             HESS      66 HBC    0 CHARGED PI ONLY 10/66

R   *FOR 1+ NONET SU3 RATES SEE E.G. GOLDHABER, REVIEW BERKELEY CONF.1966

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                           REFERENCES FOR E MESON

ARMENTER 64 DUBNA CONF 1 467  ARMENTEROS,EDWARDS,JACOBSEN,ASTIER+ //CERN
ROSENFEL 65 OXFORD CONF 58    A H ROSENFELD ////////////////// LRL--RVUE
BAILLON  66  PREPRINT - NC    +EDWARDS+D.ANDLAU+ASTIER+ //// CERN+CDF+IR
BARASH   66  CU258(NEVIS 154) BARASH,KIRSCH,MILLER,TAN //////// COLUMBIA
HESS     66 UCRL-16832        R I HESS (THESIS, BERKELEY)         // LRL
SEE ALSO 65 PRL 14 1074       MILLER,CHUNG,DAHL,HESS,HARDY,KIRZ+ /LRL+UC

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$K_s K_s$(1440) / $\rho\rho$ (1410)

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                 29  KSKS(1440) AND RHORHO(1410) (JPG=  +) I GTE 0

                 EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE

                 29  KSKS ANC RHORHO MASS  (MEV)

M           1410.0                       BETTINI   66 DBC   C  O. PBARP TO 5PR  9/66
M           1439.0   SHOULDER ON A2      BEUSCH    66 SPRK    5-12 PI- P        9/66

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                 29  KSKS ANC RHORHO WIDTH (MEV)

W             90.0                     . BETTINI   66 DBC   C O. PBAR P TO 5PR  9/66
W             43.0     40.0              BEUSCH    66 SPRK    5-12 PI- P        9/66

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                           REFERENCES FOR KSKS(1440) AND RHO RHO(1410)

BETTINI  66 NC 42A 695         +CRESTI,LIMENTANI,LORIA,PERUZZO+//PAD+PISA
BEUSCH W 66  BERKELEY CONF     +ASTBURY,FINOCCHIARO,MICHELIN//CERN,ZURICH

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f′ (1500)

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                 13  F PRIME (1500,JPG=2++)  I=0

                 13  F PRIME(1500) MASS (MEV)

M   *   14 1480.0                        CRENNELL  66 HBC       6.0 PI- P       8/66
M       35 1514.0      16.0              BARNES    66 HBC  K1 K1 ONLY 5.0 K-P   9/66

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                 13  F PRIME(1500) WIDTH (MEV)

W       35   86.       23.               BARNES    66 HBC  K1 K1 ONLY 5.0 K-P  10/66

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                 13  F PRIME PARTIAL DECAY MODES

P1          F PRIME INTO PI+ PI-                            S08S08
P2          F PRIME INTO K KBAR                             S12S12
P3          F PRIME INTO K K*(890)                          S10U18
P4          F PRIME INTO ETA ETA                            S14S14

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                 13  F PRIME BRANCHING RATIOS

R1  *       F PRIME INTO (PI+ PI-)/(K KBAR)                (P1)/(P2)
R1  *          0.14  OR LESS             BARNES    66 HBC     CONF.LIMIT 0.95  10/66
R1  N  SU3      .03  ESTIMATE FROM SU3 GLASHOW     65  SU3

R2  *       F PRIME INTO (K KBAR) / TOTAL                  (P2)/TOTAL
R2  X          0.64     0.31             GOLDBERG  66, WITHDRAWN                8/66
R2  X   BARNES 66 POINT OUT THAT F PRIME UNRESOLVABLE FROM E MESON

R3  *       F PRIME INTO (ETA ETA)/(K KBAR)                (P4)/(P2)
R3  *          1.0   OR LESS             BARNES    66 HBC     CONF.LIMIT 0.95  10/66

R   *FOR 2+ NONET SU3 RATES SEE E.G. GLASHOW,SOCOLOW, PRL 15,329(65)

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                           REFERENCES FOR F PRIME

GLASHOW  65 PRL 15 329         S L GLASHOW, R H SOCOLOW     //SU3 BERKELEY
BARNES   66  BERKELEY CONF.    +DORNAN,GUIDONI,KALBFLEISCH,LONDON/BNL,SYR I=0
BARNES   65 PRL 15 322         REPLACED BY REFERENCE ABOVE
CRENNELL 66 PRL  16  1025      + KALBFLEISCH,LAI,SCARR,SCHUMANN +   // BNL I
GOLDBERG 66  SUBMITTED TO NC   + LEITNER,MUSTO,O RAIFEARTAIGH   //SYRACUSE
CRENNEL2 66  BERKELEY CONF     +KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL I=0

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ρ (760)

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                 9 RHO (760,JPG=1-+)  I=1

                 9 RHO  MASS (MEV)

M+  C       760.0      9.0              CARMONY   64 HBC  +
M+  C   CARMONY  MASS CALCULATED FOR MOMENTUM TRANSFER LESS THAN 4 (MPI**2)
M+          760.       10.              ARMENISE  65 HBC  +
M+          765.0       5.0             ALFF-STEI 66 HBC  +   2-3 PI+ P        6/66
M+  *       783.0       6.0             JAMES     66 HBC    + 2.1 PI+ P        6/66
M+          758.0      10.0             JAMES     66 HBC  SEE NOTE J BELOW     8/66
M+  J  FROM JAMES WE USE MASS CALC FOR MOMENTUM TRANSFER LESS THAN 2.5 MPI**2

M+          750.0       3.0             BALTAY    66 HBC  +-  0.0 PBARP        6/66
M+          730.       11.              BARLOW    66 HBC  +- 1.2 PBAR P       11/66

M-  *       748.0                       KENNEY    62 HBC   -
M-          765.0      10.0             ERWIN     63 HBC   -
M-  *  130  775.0                       GUIRAGOSS 63 HBC   -
M-          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 CJT18 11/66
M-          760.0       5.0             HAGOPIAN  66 HBC   -  3.0 PI- P        6/66
M-  *       777.0       6.0             MILLER    66 HBC   -  2.7 PI-,T CUT 5  9/66
M-          775.0       5.0             MILLER    66 HBC   -  2.7 PI-,T CJT10  9/66
M-  *       768.0       5.0             MILLER    66 HBC   -  2.7 PI-,T CJT20  9/66
M-          749.0       3.0             WEST      66 HBC   -  2.1 PI- P       10/66
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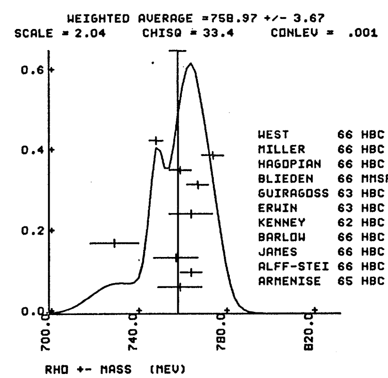
(Ideogram below)

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M0  *  190  750.0      20.0             SAMIOS    62 HBC   0
M0     300  760.0      10.0             ABOLINS   63 HBC   0
M0          763.0      10.0             ERWIN     63 HBC   0
M0  *  160  775.0                       GUIRAGOSS 63 HBC   0
M0     500  770.0      10.0             GOLDHABER 64 HBC   0
M0  *       735.0      10.0             ALYEA     65 DBC   0 2.2 K- P          6/66
M0          750.0                       CLARK     65 SPRK  0
M0          763.0                       DERADO    65 DBC   0 4.0 PI- P         6/66
M0          750.0      15.0             GUTAY     65 HBC   0 2.0 PI- P         6/66
M0  N       736.0                       CLARK     65 SPRK  0 1.5 PI- P        10/66
M0  N  AT PI PI SCATT.ANGLE OF 90 DEG.WITHOUT INTERFERENCE WITH NONRES.BACKGD
M0  M       753.0                       CLARK     65 SPRK  0 1.5 PI- P        10/66
M0  M  AT PI PI SCATT.ANGLE OF 90 DEG. ALLOWING FOR INTERF.WITH NONRES.BACKGD
M0          768.0      14.0             ACCENSI   66 HBC   0 5.7 PBARP         6/66
M0          750.0       5.0             ALFF-STEI 66 HBC   0 2-3 PI+ P         6/66
M0          749.4       3.3             BALTAY    66 HBC   0 0.0 PBARP         6/66
M0          745.        9.              BARLOW    66 HBC   0 1.2 PBAR P       11/66
M0          773.0      12.0             CASON     66 HBC   0 7.0 PI- P         9/66
M0          775.0       5.0             HAGOPIAN  66 HBC   0 3.0 PI- P         6/66
M0          765.0       8.0             JAMES     66 HBC   0 2.1 PI+ P         6/66
M0          770.0       4.0             MILLER    66 HBC   0 2.7 PI-,T CJT20   9/66
M0          760.0       3.0             WEST      66 HBC   0 2.1 PI- P        10/66

M0  P  IN PHOTOPRODUCTION EXPERIMENTS THE RHO0 MASS VALUE APPEARS SHIFTED
M0  P       740.0      10.0             LANZEROTT 65 CNTR  0 GAMMA P          10/66
M0  P       728.0       8.0             CAMBRIDGE 66 HBC   0 1.0-6.0 GAMMA P 10/66
M0  P       728.0       6.0             GERMAN CO 66 HBC   0 3.5-5.8 GAMMA P 10/66
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(Ideogram on next page)

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M      290  755.0                       CHADWICK  63 HBC  +-0

M           740.0                       WALKER    62 HBC   -0
M      240  752.0                       ALITTI    63 HBC   -0
M           765.0                       LEE       65 HBC   -0

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                 9  RHO  WIDTH (MEV)

W+  C        77.0      20.0             CARMONY   64 HBC  +
W+  C   CARMONY WIDTH CALCULATED FOR MOMENTUM TRANSFER LESS THAN 4 (MPI**2)
W+           90.0      10.0             SACLAY    63 HBC  +
W+          160.       10.              ARMENISE  65 HBC  +
W+          100.0                       ALFF-STEI 66 HBC  +   2-3 PI+ P        6/66
W+  *       177.0      15.0             JAMES     66 HBC    + 2.1 PI+ P        7/66
W+          147.0      19.0             JAMES     66 HBC  SEE NOTE J BELOW     8/66
W+  J FROM JAMES WE USE WIDTH CALC FOR MOMENTUM TRANSFER LESS THAN 2.5 MPI**2

W+          150.0      30.0             BALTAY    66 HBC  +-  0.0 PBARP        6/66
W+          130.       25.              BARLOW    66 HBC  +- 1.2 PBAR P       11/66
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W-  *       65.0   20.0               ERWIN     63 HBC  -
W-  *  130 125.0                      GUIRAGOSS 63 HBC  -
W-      98 180.0                      BONDAR    64 HBC  -
W-         127.0    5.0               BLIEDEN   66 MMSP -  3-5 PI- P         6/66
W-         150.0   20.0               HAGOPIAN  66 HBC  -  3.0 PI- P         6/66
W-  *      137.0   17.0               MILLER    66 HBC  -  2.7 PI-,T CJT 5   9/66
W-         145.0   12.0               MILLER    66 HBC  -  2.7 PI-,T CJT10   9/66
W-  *      153.0   13.0               MILLER    66 HBC  -  2.7 PI-,T CJT20   9/66
W-         149.0    13.0              WEST      66 HBC  -  2.1 PI- P        10/66

WO  *  190 150.0   20.0               SAMIOS    62 HBC   0
WO  *  160 175.0                      GUIRAGOSS 6  H
WO     300  90.0   10.0               ABOLINS   63 HBC   0
WO         165.0   20.0               ERWIN     63 HBC   0
WO      96 210.0                      BONDAR    64 HBC   0
WO     500 130.0                      GOLDHABER 64 HBC   0
WO         110.0   20.0               ALYEA     65 DBC   0 2.2 K- P          6/66
WO         130.0                      CLARK     65 SPRK  0
WO         150.0                      DERADO    65 HBC   0 4.0 PI- P         6/66
WO          80.0   15.0               GUTAY     65 HBC   0 2.0 PI- P         6/66
WO  *      150.0   10.0               LANZEROTT 65 CNTR  0
WO          72.0   30.0               ACCENSI   66 HBC   0 5.7 PBARP         6/66
WO         100.0                      ALFF-STEI 66 HBC   0 2-3 PI+ P         6/66
WO         146.0   17.0               BALTAY    66 HBC   0 0.0 PBARP         6/66
WO          92.    42.                BARLOW    66 HBC   0 1.2 PBAR P       11/66
WO  *      175.0                      CAMBRIDGE 66 HBC   0 5-6 GAM P         9/66
WO          57.0   25.0      15.0     CASON     66 HBC   0 7.0 PI- P         9/66
WO         120.0   10.0               HAGOPIAN  66 HBC   0 3.0 PI- P         6/66
WO         103.0   13.0               JAMES     66 HBC   0 2.1 PI+ P         6/66
WO         160.0   15.0               MILLER    66 HBC   0 2.7 PI-,T CJT20   9/66
WO         173.0   13.0               WEST      66 HBC   0 2.1 PI- P        10/66
                       (Ideograms below)
W      290 110.0                      CHADWICK  63 HBC  +-0

W          120.0                      WALKER    62 HBC   -0
W          125.0   15.                LEE       65 HBC   -0

W   *      170.0                      WOLF      65 RVUE                      6/66
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9 RHO PARTIAL DECAY MODES

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P1     RHO INTO 2PI                                      S 8S 8
P2     RHO INTO 4PI                                      S 8S 8S 8S 8
P3     RHO INTO PI GAMMA                                 S 8S 0
P4     RHO INTO E+ E-                                    S 3S 3
P5     RHO INTO PI ETA                                   S 8S14
P6     RHO INTO MU+ MU-                                  S 4S 4
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9 RHO BRANCHING RATIOS

```
R1  *  RHO INTO 4PI/2PI                                  (P2)/(P1)

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 10/66
R1  *         0.0035   0.004          JAMES     66 HBC                      11/66

R1  *  RHO 0 INTO  (PI+ PI- PI+ PI-) / (PI+ PI-)
R1  *         0.008 OR LESS           JAMES     66 HBC   +                   6/66
R1  *    8    0.006 OR LESS           GERMAN CO 66 HBC   0 3.5-5.5 GAMMA P 10/66

R2  *  RHO INTO PI GAMMA/2PI                             (P3/P1)
R2  *         0.02  OR LESS           DAUDIN    64 HBC  +
R2  N         0.02 OR LESS            LANZEROTT 65 CNTR                     11/66
R2  N      ONE PION EXCHANGE MODEL USED IN THIS ESTIMATION
R2  *         0.005 OR LESS           FIDECARO  66 SPRK - 0.97 CONF LEV     10/66
R2  M         0.004 OR LESS           GERMAN CO 66 HBC   0 3.5-5.5 GAMMA P 10/66
R2  M      ONE PION EXCHANGE MODEL USED IN THIS ESTIMATION
R2  *         0.007 OR LESS           HUSON     66 HLBC  -                   6/66

R3  *  RHO INTO(E+ E-)/(PI+PI-)     (UNITS 10**-4)       (P4)/(P1)
R3            0.65      1.1      0.5  HERTZBACH 66 SPRK ASSUME SU(3)+MIKING 10/66

R4  *    RHO INTO (PI ETA)/(2PI)                         (P5)/(P1)
R4  *         0.03 OR LESS            DEUTSCHMA 66 HBC  +   8.0 PI+ P        6/66

R5  *    RHO INTO (MU+ MU-)/(PI+ PI-) (UN 10**-4)        (P6)/(P1)
R5            0.33      0.16     0.07 DE PAGTER 66 CNTR  0 5.2 GAM P         6/66
R5  *        14. OR LESS              HERTZBACH 66 SPRK                     10/66

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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
WALKER   62 CERN CONF 42       W D WALKER,E WEST A R ERWIN + // WISCONSIN
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
ERWIN    63 SIENA CONF 1 112   ERWIN,SATTERBLOM,WALKER,WEST /// WISCONSIN
SACLAY   63 SIENA CONF 1 239   SACLAY+ORSAY+BARI + BOLOGNA(COLLABORATION)

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
DAUDIN   64 REPORT CEA-R-2525  DAUDIN,JABIOL,MONGELLI + ///// SACLAY+BARI
GOLCHABE 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 (COLLABORATION )
BLIEDEN  65 PL 19 444          BLIEDEN,FREYTAG,GEIBEL,HASSAN + ///// 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 ////////////// FLORIDA
LANZEROT 65 PRL 15 210         LANZEROTTI,BLUMENTHAL,EHN,FAISSLER +/HARVD
LEE      65 MICH 04938         YONG-YUNG LEE ////////////////// MICHIGAN
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
BARLOW   66  CERN-TC66-22 -NC  BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BLIEDEN  66 NC 43 71           +FREYTAG,GEIBEL,HASSAN,KIENZLE+ ///// CERN
CAMBRIDG 66 PR  146  994       CAMBRIDGE BUBBLE CHAMBER GROUP //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
GERMAN C 66  BERKELEY CONF     GERMAN COLL./ AACH+BERL+BONN+HAMB+HEID+MUN
HAGOPIAN 66 PR 145 1128        HAGOPIAN,SELOVE,ALITTI,BATON+//PENN+SACLAY
HERTZBAC 66  PREPRINT          HERTZBACH,KRAEMER,MADANSKI,ZDANIS+/JHU+BNL
   (SEE ALSO ZDANIS 65)
HUSON    66 PL 20 91           HUSON,ALLARD,DRIJARD,HENNESSY + //ORSAY+EP
JAMES    66 PR 142 896         F E JAMES,KRAYBILL /////// YALE+BROOKHAVEN
MILLER   66  BERKELEY CONF.    MILLER,GUTAY,JOHNSCN,LOEFFLER +  // PURDUE
WEST     66 PR 149 1089        WEST,BOYD,ERWIN,WALKER ///////// WISCONSIN

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δ (965)   36 DELTA MESON (963,JPG=) I = 1

COMPILATION AVAILABLE SEPARATELY IN UCRL-8030-SPECTRA

36 DELTA (963) MASS (MEV)

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M          SEE GOLDHABER MESCN REVIEW, 1966 BERKELEY CCNF

M           910.                        TURKOT    63 MMS  +  3.3 PP TC D + MM 10/66
M       262 962.0      5.0              KIENZLE   65 MMS  -   3-5 PI- P        9/66
M   *    36 965.0                       ALLEN     66 HBC  -   1.7 PI- P        9/66
M       106 965.0   COMPILATION BY      ALLEN     66 HBC  +-C 1-8 PI  P        9/66
M           966.0      8.0              OOSTENS   66 MMS  +  3. P P TC D + MM  9/66
FOR RESULTS WHICH DO NOT SUPPORT ALLEN 66, SEE JACOBS 66 AND WEST 66
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36 DELTA (963) WIDTH (MEV)

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W            50.                        TURKOT    63 MMS  +  3.3 PP TO D + MM 10/66
W       262   5.0   OR LESS             KIENZLE   65 MMS  -   3-5 PI- P        9/66
W        36  25.    OR LESS             ALLEN     66 HBC  -   1.7 PI- P        9/66
W            10.0   OR LESS             OOSTENS   66 MMS  +  3. P P TO D + MM  9/66
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36 DELTA MESON PARTIAL DECAY MODES

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P1         DELTA MESON INTO 2 PI                          S 8S 8
P2         DELTA MESON INTO 3 PI                          S 9S 9S 9
P3         DELTA MESCN INTO 4 PI                          S 9S 9S 9S 9
P4   *     DELTA MESON INTO 5 PI
P5         DELTA MESCN INTO ETA PI                        S14S 9
P6         DELTA MESON INTO RHO PI                        U 9S 9
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36 DELTA MESON BRANCHING RATIOS

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R1         CHARGEC DELTA INTO (1 CHARGED) / (3 OR MORE CHARGED)
R1            1.3       0.9       0.7  KIENZLE   66 MMS   -  3-5 PI- P        9/66

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REFERENCES FOR DELTA(963)


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TURKOT   63 SIENNA CONF I 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//COLU G=+
JACOBS   66  DISS. BERKELEY   L.D.JACOBS ///////////////////////////// LRL
OOSTENS  66 PL  22  708       +CHAVANON,CROZON,TOCQUEVILLE  // SACLAY,CF I=1
WEST     66 PR 149 1089       WEST,BOYD,ERWIN,WALKER ///////// WISCONSIN

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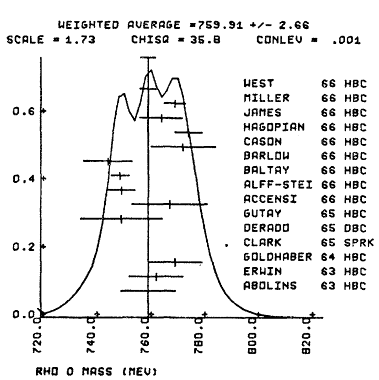

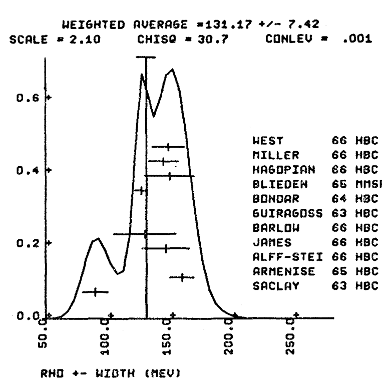

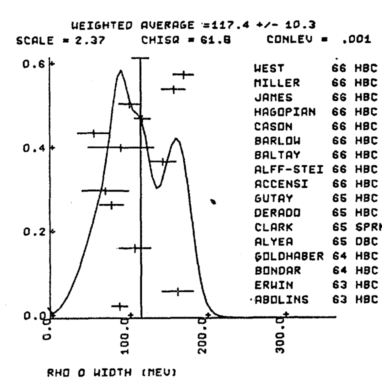

π_V (1003) → $K\bar{K}$

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                        16 PI(1003,JPG=    ) I=1

                        16 PI(1003) MASS  (MEV)
M    *        1060.0                      BELYAKOV  64 PBC      7.5 PI- P        6/66
M    *    50 1025.0   APPROX.             ARMENTERO 65 HBC  +-  .0.0 PBAR P
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    *       SCAT. LENGTH 2.4+-.5 FERMI BARLOW      66 HBC  +- 1.2 PBAR P       11/66

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                        16 PI(1003) WIDTH (MEV)

W    *         60.0                       BELYAKOV  64 PBC                       6/66
W    *   50    40.0   APPROX.             ARMENTERO 65 HBC  +-
W    *  143    57.0     13.0+SYSTEMATIC ROSENFELD 65 RVUE +-                      8/66
W              70.      15.               MONTANET  66 HBC                      11/66

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             16 PI(1003) PARTIAL CECAY MODES

P1           PI(1003) INTO K KBAR                               S10S11
P2           PI(1003) INTO ETA PI                               S14S 8

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The I = 1$\bar{K}$K enhancement has been seen only in $\bar{p}p$ annihilations, where no $\eta\pi$ mass spectra are known to us. There are $\eta\pi$ spectra in π^-p interactions [see Alitti et al., Phys. Letters 15, 69 (1965)], but the total production of KK_1 is ≤3 μb at 3.2 GeV/c [see Richard I. Hess et al., Phys Rev. Letters 17, 1109 (1966)].

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                           REFERENCES FOR PI(10C3)

BELYAKOV 64 JINR P-1586       BELYAKOV,VIRYASUV,KLADNITSKAYA + /// DUBNA
ARMENTER 65 PL 17 344         ARMENTEROS,EDWARDS,JACOBSEN +///CERN+PARIS
ASTIER   65 OXFORC ABSTRACT 143 AND SUPPLEMENT P 13  // CERN+COLL DE FR.
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
BARLOW   66  CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
MONTANET 66  PRIVATE COMM.    L.MONTANET //////////////////////////// CERN

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A1 (1080)

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                        10  A1 MESON (1C79, JPG=  -)  I=1

                        SEE COMPILATION AND DISCUSSION IN G.GOLDHAVERS REVIEW
                        1966 BERKELEY CONFERENCE.

                        10  A1 MESON  MASS (MEV)

M           1080.0                        ADERHOLZ  64 HBC
M           1080.0      20.0              ALLARD    64 FBC   -
M           1080.0      10.0              HESS      64 HBC   -
M           1076.0      14.0              DEUTSCH 2 66 HBC   +                   9/66

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                        10  A1 MESON  WIDTH (MEV)

W             80.0                        ADERHOLZ  64 HBC
W    *       150.0    APPROX              ALLARD    64 FBC   -
W    *       100.0    APPROX              HESS      64 HBC   -
W            130.0      50.0      40.0    DEUTSCH 2 66 HBC   +                   9/66

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                        10  A1 PARTIAL CECAY MODES

P1       A1 INTO RHO PI                                     L 9S 8
P2       A1 INTO KBAR K                                     S10S11
P3       A1 INTO ETA PI                                     S14S 8
P4       A1 INTO ETA PRIME PI                               L 2S 8

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                        10  A1 BRANCHINC RATIOS

R1   *   A1 INTO (KBAR K)/(RHO PI)                         (P2)/(P1)
R1   *       0.01 OR LESS             DEUTSCH 1 66 HBC   +                      6/66
R1   *       0.0025 OR LESS           HESS      66 HBC   -  4.0 PI- P          10/66

R2   *    A1 INTO (ETA PI)/(RHO PI)                        (P3)/(P1)
R2   *       0.015 OR LESS            DEUTSCH 1 66 HBC   +                      6/66

R3   *    A1 INTC (ETA PRIME P1)/(RHO PI)                  (P4)/(P1)
R3   *       0.015 OR LESS            DEUTSCH 1 66 HBC   +                      6/66

R    *FOR 1+ NCNET SU3 RATES SEE E.G. GOLDHABER, REVIEW BERKELEY CONF.1966

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                           REFERENCES FOR A1

BELLINI  63 NC 29 896         BELLINI,FIORINI,HERZ,NEGRI,RATTI /// MILAN
ADERHOLZ 64 PL 10 226         AACH+BERL+BIRM+BONN+DESY+HAMB+IMP.COL+ MPI
ALLARD   64 PL 12 143         ALLARD+ // PARIS+CERN+MILAN+CEA-SAC+UC-BKY
GOLDHABE 64 PRL 12 336        GOLDHABER,BROWN,KADYK,SHEN,TRILLING/LRL+UC
HESS     64 DUBNA CONF  1 422 HESS,CHUNG,DAHL,HARDY,KIRZ,MILLER //// LRL
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
DEUTSCH1 66 PL 20 82          DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
DEUTSCH2 66 PL 22 112         DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
GOLDHABE 66  BERKELEY CONF    G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
HESS     66 UCRL-16832        R I HESS (THESIS, BERKELEY)          // LRL

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B (1210)

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                        11  B MESON (1210,JPG=  +) I=1
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The B meson was first seen in πp collisions, where its analysis was complicated by Deck Effect (see CHUNG + 64). However, in 1966 Baltay et al. reported a significant B peak in $\bar{p}p$ annihilations. This seems to confirm the existence of the B.

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                        11  B MESON  MASS (MEV)

M       60 1220.0                         ABOLINS   63 HBC  +
M          1220.0                         HESS      64 HBC  -
M          1220.0                         GOLDHABER 65 HBC
M      344 1200.0      15.0               BALTAY    66 HBC     0.0 PBAR P       9/66
M    *     FOR EVIDENCE THAT THE B IS JUST DECK EFFECT, SEE CHUNG 66

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                        11  B MESON  WIDTH (MEV)

W       60  100.0      20.0               ABOLINS   63 HBC  +
W           180.0      30.0               HESS      64 HBC  -
W            80.0                         GOLDHABER 65 HBC
W      344  100.0      30.0               BALTAY    66 HBC     0.0 PBAR P       9/66

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                        11  B MESON PARTIAL DECAY MODES

P1       B MESON INTO OMEGA+PI                              L 1S 8
P2       B MESON INTO 2PI+ 2PI-                             S 8S 8S 8S 8
P3       B MESON INTO K KBAR                                S10S10
P4       B MESON INTO PI PI                                 S 8S 8
P5       B MESON INTO PI PHI                                S 9U 4

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                        11  B MESON  BRANCHING RATIOS

R1   *   B INTO  4PI/(OMEGA PI)                           (P2)/(P1)
R1   *          0.5   OR LESS             ABOLINS   63 HBC  +

R2   *   B MESON INTO (K KBAR)/(OMEGA PI)                 (P3)/(P1)
R2   *          0.02  OR LESS             HESS      66 HBC  -  1.6-4.2 PI- P  10/66

R3   *   B MESON INTO (PI PI)/(PI OMEGA)                   (P4)/(P1)
R3   *          0.3   OR LESS             ADERHOLZ  64 HBC                     7/66

R4   *   B MESON INTO (PI PHI) / (PI OMEGA)                (P5)/(P1)
R4   *          0.015 OR LESS             HESS      66 HBC     1.6-4.2 PI- P  10/66

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                           REFERENCES FOR B MESON

ABOLINS  63 PRL 11 381        ABOLINS,LANDER,MEHLHOP,XLONG,YAGER // UCSD
BONDAR   63 PL 5 209          BONDAR,DODD+//AACHEN+BIRM+HAMB+IC-LOND+MPI
ADERHOLZ 64 PL 10 240         AACHEN+BERLIN+BIRM+BONN+HAMBUR+IC-LOND+MPI
HESS     64 DUBNA CONF 1 422  HESS,CHUNG,DAHL,HARDY,KIRZ,MILLER //// LRL
   SEE ALSC CHUNG 66
GOLDHABE 65 PRL 15 118        G GOLDHABER,S GOLDHABER,KADYK,SHEN /// LRL
BALTAY C 66  BERKELEY CONF    +FRANZINI,SEVERIENS,YEH,ZANELLO //BNL,CCNY
CHUNG S  66 PRL 16 481        +NEVEU,DAHL,KIRZ,MILLER,GUIRAGOSIAN // LRL
HESS     66 UCRL-16832        R I HESS (THESIS, BERKELEY)          // LRL

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

CARMCNY  64 PRL 12 254        CARMONY,LANDER,RINDFLEISCH,XUONG,YAGER//UC   JP

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A2 (1300)

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                        12  A2 MESON (1300,JPG=2+-)  I=1

                        SEE COMPIL. AND DISC. IN G.GOLDHABERS REVIEW 1966
                        BERKELEY CONF.

                        12  A2 MESON  MASS (MEV)

M           1320.0                        ADERHOLZ  64 HBC
M           1335.0      10.0              GOLDHABER 64 HBC  +-  3.7 PI+- P
M           1285.0                        ARMENTERO 65 HBC     KIKI DECAY       6/66
M           1270.0                        DERADO    65 HBC                      6/66
M       130 1310.0                        FORINO    65 DBC  + C 4.5 PI+ D      10/66
M      1425 1290.0       5.0              LEFEBVRES 65 MMSP -                   6/66
M           1300.0                        SEIDLITZ  65 DBC  -                   6/66

M           1325.0                        BARI      66 DBC    C 5.1 PI+ D      10/66
M           1317.        3.               BARLOW    66 HBC  +- (K KBAR MODE)   11/66
M           1333.       13.               BARLOW    66 HBC  +- (K KBAR MODE)   11/66
M           1290.0      10.0              BARNES    66 HBC  -                   6/66
M           1310.0      10.0              BENSON    66 DBC                      6/66
M           1325.0                        BEUSCH    66 SPRK  0 5-12 PI- P      10/66
M           1317.0       5.0              CHUNG     66 HBC  -0 3-4 PI- P       10/66
M           1280.0                        DEUTSCHMA 66 HBC  +   8.0 PI+ P       6/66
M    * 1800 1310.0      10.0     COMP.BY FERBEL     66      +-  PI+- P         10/66
M    S      1260.0      10.0              LEVRAT    66 MMS  -  7-12 PI- P      10/66
M    S      1312.0      10.0              LEVRAT    66 MMS  -  7-12 PI- P      10/66
M    S   LEVRAT ET AL SEE SLIGHT EVIDENCE FOR TWO NARROW A2 PEAKS.
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(Ideogram below)

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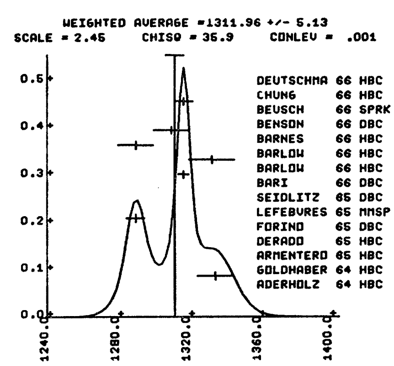

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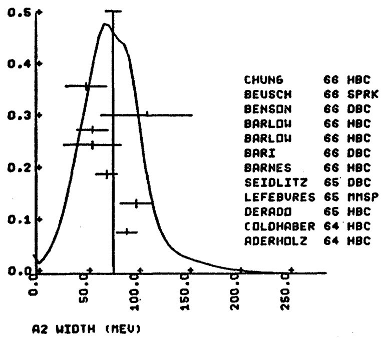
                    12  A2 MESON  WIDTH (MEV)

W           100.0                          ADERHOLZ  64 HBC
W            90.0    10.0                  GOLDHABER 64 HBC  +-  3.7 PI+- P
W           150.0                          DERADO    65 HBC                        6/66
W     1425   99.0    15.0                  LEFEBVRES 65 MMSP  -                    6/66
W           140.0                          SEIDLITZ  65 DBC   -                    6/66

W            70.0    10.0                  BARNES    66 HBC   -                    6/66
W           120.0                          BARI      66 DBC   0 5.1 PI+ D         10/66
W            56.     28.                   BARLOW    66 HBC  +- (K KBAR MODE)     11/66
W            56.     15.                   BARLOW    66 HBC  +- (K KBAR MODE)     11/66
W           110.0    45.0                  BENSON    66 DBC                        6/66
W            90.0                          BEUSCH    66 SPRK  0 5-12 PI- P        10/66
W            50.0    20.0                  CHUNG     66 HBC  -0 3-4 PI- P         10/66
W   * 1800   80.0    10.0      COMP.BY     FERBEL    66      +-  PI+- P           10/66
W   S        26.0   OR LESS                LEVRAT    66 MMS   -  FOR BOTH PEAKS   10/66
```

(Ideogram below)

WEIGHTED AVERAGE =76.59 +/- 7.23
SCALE = 1.32 CHISQ = 8.7 CONLEV = 0.124

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                    12  A2 MESON PARTIAL DECAY MODES

P1         A2 MESON INTO RHO PI                           U 9S 8
P2         A2 MESON INTO KBAR K                           S10S12
P3         A2 MESON INTO ETA PI                           S14S 8
P4         A2 MESON INTO ETA PRIME PI                     U 2S 8
P5         A2 MESON INTO PI+ PI- PI0                      S 8S 8S 9
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                    12  A2 MESON  BRANCHING RATIOS

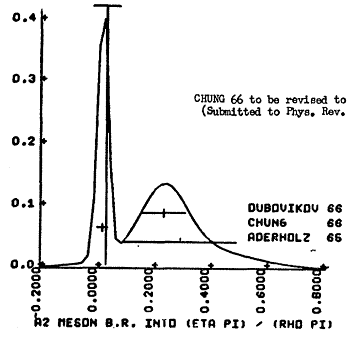
R1   *   A2 MESON  INTO (K KBAR) / (RHO PI)              (P2)/(P1)
R1   *       0.08  OR LESS           LANDER     64 HBC  +                  10/66
R1   *       0.04  OR LESS           ARMENTERO  65 HBC  -
R1           0.053    0.021          CHUNG      66 HBC  -0                 10/66
R1           0.03     0.02           DEUTSCHMA  66 HBC  +                   6/66

R2   *   A2 MESON INTO (ETA PI)/TOTAL                    (P3)/TOTAL
R2   *       0.03 OR LESS            DEUTSCHMA  66 HBC  +                   6/66

R3   *   A2 MESON INTO (ETA PI) / (RHO PI)               (P3)/(P1)
R3           0.3      0.2            ADERHOLZ   65 HBC
R3           0.022    0.018          CHUNG      66 HBC  -0                 10/66
R3           0.24     0.08           DUBOVIKOV  66 HBC  -                  11/66
```

(Ideogram below)

WEIGHTED AVERAGE =0.0346 +/- 0.0466
SCALE = 2.66 CHISQ = 7.1 CONLEV = 0.008




```
R4   *   A2 MESON INTO (ETA PRIME PI) / TOTAL             (P4)/TOTAL
R4   *       0.1   OR LESS           CHUNG      65 HBC  -
R4   *       0.015 OR LESS           DEUTSCHMA  66 HBC  +                   6/66

R5   *   A2 MESON INTO (PI+ PI- PI0) / (RHO PI)          (P5)/(P1)
R5   *       0.17  OR LESS           BENSON     66 DBC   0

R    *FOR 2+ NONET SU3 RATES SEE E.G. GLASHOW,SOCOLOW, PRL 15,329(65)
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                         REFERENCES FOR A2

ADERHOLZ 64 PL 10 248             AACHEN+BERLIN+BIRM+BONN+HAMB+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
ARMENTER 65 PL 17 344             ARMENTEROS,EDWARDS,JACOBSEN +  //CERN+CDEF
CHUNG    65 PRL  15  325          +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER // LRL
DERADO   65 PRL 14 872            DERADO,KENNEY,POIRIER,SHEPHARD//NOTRE DAME
FORINO   65 PL 19 68              +GESSAROLI+LENDINARA+/BOL+BARI+FIR+ORS+SAC
LEFEBVRE 65 PL 19 434             LEFEBVRES,LEVRAT,BLIEDEN,DUBAL +    //CERN
SEIDLITZ 65 PRL 15 217            L SEIDLITZ,O I DAHL,D H MILLER /////// LRL

BARI     66  BERKELEY CONF 7A BARI-BOLOGNA-FIRENZE-ORSAY   COLLABORATION
BARLOW   66  CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BARNES   66 PRL 16 41             BARNES,FOWLER,LAI,ORENSTEIN + /// BNL+CCNY
BENSON   66 PRL 16 1177           G BENSON,LOVELL,MARQUIT,ROES + // MICHIGAN
BEUSCH   66  BERKELEY CONF 7A +FISCHER,GOBBI,PEPIN,ASTBURY + // ETH+CERN
CHUNG    66  BERKELEY CONF 7A S CHUNG,DAHL,HARDY,HESS,KIRZ,MILLER // LRL  JP
SEE ALSO 66 UCRL-16832            RICHARD I HESS--THESIS,BERKELEY     // LRL
DEUTSCHM 66 PL 20 82              DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
DUBOVIKO 66  BERKELEY+PRIV.C. DUBOVIKOV,GRIGORIEV,VLADIMIRSKY +  // ITEP
FERBEL   66 PL 21 111             FERBEL                          // ROCHESTER
GOLDHABE 66  BERKELEY CONF     G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
LEVRAT   66 PL  22  714           +TOLSTRUP,SCHUBELEIN,NEF,MAGLIC  + // CERN

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

LANDER   64 PRL 13 346 A          LANDER,ABOLINS,CARMONY,HENDRICKS +/// UCSD  JP
ADERHOLZ 65 PR 138 B 897.         AACHEN+BERLIN+BIRM+BONN+HAMB+LUND+MUENCHEN
ALITTI   65 PL 15 69              ALITTI,BATON,DELER,CRUSSARD+/ SACLAY+BOLOG   JP
         FOR QUANTUM NUMBERS OF NEUTRAL A2, SEE BENSON ABOVE
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π (1640) → 3π

```
            34  PI (1640, JPG=  -)  I GTE 1

   *        FOR COMPILATION BY T. FERBEL, SEE REVIEW ON MESONS,
   *        1966 BERKELEY CONFERENCE

            34   3 PI (1640) MASS  (MEV)

M   C   30 1600.0                    FORINO    65 DBC  0  4.5 PI+ D         10/66
M   C 1700 EVENTS,COMPILED BY FERBEL. ABC COLL. 66  HBC +   8.0 PI+ P       10/66
M   C 4000 EVENTS,COMPILED BY FERBEL. BALTAY    66  HBC +   8.4 PI+ P       10/66
M   C 2000 EVENTS,COMPILED BY FERBEL. SLATTERY  66  HBC +   7.0 PI+ P       10/66
M   C THESE ARE MOST OF THE AVAILABLE DATA ABOVE 6 GEV/C PI+ P               10/66
M      110 1640.     20.             FERBEL    66 RVUE +   7-8 PI P         11/66
M   *   20 1630.0    30.0            VETLITSKY 66 HBC  -   4.7 PI- P
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```
            34  3 PI (1640) WIDTH  (MEV)

W      110  100.     20.             FERBEL    66 RVUE +   7-8 PI P         11/66
W   *   20  100.                     VETLITSKY 66 HBC  -                     6/66
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            34  PI (1640) PARTIAL DECAY MODES

P1          PI(1640) INTO 3 PI                          S 9S 9S 9
P2          PI(1640) INTO RHO PI                        S 9U 9
P3          PI(1640) INTO ETA PI                        S 9S14
P4    *     PI(1640) INTO 5 PI
P5          PI(1640) INTO K K*(890)                     S11U18
P6          PI(1640) INTO K KBAR PI                     S11S11S 9
P7          PI(1640) INTO K KBAR                        S11S11
P8          PI(1640) INTO F PI                          U 5S 9
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            34  PI (1640)  BRANCHING RATIOS

R1    *     PI(1640) INTO (K KBAR) / (3 PI)             NUM      7
R1    *                                                 DEN 1
R1    *          .40  OR LESS (ESTIMATED FROM DATA OF DEUTSCHMANN 66)        11/66
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                        REFERENCES FOR PI(1640)

ABC COLL 66 COMM.TO T. FERBEL FOR AUTHORS SEE PL 19 608(65)AACHEN,BERLIN,CERN
BALTAY C 66 COMM.TO T. FERBEL +YEH,FRANZINI,KUNG,PLANO,RAVIN//COL.RUTGER
DEUTSCHM 66 PL 20 82          DEUTSCHMANN,STEINBERG + / AACH+BERLIN+CERN
FERBEL   66  BERKELEY CONF.   SEE G. GOLDHABER, REVIEW ON MESONS /// LRL
FORINO   65 PL 19 68          +GESSAROLI+LENDINARA+/BOL+BARI+FIR+ORS+SAC
LUBATTI  66  THESIS BERKELEY  H.J.LUBATTI /////////////////////////// LRL 1-2-
SLATTERY 66 U.ROCH.875153--NC +H.KRAYBILL, B.FORMAN, T.FERBEL//ROCH.YALE
VETLITSK 66 PL  21  579       VETLITSKY,GUSZAVIN,KLIGER,ZOLGANOV+ //ITEP
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ρ (1650) → 2π

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            15  RHO (1650, JPG=  +) I=

   *        FOR COMPILATION SEE GOLDHABER MESON REVIEW
            1966 BERKELEY CONFERENCE.

            15  RHO (1650)  MASS (MEV)

M          1700.0    100.0           BELLINI   65 HLBC  0                    6/66
M          1620.0     20.0           DEUTSCHMA 65 HBC  +                     6/66
M          1640.0                    FORINO    65 DBC   0                    6/66
M          1670.0     30.0           GOLDBERG  65 HBC   0
M       70 1700.                     CRENNELL1 66 HBC   0 6.0 PI-P          10/66
M       25 1625.                     CRENNELL1 66 HBC  -  6.0 PI-P          10/66
M   C      MOST OF DATA ABOVE COMPILED BY GOLDHABER                          9/66
M   C  300 1650.0            COMP. BY GOLDHABER 66 RVUE  0 5-8 PI P, PI D    9/66
M   C   50 1650.0            COMP. BY GOLDHABER 66 RVUE +-  5-8 PI P, PI D   9/66

           ------ DECAY INTO FOUR PIONS ------
M   *   23 1610.0     40.            KERNAN    65 HBC   0 2.7 PBAR P        10/66
M   *      1680.0   APPROX.          CONTE     66 HBC  -  11 PI- P          10/66
```

```
            15  RHO (1650)  WIDTH (MEV)

W        13   80.0    40.0           DEUTSCHMA 65 HBC  +                     6/66
W             40.0                   FORINO    65 DBC   0                    6/66
W            180.0    40.0           GOLDBERG  65 HBC   0
W        70  200.                    CRENNELL1 66 HBC   0 6.0 PI-P          10/66
W        25   60.                    CRENNELL1 66 HBC  -  6.0 PI-P          10/66
W   C   350  150.0    50.0  COMP. BY GOLDHABER 66 RVUE +-0 5-8 PI P, PI D    9/66

           ------ DECAY INTO FOUR PIONS ------
W   *        155.     85.            KERNAN    65 HBC   0 2.7 PBAR P        10/66
W   *        160.0  APPROX.          CONTE     66 HBC  -  11 PI- P          10/66
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                   15  RHO (1650)     PARTIAL DECAY MODES
P1          RHO (1650) INTO PI PI                          S 8S 8
P2          RHO (1650) INTO PI PI PI PI                    S 8S 8S 8S 8
P3          RHO (1650) INTO PI PI RHO                      S 8S 8U 9
P4          RHO (1650) INTO RHO RHO                        U 9U 9

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                   15  RHO (1650)  BRANCHING RATIOS

R1   *      RHO(1650) INTO  (4 PI) / TOTAL                NUM  2
R1   *                                                    DEN 1234
R1   *      KERNAN+ PROBABLY SEE THIS MODE                                 10/66
R1   *      CONTE+  PROBABLY SEE THIS MODE                                 10/66

R2   *      RHO(1650) INTO  (PI PI RHO) / (4 PI)          NUM   3*
R2   *                                                    DEN  2
R2   *        0.25  OR LESS              KERNAN    65 HBC                  10/66
R2   *      SEEN PROBABLY                CONTE     66 HBC                  10/66

****** ********* ********* ********* ********* ********* ********* *********

                              REFERENCES FOR RHO(1650)

BELLINI  65 NC 40 A 948        BELLINI,DI CORATO,DUIMINO,FIORINI //MILANO
DEUTSCHM 65 PL 18 351          DEUTSCHMANN,SCHULTE + //// AACH+ZEUTH+CERN
FORINO   65 PL 19 65           FORINO,GESSAROLI +  //BOLOGNA+ORSAY+SACLAY
GOLDBERG 65 PL 17 354          GOLDBERG+/CERN+PARIS+ORSAY+MILANO+CEA-SACL
CONTE    66 PL 22 702          +TOMASINI+DITTMANN+/GENOVA+HAMB+MIL+SACLAY
CRENNEL1 66  BERKELEY CONF     +HOUGH,KALBFLEISCH,LAI,BACHMAN+// BNL,CCNY
GOLDHABE 66  BERKELEY CONF     G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
KERNAN   65 PRL 15 803         +LYON+CRAWLEY ////////////////////////// IOWA
   KERNAN+  SEE DECAY ONLY INTO NEUTRAL 4 PION STATE

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
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R (1700)

```
        30  R (1700, JPG=   )  I GTE 1,  MAY BE 3 PEAKS

   *                OMITTED FROM TABLE.  SEE NOTES
   *                ON MESONS FOLLOWING THIS LISTING.

                    30  R (1700)  MASS (MEV)

M    *  360 1632.0    15.0   R1       LEVRAT     66 MMS   - 7-12 PI P      9/66
M    *  485 1700.0    15.0   R2       LEVRAT     66 MMS   - 7-12 PI P      9/66
M    *  425 1748.0    15.0   R3       LEVRAT     66 MMS   - 7-12 PI P      9/66
M        75 1675.                     CRENNELL1 66 HBC   -  6.0 PI-P     10/66

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                    30  R (1700) WIDTH (MEV)

W    *        21.0  OR LESS  R1       LEVRAT     66 MMS   - 7-12 PI P      9/66
W    *        30.0  OR LESS  R2       LEVRAT     66 MMS   - 7-12 PI P      9/66
W    *        38.0  OR LESS  R3       LEVRAT     66 MMS   - 7-12 PI P      9/66
W        75  150.                     CRENNELL1 66 HBC   -  6.0 PI-P     10/66

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                    30 D(SIGMA)/D(T) ( MICROBARNS/(GEV/C)**2 )

CS   *       125.0     30.0           FOCACCI    66 MMS  .23 LTE T LTE .28   9/66

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                    30  R1,R2,R3 BRANCHING RATIOS

R1   *      R1 MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R1   *         0.37 /   0.59 /   0.04  FOCACCI    66 MMS    -             10/66

R2   *      R2 MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R2   *         0.42 /   0.56 /   0.01  FOCACCI    66 MMS    -             10/66

R3   *      R3 MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R3   *         0.14 /   0.80 /   0.05  FOCACCI    66 MMS    -             10/66

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                              REFERENCES FOR R(1700)

FOCACCI  66 PRL  17  890       + KIENZLE,LEVRAT,MAGLIC,MARTIN      // CERN
LEVRAT   66 PL   22  714       + TOLSTRUP,MAGLIC,FOCACCI,DUBAL +  // CERN
CRENNEL1 66  BERKELEY CONF     +HOUGH,KALBFLEISCH,LAI,BACHMAN+// BNL,CCNY

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S (1930)

```
                    31 S(1930, JP=  , I GTE 1) 3 CHARGED DECAY TRACKS

                    31  S (1930)  MASS (MEV)

M          1929.0     14.0            CHIKOVANI 66 MMSP  -                 8/66
M       15 1910.0     20.0            DEUTSCHMA 66 HBC   +                 6/66

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                    31  S (1930) WIDTH (MEV)

W             35.0  OR LESS           CHIKOVANI 66 MMSP  -                 8/66
W       15    90.0     40.0           DEUTSCHMA 66 HBC   +                 6/66

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                    31 D(SIGMA)/D(T) ( MICROBARNS/(GEV/C)**2 )
CS   *        35.0     12.0           FOCACCI    66 MMS  .22 LTE T LTE .36   9/66

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                              REFERENCES FOR S(1930)

CHIKOVAN 66 PL  22  233        +DUBAL,FOCACCI,KIENZLE,LEVRAT,MAGLI+/CERN+
FOCACCI  66 PRL  17  890       + KIENZLE,LEVRAT,MAGLIC,MARTIN      // CERN
DEUTSCHM 66  BERK.CONF.--PL    +SCHULTE+STEINBERG+ ///// AACH+BERLIN+CERN

    POSSIBLE CONTRADICTION SINCE MMS  HAS LESS THAN 20 PERCENT OF DECAYS
    WITH 1 CHARGED TRACK, WHEREAS HBC SEES DECAY INTO PI+ PIO.

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```

T (2195)

```
                    32 T(2200, JP=  , I GTE 1) 3 CHARGED DECAY TRACKS

                    32 T(2200) MASS (MEV)

M          2195.0     15.0            CHIKOVANI 66 MMSP  -                 8/66

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                    32 T(2200) WIDTH (MEV)

W             13.0  OR LESS           CHIKOVANI 66 MMSP  -                 8/66

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                    32 D(SIGMA)/D(T) ( MICROBARNS/(GEV/C)**2 )

CS   *        29.0     10.0           FOCACCI    66 MMS  .22 LTE T LTE .36   9/66

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                              REFERENCES FOR T(2200)

CHIKOVAN 66 PL  22  233        +DUBAL,FOCACCI,KIENZLE,LEVRAT,MAGLI+/CERN+
FOCACCI  66 PRL  17  890       + KIENZLE,LEVRAT,MAGLIC,MARTIN      // CERN

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U (2382)

```
                    33 U(2380, JP=  , I GTE 1) 1,3,5  CHARGED TRACKS

                    33 U(2380)  MASS (MEV)

M          2382.0     24.0            CHIKOVANI 66 MMSP  -                 8/66

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                    33 U(2380) WIDTH (MEV)

W    *        30.0  OR LESS           CHIKOVANI 66 MMSP  -                 8/66

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                    33 D(SIGMA)/D(T) ( MICROBARNS/(GEV/C)**2 )

CS   *        42.0     14.0           FOCACCI    66 MMS  .28 LTE T LTE .36   9/66

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                    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    -             10/66

****** ********* ********* ********* ********* ********* ********* *********

                              REFERENCES FOR U(2380)

CHIKOVAN 66 PL  22  233        +DUBAL,FOCACCI,KIENZLE,LEVRAT,MAGLI+/CERN+
FOCACCI  66 PRL  17  890       + KIENZLE,LEVRAT,MAGLIC,MARTIN      // CERN

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K (725)

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                    17  KAPPA (725,JP=  )  I=1/2

   *                COMPILED IN APPENDIX A.

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K* (892)

```
                    18  K*  (890,JP =1- )  I=1/2

                    18  K* (890) MASS (MEV)

M           898.0      5.0            CHADWICK  63 HBC  +
M           891.0      3.0            FERRO-LUZ 65 HBC  +

M           890.5                     ARMENTERO 65 HBC  +-
M           890.       2.             BARLOW    66 HBC  +-  1.2 PBAR P    11/66
M           889.       3.             BARLOW    66 HBC  +-  1.2 PBAR P    11/66

M      3870 891.0      1.0            WOJCICKI  63 HBC   -
M           895.0      3.0            GELSEMA   65 HBC   -

M       200 880.0                     ALEXANDER 62 HBC  + 0
M           895.0      2.0            FERROLUZZ 65 HBC  + 0                6/66
M           895.0                     WANGLER   65 HBC  + 0                6/66

M           885.0                     ARMENTERO 62 HBC  +-0

M        70 897.0     10.0            COLLEY    62 HBC    0
M       200 892.0      2.0            KRAEMER   63 HBC    0
M       150 885.0                     SMITH     63 HBC    C
M           889.5      2.5            ADELMAN   65 HBC                     6/66
M           899.       4.             BARLOW    66 HBC    0 1.2 PBAR P    11/66
M           897.       4.             BARLOW    66 HBC    0 1.2 PBAR P    11/66
M       160 891.       5.             CRENNELL3 66 HBC    0 6.0 PI-P      10/66
                             (Ideogram below)
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                    18  K*(0) - K*(+) MASS DIFF. (MEV)

D             6.5      3.8            BARASH    66 HBC      0 PBAR P      11/66

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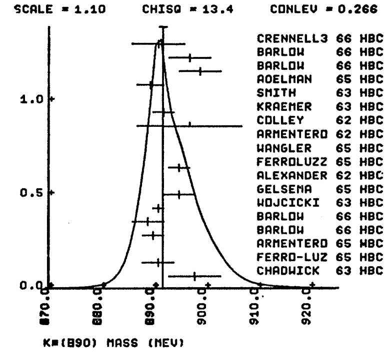
```

WEIGHTED AVERAGE =891.894 +/- 0.705
SCALE = 1.10   CHISQ = 13.4   CONLEV = 0.266



```
                   18  K* (890) WIDTH (MEV)

W          46.0     8.0            CHADWICK  63 HBC  +
W          47.0     4.0            FERRO-LUZ 65 HBC  +

W   3870   46.0     3.0            WOJCICKI  63 HBC   -
W          50.0    15.0            GELSEMA   65 HBC   -

W          31.0                    ARMENTERO 65 HBC  +-
W          44.      7.             BARLOW    66 HBC  +-  1.2 PBAR P      11/66
W          43.      9.             BARLOW    66 HBC  +- 1.2 PBAR P       11/66
W          53.      7.             BARLOW    66 HBC  +-  1.2 PBAR P      11/66

W    200   60.0     5.0            ALEXANDER 62 HBC  + 0
W          51.8     3.5            FERROLUZZ 65 HBC  + 0                  6/66
W          40.0                    WANGLER   65 HBC  + 0                  6/66

W          55.0                    ARMENTERO 62 HBC  +-0

W     70   60.0    10.0            COLLEY    62 HBC   0
W    200   50.0     5.0            KRAEMER   63 HBC   0
W    150   50.0                    SMITH     63 HBC   0
W          51.0     3.0            ADELMAN   65 HBC                       6/66
W          53.     13.             BARLOW    66 HBC   0 1.2 PBAR P       11/66
W          34.      8.             BARLOW    66 HBC   0 1.2 PBAR P       11/66
W    160   49.      6.             CRENNELL3 66 HBC   0 6.0 PI-P         10/66
                         (Ideogram below)
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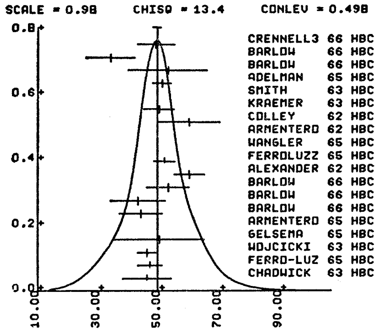
```

WEIGHTED AVERAGE =49.41 +/- 1.31
SCALE = 0.98 CHISQ = 13.4 CONLEV = 0.498



K*(890) WIDTH (MEV)

```
                   18  K* (890) PARTIAL DECAY MODES

P1    K* INTO K PI                                     S10S 8
P2    K*(890) INTO (K PI PI)                           S10S 8S 8

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                   18  K* (890) BRANCHING RATIOS

R1  *  K*(890) INTO (K PI PI)/(K PI)                  (P2)/(P1)
R1  *    0     0.002 OR LESS        WOJCICKI+ 63 HBC   -

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REFERENCES FOR K*


```
ALSTON   61 PRL 6 300          ALSTON,ALVAREZ,EBERHARD,GOOD,GRAZIANO+/LRL
ALEXANDE 62 PRL 8 447          ALEXANDER,KALBFLEISCH,MILLER,G SMITH //LRL
ARMENTER 62 CERN CONF 295      ARMENTEROS,MONTANET,D ANDLAU + ///CERN+CDF
COLLEY   62 CERN CONF 315      D COLLEY,N GELFAND + //// COLUMBIA+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

FERROLUZ 64 PL 12 255          FERRO-LUZZI,GEORGE,HENRI,JONGEJANS+ //CERN
WOJCICKI 64 PR 135 B 495       S WOJCICKI,M ALSTON,G KALBFLEISCH //// LRL
WOJCICKI 64 PR 135 B 484       STANLEY G WOJCICKI //////////////////// LRL

ADELMAN  65 ATHENS 527         STUART LEE ADELMAN               // CAVENDISH
ARMENTER 65 PL 17 170          ARMENTEROS,EDWARDS,JACOBSEN + //CERN+PARIS
FERROLUZ 65 NC 36 1101         FERRO-LUZZI,GEORGE,HENRI,JONGEJANS // CERN
FERROLUZ 65 NC 39 417          FERRO-LUZZI,GEORGE,GOLDSCHMIDT-CLER+//CERN
GELSEMA  65  DISS. AMSTERDAM   E.S.GELSEMA (SEE ALSO PL 10 341) / AMSTERD
WANGLER  65 PR 137 B 414       WANGLER,ERWIN,WALKER /////////// WISCONSIN

BARLOW   66  CERN-TC66-22 -NC  BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
CRENNEL3 66  BERKELEY CONF     +KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

CHINOWSK 62 PRL 9 330          CHINOWSKY,GOLDHABER,LEE,OHALLORAN //// LRL  J
```


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K_V (1080)

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       19  KV (1080)

           VERY TENTATIVE EVIDENCE HAS BEEN FOUND BY
           DE BAERE+ (BRUXELLES+CERN), 1966 BERKELEY CONF.
           OMITTED FROM TABLE.

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K_C (1215)

```
       20 KC MESON (1215,JP=  ) I=1/2

  *        SEEN ONLY IN ANNIHILATIONS AT REST.
  *        NO COMPELLING EVIDENCE FOR RESONANCE
  *        OMITTED FROM TABLE.

           20  KC MASS  (MEV)

M          1215.0    15.0              ARMENTERO 64 HBC

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                   20  KC WIDTH (MEV)

W          60.0    15.0              ARMENTERO 64 HBC

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                   20  KC PARTIAL DECAY MODES

P1    KC INTO K RHO                                      S10U 9
P2    KC INTO K* PI                                      U18S 8
P3    KC INTO K PI PI                                    S11S 8S 8

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                   20  KC BRANCHING RATIOS

R1  *  KC INTO (K RHO)/TOTAL          (UNITS OF 10**-2)  (P1)/TOTAL
R1        75.0      10.0               ARMENTERO 64 HBC                6/66

R2  *  KC INTO (K* PI)/TOTAL          (UNITS OF 10**-2)  (P2)/TOTAL
R2        25.0      10.0               ARMENTERO 64 HBC                6/66

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```

REFERENCES FOR KC(1215)


```
ARMENTER 64 DUBNA CONF 1 577   ARMENTEROS,EDWARDS,D ANDLAU +//// CERN+CDF
    ALSO    DUBNA CONF 1 617   R ARMENTEROS (RAPPORTEUR)
SEE ALSO 66 PR  145  1095      BARASH,KIRSCH,MILLER,TAN       // COLUMBIA
```


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```

K_A (1320)

```
       21  KA (1320,JP=  ) I=1/2

  *        THIS BUMP PARTLY DECK EFFECT BUT BISHOP+,
  *        SHEN+ SEE EVIDENCE FOR RESONANCE

           21  KA (1320) MASS (MEV)

M       12 1320.0    25.0            ALMEIDA  65  HBC  +  3-5 K+  P        8/66
M   B      1310.0  SEE NOTE BELOW    BRITISH  65 HBC   -  6. K-P TO K 2PI 10/66
M   B      WIDTH ABOUT 300 MEV, MIXED REAL + DECK + TRIANGLE SINGULARITY  10/66
M       50 1320.0                    DE BAERE 65  HBC  +  3-5 K+  P        8/66
M   *      1330.   APPROX.           BARTSCH  66 HBC   - 10.0 K-  P       11/66
M       20 1305.0    10.0            BISHOP   66 HBC  + 0 2.6 K+ P         8/66
M       40 1310.0                    BISHOP   66 HBC K PI MODE-SURPRISE    8/66
M       70 1320.0    10.0            SHEN     66  HBC  +  4.6 K+  P        8/66

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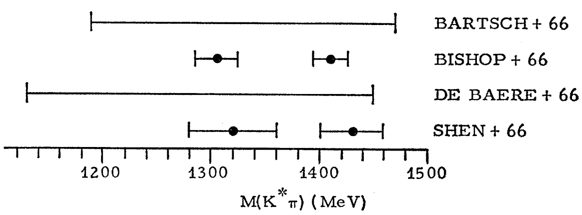
Mass of K_A(1320)

There are appreciable discrepancies between the $K\pi\pi$ mass spectra measured in different experiments, as indicated below.



The bars show position and widths of bumps.

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                   21  KA (1320) WIDTH (MEV)

W       12   60.0    20.0            ALMEIDA   65  HBC  +                  8/66
W   *        250.    APPROX.         BARTSCH   66 HBC   -                 11/66
W       60   40.0    15.0            BISHOP    66  HBC  +                  8/66
W       70   80.0    20.0            SHEN      66  HBC  +                  8/66

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                   21  KA (1320) PARTIAL DECAY MODES

P1        KA INTO K*(890) PI                              U18S08
P2        KA INTO K RHO                                   S11U09
P3        KA INTO K OMEGA                                 S11U01
P4        KA INTO K PI                                    S10S 8
P5        KA INTO K ETA                                   S10S14

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                   21  KA (1320) BRANCHING RATIOS

R1  *     KA INTO K*(890) PI AND K RHO (OVERLAPPING BANDS)
R1     70    1.0                    SHEN     66  HBC  +                    8/66

R2  *     KA INTO(K OMEGA)/(K*(890) PI)                 (P3)/(P1)
R2  *        0.1   OR LESS          SHEN     66 HBC  +                    10/66

R3  *     KA (1320) INTO (K*(890) PI)/ TOTAL            (P1)/TOTAL
R3  C        0.24       0.09        BISHOP   66 HBC                        6/66

R4  *     KA(1320) INTO (K PI) / TOTAL                  (P4)/TOTAL
R4  C        0.68       0.12        BISHOP   66 HBC                        6/66

R5  *     KA (1350) INTO (K RHO) / TOTAL                (P2)/TOTAL
R5  C        0.06       0.06        BISHOP   66 HBC                        6/66

R6  *     KA (1320) INTO (K ETA) / TOTAL                (P5)/TOTAL
R6  C        0.0        0.030       BISHOP   66 HBC                        6/66

R7  *     KA (1320) INTO ( K OMEGA ) / TOTAL            (P3)/TOTAL
R7  C        0.020      0.020       BISHOP   66 HBC                        6/66

R8  *     KA (1320) INTO (K PI) / (K*(890) PI)           (P4)/(P1)
R8  *        0.30   OR LESS         SHEN     66 HBC  +                    10/66
R8  *        0.21   OR LESS         DE BAERE 66 HBC                       11/66

R   C     ADDITIONAL DATA ARE FORTHCOMING. SEE GOLDHABER MESON REV.BERK.CONF
R   *FOR 1+ NONET SU3 RATES SEE E.G. GOLDHABER, REVIEW BERKELEY CONF.1966
```

NOTE ON K OMEGA MODE

BESIDES A WIDE PEAK IN THE (K* PI) MASS DISTRIBUTION, BARTSCH+ SEE A SIMILAR PEAK IN THE (K OMEGA) MASS. SINCE THE (K OMEGA) DECAY OF THE KV(1420) APPEARS TO BE VERY WEAK, IT IS REASONABLE TO ASSOCIATE AT LEAST PART OF THE (K OMEGA) PEAK OBSERVED BY BARTSCH+ WITH A (K OMEGA) MODE OF THE KA(1320).

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REFERENCES FOR KA(1320)

ALMEIDA 65 PL 16 184 — ALMEIDA,ATHERTON,BYER,DORNAN,FORSON+/CAMBR
BRITISH 65 OXFORD CONF — BIRM,GLASGOW,IC--LONDON,MUNICH,OXFORD,RUTH
DE BAERE 65 OXFORD SUPPL. 53 — +DEBAISIEUX,DUFOUR,JONGEJANS+ // CERN+BRUX
BARTSCH 66 PL 22 357 — +DEUTSCHMANN,GROTE,MORRISON,+ // ABCL(IC)V
BISHOP 66 PRL 16 1069 — +GOSHAW,ERWIN,THOMPSON,WALKER,WEINBE//WISC
DE BAERE 66 BERK.CONF. - NC — DE BAERE,DEBAISIEUX,FILIPPAS+ // BRUX+CERN
AND PRIVATE COMMUNICATION BY B. JONGEJANS
SHEN 66 PRL 17 726 — +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
ALSO SHEN BERKELEY CONF — +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL

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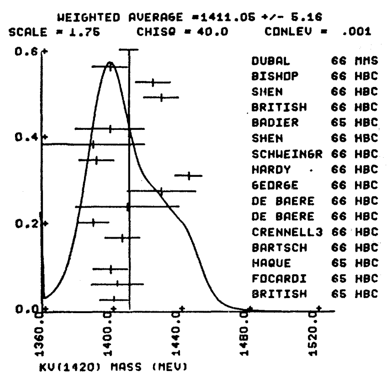
K_V (1420) 22 KV (1420,JP=) I=1/2

22 KV(1420) MASS (MEV)

M	*		1480.0	20.0		BRITISH	65 HBC	- 6. K-P (K PI)	10/66
M			1402.0	8.0		BRITISH	65 HBC	-0 3.5 K- P (K PI)	10/66
M			1404.0	15.0		FOCARDI	65 HBC	-0 3. K- P (K PI)	10/66
M		21	1400.0	10.0		HAQUE	65 HBC	- 3.5 K- P (K PI)	10/66
M		40	1440.0			BARTSCH	66 HBC	- 10. K- P (K PI)	
M		35	1407.0	10.0		CRENNELL3	66 HBC	0 6. PI- P (K PI)	10/66
M			1390.	9.0		DE BAERE	66 HBC	+ 3.5 K+P (K0 PI+)	10/66
M			1410.	20.0	40.	DE BAERE	66 HBC	+ 3.5 K+P (K+ PI0)	10/66
M			1430.0	20.0		GEORGE	66 HBC	0 5. K+ P (K PI)	10/66
M			1446.0	7.9		HARDY	66 HBC	0 4. PI- P (K PI)	10/66
M			1392.0	10.0		SCHWEINGR	66 HBC	0 4.1+5.5 K- P (K PI)	10/66
M			1390.0	30.0		SHEN	66 HBC	+ 0 4.6 K+ P (K PI)	10/66
M			1400.0	20.0		BADIER	65 HBC	- 3. K- P (K*PI)	10/66
M	*		1450.0	20.0		BRITISH	65 HBC	- 6. K-P (K*PI)	10/66
M			1430.0			BRITISH	66 HBC	0 6. K- P (K*PI)	10/66
M	*		1450.0	APPROX.		SCHWEINGR	66 HBC	0 4.1+5.5 K- P (K*PI)	10/66
M			1430.0	10.0		SHEN	66 HBC	+ 0 4.6 K+ P (K*PI)	10/66
M			1425.0	10.0		BISHOP	66 HBC	+ 3.5 K+ P	10/66
M			1400.0	10.0		DUBAL	66 MMS	- 7-12 K- P	10/66

(Ideogram below)



22 KV(1420) WIDTH (MEV)

W			140.0	20.0		BRITISH	65 HBC	-0 3.5 K-P (K PI)	10/65
W	*		150.0	50.0		BRITISH	65 HBC	- 6. K-P (K PI)	10/66
W			92.0	14.0		FOCARDI	65 HBC		
W	*	21	160.0			HAQUE	65 HBC		
W		35	70.	30.	15.	CRENNELL3	66 HBC	0 6.0 PI-P	10/66
W			100.0	25.0		DE BAERE	66 HBC	+ 3.5 K+ P	10/66
W			110.0	40.0		GEORGE	66 HBC	0 5.0 K+ P	10/66
W			61.0	24.0		HARDY	66 HBC	0 3.8-4.2 PI- P	9/66
W			124.0	25.0		SCHWEINGR	66 HBC	0 4.1+5.5 K- P	9/66
W			75.0	25.0		SHEN	66 HBC	4.6 K+ P	8/66
W			105.0	30.0		BADIER	65 HBC		6/66
W	*		160.0	50.0		BRITISH	65 HBC	- 6. K-P TO K* PI	10/66
W			96.0	10.0		BISHOP	66 HBC		6/66
W			62.0	16.0		DUBAL	66 MMS	- 7-12 K- P	9/66

(Ideogram at right)

22 KV (1420) PARTIAL DECAY MODES

P1	KV(1420) INTO K PI	S10S 8
P2	KV(1420) INTO K*(890) PI	U18S 8
P3	KV(1420) INTO K RHO	S10U 9
P4	KV(1420) INTO K OMEGA	S10U 1
P5	KV(1420) INTO K ETA	S10S14

U22 KV(1420) BRANCHING RATIOS

R1	*	KV(1420) INTO (K PI)/TOTAL				(P1)/TOTAL	
R1		0.37	0.19	BADIER	65 HBC		6/66
R1		0.33	0.07	BISHOP	66 HBC		6/66
R2	*	KV(1420) INTO (K*(890) PI) / TOTAL				(P2)/TOTAL	
R2		0.41	0.14	BADIER	65 HBC		6/66
R2		0.56	0.10	BISHOP	66 HBC		6/66
R3	*	KV(1420) INTO (K RHO)/TOTAL				(P3)/TOTAL	
R3		0.14	0.05	BADIER	65 HBC		6/66
R3		0.10	0.05	BISHOP	66 HBC		6/66
R4	*	KV(1420) INTO (K OMEGA)/TOTAL				(P4)/TOTAL	
R4		0.07	0.04	BADIER	65 HBC		6/66
R4		0.007	0.008	BISHOP	66 HBC		6/66
R5	*	KV(1420) INTO (K ETA)/TOTAL				(P5)/TOTAL	
R5		0.02	0.02	BADIER	65 HBC		6/66
R5		0.017	0.020	BISHOP	66 HBC		6/66
R6	*	KV(1420) INTO (K*(890) PI) / (K PI)				(P2)/(P1)	
R6		6 0.33	0.33	CHUNG	65 HBC	+ 0 3.9-4.2 PI- P	8/66
R6		0.56	0.11	SCHWEINGR	66 HBC	0 4.1+5.5 K- P	9/66
R6		0.65	0.20	SHEN	66 HBC	0 N* PRODUCED	10/66
R6		0.63	0.20	SHEN	66 HBC	+ NO N* PRODUCED	10/66
R7	*	KV(1420) INTO (K OMEGA) / K PI				(P4)/(P1)	
R7		0.08	OR LESS	SHEN	66 HBC		8/66
R8	*	KV(1420) INTO (K RHO) / (K PI)				(P3)/(P1)	
R8	*	0.09	OR LESS	CHUNG	65 HBC	+ 0 3.9-4.2 PI- P	8/66
R8		0.35	0.20	SCHWEINGR	66 HBC	0 4.1+5.5 K- P	9/66

R *FOR 2+ NONET SU3 RATES SEE E.G. GLASHOW,SOCOLOW, PRL 15,329(65)

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REFERENCES FOR KV(1420)

BADIER 65 PL 19 612 — BADIER,DEMOULIN,GOLDBERG+//EP+SACLY+ZEEMAN
BRITISH 65 OXFORD CONF — BIRM,GLASGOW,IC--LONDON,MUNICH,OXFORD,RUTH
CHUNG 65 PRL 15 325 — +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER // LRL
FOCARDI 65 PL 16 351 — FOCARDI,MINGUZZI RANZI,SERRA+ /BOLOGNA+CEN
HAQUE 65 PL 14 338 — HAQUE,SCOTTER + /////BIRM,IMP COL+OXF+RUTH

BARTSCH 66 PL 22 357 — +DEUTSCHMANN+GROTE+MORRISON+ /// ABCL(IC)V
BISHOP 66 PRL 16 1069 — BISHOP,GOSHAW,ERWIN,THOMPSON+ // WISCONSIN
BRITISH 66 BERKELEY CONF. — BIRM+GLASGOW+LONDON(IC)+MUNICH+OXFORD+RUTH
CRENNEL3 66 BERKELEY CONF — +KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL I,JP
DE BAERE 66 BERK.CONF. - NC — DE BAERE,DEBAISIEUX,FILIPPAS+ // BRUX+CERN
DUBAL 66 BERKELEY CONF — +BAREYRE,BRICMAN,CHIKOVANI,MAGLIC+ // CERN
GEORGE 66 BERK.CONF. - NC — +GOLDSCHMIDT-CLERMONT+HENRI+ /// CERN+BRUX
HARDY L 66 UCRL 16788 — LYNDON M HARDY (THESIS, BERKELEY) // LRL
SEE ALSO 65 PRL 14 401 — HARDY,CHUNG,DAHL,HESS,KIRZ,MILLER //// LRL
SCHWEING 66 (PREPRINT) — SCHWEINGRUBER,SIMPSON,AMMAR+ // ARGONNE+NW
SHEN 66 BERKELEY CONF — +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
ALSO SHEN66 PRL 17 726 — +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
ALSO 66 (PRIVATE COMMUN)GERSON GOLDHABER /// LRL

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K_A (1800) 23 KA (1800, JP=) I = 1/2

NAMED L BY BARTSCH+

U23 KA (1800) MASS (MEV)

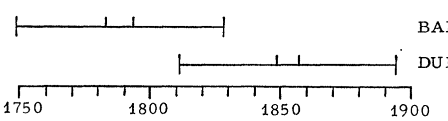
M		80	1789.0	10.0		BARTSCH	66 HBC	- 10.0 K- P	8/66
M	*	35	1852.0	8.0		DUBAL	66 MMS	- 12.0 K- P	8/66

U23 KA (1800) WIDTH (MEV)

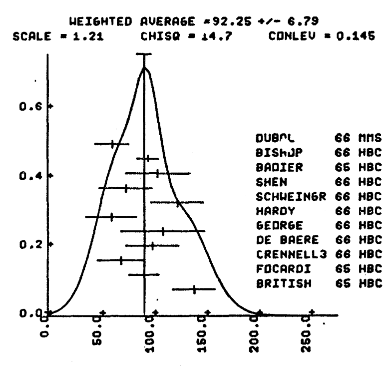
W			80.0	20.0	40.0	BARTSCH	66 HBC		8/66
W	*		84.0	14.0		DUBAL	66 MMS		8/66

Mass and Width of $K_A(1800)$

The results of the two experiments can be sketched as follows:



The total length of the bars is Γ; the smaller hatch marks show the uncertainty in mass reported by the two groups. It can be seen that the central values, with the errors reported, are inconsistent ($\chi^2 = 4.9^2$), and accordingly the result of Dubal et al. has been suppressed with an * until more data are obtained, at the suggestion of Bogdan Maglic. However the sketch shows that the results are not really as inconsistent as suggested by the large value of χ^2.



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                    U23    KA (1800) PARTIAL DECAY MODES

P1      KA    INTO K PI                                      S11S 9
P2      KA    INTO K RHO                                     S11U 9
P3      KA    INTO K*(890) PI                                S 9U18
P4      KA    INTO K OMEGA                                   S11U 1
P5      KA    INTO K PI PI                                   S11S 9S 9
P6      KA    INTO K*(1420) PI                               S 9U22
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                    U23    KA (1800) BRANCHING RATIOS

R1   *  KA    INTO (K PI)/TOTAL              BARTSCH+ SEE NONE(LESS THAN .05).  8/66

R2   *  KA    INTO (K RHO)/TOTAL
R2              0.075     0.05          BARTSCH 2 66 HBC    -                   10/66

R3   *  KA    INTO (K*(890) PI)/TOTAL
R3              0.35      0.12          BARTSCH 2 66 HBC    -                   10/66

R4   *  KA    INTO (K OMEGA)/TOTAL           BARTSCH+ PROBABLY SEE THIS MODE    8/66
R4              0.10      0.03          BARTSCH 2 66 HBC    -                   10/66

R5   *  KA    INTO 1 CHARGED/(3 CH.+ 5 CH.) DUBAL 66 GIVE ABOUT 0.4.            8/66

R6   *  KA    INTO (K PI PI)/(TOTAL)                   (P5)/TOTAL
R6              0.40      0.15          BARTSCH 2 66 HBC    -                   10/66

R7   *  KA    INTO (K*(1420) PI) / TOTAL               (P6)/TOTAL
R7              0.085     0.05          BARTSCH 2 66 HBC                        10/66
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                    NOTE ON KA (1800) - NEGATIVE EVIDENCE

                    NUMBER OF ACCEPTED 4C EVENTS / NUMBER OF  KA (1800)
          REACTION   P K-PI+PI-   P KO PI-PIO   N KO PI+PI-   P K-OMEGA

 BARTSCH 66 10 K- P    999 / 35     425 / 35       -           40 / 10
 BGLMOR  66  6 K- P       -        1150 / 0     740 / 0          -

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                         REFERENCES FOR KA(1800)

BARTSCH  66 PL  22 357        DEUTSCHMANN,GROTE,MORRISON,+    //ABCL(IC)V
BARTSCH2 66  BERKELEY CONF.   BARTSCH ET AL, QUOTED BY GOLDHABER,MESON REVIEW
BGLMOR   66  BERKELEY CONF.   BIRM+GLASGOW+LONDON(IC)+MUNICH+OXFORD+RUTH
DUBAL    66  BERKELEY CONF    +BAKEYRE,BRICMAN,CHIKOVANI,MAGLIC+ // CERN

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$K^*_{3/2}$ (1175)

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24 K* 3/2 (1175,JP=  ) I = 3/2

              EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE.
   *          FOR COMPILATIONS + NEG. EVIDENCE, SEE ROSENFELD, OXFORD
   *          1965 SUPPL..
   *          BISHOP 66 SEES SLIGHT EVIDENCE FOR I=3/2.

              24 K* 3/2 (1175) MASS (MEV)

M   *   23 1175.0                        WANGLER   64 HBC
M   *   15 1160.0     10.0               MILLER    65 HBC       PURDUE
M   *      1180.0                        BISHOP    66 HBC    SUGGEST I=3/2      6/66
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                    24 K* 3/2 (1175) WIDTH (MEV)

W   *   23   25.0  OR LESS              WANGLER   64 HBC
W   *   15   35.0     10.0              MILLER    65 HBC        PURDUE
W   *        50.0                       BISHOP    66 HBC                        6/66

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                         REFERENCES FOR K*3/2(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 65 OXFORD CONF 58     A H ROSENFELD ///////////////// LRL--RVUE
                FOR SLIGHT EVID. FOR K*PI(1175) WITH I = 3/2 SEE BISHOP 66
BISHOP   66 PRL 16 1069        +GOSHAW,ERWIN,THOMPSON,WALKER,WEINBE//WISC I

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$K^*_?$ (1270)

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25  K* /2(1270,JP=    ) I=

              EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE.
   *          FOR COMPILATIONS + NEG. EVIDENCE, SEE ROSENFELD, OXFORD
   *          1965 SUPPL., AND G. GOLDHABER, BERKELEY CONF. 1966.

              25  K*(1270) MASS (MEV)

M   *      1270.0      20.0   I=3/2    BOCK       64 HBC
M   *      1270.0   I = 1/2            DE BAERE   66 HBC      3.5-5 K+ P       10/66
M   *      1280.0   I = 1/2            SHEN       66 HBC    +0 4.6 K+P TO  3PI 10/66
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              25  K*(1270) WIDTH (MEV)

W   *        60.0      30.0   I=3/2    BOCK       64 HBC
W   *       200.0   I = 1/2            DE BAERE   66 HBC      3.5-5 K+ P       10/66
W   *       100.0      20.0   I = 1/2  SHEN       66 HBC    +0 4.6 K+P TO  3PI 10/66
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              25  K*(1270) PARTIAL DECAY MODES

P1          K*(1270) INTO K PI                               S11S 9
P2          K*(1270) INTO K*(890) PI                         U18S 9
P3          K*(1270) INTO K RHO                              S11U 9
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              25  K*(1270) BRANCHING RATIOS

R1   *      K*(1270) INTO (K PI) / (K*(890) PI)              (P1)/(P2)
R1   *         0.8    OR LESS          SHEN       66 HBC                       10/66

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                         REFERENCES FOR K*(1270)

BOCK     64 PL 12 65           BOCK,FRENCH,KINSON,BADIER+//CERN+PAR+ LOND
ROSENFEL 65 OXFORD CONF 58     A H ROSENFELD ////////////////// LRL--RVUE
GOLDHABE 66  BERKELEY CONF     G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
DE BAERE 66  BERKELEY CONF     DE BAERE,DEBAISIEUX,DUFOUR+/BRUXELLES+CERN
SHEN     66  BERKELEY CONF     +BUITERWORTH,FU,GOLDHABERS,TRILLING // LRL

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DATA ON BARYON RESONANCES

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

  N  ANY SYMBOL IN COLUMN 8 INDICATES DATA IGNORED BY AVERAGING PROGRAMS
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N (1400)

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              61  N*1/2(1400, JP=1/2+) I=1/2      P11

              WHETHER THE BUMP NEAR 1400 MEV SEEN IN INELASTIC PP
              SCATTERING IS A RESONANCE OR A KINEMATIC EFFECT IS A
              SUBJECT OF DEBATE.  SEE GELLERT 66 FOR THE VIEW THAT
IT IS A KINEMATIC EFFECT -- SEE ALMEIDA 66 FOR THE OPPOSITE VIEW.  WE
LIST BUT STAR RESULTS OF PP SCATTERING EXPERIMENTS.  PHASE-SHIFT ANAL-
YSES APPEAR TO GIVE BETTER EVIDENCE FOR A RESONANCE IN THIS REGION.
HOWEVER THAT DOESNT END THE PROBLEM.  THE RESONANT ENERGY IS PROBABLY
NOT WHERE THE P11 AMPLITUDE BECOMES PURE IMAGINARY BUT RATHER SOMEWHAT
LOWER WHERE THE AMPLITUDE VARIES MOST RAPIDLY.  SEE THE NOTE ON THE
N*1/2(1400) FOLLOWING THE LISTINGS.  (THE AUTHORS OF THE PHASE-SHIFT
ANALYSES ARE NOT RESPONSIBLE FOR THE NUMBERS WE DEDUCE FROM THEIR WORK.)

---------------   61  N*1/2(1400) MASS (MEV)   ------------------------

M   *      1400.0          APPROX     COCCONI   64 CNTR +  PP 3.6-12 BEV/C
M   *      1425.0          APPROX     ADELMAN   64 HBC  +  K-P 1.45 BEV/C    7/66
M   *      1430.0          APPROX     ANKENBRAN 65 CNTR +  PP 7.1 BEV/C      7/66
M   *      1400.0          APPROX     BELLETTIN 65 SPRK +  PP,D 10-26 BEV/C  7/66
M   *      1405.0    15.0             ANDERSON  66 SPRK +  PP 6-30 BEV/C     9/66
M   *      1410.0    15.0             BLAIR     66 CNTR +  PP 2.8-7.9 BEV/C  9/66
M   *      1450.0                     ALMEIDA   66 HBC  +  PP 2PI 10 BEV/C   9/66
M   *      1380.0                     ROPER     65 RVUE    PHASE-SHIFT ANAL  9/66
M          1400.0                     BAREYRE   65 RVUE    PHASE-SHIFT ANAL  7/66
M   *      1370.0                     BRANDSEN  65 RVUE    PHASE-SHIFT ANAL  9/66
M   N      1471.0                     LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66
    N      WHERE THE AMPLITUDE IS PURE IMAGINARY.  DONT HAVE ARGAND DIAGRAM
           TO GET POINT OF FASTEST VARIATION.

---------------   61  N*1/2(1400) WIDTH (MEV)   ------------------------

W   *       200.0          APPROX     BELLETTIN 65 SPRK +                    7/66
W   *       180.0    50.0             ANDERSON  66 SPRK +                    9/66
W   *       125.0    20.0             BLAIR     66 CNTR +                    9/66
W           210.0                     BAREYRE   65 RVUE                      7/66
W   N       204.0                     LOVELACE  66 RVUE    SEE NOTE ON MASS  9/66

----------------   61  N*1/2(1400) PARTIAL DECAY MODES   ----------------

P1          N*1/2(1400) INTO PI N                            S 8S16
P2          N*1/2(1400) INTO N SIGMA (SIGMA MESON)           S16U 7
P3          N*1/2(1400) INTO N*3/2(1236) PI                  U8IS 8

----------------   61  N*1/2(1400) BRANCHING RATIOS   -------------------

R1          N*1/2(1400) INTO (PI N)/TOTAL                    (P1)/TOTAL
R1             0.7                    BAREYRE   65 RVUE                    7/66
R1   N         0.60                   LOVELACE  66 RVUE    SEE NOTE ON MASS 9/66

R2          N*1/2(1400) INTO (N SIGMA)/TOTAL                 (P2)/TOTAL
R2             DOMINANT INEL DECAY    LOVELACE  66 RVUE                    .9/66

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                         REFERENCES -- N*1/2(1400)

COCCONI  64 PL 8 134           +LILLETHUN,SCANLON,STAHLBRANDT, +   //CERN
ADELMAN  64 PRL 13 555         S L ADELMAN                //CAMBRIDGE(CERN)
ANKENBRA 65 NC 35 1052         ANKENBRANDT,CLYDE,CORK,KEEFE,KERTH,+ //LRL
BELLETTI 65 PL 18 167          BELLETTINI,COCCONI,DIDDENS, +        //CERN
ANDERSON 66 PRL 16 855         +BLESER,COLLINS,FUJII, +    //BNL,CARNEGIE
BLAIR    66 PRL 17 789         +TAYLOR,CHAPMAN,+//HARWELL,QUEENMARY,RTHFD
GELLERT  66 PRL 17 884         +SMITH,WOJCICKI,COLTON,SCHLEIN,+//LRL,UCLA
ALMEIDA  66 BERKELEY CONF      +RUSHBROOKE, +             //CAVNDSH,HAMBURG
ROPER    65 PR 138 B190        LD ROPER,RM WRIGHT,BT FELD  //LRL-LVMR,MIT IJP
BAREYRE  65 PL 18 342          +BRICMAN, STIRLING, VILLET         //SACLAY IJP
BRANDSEN 65 PR 139 B1566       +ODONNELL, MOORHOUSE          //DURHAM,RTHFD IJP
LOVELACE 66 BERKELEY CONF      C LOVELACE                           //CERN IJP

                    PAPERS NOT REFERRED TO IN DATA CARDS.

BAREYRE  64 PL 8 137           +BRICMAN,VALLADAS,VILLET, +  //SACLAY,CAFN  IJ
ADELMAN  65 PRL 14 1043        S L ADELMAN                //CAMBRIDGE(CERN)
DALITZ   65 PL 14 159          R H DALITZ, R G MOORHOUSE        //OXF,RTHFD
      --  DALITZ 65 REVIEWS EARLY PHASE-SHIFT-ANALYSIS RESULTS (AND DISCUSSES
          WHETHER THEY IN FACT REQUIRE THE EXISTENCE OF A RESONANCE).
FRIDMAN  66 PL 23 386          +MAURER,MICHALON, +      //STRASBOURG,HEIDEL
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE   //CERN IJP
      --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1518)

62 N*1/2(1518, JP=3/2-) I=1/2 D13

WE LIST MASS, WIDTH, AND ELASTICITY FROM PHASE-SHIFT ANALYSES ALONE. THE PROXIMITY OF THE P11 AND S11 STATES MAKES THE DETERMINATION OF THE D13 PARAMETERS FROM LESS SOPHISTICATED METHODS (SUCH AS BUMPS IN TOTAL CROSS SECTIONS OR INVARIANT MASSES) SUBJECT TO ERROR. FOR REFERENCE TO SUCH EARLIER DETERMINATIONS, SEE THE LAST EDITION (RMP 37, 633, 1965).

---------------- 62 N*1/2(1518) MASS (MEV) ---------------------------

M	*	1536.0	ROPER	65 RVUE	PHASE-SHIFT ANAL	9/66
M		1535.0	BAREYRE	65 RVUE	PHASE-SHIFT ANAL	9/66
M	*	1530.0	BRANDSEN	65 RVUE	PHASE-SHIFT ANAL	9/66
M		1519.0	LOVELACE	66 RVUE	PHASE-SHIFT ANAL	9/66

---------------- 62 N*1/2(1518) WIDTH (MEV) -------------------------

W		110.0	BAREYRE	65 RVUE	9/66
W	*	111.0	BRANDSEN	65 RVUE	9/66
W		102.0	LOVELACE	66 RVUE	9/66

---------------- 62 N*1/2(1518) PARTIAL DECAY MODES -----------------

P1	N*1/2(1518) INTO PI N	S 8S16
P2	N*1/2(1518) INTO N*3/2(1236) PI	L81S 8
P3	N*1/2(1518) INTO N PI PI	S16S 8S 8
P4	N*1/2(1518)+ INTO NEUTRON PI+	S17S 8
P5	N*1/2(1518)+ INTO PROTON PI+ PI-	S16S 8S 8

---------------- 62 N*1/2(1518) BRANCHING RATIOS --------------------

R1		N*1/2(1518) INTO (PI N)/TOTAL					(P1)/TOTAL	
R1		0.60			BAREYRE	65 RVUE		9/66
R1	*	0.6			BRANDSEN	65 RVUE		9/66
R1		0.72			LOVELACE	66 RVUE		9/66

EXPERIMENTS DISAGREE ABOUT WHETHER THE N PI PI MODE IS MAINLY N*3/2(1236) PI. IN ANY CASE THE MEASUREMENTS OF THE INELASTIC BRANCHING RATIOS ARE MODEL DEPENDENT AND OUGHT NOT BE TAKEN AS MORE THAN QUALITATIVE INDICATIONS OF TRUTH. ONLY OLSSON 66 AND KIRZ 66 DEFINITELY ASSOCIATED THE OBSERVED EFFECT WITH THE D13 WAVE.

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	66 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	66 HBC		9/66
R5	N*1/2(1518) INTO (NEUTRON PI+)/(P PI+ PI-)					(P4)/(P5)	
R5	0.77	0.45		ALEXANDER	66 HBC +	PP 5.5 BEV/C	9/66

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REFERENCES -- N*1/2(1518)

ROPER 65 PR 138 B190 LC ROPER,RM WRIGHT,BT FELD //LRL-LVMR,MIT IJP
BAREYRE 65 PL 18 342 + BRICMAN, STIRLING, VILLET //SACLAY IJP
BRANDSEN 65 PR 139 B1566 +ODONNELL, MOORHOUSE //DURHAM,RTHFD IJP
OLSSON 66 PR 145 1309 M G OLSSON, G B YODH //WISC,MD
ALLES-BO 66 NC (SUBMITTED) ALLES-BORELLI,FRENCH,FRISK,MICHEJDA //CERN
LOVELACE 66 BERKELEY CONF C LOVELACE //CERN IJP
ALEXANDE 66 BERKELEY CONF ALEXANDER,BENARY,CZAPEK,+ //WEIZMANN(CERN)
KIRZ 66 PRIVATE COMM J KIRZ //LRL
-- NUMBER EXTRACTED FROM DATA DISCUSSED IN KIRZ 63.

PAPERS NOT REFERRED TO IN DATA CARDS.
SEE LAST EDITION (RMP 37, 633, 1965) FOR EARLY REFERENCES.

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
MERLO 66 P ROY SOC 289 489 J P MERLO, G VALLADAS //SACLAY
-- THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE RESONANCE.
DONNACHI 66 BERKELEY CONF DONNACHIE, KIRSOPP, LEA, LOVELACE //CERN IJP
-- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1570)

63 N*1/2(1570, JP=1/2-) I=1/2 S11

SEE NOTE IN MAIN TEXT ON S-WAVE BUMPS NEAR THRESHOLD.

63 N*1/2(1570) 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
	N	FITTING GIVES TWO SOLUTIONS. PROBLEMS MATCHING PI P PHASE SHIFTS.				
M	K	1561.0	LOVELACE	66 RVUE	PHASE-SHIFT ANAL	9/66
	K	AS GIVEN. WITHOUT ARGAND DIAGRAM WE DONT KNOW HOW DETERMINED.				

---------------- 63 N*1/2(1570) 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	K	180.0	LOVELACE	66 RVUE	SEE NOTE ON MASS	9/66

---------------- 63 N*1/2(1570) PARTIAL DECAY MODES -----------------

P1	N*1/2(1570) INTO PI N	S 8S16
P2	N*1/2(1570) INTO N ETA	S17S14
P3	N*1/2(1570) INTO N PI PI	S16S 8S 8

---------------- 63 N*1/2(1570) BRANCHING RATIOS --------------------

R1		N*1/2(1570) 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	K	0.40	LOVELACE	66 RVUE	SEE NOTE ON MASS	9/66
R2		N*1/2(1570) 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
R3		N*1/2(1570) INTO (N PI PI)/TOTAL			(P3)/TOTAL	
R3		SMALL TRACE	LOVELACE	66 RVUE		9/66

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REFERENCES -- N*1/2(1570)

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
LOVELACE 66 BERKELEY CONF C LOVELACE //CERN IJP

PAPERS NOT REFERRED TO IN DATA CARDS.

BULOS 64 PRL 13 486 + //BROWN,BRANDEIS,HARVARD,MIT,PADOVA I
RICHARDS 66 PRL 16 1221 +CHIU,EANDI,HELMHOLZ,KENNEY,+ //LRL,HAWAII IJ
-- BULOS 64 AND RICHARDS 66 ARE EXPERIMENTS ON PI- P TO ETA N NEAR THRESHOLD. THEY ARE IN SOME DISAGREEMENT.
BRANDSEN 65 PR 139 B1566 +ODONNELL, MOORHOUSE //DURHAM,RTHFD IJP
-- BASIS OF NUMBERS WE QUOTE FROM HENDRY 65.
PREPOST 65 DESY CONF II 152 R PREPOST, D LUNDQUIST, D QUINN //STANFORD
BACCI 66 PRL 16 157 +PENSO,SALVINI,MENCUCCINI,+//ROME,FRASCATI
-- PREPOST 65 AND BACCI 66 ARE EXPERIMENTS ON ETA PHOTOPRODUCTION NEAR THRESHOLD.
THE FOLLOWING THREE ARE ANALYSES OF ETA PRODUCTION NEAR THRESHOLD --
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
DONNACHI 66 BERKELEY CONF DONNACHIE, KIRSOPP, LEA, LOVELACE //CERN IJP
-- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1670)

64 N*1/2(1670, JP=5/2-) I=1/2 D15

UNTANGLED FROM THE 1688 MEV BUMP BY DUKE 65 AND PHASE-SHIFT ANALYSES. SEE THE NOTE ON THE N*1/2(1688).

---------------- 64 N*1/2(1670) MASS (MEV) ---------------------------

M	*	1674.0		DUKE	65 CNTR	PI+- P EL DSIG,P	7/66
M		1690.0		BAREYRE	65 RVUE	PHASE-SHIFT ANAL	7/66
M	*	1650.0	APPROX	BRANDSEN	65 RVUE	PHASE-SHIFT ANAL	7/66
M		1652.0		LOVELACE	66 RVUE	PHASE-SHIFT ANAL	9/66

---------------- 64 N*1/2(1670) WIDTH (MEV) -------------------------

W	*	100.0	DUKE	65 CNTR	7/66
W		150.0	BAREYRE	65 RVUE	9/66
W		134.0	LOVELACE	66 RVUE	9/66

---------------- 64 N*1/2(1670) PARTIAL DECAY MODES -----------------

P1	N*1/2(1670) INTO PI N	S 8S16
P2	N*1/2(1670) INTO N ETA	S17S14
P3	N*1/2(1670) INTO LAMBDA K	S18S11
P4	N*1/2(1670) INTO N*3/2(1236) PI	L81S 8

---------------- 64 N*1/2(1670) BRANCHING RATIOS --------------------

R1		N*1/2(1670) INTO (PI N)/TOTAL			(P1)/TOTAL	
R1	*	0.42	DUKE	65 CNTR		7/66
R1		0.41	BAREYRE	65 RVUE		9/66
R1	*	0.52	BRANDSEN	65 RVUE		9/66
R1		0.40	LOVELACE	66 RVUE		9/66

SEE NOTE PRECEDING THE N*1/2(1688) INELASTIC DECAY MODE MEASUREMENTS.

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REFERENCES -- N*1/2(1670)

DUKE 65 PRL 15 468 +JONES,KEMP,MURPHY,PRENTICE, + //RTHFD,OXF IJP
BAREYRE 65 PL 18 342 + BRICMAN, STIRLING, VILLET //SACLAY IJP
BRANDSEN 65 PL 19 420 +ODONNELL, MOORHOUSE //DURHAM,RTHFD IJP
LOVELACE 66 BERKELEY CONF C LOVELACE //CERN IJP

PAPER NOT REFERRED TO IN DATA CARDS.

DONNACHI 66 BERKELEY CONF DONNACHIE, KIRSOPP, LEA, LOVELACE //CERN IJP
-- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1688)

65 N*1/2(1688, JP=5/2+) I=1/2 F15

WE LIST MASS, WIDTH, AND ELASTICITY FROM PHASE-SHIFT ANALYSES ALONE. THE PROXIMITY OF THE D15 AND S11 STATES MAKES THE DETERMINATION OF THE F15 PARAMETERS FROM LESS SOPHISTICATED METHODS (SUCH AS BUMPS IN TOTAL CROSS SECTIONS) SUBJECT TO SERIOUS ERROR. FOR REFERENCE TO SUCH EARLY DETERMINATIONS, SEE THE LAST EDITION (RMP 37, 633, 1965).

---------------- 65 N*1/2(1688) MASS (MEV) ---------------------------

M	*	1688.0	APPROX	DUKE	65 CNTR	PI+- P EL DSIG,P	7/66
M		1695.0		BAREYRE	65 RVUE	PHASE-SHIFT ANAL	7/66
M	*	1680.0		BRANDSEN	65 RVUE	PHASE SHIFT ANAL	7/66
M		1672.0		LOVELACE	66 RVUE	PHASE-SHIFT ANAL	9/66

---------------- 65 N*1/2(1688) WIDTH (MEV) -------------------------

W	*	100.0	DUKE	65 CNTR	VERY ENERGY DEP	7/66
W		120.0	BAREYRE	65 RVUE		9/66
W		104.0	LOVELACE	66 RVUE		9/66

---------------- 65 N*1/2(1688) PARTIAL DECAY MODES -----------------

P1	N*1/2(1688) INTO PI N	S 8S16
P2	N*1/2(1688) INTO N ETA	S17S14
P3	N*1/2(1688) INTO LAMBDA K	S18S11
P4	N*1/2(1688) INTO N*3/2(1236) PI	L81S 8
P5	N*1/2(1688) INTO N PIPI	S16S 8S 8
P6	N*1/2(1688)+ INTO NEUTRON PI+	S17S 8
P7	N*1/2(1688)+ INTO PROTON PI+ PI-	S16S 8S 8
P8	N*1/2(1688)+ INTO N*3/2(1236)++ PI-	L81S 8

---------------- 65 N*1/2(1688) BRANCHING RATIOS --------------------

R1		N*1/2(1688) INTO (PI N)/TOTAL			(P1)/TOTAL	
R1	*	0.80	DUKE	65 CNTR		7/66
R1		0.62	BAREYRE	65 RVUE		9/66
R1	*	0.61	BRANDSEN	65 RVUE		9/66
R1		0.66	LOVELACE	66 RVUE		9/66

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. THERE IS SOME DISAGREEMENT ABOUT WHETHER THIS IS DOMINATED BY N*3/2(1236) PI. IN ANY CASE THE MEASUREMENTS OF THE BRANCHING RATIO TO THIS FINAL STATE ARE MODEL DEPENDENT AND OUGHT NOT BE TAKEN AS MORE THAN QUALITATIVE INDICATIONS OF TRUTH.

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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  66 HBC  +  PBAR P 5.7 BEV/C  9/66

R3        N*1/2(1688) INTO (N ETA)/(PI N)                      (P2)/(P1)
R3            0.027       OR LESS       HEUSCH     66 RVUE +  PIC, ETA PHOTO     9/66

R4        N*1/2(1688) INTO (LAMBDA K)/TOTAL                    (P3)/TOTAL
R4            0.013 OR LESS (95PC CL) A-BORELLI  66 HBC  +                       9/66

R5        N*1/2(1688) INTO (N PI)/(N PI PI)                    (P1)/(P5)
R5            1.25 OR LESS (95PC CL)  A-BORELLI  66 HBC  +                       9/66

R6        N*1/2(1688) INTO (N*3/2(1236) PI)/(N PI PI)          (P4)/(P5)
R6            NO EVIDENCE               A-BORELLI  66 HBC  +                       9/66

R7        N*1/2(1688) INTO (NEUTRON PI+)/(P PI+ PI-)           (P6)/(P7)
R7            0.67        0.04          ALEXANDER  66 HBC  +  PP 5.5 BEV/C       9/66

R8        N*1/2(1688) INTO (N*(1236)++ PI-)/(P PI+ PI-) (P8)/(P7)
R8            0.7         0.3           ALEXANDER  66 HBC  +                       9/66
R8            1.0                  0.3  ALMEIDA    66 HBC  +  PP 10 BEV/C        9/66

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                         REFERENCES -- N*1/2(1688)

KRAEMER   64 PR 136 B496           +MACANSKY,+ //J HOPKINS,NWESTERN,WOODSTOCK  I
DUKE      65 PRL 15 468            +JONES,KEMP,MURPHY,PRENTICE, + //RTHFD,OXF IJP
BAREYRE   65 PL 18 342             + BRICMAN, STIRLING, VILLET        //SACLAY IJP
BRANDSEN  65 PL 19 420             +ODONNELL, MOORHOUSE         //DURHAM,RTHFD IJP
LOVELACE  66 BERKELEY CONF         C LOVELACE                          //CERN IJP
HEUSCH    66 PRL 17 1019           C A HEUSCH, C Y PRESCOTT, R F DASHEN //CIT
ALLES-BC  66 NC (SUBMITTED)        ALLES-BORELLI,FRENCH,FRISK,MICHEJDA //CERN
ALMEIDA   66 BERKELEY CONF         +RUSHBROOKE, +          //CAVNDSH,DESY(CERN)
ALEXANDE  66 BERKELEY CONF         ALEXANDER,BENARY,CZAPEK,+ //WEIZMANN(CERN)

                  PAPERS NOT REFERRED TO IN DATA CARDS.
                 SEE LAST ECITION (RMP 37, 633, 1965) FOR EARLY REFERENCES.

CROUCH    65 DESY CONF II 21    +  //BROWN,CEA,HARVARD,MIT,PADOVA,WEIZMANN
DERADO    65 ATHENS CONF 244    +KENNEY,LAMSA, +       //NOTRE DAME,KENTUCKY
MERLO     66 P ROY SOC 289 489 J P MERLO, G VALLADAS                //SACLAY
      -- THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE BUMP.
DONNACHI  66 BERKELEY CONF       DONNACHIE, KIRSOPP, LEA, LOVELACE   //CERN IJP
      -- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N(1700)

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N(1700)   66  N*1/2(1700, JP=1/2-) I=1/2      S11

               EXISTENCE NOT CONCLUSIVE.  SEE LOVELACE 66.

               66  N*1/2(1700) MASS (MEV)     ---------------------------

M    *    1695.0                         BRANDSEN   65 RVUE    PHASE-SHIFT ANAL  9/66
M         1700.0                         MICHAEL    66 RVUE    FITS BAREYRE S11  7/66

----------------- 66  N*1/2(1700) WIDTH (MEV)   ---------------------------

W          240.0                         MICHAEL    66 RVUE                      7/66

----------------- 66  N*1/2(1700) PARTIAL DECAY MODES ---------------------

P1        N*1/2(1700) INTO PI N                          S 8S16
P2        N*1/2(1700) INTO N ETA                         S17S14
P3        N*1/2(1700) INTO LAMBDA K                      S18S11

----------------- 66  N*1/2(1700)  BRANCHING RATIOS ----------------------

R1        N*1/2(1700) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1            1.0         APPROX         MICHAEL    66 RVUE                      7/66

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                         REFERENCES -- N*1/2(1700)

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 MICFAEL                             //OXF
LOVELACE  66 BERKELEY CONF         C LOVELACE                            //CERN
      -- LOVELACE 66 QUESTIONS THE EXISTENCE OF THIS SECOND S11 RESONANCE.

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N (2190)

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N (2190)  71  N*1/2(2190, JP=7/2-) I=1/2

               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 + PCL  7/66

----------------- 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

----------------- 71  N*1/2(2190) PARTIAL DECAY MODES   -------------------

P1        N*1/2(2190) INTO PI N                          S 8S16
P2        N*1/2(2190) INTO LAMBDA K                      S18S11

----------------- 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

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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

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

CARROLL   66 PRL 16 288            +CORBETT,DAMERELL,MIDDLEMAS, + //RTHFD,OXF J-L
KORMANYO  66 PRL 16 709            KORMANYOS,KRISCH,OFALLON, +     //MICH,ARG  P
BARGER    66 PRL 16 913            V BARGER, D CLINE                   //WISC  P

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N (2650)

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N (2650)  72  N*1/2(2650, JP=11/2-) I=1/2

               FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

               72  N*1/2(2650) MASS (MEV)     ---------------------------

M    *    2700.0                         ALVAREZ    64 CNTR    PI PHOTOPROD
M    *    2600.0          APPROX         WAHLIG     64 SPRK C  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

----------------- 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

----------------- 72  N*1/2(2650) PARTIAL DECAY MODES   -------------------

P1        N*1/2(2650) INTO PI N                          S 8S16
P2        N*1/2(2650) INTO LAMBDA K                      S18S11

----------------- 72  N*1/2(2650) BRANCHING RATIOS   ---------------------

R1        N*1/2(2650) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1            0.0703    0.0045           CITRON     66 CNTR    ASSUMING J=11/2   7/66

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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 PRL 16 913            V BARGER, D CLINE                   //WISC  P

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N (3030)

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N (3030)  73  N*1/2(3030, JP=15/2-) I=1/2

               EVIDENCE FOR EXISTENCE NOT COMPLETELY CONCLUSIVE.  FOR
               JP ASSIGNMENT SEE BARGER 66 AND NOTE FOLLOWING LISTINGS.

----------------- 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 TOTAL      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   -------------------

P1        N*1/2(3030) INTO PI N                          S 8S16

----------------- 73  N*1/2(3030) BRANCHING RATIOS   ---------------------

R1        N*1/2(3030) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1            0.0070                     CITRON     66 CNTR    ASSUMING J=15/2   7/66

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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 PRL 16 913            V BARGER, D CLINE                   //WISC  P

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$N_?$(3245)

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N?(3245)  74  N* /2(3245, JP=     )

               EXISTENCE ONLY TENTATIVE.  I-SPIN NOT DETERMINED BUT
               NARROW WIDTH PRECLUDES IDENTIFICATION WITH N*3/2(3230).
               OMITTED FROM TABLE.

----------------- 74  N* /2(3245) MASS (MEV)    ---------------------------

M         3245.0     10.0                KORMANYOS  66 CNTR    PI-P EL AT 180 D  7/66

----------------- 74  N* /2(3245) WIDTH (MEV)   ---------------------------

W           35.0          OR LESS        KORMANYOS  66 CNTR                      7/66

----------------- 74  N* /2(3245) PARTIAL DECAY MODES   -------------------

P1        N* /2(3245) INTO PI N                          S 8S16

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                         REFERENCES -- N* /2(3245)

KORMANYO  66 PRL 16 709          KORMANYOS,KRISCH,OFALLON, +      //MICH,ARG

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N (3695)

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N (3695)  75  N*1/2(3695, JP=     ) I=1/2

               EVIDENCE PRELIMINARY AND NOT COMPELLING.  OMITTED FROM
               TABLE.

----------------- 75  N*1/2(3695) MASS (MEV)    ---------------------------

M         3694.0      7.0                BARTKE     66 HBC  +  PI+P 8 PRONGS     9/66

----------------- 75  N*1/2(3695) WIDTH (MEV)   ---------------------------

W           46.0     23.0                BARTKE     66 HBC  +                    9/66

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                         REFERENCES -- N*1/2(3695)

BARTKE    66 BERKELEY CONF     +CZYZEWSKI,DANYSZ,ESKREYS,+ //KRAKOW(CERN)  I

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Δ (1236)

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81  N*3/2(1236, JP=3/2+) I=3/2      P33

                  81  N*3/2(1236) MASS (MEV)      ---------------------------

M    *    1234.0                   ROPER     65 RVUE C++PHASE-SHIFT ANAL
M++       1236.0      0.55         OLSSON    65 RVUE ++ TOTAL-SIGMA DATA
M++  *    1232.0      6.0          FERRO-LUZ 65 HBC  ++ K+P TO KC 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 C
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
     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++        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 C
W-   *     149.0     18.0          GIDAL     66 DBC  -                    7/66

----------------  81  N*3/2(1236) PARTIAL DECAY MODES    -----------------

P1        N*3/2(1236) INTO PI N                          S 8S16

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                        REFERENCES -- N*3/2(1236)

OLSSCN   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
GIDAL    66 PR 141 1261        G GIDAL, A KERNAN, S KIM             //LRL
DEANS    66 PREPRINT           S R DEANS, W G HOLLADAY       //VANDERBILT

       FOR EXTENSIVE REFERENCES TO DATA AND PHASE-SHIFT ANALYSES TILL 1965,
       SEE ROPER 65, ESPECIALLY APPENDIX II.
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Δ (1670)

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82  N*3/2(1670, JP=1/2-) I=3/2      S31

                  82  N*3/2(1670) MASS (MEV)      ---------------------------

M    *    1648.0     12.0          DEVLIN    65 CNTR    PI+- P TOTAL
M         1665.0                   BAREYRE   65 RVUE    PHASE SHIFT ANAL  7/66
M         1692.0                   LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66

----------------  82  N*3/2(1670) WIDTH (MEV)    ------------------------

W    *     201.0     74.0          DEVLIN    65 CNTR    VERY ASYMMETRIC
W          130.0                   BAREYRE   65 RVUE                      7/66
W          230.0                   LOVELACE  66 RVUE                      9/66

----------------  82  N*3/2(1670) PARTIAL DECAY MODES    -----------------

P1        N*3/2(1670) INTO PI N                          S 8S16

----------------  82  N*3/2(1670) BRANCHING RATIOS    --------------------

R1        N*3/2(1670) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1   *       0.56                  DEVLIN    65 CNTR
R1           0.33                  BAREYRE   65 RVUE                      7/66
R1           0.44                  LOVELACE  66 RVUE                      9/66

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                        REFERENCES -- N*3/2(1670)

DEVLIN   65 PRL 14 1031        T J DEVLIN,J SOLOMON,G BERTSCH //PRINCETON  I
BAREYRE  65 PL 18 342          + BRICMAN, STIRLING, VILLET      //SACLAY IJP
LOVELACE 66 BERKELEY CONF      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       +CEVLIN,HAGGE,LONGO,MOYER,WOOD       //LRL  I
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
      -- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.
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Δ (1920)

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83  N*3/2(1920, JP=7/2+) I=3/2

                  83  N*3/2(1920) 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
     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         1920.0        APPROX     DUKE      65 CNTR    PI+- P EL, POLAR  7/66
M         1950.0        APPROX     YOKOSAWA  66 CNTR    PI- P DSIG + PCL  7/66
M         1950.0                   LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66

----------------  83  N*3/2(1920) 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          250.0                   LOVELACE  66 RVUE                      9/66

----------------  83  N*3/2(1920) PARTIAL DECAY MODES    -----------------

P1        N*3/2(1920) INTO PI N                          S 8S16
P2        N*3/2(1920) INTO SIGMA K                       S20S10
P3        N*3/2(1920) INTO N*3/2(1236) PI                L81S 8

----------------  83  N*3/2(1920) BRANCHING RATIOS    --------------------

R1        N*3/2(1920) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1   N       0.33                  LAYSON    63 RVUE                      7/66
     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           0.50                  LOVELACE  66 RVUE                      9/66

R2        N*3/2(1920) INTO (SIGMA K)/TOTAL               (P2)/TOTAL
R2           SEEN                  HOLLADAY  65 RVUE    PI+P DATA        11/66

R3        N*3/2(1920) INTO (N*3/2(1236) PI)/TOTAL        (P3)/TOTAL
R3        DOMINANT INEL DECAY      LOVELACE  66 RVUE                      9/66

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                        REFFRENCES -- N*3/2(1920)

COOL     56 PR 103 1082        R COOL, O PICCIONI, D CLARK          //BNL  I
BRISSON  61 NC 19 210          +CETOEUF,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, + //RTHFD,OXF IJP
HOLLADAY 65 PR 139 B1348       W G HOLLADAY                  //VANDERBILT
YOKCSAWA 66 PRL 16 714         +SUWA, HILL, ESTERLING, BOOTH   //ARG,CHI IJP
LOVELACE 66 BERKELEY CONF      C LOVELACE                         //CERN IJP

                  PAPERS NOT REFERRED TO IN DATA CARDS.

HELLAND  64 PR 134 B1062       +CEVLIN,HAGGE,LONGO,MOYER,WOOD       //LRL  IJ
AUVIL    64 NC 33 473          P AUVIL, C LOVELACE              //IMPCOL IJP
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
      -- NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.
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Δ (2420)

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84  N*3/2(2420, JP=11/2+) I=3/2

              FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                  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 C  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

----------------  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

----------------  84  N*3/2(2420) PARTIAL DECAY MODES    -------+---------

P1        N*3/2(2420) INTO PI N                          S 8S16
P2        N*3/2(2420) INTO SIGMA K                       S20S10

----------------  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

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                        REFERENCFS -- N*3/2(242C)

DIDDENS  63 PRL 10 262         +JENKINS, KYCIA, RILEY               //BNL  I
ALVAREZ  64 PRL 12 710         +BAK-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
CITRCN   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913         V BARGER, D CLINE                   //WISC  P
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Δ (2850)

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85  N*3/2(2850, JP=15/2+) I=3/2

              FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                  85  N*3/2(2850) MASS (MEV)      ---------------------------

M    *    2700.0        APPROX     WAHLIG    64 SPRK C  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    -----------------

P1        N*3/2(2850) INTO PI N                          S 8S16
P2        N*3/2(2850) INTO P PI PI PI                    S16S 8S 8S 8

----------------  85  N*3/2(2850) BRANCHING RATIOS    --------------------

R1        N*3/2(2850) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1           0.0314   0.0025       CITRON    66 CNTR    ASSUMING J=15/2   7/66

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                        REFERENCES -- N*3/2(285C)

WAHLIG   64 PRL 13 103         +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRCN   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARDADIN 66 PL 21 357          BARCADIN-OTWINOWSKA,DANYSZ, +     //WARSAW
BARGER   66 PRL 16 913         V BARGER, D CLINE                   //WISC  P
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Δ (3230)

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86  N*3/2(3230, JP=19/2+) I=3/2

              EVIDENCE FOR EXISTENCE NOT COMPLETELY CONCLUSIVE.  FCR
              JP ASSIGNMENT SEE BARGER 66 AND NOTE FOLLOWING LISTINGS.

----------------  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    -----------------

P1        N*3/2(3230) INTO PI N                          S 8S16
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86 N*3/2(3230) BRANCHING RATIOS

R1	N*3/2(3230) INTO (PI N)/TOTAL			(P1)/TOTAL	
R1	0.0063	CITRON	66 CNTR	ASSUMING J=19/2	7/66

REFERENCES -- N*3/2(3230)

CITRCN 66 PR 144 1101 +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL I
BARGER 66 PRL 16 913 V BARGER, D CLINE //WISC P

$N^*_{5/2}(1560)$

91 N*5/2(1560, JP=) I=5/2

PROBABLE KINEMATIC EFFECT. SEE DASH 66, CONTE 66, AND ALEXANDER 66. 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	66 HBC	+++PP 4PI 5.5 BEV/C	9/66

91 N*5/2(1560) WIDTH (MEV)

W	220.0	20.0	GOLDHABER	64 HBC	+++	7/66
W	140.0		ALEXANDER	66 HBC	+++	9/66

91 N*5/2(1560) PARTIAL DECAY MODES

P1	N*5/2(1560) INTO N PI PI	S16S 8S 8
P2	N*5/2(1560) INTO N*3/2(1236) PI	L81S 8

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 SWINHART //LRL
CONTE 66 BERKELEY CONF +CAMERI,RATTI,RUSSO, + //GENOVA,MILANO,OXF
ALEXANDE 66 BERKELEY CONF ALEXANDER,BENARY,CZAPEK,+ //WEIZMANN(CERN)

PAPER NOT REFERRED TO IN DATA CARDS.

ALEXANDE 65 PRL 15 207 ALEXANDER,BENARY,REUTER,+ //WEIZMANN(CERN) I
-- REPLACED BY ALEXANDER 66.

$Z_0(1865)$

96 Z*0(1865, JP=) I=0

IT IS NOT ESTABLISHED THAT THIS EFFECT IS A RESONANCE. HOWEVER IF SUCH A LARGE EFFECT APPEARED IN A PI N OR KBAR N CHANNEL IT WOULD IMMEDIATELY BE TAKEN AS A RESONANCE. WE INCLUDE IT IN THE TABLE UNTIL A PLAUSIBLE ALTERNATE INTERPRETATION IS PUT FORTH.

96 Z*0(1865) MASS (MEV)

M	1863.0	COOL	66 CNTR +	K+P, D TOTAL	7/66

96 Z*0(1865) WIDTH (MEV)

W	150.0	COOL	66 CNTR +	7/66

96 Z*0(1865) PARTIAL DECAY MODES

P1	Z*0(1865) INTO K N	S10S17
P2	Z*0(1865) INTO K*(892) N	L18S16

96 Z*0(1865) BRANCHING RATIOS

R1	Z*0(1865) INTO (K N)/TOTAL			(P1)/TOTAL	
R1	0.55	COOL	66 CNTR +	IF J=1/2	7/66

REFERENCES -- Z*0(1865)

COOL 66 PRL 17 102 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I

PAPER NOT REFERRED TO IN DATA CARDS.

BLAND 66 BERKELEY CONF +BOWLER,BROWN,G+S GOLDHABER,HIRATA,+ //LRL
-- PRELIMINARY RESULTS INDICATING THAT INELASTIC CHANNELS ARE NOT AS DOMINANT AS IN THE I=1 EFFECT (SEE THE Z*1(1910) BELOW).

$Z_1(1910)$

97 Z*1(1910, JP=) I=1

ESSENTIALLY ALL THE EFFECT IS DUE TO A BUMP IN THE KN* CHANNEL NEAR ITS THRESHOLD. ANGULAR DISTRIBUTIONS IN THIS CHANNEL INDICATE THE PREDOMINANCE OF THE P3/2 STATE IN THE K N* (AND THUS ALSO IN THE K N) SYSTEM. HOWEVER IT MAY BE POSSIBLE TO UNDERSTAND THIS CHANNEL WITHOUT INVOKING RESONANT BEHAVIOR -- SEE BLAND 66. OMITTED FROM TABLE.

97 Z*1(1910) MASS (MEV)

M	1910.0	20.0	COOL	66 CNTR ++	K+P TOTAL	7/66

97 Z*1(1910) WIDTH (MEV)

W	180.0	COOL	66 CNTR ++	7/66

97 Z*1(1910) PARTIAL DECAY MODES

P1	Z*1(1910) INTO K N	S10S16
P2	Z*1(1910) INTO N*3/2(1236) K	U81S10

97 Z*1(1910) BRANCHING RATIOS

R1	Z*1(1910) INTO (K N)/TOTAL			(P1)/TOTAL	
R1	0.31	COOL	66 CNTR ++	IF J=1/2	7/66
R2	Z*1(1910) INTO (N*3/2(1236) K)/TOTAL			(P2)/TOTAL	
R2	DOMINANT DECAY	BLAND	66 HBC ++		9/66

REFERENCES -- Z*1(1910)

COOL 66 PRL 17 102 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I
BLAND 66 BERKELEY CONF +BOWLER,BROWN,G+S GOLDHABER,KADYK, + //LRL I

PAPER NOT REFERRED TO IN DATA CARDS.

LEA 66 PL 23 380 LEA, MARTIN, OADES //COPENHAGEN,NORDITA
-- PRELIMINARY PHASE-SHIFT ANALYSIS. THE ONLY WAVE WITH POSITIVE AND INCREASING PHASE IS THE P1/2.

$\Lambda(1405)$

37 Y*0(1405, JP=1/2-) I=0

THIS RESONANCE CAN BE IDENTIFIED WITH THE VIRTUAL BOUND STATE IN THE KBAR-N SYSTEM 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 66. THE PARAMETERS ARISING FROM ZERO-EFFECTIVE-RANGE FITS ARE MODEL DEPENDENT AND SHOULD NOT BE TAKEN AS SERIOUSLY AS THE SMALL QUOTED ERRORS SUGGEST. SEE THE NOTE IN THE MAIN TEXT ON S-WAVE BUMPS NEAR THRESHOLD.

37 Y*0(1405) MASS (MEV)

M		1405.0		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
	N	DATA OF SAKITT ARE USED IN FIT BY KITTEL.					
M		1407.5	1.2	KITTEL	66 HBC	0-EFF-RANGE FIT	7/66

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
	N	DATA OF SAKITT ARE USED IN FIT BY KITTEL.				
W		34.1	4.1	KITTEL	66 HBC	7/66

37 Y*0(1405) PARTIAL DECAY MODES

P1	Y*0(1405) INTO SIGMA PI	S20S 8

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
DALITZ 66 PREPRINT DALITZ, WONG, RAJASEKARAN //OXFORD,BOMBAY

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 +UREN, 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.

$\Lambda(1520)$

38 Y*0(1520, JP=3/2-) I=0

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

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	18.0	OR LESS	HARDY	66 HBC	9/66

38 Y*0(1520) PARTIAL DECAY MODES

P1	Y*0(1520) INTO KBAR N	S11S17
P2	Y*0(1520) INTO SIGMA PI	S20S 8
P3	Y*0(1520) INTO LAMBDA PI PI	S18S 8S 8

38 Y*0(1520) PARTIAL WIDTHS (MEV)

W1	Y*0(1520) INTO KBAR N				(P1)
W1	4.8	0.5	WATSON	63 HBC	
W2	Y*0(1520) INTO SIGMA PI				(P2)
W2	9.0	1.0	WATSON	63 HBC	

38 Y*0(1520) BRANCHING RATIOS

R1	Y*0(1520) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	0.47	0.09	HESS	66 HBC	PI-P 1.6-4 BEV/C	9/66
R2	Y*0(1520) INTO (SIGMA PI)/TOTAL				(P2)/TOTAL	
R2	0.45	0.04	HARDY	66 HBC		9/66
R3	Y*0(1520) INTO (KBAR N)/(SIGMA PI)				(P1)/(P2)	
R3	0.58	0.26	MUSGRAVE	65 HBC		7/66
R4	Y*0(1520) INTO (SIGMA PI)/(LAMBDA PI PI)				(P2)/(P3)	
R4	4.5	1.0	ARMENTERO	65 HBC		7/66
R4	4.8	1.2	UHLIG	66 HBC	K-P .9-1.0 BEV/C	9/66

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
HARDY 66 UCRL-16788 THESIS L M HARDY //LRL
HESS 66 UCRL-16832 THESIS R I HESS //LRL
UHLIG 66 PR (ACCEPTED) +CHARLTON,CONDON,GLASSER,YODH,+ //MD,LSNRL

Λ (1670)

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40  Y*0(1670, JP=1/2-) I=0

    SEE NOTE IN MAIN TEXT ON S-WAVE BUMPS NEAR THRESHOLD.

                 40  Y*0(1670) MASS (MEV)   -----------------------------

M          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

-----------------  40  Y*0(1670) WIDTH (MEV)  -----------------------------

W            20.0     OR LESS      Y-CHANG   64 PBC                      7/66
W            18.0                  BERLEY    65 HBC                      7/66

-----------------  40  Y*0(1670) PARTIAL DECAY MODES  --------------------

P1          Y*0(1670) INTO KBAR N                      S11S17
P2          Y*0(1670) INTO LAMBDA ETA                  S18S14
P3          Y*0(1670) INTO SIGMA PI                    S20S 8

-----------------  40  Y*0(1670) BRANCHING RATIOS  -----------------------

R1  *       Y*0(1670) INTO ((KBAR N)(LAM ETA))/TOTAL**2   (P1*P2)/TOTAL**2
R1  *         0.046                BERLEY    65 HBC                      7/66

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                     REFERENCES -- Y*C(1670)

Y-CHANG  64 DUBNA CCNF I 615  YUNG-CHANG, IN, KLADNITSKAYA, +    //DUBNA  I
BERLEY   65 PRL 15 641        +CONNOLLY,HART,RAHM,STONEHILL, +     //BNL IJP

                PAPER NOT REFERRED TO IN DATA CARDS.

BANNIK   66 BERKELEY CONF      +BUBELEV,CHADRAA, + //DUBNA,BUCHAREST,CERN  I
   -- SUPPORTS RESULT OF YUNG-CHANG 64.

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Λ (1700)

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55  Y*0(1700, JP=3/2-) I=0

    SPIN-PARITY DETERMINATION TENTATIVE.

                 55  Y*0(1700) MASS (MEV)   -----------------------------

M          1705.0      10.0        ARMENTERO 66 HBC    K-P EL, CH EX     9/66
M          1698.0       5.0        DAVIES    66 CNTR   K-P, D TOTAL     11/66

-----------------  55  Y*0(1700) WIDTH (MEV)  -----------------------------

W            30.0        APPROX    ARMENTERO 66 HBC                      9/66
W            40.0      10.0        DAVIES    66 CNTR                    11/66

-----------------  55  Y*0(1700) PARTIAL DECAY MODES  --------------------

P1          Y*0(1700) INTO KBAR N                      S11S17
P2          Y*0(1700) INTO SIGMA PI                    S20S 8

-----------------  55  Y*0(1700) BRANCHING RATIOS  -----------------------

R1          Y*0(1700) INTO (KBAR N)/TOTAL              (P1)/TOTAL
R1            0.18       APPROX    ARMENTERO 66 HBC                      9/66
R1            0.24                 DAVIES    66 CNTR   ASSUMING J=3/2   11/66

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                     REFERENCES -- Y*C(17C0)

ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

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Λ (1815)

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39  Y*0(1815, JP=5/2+) I=0

                 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   N      1811.0       4.0        LEVI SETT 66 RVUE   SOME REAL BGD     9/66
M   N   OR 1814.0       3.0        LEVI SETT 66 RVUE   BGD PURE IMAG     9/66
    N      RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TOC.
M          1820.0       5.0        ARMENTERO 66 HBC    2-BODY CHANNELS   9/66
M          1819.0       5.0        DAVIES    66 CNTR   K-P, D TOTAL     11'/66

-----------------  39  Y*0(1815) WIDTH (MEV)  -----------------------------

W   *        70.0                  GALTIERI  63
W            60.0                  BIRGE     65 HBC                      7/66
W   N        73.0      10.0        LEVI SETT 66 RVUE   SOME REAL BGD     9/66
W   N   CR   70.5       9.0        LEVI SETT 66 RVUE   BGD PURE IMAG     9/66
    N      RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TCC.
W            80.0      10.0        ARMENTERO 66 HBC                      9/66
W            90.0      15.0        DAVIES    66 CNTR                    11/66

-----------------  39  Y*0(1815) PARTIAL DECAY MODES  --------------------

P1          Y*0(1815) INTO KBAR N                      S11S17
P2          Y*0(1815) INTO SIGMA PI                    S20S 8
P3          Y*0(1815) INTO LAMBCA ETA                  S18S14
P4          Y*0(1815) INTO Y*1(1385) PI                U43S 8

-----------------  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       LEVI SETT 66 RVUE   SOME REAL BGD     9/66
R1  N   OR    0.61      0.07       LEVI SETT 66 RVUE   BGD PURE IMAG     9/66
    N      RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TCO.
R1            0.60      0.05       ARMENTERO 66 HBC                      9/66
R1            0.74                 DAVIES    66 CNTR                    11/66

R2          Y*0(1815) INTO (SIGMA PI)/TOTAL            (P2)/TOTAL
R2            0.12      0.02       ARMENTERO 66 HBC                      9/66

R3          Y*0(1815) INTO (LAMBCA ETA)/TOTAL          (P3)/TOTAL
R3            0.01                 ARMENTERO 66 HBC                      9/66

R4          Y*0(1815) INTO (Y*1(1385) PI)/TOTAL        (P4)/TOTAL
R4            0.20      0.05       BIRGE     65 HBC                      7/66
R4            0.19      0.04       BARLOUTAU 66 HBC    ASSUMING R1=0.60  9/66

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                     REFERENCES -- Y*C(1815)

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
LEVI SET 66 BERKELEY CONF     R LEVI SETTI, E PREDAZZI           //CHI
ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP'
BARLOUTA 66 BERKELEY CONF     BARLOUTAUD,GRANET, +  //SACLAY,HEIDEL,CERN IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

                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
   -- SODICKSCN 64 AND HOLLEY 65 ELASTIC SCATTERING WORK INDICATED J=5/2.
GELFAND  66 BERKELEY CONF     +HARMSEN,LEVI SETTI,RAYMUND, +   //CHI,ARG
   -- ELASTIC SCATTERING DATA FIT BY LEVI SETTI 66.

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Λ (2100)

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41  Y*0(2100, JP=7/2-) I=C

                 41  Y*0(2100) MASS (MEV)   -----------------------------

M   *      2097.0       6.0            BOCK      65 HBC    PBAR P 5.7 BEV/C  7/66
M          2100.0      20.0            COOL      66 CNTR   K-P, D TOTAL      7/66
M   *      2120.0                      WOHL      66 HBC    K-P CH EX         7/66

-----------------  41  Y*0(2100) WIDTH (MEV)  -----------------------------

W   *        24.0      14.0     24.0   BOCK      65 HBC    INTO KBAR N (PI)  7/66
W           160.0                      COOL      66 CNTR                     7/66
W           145.0                      WOHL      66 HBC                      7/66

-----------------  41  Y*0(2100) PARTIAL DECAY MODES  --------------------

P1          Y*0(2100) INTO KBAR N                          S11S17
P2          Y*0(2100) INTO SIGMA PI                        S20S 8
P3          Y*0(2100) INTO LAMBCA OMEGA                    S18S 1
P4          Y*0(2100) INTO KBAR N PI                       S11S17S 8

-----------------  41  Y*0(2100) BRANCHING RATIOS  -----------------------

R1          Y*0(2100) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1            0.29                     COOL      66 CNTR                     7/66
R1            0.25                     WOHL      66 HBC                      7/66

R2          Y*0(2100) INTO (LAMBCA OMEGA)/TOTAL            (P3)/TOTAL
R2            0.1        OR LESS       FLATTE    66 HBC                      9/66

R3          Y*0(2100) INTO (KBAR N PI)/TOTAL               (P4)/TOTAL
R3             SEEN                    BOCK      65 HBC                      9/66

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                     REFERENCES -- Y*C(2100)

BOCK     65 PL 17 166         +COOPER,FRENCH,KINSON, +       //CERN,SACLAY
COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
WOHL     66 PRL 17 107        C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP
FLATTE   66 PRIVATE COMM      S M FLATTE                          //LRL

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Λ (2340)

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42  Y*0(2340, JP=    ) I=0

                 42  Y*0(2340) MASS (MEV)   -----------------------------

M          2340.0      20.0            COOL      66 CNTR   K-P, D TOTAL      7/66

-----------------  42  Y*0(2340) WIDTH (MEV)  -----------------------------

W           105.0                      COOL      66 CNTR                     7/66

-----------------  42  Y*0(2340) PARTIAL DECAY MODES  --------------------

P1          Y*0(2340) INTO KBAR N                          S11S17

-----------------  42  Y*0(2340) BRANCHING RATIOS  -----------------------

R1          Y*0(2340) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1            0.102                    COOL      66 CNTR   ASSUMING J=9/2    7/66

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                     REFERENCES -- Y*C(2340)

COOL      66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I

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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 ARE
                  ATTEMPTS TO OBTAIN THE SEPARATE CHARGE-STATE MASSES AND
                  WIDTHS.  SEE HOWEVER THE IDEOGRAMS INSERTED IN LISTINGS.
   THESE INDICATE SERIOUS SYSTEMATICS, PERHAPS ARISING FROM INTERFERENCE EF-
   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  C+ 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  C- PI- PRP 2. BEV/C
MO   *   106 1381.0       4.0          CURTIS    63 SPRK C  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      66 HBC  +  K-P 1.22 BEV/C
M+           1382.0       1.0          ARMENTERO 65 HBC  +  K-P .9-1.2 BEV/C
M+           1378.0       5.0          LONDON    66 HBC  +  K-P 2.24 BEV/C    7/66
M+           1384.3       1.1          COLTON    66 HBC  +  K-P 1.8 BEV/C     9/66
M+           1382.6       1.4          COLTON    66 HBC  +  K-P 1.95 BEV/C    9/66
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-           1389.0       9.0          LONDON    66 HBC  -                    7/66
M-           1391.5       1.8          COLTON    66 HBC  -  K-P 1.8 BEV/C     9/66
M-           1399.8       1.4          COLTON    66 HBC  -  K-P 1.95 BEV/C    9/66
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(Ideograms on next page)

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-----------------  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         11.0       9.0          LONDON    66 HBC  +- K-P 2.24 BEV/C    8/66
D    R          7.2       2.1          COLTON    66 HBC  +- K-P 1.8 BEV/C     9/66
D    R         17.2       2.0          COLTON    66 HBC  +- K-P 1.95 BEV/C    9/66
     R       REDUNDANT WITH DATA IN MASS LISTING.
D               9.0       6.0          LONDON    66 HBC  +- LAMBDA 3 PI EVTS  7/66
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-----------------   43  Y*1(1385) WIDTH (MEV)   ----------------------------

W   *     64.0                   ALSTON    60 HBC  +-
W   *     20.0       OR LESS     MARTIN    61 HBC  C+
W   *     40.0                   BERGE     61 HBC  +-
W   *     80.0     10.0          COLLEY    62 PBC  C-
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          COLTON    66 HBC  +  K-P 1.8 BEV/C    9/66
W+        33.1      3.8          COLTON    66 HBC  +  K-P 1.95 BEV/C   9/66
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          COLTON    66 HBC  -  K-P 1.80 BEV/C   9/66
W-        17.1      4.4          COLTON    66 HBC  -  K-P 1.95 BEV/C   9/66
                      (Ideograms below)
-----------------   43  Y*1(1385) PARTIAL DECAY MODES   --------------------

P1         Y*1(1385) INTO LAMBCA PI                    S18S 8
P2         Y*1(1385) INTO SIGMA PI                     S20S 8

-----------------   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
                      (Ideogram below)
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REFERENCES -- Y*1(1385)


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ALSTCN   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, +   //COLUMBIA,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
LONDON   66 PR 143 1034        +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR  J
COLTCN   66 H E P MEMO 27      +TICHO,DAUBER,SCHLEIN,SLATER,SMITH,+//UCLA
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QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.


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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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Σ (1660)   44 Y*1(1660, JP=3/2-) I=1

THE Y*1(1660) IS DIFFICULT TO STUDY IN FORMATION EXPERIMENTS BECAUSE (1) IT COUPLES ONLY SLIGHTLY TO THE KBAR N CHANNEL, AND (2) THERE ARE NEIGHBORING RESONANCES, THE Y*0(1670) AND Y*0(1700) AND PERHAPS OTHERS YET UNDETECTED, TO COMPLICATE THE ANALYSIS. THE LAMBDA PI CHANNEL HAS INDICATED THE PROBABLE JP=3/2- ASSIGNMENT. THERE IS NOT MUCH AGREEMENT BETWEEN FORMATION AND PRODUCTION EXPERIMENTS ON BRANCHING RATIOS.

THERE IS ALSO DISAGREEMENT AMONG EXPERIMENTS PRODUCING CHARGED Y*1(1660) AT DIFFERENT ENERGIES. THUS EVEN WHEN THE I=1 STATE IS LOOKED AT ALONE THERE ARE PROBLEMS. HOWEVER, EXCEPT FOR LEVEQUE 65 THE EXPERIMENTS DO AGREE THAT THE MOST PROBABLE JP ASSIGNMENT IS 3/2-.

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----------------   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          1662.0     5.0           DAVIES    66 CNTR    K-P, D TOTAL     11/66

----------------   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  C                    7/66
W            55.0    10.0           LEVEQUE   65 HBC  +                    7/66
W            45.0    15.0           DAVIES    66 CNTR                     11/66

----------------   44  Y*1(1660) PARTIAL DECAY MODES   -------------------

P1          Y*1(1660) INTO KBAR N                     S11S1/
P2          Y*1(1660) INTO LAMBCA PI                  S18S 8
P3          Y*1(1660) INTO SIGMA PI                   S20S 8
P4          Y*1(1660) INTO LAMBCA PI PI               S18S 8S 8
P5          Y*1(1660) INTO SIGMA PI PI                S20S 8S 8
P6          Y*1(1660) INTO Y*1(1385) PI               U43S 8
P7          Y*1(1660) INTO Y*0(1405) PI               U37S 8

----------------   44  Y*1(1660) BRANCHING RATIOS   ----------------------

R1          Y*1(1660) INTO (KBAR N)/TOTAL             (P1)/TOTAL
R1            0.05       OR LESS    ALVAREZ   63 HBC  +
R1   *        0.16       OR MORE    BASTIEN 2 63 HBC  C
R1            0.2        OR LESS    LONDON    66 HBC  +                    7/66
R1            0.065                 DAVIES    66 CNTR   ASSUMING J=3/2    11/66

R2          Y*1(1660) INTO (LAMBCA PI)/TOTAL          (P2)/TOTAL
R2            0.32                  ALVAREZ   63 HBC  +
R2            0.09       OR LESS    BASTIEN 2 63 HBC  0
R2            0.2        OR LESS    LONDON    66 HBC  +                    7/66
R2            0.06     0.06         SMART     66 DBC  -  ASSUMING R1=0.15  7/66
R2            0.45                  ARMENTERO 66 HBC  0  ASSUMING R1=0.15  9/66

R3          Y*1(1660) INTO (SIGMA PI)/TOTAL           (P3)/TOTAL
R3            0.27                  ALVAREZ   63 HBC  +
R3   *        0.22     0.06         BASTIEN 2 63 HBC  C
R3            0.25     0.15         LONDON    66 HBC  +                    7/66
R3            0.15                  ARMENTERO 66 HBC  C  ASSUMING R1=0.15  9/66

R4          Y*1(1660) INTO (LAMBCA PI PI)/TOTAL       (P4)/TOTAL
R4            0.18                  ALVAREZ   63 HBC  +
R4   *        0.16     0.05         BASTIEN 2 63 HBC  C
R4            0.2        OR LESS    LONDON    66 HBC  +                    7/66
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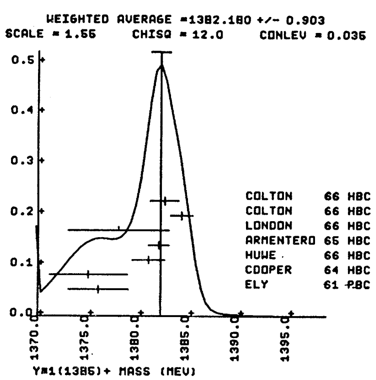

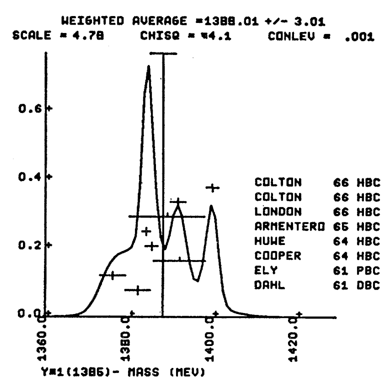

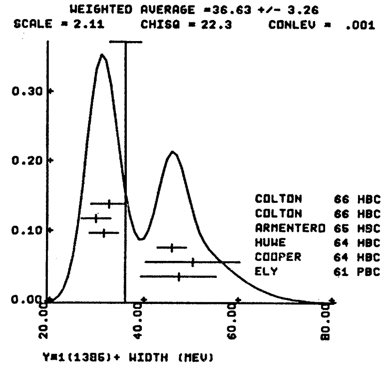

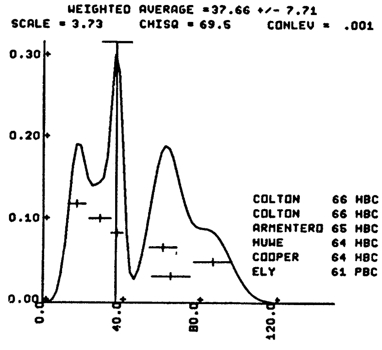

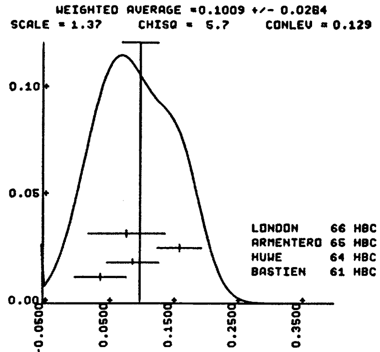

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R5         Y*1(1660) INTO (SIGMA PI PI)/TOTAL              (P5)/TOTAL
R5            0.18                        ALVAREZ   63 HBC  +
R5   *        0.25     0.06               BASTIEN 2 63 HBC  O

R6         Y*1(1660) INTO (Y*0(1405) PI)/TOTAL             (P7)/TOTAL
R6            0.75     0.25               LONDON    66 HBC  +                 7/66

R7         Y*1(1660) INTO (KBAR N)/(LAMBDA PI)             (P1)/(P2)
R7            0.43        OR MORE         SMITH     63 HBC  C-

R8         Y*1(1660) INTO (SIGMA PI)/(LAMBDA PI)           (P3)/(P2)
R8            0.86                        SMITH     63 HBC  O-
R8            6.8      3.0                HUWE      64 HBC  +

R9         Y*1(1660) INTO (LAMBCA PI PI)/(LAMBDA PI)       (P4)/(P2)
R9            0.14                        SMITH     63 HBC  C-

R10        Y*1(1660) INTO (Y*0(1405) PI)/(SIGMA PI PI)     (P7)/(P5)
R10           0.90     0.10      0.16     EBERHARD  65      +                 7/66

R11        Y*1(1660) INTO (Y*0(1405) PI)/(Y*1(1385) PI)    (P7)/(P6)
R11           0.8         OR MORE         EBERHARD  65      +                 7/66

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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,IMPCOL,OXF,RTHFD  JP
LONDCN   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
ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I
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PAPERS NOT REFERRED TO IN DATA CARDS.

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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.
EBERHARD 65 BAPS 10 478       P EBERHARD                           //LRL IJP
SLATER   65 BAPS 10 1196      +CAUBER, SCHLEIN, STORK, TICHO      //UCLA  JP
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 (1765)

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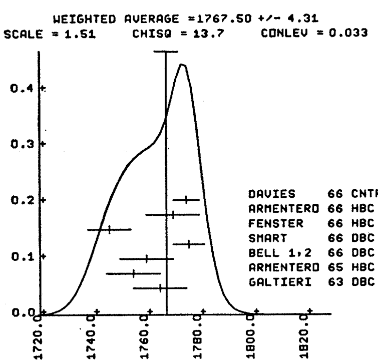
              45  Y*1(1765, JP=5/2-) I=1

              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          ARMENTERO 65 HBC  C  K-P TO Y*1520 PI  7/66
M            1760.0     10.0          BELL 1,2  66 DBC  -  K-N TO Y*1520 PI  7/66
M            1776.0      6.0          SMART     66 DBC  -  K-N TO LAM 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          LEVI SETT 66 RVUE    SOME REAL BGD     9/66
M    N   OR  1770.0     11.0          LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
     N       RES + DIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TOO.
M            1770.0     10.0          ARMENTERO 66 HBC  C  2-BODY CHANNELS   9/66
M            1775.0      5.0          DAVIES    66 CNTR    K-P, D TOTAL     11/66
```

(Ideogram below)

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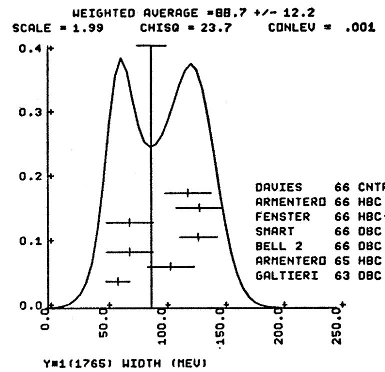
----------------  45  Y*1(1765) WIDTH (MEV)  ------------------------------

W             60.0     10.0           GALTIERI  63 DBC  C
W            105.0     20.0           ARMENTERO 65 HBC  C                    7/66
W             70.0     20.0           BELL 2    66 DBC  -                    7/66
W            129.0     16.0           SMART     66 DBC  -                    7/66
W.            70.0     20.0           FENSTER   66 HBC  C                    9/66
W    N       113.0     25.0           LEVI SETT 66 RVUE    SOME REAL BGD     9/66
W    N   OR  158.0     38.0           LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
     N      RES + DIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TOC.
W            130.0     20.0           ARMENTERO 66 HBC  C                    9/66
W            120.0     20.0           DAVIES    66 CNTR                     11/66
```

(Ideogram below)

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----------------  45  Y*1(1765) PARTIAL DECAY MODES  --------------------

P1          Y*1(1765) INTO KBAR N                         S11S17
P2          Y*1(1765) INTO LAMBDA PI                      S18S 9
P3          Y*1(1765) INTO SIGMA PI                       S20S 8
P4          Y*1(1765) INTO SIGMA ETA                      S21S14
P5          Y*1(1765) INTO Y*1(1385) PI                   U43S 8
P6          Y*1(1765) INTO Y*0(1520) PI                   L38S 8

----------------  45  Y*1(1765) BRANCHING RATIOS  ----------------------

R1          Y*1(1765) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1   *         0.6                     GALTIERI  63 HBC  O  K-P RVUE
R1             0.53     0.09           UHLIG     66 HBC  C                    9/66
R1   N         0.46     0.05           LEVI SETT 66 RVUE    SOME REAL BGD     9/66
R1   N   OR    0.46     0.04           LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
     N      RES + DIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TOC.
R1             0.45     0.05           ARMENTERO 66 HBC  C                    9/66
R1             0.43                    DAVIES    66 CNTR                     11/66

R2          Y*1(1765) INTO (LAMBCA PI)/TOTAL              (P2)/TOTAL
R2             0.14     0.02           SMART     66 DBC  -  ASSUMING R1=0.5   7/66
R2             0.17     0.02           UHLIG     66 HBC  C                    9/66
R2             0.20     0.05           ARMENTERO 66 HBC  O  ASSUMING R1=0.44  9/66

R3          Y*1(1765) INTO (SIGMA PI)/TOTAL               (P3)/TOTAL
R3             0.01     0.01           UHLIG     66 HBC  C                    9/66
R3             0.01        OR LESS     ARMENTERO 66 HBC  C                    9/66

R4          Y*1(1765) INTO (SIGMA ETA)/TOTAL              (P4)/TOTAL
R4             0.02        APPROX      ARMENTERO 66 HDBC C-                   9/66

R5          Y*1(1765) INTO (Y*1(1385) PI)/TOTAL           (P5)/TOTAL
R5             0.14     0.05           UHLIG     66 HBC  C                    9/66
R5             0.12     0.02           BARLOUTAU 66 HBC  C  ASSUMING R1=0.44  9/66

R6          Y*1(1765) INTO (Y*1(1520) PI)/TOTAL           (P6)/TOTAL
R6             0.15     0.03           ARMENTERO 65 HBC  C  R1=0.5, HYPERONS  7/66
R6             0.24     0.06           FENSTER   66 HBC  O  R1=0.5, KBAR N    9/66
R6             0.15     0.02           UHLIG     66 HBC  C                    9/66

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REFERENCES -- Y*1(1765)


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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
SMART    66 PRL 17 556        W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
FENSTER  66 PRL 17 841        +GELFAND,HARMSEN,L-SETTI,+ //CHI,ARG(CERN) IJP
UHLIG    66 PR (ACCEPTED)     +CHARLTON,CONDON,GLASSER,YODH,+ //MD,LSNRL  IJ
LEVI SET 66 BERKELEY CONF     R LEVI SETTI, E PREDAZZI            //CHI
ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
BARLOUTA 66 BERKELEY CONF     BARLOUTAUD,GRANET, +  //SACLAY,HEIDEL,CERN IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I
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PAPERS NOT REFERRED TO IN DATA CARDS.

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YODH     65 ATHENS CCNF 269   G B YODH                        //MARYLAND IJ
BIRGE    65 ATHENS CONF 296   +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA, + //LRL IJP
     --  YCDH 65 AND BIRGE 65 ARE PRECURSORS OF UHLIG 66 AND BELL 66.
GELFAND  66 BERKELEY CONF     +HARMSEN,LEVI SETTI,RAYMUND, +   //CHI,ARG
     --  ELASTIC SCATTERING CATA FIT BY LEVI SETTI 66.
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Σ (1780)

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              57  Y*1(178C, JP=    ) I=1

              SIGMA ETA THRESHOLD EFFECT.  INTERPRETATION AS RESONANCE
              NOT CONCLUSIVE.  SEE FERRO-LUZZI 66.  OMITTED FROM TABLE

----------------  57  Y*1(1780) MASS (MEV)  ----------------------------

M            1780.0                    CLINE     66 DBC  -  K-N TO SIG- ETA   9/66

----------------  57  Y*1(1780) WIDTH (MEV)  ---------------------------

W             100.0                    CLINE     66 DBC  -                    9/66

----------------  57  Y*1(1780) PARTIAL DECAY MODES  -------------------

P1          Y*1(1780) INTO KBAR N                         S11S17
P2          Y*1(1780) INTO SIGMA ETA                      S20S14

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REFERENCES -- Y*1(1780)


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CLINE    66 BERKELEY CONF     D CLINE, M OLSSON                //WISC(LRL)  I
F-LUZZI  66 BERKELEY CONF     M FERRO-LUZZI                        //CERN
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Σ (1915) 46 Y*1(1915, JP=5/2+) I=1

PERHAPS SOME SLIGHT RESERVATION SHOULD BE HELD AGAINST COMPLETE ACCEPTANCE OF THE INTERPRETATION OF THIS EFFECT AS (1) BEING A RESONANCE (2) HAVING JP = 5/2+.

---------------- 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		DAVIES	66 CNTR		K-P, D TOTAL	11/66

---------------- 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	20.0		DAVIES	66 CNTR		11/66

---------------- 46 Y*1(1915) PARTIAL DECAY MODES -------------------

P1	Y*1(1915) INTO KBAR N	S11S17
P2	Y*1(1915) INTO LAMBDA PI	S18S 8
P3	Y*1(1915) INTO SIGMA PI	S20S 8

---------------- 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	0.06	0.02	ARMENTERO	66 HBC	C	K-P EL, CH EX	9/66
R1	0.1		DAVIES	66 CNTR		ASSUMING J=5/2	11/66
R2	Y*1(1915) INTO (LAMBCA PI)/TOTAL					(P2)/TOTAL	
R2	0.12	0.08	SMART	66 DBC	-	ASSUMING R1=0.10	7/66
R2	0.10		ARMENTERO	66 HBC	C	ASSUMING R1=0.06	9/66
R3	Y*1(1915) INTO (SIGMA PI)/TOTAL					(P3)/TOTAL	
R3	0.03	0.02	ARMENTERO	66 HBC	C	ASSUMING R1=0.06	9/66

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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 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES 66 PRL (TO BE SUBM) +DOWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD I

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Σ (2035) 47 Y*1(2035, JP=7/2+) I=1

47 Y*1(2035) MASS (MEV) ----------------------------

M	*	2022.0	20.0	BLANPIED	65 CNTR	C	GAMMA P TO K+ Y*	
M		2040.0	20.0	COOL	66 CNTR	0-	K-P, D TOTAL	7/66
M		2030.0	20.0	WOHL	66 HBC	0	K-P TO LAM PI0	7/66

---------------- 47 Y*1(2035) WIDTH (MEV) ---------------------------

W	*	120.0	20.0	BLANPIED	65 CNTR	C	
W		150.0		COOL	66 CNTR	C	7/66
W		170.0		WOHL	66 HBC	C	7/66

---------------- 47 Y*1(2035) PARTIAL DECAY MODES -------------------

P1	Y*1(2035) INTO KBAR N	S11S17
P2	Y*1(2035) INTO LAMBDA PI	S18S 9
P3	Y*1(2035) INTO SIGMA PI	S20S 8

---------------- 47 Y*1(2035) BRANCHING RATIOS ----------------------

R1	Y*1(2035) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	0.155	COOL	66 CNTR	C	K-P TOTAL	7/66
R1	0.25	WOHL	66 HBC	0	K-P CH EX	7/66
R2	Y*1(2035) INTO (LAMBCA PI)/TOTAL				(P2)/TOTAL	
R2	0.16	WOHL	66 HBC	C	ASSUMING R1=0.25	7/66

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REFERENCES -- Y*1(2035)

BLANPIED 65 PRL 14 741 +GREENBERG,HUGHES,KITCHING,LU,+//YALE(CEA)
COOL 66 PRL 16 1228 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I
WOHL 66 PRL 17 107 C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP

PAPERS NOT REFERRED TO IN DATA CARDS.

SMART 66 PRL 17 556 W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
-- SMART 66 AND ARMENTEROS 66 TEND TO CONFIRM THE JP ASSIGNMENT.

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Σ (2260) 48 Y*1(2260, JP=) I=1

EVIDENCE NOT COMPLETELY CONCLUSIVE. THE BUMP IS SMALL AND SENSITIVE TO DETAILS OF THE UNFOLDING OF THE EFFECTS OF INTERNAL MOMENTA OF THE NUCLEONS IN THE DEUTERON.

---------------- 48 Y*1(2260) 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		2260.0	20.0	COOL	66 CNTR	K-P, D TOTAL	7/66

---------------- 48 Y*1(2260) WIDTH (MEV) ---------------------------

W	*	150.0			BLANPIED	65 CNTR	
W	*	21.0	17.0	21.0	BOCK	65 HBC	
W		180.0			COOL	66 CNTR	7/66

---------------- 48 Y*1(2260) PARTIAL DECAY MODES -------------------

P1	Y*1(2260) INTO KBAR N	S11S17
P2	Y*1(2260) INTO KBAR N PI	S11S17S 8

---------------- 48 Y*1(2260) BRANCHING RATIOS ----------------------

R1	Y*1(2260) INTO (KBAR N)/TOTAL			(P1)/TOTAL	
R1	0.14	COOL	66 CNTR	ASSUMING J=9/2	7/66

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REFERENCES -- Y*1(2260)

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

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 COOL 66 PARAMETERS.

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Σ (3000) 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 KO. EVIDENCE NOT CONCLUSIVE. OMITTED FROM TABLE.

---------------- 59 Y*1(3000) MASS (MEV) ----------------------------

M	3000.0	EHRLICH	66 HBC	C	PI-P 7.91 BEV/C	9/66

---------------- 59 Y*1(3000) PARTIAL DECAY MODES -------------------

P1	Y*1(3000) INTO KBAR N	S11S17
P2	Y*1(3000) INTO LAMBCA PI	S18S 8

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REFERENCES -- Y*1(3000)

EHRLICH 66 PR (SUBMITTED) R EHRLICH, W SELOVE, H YUTA //PENN(BNL) I

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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	C-	K-P 1.8 BEV/C	
M	*	1532.0	2.0	BADIER	64 HBC	C-	K-P 3 BEV/C	
M-		1535.7	3.2	LONDON	66 HBC	-	K-P 2.24 BEV/C	7/66
M0		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
	R	REDUNDANT WITH DATA IN MASS LISTING.						
D		2.0	3.2	MERRILL	66 HBC	C-	K-P 1.7-2.7 BE/C	7/66

---------------- 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	C		7/66
W	7.0	7.0	BERGE	66 HBC	C	K-P 1.5-1.7 BE/C	7/66

---------------- 49 XI*1/2(1530) PARTIAL DECAY MODES -----------------

P1	XI*1/2(1530) INTO XI PI	S22S 8

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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

QUANTUM NUMBER DETERMINATION NOT REFERRED TO IN DATA CARDS.

SHAFER 66 PR 142 883 BUTTON-SHAFER,LINDSEY,MURRAY,SMITH //LRL JP

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Ξ (1705) 51 XI*1/2(1705, JP=) I=1/2

EVIDENCE NOT COMPELLING. OMITTED FROM TABLE.

51 XI*1/2(1705) MASS (MEV) --------------------------

M	1705.0	APPROX	SMITH	65 HBC	C-	K-P 2.1-.7 BEV/C

---------------- 51 XI*1/2(1705) WIDTH (MEV) -------------------------

W	20.0	APPROX	SMITH	65 HBC	C-

---------------- 51 XI*1/2(1705) PARTIAL DECAY MODES -----------------

P1	XI*1/2(1705) INTO XI PI	S22S 8
P2	XI*1/2(1705) INTO LAMBDA KBAR	S18S11

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REFERENCES -- XI*1/2(1705)

SMITH 65 ATHENS CONF 251 G A SMITH, J S LINDSEY //LRL I

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Ξ (1815) 50 XI*1/2(1815, JP=) I=1/2

50 XI*1/2(1815) MASS (MEV) --------------------------

M	*	1770.0		HALSTEINS	63 FBC	0-	K-FR 3.5 BEV/C
M		1817.0	7.0	SMITH 1	65 HBC	C-	K-P 2.4-.7 BEV/C
M		1814.0	4.0	BADIER	65 HBC	0	K-P 3 BEV/C

---------------- 50 XI*1/2(1815) WIDTH (MEV) -------------------------

W	*	80.0		OR LESS	HALSTEINS	63 FBC	0-
W		12.0	4.0		BADIER	65 HBC	C
W		30.0	7.0		SMITH 2	65 HBC	C-

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-----------------   50  XI*1/2(1815) PARTIAL DECAY MODES  ------------------

P1          XI*1/2(1815) INTO LAMBCA KBAR                    S18S11
P2          XI*1/2(1815) INTO XI PI                          S22S 8
P3          XI*1/2(1815) INTO XI*1/2(1530) PI                U49S 8
P4          XI*(1815) INTO XI PI PI (XI PI NOT XI*(1530))   S22S 8S 8

-----------------   50  XI*1/2(1815) BRANCHING RATIOS   --------------------

R1          XI*1/2(1815) INTO (LAMBDA KBAR)/TOTAL            (P1)/TOTAL
R1   *        LARGE                      BADIER    65 HBC                          7/66
R1   *        LARGE                      SMITH 2   65 HBC                          7/66

R2          XI*1/2(1815) 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

R3          XI*1/2(1815) INTO (XI*(1530) PI)/(LAM KBAR)      (P3)/(P1)
R3            0.26      0.13             SMITH 1   65 HBC
R3   *        SMALL                      BADIER    65 HBC                          7/66

R4          XI*1/2(1815) INTO (XI PI PI)/(LAMBDA KBAR)       (P4)/(P1)
R4            0.1          OR MORE       SMITH 1   65 HBC
R4   *        SMALL                      BADIER    65 HBC                          7/66

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                        REFERENCES -- XI*1/2(1815)

HALSTEIN 63 SIENA CCNF 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         +CEMOULIN,GOLDBERG, +    //CP,SACLAY,AMSTR  I
SMITH 2  65 ATHENS CONF 251   G A SMITH, J S LINDSEY                 //LRL

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Ξ (1935) 52  XI*1/2(1935, JP=    ) I=1/2
            52  XI*1/2(1935) MASS (MEV)    --------------------------

M           1933.0     16.0            BADIER    65 HBC   C  K-P 3 BEV/C

-----------------   52  XI*1/2(1935) WIDTH (MEV)   --------------------------

W            140.0     35.0            BADIER    65 HBC   0

-----------------   52  XI*1/2(1935) PARTIAL DECAY MODES  ------------------

P1          XI*1/2(1935) INTO XI PI                        S22S 8
P2          XI*1/2(1935) INTO LAMBDA KBAR                  S18S11

****** ********* ********* ********* ********* ********* ********* *********

                        REFERENCES -- XI*1/2(1935)

BADIER   65 PL 16 171         +DEMOULIN,GOLDBERG, +     //EP,SACLAY,AMST  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
Ξ? (2270) 53  XI* /2(2270, JP=    ) I= /2

         EVIDENCE PRELIMINARY.  OMITTED FROM TABLE.

            53  XI* /2(2270) MASS (MEV)    --------------------------

M           2270.0                     ABRAMS    66 HBC     K-P 4.25 BEV/C    9/66

****** ********* ********* ********* ********* ********* ********* *********

                        REFERENCES -- XI* /2(227C)

ABRAMS   66 BERKELEY CONF     +CAY,GLASSER,KEHOE,SECHI-ZORN, + //MD(BNL)

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Eta Decay Into Neutrals (Price, Nov. '66)

Certain HBC and DBC experiments report the mode "$\eta \to 3\pi^0$", but actually they detect both $\eta \to 3\pi^0$ plus $\eta \to \pi^0 2\gamma$, and they cannot distinguish them (we ignore the mode $\eta \to 2\pi^0\gamma$). Since the detection efficiencies are different for the various modes, one may not merely substitute the combined rate $(3\pi^0 + \pi^0 2\gamma)$ for the reported $3\pi^0$ rate in these experiments. MULLER+ 63 (DBC) state that their detection efficiency per γ ray is about the same regardless of the mode of decay ($3\pi^0$ or $\pi^0 2\gamma$). CRAWFORD 2 66 (HBC) has shown that the same is true for the HBC experiments listed. Thus for all these experiments (assuming $\eta \to 2\pi^0\gamma$ to be equal to zero)

$$3\pi^0_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{1}{1+\frac{4}{6}r} \qquad (1)$$

and

$$\pi^0 2\gamma_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{r}{1+\frac{4}{6}r}, \qquad (2)$$

where

$$r \equiv \frac{\pi^0 2\gamma}{3\pi^0}. \qquad (3)$$

CRAWFORD2 gives values for $3\pi^0/\pi^+\pi^-\pi^0$, using (1) and assuming $r = 1.79 \pm 0.58$, from DIGIUGNO+ 66 (CNTR).

Now in principle it would be possible for us to include "r" in our least-squares fitting, recalculating it at every step. In reality, however, this would require a major programming change in program AHR. Thus we have not included these particular HBC and DBC experiments in our present constrained fitting. For the purposes of comparison, we note that our over-all best fits to all data (excluding the particular HBC and DBC experiments) gives

$$R \equiv \frac{3\pi^0}{\pi^+\pi^-\pi^0} = 0.94 \pm 0.16.$$

If we now use the experimental results from the BC experiments along with our best-fit values for the partial modes $\pi^0 2\gamma$ and $3\pi^0$, we have [Eqs. (1) and (3)]:

$$R = 0.50 \pm 0.12.$$

The agreement is not good (it is about 2 standard deviations). If such a discrepancy persists, we will recode program AHR to accept all of the data next time.

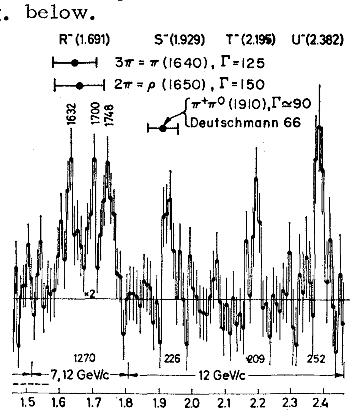
Relationship between peaks seen in missing mass spectrometer and in bubble chamber experiments

a) Relationship between:
   1. Narrow R^- peaks seen by MMS
   2. Broad 3π peak, $\pi(1640)$ seen by HBC
   3. Broad 2π peak, $\rho(1650)$ seen by HBC

The figure below shows the R^- data of the MMS group (LEVRAT + 66). We have added the average mass and width of the HBC bumps (GOLDHABER + 66RVUE). The observations must be related, but there is not yet enough information to apportion them.

b) Relationship between:
   1. Narrow S^- peak seen by MMS
   2. $\Gamma = 90 \pm 40$ MeV $\pi^+\pi^0$ peak seen in HBC

It is hard to relate these, since MMS bump has 3 charged tracks, HBC is $\pi^+\pi^0$. See fig. below.



Notes on Baryon Resonances

Parameters of the lower N^*'s (Rosenfeld, Wohl)

We take masses, widths, and elasticities of the lower N^*'s [except for the $\Delta(1236)$] from phase-shift analyses of BAREYRE 65 and LOVELACE 66. These are the latest of a number of such analyses and appear to be the most complete and comprehensive. However it should be kept in mind that even these are only in qualitative agreement with one another.

The Argand diagrams of BAREYRE 65 are shown in Fig. 4. Those of Donnachie et al. have not yet appeared; their best estimates of resonance parameters are given by LOVELACE 66. We would be happy to include their diagrams (as well as anyone else's) in future editions. Argand diagrams are clearly the most succinct form for presenting and comparing results of phase-shift analyses.

A resonating partial-wave elastic-scattering amplitude with no background has the simple Breit-Wigner form

$$T(E) = x/(\epsilon - i), \qquad (1)$$

where x is elasticity and ϵ is $(M-E)/(\Gamma/2)$. This amplitude traces a circle of diameter x and becomes entirely imaginary at $E = M$. The amplitude also has greatest velocity $|d\underset{\sim}{T}/dE|$ at $E=M$, for it is easy to show that

$$\left|\frac{d\underset{\sim}{T}}{dE}\right| = \frac{x}{\epsilon^2+1} = \text{Im } T, \qquad (2)$$

which is a maximum at $E = M$. The $P_{33}\,\Delta(1236)$ is a good example of a resonant partial wave with no background until E is well above M.

If the resonance is superimposed on a varying background, the resonant circle may be translated, rotated, and distorted. The S_{31} amplitude shows these effects well. Since this amplitude never becomes entirely imaginary, we must choose another criterion for the resonant energy. If the background varies only slowly, it is reasonable to choose the point at which the velocity of the amplitude is greatest.

The S_{11} amplitude is obviously quite complex. MICHAEL 66 has visually fitted the solution of BAREYRE 65 to two resonant circles plus no background. We use his results.

The influence of background on the P_{11} amplitude is less apparent. The clue is that the amplitude varies most rapidly somewhat below the energy at which it becomes entirely imaginary. This behavior suggests that the resonant circle is rotated, an interpretation supported by the fact that the phase shift starts off negative before commencing its counterclockwise rotation and recrossing the origin at 1175 MeV. Maximum velocity is reached at about 1400 MeV or slightly lower.

Let us consider the P_{11} amplitude to be the result of two opposite forces, a repulsive force responsible for a negative scattering length A, and an attractive resonant interaction. The scattering length will produce a phase shift $2i\delta'$ and a contribution to the T matrix

$$T' = \frac{e^{2i\delta'}-1}{2i}. \qquad (3)$$

The resonant term T will be given by (1). The total amplitude, obtained by multiplying the S-matrix elements[1] (S is related to T by $S = 2iT + 1$), will now start out negative, and then superimposed on its clockwise motion will be the counterclockwise circular resonant behavior.

How far around this resonant circle is 1400 MeV? To solve this simple problem, assume that the repulsive phase shift $2\delta'$ is related to a scattering length by

$$k^3 \cot\delta' = 1/A,$$

or more precisely, using McKinley's phase shifts,[2]

$$(k/m_\pi)^3 \cot\delta' = -(.015)^{-1}.$$

Then, at 1400 MeV, δ' has reached -15 deg. We have plotted the corresponding point on Fig. 4. It is encouraging that this point lies almost diametrically across the resonant circle from 1400 MeV.

The other resonating amplitudes, the D_{13}, the D_{15}, and the F_{15}, appear to have little background; the variation is most rapid approximately where the amplitude becomes imaginary. Therefore the resonant parameters may be chosen as follows: M is where T(E) is entirely imaginary; x is the length of T at this point; and $\Gamma/2$ is $(M - E')$, where E' is the energy at which Im T is $x/2$.

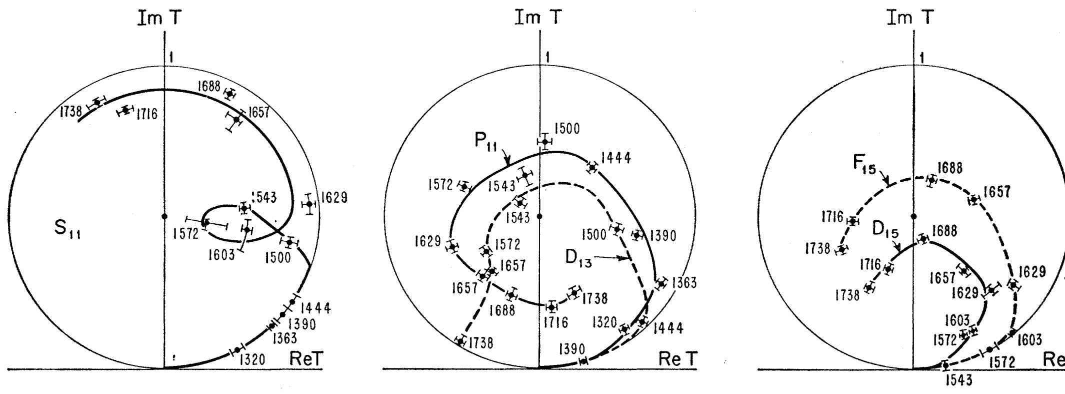
---

1. By multiplying S matrices we get

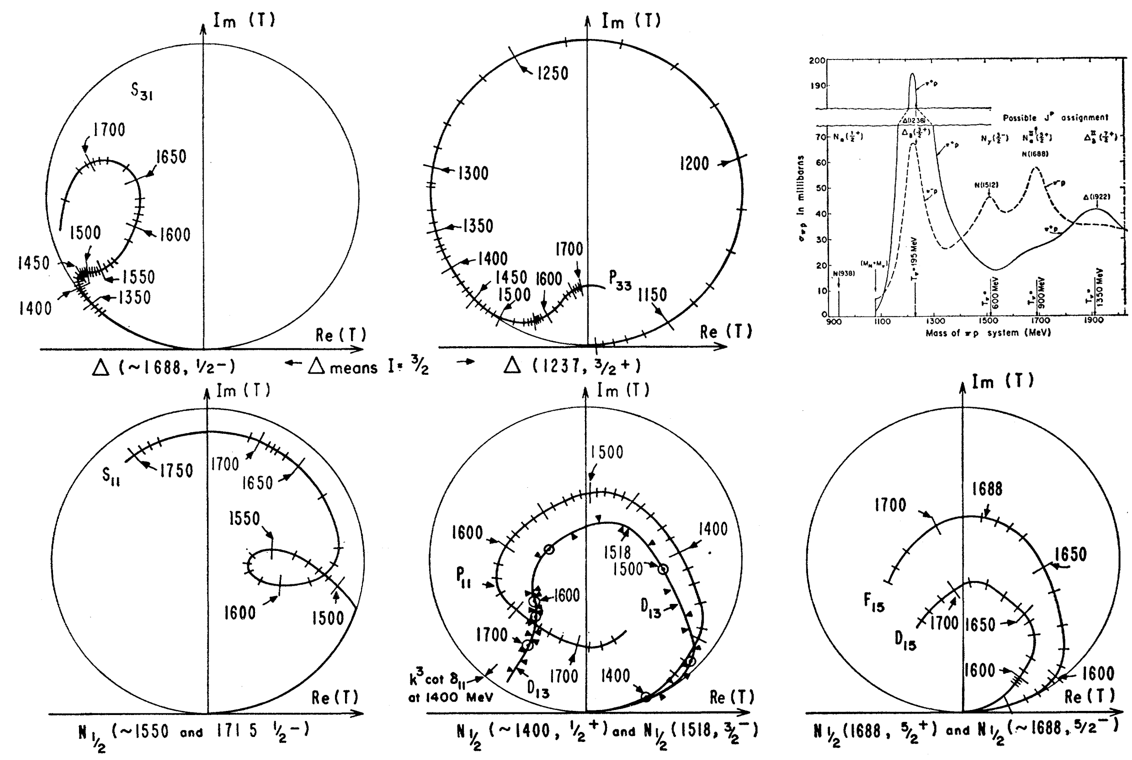
$$S'' = S'\,S = \eta' e^{2i\delta'}\,\eta e^{2i\delta} = 2iT'' + 1.$$

Hence $T'' = \dfrac{\eta'\eta\, e^{2i(\delta'+\delta)} - 1}{2i}$ which rotates the clockwise resonant circle by $2i\delta'$, keeping it tangent to the unit circle.

2. J. M. McKinley, Rev. Mod. Phys. 35, 788 (1963).



Solutions of Bareyre et al. to I-spin 1/2 resonant partial waves. The crosses show the amplitudes and errors computed from the data at various energies. The smooth connecting lines are guesses.



The smooth guessed curves above are replotted with the actual calculated amplitudes replaced by hatch marks interpolated every 10 MeV. For a resonance they should be spaced proportionally to $\mathrm{Im}(T) = (1+\epsilon^2)^{-1}$. The I-spin 3/2 resonant partial waves have been added at the top, along with a summary of the total cross section for π^+p and π^-p.

Fig. 4

Spin-parity assignments of the higher mass N*'s

Spins and parities of the higher mass N*'s are taken from Barger and Cline (BARGER 66). They classify all the N*'s as Regge recurrences on three straight-line trajectories [namely, recurrences of N(938), N(1525), and $\Delta(1236)$] in a Chew-Frautchi plot. In addition they construct a model for π^-p elastic scattering, near and at 180°, based on interference of the resonance amplitude with an amplitude due to Regge exchange of $\Delta(1236)$ in the crossed channel. The predictions compare well with the existing experimental data on the energy dependence of the π^-p differential cross section at 180° and the general shape of the π^-p angular distribution near 180°.[1] This result confirms the consistency of the Regge recurrence parity assignments with the scattering data. In addition to the N* reported in the Table on Baryons, they predict two more states: one at ≈ 2200 MeV (J^P = 9/2+) and another one at ≈2630 MeV (J^P = 13/2 +) which they can accomodate in the prediction of the backward πp scattering by changing the elasticities of the neighboring resonances. We do not list these two resonances since they have not yet been experimentally observed.

1. V. Barger and D. Cline, Regge Recurrence Parity Assignments for the S = 0 Recurrences, paper submitted to the XIII International Conference on High Energy Physics, August 31 through September 7, 1966, Berkeley (proceedings to be published by the Univ. of Calif. Press).

Appendix A. Compiled Spectra Relevant to H and κ Mesons

In an attempt to confirm or deny the existence of certain tentative bumps, we have started compiling the relevant published spectra. It would be better to compile events, rather than spectra, but the former entails collecting data summary tapes, whereas the latter involves only key-punching published data. Perhaps this simpler procedure will stimulate experimental groups to combine their data more effectively.

The compiling is done with a Fortran program SCHISM, written by Alan Rittenberg. SCHISM rebins the input data into common intervals, then outputs the combined histograms. An alphameric character is assigned to each input histogram and is displayed on output, permitting the reader to identify the source of the data. To facilitate reading of the histograms, certain rows and columns of letters have been changed to dots.

Our latest compilations will be continuously available from the Lawrence Radiation Laboratory as UCRL-8030 Spectra. However, we present here two examples, partly as an advertisement for help; we hope readers will call to our attention omitted data and send us new relevant data. The two mesons investigated are H and κ. The results for both are inconclusive. The H spectra show that there is not enough data for us to rely on histograms alone (we will have to go to combined events): the κ spectra discredit but do not kill the κ. In any case, we try to present enough spectra that the reader can form his own opinion on these bumps.

1. The κ(725) (Lynch, Rittenberg, Rosenfeld, Söding, Dec. 1966)

We are beginning to think that κ should be classified along with flying saucers, the Loch Ness Monster, and the Abominable Snowman. We have heard of several experiments which were supposed to confirm it, and each one has either failed completely or failed to find it in the sought-for channel, but found instead a small Kπ peak near 725 MeV in some other channel.

We present here a collection of 19 histograms, some of which represent the results of particular experiments in which the experimenters have claimed to have found the κ; the rest summarize experiments relevant for confirmation or rejection of the κ as a resonance. In Table A-I we list the various reactions and experiments which are discussed and compiled in this appendix, and give numbers of events, incident momenta, and references.

a. $\pi^-p \to (K\pi)\, Y$

The κ was first reported by ALEXANDER+ 62 and MILLER+ 63 in the reaction $\pi^-p \to \Sigma^{-,0}(\pi K)^{+,0}$ at 1.9 to 2.4 GeV/c. Figure A1, taken from MILLER+ 63 (which incorporates events from ALEXANDER+ 62), shows an enhancement of 55 "κ mesons" just at the peak of phase space. These data have now more than doubled, and appear in the thesis of HARDY 66, from which we have gathered two histograms to make Fig. A2. The enhancement has become considerably less impressive and, if present, corresponds to ≤ 40 events. The corresponding plot at higher primary energy, Fig. A3 (also from HARDY 66), also shows no evidence for κ.

The data of Fig. A2 included only Σ^- events, although the original paper of ALEXANDER+ 62 (see Fig. A4) included also Σ^0. Improved Σ^0 statistics have failed to produce any evidence for κ, either near the threshold range shown in Fig. A5 or at higher energy, as shown in Fig. A6.

Table A-I. Experiments on κ discussed in Appendix A.

Reaction	Beam momentum (GeV/c)	Decay products studied	Number of combinations	Published as evidence for κ	Reference	m_κ (MeV)	Γ_κ (MeV)	κ Prod. Cross Section (μb)	Plot symbol	Figure
$\pi^- p \to (K\pi)^{+,0}\Sigma^{-,0}$	1.9 -2.0	$(K^+\pi^0)+(K^0\pi^+)+(K^+\pi^-)$		+	Alexander 62[a] Fig. 3 (incl. in Hardy below)	≈730	≤ 20			A4
$\pi^- p \to (K\pi)^+\Sigma^-$	1.8 - 2.2	$K^+\pi^0$	736		Hardy 66[b] Fig. 12(g)				K	A2
	1.9 - 2.4	$K^+\pi^0$	520	+	Miller 63[c] Fig. 2(b) (incl. in Hardy above)	726±3§	≤ 20§	6-3§		A1
	1.8 - 2.2	$K^0\pi^+$	1602		Hardy 66[b] Fig. 13(g)				N	A2
	1.9 - 2.4	$K^0\pi^+$	1202	+	Miller 63[c] Fig. 2(c) (incl. in Hardy above)	726±3§	≤ 20§	6-3§		A1
	2.9 - 3.3	$K^+\pi^0$	299		Hardy 66[b] Fig. 12(h)				L	
	2.9 - 3.3	$K^0\pi^+$	732		Hardy 66[b] Fig. 13(h)				P	A3
	3.8 - 4.2	$K^+\pi^0$	123		Hardy 66[b] Fig. 12(i)				M	
	3.8 - 4.2	$K^0\pi^+$	223		Hardy 66[b] Fig. 13(i)				Q	
$\pi^- p \to (K\pi)^0\Sigma^0$	1.8 - 2.2	$K^+\pi^-$	670		Hardy 66[b] Fig. 11(g)				H	A5
	2.9 - 3.3	$K^+\pi^-$	314		Hardy 66[b] Fig. 11(h)				I	A6
	3.8 - 4.2	$K^+\pi^-$	104		Hardy 66[b] Fig. 11(i)				J	
$\pi^- p \to (K\pi)^0\Lambda$	1.5	$K^0\pi^0$	154	+	Kim 65[d] Fig. 3	735±5†	< 20		A	
	1.59	$K^0\pi^0+K^+\pi^-$	104		Sene[e] Fig. 2. 10				Z	A7
	1.8	$K^0\pi^0$	259	+	Kim 65[d] Fig. 4	735±5†	< 20		B	
	1.8 - 2.2	$K^0\pi^0$	522		Hardy 66[b] Fig. 15(g)				U	A8
	1.8 - 2.2	$K^+\pi^-$	1590		Hardy 66[b] Fig. 14(g)				R	
	2.9 - 3.3	$K^0\pi^0$	208		Hardy 66[b] Fig. 15(h)				V	
	2.9 - 3.3	$K^+\pi^-$	688		Hardy 66[b] Fig. 14(h)				S	A9
	3.8 - 4.2	$K^0\pi^0$	72		Hardy 66[b] Fig. 15(i)				W	
	3.8 - 4.2	$K^+\pi^-$	263		Hardy 66[b] Fig. 14(i)				T	
$\pi^+ p \to (K\pi)^+\pi^+\Lambda$ (4-body)	3.2	$K^+\pi^0+K^0\pi^+$	314	+	Cason 66[f] Fig. 1 (213 events)	731±2	≲ 12		C	A10
$K^- p \to (\bar{K}\pi)^- p$ (3-body)	0.78-0.99	$K^-\pi^0$	220		Gelfand 66[g] Fig. 10				C	
	0.8 -1.05	$K^-\pi^0$	203		Kalmus 66[h]				N	
	0.78-0.99	$\bar{K}^0\pi^-$	79		Gelfand 66[g] Fig. 10				G	
	0.8 -1.05	$\bar{K}^0\pi^-$	143		Kalmus 66[h]				L	
	1.02-1.18	$K^-\pi^0$	300		Gelfand 66[g] Fig. 10				D	A11
	1.05-1.2	$K^-\pi^0$	180		Kalmus 66[h]				K	
	1.02-1.18	$\bar{K}^0\pi^-$	270		Gelfand 66[g] Fig. 10				H	
	1.05-1.2	$\bar{K}^0\pi^-$	186		Kalmus 66[h]				I	
	1.2	$K^-\pi^0$	894		Lynch 66[i]				O	
	1.2	$\bar{K}^0\pi^-$	891		Lynch 66[i]				Q	
	1.0 -1.7	$\bar{K}^0\pi^-$	4296	+	Wojcicki 63[j] Fig. 1	723±3	< 12	30-0	B	A13
	1.4 -1.7	$K^-\pi^0$	2543		Lynch 66[i]				R	
	1.4 -1.7	$\bar{K}^0\pi^-$	2166		Lynch 66[i]				T	
	1.8 -2.1	$K^-\pi^0$	2925		Lynch 66[i]				U	
	1.8 -2.1	$\bar{K}^0\pi^-$	2584		Lynch 66[i]				W	A14
	2.4 -2.7	$K^-\pi^0$	1950		Lynch 66[i]				X	
	2.1 -2.7	$\bar{K}^0\pi^-$	5833		Friedman 66[k]				A	
	2.4 -2.7	$\bar{K}^0\pi^-$	1833		Lynch 66[i]				Z	
$K^- p \to (\bar{K}\pi)^0 n$	0.78-0.99		114		Gelfand 66[g] Fig. 10				E	
	0.8 -1.05		194		Kalmus 66[h]				M	
	1.02-1.18		314		Gelfand 66[g] Fig. 10				F	A12
	1.05-1.2	$K^-\pi^+$	215		Kalmus 66[h]				J	
	1.2		1068		Lynch 66[i]				P	
	1.4 -1.7		3732		Lynch 66[i]				S	
	1.8 -2.1		4554		Lynch 66[i]				V	A15
	2.4 -2.7		2834		Lynch 66[i]				Y	
$K^- p \to (K\pi)^{+,0}\Xi^{-,0}$	2.24	$K^+\pi^0+K^0\pi^++K^+\pi^-$	413	+	London 66[ℓ] Fig. 28	730	≲ 15		L	A16
$K^- p \to$ $(\bar{K}\pi)^0\pi^- p$ / $(\bar{K}\pi)^-\pi^+ n$ / $(\bar{K}\pi)^-\pi^0 p$	1.2 -1.7	$K^-\pi^++\bar{K}^0\pi^-$	1523	+	Wojcicki 64[m] Fig. 5	≈ 725	< 12		W	A17
$K^- p \to (\bar{K}\pi)^0\pi^- p$ (4-body)	1.45	$K^-\pi^+$	101		Almeida 64[n] Fig. 4			< 3±1.7	A	
	2.0	$K^-\pi^+$	4519		Dauber 66[o] Fig. 45(b)	≈ 690	≲ 30		D	
	2.1 -2.7	$\bar{K}^0\pi^0$	4367		Friedman 66[k]				F	
	2.68	$K^-\pi^+$	1857		Pripstein 66[p] Fig. 8				P	
$K^- p \to (\bar{K}\pi)^-\pi^0 p$	2.1 - 2.7	$\bar{K}^0\pi^-$	4338		Friedman 66[k]				G	A18
$K^- p \to (\bar{K}\pi)^-\pi^+ n$	2.1 - 2.7	$\bar{K}^0\pi^-$	3909		Friedman 66[k]				H	
$K^+ p \to (K\pi)^+\pi^+\pi^- p$ (5-body)	3.0	$K^+\pi^0$	312	+	Ferro-Luzzi 64[q] Fig. 2(a)	725±5*	< 30*	85	F	
	3.0	$K^0\pi^+$	226	+	Ferro-Luzzi 64[q] Fig. 2(c) (113 events)				F	A19
	3.52	$K^0\pi^+$	1144	-	Goshaw 66[r] Fig. 2 (572 events)			<3	G	
$K^+ p \to (K\pi)^0\pi^+\pi^0 p$	3.0	$K^+\pi^-$	312	+	Ferro-Luzzi 64[q] Fig. 2b	725±5*	< 30*	65	F	
		total number	≈ 60 000							

§Values obtained from the combined $(K^+\pi^0)$ and $(K^0\pi^+)$ mass distributions.

†Values obtained from the combined 1.5 and 1.8 GeV/c data.

*Values obtained from the combined $(K^+\pi^0)$, $(K^0\pi^+)$, and $(K^+\pi^-)$ mass distributions.

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Miller, claim.

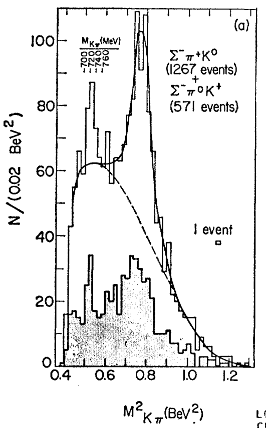

Fig. A1. $M^2(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 1.9 to 2.4 GeV/c. From MILLER+ 63.

Miller decreased

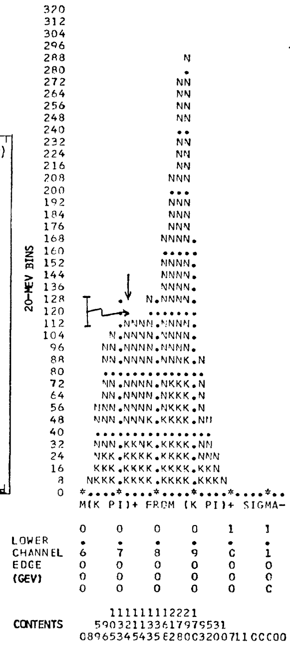

Fig. A2. $M(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 1.8 to 2.2 GeV/c.

Same channel, higher energy.

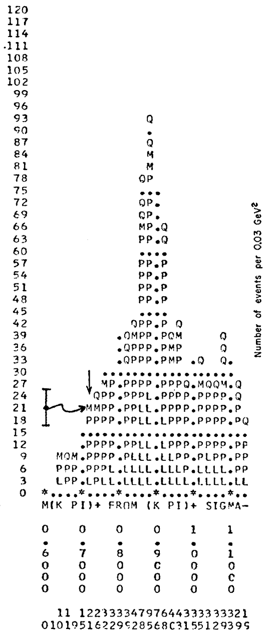

Fig. A3. $M(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 2.9 to 4.2 GeV/c.

Alexander $\Sigma^-, \Sigma^0, \Lambda$.

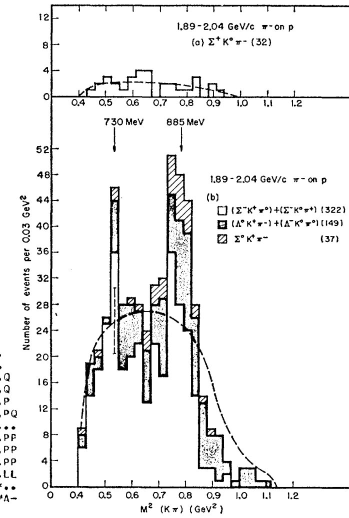

Fig. A4. $M^2(K\pi)$ from $\pi^-p\to(K\pi)^{+,0}\ \Sigma^{-,0}$, and $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.9 to 2.0 GeV/c. From ALEXANDER+ 62.

Alexander Σ^0 disappeared.

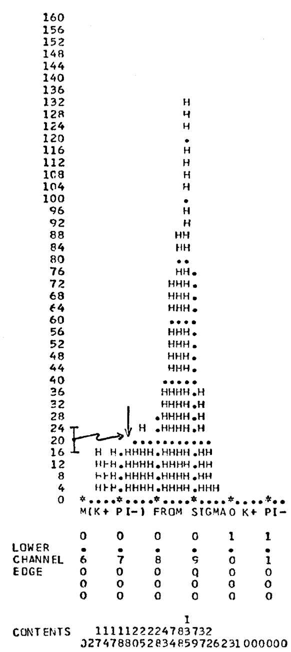

Fig. A5. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Sigma^0$, P_{inc} = 1.8 to 2.2 GeV/c.

Same channel, higher energy.

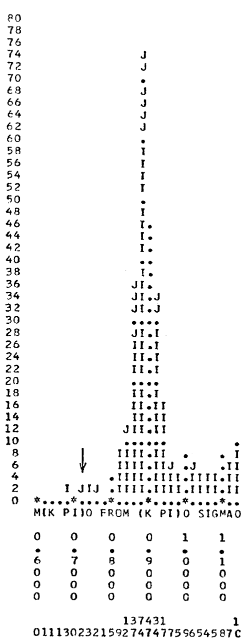

Fig. A6. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Sigma^0$, P_{inc} = 2.9 to 4.2 GeV/c.

Kim claim (A+B) + other (Z), strong uncorroborated peak.

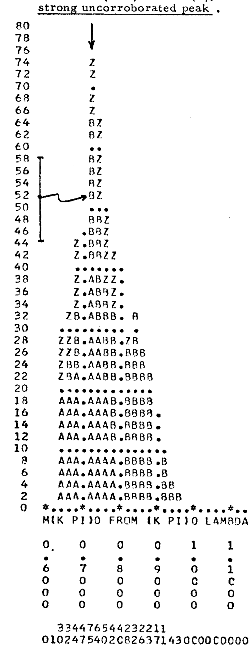

Fig. A7. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.5 to 1.8 GeV/c.

Same channel, higher energy.

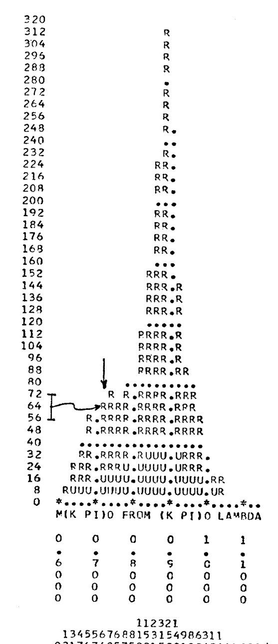

Fig. A8. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.8 to 2.2 GeV/c.

On the other hand, some positive evidence for an enhancement at 735 MeV comes from studies of $(K\pi)^0\Lambda$ final states! This evidence is shown in Fig. A7, which is a compilation of 517 events from two experiments (KIM+ 65, SENE 66) with incident momenta of 1.5 to 1.8 GeV/c, partly below the K^* production threshold. In an experiment with 6× better statistics (3342 events), HARDY 66 has found no evidence for the κ (Figs. A8 and A9), but his experiment covers only the momentum range well above K^* threshold (1.66 MeV) and therefore does not invalidate the positive results of KIM+ 65 and SENE 66.

b. $\pi^+p \rightarrow (K\pi)^+\pi^+\Lambda$

From a recent experiment involving 314 events of this type (Fig. A10), CASON+ 66 claim to have found evidence for the κ. To our knowledge, there is no similar experiment with comparable statistics to either support or weaken the conclusion of CASON+ 66.

c. $K^-p \rightarrow (K\pi)\ N$

Historically, the second experiment to report the κ was that of WOJCICKI+ 63, in which 4296 events of the reaction $K^-p \rightarrow \bar{K}^0\pi^-p$ were studied. In agreement with the original κ evidence, their κ has a mass of 723±3 MeV and a width of < 12 MeV. Wojcicki's largest effect was at 1.08 GeV/c.

There are now several other experiments measuring $(\bar{K}\pi)^-p$ final states in this region of incident K^- momenta. Figure A11 is a compilation of 3367 events (not including Wojcicki's); it represents an independent confirmation of Wojcicki's observation of a peak in the $(\bar{K}\pi)^-$ mass at about 725 MeV. Moreover, a compilation of recent results from $(K\pi)^0n$ final states in the same energy region (1882 events) also shows an enhancement (see Fig. A12), perhaps at a slightly higher mass value. Although the statistical significance of each of these peaks is not larger than 1 to 2 standard deviations, it is hard to deny that some peculiar effect seems to be present here.

Again, larger statistics is available at higher energies, but no peak is observed (see compilation in Figs. A13, A14, and A15).

d. $K^-p \rightarrow (K\pi)^{+,0}\ \Xi^{-,0}$

Evidence for the κ was reported by LONDON+ 66 on the basis of 413 events of this type (see Fig. A16). This is still waiting for confirmation or disproval.

e. $K^-p \rightarrow (\bar{K}\pi)^{0,-}\ \pi N$

The κ was also reported, with $m \approx 725$ MeV and $\Gamma < 12$ MeV, by WOJCICKI+ 64 in 1523 events with 4-body final states, for incident momenta between 1.2 and 1.7 GeV/c. A compilation of 6152 events presently available for this reaction (including the data of WOJCICKI+ 64) in the range of 1.2 to 2 GeV/c (Fig. A17) shows, instead, a broad maximum around 700 MeV. However 700 MeV is just the peak of phase space and we would not take such a broad maximum as evidence for an enhancement in the 725-MeV mass region. A compilation of 14 467 events at 2.1 to 2.7 GeV/c similarly shows no κ (see Fig. A18).

f. $K^+p \rightarrow (K\pi)^{0,+}\pi^{0,-}\pi^+p$

Finally, the κ was reported from a CERN experiment by FERRO-LUZZI+ 64, who saw a peak in the reaction $K^+p \rightarrow NK\pi\pi\pi$. This κ was at 725 MeV and had a width of < 30 MeV. The effect was found in the 3 GeV/c data, but was absent in the 3.5 GeV/c data. An experiment at Wisconsin at 3.6 GeV/c with three times as many events as the CERN experiment also indicated no evidence for a κ.

The combined distribution of the $(K\pi)^{+,0}$ mass from these experiments is shown in Fig. A19. There is no peak at ≈ 730 MeV; although a broad enhancement centered at about 750 MeV can be seen, this is where phase space also peaks.

The κ has also been looked for in other experiments--e.g., the CERN group (V. Henri, private communication) has looked for the κ_+ below K^* threshold in the reaction $K^+p \rightarrow K^0\pi^+p$, but did not find it.

What can we conclude from this study? If the κ is real, then each claim for its existence should be strengthened when combined with later data. We now summarize the discussion above for each claim:

§. The MILLER 63 signal has decreased from 53 to < 40 events, and the signal of FERRO-LUZZI 64 has disappeared.

§. There are no new data to compare with the claims of KIM 65, CASON 66, or LONDON 66; they are of course still impressive.

§. The fate of the claim of WOJCICKI 63 is undecided. His data suggested a κ produced by K^- between 1 and 1.7 GeV/c. When combined with new data over this entire range, the signal has disappeared. On the other hand, with limited statistics, Wojcicki's best signal/noise ratio was at 1.08 GeV/c. We have compiled events produced by K^- between 0.78 and 1.2 GeV/c, and indeed see a 1 to 2-σ signal for both κ and κ^0.

Same channel, still higher energy.

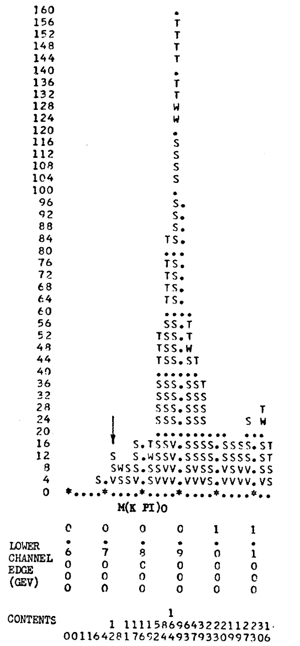

Fig. A9. M(Kπ) from $\pi^- p \to (K\pi)^0 \Lambda$, P_{inc} = 2.9 to 4.2 GeV/c.

Cason claim, strong uncorroborated peak.

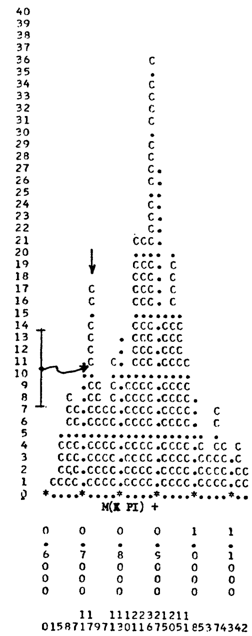

Fig. A10. M(Kπ) from $\pi^- p \to (K\pi)^+ \pi^+ \Lambda$, P_{inc} = 3.2 GeV/c.

No claim, but κ near threshold, supports Wojcicki.

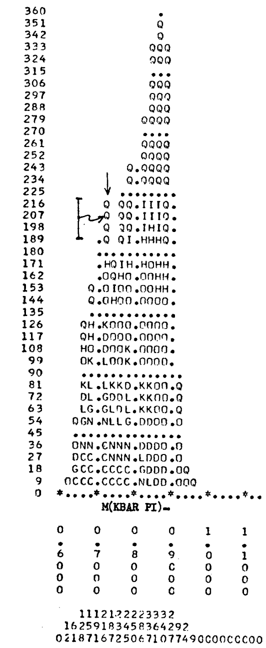

Fig. A11. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 0.78 to 1.2 GeV/c.

Same reactions, different charge, supports Wojcicki.

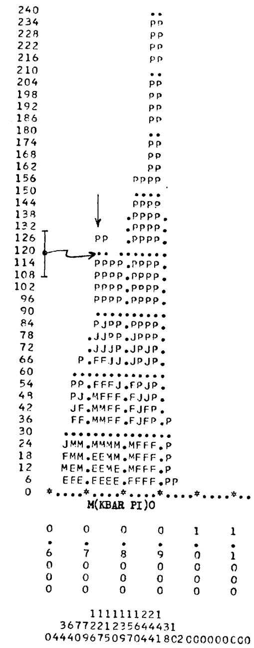

Fig. A12. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^0 n$, P_{inc} = 0.78 to 1.2 GeV/c.

Wojcicki claim (B), + others, up to 1.7 GeV/c, Signal decreased.

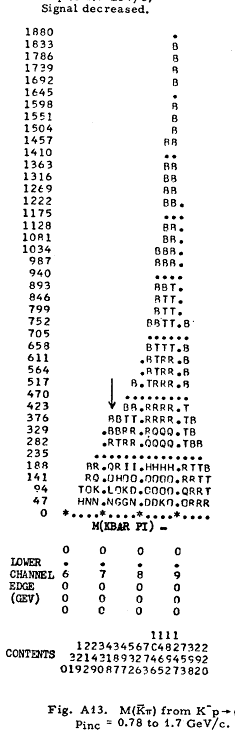

Fig. A13. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 0.78 to 1.7 GeV/c.

Same channel, higher energy. No κ.

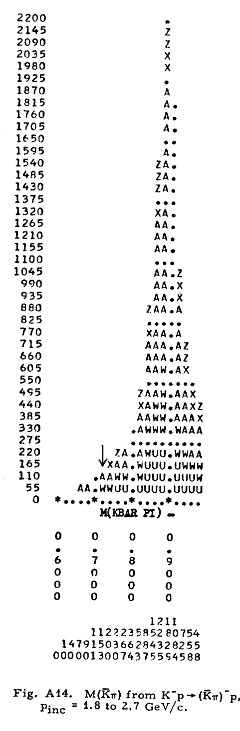

Fig. A14. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 1.8 to 2.7 GeV/c.

Same reactions, different charge. No κ.

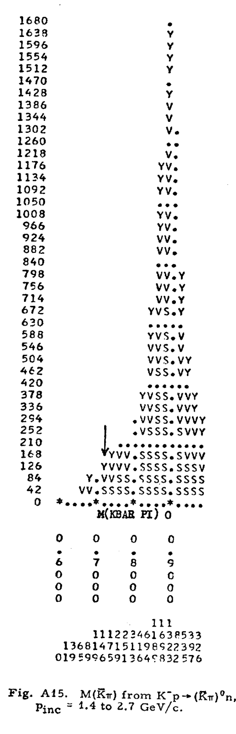

Fig. A15. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^0 n$, P_{inc} = 1.4 to 2.7 GeV/c.

London claim, strong uncorroborated peak.

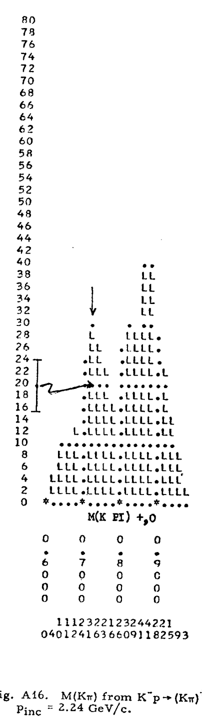

Fig. A16. M(Kπ) from $K^- p \to (K\pi)^{+0} \Xi^{-,0}$, P_{inc} = 2.24 GeV/c.

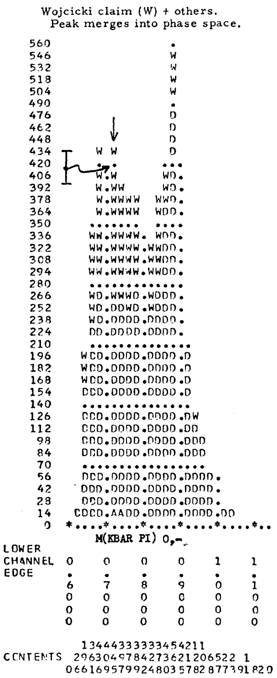

Fig. A17. $M(\bar{K}\pi)$ from $K^-p\to(\bar{K}\pi)^{0,-}\pi N$, P_{inc} = 1.2 to 2 GeV/c.

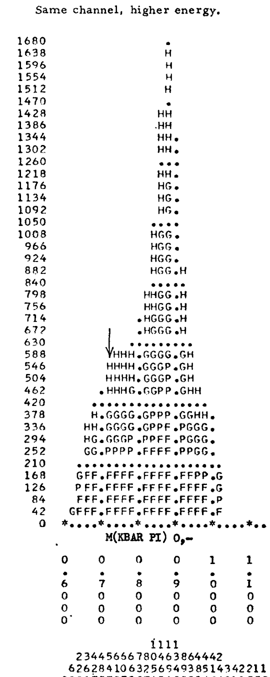

Fig. A18. $M(\bar{K}\pi)$ from $K^-p\to(\bar{K}\pi)^{0,-}\pi N$; P_{inc} = 2.1 to 2.7 GeV/c.

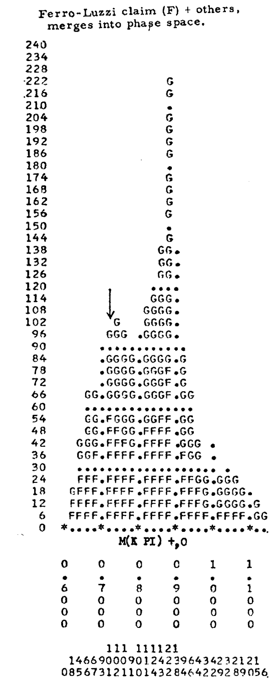

Fig. A19. $M(K\pi)$ from $K^+p\to(K\pi)^{+,0}\pi^{-,0}\pi^+p$, P_{inc} = 3 to 3.5 GeV/c.

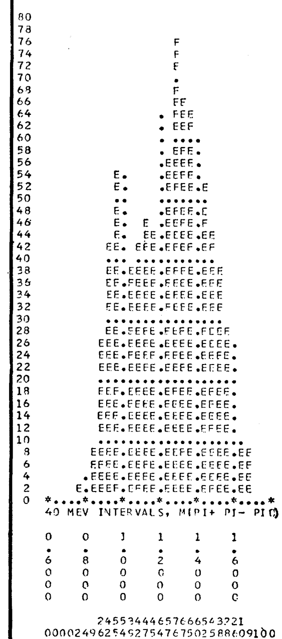

Fig. A20. $M(\rho\pi)^0$ from $\pi^+p\to(\rho\pi)^0\Delta^{++}$, P_{inc} = 4 GeV/c. From BARTSCH+64.

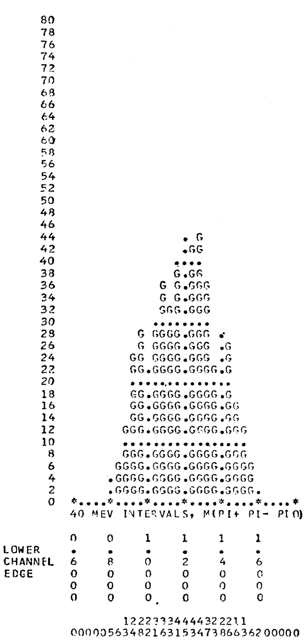

Fig. A21. $M(\rho\pi^0)$ from $\pi^+p\to(\rho\pi)^0\Delta^{++}$, P_{inc}=3.65 GeV/c. From G. GOLDHABER 65.

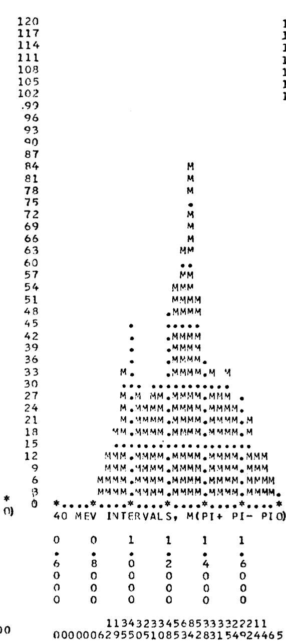

Fig. A22. $M(\rho\pi)^0$ from $\pi^+d\to(\rho\pi)^0pp$, P_{inc} = 3.65 GeV/c. From BENSON+ 66.

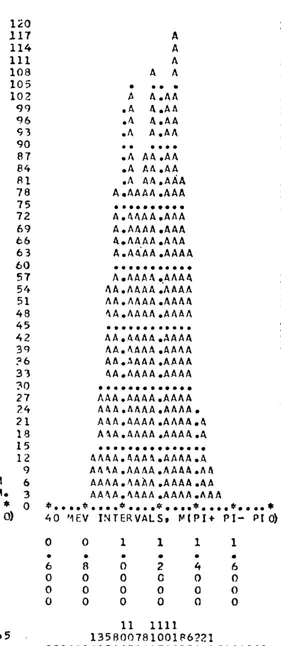

Fig. A23. $M(\rho\pi)^0$ from $\pi^+p\to(\rho\pi)^0\Delta^{++}$, P_{inc}=3.2 and 3.5 GeV/c. From ABOLINS+ 66.

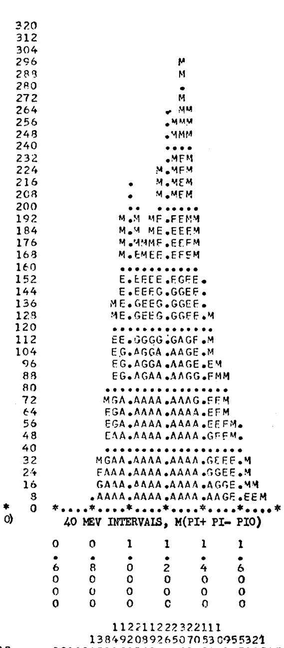

Fig. A24. $M(\rho\pi)^0$ from $\pi^+p\to(\rho\pi)^0\Delta^{++}$ and $\pi^+d\to(\rho\pi)^0pp$, 3.2 to 4 GeV/c.

This behavior could be that of a real κ, but it is more what one would expect of statistical fluctuations.

The fact remains that we compiled 19 histograms (representing 60 000 events) and found 5 (6000 events) which show surprising peaks apparently not statistical fluctuations. We now try to explain it as a bias. We have keypunched any spectrum associated with a positive κ claim, but stopped at 60 000 total events simply because of the work involved. (We shall next automate the preparation of input data.) We estimate that 1.5 to 2 million events have been measured, each of which yields a Kπ mass value. Our reasoning is as follows:

Last year ≈ 2 million events were measured in the United States,[1] and we guess ≈ 3 million events for the world-wide annual rate. This rate has been roughly doubling every two years,[2] so the time integral of the number of bubble-chamber events measured must be ≈10 million. By comparing the number[3] of pictures exposed to $K^{\pm}$ with the number exposed to $\pi^{\pm}$ and p, we see that a quarter of these 10 million events were produced by $K^{\pm}$ with enough energy to produce Kπ events in the final state (with Kπ mass > 725 MeV).

So physicists have looked at Kπ spectra from ≈ 2.5 million events. We guess that 1.5 to 2 million events have been assembled in large collections and looked at carefully. If a κ peak is seen, it is published, and we keypunch. If nothing surprising is seen, one may not even publish the data, and we may not punch it. (But if readers will send us large relevant spectra, we will enter them from now on.) Then, at 1000 events/histogram, 2 million events yield 200 uninteresting histograms. Then the five surprising ones (only three from $K^{\pm}$ experiments) are perhaps to be expected.

So we restate our conclusion. We have not killed the κ but we do feel that we have further discredited it.

2. The H Meson (Ferbel, Rosenfeld, Soding)

The "H meson" is a supposed $I^G = 0^-$ state with a mass $m_H \approx 1000$ MeV, decaying into $(\rho\pi)^0$. Table A-II lists the experiments in which evidence was observed for a bump near 1000 MeV in the $(\rho\pi)^0$ mass spectrum. Figures A20 through A23 show the distributions of $M(\rho\pi)^0$ from these experiments. Goldhaber[4] discussed the H meson and compiled the data of Figs. A20 and A21, plus 1705 events from the reaction $\pi^+ d \to (\rho\pi)^0 pp$ from Benson et al.[5] After consultation with Benson et al., however, we have decided that it would be better to use only 790 events remaining in their sample after $p\pi^+$ combinations in the Δ band have been excluded. We have also added 1204 events that were contributed by the La Jolla group[6] but not used by Goldhaber because they were not yet available.

Table A-II. Experiments on H meson discussed in Appendix A.

Reaction	Beam momentum (GeV/c)	Number of events	Constraints	Reference	Plot symbol	Figure
$\pi^+ p \to (\rho\pi)^0 \Delta^{++}$	3.2 and 3.5	1204		Abolins 66[a]	A	A23
	3.65	519	no ω	Goldhaber 66[b]	G	A21
	4.0	975		Bartsch 64[c]	E	A20
$\pi^+ d \to (\rho\pi)^0 pp$	3.65	790	no Δ^{++}	Benson 66[d]	M	A22
	Total	3488				

a. See Ref. 6
b. Gerson Goldhaber, Experimental Study of Multiparticle Resonance Decays, in Proceedings of the 1965 Coral Gables Conference on Symmetry Principles at High Energies, University of Miami, Florida, 1965 (W. H. Freeman and Co., San Francisco, Calif., 1965), p. 34.
c. J. Bartsch et al., Phys. Letters 11, 167 (1964).
d. See Ref. 5.

The combined spectrum (Fig. A24) shows a peak extending from 960 to 1080 MeV, with an estimated significance of at least four standard deviations. Note, however, that its mean mass is about 1020 MeV, only about 50 MeV below that of the A1 meson. And its width, $\Gamma \approx 120$ MeV, is the same as Γ(A1).

This peak is presently seen only in experiments in the beam momentum range 3.2 GeV/c $\leq p(\pi^+) \leq 4$ GeV/c. It is not seen in similar experiments in the range 5.1 GeV/c $\leq p(\pi^+) \leq$ 8.5 GeV/c. This means that whatever the H phenomenon is, its production cross section drops rapidly at energies greater than $p(\pi^+) =$ 4 GeV/c. Note that 4 GeV/c is already high above the threshold, which is at $p(\pi^+) = 2.18$ GeV/c for $\pi^+ p \rightarrow H\Delta^{++}$ and even lower for $\pi^+ d \rightarrow Hpp$. Moreover, the data for $p(\pi^+) \leq 4$ GeV/c presented above are incomplete; we estimate that at least ≈ 1000 events from other experiments exist but are not yet accessible to us.

Let us accept the evidence for a neutral A1-like peak 50 MeV below the mass of A1. Is it a new meson, H, or is it the neutral A1, displaced to low energy by one half-width through interference with background? We know that the A1 is seen only when enhanced by the Deck effect, i.e., A1 seems to be produced weakly, and needs to interfere positively with background in order to be seen. But the interference could also displace its peak upwards by ≈ 25 MeV. The $A1^{\pm}(\rho\pi)^{\pm}$ is seen recoiling against a proton; the $H(\rho\pi)^0$ is seen recoiling against a Δ^{++}. Could the background phases differ enough between these two experiments that the $(\rho\pi)^0$ peak is displaced downwards by about 25 MeV? We do not know how to answer this question until more work is done.

The Michigan group [5] has suggested that as a next step one should look for an H peak in $\rho^0\pi^0$ only, where the A1, having isopin I = 1, cannot contribute. One can do this in two ways:

1) Compile $\rho^0\pi^0$ spectra, or 2) compile events from data-summary tapes. The latter procedure seems more likely to give us the information we want, for the following considerations. The $\pi^+\pi^-\pi^0$ Dalitz plot has three ρ bands (ρ^0, ρ^+, and ρ^-) which overlap partly at 1000 MeV, and overlap three deep at $\sqrt{3}m_\rho \approx 1300$ MeV. As the Michigan group shows in Fig. 2 of their paper, $\rho^0\pi^0$ spectra are contaminated with overlapping $\rho^{\pm}\pi^{\mp}$, but if one selects out the overlapping, double-ρ events, one produces an artificial bump at 1000 MeV. One can get around this difficulty by compiling the actual events and doing a maximum-likelihood fit to the population of the ρ^0 band. We shall do this.

A final difficulty with the H bump is contamination from the radiative decay of another meson, $\eta' \rightarrow \rho^0\gamma$, which will often fit the interpretation $\rho^0\pi^0$. The Michigan group[5] estimates that 6 ± 3 of their events are such intruders; their spectrum, Fig. A22, seems to contain about 36 H mesons from all the ρ bands; about half might come from $\rho^0\pi^0$.

In summary, the compilation of spectra carried out so far shows a bump but seems inadequate to distinguish between H and a neutral A1 peak. We feel that a compilation of very carefully selected $\rho^0\pi^0$ events is the most promising next step.

APPENDIX REFERENCES

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2. We assume that the world growth rate is the same as that of the Alvarez group, which has been doubling its rate every 2 years for 6 to 8 years. See L. W. Alvarez, Round-Table Discussion on Bubble Chambers, in Proceedings of the 1966 International Conference on Instrumentation for High Energy Physics, SLAC, Stanford, California, Sept. 9, 10, 1966; also Lawrence Radiation Laboratory Report UCRL-17096 (Sept. 1966) (unpublished).
3. L. Piekenbrock, Annual Survey of Bubble Chamber Film, University of Colorado, Boulder, Colorado.
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