Data on Elementary Particles and Resonant States

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This data survey represents a merging of two periodic compilations of data—University of California Radiation Laboratory Report UCRL-8030 by Barkas and Rosenfeld, which has been issued several times since 1957, with accompanying wallet cards, and the tables of Matts Roos.[1] The wallet cards contain considerably more information than is summarized here; accordingly, they and the complete UCRL-8030 Rev will continue to be available from the Lawrence Radiation Laboratory, University of California, Berkeley. (The wallet cards can be requested in two sizes: 2.5x3.5 in., to fit American wallets, and 7x10 cm, to fit European wallets.) We hope that readers will inform us of mistakes and omissions in our data.

As the available particle-spectroscopic data have grown, so has the job of compiling them, and we have finally automated the process. Accordingly, all data and references have been punched on cards. Cards are listed on pages 986–996. The data averaging has in most cases been done by a computer program. Further, our program plots ideograms of the input data, so that we can display clearly the cases with inconsistencies which make that averaging fraught with danger. Wherever it is possible, we have calculated a χ^2 for the sample, and if χ^2 is larger than its expectation value, we have written in the tables, after each error, "× Scale," where "Scale"$=[\chi^2/(N-1)]^{\frac{1}{2}}$, N being the number of experiments used in the calculation. Whenever this warning is included, we suggest that the reader look at the appropriate ideogram (pages 997–1000) and make his own estimates of the experimental situation. "Scale" is discussed further under "Procedures for Treating the Data."

The data are summarized in three tables. Table S covers all the stable particles: leptons, mesons, and baryons—i.e., those states which are immune to decay via the strong interaction.

There are two tables of data on the unstable particles, one on meson resonances, and one on baryon resonances. For the reader's convenience, these tables include again basic information on stable mesons and baryons.

Each table is of slightly different form; thus Table S includes mass differences, and will eventually include magnetic moments, whereas the baryon table includes information on what pion and K-meson beams will form certain resonances.

NOTES ON THE TABLES

Quoted errors represent standard deviations.

The quantum number C stands for the eigenvalue of the charge-conjugation operator applied to a neutral meson. The notation C_n (n for neutral) means the eigenvalue of C applied to the *neutral member* of a nonstrange triplet, like the pion.

The approximate quantum number A has been suggested for mesons and the photon by Bronzan and Low.[2] It is far from established as a good approximation even for low-mass mesons, but we list it because at present it is a handy mnemonic.

Well-established quantum numbers are underlined (except for Table S, where most of the quantum numbers are established). We have used flimsy evidence to guess many of the remaining ones and we have indicated with ? the ones for which there is almost no evidence.

We assume that particles and antiparticles share the same spins, masses, and mean lives.[3–5]

For particles whose quantum numbers are well established, we list only those decays which do not violate strong selection rules.

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 $N_{\frac{3}{2}}^*(1238)$ or $Y_0^*(1520)$ it is conventional to call M_R or E_R the energy at which the resonant amplitude becomes pure imaginary. [For $N_{\frac{3}{2}}^*(1238)$ this corresponds to 1238 MeV.] 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. This is discussed in Appendix I to the original UCRL-8030. Thus the peak in the πp cross section near 1238 MeV actually occurs at 1225 MeV. Nevertheless, for all resonances except $Y_0^*(1520)$ and $N_{\frac{3}{2}}^*(1238)$, it is conventional simply to report the energy of the peak in the observed cross section. We follow this inconsistent convention. Perhaps our next edition will include a small correction table.

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[1] Matts Roos, Nucl. Phys. **52**, 1 (1964); and Rev. Mod. Phys. **35**, 314 (1963).

[2] J. B. Bronzan and F. E. Low, Phys. Rev. Letters **12**, 522 (1964).

[3] T. D. Lee, R. Oehme, and C. Yang, Phys. Rev. **106**, 340 (1957).

[4] S. Okubo, Phys. Rev. **109**, 984 (1958).

[5] A. Pais, Phys. Rev. Letters **3**, 342 (1959).

TABLES FROM UCRL-8030(rev.) June 1964

Table S - Stable particles

							Important decays			
		$I(J^{PG})CA$	Mass (MeV)	Mass diff. (MeV)	Mean life (sec)	Mass^2 (BeV)^2	Partial mode	Fraction	Q (MeV)	p or p_{max} (MeV/c)
	γ	$J^P=1^-C^-A^+$?	0		stable	0	stable			
LEPTONS	ν_e	J=1/2	0(<0.2 keV)		stable	0	stable			
	ν_μ		0(<4)			0				
	$e^\mp$	J=1/2	0.511006 ±0.000002		stable	0.000	stable			
	$\mu^\mp$	J=1/2	105.659 ±0.002	-33.95 ±0.05	2.2001×10^{-6} ±.0008 ×scale=2.5	0.011	$e\nu\nu$	100%	105.15	52.8
MESONS	$\pi^\pm$	$1(0^{--})C_n^+A^-$?	139.60 ±0.05	4.590 ±.004 ×scale=2.4	2.551×10^{-8} ±.026	0.019	$\mu\nu$	100%	33.95	29.80
							$e\nu$	$(1.24\pm.05)10^{-4}$	139.10	69.80
							$\mu\nu\gamma$	$(1.24\pm.25)10^{-4}$	33.94	29.81
							$\pi^0e\nu$	$(1.5\pm.3)10^{-8}$	4.08	4.49
	π^0		135.01 ±0.05		1.80×10^{-16} ±.29 ×scale=1.3	0.018	$\gamma\gamma$	98.8	135.01	67.51
							γe^+e^-	(1.19±.05)%	133.99	67.50
	$K^\pm$	$1/2(0^-)A^-$?	493.8 ±0.2	-4.2 ±0.5 ×scale=1.2	1.229×10^{-8} ±.008	0.244	$\mu\nu$	(63.1±.4)%	388.1	235.6
							$\pi^\pm\pi^0$	(21.5±.4)%	219.2	205.2
							$\pi^\pm\pi^-\pi^+$	(5.5±.1)%	75.0	125.5
							For other decays see Table S Decays			
	K^0		498.0 ±0.5		50% K1, 50%K2					
	K_1			$-0.91\times1/\tau_1$ ±0.07 ×scale=2.3	0.92×10^{-10} ±.02	0.248	$\pi^+\pi^-$	(69.4±5.1)%	218.8	206.2
							$\pi^0\pi^0$	(30.6±1.1)%	228.0	209.2
	K_2				5.62×10^{-8} ±.68	0.248	$\pi^0\pi^0\pi^0$	(27.1±3.6)%	93.0	139.5
							$\pi^+\pi^-\pi^0$	(12.7±1.7)%	83.8	133.1
							$\pi\mu\nu$	(26.6±3.2)%	252.7	216.2
							$\pi e\nu$	(33.6±3.3)%	357.9	229.4
	η	$0(0^{-+})C^+A^-$?	548.7 ±0.5		$\Gamma<10$ MeV	0.301	$\gamma\gamma$	(35.3±3.0)% ×scale=1.1	548.7	274.4
							$3\pi^0$ or $\pi^02\gamma$	(31.8±2.3)%	143.7	179.4
							$\pi^+\pi^-\pi^0$	(27.4±2.5)%	134.5	174.4
							$\pi^+\pi^-\gamma$	(5.5±1.3)%	269.5	236.2
BARYONS	p	$1/2(1/2^+)$	938.256 ±0.005	-1.2933 ±.0001	stable	0.880				
	n		939.550 ±0.005		1.01×10^{3} ±.03	0.883	$pe^-\nu$	100%	0.78	1.19
	Λ	$1/2(1/2^+)$	1115.40 ±0.11		2.62×10^{-10} ±.02 ×scale=1.5	1.244	$p\pi^-$	(67.7±1.0)% ×scale=1.2	37.5	100.2
							$n\pi^0$	(31.6±2.6)%	40.9	103.6
							$p\mu\nu$	$<1\times10^{-4}$	71.5	130.7
							$pe\nu$	$(.88\pm.08)10^{-3}$ ×scale=1.7	176.6	163.1
	Σ^+	$1/2(1/2^+)$	1189.41 ±0.14	2.9	0.788×10^{-10} ±.027	1.415	$p\pi^0$	51.0±2.4%	116.13	189.03
							$n\pi^+$	49.0±2.4%	110.26	185.06
							For other decays see Table S Decays			
	Σ^0		1192.3 ±0.3	4.75 ±.10	$<1.0\times10^{-14}$	1.422	$\Lambda\gamma$	100%	77.0	74.5
	Σ^-		1197.08 ±0.19 ×scale=1.4		1.58×10^{-10} ±.05	1.433	$n\pi^-$	100%	116.94	191.73
							For other decays see Table S Decay			
	Ξ^0	$1/2(1/2^+)$?	1314.3 ±1.0	6.5 ±1.0	3.06×10^{-10} ±.40	1.727	$\Lambda\pi^0$	100%	76.9	150.1
							For other decays see Table S Decay			
	Ξ^-		1320.8 ±0.2 ×scale=1.3		1.74×10^{-10} ±.05	1.745	$\Lambda\pi^-$	100%	65.8	138.7
							$\Lambda e^-\nu$	$(3.0\pm1.7)10^{-3}$	204.9	189.4
							$n\pi^-$	$<5\times10^{-3}$	214.7	303.0
	Ω^-	$0(3/2^+)$? ?	1675 ±3		$\sim0.7\times10^{-10}$		$\Xi\pi$	?	221	296
							ΛK	?	66	216

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Table S Decay

An Appendix to Table S for particles with many decay modes

	Partial mode	Rate		Q (MeV)	p or p_{max} (MeV/c)
$K^{\pm}$	$\mu^{\pm}\nu$	$63.1\pm.5\%$	Xscale=1.6	388.1	235.6
	$\pi^{\pm}\pi^{0}$	$21.5\pm.4\%$		219.2	205.2
	$\pi^{\pm}\pi^{+}\pi^{-}$	$5.5\pm.1\%$		75.0	125.5
	$\pi^{\pm}\pi^{0}\pi^{0}$	$1.7\pm.1\%$		84.2	133.0
	$\pi^{0}\mu^{\pm}\nu$	$3.4\pm.2\%$		253.1	215.2
	$\pi^{0}e^{\pm}\nu$	$4.8\pm.2\%$		358.3	228.4
	$\pi^{\pm}\pi^{\mp}e^{\pm}\nu$	$(4.3\pm.9)10^{-5}$		214.1	203.5
	$\pi^{\pm}\pi^{\pm}e^{\mp}\nu$	$<0.1\times10^{-5}$		214.1	203.5
Σ^{+}	$p\pi^{0}$	$(51.0\pm2.4)\%$		116.1	189.0
	$n\pi^{+}$	$(49.0\pm2.4)\%$		110.3	185.1
	$n\pi^{+}\gamma$	$\sim0.4\times10^{-4}$		110.3	185.1
	$\Lambda e^{+}\nu$	$\sim0.2\times10^{-4}$		73.5	71.7
	$p\gamma$	$\sim3\times10^{-3}$		251.1	224.6
	$n\mu^{+}\nu$	$<2.3\times10^{-4}$		144.2	202.4
	$ne^{+}\nu$	$<1.0\times10^{-4}$		249.3	223.6
Σ^{-}	$n\pi^{-}$	100%		117.9	192.7
	$n\pi^{-}\gamma$	$\sim0.1\times10^{-4}$		117.9	192.7
	$n\mu^{-}\nu$	$(0.66\pm0.14)10^{-3}$		151.9	209.3
	$ne^{-}\nu$	$(1.4\pm0.3)10^{-3}$		257.0	229.8
	$\Lambda e^{-}\nu$	$(0.75\pm0.28)10^{-4}$		81.2	78.9
Ξ^{0}	$\Lambda\pi^{0}$	$\sim100\%$		76.9	150.1
	$p\pi^{-}$	$<0.4\%$		249.4	309.3
	$pe^{-}\nu$	$<0.4\%$		388.5	332.0
	$\Sigma^{+}e^{-}\nu$	$<0.3\%$		137.4	130.7
	$\Sigma^{-}e^{+}\nu$	$<0.25\%$		129.7	123.8

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Notes on Table S

The quantum numbers of all the stable particles seem well established, with the exception of the parity of Ξ. Of course, if we accept SU_3, then Ξ becomes $\frac{1}{2}^+$, and Ω^- must be $\frac{3}{2}^+$.

Note that, since the preceding compilation, the proton mass has risen by 43 keV, and the Λ mass by 40 keV (see notes on these individual entries).

Notes on the Meson Table

Quantum Numbers and the Symbol C_n

For nonstrange mesons we list the eigenvalue of the G parity operator[6,7]

$$G=Ce^{2\pi i I_y}. \qquad (1)$$

For neutral mesons, C has the eigenvalue ± 1, and it turns out that we can write[8]

$$G=C(-1)^I. \qquad (2)$$

Now G and I have eigenvalues, of course, for all members of a charge multiplet, 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

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

The Symbol-Minded Approach

In addition to their colloquial names, we have used the names suggested by Chew, Gell-Mann, and Rosenfeld[9,10]: atomic mass number A, hypercharge Y, and isospin I have been grouped into a single symbol. For mesons ($A=0$), we use η for ($Y=I=0$), π for ($Y=0$, $I=1$), and K for ($Y=1$, $I=\frac{1}{2}$). A, Y, I are easily determined, so all mesons can be given a symbol independent of ideas about Regge trajectories or SU_3. In addition we introduce some subscripts to condense data on J and P:

α for 0^+, α^{II} for its Regge recurrence 2^+,
β for 0^-, β^{II} for its Regge recurrence 2^-,
γ for 1^- (like the γ ray),
δ for 1^+.

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[9] that for a neutral pair

$$C=(-1)^l; \qquad (4)$$

for a charged pair, C has no eigenvalue, but G does,[9] namely,

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

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_1, so $I=1$. Then, by (5), observation of this mode establishes that l is even.

Next consider the $A1$ 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 we have guessed correctly that $A1$ has $J^P=0^-$, 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 nonobservation of $\bar{K}K$ is evidence against a 1^- interpretation of B.

Whenever l is even, neutral $\bar{K}K$ must appear as K_1K_1, K_2K_2, and K^+K^- in the ratio 1:1:2. If l is odd, we can find only K_1K_2 and K^+K^-, in equal numbers.[11]

Notes on the Baryon Table

Here we have included one extra column to describe the beam with which these resonances can be formed. In the case of "πp" resonances, where we are accustomed to talking of the "600 MeV" and "900 MeV" resonances, we have listed the beam energy in MeV. But beams nowadays are usually referred to by momentum, so for the more recently discovered "Kp" resonances, we list the K beam in MeV/c. One can convert back and forth with the help of Fig. 2 on wallet card 2.

Symbol-Minded Approach for Baryons

Again we use familiar symbols to denote $A=1$, and various values of strangeness and isospin: namely N, Λ (for $Y_0{}^*$), Σ (for $Y_1{}^*$), Ξ, and Ω^-. Since there is no current symbol for $N_{\frac{3}{2}}{}^*$, we invent Δ.

To get subscripts we add $\frac{1}{2}$ unit of J to the list of subscripts for mesons, i.e.,

α for $\frac{1}{2}^+$, α^{II} for $\frac{5}{2}^+$,
like the Regge series $N(938)$, $N(1688)$, $\cdots$,

β for $\frac{1}{2}^-$,

γ for $\frac{3}{2}^-$,

δ for $\frac{3}{2}^+$, like the series $\Delta(1238)$, $\Delta(1920)$, $\cdots$.

PROCEDURES FOR TREATING THE DATA

Except for mean lives, we have averaged the input data weighted according to inverse-square error, i.e., according to the prescription of least squares. We have belatedly realized that it would have been just as easy

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[6] T. D. Lee and C. N. Yang, Nuovo Cimento **3**, 749 (1956).

[7] L. Michel, Nuovo Cimento **10**, 319 (1953).

[8] A. H. Rosenfeld, in *Proceedings of the Varenna Summer School, Course 26, 1962* (Academic Press Inc., New York, 1963).

[9] A. H. Rosenfeld, in *Proceedings of the 1962 Annual International Conference on High-Energy Physics* (CERN, Geneva, 1962), p. 325.

[10] G. F. Chew, M. Gell-Mann, and A. H. Rosenfeld, Sci. Am. **210**, 74 (1964).

[11] M. Goldhaber, T. D. Lee, and C. N. Yang, Phys. Rev. **112**, 1796 (1958); D. R. Inglis, Rev. Mod. Phys. **33**, 1 (1961).

Mesons

		Mass (MeV)	$I(J^{PG})CA$ — = estab.	Symb.	Γ (MeV)	M^2 (BeV^2)	Important decays: Partial modes	Fraction %	Q (MeV)	p or pmax (MeV/c)
η	η	548.7	$0(0^{-+})C^+A^-$	η_β	<10	0.301	See table S			
		±0.5	├──┤							
	ω	782.8	$0(1^{--})C^-A^-$	η_γ	9.4	0.613	$\pi^+\pi^-\pi^0$	86	369	327
		±0.5	├──┤		±1.7		$\pi^+\pi^-$	<1	504	366
		Xscale = 1.8					neutral($\pi^0\gamma$)	11±1	648	380
							$\pi^+\pi^-\gamma$	3.2±1	504	366
							e^+e^-	<0.3	782	391
							$\mu^+\mu^-$	<0.5	572	377
	η2π	959	$0(0^{-+},1^{++},\ldots)C^+A^-$	η	<12	0.920	η2π	large	131	232
		±2					2π	<20	680	459
			Conceivably strongly decaying				3π	<30	540	427
			$1(J^{P+})C^-$ or electromagnetic				4π	< 3	400	372
			decay of G = -1 meson				6π	< 3	121	189
							ππγ	?	680	459
	K_1K_1	~1000	May be just large $\bar{K}K$ scattering length, see listings of data cards.							
	φ	1019.5	$0(1^{--})C^-A^+$	η_γ	3.1	1.040	K_1K_2	41±6	23	109
		±0.3	├──┤		±0.6		K^+K^-	59±6	32	126
		Xscale = 1.7					ππ	<8	740	490
			Suppressed by A=+1 approximation {				πρ+3π	<10	117	188
							$\pi^0\gamma$		885	501
	f	1253	$0(2^{++})C^+A^+$	η_a^{II}	100	1.571	ππ	large	974	611
		±20	├──┤		±25		4π	8±6	695	547
							$\bar{K}K$	?	265	386
	$\bar{K}K\pi$	1410	$\leq 1(0^{-+},1^{++},\ldots)C^+A^-$	η	60		$K^*\bar{K}$	large	25	126
			—				$K\bar{K}\pi$	small	283	421
			If we guess I=0, then G=+1				2π	?	1131	691
							$\bar{K}K$	?	422	503
							3π	?	991	670
π	$\pi^\pm$	139.6	$1(0^{--})C_n^+A^-$	π_β			See table S			
	π^0	135.0	├──┤							
	ρ	763	$1(1^{-+})C_n^-A^+$	π_γ	106	0.582	2π	100	483	355
		±4	├──┤		±5		4π	small	204	241
					Xscale=1.5					
	A1	1090	$\geq 1(0^{--})C_nA^-$	π	125		ρπ	~100	188	251
		±?	├┤ ├┤ ?		±25		$\bar{K}K$	<5	G- forbidden for	
		May be just large ρπ scattering length							odd ℓ if I=1	
		Only recently separated from A2								
	B	1215	$1(1^{++},2^{-})C_n^-A^+$	π_δ	122	1.476	ωπ	~100	293	335
		±18	├┤ ├┤ ├┤		±17		ππ	<30	I forbidden for even ℓ	
					Xscale = 1.9		$\bar{K}K$	<10	G forbidden for even ℓ	
							4π	<50	657	525
	A2	1310	$1(2^{+-})C_n^+A^?$	π_a^{II}	80		ρπ	~70	408	418
			├──┤				$\bar{K}K$	~30±7	816	562
		Only recently separated from A1(1090)					ηπ	seen	622	529
K	$K^\pm$	493.8	$1/2(0^-)A^-$	K_β		0.244	See table S			
	K^0	498.0	├──┤							
	κ	725	Existence not yet definitely established							
	K^*	891	$1/2(1^-)A^+$	K_γ	50	0.794	Kπ	~100	258	288
		±1	├──┤		±2		Kππ	<0.2	118	215
					Xscale=1.3		κπ	<0.2	27	82
	K_C	1215	$\leq 3/2(1^+)A^-$	K	60	1.476	Kρ	strong	-30	<0
		±15	├──┤ ? ?		±10		$K^*\pi$	?	184	253

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Baryons

		Beam πp(MeV) or Kp(MeV/c)	$I(J^P)$ ↦=estab.	Symbol	Mass (MeV)	Γ (MeV)	Mass^2 $(\mathrm{BeV})^2$	Important Decays Partial mode	Fraction (%)	Q (MeV)	p or p_{max} (MeV/c)
	p n		$1/2(1/2^+)$ ↦	N_α	938.2 939.6		0.88 0.88	See table S			
	$N^*_{1/2}(1480)$	550 πp (MeV)	$1/2(1/2^+)$ ↦	N_α	~1480	~240	2.19	πN	~50	402	426
	$N^*_{1/2}(1512)$	600 πp	$1/2(3/2^-)$ ↦	N_γ	1518 ± 10	125 ±12	2.30	πN	~80	440	454
								$N\pi\pi$		301	408
N	$N^*_{1/2}(1688)$	900 πp	$1/2(5/2^+)$ ↦	N_α^{II}	1688	100	2.85	πN	~80	610	572
								$N\pi\pi$		471	538
	$N^*_{1/2}(2190)$	1935 πp	$1/2(9/2^+)$ ↦ ? ?	N_α^{III}(?)	2190	~200	4.80	πN	~30	1112	888
								Λk		577	710
	$N^*_{1/2}(2700)$	3265 πp	1/2 ↦	N	2700	~100	7.29	ηN	large	1213	1115
								πN	~6	1622	1182
	$N^*_{3/2}(1238)$	198 πp	$3/2(3/2^+)$ ↦	Δ_δ	1236 ± 2	125	1.53	πN	100	160	233
Δ	$N^*_{3/2}(1920)$	1347 πp	$3/2(7/2^+)$ ↦	Δ_δ^{II}	1924	170	3.70	πN	34	842	722
								ΣK		237	430
	$N^*_{3/2}(2360)$	2350 πp	$3/2(11/2^+)$ ↦ ? ?	Δ_δ^{III}(?)	2360	~200	5.57	πN	~10	1282	988
	Λ		$0(1/2^+)$ ↦	Λ_α	1115.4		1.24	See table S			
Λ	$Y^*_0(1405)$	<0 Kp	$0(1/2^-)$ ↦	Λ_β	1405	50	1.97	$\Sigma\pi$	100	76	151
								$\Lambda\pi\pi$	< 1	10	69
	$Y^*_0(1520)$	Kp 395 (MeV/c)	$0(3/2^-)$ ↦	Λ_γ	1518.9 ±1.5	16 ±2	2.31	$\Sigma\pi$	55±7	190	266
								$\bar{K}N$	29±4	87	243
								$\Lambda\pi\pi$	16±2	124	251
	$Y^*_0(1815)$	1040 Kp	$0(5/2^+)$ ↦	Λ_α^{II}	1815	70	3.29	$\bar{K}N$	80	383	541
								$\Sigma\pi$	<10	486	504
								$\Lambda\pi\pi$	<15	420	515
								$\Lambda\eta$	?	151	344
	Σ	<0 Kp	$1(1/2^+)$ ↦	Σ_α	+1189.4 -1197.1 1192.4		1.41 1.43 1.42	See table S			
Σ	$Y^*_1(1385)$	<0 Kp	$1(3/2^+)$ ↦	Σ_δ	1382.1 ±.9 ×scale=1.5	53 ±2 ×scale=2.4	1.91	$\Lambda\pi$	96±4	127	205
								$\Sigma\pi$	9±4	55	124
	$Y^*_1(1660)$	715 Kp	1 ( ) ↦	Σ	1660 ±10	44 ±5	2.76	$\bar{K}N$	~16	225	406
								$\Sigma\pi$	~32	328	383
								$\Lambda\pi$	~6	405	439
								$\Sigma\pi\pi$	~33	188	321
								$\Lambda\pi\pi$	~23	265	389
	$Y^*_1(1765)$	940 Kp	$1(5/2^-)$ ↦	Σ	1765 ±10	60 ±10	3.12	$\bar{K}N$	60	343	508
								$\Lambda\pi$		510	517
		Only recently resolved from $Y^*_0(1815)$						$\Sigma\pi$ $\Lambda\pi\pi$	Not yet resolved from $Y^*_0(1815)$		
	Ξ		$1/2(1/2^+)$ ↦	Ξ_α	-1321 1314		1.75 1.73	See table S			
Ξ	$\Xi^*(1530)$		$1/2(3/2^+)$ ↦ p wave	Ξ_δ	1529.1 ±1.0	7.5 ±1.7	2.34	$\Xi\pi$	~100	73	148
	$\Xi^*(1810)$		1/2( ) ↦	Ξ	1810 ±20	~70	3.27	$\Xi^*\pi$	~45	141	225
								$\Lambda\bar{K}$	~45	197	386
								$\Xi\pi$	<10	354	406
								$\Sigma\bar{K}$	<10	127	307
Ω	$\Omega^-(1675)$		$0(3/2^+)$ ↦	Ω_δ	1675 ±3		2.81	See table S			

A. H. Rosenfeld, A. Barbaro-Galtieri, W. H. Barkas, P. L. Bastien, J. Kirz, M. Roos
UCRL-8030 - Part I. June 1964.

to weight them according to the prescription of maximum likelihood, and we may do this in the next edition.

When no errors are reported, we merely list the data for inspection.

When inequalities are reported, we have on the first iteration ignored that experiment; then checked to see if the weighted average violates the inequality. If so, we changed the input data from $<x$ to $x\pm x$, or from $>x$ also to $x\pm x$.

χ^2 Scale Factor

When we calculate the weighted average $\langle x\rangle$, we also calculate χ^2. 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 should probably not average the data. So we plot an ideogram to help the reader decide which data to reject. He can then make his own selected average. However, if χ^2 is not too 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 $(\chi^2/N-1)^{\frac{1}{2}}\equiv$"scale"]. If this were true, then we could correct the calculated error of the mean $\delta\langle x\rangle$ simply by multiplying it by "scale." The reader may wish to do this. This scaling approach is already common practice in bubble-chamber experiments, where track distortions are not fully understood. For bubble-chamber data, it can be justified. For this compilation, it has all the disadvantages of penalizing a whole class of students because of one naughty child, but (like the schoolmaster) we sometimes know of no other simple solution.

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

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

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

Or alternatively he can report a rate

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

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 on mean life τ, with N in the denominator, will be badly skewed. Accordingly we have inverted all mean lives before averaging or making ideograms.

Branching Ratios

We take the η as an example. We can think of only four decay modes (partial widths) which should add up to 100%, i.e., $P1(\eta\rightarrow\gamma\gamma)$, $P2(\rightarrow3\pi^0+\pi^0\gamma\gamma)$, $P3(\rightarrow\pi^+\pi^-\pi^0)$, and $P4(\rightarrow\pi^+\pi^-\gamma)$.

Six different sorts of branching ratios have already been reported, each involving different combinations of $P1\cdots P4$, i.e.,

$$R1=\frac{\text{neutral}}{\text{charged}}=\frac{P1+P2}{P3+P4},$$

$$R2=\frac{2\gamma}{\text{charged}}=\frac{P1}{P3+P4},$$

$$R4=\frac{\pi^+\pi^-\gamma}{\pi^+\pi^-\pi^0}=\frac{P4}{P3},\ \text{etc.}$$

J. Peter Berge has kindly provided us with a program which makes a simultaneous best χ^2 fit of all Pi (where $i=1, 2, 3, \cdots$) to the input ratios, and then calculates an error matrix. We list the $\langle Pi\rangle$ and $\delta\langle Pi\rangle$ from this program, where $\delta\langle Pi\rangle$ are the diagonal elements of the error matrix.

NOTES ON THE DATA CARDS

Most of the entries are self-explanatory. In the case of bubble-chamber experiments on resonances, we thought is useful to fill in the actual number of events seen in the resonance peak—hence the second field entitled "Events in Peak."

Some of the data on the mass of the ρ, for example, are followed at the far right by the enties $+$, $-$, or 0, 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 were symmetric.

Partial decay modes: For two-body decays our computer program calculates the Q value, and the momentum of decay. For the 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 mass codes of the decay products for this program.

COMMENTS ON THE INDIVIDUAL PARTICLES

Stable Particles

Mass of the Electron

This is taken from Cohen and DuMond (COHEN 63). Note that the electron mass estimate has increased by about one part in 10^4.

Mass of the Charged Pion

A series of experiments by Barkas, Birnbaum, and Smith (BARKAS 56) yielded

$$m_\pi/m_p=0.148876\pm0.00016.$$

(The error here is a standard deviation; originally, a probable error was quoted.)

Using the current proton mass value, we then have

$$m_\pi = 139.68 \pm 0.15 \text{ MeV}.$$

These experiments also report a mass for the negative pion, but in view of the present evidence that the stopping power of matter is not the same for negative particles as for positive, the result for negative pions is now rejected. A good measurement has, however, been made by Crowe and Phillips (CROWE 54) by observing photons from π^- capture in hydrogen:

$$m_\pi = 139.37 \pm 0.14 \text{ MeV}.$$

These constitute the reliable *direct* measurements of the charged pion masses. By assuming that the neutral particle emitted in π^+ decay is massless, however, and by measuring the momentum of the muon emitted in pion decay, Barkas, Birnbaum, and Smith were able to make another estimate of the pion–muon mass difference which apparently is more accurate. The measurements obtained in two experiments are

$$m_\pi - m_\mu = 34.00 \pm 0.076 \text{ MeV},$$

and

$$m_\pi - m_\mu = 33.89 \pm 0.076 \text{ MeV},$$

$$\text{average} = 33.94 \pm 0.05 \text{ MeV}.$$

With this mass difference, and the muon mass quoted above, one obtains the value listed in Table S:

$$m_\pi = 139.60 \pm 0.05 \text{ MeV}.$$

Because the masses of all the heavier mesons, of the unstable baryons, and of the strongly decaying states all depend on the pion mass, the present situation in which everything depends on a single ten-year-old experiment is unsatisfactory, especially because the current mass value is nearly two standard deviations larger than the excellent measurement by Crowe and Phillips.

The pion-to-proton mass ratio was carefully measured and is believed to be reliable to the accuracy quoted for it. The muon decay momentum, from which the π-μ mass difference is obtained, on the other hand, was something of a by-product of the main experiment. Consequently it was not measured many times and with a variety of experimental arrangements, as it should have been had it then been considered of prime importance. The two determinations from which the present value are derived in fact differ by 0.11 MeV. It is clear that a new, precise determination of the pion mass is overdue.

Mass of the Neutral Pion

The $\pi^- - \pi^0$ mass difference has been measured with a very good accuracy and the quoted error is too small to affect the π^0 mass uncertainty, which is therefore the same as that for the charged pion.

Mass of Charged K Mesons

Because the three-pion decay mode has a low Q value, the K^+ mass is best obtained from the measured ranges of the pion decay products. The Q value adopted by Cohen, Crowe, and DuMond (COHEN 57) need not be changed because there has been no better new data: it is $Q = 75.11 \pm 0.14$ MeV. This, with the mass of three pions, gives $M_{K^+} = 493.9 \pm 0.2$ MeV. A measurement of the K^- mass has been made with comparable accuracy by Barkas, Dyer, and Heckman. They give

$$M_{K^-} = 493.7 \pm 0.3 \text{ MeV}.$$

We take for the mass of the charged K meson 493.8 ± 0.2 MeV.

Sign of the $K_1 - K_2$ Mass Difference

According to the experiment performed by Meisner *et al.* (MEISNER 63), K_2 is heavier than K_1.

Mass of the Proton

This report does not undertake any new re-evaluation of the fundamental physical constants. We quote the National Research Council Committee on Fundamental Constants (COHEN 63) for the proton mass and other equally basic data. Even such well-known quantities are, however, still in a state of flux. When the current values are compared with those in the book of Cohen, Crowe, and DuMond (COHEN 57), for example, the electron charge is found now to be larger by one part in 40 000 and the electron mass is larger by 9 parts in 10^5. Although none of the changes is serious for most work in high-energy physics, the proton mass has been readjusted upwards by 0.043 MeV to a point where it affects the Λ mass.

Mass of the Neutron

Here we use the neutron–proton mass difference, the error in which is too small to affect the neutron mass. Taken together with the new proton mass, this number gives the quoted neutron mass.

Mass of the Λ Hyperon

The Λ mass from emulsion measurements has been recently reviewed (BHOWMIK 63). This is combined with hydrogen bubble-chamber measurements (BALTAY 62) (ARMENTEROS 62). The weighted average obtained was

$$M_\Lambda = 1115.35 \pm 0.11 \text{ MeV}.$$

In view of the readjusted proton mass, we quote it as

$$M_\Lambda = 1115.40 \pm 0.11 \text{ MeV},$$

which is about 0.04 MeV higher than our value of 1115.36 quoted in the preceding edition of UCRL-8030.

Masses of the Charged Σ Hyperons

These come from Barkas, Dyer, and Heckman (BARKAS 63) and from Burnstein *et al.* (BURNSTEIN 64).

The errors are largely systematic and reflect the uncertainty in the π and K masses as well as in the hydrogen and emulsion range-energy relations. The raising of proton and pion masses has a slight effect in the Σ masses.

Masses of Cascade Hyperons

These are affected to the extent of 0.04 MeV by the revised mass of the Λ.

Branching Ratios of the η Mesons

The neutral decay modes of the η have so far been resolved experimentally only into "2γ" and "non-2γ". For the latter, the most likely candidates are $3\pi^0$ and $\pi^0\gamma\gamma$, both of which are electromagnetic decays of amplitude e^2 with comparable phase space. However, we have the theoretical prejudice that $3\pi^0$ should be rather close to $(\frac{3}{2})\pi^+\pi^-\pi^0$. Accordingly all experimentalists have assumed that the "non 2γ" decays represented six photons coming from the decay of $3\pi^0$, and calculated their detection efficiency on this reasonable hypothesis.

Unstable Mesons

Difficulties with Assignment of the Approximate Quantum Number A to the $A2$ Meson

The two dominant decay modes of $A2$ seem to be $\rho\pi$ and $\bar{K}K$, roughly in the ratio of 7/3. But $\rho\pi$ has $A=-1$, $\bar{K}K$ must of course have $A=+1$. This seems to be the only meson for which the A approximation fails almost completely. Even if the approximation turns out to be good for low mass, it apparently becomes poor for these heavier mesons.

2π Decay Mode of the K_1K_1 Enhancement

The K_1K_1 enhancement (be it an actual resonance or a large s-wave scattering) probably has a two-pion mode, but even if the $\pi\pi/\bar{K}K$ branching ratio were as large as 1/1 the two-pion mode would not yet have been detected. The explanation is that the production of K_1K_1 is very small compared with the production of pion pairs. Thus Alexander *et al.* (ALEXANDER 62) reported a K_1K_1 peak containing about 30 visible events. For their path length of 10 events/μb, if we assume that there exists a 0^{++} state X^0 that decays into K_1K_1, K_2K_2, and $K^\pm K^\mp$ in the ratio of 1:1:2, and that K_1K_1 pairs are seen only $\frac{4}{9}$ of the time, this still corresponds to X^0 production of only ≈ 30 μb.

Now the cross section for the reaction $\pi^- p \Rightarrow n\pi^+\pi^-$ induced by pions of the same momentum (about 2 BeV/c) is 5 mb, and $\frac{1}{10}$ of these pion pairs have an invariant mass in the X^0 region (1000 ± 50) MeV. For the purpose of this discussion this means that the two-pion background in the K region is 500 μb, or 15-fold larger than the signal, and explains why interesting upper limits in the $\pi\pi/\bar{K}K$ ratio are experimentally inaccessible.

ACKNOWLEDGMENTS

We have had many instructive discussions with Frank S. Crawford and Frank T. Solmitz on the statistical treatment of data; Robert D. Tripp has contributed greatly to our understanding of Baryon resonances, and J. P. Berge has been most cooperative in helping us with programs.

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Stable Particles

DATA FOR TABLE S (REFERENCES AT LOWER RIGHT)

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                                        (GALTIERI,ROSENFELD JUNE/64)

                          DATA FOR TABLE S ON STABLE PARTICLES
                               STABLE MEANING IMMUNE TO STRONG DECAY

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECHNIQUE.
     IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS

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

S 1M *     LESS THAN               0.25     LANGER      52 CNTR
S 1M *     LESS THAN               0.15     HAMILTON    53 CNTR
S 1M *     LESS THAN    0.55 +OR- 0.28     FRIEDMAN    58 CNTR


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

                            2  MU-NEUTRINO  MASS (MEV)
S 2M *     LESS THAN               3.5      BARKAS      56 EMUL
S 2M *     LESS THAN               4.0      DUDZIAK     59 CNTR


                            3  ELECTRON  (0.5,J=1/2)
 e
                            3  ELECTRON  MASS (MEV)

S 3M        0.511006  0.000002              COHEN       63 RVUE


                            4  MUON  (106,J=1/2)
 μ
                            4  MUON  MASS (MEV)

S 4M       105.659      0.002               FEINBERG    63 RVUE

                            4  MUON LIFETIME (UNITS 10**-6)

S 4T         2.200      0.015      0.015     FISHER      59 CNTR
S 4T         2.211      0.003      0.003     REITER      60 CNTR
S 4T         2.225      0.006      0.006     ASTBURY     60 CNTR
S 4T         2.208      0.004      0.004     TELEGDI     60 CNTR
S 4T         2.203      0.004      0.004     LUNDY       62 CNTR

S 4T         2.198      0.001      0.001     FARLEY      62 CNTR
S 4T         2.202      0.003      0.003     ECKHAUSE    62 CNTR
S 4T         2.197      0.002      0.002     MEYER       63 CNTR

                            4  MUON PARTIAL DECAY MODES

S 4P1      MUON INTO E (E-NEU) (MU-NEU)                          S 3S 1S 2
S 4P2      MUON INTO E 2GAMMA                                    S 3S 0S 0
S 4P3      MUON INTO 3ELECTRONS                                  S 3S 3S 3
S 4P4      MUON INTO E GAMMA                                     S 3S 0

                            4  MUON  BRANCHING RATIOS

S 4R1*     MUON INTO  E+2GAMMA  (IN UNITS OF 10**-5)          (P2)/(P1)
S 4R1*     LESS THAN               1.6      FRANKEL 1  63 SPRK

S 4R2*     MUON INTO 3E (IN UNITS OF 10**-7)                   (P3)/(P1)
S 4R2*     LESS THAN               5.0      PARKER 1   62 CNTR
S 4R2*     LESS THAN               1.3      ALIKHANOV  62 SPRK
S 4R2*     LESS THAN               1.5      FRANKEL 2  63 CNTR
S 4R2*     LESS THAN               1.45     BABAEV     63 SPRK

S 4R3*     MUON INTO  E+GAMMA  (IN UNITS OF 10**-8)           (P4)/(P1)
S 4R3*     LESS THAN               1.2      FRANKEL 1  63 SPRK
S 4R3*     LESS THAN               0.6      PARKER 2   64 SPRK

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

                            8  CHARGED PI  MASS (MEV)

S 8M *      139.37      0.14                CROWE       54 CNTR  -
S 8M *      139.68      0.15                BARKAS      56 EMUL +

                            8  PI+ MU+ MASS DIFFERENCE (MEV)

S 8D         34.00      0.076               BARKAS      56 EMUL
S 8D         33.89      0.076               BARKAS      56 EMUL


                            8  CHAR.PI LIFETIME (UNITS 10**-9)
S 8T         25.6       0.5        0.5       CROWE       57 RVUE
S 8T 8C00    25.46      0.32       0.32      ASHKIN      60 CNTR
S 8T         25.6       0.8        0.8       ANDERSON    60 CNTR
S 8T *                                       MERRISON    62 RVUE

                            8  CHARGED PION PARTIAL DECAY MODES

S 8P1      CHAR.PION INTO MU (MU-NEU)                            S 4S 2
S 8P2      CHAR.PION INTO E (E-NEU)                              S 3S 1
S 8P3      CHAR.PION INTO MU (MU-NEU) GAMMA                      S 4S 2S 0
S 8P4      CHAR.PION INTO PIO E (E-NEU)                          S 9S 3S 1

                            8  CHARGED PION BRANCHING RATIOS

S 8R1*     CHAR.PION INTO MU NEU GAMMA  (UNITS 10**-4)        (P3)/(P1)
S 8R1  26     1.24      0.25                CASTAGNOLI 58 EMUL

S 8R2*     CHAR.PION INTO E NEU         (UNITS 10**-4)        (P2)/(P1)
S 8R2         1.21      0.07                ANDERSON    60 CNTR
S 8R2         1.247     0.028               DI CAPUA    64 CNTR

S 8R3*     CHAR.PION INTO PIO E NEU     (UNITS 10**-8)        (P4)/(P1).
S 8R3  10     7.0       0.6                 BACASTOW    62 CNTR
S 8R3  52     1.15      0.22                DEPOMMIER   63 CNTR
S 8R3  40     1.30      0.35                DUNAITSEV   63 CNTR
S 8R3         0.96      0.23                BARTLETT    64 SPRK
                            9  NEUTRAL PION  (135,JPG=0--)  I=1
 π0
                            9  PI MASS DIFFERENCE (PI+-)-(PIO)(MEV)

S 9D          4.59      0.01                PANOFSKY    51 CNTR +
S 9D          4.59      0.01                CHINOWSKY   54 CNTR  -
S 9D          4.54      0.01                HADDOCK     59 CNTR  -
S 9D          4.60      0.04                HILLMAN     59 CNTR
S 9D          4.55      0.07                CASSELS     59 CNTR

S 9D          4.6056    0.0055              CZIRR       63 CNTR
S 9D          4.59      0.03                PETRUKHIN   63 CNTR  -
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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECHNIQUE.
     IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS

                            9  PIO  LIFETIME (UNITS 10**-16)

S 9T   76     1.9       0.5        0.5       GLASSER     61 EMUL  *
S 9T   44     1.9       1.3        0.8       SHWE        62 EMUL
S 9T   45     2.3       1.1        1.0       TIETGE      62 EMUL
S 9T   88     2.8       0.9        0.9       KOLLER      63 EMUL
S 9T          1.05      0.18       0.18      VON DARDEL  63 CNTR

S 9T   47     1.25      0.57       0.45      EVANS       63 EMUL

                            9  NEUTRAL PION PARTIAL DECAY MODES

S 9P1      PIO INTO 2GAMMA                                       S 0S 0
S 9P2      PIO INTO E+ E- GAMMA                                  S 3S 3S 0
S 9P3      PIO INTO 4ELECTRONS                                   S 3S 3S 3S 3

                            9  NEUTRAL PION BRANCHING RATIOS

S 9R1*     PIO INTO (GAMMA E+ E-)/(2GAMMA)                     (P2)/(P1)
S 9R1       0.01187   0.00046              SAMIOS      61 HBC
S 9R1*     USING  PANOFSKY RATIO = 1.54
S 9R1  27   0.0117    0.0015               BUDAGOV     60 HBC
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                    REFERENCES FOR TABLE S ON STABLE PARTICLES

IDENTIFIC.   YR AUTHORS                          JOUR.VOL PAGE YR INSTITUTION       COU

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

LANGER       52 CNTR L M LANGER , RJD MOFFAT PR     88  689 52 INDIANA             S 1
HAMILTON     53 CNTR D R HAMILTON +          PR     92 1521 53 PRINCETON           S 1
FRIEDMAN     58 CNTR L FRIEDMAN , L G SMITH  PR    109 2214 58 B N L               S 1


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

BARKAS       56 EMUL W H BARKAS +            PR    101  778 56 L R L               S 2
DUDZIAK      59 CNTR W DUDZIAK +             PR    114  336 59 L R L               S 2

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

COHEN        63 RVUE E R COHEN ,JWM DUMOND   REPORT IUPAP  63 RVUE                 S 3

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

FISHER       59 CNTR J FISHER +              PRL     3  349 59 CERN                S 4
ASTBURY      60 CNTR A ASTBURY +             ROCH   60  542 60 LIVERPOOL           S 4
DEVONS       60 XRAY S DEVONS +              PRL     5  330 60 COLUMBIA            S 4
LATHROP      60 XRAY J LATHROP +             NC     17  109 60 CHICAGO             S 4
LATHROP      60 XRAY J LATHROP +             NC     17  114 60 CHICAGO             S 4
REITER       60 CNTR R A REITER +            PRL     5   22 60 CARNEGIE            S 4
TELEGDI      60 CNTR V L TELEGDI             ROCH   60  713 60 CHICAGO             S 4

CHARPAK      61 CNTR G CHARPAK +             PRL     6  128 61 CERN                S 4
HUTCHINSON   61 CNTR D P HUTCHINSON +        PRL     7  129 61 COLUMBIA            S 4

ALIKHANOV    62 SPRK A I ALIKHANOV +         CERN       423 62 ITEP                S 4
CHARPAK      62 CNTR G CHARPAK +             PL      1   16 62 CERN                S 4
FARLEY       62 CNTR F J M FARLEY +          CERN   62  415 62 CERN                S 4
LUNDY        62 CNTR R A LUNDY               PR    125 1686 62 CHICAGO             S 4
PARKER 1     62 CNTR S PARKER, S PENMAN      NC     23  485 62 EFINS               S 4
SHAPIRO      62 RVUE G SHAPIRO +             PR    125 1022 62 COLUMBIA            S 4

BABAEV       63 SPRK A I BABAEV +            JETP   16 1397 63 ITEP                S 4
ECKHAUSE     63 CNTR M ECKHAUSE              PR    132  422 63 CARNEGIE            S 4
FEINBERG     63 RVUE G FEINBERG, LM LEDERMAN ARNS   13  431 63 RVUE                S 4
FRANKEL 1    63 SPRK S FRANKEL +             NC     27  894 63 PEN + LRL           S 4
FRANKEL 2    63 CNTR S FRANKEL +             PR    130  351 63 PEN + LRL           S 4
MEYER        63 CNTR S L MEYER  +            PR    132 2693 63 COLUMBIA            S 4
PARKER 2     64 SPRK PARKER,ANDERSON,RAY     PR    133 B768 64 EFINS               S 4

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

CROWE        54 CNTR K M CROWE,RH PHILLIPS   PR     96  470 54 L R L               S 8
BARKAS       56 EMUL BARKAS,BIRNBAUM,SMITH   PR    101  778 56 L R L               S 8
CROWE        57 RVUE K M CROWE               NC      5  541 57 STANFORD            S 8
CASTAGNOLI   58 EMUL C CASTAGNOLI,M MUCHNICH PR    112 1779 58 ROME                S 8

ANDERSON     60 CNTR H L ANDERSON +          PR    119 2050 60 EFINS               S 8
ASHKIN       60 CNTR J ASHKIN +              NC     16  490 60 CERN                S 8
BACASTOW     62 CNTR R BACASTOW +            PRL     9  400 62 L R L               S 8
MERRISON     62 RVUE A W MERRISON            ADVP   11    1 62 LIVERPOOL           S 8
SHAPIRO      62 RVUE G SHAPIRO +             PR    125 1022 62 COLUMBIA            S 8

CZIRR        63 CNTR J B CZIRR               PR    130  341 63 L R L               S 8
DEPOMMIER    63 CNTR P DEPOMMIER +           PL      5   61 63 CERN                S 8
DUNAITSEV    63 CNTR A F DUNAITSEV +         BNL        344 63 JINR                S 8

BARTLETT     64 SPRK D BARTLETT +            BAPS    9   71 64 COLUMBIA            S 8
DI CAPUA     64 CNTR E DI CAPUA +            PR    133B1333 64 COLUMBIA            S 8

 π0                         9  NEUTRAL PION  (135,JPG=0--)  I=1

PANOFSKY     51 CNTR PANOFSKY,AAMODT,HADLEY  PR     81  565 51 L R L               S 9
CASSELS      59 CNTR J M CASSELS +           PPS    74   92 59                     S 9
CHINOWSKY    54 CNTR W CHINOWSKY,STEINBERGER PR     93  586 54 COLUMBIA            S 9
HADDOCK      59 CNTR R P HADDOCK             PRL     3  478 59 L R L               S 9
HILLMANN     59 CNTR P HILLMAN +             NC     14  887 59                     S 9
BUGADOV      60 HBC  YU BUGADOV, NIKITIN     JETP   11  755 60 JINR                S 9
SAMIOS       61 HBC  N P SAMIOS              PR    121  275 61 COLUMBIA+BNL        S 9
GLASSER      61 EMUL R G GLASSER +           PR    123 1014 61 NAVAL RES           S 9
SHWE         62 EMUL H SHWE +                PR    125 1024 62 L R L               S 9
TIETGE       62 EMUL J TIETGE +              PR    127 1324 62 M PLANCK            S 9

CZIRR        63 CNTR J B CZIRR               PR    130  341 63 L R L               S 9
EVANS        63 EMUL D EVANS, J MULVEY       SIENA      477 63 OXFORD              S 9
KOLLER       63 EMUL E L KOLLER +            NC     27 1405 63 STEVENS             S 9.
PETRUKHIN    63 CNTR VI PETRUKHIN,PROKOSHKIN SIENA      208 63 DUBNA               S 9
VON DARDEL   63 CNTR G VON DARDEL +          PL      4   51 63 CERN                S 9
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Stable Particles (*Continued*)

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                                        (GALTIERI,ROSENFELD JUNE/64)

                          DATA FOR TABLE S ON STABLE PARTICLES
                              STABLE MEANING IMMUNE TO STRONG DECAY

CODE EVENT QUANTITY  ERROR+     ERROR-     REFERENCE  YR TECH SIGN
   IN PEAK

     • INDICATES DATA IGNORED BY PROGRAMS
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$K^{\pm}$

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

                    10  CHARGED K  MASS (MEV)

S10M        493.9       0.2                    COHEN       57 RVUE +
S10M        493.7       0.3                    BARKAS      63 EMUL  -

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

S10T          0.95      0.36       0.25        ILOFF       56 EMUL
S10T          1.211     0.026      0.026       FITCH       57 CNTR
S10T          1.227     0.015      0.015       ALVAREZ     57 CNTR
S10T    52    1.60      0.3        0.3         EISENBERG   58 EMUL
S10T          1.21      0.06       0.06        BURROWES    59 CNTR

S10T    33    1.38      0.24       0.24        FREDEN      60 EMUL
S10T    51    1.27      0.36       0.23        BHOWMIK     61 EMUL
S10T   293    1.31      0.08       0.08        NORDIN      61 H BC
S10T          1.25      0.22       0.17        BARKAS      61 EMUL
S10T          1.231     0.011      0.011       BOYARSKY    62 CNTR

                    10  CHARGED K PARTIAL DECAY MODES

S10P1      CHAR. K INTO MU (NEU)                K MU 2        S 4S 2

S10P2      CHAR. K INTO PI PIO                  K PI 2        S 8S 9
S10P3      CHAR. K INTO PI PI+ PI-              TAU           S 8S 8S 8
S10P4      CHAR. K INTO PI 2PIO                 TAU PRIME     S 8S 9S 9
S10P5      CHAR. K INTO MU PIO NEU              K MU 3        S 4S 9S 2
S10P6      CHAR. K INTO E PIO NEU               K E  3        S 3S 9S 1
S10P7      POSIT.K INTO PI+ PI- E+NEU           K E+ 4        S 8S 8S 3S 1
S10P8      POSIT.K INTO PI+ PI+ E-NEU           K E- 4        S 8S 8S 3S 1

                   10  CHARGED K BRANCHING RATIOS

S10R1•     CHAR. K INTO MU NEU (MU2)       (UNITS 10**-2)      (P1)/TOTAL
S10R1        58.5        3.0                BIRGE       56 EMUL +
S10R1        56.9        2.6                ALEXANDER   57 EMUL +
S10R1        64.2        1.3                ROE         61 XBC  +
S10R1        63.0        0.8                SHAKLEE     64 XBC  +

S10R2•     CHAR. K INTO PI PIO (PI2)       (UNITS 10**-2)      (P2)/TOTAL
S10R2        27.7        2.7                BIRGE       56 EMUL +
S10R2        23.2        2.2                ALEXANDER   57 EMUL +
S10R2        18.6        0.9                ROE         61 XBC  +
S10R2        22.4        0.8                SHAKLEE     64 XBC  +

S10R3•     CHAR. K INTO PI PI+ PI-(TAU)    (UNITS 10**-2)      (P3)/TOTAL
S10R3         5.6        0.4                BIRGE       56 EMUL +
S10R3         6.8        0.4                ALEXANDER   57 EMUL +
S10R3         5.2        0.3                TAYLOR      59 EMUL +
S10R3         5.7        0.3                ROE         61 XBC  +
S10R3         5.1        0.2                SHAKLEE     64 XBC  +
S10R3 2332    5.52       0.13               CALLAHAN    64 XBC  +

S10R4•     CHAR. K INTO PI 2PIO (TAU PRIME)(UNITS 10**-2)      (P4)/TOTAL
S10R4         2.1        0.5                BIRGE       56 EMUL +
S10R4         2.2        0.4                ALEXANDER   57 EMUL +
S10R4         1.5        0.2                TAYLOR      59 EMUL +
S10R4         1.7        0.2                ROE         61 XBC  +
S10R4         1.8        0.2                SHAKLEE     64 XBC  +

S10R5•     CHAR. K INTO MU PIO NEU (MU3) (UNITS 10**-2)        (P5)/TOTAL
S10R5         2.8        1.0                BIRGE       56 EMUL +
S10R5         5.9        1.3                ALEXANDER   57 EMUL +
S10R5         2.8        0.4                TAYLOR      59 EMUL +
S10R5         4.8        0.6                ROE         61 XBC  +
S10R5         3.0        0.5                SHAKLEE     64 XBC  +

S10R6•     CHAR. K INTO E PIO NEU (E3)   (UNITS 10**-2)        (P6)/TOTAL
S10R6         5.1        1.3                ALEXANDER   57 EMUL +
S10R6         3.2        1.3                BIRGE       56 EMUL +
S10R6         5.0        0.5                ROE         61 XBC  +
S10R6         4.7        0.3                SHAKLEE     64 XBC  +

S10R7•     POSIT.K INTO PI+ PI- E+ NEU   (UNITS 10**-5)        (P7)/TOTAL
S10R7   11    2.3        0.7                BIRGE       63 FBC  +
S10R7   75    4.3        0.9                BIRGE       64 FBC  +

S10R8•     POSIT.K INTO PI+ PI+ E- NEU   (UNITS 10**-5)        (P8)/TOTAL
S10R8•  0      0.1 OR LESS                  BIRGE       64 FBC  +


S10R9•    CHAR. K INTO (MU PIO NEU)/(PI PI+ PI-)                (P5)/(P3)
S10R9 1220    0.61       0.05               BISI        64 PBC
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K^0

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

                    11  K0-K CH. MASS DIFFERENCE (MEV)

S11D          3.9       0.6                   ROSENFELD  59 HBC  -
S11D    -     5.4       1.1                   CRAWFORD   59 HBC  +
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K_1^0

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                    12  K01 LIFETIME (UNITS 10**-10)

S12T    90    1.07      0.13       0.13       BOLDT      58 CC
S12T    62    0.81      0.23       0.15       BROWN      58 PBC
S12T    29    0.84      0.35       0.19       COOPER     58 CC
S12T    39    1.15      0.40       0.25       BLUMENFELD 58 CC
S12T   259    1.06      0.08       0.06       EISLER     58 PBC

S12T   512    0.94      0.05       0.05       CRAWFORD   59 HBC
S12T    63    1.09      0.18       0.15       BOWEN      60 CC
S12T   500    0.90      0.05       0.05       GARFINKEL  62 HBC
S12T   378    0.94      0.05       0.05       BERTANZA   62 HBC
S12T  2500    0.895     0.025      0.025      GOLDEN     62 HBC

S12T   600    0.85      0.04       0.04       WOJCICKI   63 HBC
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CODE EVENT QUANTITY  ERROR+     ERROR-     REFERENCE  YR TECH SIGN
   IN PEAK

     • INDICATES DATA IGNORED BY PROGRAMS

                         12  K01 PARTIAL DECAY MODES

S12P1      K01 INTO PI+ PI-                                         S 8S 8
S12P2      K01 INTO PIO PIO                                         S 9S 9

                         12  K01  BRANCHING RATIOS

S12R1•     K01 INTO (PI+ PI-)/TOTAL                                (P1)/TOTAL
S12R1          0.68       0.09                 CRAWFORD   59 HBC
S12R1          0.70       0.18                 COLUMBIA   60 HBC
S12R1          0.74       0.07                 ANDERSON   62 HBC

S12R2•     K01 INTO (PIO PIO)/TOTAL                                (P2)/TOTAL
S12R2          0.27       0.11                 CRAWFORD   59 HBC
S12R2          0.26       0.06                 BAGLIN     60 PBC
S12R2          0.30       0.035                BROWN      61 XBC
S12R2 1066     0.335      0.014                BROWN      63 XBC
S12R2  198     0.288      0.021                CHRETIEN   63 PBC
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                        REFERENCES FOR TABLE S ON STABLE PARTICLES

IDENTIFIC.  YR AUTHORS                          JOUR.VOL PAGE YR INSTITUTION      COD
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$K^{\pm}$

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

BIRGE       56 EMUL R W BIRGE +                NC       4  834 56 L R L             S10
ILOFF       56 EMUL E L ILOFF +                PR     102  927 56 L R L             S10
ALEXANDER   57 EMUL G ALEXANDER +              NC       6  478 57 DUBLIN            S10
ALVAREZ     57 CNTR L W ALVAREZ +              UCRL8030        57 L R L             S10
COHEN       57 RVUE E R COHEN,CROWE,DUMOND     FUND.CONS.PHYS57 RVUE                S10
FITCH       57 CNTR V FITCH +                  UCRL8030        57 PRINCETON         S10

EISENBERG   58 EMUL Y EISENBERG +              NC       8  663 58 BERN              S10
BURROWES    59 CNTR H C BURROWES +             PRL      2  117 59 M I T             S10
TAYLOR      59 EMUL S TAYLOR +                 PR     114  359 59 COLUMBIA          S10
FREDEN      60 EMUL S C FREDEN +               PR     118  564 60 L R L LIV         S10

BARKAS      61 EMUL W H BARKAS +               PR     124 1209 61 L R L             S10
BHOWMIK     61 EMUL B BHOWMIK +                NC      20  857 61 DELHI             S10
NORDIN      61 HBC  P NORDIN JR                PR     123 2168 61 L R L             S10

ROE         61 XBC  B P ROE +                  PRL      9  346 61 MICHIGAN+LRL      S10
BOYARSKY    62 CNTR A M BOYARSKY +             PR     128 2398 62 M I T             S10

BARKAS      63 EMUL BARKAS,DYER,HECKMAN        PRL     11   26 63 L R L             S10
BIRGE       63 FBC  R W BIRGE +                PRL     11   35 63 LRL+WISCON+BARI   S10
BIRGE       64 FBC  R W BIRGE +                DUBNA           64 LRL+WISCON+BARI   S10
BISI        64 PBC  BISI,BORREANI,CESTER +     PRL     12  490 64 TORINO            S10
CALLAHAN    64 XBC  CALLAHAN,MARCH,STARK       SUBM. PR JUNE 64 WISCONSIN           S10
SHAKLEE     64 XBC  F S SHAKLEE +              BAPS     9   34 64 MICHIGAN          S10

         QUANTUM NUMBERS DETERMINATIONS NOT REFERRED TO IN DATA CARDS

BLOCK       62 HEBC BLOCK,LENDINARA,MONARI     CERN        371 62 NWEST+BOLOGNA     S10
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K^0

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

CRAWFORD    59 HBC  F S CRAWFORD +             PRL      2  112 59 L R L             S11
ROSENFELD   59 HBC  ROSENFELD,SULMITZ,TRIPP    PRL      2  110 59 L R L             S11
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K_1^0

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                      12  K01  (JP=0-)  I=1/2

BLUMENFELD  58 CC   H BLUMENFELD +             CERN        272 58 COLUMBIA          S12
BOLDT       58 CC   E BOLDT +                  PRL      1  150 58 M I T             S12
BROWN       58 PBC  J BROWN +                  CERN        272 58 MICHIGAN          S12
COOPER      58 CC   A COOPER +                 CERN        272 58 JUNGFRAU          S12
EISLER      58 PBC  F EISLER +                 CERN        272 58 COLUMBIA          S12

CRAWFORD    59 HBC  F S CRAWFORD +             PRL      2  266 59 L R L             S12
BAGLIN      60 PBC  C BAGLIN +                 NC      18 1043 60 ECOL.POLYT.       S12
BIRGE       60 PBC  R W BIRGE +                ROCH    60  601 60 L R L             S12
BOWEN       60 CC   T BOWEN +                  PR     119 2030 60 PRINCETON         S12
COLUMBIA    60 HBC  REPORTED VIA M SCHWARZ     ROCH        727 60 COLUMBIA          S12
MULLER      60 PBC  F MULLER +                 PRL      4  418 60 L R L             S12

BROWN       61 XBC  J L BROWN +                NC      19 1155 61 LRL+MICHIGAN      S12
FITCH       61 CNTR V L FITCH +                NC      22 1160 61 PRINCETON         S12
GOOD        61 PBC  R H GOOD +                 PR     124 1223 61 L R L             S12

ANDERSON    62 HBC  J A ANDERSON +             CERN        836 62 L R L             S12
BERTANZA    62 HBC  L BERTANZA +               PREPRINT        62 BROOKHAV.         S12
CRAWFORD    62 RVUE F S CRAWFORD               CERN        827 62 RVUE              S12
GARFINKEL   62 HBC  A F GARFINKEL              NEVIS104        62 COLUMBIA          S12
GOLDEN      62 HBC  R L GOLDEN                 CERN        839 62 L R L             S12

BROWN       63 XBC  J L BROWN +                PR     130  769 63 LRL+MICHIG        S12
CHRETIEN    63 PBC  M CHRETIEN +               PR     131 2208 63 BRA+BRO+HAR+MIT   S12
WOJCICKI    63 HBC  S G WOJCICKI               PRIV COMM       63 L R L             S12
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Stable Particles (*Continued*)

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                                 (GALTIERI,ROSENFELD JUNE/64)

                    DATA FOR TABLE S ON STABLE PARTICLES
                         STABLE MEANING IMMUNE TO STRONG DECAY


   CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
        IN PEAK
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K_2^0

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        • INDICATES DATA IGNORED BY PROGRAMS

                     13  KO2-KO1  MASS DIF.(UNITS OF 1/TAU1)

S13D •     FOR SIGN OF MASS DIFF.,SEE MEISNER 63
S13D          1.9       0.3                 FITCH       61 CNTR
S13D          0.84      0.29      0.21      GOOD        61 PBC
S13D          1.5       0.2                 CAMERINI    62 PBC
S13D • 48     0.6       0.6                 CRAWFORD    64 HBC
S13D          0.47      0.15      0.20      CHRISTENSON63 SPRK'
S13D          0.78      0.20                AUBERT      64 PBC
S13D          0.82      0.12                FUJII       64 SPRK

                     13  KO2 LIFETIME (NANOSEC)

S13T •      ASSUMED DS=DQ AND DELTA I=1/2 CRAWFORD    59 HBC
S13T   34    81.0       32.0      24.0      BARDON      58 CC
S13T   15    51.0       24.0       13.0     DARMON      62 FBC
S13T         54.0        6.0                FUJII       64 SPRK

                     13  KO2 PARTIAL DECAY MODES

S13P1      KO2 INTO 3PIO                                        S 9S 9S 9
S13P2      KO2 INTO PI+ PI- PIO                                 S 8S 8S 9
S13P3      KO2 INTO PI MU NEUTRINO                              S 8S 4S 2
S13P4      KO2 INTO PI E NEUTRINO                               S 8S 3S 1
S13P5      KO2 INTO PI+ PI-                                     S 8S 8

                     13  KO2 BRANCHING RATIOS

S13R1•     KO2 INTO (PIO PIO PIO)/CHARGED                       (P1)/(P2+P3+P4)
S13R1          0.38       0.07              ANIKINA     62 CC

S13R2•     KO2 INTO (PI+ PI- PIO)/CHARGED                       (P2)/(P2+P3+P4)
S13R2 320     0.185       0.038     0.034   ASTIER      61 CC
S13R2  304    0.13        0.02              CERN+ETH    63 CC
S13R2 479     0.157       0.03              LUERS       64 HBC

S13R3•     KO2 INTO (PI MU NEUTRINO)/CHARGED                    (P3)/(P2+P3+P4)
S13R3• 304    0.18        0.03              CERN+ETH    63 CC
S13R3 479     0.356       0.07              LUERS       64 HBC

S13R4•     KO2 INTO (PI E NEUTRINO)/CHARGED                     (P4)/(P2+P3+P4)
S13R4• 304    0.69        0.03              CERN+ETH    63 CC
S13R4 479     0.487       0.05              LUERS       64 HBC

S13R5•     KO2 INTO (PI E NEU)/((PI E NEU)+(PI MU NEU))         (P4)/(P3+P4)
S13R5  320    0.415       0.120             ASTIER      61 CC

S13R6•     KO2 INTO(PI+ PI- PIO)/TOTAL                          (P2)/TOTAL
S13R6  16     0.18        0.05              STERN       64 HBC

S13R7•     KO2 INTO(LEPTON PI NEUTRINO)/TOTAL                   (P3+P4)/TOTAL
S13R7  14     0.58        0.17              ALEXANDER   62 HBC


S13R9•     KO2 INTO (PI+ PI-)/CHARGED                           (P5)/(P2+P3+P4)
S13R9•  0     0.01 OR LESS                  NEAGU       61 CC
S13R9•  0     0.015 OR LESS                 LUERS       64 HBC
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                     14  ETA (549,JPG=0-+)  I=0

                     14  ETA  MASS (MEV)

S14M   53  549.0        1.2                 BASTIEN     62 HBC
S14M   35  546.0        4.0                 PICKUP      62 HBC
S14M   91  548.0        1.0                 ALFF        62 HBC
S14M   50  546.0                            TOOHIG      62 HBC
S14M       549.3        2.9                 DELCOURT    63 CNTR
S14M  143  549.0        0.7                 FOELSCHE    64 HBC

                     14  ETA  WIDTH (MEV)

S14W • 53    12 OR LESS                     BASTIEN     62 HBC
S14W • 91    10 OR LESS                     ALFF        62 HBC
S14W • 50    14.0 OR LESS                   TOOHIG      62 HBC
S14W •148    10 OR LESS                     FOELSCHE    64 HBC

                     14  ETA PARTIAL DECAY MODES

S14P1      ETA INTO 2GAMMA                                      S 0S 0
S14P2      ETA INTO 3PIO AND PIO 2 GAMMA, CALLED 3PIO           S 9S 9S 9
S14P3      ETA INTO PI+ PI- PIO                                 S 8S 8S 9
S14P4      ETA INTO PI+ PI- GAMMA                               S 8S 8S 0

                     14 ETA   BRANCHING RATIOS

S14R1•     ETA INTO NEUTRAL/CHARGED                             (P1+P2)/(P3+P4)
S14R1  10     2.5         1.0               PICKUP      62 HBC
S14R1  53     3.20        1.26              BASTIEN     62 HBC
S14R1  91     2.5         0.5               ALFF        62 HBC
S14R1         2.7         0.8               SHAFER      62 HBC
S14R1         3.1         0.7               FIELDS      63 HBC

S14R2•     ETA INTO 2GAMMA/CHARGED                              (P1)/(P3+P4)
S14R2         0.99        0.48              CRAWFORD    63 HBC
S14R2         1.05        0.45              PETERS      64 HBC

S14R3•     ETA INTO 3PIO/CHARGED                                (P2)/(P3+P4)
S14R3         0.66        0.25              CRAWFORD    63 HBC
S14R3         0.55        0.23              PETERS      64 HBC

S14R4•     ETA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)               (P4)/(P3)
S14R4         0.26        0.08              FOWLER      63 HBC
S14R4         0.14        0.08              FOELSCHE    64 HBC

S14R5•     ETA INTO 3PIO/(PI+ PI- PIO)                          (P2)/(P3)
S14R5         2.0         1.0               FOELSCHE    64 HBC

S14R6•     ETA INTO 2GAMMA/3PIO                                 (P1)/(P2)
S14R6•        1.1         0.3 OR LESS       CHRETIEN    62 PBC
S14R6         0.80        0.25              BACCI       63 CNTR
S14R6         1.10        0.5               MULLER      63 DBC
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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

     • INDICATES DATA IGNORED BY PROGRAMS
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                  16  PROTON  (938,J=1/2)  I=1/2

                  16  PROTON  MASS (MEV)

S16M        938.256     0.005              COHEN      63 RVUE

                  16  PROTON LIFETIME  (UNITS 10**26 YR)

S16T •    OVER                     1.5     BACKENSTOSS60 CNTR
S16T •    OVER                     1.0     GIAMATI    62 CNTR
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n

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

                  17  NEUTRON-PROTON MASS DIF.(MEV)

S17D          1.2939    0.0004             BONDELID   60 CNTR
S17D          1.2933    0.0001             SALGO      64

                  17  NEUTRON LIFETIME (UNITS 10**3)

S17T          1.01      0.03      0.03     SOSNOVSKIJ 59 PILE
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                  REFERENCES FOR TABLE S ON STABLE PARTICLES

IDENTIFIC.  YR AUTHORS                  JOUR.VOL PAGE YR INSTITUTION      COD
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K_2^0

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                       13  KO2  (JP=0-)  I=1/2

BARDON      58 CC   M BARDON ET AL         ANP    5  156 58 COLUMBIA       S13
CRAWFORD    59 HBC  F S CRAWFORD +         PRL    2  361 59 L R L          S13
ASTIER      61 CC   A ASTIER +             AIX    1  227 61 ECOLE POLYT.   S13
FITCH       61 CNTR V L FITCH,PIROUE,PERKINSNC   22 1160 61 PRINC+LOSALA.  S13
GOOD        61 PBC  R H GOOD +             PR   124 1223 61 L R L          S13
NEAGU       61 CC   D NEAGU +              PRL    6  552 61 JINR (MOSCOW)  S13

ALEXANDER   62 HBC  G ALEXANDER +          PRL    9   69 62 L R L          S13
ANIKINA     62 CC   M H ANIKINA +          CERN      452 62 DUBNA          S13
CAMERINI    62 PBC  U CAMERINI +           PR   128  362 62 WISCONSIN+LRL  S13
DARMON      62 FBC  J DARMON,ROUSSET,SIX   PL     3   57 62 EP             S13

CERN+ETH    63 HBC  CERN+ETH               SIENA      25 63 CERN+ETH       S13
  DATA NOT USED, TOTAL LEPTONIC RATES NORMAL, BUT MU3/E3 SURPRISINGLY SMALL
CHRISTENSON 63 SPRK J H CHRISTENSON +      BNL        74 63 PRINCETON      S13
JOVANOVICH  63 SPRK J V JOVANOVICH +       BNL        42 63 BNL/MD         S13
MEISNER     63 HBC  G W MEISNER,CRAWFORD+  BNL        67 63 L R L          S13

AUBERT      64 PBC  B AUBERT +             PREPRINT      64 ECOLE POLIT.   S13
CRAWFORD    64 HBC  CRAWFORDS,GOLDEN,MEISNERBAPS  9  443 64 L R L          S13
FUJII       64 SPRK T FUJII +              BAPS   9  442 64 BNL + MARYLAND S13
LUERS       64 HBC  D LUERS +              PR   133B1277 64 B N L          S13
STERN       64 HBC  D STERN +              PRL   12  459 64 WISCONSIN+LRL  S13
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                       14  ETA (549,JPG=0-+)  I=0

PEVSNER     61 HBC  A PEVSNER +            PRL    7  421 61 HOPKINS/N-WSTRN S14
ALFF        62 HBC  C ALFF +               PRL    9  322 62 COLUMBIA+RUTG  S14
BASTIEN     62 HBC  PL BASTIEN +           PRL    8  114 62 L R L          S14
CHRETIEN    62 PBC  M CHRETIEN  +          PRL    9  127 62 BRA+BRU+HA+MIT+PS14
FOELSCHE    62 HBC  HW FOELSCHE,+          PRL    9  223 62 YALE           S14
PICKUP      62 HBC  E PICKUP +             PRL    8  329 62 NRC OTTAWA+ BNL S14
SHAFER      62 HBC  J BUTTON-SHAFER +      CERN      309 62 L R L          S14
TOOHIG      62 HBC  T TOOHIG +             CERN       99 62 JOHNS-HOPK+NWS S14

BACCI       63 CNTR C BACCI +              PRL   11   37 63 FRASCATI       S14
BERTHELOT   63 RVUE A BERTHELOT            SIENA  2   64 63 RVUE           S14
BUSCHBECK-CZ63 HBC  B BUSCHBECK-CZAPP +    SIENA  1  166 63 VIENNA-CERN-AR S14
CRAWFORD    63 HBC  F S CRAWFORD +         PRL   10  546 63 L R L +DUKE    S14
DELCOURT    63 CNTR B DELCOURT +           PL     7  215 63 ENS-ORSAY      S14

FIELDS      63 HBC  T FIELDS +             ATHENS    185 63 N-WES,JHOPK,WOC S14
FOWLER      63 HBC  E C FOWLER +           PRL   10  110 63 DUKE+LRL       S14
MULLER      63 DBC  A MULLER +             SIENA      99 63 SACLAY+ROME    S14
FOELSCHE    64 HBC  HW FOELSCHE,H KRAYBILL PR TO BE PUBL 64 YALE           S14
PETERS      64 HBC  M W PETERS             THESIS        64 WISCONSIN      S14

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

BASTIEN     62 HBC  PL BASTIEN +           PRL    8  114 62 I,J,P,G,C      S14
CARMONY     62 HBC  D D CARMONY +          PRL    8  117 62 I,J            S14
ROSENFELD   62 HBC  A H ROSENFELD +        PRL    8  293 62 G              S14
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                       16  PROTON  (938,J=1/2)  I=1/2

BACKENSTOSS 60 CNTR G K BACKENSTOSS +      NC    16  749 60 CERN           S16
GIAMATI     62 CNTR C C GIAMATI + F REINES PR   126 2178 62 CASE IT        S16
COHEN       63 RVUE E R COHEN,JWM DUMOND   REPORT IUPAP  63 RVUE           S16
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                       17  NEUTRON (939,J=1/2)  I=1/2

SOSNOVSKIJ  59 PILE SOSNOVSKIJ +           JETP   9  717 59 RUSSIA         S17
BONDELID    60 CNTR R O BONDELID +         PR   120  887 60 USNR+CATOUNI.  S17
SALGO       64          SALGO +            NP    53  457 64                S17
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Stable Particles (*Continued*)

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                                     (GALTIERI,ROSENFELD JUNE/64)

                         DATA FOR TABLE S ON STABLE PARTICLES
                              STABLE MEANING IMMUNE TO STRONG DECAY

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
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                          18  LAMBDA (1115,JP=1/2+)  I=0

                          18  LAMBDA  MASS (MEV)

S18M       1115.25       0.36                  BALTAY      62 HBC
S18M   25  1115.04       0.41                  ARMENTERUS  62 HBC
S18M  317  1115.40       0.13                  BHUWMIK     63 RVUE
S18M *     LAMBDA MASS TO BE RAISED OF  0.043 BECAUSE PROTON MASS RAISED

                          18  LAMBDA LIFETIME (UNITS 10**-10)

S18T  188     2.63       0.21      0.21        BOLDT       58 CC
S18T   74     2.75       0.45      0.38        BLUMENFELD  58 CC
S18T   61     2.08       0.46      0.31        BROWN       58 PBC
S18T   40     3.04       0.78      0.51        COOPER      58 CC
S18T  454     2.29       0.15      0.13        EISLER      58 HBC

S18T  825     2.72       0.16      0.16        CRAWFORD    59 HBC
S18T  140     2.72       0.29      0.27        BOWEN       60 CC
S18T  600     2.69       0.14      0.12        FUNG        62 PBC
S18T  799     2.69       0.11      0.11        HUMPHREY    62 HBC
S18T  748     2.58       0.11      0.11        BERTANZA    62 HBC

S18T  900     2.44       0.11      0.11        GARFINKEL   62 HBC
S18T 2250     2.31       0.09      0.09        CRONIN      62 SPRK
S18T 5000     2.68       0.03      0.03        GOLDEN      62 HBC
S18T          2.60       0.28      0.20        C-C CHANG   62 HBC
S18T 2500     2.70       0.07      0.07        MURRAY      62 HBC

S18T 2239     2.36       0.06      0.06        BLOCK       63 HEBC
S18T  820     2.75       0.12      0.12        BERGE       63 HBC
S18T  794     2.59       0.09                  HUBBARD     64 HBC
S18T 1378     2.59       0.07                  SCHWARTZ    64 HBC

                          19  LAMBDA PARTIAL DECAY MODES

S18P1      LAMBDA INTO PROTON PI-                                  S16S 8
S18P2      LAMBDA INTO NEUTRON PIO                                 S17S 9
S18P3      LAMBDA INTO PROTON MU- NEUTRINO                         S16S 4S 2
S18P4      LAMBDA INTO PROTON E- NEUTRINO                          S16S 3S 1

                          18  LAMBDA BRANCHING RATIOS

S18R1*     LAMBDA INTO (P PI-)/((P PI-)+(N PIO))                (P1)/(P1+P2)
S18R1         0.627      0.031                 CRAWFORD    59 HBC
S18R1         0.65       0.05                  COLUMBIA    60 HBC
S18R1 903     0.643      0.016                 HUMPHREY    62 HBC
S18R1         0.685      0.017                 ANDERSON    62 HBC

S18R2*     LAMBDA INTO (N PIO)/((P PI-)+(N PIO))                (P2)/(P1+P2)
S18R2         0.23       0.09                  EISLER      57 PBC
S18R2         0.43       0.14                  CRAWFORD    59 HBC
S18R2         0.28       0.08                  BAGLIN      60 PBC
S18R2         0.35       0.05                  BROWN       63 XBC
S18R2  75     0.291      0.034                 CHRETIEN    63 PBC

S18R3*     LAMBDA INTO (P E- NEU)/TOTAL     (UNITS  10**-3)   (P4)/(P1+P2)
S18R3  15     2.0        0.5                   HUMPHREY    61 RVUE
S18R3   8     3.0        1.5       1.2         AUBERT      61 FBC
S18R3 150     0.82       0.12      0.13        ELY         63 FBC
S18R3  95     0.78       0.12                  BAGLIN      63 FBC
S18R3  20     1.55       0.34                  LIND        64 HBC

S18R4*     LAMBDA INTO (P MU- NEU)/TOTAL    (UNITS  10**-4)   (P3)/(P1+P2)
S18R4*  1     0.2 OR GREATER                   GOOD        62 HBC
S18R4*  1     1.0      OR LESS                 ALSTON      63 HBC
S18R4*  2     1.0 OR LESS                      KERNAN      64 FBC

                          18  LAMBDA MAGNETIC MOMENT (MAGNETONS,938.26 MEV)
S18MM*       -1.5        0.5                   COOL        62 SPRK
S18MM*        0.0        0.6                   KERNAN      63 CC
S18MM*8500   -1.4        0.7                   ANDERSON    64 HBC
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                          19  SIGMA+   (1189,JP=1/2+)  I=1

S19M       1189.40       0.15                  BARKAS      63 EMUL
S19M       1189.5        0.5                 BURNSTEIN 64 HBC

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

S19T *                                         GLASER      58 RVUE
S19T  127     0.98       0.16      0.12        PUSCHEL     60 EMUL
S19T   41     0.82       0.34      0.20        EVANS       60 EMUL
S19T  117     0.85       0.14      0.11        FREDEN      60 EMUL
S19T   54     0.80       0.10      0.067       KAPLON      60 EMUL

S19T   23     0.76       0.22      0.14        CHIESA      61 EMUL
S19T   49     0.75       0.13      0.09        BERTHELOT   61 PBC
S19T  140     0.82       0.10      0.08        BARKAS      61 EMUL
S19T  192     0.749      0.056     0.052       GRARD       62 HBC
S19T  456     0.765      0.04      0.04        HUMPHREY    62 HBC

                          19  SIGMA+ PARTIAL DECAY MODES

S19P1      SIGMA + INTO PROTON PIO                                 S16S 9
S19P2      SIGMA + INTO NEUTRON PI+                                S17S 8
S19P3      SIGMA + INTO NEUTRON PI+ GAMMA                          S17S 8S 0
S19P4      SIGMA + INTO LAMBDA E+ NEU                              S18S 3S 0
S19P5      SIGMA + INTO PROTON GAMMA                               S16S 0
S19P6      SIGMA + INTO NEUTRON MU+ NEUTRINO                       S17S 4S 2
S19P7      SIGMA + INTO NEUTRON E+ NEUTRINO                        S17S 3S 1
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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS

                    19  SIGMA+  BRANCHING RATIOS

S19R1*    SIGMA+  INTO (NEUTRON PI+)(NUCLEON PI)                (P2)/(P1+P2)
S19R1 308    0.490     0.024                 HUMPHREY   62 HBC

S19R2*    SIGMA+  INTO (NEUTRON PI+ GAM)/(PI+ N)  (10**-4) (P3)/(P2)
S19R2*    ABOUT                      0.4     COURANT    63 HBC

S19R3*    SIGMA+  INTO (LAMBDA E+ NEU)/(PI+ N)    (10**-4) (P4)/(P2)
S19R3*  1    0.25 APPROX                     BURNSTEIN  63 HBC

S19R4*    SIGMA+  INTO (N MU+/NEU)/(PI+N)         (10**-4) (P6)/(P2)
S19R4*  0 LESS THAN                  2.3     BURNSTEIN  63 HBC

S19R5*    SIGMA+  INTO (N E+ NEU)/(N PI+)  (UNITS 10**-4)  (P7)/(P2)
S19R5*  0 LESS THAN                  2.6     BURNSTEIN  63 HBC
S19R5*    LESS THAN                  4.0     MURPHY     64 PBC
S19R5*  1 LESS THAN                  1.03    NAUENBERG  64 HBC

S19R6*    SIGMA+  INTO (P GAMMA)/(P PIO)        (10**-3)   (P5)/(P1)
S19R6*  8 ABOUT                      3.0     NAUENBERG  64 HBC

                    19  SIGMA+ MAGNETIC MOMENT (MAGNETONS,938.26 MEV)
S19MM*       3.8       1.3                   MCINTURF   64 EMUL
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                     REFERENCES FOR TABLE S ON STABLE PARTICLES

IDENTIFIC.  YR AUTHORS                        JOUR.VOL PAGE YR INSTITUTION      COD
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                          18  LAMBDA (1115,JP=1/2+)  I=0

EISLER      57 PBC  F EISLER +                NC      5 1700 57 COLUMBIA+BNL     S18
BLUMENFELD  58 CC   H BLUMENFELD +            CERN       270 58 COLUMBIA         S18
BOLDT       58 CC   E BOLDT +                 PRL     1  148 58 M I T            S18
BROWN       58 PBC  J BROWN +                 CERN       270 58 MICHIGAN         S18
COOPER      58 CC   A COOPER +                CERN       270 58 JUNGFRAU         S18
EISLER      58 HBC  F EISLER +                CERN       270 58 COLUMBIA+PI+BO   S18

CRAWFORD    59 HBC  F S CRAWFORD +            PRL     2  266 59 L R L            S18
BAGLIN      60 PBC  C BAGLIN +                NC     18 1043 60 ECOLE POLYT      S18
BOWEN       60 CC   T BOWEN +                 PR    119 2030 60 PRINCETON        S18
COLUMBIA    60 HBC  REPORTED BY M SCHWARTZ    ROCH       726 60 COLUMBIA         S18
AUBERT      61 FBC  B AUBERT +                AIX     1  197 61 ECOLE POLIT.     S18
HUMPHREY    61 RVUE W E HUMPHREY +            PRL     6  478 61 L R L            S18

ANDERSON    62 HBC  J A ANDERSON +            CERN       832 62 L R L  .         S18
ARMENTEROS  62 HBC  R ARMENTEROS +            CERN       236 62 CERN ETC         S18
BALTAY      62 HBC  C BALTAY +                CERN       233 62 YALE,BRKH        S18
BERTANZA    62 HBC  L BERTANZA +              PREPRINT       62 B N L            S18
CHANG       62 HBC  C-C CHANG                 NSA    16 2967662 DUKE             S18

COOL        62 SPRK COOL,JENKINS,KYCIA,HILL+PR   127 2223 62 B N L            S18
CRONIN      62 SPRK J CRONIN +                CERN       459 62 PRINCETON        S18
FUNG        62 PBC  S YIU FUNG                BAPS    7  619 62 L R L            S18
GARFINKEL   62 HBC  A F GARFINKEL             NEVIS104       62 COLUMBIA         S18
                                          AND PRIV COMM      63 COLUMBIA         S18
GOLDEN      62 HBC  R L GOLDEN +              CERN       839 62 L R L            S18
GOOD        62 HBC  M L GOOD,V G LIND         PRL     9  518 62 WISCONSIN        S18
HUMPREY     62 HBC  W HUMPREY,R RUSS          PR    127 1305 62 L R L            S18
MURRAY      62 HBC  MURRAY +                  CERN       839 62 L R L            S18

ALSTON      63 HBC  M H ALSTON +              UCLRL   10926 63 L R L             S18
BAGLIN      63 FBC  C BAGLIN +                SIENA        8 63 EP+CERN+UC+RU+BES18
BERGE       63 HBC  J P BERGE                 THESIS         63 L R L            S18
BHOMWIK     63 RVUE B BHOMWIK,DP GOYAL        NC     28 1494 63 RVUE             S18
BLOCK       63 HEBC M M BLOCK +               PR    130  766 63 N WESTERN        S18

BROWN       63 XBC  J L BROWN +               PR    130  769 63 LRL+MICHIG       S18
CHRETIEN    63 PBC  H R CHRETIEN +            PR    131 2208 63 BRA+BRO+HAR+MIT  S18
ELY         63 FBC  R P ELY +                 PR    131  868 63 LRL+UNIV.COL.    S18
KERNAN      63 CC   KERNAN,NOVEY,WARSHAW +    PR    129  870 63 ARGONNE          S18

ANDERSON    64 HBC  J ANDERSON,CRAWFORD       BAPS    9  459 64 L R L            S18
HUBBARD     64 HBC  J R HUBBARD +             PR        JUNE 64 L R L            S18
KERNAN      64 PBC  A KERNAN +                PR    1338127I 64 LRL+UNIV.COL.    S18
LIND        64 HBC  LIND,BINFORD,GOOD,STERN PREPRINT         64 WISCONSIN        S18
SCHWARTZ    64 HBC  J SCHWARTZ                UCRL   11360   64 L R L            S18
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                          19  SIGMA + (1189,JP=1/2+)  I=1

GLASER      58 RVUE D A GLASER +              CERN       270 58 RVUE             S19
EVANS       60 EMUL D EVANS +                 NC     15  873 60 BRISTOL          S19
FREDEN      60 EMUL S C FREDEN +              NC     16  611 60 L R L LIV        S19
KAPLON      60 EMUL M F KAPLON +              ANP     9  139 60 ROCHESTER        S19
PUSCHEL     60 EMUL W PUSCHEL                 NP     20  254 60 M PLANCK         S19

BARKAS      61 EMUL W H BARKAS +              PR    124 1209 61 L R L            S19
BERTHELOT   61 PBC  A BERTHELOT +             NC     21  693 61 SACLAY           S19
CHIESA      61 EMUL A M CHIESA +              NC     19 1171 61 TORINO           S19
GRARD       62 HBC  F GRARD + G A SMITH       PR    127  607 62 L R L            S19
HUMPHREY    62 HBC  W E HUMPHREY + R R RUSS   PR    127 1305 62 L R L            S19

BARKAS      63 EMUL BARKAS,DYER,HECKMAN       PRL    11   26 63 L R L            S19
      ALSO  61 EMUL J DYER                    UCRL      9450 61 L R L            S19
BURNSTEIN   63 HBC  R A BURNSTEIN +           BNL        427 63 MARYL+CERN+BNL   S19
COURANT     63 HBC  H COURANT +               SIENA       15 63 CERN+MARYLAND    S19

BURNSTEIN   64 HBC  BURNSTEIN,DAY,KEHOE +     PREPRINT       64 MARYL            S19
MCINTURF    64 EMUL A D MUCFNTURF,ROOS        BAPS    9  459 64 VANDERBILT       S19
MURPHY      64 PBC  C T MURPHY                PR    134 B188 64 WISCONSIN        S19
NAUENBERG   64 HBC  U NAUENBERG +             PRL    12  679 64 COL+RUTG+PRIN    S19
                                          AND PRIV COMM MAY 64 COL+RUTG+PRINC    S19

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

TRIPP       62 HBC  TRIPP,WATSON,FERROLUZZI   PRL     8  175 62 P                S19
ALFF        63 HBC  C ALFF +                  SIENA   1  205 63 COLUM+RUTG+BNL   S19
COURANT     63 HBC  H COURANT +               SIENA   1   73 63 MARYL+CERN+NRL   S19
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Stable Particles (*Continued*)

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                                   (GALTIERI,ROSENFELD JUNE/64)

                    DATA FOR TABLE S ON STABLE PARTICLES
                         STABLE MEANING IMMUNE TO STRONG DECAY

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
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                    20  SIGMA-  (1198,JP=1/2+)  I=1

                    20  SIGMA-   MASS (MEV)

S20M       1197.6      0.5                    BARKAS     63 EMUL
S20M   588 1197.0      0.2                    BURNSTEIN  64 HBC

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

S20T          1.67     0.40      0.28         BROWN      58 PBC
S20T          1.89     0.33      0.25         EISLER     58 PBC
S20T          1.45     0.12      0.12         CRAWFORD   59 HBC
S20T    45    1.35     0.32      0.17         CHIESA     61 EMUL
S20T    41    1.75     0.39      0.30         BARKAS     61 EMUL

S20T 1208     1.58     0.06      0.06         HUMPHREY   62 HBC

                    20  SIGMA- PARTIAL DECAY MODES

S20P1     SIGMA - INTO  NEUTRON PI-                              S17S 8
S20P2     SIGMA - INTO  NEUTRON PI- GAMMA                        S17S 8S 0
S20P3     SIGMA - INTO  NEUTRON MU- NEUTRINO                     S17S 4S 2
S20P4     SIGMA - INTO  NEUTRON E- NEUTRINO                      S17S 3S 1
S20P5     SIGMA - INTO  LAMBDA E- NEUTRINO                       S18S 3S 1

                    20  SIGMA-  BRANCHING RATIOS

S20R1*    SIGMA - INTO (N MU- NEU)/(N PI-) (UNITS 10**-3)  (P3)/(P1)
S20R1        0.66      0.14                 BURNSTEIN  63 HBC

S20R2*    SIGMA - INTO (N E- NEU)/(N PI-)  (UNITS 10**-3)  (P4)/(P1)
S20R2        1.4       0.3                  BURNSTEIN  63 HBC
S20R2    9   1.0       0.4        0.3       MURPHY     64 PHC
S20R2   16   1.37      0.34                 NAUENBERG  64 HBC

S20R3*    SIGMA - INTO (LAMBDA E- NEU)/(N PI-) (UN. 10**-4)(P5)/(P1)
S20R3        0.75      0.28                 BURNSTEIN  63 HBC

S20R4*    SIGMA - INTO (N PI- GAMMA)/(N PI-) (UN. 10**-4)  (P2)/(P1)
S20R4*    ABOUT                   0.1       COURANT    63 HBC
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                   21  SIGMA 0  (1193,JP=1/2+)  I=1

                   21  SIGMA- MASS DIFFER.(-)-(0)(MEV)

S210   18    4.75      0.1                  BURNSTEIN  64 HBC

                   21  SIGMAO LIFETIME (UNITS 10**-14)

S21T *       1.0 OR LESS                    DAVIS      62 EMUL
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                   22  XI-  (1321,JP=1/2 ) I=1/2

                   22  XI-  MASS (MEV)

S22M    12 1320.4      2.2                 UCRL 8030  58 RVUE
S22M    11 1317.0      2.2                 KANG-CHANG 61 PBC
S22M    18 1317.9      1.9                 FOWLER     61 PBC
S22M     1 1322.0      1.3                 BROWN      62 HBC
S22M       1321.0      0.5                 BERTANZA   62 HBC

S22M    62 1321.1      0.65                SCHNEIDER  63 HBC
S22M   517 1321.4      0.4                 JANEAU     63 FBC
S22M   505 1320.4      0.3                 LONDON     64 HBC
S22M *    ALL THE XI- MASSES TO BE RAISED 0.09 MEV BECAUSE LAMBDA RAISED

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

S22T    11     3.5     3.4       1.23      KANG-CHANG 61 PBC
S22T    18     1.28    0.41      0.25      FOWLER     61 PBC
S22T    62     1.55    0.31      0.31      SCHNEIDER  63 HBC
S22T   332     1.80    0.16      0.15      CONNOLLY   63 HBC
S22T   517     1.86    0.15      0.14      JAUNEAU    63 FBC
S22T   356     1.77    0.12                CARMONY    64 HBC
S22T   794     1.69    0.07                HUBBARD    64 HBC

                   22  XI- PARTIAL DECAY MODES

S22P1     XI- INTO LAMBDA PI-                                  S18S 8
S22P2     XI- INTO LAMBDA E- NEUTRINO                          S18S 3S 1
S22P3     XI- INTO NEUTRON PI-                                 S17S 8

                   22  XI- BRANCHING RATIOS

S22R1*    XI- INTO (LAMBDA E- NEU)/(LAMBDA PI-)  (10**-3)  (P2)/(P1)
S22R1*  1    1.7     OR LESS              CARMONY +  63 HBC QUOTED BY TICHO

S22R2*    XI- INTO (NEUTRON PI-)/(LAMBDA PI-)    (10**-3)  (P3)/(P1)
S22R2*  0 LESS THAN              5.0       FERRO-LUZZI63 HBC
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                  23  XI 0  (1314,JP=1/2 ) I=1/2

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

S23D    23     6.8     1.6                 JAUNEAU    63 FBC
S23D    34     6.9     2.2                 LONDON     64 HBC
S23D    45     6.1     1.6                 CARMONY    64 HBC

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

S23T     1     1.5                         ALVAREZ    59 HBC
S23T    24     3.8     1.0       0.65      JAUNEAU    63 FBC
S23T    45     3.5     1.0        0.8      CARMONY    63 HBC
S23T   101     2.5     0.4        0.3      HUBBARD    63 HBC
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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS

                  23  XI O  PARTIAL DECAY MODES
S23P1     XI O INTO LAMBDA PI0                               S16S 9
S23P2     XI O INTO PROTON PI-                               S16S 8
S23P3     XI O INTO PROTON E- NEU                            S16S 3S 1
S23P4     XI O INTO SIGMA+ E- NEU                            S19S 3S 1
S23P5     XI O INTO SIGMA- E+ NEU                            S20S 3S 1

                  23  XI O  BRANCHING RATIOS

S23R1*     XI 0 INTO(PROTON PI-)/(LAMBDA PI0)                (P2)/(P1)
SR3R1*  0 0.027      OR LESS              TICHO      63 HBC

S23R2*     XI 0 INTO(PROTON E- NEU)/(LAMBDA PI0)             (P3)/(P1)
S23R2*  0 0.027      OR LESS              TICHO      63 HBC

S23R3*     XI 0 INTO(SIGMA+ E- NEU)/(LAMBDA PI0)             (P4)/(P1)
S23R3*  0 0.013      OR LESS              TICHO      63 HBC
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                  24  OMEGA-  (1675,JP=3/2+)   I=0

                   24  OMEGA-  MASS (MEV)
S24  *          QUANTUM NUMBERS ASSIGNED FROM SU3
S24M    1 1620.0     25.0      10.0      EISENBERG  54 EMUL
S24M    2 1675.0      3.0                BARNES     64 HBC

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

S24T    1    0.7                         BARNES     64 HBC

0         1         2         3         4         5         6         7         8
12345*78901234567890123456789012345678901234567890123456789012345678901234567890
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                         REFERENCES FOR TABLE S ON STABLE PARTICLES

 IDENTIFIC.  YR AUTHORS                           JOUR.VOL PAGE YR INSTITUTION    COD
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                           20  SIGMA - (1198,JP=1/2+)  I=1

 BROWN       58 PBC  J BROWN +                    CERN       270 58 MICHIGAN      S20
 EISLER      58 PBC  F EISLER +                   CERN       270 58 COLUMBIA      S20
 CRAWFORD    59 HBC  F S CRAWFORD +               PRIV COMM      59 L R L         S20
 BARKAS      61 EMUL W H BARKAS +                 PR    124 1209 61 L R L         S20
 CHIESA      61 EMUL A M CHIESA +                 NC     19 1171 61 TORINO        S20

 HUMPHREY    62 HBC  W E HUMPHREY + R R ROSS PR   127 1305 62 L R L            S20
 BARKAS      63 EMUL W H BARKAS,DYER,HECKMAN PRL   11   26 63 L R L            S20
 BURNSTEIN   63 HBC  R A BURNSTEIN +         BNL           427 63 MARYL+CERN+BNL  S20
                           AND PRIV COMM                  64 MARYL+CERN+BNL  S20
 COURANT     63 HBC  H COURANT +             SIENA          15 63 CERN+MARYLAND   S20

 BURNSTEIN   64 HBC  BURNSTEIN, DAY, KEHOE + PREPRINT JUNE 64 MARYL          S20
 MURPHY      64 PBC  C T MURPHY              PR                64 WISCONSIN      S20
 NAUENBERG   64 HBC  U NAUENBERG +           PRL    12   679 64 COL+RUTG+PRIN  S20
                                  AND PRIV COMM MAY 64 COL+RUTG+PRINC           S20
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Σ^0

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

 DAVIS       62      D H DAVIS +             PR     127  605 62 EFINS          S21
 BURNSTEIN   64 HBC  BURNSTEIN,DAY,KEHOE +   PREPRINT        64 MARYL          S21
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                           22  XI - (1321,JP=1/2)  I=1/2

 UCRL8030    58 RVUE W H BARKAS A H ROSENFELDUCRL8030       58 RVUE            S22
 FOWLER      61 PBC  W B FOWLER +            PRL      6  134 61 L R L          S22
 KANG-CHANG  61 PBC  W KANG-CHANG +          JETP    13  512 61 JINR RUSS      S22

 BERTANZA    62 HBC  L BERTANZA +            PRL      9  229 62 BROOKHAV.      S22
 BROWN       62 HBC  H N BROWN +             PRL      8  255 62 BROOKHAV       S22
 CONNOLLY    63 HBC  P L CONNOLLY +          SIENA         34 63 B N L         S22
                  AND PRIV COMM BY G LONDON APRIL     64 B N L              S22
 FERRO-LUZZI 63 HBC  M FERRO-LUZZI +         PR     130 1568 63 L R L          S22

 JAUNEAU     63 FBC  L JAUNEAU +             SIENA          4 63 EP+CERN+UC+RU+BES22
        ALSO 63 FBC  L JAUNEAU +             PL       4   49 63 EP+            S22
 SCHNEIDER   63 HBC  H SCHNEIDER             PL       4  360 63 CERN           S22
 TICHO       63 RVUE H K TICHO               BNL          410 63 RVUE          S22

 CARMONY     64 HBC  D D CARMONY +           PRL     12  482 64 UCLA           S22
 HUBBARD     64 HBC  J R HUBBARD +           PR        JUNE 64 L R L           S22
 LONDON      64 HBC  G W LONDON +            BAPS     9   22 64 BNL+SYR        S22

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

 CARMONY     64 HBC  D D CARMONY +           PRL     12  482 64 UCLA,   J      S22
 SHAFER      64 HBC  J B SHAFER,     ALVAREZ MEMO 508   MAY 64 L R L, J        S22
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Ξ^0

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

 ALVAREZ     59 HBC  L W ALVAREZ +           PRL      2  215 59 L R L          S23
 JAUNEAU     63 FBC  L JAUNEAU +             SIENA    1    1 63 EP+CERN+UC+RU+BES23
        ALSO 63 FBC  L JAUNEAU +             PL       4   49 63 EP+            S23
 TICHO       63 RVUE HUBBARD +,CARMONY +     BNL          410 63 LRL+UCLA      S23

 CARMONY     64 HBC  D D CARMONY +           PRL     12  482 64 UCLA           S23
 HUBBARD     63 HBC  J R HUBBARD +           PR        JUNE 64 L R L           S23
 LONDON      64 HBC  G W LONDON +            BAPS     9   22 64 BNL+SYR        S23
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                           24  OMEGA - (1675,JP=3/2+)   I=0

 EISENBERG   54 EMUL Y EISENBERG             PR      96  541 54 CORNEL         S24
 BARNES      64 HBC  V E BARNES +            PRL     12  204 64 B N L          S24
                                  AND PRIV COMM MAY 64 B N L                   S24

0         1         2         3         4         5         6         7         8
1234567890123456789012345678901234567890123456789012345678901234567890
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Meson Resonances

(REFERENCES AT LOWER RIGHT)

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                                   (GALTIERI,ROSENFELD JUNE/6/64)

                 DATA ON MESON RESONANCES

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECHNIQUE.
     IN PEAK

      * INDICATES DATA IGNORED BY PROGRAMS

                 1  OMEGA (780,JPG=1--)  I=0
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                 1  OMEGA  MASS (MEV)

U 1M  400  782.0       1.0                ALFF       62 HBC
U 1M   64  779.4       1.4                ARMENTEROS 62 HBC
U 1M   90  784.0       0.9                GELFAND    63 HBC
U 1M  653  782.0                          MURRAY     63 HBC
U 1M   34  784.0       1.0                ARMENTEROS 63 HBC

                 1  OMEGA FULL WIDTH (MEV)

U 1W   90    9.5       2.1                GELFAND    63 HBC
U 1W   34    9.0       3.0                ARMENTEROS 63 HBC

                 1  OMEGA PARTIAL DECAY MODES

U 1P1      OMEGA INTO PI+ PI- PIO                                S 8S 8S 9
U 1P2      OMEGA INTO PI+ PI-                                    S 8S 9
U 1P3      OMEGA INTO PI+ PI- GAMMA                              S 8S 8S 0
U 1P4      OMEGA INTO PIO GAMMA                                  S 9S 0
U 1P5      OMEGA INTO 2PIO GAMMA                                 S 9S 9S 0
U 1P6      OMEGA INTO MU+ MU-                                    S 4S 4
U 1P7      OMEGA INTO E+ E-                                      S 3S 3

                 1  OMEGA  BRANCHING RATIOS

U 1R1*     OMEGA INTO NEUTRAL/(PI+ PI- PIO) I.E.            (P4+P5)/(P1)
U 1R1         0.10       0.04             ALFF       62 HBC
U 1R1  40     0.10       0.03             MURRAY     63 HBC
U 1R1         0.17       0.04             ARMENTEROS 63 HBC
U 1R1  20     0.11       0.02             BUSCHBECK-C63 HBC
U 1R1         0.08       0.04             FIELDS     63 HBC

U 1R2*     OMEGA INTO (PI+ PI-)/(PI+ PI- PIO)               (P2)/(P1)
U 1R2*        0.010 OR LESS               BUTTON     61 HBC
U 1R2*        0.02 OR LESS                ALFF       62 HBC
U 1R2*100     0.005 OR GREATER            FICKINGER  63 HBC
U 1R2*        0.07                        ALITTI     63 HBC
U 1R2* 32     0.045      0.016     0.01   MURRAY     63 HBC  NO INTERFERE
U 1R2*        0.005 OR LESS               ARMENTEROS 63 HBC
U 1R2*        0.02                        JAMES      63 HBC
U 1R2*        0.018      0.012     0.006  WALKER     64 RVUE
U 1R2*        0.005  OR LESS              LUTJENS    64 RVUE NO INTERFERE
U 1R2* 42     0.006 - 0.002 OR GREATER    HUWE       64 HBC  - INTEFERE
U 1R2* 42     0.11 + 0.01 OR LESS         HUWE       64 HBC  + INTERFERE

U 1R3*     OMEGA INTO (PIO+GAMMA)/(NEUTRAL)                 (P4)/(P1)
U 1R3*     DOMINANT                       BARMIN 1   63 XBC

U 1R4*     OMEGA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)         (P3)/(P1)
U 1R4         0.032      0.013            SHAFER     63 HBC

U 1R5*     OMEGA INTO (E+ E-)/(PI+ PI- PIO)                 (P7)/(P1)
U 1R5         0.005      0.003            SHAFER     63 HBC
U 1R5*        0.0039 + 0.0015 OR LESS     BARMIN 2   63 PBC
U 1R5*        0.003  OR LESS              GALTIERI   64 HBC

U 1R6*     OMEGA INTO (MU+ MU-)/(PI+ PI- PIO)               (P6)/(P1)
U 1R6*        0.007  OR LESS              GALTIERI   64 HBC
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$\eta 2\pi$

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                 2  ETA,2PI (960,JPG=  +)  I=0,1
           PROBABLY STRONG DECAY OF G(0-+ OR 1++) C = +1

                 2  ETA,2PI  MASS (MEV)

U 2M         950.0                        GOLDBERG 1 64 HBC
U 2M   81    959.0     2.0                KALBFLEISCH64 HBC
U 2M   89    960.0     5.0                GOLDBERG 2 64 HBC

                 2  ETA,2PI  WIDTH (MEV)

U 2W * 81   12.0 OR LESS                  KALBFLEISCH64 HBC
U 2W * 89   20.0 OR LESS                  GOLDBERG 2 64 HBC

                 2  ETA,2PI  PARTIAL DECAY MODES

U 2P1      ETA,2PI  INTO ETA 2PI                                 S14S 8S 8
U 2P2      ETA,2PI  INTO 2PI                                     S 8S 8
U 2P3      ETA,2PI  INTO 3PI                                     S 8S 8S 8
U 2P4      ETA,2PI  INTO OTHER

                 2  ETA,2PI  BRANCHING RATIOS

U 2R1*     ETA,2PI INTO PI+ PI-+(NEUTRAL + CHARGED ETA)
U 2R1* 33    33/70       0.1              KALBFLEISCH64 HBC

U 2R2*     ETA,2PI INTO ALL NEUTRALS (PROB. 2PIO (NEUTRAL ETA))
U 2R2* 27    27/70       0.1              KALBFLEISCH64 HBC

U 2R3*     ETA,2PI INTO PI+ PI-+(NEUTRAL HEAVIER THAN 2PIO BUT NOT ETA)
U 2R3* 10    10 OR LESS/70                KALBFLEISCH64 HBC

U 2R4*     ETA,2PI INTO PI+ PI-+(NEUTRAL LIGHTER THAN 2PIO)
U 2R4*     NOT YET STUDIED                KALBFLEISCH64 HBC
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K_1K_1

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                 3  K1 K1 (1020,JPG=EVEN++) I=0
           K1 K1 MAYBE JUST LARGE KK SCATTERING LENGTH, OMITTED FROM TABLE

                 3  K1 K1  MASS (MEV)

U 3M * 15 1020.0                          ALEXANDER  62 HBC
U 3M *    1000.0    APPROX                BINGHAM    62 PBC
U 3M *    1000.0    APPROX                BIGI       62 HBC

                 3 K1K1 DECAY MODES AND BRANC. RATIOS SEE TEXT
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                 4  PHI (1020,JPG=1.- ) I=0

                 4  PHI  MASS (MEV)

U 4M   34 1019.0       2.0                SCHLEIN    63 HBC
U 4M   17 1019.6       0.5                GELFAND    63 HBC
U 4M      1017.0       2.0                ARMENTERUS 63 HBC
U 4M   95 1020.5       0.5                CONNOLLY 2 63 HBC
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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

      * INDICATES DATA IGNORED BY PROGRAMS

                 4  PHI  WIDTH (MEV)

U 4W * 34    5.0 OR LESS                  SCHLEIN    63 HBC
U 4W   19    3.1         1.0              GELFAND    63 HBC
U 4W   85    3.1         0.8              CONNOLLY 2 63 HBC
U 4W         3.4         1.7              ARMENTERUS 63 HBC

                 4  PHI PARTIAL DECAY MODES

U 4P1      PHI INTO K+ K-                                      S10S10
U 4P2      PHI INTO K01 K02                                    S11S11
U 4P3      PHI INTO RHO PI                                     U 9S 8
U 4P4      PHI INTO PI+ PI-                                    S 8S 8
U 4P5      PHI INTO E+  E-                                     S 3S 3
U 4P6      PHI INTO MU+ MU-                                    S 4S 4
U 4P7      PHI INTO PIO GAMMA                                  S 9S 0

                 4  PHI  BRANCHING RATIOS

U 4R1*     PHI INTO (K1 K2)/(K1 K2 AND K+ K-)               (P2)/(P1+P2)
U 4R1  10     0.40       0.10             SCHLEIN    63 HBC
U 4R1  26     0.41       0.07             LAI        64 HBC

U 4R2*     PHI INTO (RHO PI)/(K KBAR)                       (P3)/(P1+P2)
U 4R2         0.1        0.1              LAI        64 HBC

U 4R3*     PHI INTO (PI+ PI-)/(K KBAR)                      (P4)/(P1+P2)
U 4R3*        0.08 OR LESS                CONNOLLY 2 63 HBC

U 4R4*     PHI INTO (E+ E-)/(K KBAR)                        (P5)/(P1+P2)
U 4R4*        0.01   OR LESS              GALTIERI   64 HBC

U 4R5*     PHI INTO (MU+ MU-)/(K KBAR)                      (P6)/(P1+P2)
U 4R5*        0.01   OR LESS              GALTIERI   64 HBC
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                    REFERENCES ON MESON RESONANCES

IDENTIFIC.  YR AUTHORS                   JOUR.VOL PAGE YR INSTITUTION    COD
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                       1  OMEGA (780,JPG=1--)  I=0

BUTTON       61 HBC  J BUTTON +                UCRL     9814 61 L R L          U 1
MAGLIC       61 HBC  B C MAGLIC +              PRL     7  178 61 L R L          U 1
PEVSNER      61 HBC  A PEVSNER +               PRL     7  421 61 HOPKINS+N-WST  U 1

ALFF         62 HBC  C ALFF +                  PRL     9  322 62 COLUMBIA+RUTG  U 1
ALFF         62 HBC  C ALFF +                  PRL     9  325 62 COLUMBIA+RUTG  U 1
ARMENTERUS   62 HBC  R ARMENTERUS +            CERN        90 62 CERN+CF+EP     U 1

ALITTI       63 HBC  J ALITTI +                NC     29  515 63 SAC+ORS+BA+BO  U 1
ARMENTERUS   63 HBC  R ARMENTERUS +            SIENA   1  296 63 CERN+CF        U 1
BARMIN 1     63 XBC  V V BARMIN +              PL      6  279 63 ITEP-MOSCOW    U 1
BARMIN 2     63 PBC  V V BARMIN +              SIENA   1  207 63 ITEP           U 1
BERTHELOT    63 RVUE A BERTHELOT               SIENA   2   60 63 RVUE           U 1
BUSCHBECK-CZ63 HBC   B BUSCHBECK-CZAPP +       SIENA   1  166 63 VIENNA+CERN+AMS U 1

FICKINGER    63 HBC  FICKINGER,ROBINSON,SALANPRL  10  457 63 B N L          U 1
FIELDS       63 HBC  T FIELDS +                ATHENS     185 63 N-WES,JHOPK,WOC U 1
GELFAND      63 HBC  N GELFAND +               PRL    11  436 63 COLUMBIA+RUTG  U 1
JAMES        63 HBC  JAMES,H L KRAYBILL        PREPRINT       63 YALE           U 1
MURRAY       63 HBC  J J MURRAY +              PL      7  358 63 L R L          U 1
SHAFER       63 HBC  J BUTTON-SHAFER +         STANFORD       63 L R L          U 1

GALTIERI     64 HBC  BARBARO-GALTIERI,TRIPP    DUBNA          64 L R L          U 1
HUWE         64 HBC  D O HUWE                  THESIS         64 L R L          U 1
LUTJENS      64 RVUE G LUTJENS,STEINBERGER     PRL    12  517 64 COLUMBIA       U 1
WALKER       64 HBC  W D WALKER +              PL      8  208 64 WISCONSIN      U 1

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

XUONG        61 HBC  N H XUONG +               PRL     7  327 61 I,J,P          U 1
STEVENSON    62 HBC  M L STEVENSON             PR    125  687 62 I,J,P          U 1
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$\eta 2\pi$

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                       2  ETA,2PI (960,JPG=  +)  I=0,1

GOLDBERG 1   64 HBC  M GOLDBERG +              BAPS    9   23 64 BNL+SYR        U 2
KALBFLEISCH  64 HBC  G R KALBFLEISCH +         PRL    12  527 64 L R L          U 2
GOLDBERG 2   64 HBC  M GOLDBERG +              PRL    12  546 64 BNL+SYR        U 2
KALBFLEISCH  64 HBC  G R KALBFLEISCH +         DUBNA          64 L R L          U 2
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K_1K_1

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                       3  K1,K1 (1020,EVEN++) I=0

ALEXANDER    62 HBC  G ALEXANDER +             PRL     9  460 62 L R L          U 3
BIGI         62 HBC  A BIGI +                  CERN       247 62 CERN           U 3
BINGHAM      62 PBC  H H BINGHAM +             CERN       240 62 EP+CERN        U 3
ERWIN        62 HBC  A R ERWIN +               PRL     9   34 62 WISCONSIN      U 3
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                       4  PHI (1020,JPG=1--)  I=0

BERTANZA     62 HBC  L BERTANZA +              PRL     9  180 62 B N L          U 4
ARMENTERUS   63 HBC  QUOTED BY BERTHELOT       SIENA   2   70 63 CERN+CDF       U 4
CONNOLLY 1   63 HBC  P L CONNOLLY +            PRL    10  371 63 B N L          U 4
CONNOLLY 2   63 HBC  P L CONNOLLY +            SIENA   1  130 63 BNL+SYR        U 4
GELFAND      63 HBC  N GELFAND +               PRL    11  438 63 COLUMBIA+RUTG  U 4
SCHLEIN      63 HBC  P SCHLEIN +               PRL    10  368 63 UCLA           U 4

GALTIERI     64 HBC  BARBARO-GALTIERI,TRIPP    DUBNA          64 L R L          U 4
LAI          64 HBC  K W LAI +                 BAPS    9   22 64 BNL+SYR        U 4

        QUANTUM NUMBERS DETERMINATIONS NOT REFERRED TO IN DATA CARDS
CONNOLLY     63 HBC  P L CONNOLLY +            SIENA      130 63 BNL+SYR        U 4
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Meson Resonances (Continued)

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                      DATA ON MESON RESONANCES

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

      • INDICATES DATA IGNORED BY PROGRAMS
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                      5  F  (1250,JPG= ++)  I=0

                      5  F   MASS (MEV)

U 5M        1250.0     25.0                 SELOVE      62 HBC
U 5M        1260.0     35.0                 VEILLET     63 FBC
U 5M    65  1250.0                          GUIRAGUSSIA63 HBC
U 5M    85  1260.0                          BONDAR      63 HBC
U 5M   100  1250.0                          LEE         64 HBC

                      5  F   WIDTH (MEV)

U 5W         100.0     25.0                 SELOVE      62 HBC
U 5W •       200. OR LESS                   VEILLET     63 FBC
U 5W    85   160.0                          BONDAR      63 HBC
U 5W         140.0                          LEE         64 HBC

                      5  F  PARTIAL DECAY MODES

U 5P1      F  INTO PI+ PI-                                    S 8S 8
U 5P2      F  INTO 2PI+ 2PI-                                  S 8S 8S 8S 8

                      5  F   BRANCHING RATIOS

U 5R1•     F  INTO (4PI)/(2PI)                               (P2)/(P1)
U 5R1         0.08      0.06                BONDAR      63 HBC
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KKπ

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                      6  KKPI     (1410,JPG=  )  I=0,1

                      6  KKPI  MASS (MEV)

U 6M        1410.0                          ARMENTEROS 63 HBC     0

                      6  KKPI  WIDTH (MEV)

U 6W          60.0                          ARMENTEROS 63 HBC     0
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                      7  SIGMA MESON (390,JPG=    )  I=0
          EVIDENCE NOT YET COMPELLING,OMITTED FROM TABLE
                          PROBABLY 0(0++)

                      7  SIGMA MESON  MASS (MEV)

U 7M   173   395.0     10.0                 SAMIOS      62 HBC
U 7M         390.0                          KIRZ        63 HBC
U 7M         379.0      4.0                 DEL FABBRO 64 SPRK
S 7M •       394.0           VIA ETA        CRAWFORD    63 HBC BROWN-SINGER MODEL
S 7M •1800   337.0      4.0  VIA TAU PRIME KALMUS       64 PBC BROWN-SINGER MODEL

                      7  SIGMA MESON  WIDTH (MEV)

U 7W   173    50.0     20.0                 SAMIOS      62 HBC
U 7W          80.0                          KIRZ        63 HBC
U 7W         139.0     13.0                 DEL FABBRO 64 SPRK
S 7W •       104.0           VIA ETA        CRAWFORD    63 HBC BROWN-SINGER MODEL
S 7W •1800    87.0      9.0  VIA TAU PRIME KALMUS       64 PBC BROWN-SINGER MODEL
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                      9 RHO (750,JPG=1-+)  I=1

                      9 RHO  MASS (MEV)

U 9M   610   770.0     10.0                 ALFF        62 HBC  +
U 9M         748.0                          KENNEY      62 HBC  -
U 9M   130   775.0                          GUIRAGUSSIA63 HBC   -
U 9M         765.0     10.0                 ERWIN       63 HBC  -
U 9M         765.0     30.0                 LEE         64 HBC  -

U 9M   290   755.0                          CHADWICK    63 HBC +-0
U 9M         740.0                          WALKER      62 HBC  -0
U 9M   240   752.0                          ALITTI      63 HBC  -0

U 9M   190   750.0     20.0                 SAMIOS      62 HBC   0
U 9M   300   750.0     10.0                 ALFF        62 HBC   0
U 9M   160   775.0                          GUIRAGUSSIA63 HBC    0
U 9M   300   760.0     10.0                 ABOLINS     63 HBC   0
U 9M         763.0     10.0                 ERWIN       63 HBC   0
U 9M   500   770.0     10.0                 GOLDHABER   64 HBC   0
U 9M         765.0     15.0                 LEE         64 HBC   0

                      9  RHO  WIDTH (MEV)

U 9W   610   130.0     10.0                 ALFF        62 HBC  +
U 9W          90.0     10.0                 SACLAY      63 HBC  +
U 9W   290   110.0                          CHADWICK    63 HBC +-0

U 9W   130   125.0                          GUIRAGUSSIA63 HBC   -
U 9W          65.0     20.0                 ERWIN       63 HBC  -
U 9W    98   180.0                          BONDAR      64 HBC  -
U 9W         120.0                          WALKER      62 HBC  -0

U 9W   190   150.0     20.0                 SAMIOS      62 HBC   0
U 9W   300   100.0     10.0                 ALFF        62 HBC   0
U 9W   160   175.0                          GUIRAGOSSIA63 HBC    0
U 9W   300    90.0     10.0                 ABOLINS     63 HBC   0
U 9W   500   130.0                          GOLDHABER   64 HBC   0
U 9W         165.0     20.0                 ERWIN       63 HBC   0
U 9W    96   210.0                          BONDAR      64 HBC   0

                      9  RHO PARTIAL DECAY MODES

U 9P1       RHO INTO 2PI                                      S 8S 8
U 9P2       RHO INTO 4PI                                      S 8S 8S 8S 8

                      9  RHO BRANCHING RATIOS

U 9R1•      RHO INTO 4PI/2PI                                 (P2)/(P1)
U 9R1•         0.05 OR LESS                 XUONG       62 HBC
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      IN PEAK

      • INDICATES DATA IGNORED BY PROGRAMS
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A1

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                      10  A1 MESON (1200,JPG=  -) I=1

                      10  A1 MESON  MASS (MEV)

U10M •      1200.0    APPROX                BELLINI    63 PBC  -
U10M •170 1200.0    APPROX                  GOLDHABER  64 HBC  +
U10M   70 1090.0                            CHUNG      64 HBC  -
U10M        1080.0                          ADERHOLZ   64 HBC

                      10  A1 MESON  WIDTH (MEV)

U10W •170  350.0    APPROX                  GOLDHABER  64 HBC  +
U10W       150.0                            CHUNG      64 HBC  -
U10W   70  125.0          25.0              CHUNG,HESS 64 HBC  -
U10W        80.0                            ADERHOLZ   64 HBC

                      10  A1 PARTIAL DECAY MODES

U10P1      A1 INTO RHO PI                                   U 9S 8
U10P2      A1 INTO PI PI                                    S 8S 8
U10P3      A1 INTO KBAR K                                   S10S11

                      10  A1 BRANCHING RATIOS

U10R1•     A1 INTO (PI PI)/(RHO PI)                        (P2)/(P1)

U10R2•     A1 INTO (KBAR K)/(RHO PI)                       (P3)/(P1)
U10R2•        0.05   OR LESS                CHUNG      64 HBC
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                        REFERENCES ON MESON RESONANCES

IDENTIFIC.  YR AUTHORS                      JOUR.VOL PAGE YR INSTITUTION      COD
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                              5  F  (1250,JPG= ++)  I=0

SELOVE      62 HBC  W SELOVE +              PRL    9  272 62 PEN+BNL          U 5
BONDAR      63 HBC  L BONDAR +              PL     5  153 63 AACHEN+          U 5
GUIRAGOSSIAN63 HBC  Z G T GUIRAGOSSIAN      PRL   11   85 63 L R L            U 5
VEILLET     63 FBC  J J VEILLET +           PRL   10   29 63 EP+MILAN         U 5
LEE         64 HBC  Y Y LEE +               PRL   12  342 64 MICHIGAN         U 5

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

HAGOPIAN    63 HBC  V HAGOPIAN,W SELOVE     PRL   10  533 63 I,J              U 5
ADERHOLZ    64 HBC  M ADERHOLZ +(AACHEN+)   PL    10  240    I                U 5
SODICKSON   64 SPCH L SODICKSON +           PRL   12  485 64 I                U 5
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KKπ

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                              6  KKPI     (1410,JPG=  ) I=0,1

ARMENTEROS  63 HBC  R ARMENTEROS +          SIENA     287 63 CERN+CDF         U 6
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                              7  SIGMA MESON (390,JPG=    )  I=0

SAMIOS      62 HBC  N P SAMIOS +            PRL    9  139 62 BNL+CCNY+CU+KY   U 7
CRAWFORD    62 HBC  F S CRAWFORD +          PRL   11  564 63 L R L            U 7
DEL FABBRO  64 SPRK R DEL FABBRO +          PRL   12  674 64 FRASCATI         U 7
KIRZ        63 HBC  KIRZ,SCHWARTZ,TRIPP     PR   130 2481 63 L R L            U 7
KALMUS      64 PBC  G E KALMUS +            SUBM. PR JUNE 64 WISCONSIN+LRL    U 7
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                              9 RHO (750,JPG=1-+)  I=1

ANDERSON    61 HBC  J A ANDERSON +          PRL    6  365 61 L R L            U 9
ALFF        62 HBC  C ALFF +                PRL    9  322 62 COL.+RUTG        U 9
KENNEY      62 HBC  V P KENNEY +            PR   126  736 62 KENTUCKY UN.     U 9
SAMIOS      62 HBC  N P SAMIOS +            PRL    9  139 62 BNL+CCNY+CU+KY   U 9
WALKER      62 HBC  W D WALKER +            CERN       42 62 WISCONSIN        U 9
XUONG       62 HBC  N XUONG,G R LYNCH       PR   128 1849 62 L R L            U 9

ABOLINS     63 HBC  M ABOLINS +             PRL   11  381 63 UCSD             U 9
ALITTI      63 HBC  J ALITTI +              NC    29  515 63 SAC+ORS+BA+BO    U 9
CHADWICK    63 HBC  G B CHADWICK +          PRL   10   62 63 OXFORD + PADOVA U 9
GUIRAGOSSIAN63 HBC  ZGT GUIRAGOSSIAN        PRL   11   85 63 L R L            U 9
ERWIN       63 HBC  ERWIN,SATTERBLOM,WALKER+SIENA     112 63 WISCONSIN        U 9
SACLAY      63 HBC  SACLAY,ORSAY,BARI,BOLOG SIENA     239 63 SAC,ORS,BA,BO    U 9

BONDAR      64 HBC  L BONDAR +              NC    31  729 64 AAC,BI,BO,HA,IC+U 9
GOLDHABER   64 HBC  G GOLDHABER +           PRL   12  336 64 L R L            U 9
LEE         64 HBC  LEE,RUE,SINCLAIR +      PRL   12  342 64 MICHIGAN         U 9

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

ERWIN       61 HBC  A R ERWIN +             PRL    6  628 61  I,J             U 9
PICKUP      61 HBC  E PICKUP +              PRL    7  192 61  J               U 9
STONEHILL   61 HBC  D L STONEHILL +         PRL    6  624 61  I,J             U 9
```

A1

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                              10  A1 MESON (1200,JPG=  -) I=1

BELLINI     63 PBC  G BELLINI +             NC    29  896 63 MILAN            U10
HUSON       63 PBC  F R HUSON,W B FRETTER   BAPS   8  325 63 UC BERKELEY      U10

ADERHOLZ    64 HBC  M ADERHOLZ +            PL    10  226 64 AACHEN+          U10
CHUNG       64 HBC  S U CHUNG +             PRL   12  621 64 L R L            U10
GOLDHABER   64 HBC  G GOLDHABER +           PRL   12  336 64 L R L            U10
HESS        64 HBC  HESS,CHUNG,DAHL,MILLER+ DUBNA 64          64 L R L        U10
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Meson Resonances (*Continued*)

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                  DATA UN MESON RESONANCES

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS

B                 11  B MESON (1220,JPG=  +) I=1

                  11  B MESON  MASS (MEV)

U11M   60 1220.0                         ABOLINS    63 HBC  +
U11M   95 1215.0     85.0                CHUNG      64 HBC   -

                  11  B MESON  WIDTH (MEV)

U11W   60  100.0     20.0                ABOLINS    63 HBC  +
U11W   95  170.0     30.0                CHUNG,HESS 64 HBC   -

                  11  B MESON PARTIAL DECAY MODES

U11P1     B MESON INTO OMEGA+PI                               U 1S 8
U11P2     B MESON INTO 2PI+ 2PI-                              S 8S 8S 8S 8
U11P3     B MESON INTO K KBAR                                 S10S10
U11P4     B MESON INTO PI PI                                  S 8S 8

                  11  B MESON  BRANCHING RATIOS

U11R1*    B INTO  4PI/(OMEGA PI)                            (P2)/(P1)
U11R1*       0.5 OR LESS                 ABOLINS    63 HBC  +

U11R2*    B MESON INTO (K KBAR)/(OMEGA PI)                  (P3)/(P1)
U11R2*       0.10   OR LESS              HESS       64 HBC

U11R2*    B MESON INTO(PI PI)/(PI OMEGA)                    (P4)/(P1)
U11R2*       0.3    OR LESS              ADERHOLZ   64 HBC

A2                12  A2 MESON (1310,JPG=2+-)  I=1

                  12  A2 MESON  MASS (MEV)

U12M   70 1310.0                         CHUNG      64 HBC   -
U12M      1320.0                         ADERHOLZ   64 HBC

                  12  A2 MESON  WIDTH (MEV)

U12W   70   80.0                         CHUNG      64 HBC   -
U12W       100.0                         ADERHOLZ   64 HBC

                  12  A2 MESON PARTIAL DECAY MODES

U12P1     A2 MESON INTO RHO PI                                U 9S 8
U12P2     A2 MESON INTO KBAR K                                S10S12
U12P3     A2 MESON INTO ETA PI                                S14S 8

                  12  A2 MESON  BRANCHING RATIOS


U  R1*    A2 MESON  INTO (K K)/(RHO PI)                     (P2)/(P1)
U12R1        0.30      0.07              CHUNG,HESS 64 HBC   -

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

          KAPPA,SEEN WEAKLY AND IN OCCASIONAL EXPERIMENTS

                  17  KAPPA  MASS (MEV)

U17M       730.0                         ALEXANDER  62 HBC  + 0
U17M   92  726.0      3.0                MILLER     63 HBC  + 0
U17M   33  723.0      3.0                WOJCICKI   63 HBC   -
U17M       725.0                         CONNOLLY   63 HBC

                  17  KAPPA  WIDTH (MEV)

U17W * 92   20.0 OR LESS                 MILLER     63 HBC  + 0
U17W * 33   12.0 OR LESS                 WOJCICKI   63 HBC   -

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

                  18  K*  MASS (MEV)

U18M       898.0      5.0                CHADWICK   63 HBC  +
U18M   200 880.0                         ALEXANDER  62 HBC  + 0
U18M       885.0                         ARMENTEROS 62 HBC  +-0
U18M  3870 891.0      1.0                WOJCICKI   63 HBC   -

U18M   70  897.0     10.0                COLLEY     62 HBC    0
U18M   150 885.0                         SMITH      63 HBC    0
U18M   200 892.0      2.0                KRAEMER    63 HBC    0

                  18  K*  WIDTH (MEV)

U18W        46.0      8.0                CHADWICK   63 HBC  +
U18W   200  60.0      5.0                ALEXANDER  62 HBC  + 0
U18W        55.0                         ARMENTEROS 62 HBC  +-0
U18W  3870  46.0      3.0                WOJCICKI   63 HBC   -

U18W   70   60.0     10.0                COLLEY     62 HBC    0
U18W   150  50.0                         SMITH      63 HBC    0
U18W   200  50.0      5.0                KRAEMER    63 HBC    0


                  18  K* PARTIAL DECAY MODES

U18P1     K* INTO K PI                                        S10S 8
U18P2     K* INTO K2PI                                        S10S 8S 8
U18P3     K* INTO KAPPA PI                                    U17S 8

                  18  K*  BRANCHING RATIOS

U18R1*    K* INTO  (KAPPA PI)/(K PI)                        (P3)/(P1)
U18R1*  3    0.005 OR LESS               GOLDHABER  63 HBC   -
U18R1*  0    0.002 OR LESS               WOJCICKI+  63 HBC   -

U18R2*    K* INTO  (K 2PI)/(K PI)                           (P2)/(P1)
U18R2*  0    0.002 OR LESS               WOJCICKI+  63 HBC   -

Kππ               19  K,RHO (1200,JP =    )  I=1/2

                  19  K,RHO  MASS (MEV)

U19M   23 1175.0                         WANGLER    64 HBC
U19M      1215.0     15.0                ARMENTEROS 64 HBC

                  19  K,RHO  WIDTH (MEV)

U19W * 23   25.0 OR LESS                 WANGLER    64 HBC
U19W        60.0     10.0                ARMENTEROS 64 HBC

0         1         2         3         4         5         6         7         8
12345*78901234567890123456789012345678901234567890123456789012345678901234567890
```

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                     REFERENCES ON MESON RESONANCES

IDENTIFIC.  YR AUTHORS                    JOUR.VOL PAGE YR INSTITUTION     COD

B                          11  B MESON (1220,JPG=  +) I=1

ABOLINS     63 HBC  M ABOLINS +           PRL   11  381 63 UCSD            U11
BONDAR      63 HBC  L BONDAR +            PL     5  209 63 AACHEN +        U11
CHUNG       63 HBC  SU CHUNG +            SIENA     201 63 L R L           U11

ADERHOLZ    64 HBC  ADERHOLZ +            PL    10  240 64 AA+BI,BU,HA,IC+ U11
HESS        64 HBC  HESS,CHUNG,DAHL,MILLER+ DUBNA 64    64 L R L           U11

         QUANTUM NUMBERS DETERMINATIONS NOT REFERRED TO IN DATA CARDS

CARMONY     64 HBC  D D CARMONY +         PRL   12  254 64 UCSD J,P        U11

A2                         12  A2 MESON (1310,JPG=2+-)  I=1

ADERHOLZ    64 HBC  M ADERHOLZ +          PL    10  236 64 AACHEN+         U12
CHUNG       64 HBC  S U CHUNG +           PRL   12  621 64 L R L           U12
HESS        64 HBC  HESS,CHUNG,DAHL,MILLER+ DUBNA 64    64 L R L           U12

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

ALEXANDER   62 HBC  G ALEXANDER +         PRL    8  447 62 L R L           U17
CONNOLLY    63 HBC  P L CONNOLLY +        SIENA     125 63 BNL+SYR         U17
MILLER      63 HBC  D H MILLER +          PL     5  279 63 L R L           U17
WOJCICKI    63 HBC  S G WOJCICKI +        PL     5  283 63 L R L           U17

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

ALSTON      61 HBC  M H ALSTON +          PRL    6  300 61 L R L           U18
ALEXANDER   62 HBC  G ALEXANDER +         PRL    8  447 62 L R L.          U18
ARMENTEROS  62 HBC  R ARMENTEROS +        CERN      229 62 CERN+CDF+EP     U18
COLLEY      62 HBC  D COLLEY +            CERN      315 62 COLUMBIA+RUTG   U18

CHADWICK    63 HBC  G B CHADWICK +        PL     6  309 63 OXFORD+PADUVA   U18
GOLDHABER   63 HBC  S GOLDHABER           ATHENS     92 63 L R L           U18
KRAEMER     63 HBC  R KRAEMER +           ATHENS    130 63 JOHNS HOPK.     U18
SMITH       63 HBC  G A SMITH +           PRL   10  138 63 L R L           U18
WOJCICKI    63 HBC  S G WOJCICKI          UCRL    11138 63 L R L           U18
WOJCICKI+   63 HBC  S J WOJCICKI +        UCRL    11139 63 L R L           U18

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

CHINOWSKY   62 HBC  W CHINOWSKY +         PRL    9  330 62 J               U18

Kππ                        19  K,RHO(1200,JP=   )  I=1/2

ARMENTEROS  64 HBC  R ARMENTEROS +        PL     9  207 64 CERN+CDF        U19
                         AND PRIVATE COMUNICATION  MAY 64 CERN+CDF         U19
WANGLER     64 HBC  TP WANGLER,WALKER,ERWIN PL   9   71 64 WISCONSIN       U19

0         1         2         3         4         5         6         7         8
12345*78901234567890123456789012345678901234567890123456789012345678901234567890
```

Baryon Resonances

(REFERENCES AT LOWER RIGHT)

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                         (GALTIERI,ROSENFELD JUNE/64)

                 DATA ON BARYON RESONANCES

CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
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$N^*_{1/2}(1480)$

```
                    24  N*1/2 (1480,JP=1/2+)  I=1/2
U24  *          EXISTENCE AND JP ASSIGNMENTS SLIGHTLY DUBIOUS
                    24  N*1/2(1480) MASS (MEV)

U24M *    1400.0   APPROX                  COCCONI    64 CNTR
U24M *    1415.0   APPROX                  BAREYRE    64 RVUE
U24M *    1485.0   APPROX                  ROPER      64 RVUE

                    24  N*1/2(1480) WIDTH (MEV)

U24W       240.0                           BAREYRE    64 RVUE
U24W       238.0                           ROPER      64 RVUE
```

$N^*(1512)$

```
                    25  N*1/2 (1512,JP=3/2-)  I=1/2
                     PARITY ASSIGNMENT STILL NOT FINAL
                    25  N*1/2(1512)  MASS (MEV)

S25M      1512.0                           PEIERLS    60 RVUE
U25M      1512.0                           FALK-VARIAN61 RVUE
U25M      1512.0                           MOYER      61 RVUE
U25M      1515.0                           DETOEUF    61 RVUE
U25M      1518.0     10.0                  BELLETTINI 63 CNTR

U25M      1518.0                           AUVIL      64 RVUE

                    25  N*1/2(1512)  WIDTH (MEV)

U25W       140.0                           FALK-VARIAN61 RVUE
U25W       125.0     12.5                  DETOEUF    61 RVUE
U25W *      80.0   APPROX                  BELLETTINI 63 CNTR
U25W *      46.0   LOWER HALF WIDTH        AUVIL      64 RVUE

                    25  N*1/2(1512) PARTIAL DECAY MODES
U25P1     N*1/2(1512) INTO N PI                                   S16S 8
U25P2     N*1/2(1512) INTO N PI PI                                S16S 8S 8

                    25  N*1/2(1512) BRANCHING RATIOS

U25R1*    N*1/2(1512) INTO (N PI)/TOTAL                         (P1)/TOTAL
U25R1       0.79                           OMNES      61 RVUE
U25R1       0.62                           DEVLIN     62 CNTR
U25R1       0.67                           LAYSON     63 RVUE
U25R1       0.71     0.08                  DETOEUF    64 CNRT
U25R1       0.54     0.03                  AUVIL      64 RVUE
```

$N^*(1688)$

```
                    26  N*1/2  (1688,JP=5/2+) I=1/2
               TY ASSIGNMENT STILL NOT FINAL
                    26  N*1/2(1688)  MASS (MEV)

S26M      1715.0                           PEIERLS    60 RVUE
U26M      1683.0                           FALK-VAIRAN61 RVUE
U26M      1688.0                           MOYER      61 RVUE
U26M      1699.4                           AUVIL      64 RVUE

                    26  N*1/2(1688)  WIDTH (MEV)

U26W       120.0                           FALK-VAIRAN61 RVUE
U26W       170.0     20.0      10.0        OMNES      61 RVUE
U26W *      49.0   LOWER  HALF WIDTH       AUVIL      64 RVUE
U26W *      48.0   HIGHER HALF WIDTH       AUVIL      64 RVUE

                    26  N*1/2(1688) DECAY MODES
U26P1     N*1/2(1688) INTO N PI                                   S16S 8
U26P2     N*1/2(1688) INTO N PI PI                                S16S 8S 8
U26P3     N*1/2(1688) INTO LAMBDA K                               S18S11
U26P4     N*1/2(1688) INTO ETA PROTON                             S14S16

                    26  N*1/2(1688) BRANCHING RATIOS

U26R1*    N*1/2(1688) INTO (N PI)/TOTAL                         (P1)/TOTAL
U26R1       0.91     0.10      0.13        OMNES      61 RVUE
U26R1       0.88                           LAYSON     63 RVUE
U26R1       0.64                           AUVIL      64 RVUE
```

$N^*(2190)$

```
                    27  N*1/2  (2190,JP=    )  I=1/2

                    27  N*1/2(2190)  MASS (MEV)

U27M      2190.0                           DIDDENS    63 CNTR

                    27  N*1/2(2190)  WIDTH (MEV)

U27W       200.0                           DIDDENS    63 CNTR

                    27  N*1/2(2190) PARTIAL DECAY MODES
U27P1     N*1/2(2190) INTO N PI                                   S16S 8
U27P2     N*1/2(2190) INTO LAMBDA K                               S18S11

U27P1*    PI P FRACTION BASED ON GUESS THAT J=9/2
U27P2*    SOME LAMBDA K MODE REPORTED BY  SCHWARTZ 64
```

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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
```

$N^*(2700)$

```
                    28  N*1/2 (2700,JP=    )  I=1/2
               EVIDENCE NOT YET COMPELLING

                    28  N*1/2(2700) MASS (MEV)

U28M      2700.0                           R ALVAREZ  64 CNTR

                    28  N*1/2(2700) WIDTH (MEV)

U28W       100.0                           R ALVAREZ  64 CNTR

                    28  N*1/2(2700) PARTIAL DECAY MODES

U28P1     N*1/2(2700) INTO N ETA                                  S16S14
U28P2     N*1/2(2700) INTO N PI                                   S16S 8

                    28  N*1/2(2700) BRANCHING RATIOS

U28R1*    N*1/2(2700) INTO (N PI)/TOTAL                         (P2)/TOTAL
U28R1*      0.06   OR LESS                 R ALVAREZ  64 CNTR
```

```
                       REFERENCES ON BARYON RESONANCES

IDENTIFIC.  YR AUTHORS                      JOUR.VOL PAGE YR INSTITUTION     COD
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$N^*_{1/2}(1480)$

```
                        24  N*1/2 (1480,JP=1/2+)  I=1/2
BAREYRE     64 RVUE P BAREYRE +             PL      8  137 64 SACLAY+CAEN     U24
COCCONI     64 CNTR G COCCONI +             PL      8  134 64 CERN            U24
ROPER       64 RVUE L D ROPER               PRL    12  340 64 LRL-LIVERMORE   U24
ROPER       64 RVUE L D ROPER               PRIV.COM  MAY 64 LRL-LIVERMORE   U24
```

$N^*(1512)$

```
                        25  N*1/2 (1512,JP=3/2-)  I=1/2

PEIERLS     60 RVUE R F PEIERLS             PR    118  325 60 RVUE            U25
DETOEUF     61 RVUE J F DETOEUF             AIX     2   57 61 RVUE            U25
FALK-VARIANT61 RVUE FALK-VARIANT,VALLADAS   RMP    33  362 61 RVUE            U25
MOYER       61 RVUE B J MOYER               RMP    33  367 61                 U25
OMNES       61 RVUE R OMNES,G VALLADAS      AIX     1  467 61 RVUE            U25

DEVLIN      62 CNTR DEVLIN,MOYER,PEREZMENDEZPR    125  690 62 CNTR            U25
BELLETTINI  63 CNTR G BELLETTINI +          NC     29 1195 63 PISA+FIR+WCL    U25
LAYSON      63 RVUE W M LAYSON              NC     27  724 63 RVUE            U25

AUVIL       64 RVUE P AUVIL,C LOVELACE      PREP. ICTP 37 64 IMPER.COLLEGE   U25
DETOEUF     64 CNTR J F DETOEUF +           PL      8   74 64 SACLAY          U25

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

CENCE       63 CNTR R CENCE,MOYER +         STANFORD       63 J P             U25
AUVIL       64 RVUE P AUVIL,C LOVELACE      PREP ICTP/37   64 J P             U25
ROPER       64 RVUE L D ROPER               PRL    12  340 64 J P             U25
ROPER       64 RVUE L D ROPER               PRL    12  340 64 LRL-LIVERMORE   U25
```

$N^*(1688)$

```
                        26  N*1/2  (1688,JP=5/2+)  I=1/2

PEIERLS     60 RVUE R F PEIERLS             PR    118  325 60 RVUE            U26
FALK-VARIANT61 RVUE FALK-VARIANT,VALLADAS   RMP    33  362 61 RVUE            U26
MOYER       61 RVUE B J MOYER               RMP    33  367 61 RVUE            U26
OMNES       61 RVUE R OMNES,G VALLADAS      AIX     1  467 61 RVUE            U26

LAYSON      63 RVUE W M LAYSON              NC     27  724 63 RVUE            U26
AUVIL       64 RVUE P AUVIL,C LOVELACE      PREP. ICTP 37 64 IMPER.COLLEGE   U26

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS     U26

DETOEUF     61 RVUE J F DETOEUF             AIX     2   57 61 J               U26
CENCE       63 CNTR R CENCE,MOYER +         STANFORD       63 J P             U26
HELLAND     63 SPRK J A HELLAND +           PRL    10   27 63 J               U26
AUVIL       64 RVUE P AUVIL,C LOVELACE      PREP ICTP/37   64 J P             U26
```

$N^*(2190)$

```
                        27  N*1/2  (2190,JP=    )  I=1/2

DIDDENS     63 CNTR A N DIDDENS +           PRL    10  262 63 B N L           U27
SCHWARTZ    64 HBC  J SCHWARTZ +            BAPS    9  420 64 L R L           U27
```

$N^*(2700)$

```
                    28  N*1/2(2700,JP=    ) I=1/2
R ALVAREZ   64 CNTR R ALVAREZ +             PREPRINT  MAY 64 MIT+CAMBRIDGE   U28
```

Baryon Resonances (*Continued*)

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CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

       • INDICATES DATA IGNORED BY PROGRAMS
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$\Delta(1238)$

```
                    31  N•3/2  (1238 JP=3/2+)  I=3/2

                    31  N•3/2(1238)  MASS (MEV)

U31M       1238.0                         DE HOFFMANN54 RVUE
U31M       1236.1      0.3                KLEPIKOV   60 RVUE
U31M       1234.0                         ROPER      64 RVUE

                    31  N•3/2(1238)  WIDTH (MEV)

U31W •       42.8    LOWER HALF WIDTH     DE HOFFMANN54 RVUE
U31W        118.9      5.9                KLEPIKOV   60 RVUE
U31W •       82.0    UPPER  HALF WIDTH    VIK        63 CNTR
U31W •       43.2    LOWER HALF WIDTH     ROPER      64 RVUE
U31W •       82.6    UPPER HALF WIDTH     ROPER      64 RVUE

                    31  N•3/2(1238)  PARTIAL DECAY MODES

U31P1•    N•312(1238) INTO N PI                                S16S 8
```

$\Delta(1640)$

```
                    32  N•3/2  (1640,JP=     )  I=3/2
             EVIDENCE NOT YET COMPELLING,OMITTED FROM TABLE

U32M •     1680.0    APPROX               CARRUTHERS 60 RVUE
U32M •     1632.0    APPROX               DEVLIN     62 CNTR
```

$\Delta(1920)$

```
                    33  N•3/2  (1920,JP=7/2+)  I=3/2

                    33  N•3/2(1920)  MASS (MEV)

U33M       1922.0                         DEVLIN     62 CNTR
U33M       1926.0                         AUVIL      64 RVUE

                    33  N•3/2(1920)  WIDTH (MEV)

U33W •      109.0    LOWER HALF WIDTH     AUVIL      64 RVUE
U33W •       58.6    HIGHER HALF WIDTH    AUVIL      64 RVUE

                    33  N•3/2(1920) PARTIAL DECAY MODES
U33P1     N•1/2(1920) INTO N PI                                S16S 8
U33P2     N•1/2(1920) INTO SIGMA K                             S19S10


                    33  N•3/2(1920) BRANCHING RATIOS

U33R1•    N•3/2(1920) INTO (N PI)/TOTAL                      (P1)/TOTAL
U33R1        0.34                         AUVIL      64 RVUE
```

$\Delta(2360)$

```
                    34  N•3/2  (2360,JP=     )  I=3/2

                    34  N•3/2(2360)  MASS (MEV)

U34M       2360.0                         DIDDENS    63 CNTR

                    34  N•3/2(2360)  WIDTH (MEV)

U34W        200.0                         DIDDENS    63 CNTR
                    34  N•3/2(2360) PARTIAL DECAY MODES

U34P1•    PI P FRACTION BASED ON GUESS THAT J=11/2
```

$\Delta(2520)$

```
                    35  N•3/2 (2520,JP=     )  I=3/2
                  EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE

                    35  N•3/2(2520)  MASS (MEV)

U35M •     2520.0    APPROX.              R ALVAREZ  64 CNTR
```

$Y_0^*(1405)$

```
                    37  Y•0 (1405,JP=     )  I=0

                    37  Y•0(1405)  MASS (MEV)

U37M       1405.0                         ALSTON     62 HBC
U37M       1405.0                         ALEXANDER  62 HBC

                    37  Y•0(1405)  WIDTH (MEV)

U37W         50.0                         ALSTON     62 HBC
U37W         35.0      5.0                ALEXANDER  62 HBC
```

$Y_0^*(1520)$

```
                    38  Y•0 (1520,JP=3/2-)  I=0

                    38  Y•0(1520)  MASS (MEV)

U38M       1519.4      2.0                FERRO-LUZZI62 HBC
U38M   145 1517.0      3.0                GALTIERI   63 DBC
U38M       1520.0      4.0                ALMEIDA    64 HBC

                    38  Y•0(1520)  WIDTH (MEV)

U38W         16.0      2.0                FERRO-LUZZI62 HBC

                    38  Y•0(1520) PARTIAL DECAY MODES
U38P1     Y•(1520) INTO SIGMA PI                               S19S 8
U38P2     Y•(1520) INTO KBAR N                                 S12S17
U38P3     Y•(1520) INTO LAMBDA PI+ PI-                         S18S 8S 8

                    38  Y•0(1520)  BRANCHING RATIOS

U38R1•    Y•0(1520) INTO SIG  PI                             (P1)/TOTAL
U38R1        0.546     0.067              WATSON     63 HBC

U38R2•    Y•0(1520) INTO K   N                               (P2)/TOTAL
U38R2        0.293     0.035              WATSON     63 HBC

U38R3•    Y•0(1520) INTO LAMBDA PI PI                        (P3)/TOTAL
U38R3        0.16      0.02               WATSON     63 HBC
```

```
CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
     IN PEAK

       • INDICATES DATA IGNORED BY PROGRAMS
```

$Y_0^*(1815)$

```
                    39  Y•0 (1815,JP=5/2 )  I=0

                    39  Y•0(1815)  MASS (MEV)

U39M       1815.0                         CHAMBERLAIN62 CNTR

                    39  Y•0(1815)  WIDTH (MEV)

U39W        120.0                         CHAMBERLAIN62 CNTR
U39W         70.0                         GALTIERI   63 HBC

                    39  Y•0(1815) PARTIAL DECAY MODES

U39P1     Y•0(1815) INTO KBAR N                                S12S17
U39P2     Y•0(1815) INTO SIGMA PI                              S19S 8
U39P3     Y•0(1815) INTO LAMBDA PI+ PI-                        S18S 8S 8
U39P4     Y•0(1815) INTO LAMBDA ETA                            S18S14

                    39  Y•0 (1815) BRANCHING RATIOS

U39R1•    Y•0(1815) INOO KBAR N                              (P1)/TOTAL
U39R1        0.8                  WOHL        64 HBC

U39R2•    Y•0(1815) INTO(SIGMA PI)/TOTAL                     (P2)/TOTAL
U39R2•       0.15   OR LESS       WOHL        64 HBC

U39R3•    Y•0(1815) INTO(LAMBDA 2PI)/TOTAL                   (P3)/TOTAL
U39R3•       0.10   OR LESS       WOHL        64 HBC
```

```
                     REFERENCES ON BARYON RESONANCES

IDENTIFIC.  YR AUTHORS                     JOUR.VOL PAGE YR INSTITUTION     COD
```

$\Delta(1238)$

```
                              31  N•3/2  (1238,JP=3/2+)  I=3/2
DE HOFFMANN 54 RVUE F DE HOFFMANN +        PR     95 1587 54 RVUE           U31
KLEPIKOV    60 RVUE N P KLEPIKOV +         REPORT   D584 60 DUBNA           U31
VIK         63 CNTR O T VIK,H R RUGGE      PR    129 2311 63 L R L          U31
ROPER       64 RVUE L D ROPER              PRIV.COMU MAY 64 LRL-LIVERMORE   U31
```

$\Delta(1640)$

```
                              32  N•3/2  (1640,JP=     )  I=3/2

CARRUTHERS  60 RVUE P CARRUTHERS           PRL     4  303 60 RVUE           U32
DEVLIN      62 CNTR DEVLIN,MOYER,PEREZMENDEZPR   125  690 62 L R L          U32
```

$\Delta(1920)$

```
                              33  N•3/2  (1920,JP=7/2+)  I=3/2

DEVLIN      62 CNTR DEVLIN,MOYER,PEREZMENDEZPR   125  690 62 L R L          U33
AUVIL       64 RVUE P AUVIL,C LOVELACE     PREP. ICTP 37 64 IMPER.COLLEGE   U33
```

$\Delta(2360)$

```
                              34  N•3/2  (2360,JP=     )  I=3/2

DIDDENS     63 CNTR A N DIDDENS +          PRL    10  262 63 B N L          U34
```

$\Delta(2520)$

```
                         35  N•3/2(2520,JP=     ) I=3/2

R ALVAREZ   64 CNTR R ALVAREZ +            PREPRINT       64 MIT+CAMBRIDGE  U35
```

$Y_0^*(1405)$

```
                              37  Y•0 (1405,JP=     )  I=0

ALSTON      61 HBC  M H ALSTON +           PRL     6  698 62 L R L          U37
ALEXANDER   62 HBC  G ALEXANDER +          PRL     8  460 62 L R L          U37
ALSTON      62 HBC  M H ALSTON +           CERN       311 62 L R L          U37
```

$Y_0^*(1520)$

```
                              38  Y•0 (1520,JP=3/2-)  I=0

FERRO-LUZZI 62 HBC  M FERRO-LUZZI +        PRL     8   28 62 L R L          U38
GALTIERI    63 DBC  A BARBARO GALTIERI +   PL      6  296 63 L R L          U38

WATSON      63 HBC  WATSON,FERROLUZZI,TRIPP PR   131 2248 63 L R L          U38
ALMEIDA     64 HBC  S ALMEIDA,LYNCH        PL      9  204 64 CERN           U38
```

$Y_0^*(1815)$

```
                              39  Y•0 (1815,JP=5/2 )  I=0

CHAMBERLAIN 62 CNTR O CHAMBERLAIN +        PR    125 1696 62 L R L          U39
GALTIERI    63 HBC  A BARBARO GALTIERI +   PL      6  296 63 L R L          U39
WOHL        64 HBC  C WOHL,S WOJCICKI +    UCRL     11340 64 L R L          U39
          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS
BEALL       62 SPRK E F BEALL +            CERN       368 62 L R L          U39
                                      ALSO SIENA      123 63 L R L          U39
SODICKSON   64 SPRK L SODICKSON +          PR    133 B757 64 M I T          U39
```

Baryon Resonances (*Continued*)

```
CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
```

$Y_1^*(1385)$

```
                      43  Y*1 (1385,JP=3/2+)  I=1

                      43  Y*1(1385)  MASS (MEV)

U43M  170 1375.0      3.9                    COOPER     64 HBC  +
U43M  681 1381.0      1.6                    HUWE       64 HBC  +

U43M      1385.0                             ALSTON     60 HBC  +-
U43M  378 1376.0      3.0                    ELY        61 PBC  +-
U43M   51 1388.0                             COOPER     62 HBC  +-
U43M   76 1390.0      3.0                    BERTANZA   63 HBC  +-
U43M      1384.0                             MARTIN     61 HBC  +0
U43M      1382.0      3.0                    DAHL       61 HBC   -
U43M  200 1392.0      6.2                    COOPER     64 HBC   -

U43M  803 1385.3      1.5                    HUWE       64 HBC   -
U43M   85 1392.0      7.0                    COLLEY     62 PBC  -0

U43M  106 1381.0      4.0                    CURTIS     63 SPRK   0

                      43  Y*1(1385) MASS DIFF. (-) - (+)

U43D 1500    4.3      2.2                    HUWE       64 HBC
U43D  370   17.0      7.0                    COOPER     64 HBC

                      43  Y*1(1385)  WIDTH (MEV)

U43W  154   48.0      8.0                    ELY        61 PBC  +
U43W  239   51.0      6.5                    COOPER     64 HBC  +
U43W  681   46.5      3.0                    HUWE       64 HBC  +
U43W   51   40.0                             COOPER     62 HBC  +-
U43W   76   50.0     10.0                    BERTANZA   63 HBC  +-

U43W  224   66.0     10.0                    ELY        61 PBC   -
U43W  269   88.0      6.5                    COOPER     64 HBC   -
U43W  803   62.0      7.0                    HUWE       64 HBC   -
U43W   85   80.0     20.0                    COLLEY     62 PBC  -0
U43W  106   30.0      9.0                    CURTIS     63 SPRK   0

                      43  Y*1(1385) PARTIAL DECAY MODES

U43P1     Y*1(1385) INTO LAMBDA PI                              S18S 8
U43P2     Y*1(1385) INTO SIGMA PI                               S21S 9

                      43  Y*1(1385)  BRANCHING RATIOS

U43R1*  Y*1(1385) INTO (SIGMA+PI)/(LAMBDA+PI)                (P2)/(P1)
U43R1          0.02       0.02               BASTIEN    61 HBC  +-0
U43R1*         0.04       0.04    OR LESS    ALSTON     62 HBC
U43R1 100      0.09       0.04               HUWE       64 HBC
```

$Y_1^*(1660)$

```
                      44  Y*1 (1660,JP=    )  I=1

                      44  Y*1(1660)  MASS (MEV)

U44M      1685.0                             ALEXANDER  62 HBC  -0
U44M      1560.0     10.0                    ALVAREZ    63 HBC  +

                      44  Y*1(1660)  WIDTH (MEV)

U44W        45.0      5.0                    ALEXANDER  62 HBC  -0
U44W        40.0     10.0                    ALVAREZ    63 HBC  +

                      44  Y*1(1660) PARTIAL DECAY MODES

U44P1     Y*1(1660) INTO LAMBDA PI                              S18S 8
U44P2     Y*1(1660) INTO SIG PI                                 S21S 8
U44P3     Y*1(1660) INTO LAMBDA 2PI                             S18S 8S 8
U44P4     Y*1(1660) INTO SIGMA 2PI                              S21S 8S 8
U44P5     Y*1(1660) INTO KBAR N                                 S12S17

                      44  Y*1(1660)  BRANCHING RATIOS

U44R1*  Y*1(1660)  INTO LAMBDA+PI                            (P1)/TOTAL
U44R1 130     0.32                         ALVAREZ     63 HBC  +
U44R1*        0.07   OR LESS               BASTIEN     63 HBC

U44R2*  Y*1(1660) INTO SIGMA +PI                             (P2)/TOTAL
U44R2 130     0.27                         ALVAREZ     63 HBC  +
U44R2         0.26        0.05             BASTIEN     63 HBC

U44R3*  Y*1(1660) INTO LAMBDA+2PI                            (P3)/TOTAL
U44R3  90     0.18                         ALVAREZ     63 HBC  +
U44R3         0.19        0.06             BASTIEN     63 HBC

U44R4*  Y*1(1660) INTO SIGMA +2PI                            (P4)/TOTAL
U44R4 180     0.18                         ALVAREZ     63 HBC  +
U44R4         0.28        0.07             BASTIEN     63 HBC

U44R5*  Y*1(1660) INTO K-N                                   (P5)/TOTAL
U44R5*         0.05 OR LESS                ALVAREZ     63 HBC  +
U44R5*         0.18       0.06   OR MORE   BASTIEN     63 HBC

U44R6*    Y*1(1660) INTO (SIGMA PI)/(LAMBDA PI)              (P2)/(P1)
U44R6         0.86                         SMITH       63 HBC
U44R6         6.5         1.5              HUWE        64 HBC

U44R7*    Y*1(1660) INTO (LAMBDA 2PI)/(LAMBDA PI)            (P3)/(P1)
U44R7         0.142                        SMITH       63 HBC

U44R8*    Y*1(1660) INTO (KBAR N)/(LAMBDA PI)                (P5)/(P1)
U44R8         0.43        0.21             SMITH       63 HBC
```

$Y_1^*(1765)$

```
                    45  Y*1(1765,JP=5/2 )  I=1

                    45  Y*1(1765)  MASS (MEV)
U45M      1765.0      10.0                 GALTIERI    63 HBC

                    45  Y*1(1765)  WIDTH (MEV)

U45W        60.0      10.0                 GALTIERI    63 HBC

                    45  Y*1(1765) PARTIAL DECAY MODES

U45P1     Y*1(1765) INTO KBAR-N                                 S12S17
U45P2     Y*1(1765) INTO SIGMA PI                               S19S 8
U45P3     Y*1(1765) INTO LAMBDA PI                              S18S 8

                    45  Y*1(1765) BRANCHING RATIOS

U45R1*    Y*1(1765) INTO KBAR-N                               (P1)/TOTAL
U45R1         0.6                          GALTIERI    63 DBC

U45R *    OTHER MODES NOT YET SEPARETED FROM Y*0(1815),SEE ABOVE
```

```
CODE EVENT QUANTITY  ERROR+    ERROR-    REFERENCE  YR TECH SIGN   *
    IN PEAK

     * INDICATES DATA IGNORED BY PROGRAMS
```

$\Xi^*(1530)$

```
                    49  XI* (1530,JP=3/2+)  I=1/2

                    49  XI*(1530)  MASS (MEV)

U49M   57 1529.0      5.0                  PJERROU     62 HBC   -0
U49M   20 1535.0                           BERTANZA    62 HBC   -0
U49M      1535.7      4.7                  LONDON      64 HBC   -
U49M      1528.7      1.1                  LONDON      64 HBC    0

                    49  XI*(1530)  WIDTH (MEV)

U49W * 57     7.0 OR LESS                  PJERROU     62 HBC   -0
U49W * 20    35.0 OR LESS                  BERTANZA    62 HBC   -0
U49W  100    7.0       2.0                 SCHLEIN     63 HBC    0
U49W         8.5       3.0                 LONDON      64 HBC   -0
```

$\Xi^*(1810)$

```
                    50  XI*(1810,JP=    )  I=1/2

                    50  XI*(1810)  MASS (MEV)

U50M   20 1770.0                           HALSTEINSLI63 FBC    -0
U50M   56 1810.0        20.0               SMITH       64 HBC   -0

                    50  XI*(1810)  WIDTH (MEV)

U50W * 20     80.0 OR LESS                 HALSTEINSLI63 FBC    -0
U50W * 56     70.0 APPROX                  SMITH       64 HBC   -0

                    50  XI*(1810) PARTIAL DECAY MODES

U50P1     XI*(1810) INTO XI*(1530) PI                         U49S 9
U50P2     XI*(1810) INTO LAMBDA KBAR                          S18S11
U50P3     XI*(1810) INTO XI PI                                S22S 9
U50P4     XI*(1810) INTO SIGMA KBAR                           S19S10

                    50  XI*(1810) BRANCHING RATIOS
U50R1*    XI*(1810) INTO (LAMB.KBAR)/(XI*(1530) PI)        (P2)/(P1)
U50R1*       0.9 APPROX                    SMITH       64 HBC

U50R2*    XI*(1810) INTO (XI PI)/TOTAL                     (P3)/TOTAL
U50R2*      0.10   OR LESS                 SMITH       64 HBC

U50R3*    XI*(1810) INTO (SIGMA KBAR)/TOTAL                (P4)/TOTAL
U50R3*      0.10   OR LESS                 SMITH       64 HBC

0         1         2         3         4         5         6         7         8
12345*789012345678901234567890123456789012345678901234567890123456789012345678901234567890
```

REFERENCES ON BARYON RESONANCES

```
IDENTIFIC.  YR AUTHORS                     JOUR.VOL PAGE YR INSTITUTION     COD
```

$Y_1^*(1385)$

```
                        43  Y*1 (1385,JP=3/2+)  I=1
ALSTON      60 HBC  M H ALSTON +              PRL    5  520 60 L R L           U43
DAHL        61 HBC  O DAHL +                  PRL    6  142 61 L R L           U43
ELY         61 PBC  R P ELY +                 PRL    7  461 61 L R L           U43
MARTIN      61 HBC  M J MARTIN,LEIPUNER +     PRL    6  283 61 YALE,BNL        U43
ALSTON      62 HBC  M ALSTON,ALVAREZ +        CERN      311 62 L R L           U43
COLLEY      62 PBC  D COLLEY +                PR   128 1930 62 COL+RUTU        U43
COOPER      62 HBC  W A COOPER +              CERN      298 62 CERN+ZEEM+GLA   U43

BERTANZA    63 HBC  L BERTANZA +              PRL   10  176 63 BNL+SYR         U43
CURTIS      63 SPRK L J CURTIS +              PR   132 1771 63 MICHIGAN        U43
COOPER      64 HBC  WA COOPER +               PL     8  365 64 CERN+ZEEMAN     U43
HUWE        64 HBC  D O HUWE                  UCRL    11291 64 L R L           U43

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

SHAFER      63 HBC  J B SHAFER +              PRL   10  179 63 J P             U43
SHAFER      64 HBC  J B SHAFER +              PR             64 J P             U43
```

$Y_1^*(1660)$

```
                        44  Y*1 (1660,JP=    )  I=1
ALEXANDER   62 HBC  G ALEXANDER +             CERN      320 62 L R L           U44
ALVAREZ     63 HBC  L W ALVAREZ +             PRL   10  184 63 L R L           U44
SMITH       63 AVUF G A SMITH                 ATHENS     67 63 L R L           U44
HUWE        64 HBC  D O HUWE                  THESIS         64 LRL             U44

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

BASTIEN     63 HBC  P L BASTIEN,J P BERGE     PRL   10  188 63 I J             U44
BASTIEN     63 HBC  P L BASTIEN               UCRL    10779 63 I J             U44
TAHER       63 HBC  M TAHER-ZADEH +           PRL   11  470 63 J P             U44
```

$Y_1^*(1765)$

```
                        45  Y*1 (1765,JP=5/2 )  I=1
GALTIERI    63 DBC  A BARBARO-GALTIERI +      PL     6  296 63 L R L           U45
```

$\Xi^*(1530)$

```
                        49  XI* (1530,JP=3/2+)  I=1/2
BERTANZA    62 HBC  L BERTANZA +              PRL    9  180 62 BNL+SYR         U49
PJERROU     62 HBC  G M PJERROU +             PRL    9  114 62 UCLA            U49
CONNOLLY    63 HBC  P L CONNOLLY +            SIENA     125 63 BNL+SYR         U49
SCHLEIN     63 HBC  P E SCHLEIN +             PRL   11  167 63 UCLA            U49

LONDON      64 HBC  G W LONDON +              BAPS   9   22 64 BNL+SYR         U49
```

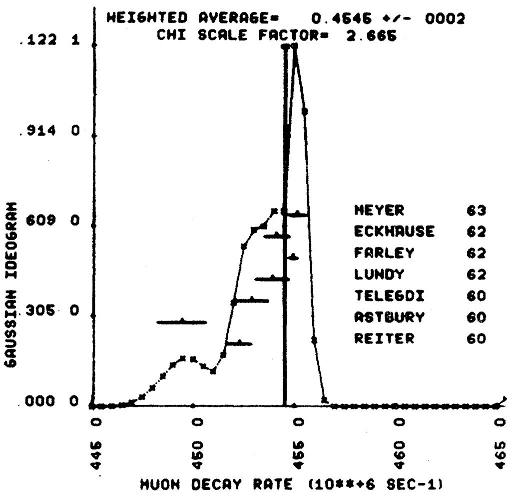
$\Xi^*(1810)$

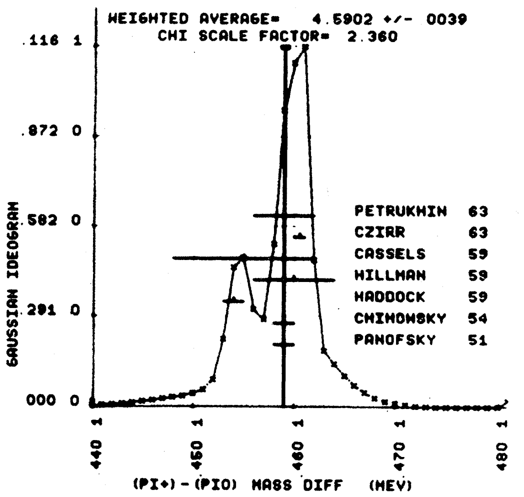
```
                        50  XI*(1810,JP=    )  I=1/2
HALSTEINSLID63 FBC  A HALSTEINSLID +          SIENA     173 63 RE+CE+EP+R+UC   U50
SMITH       64 HBC  G A SMITH +               PRL            64 L R L           U50

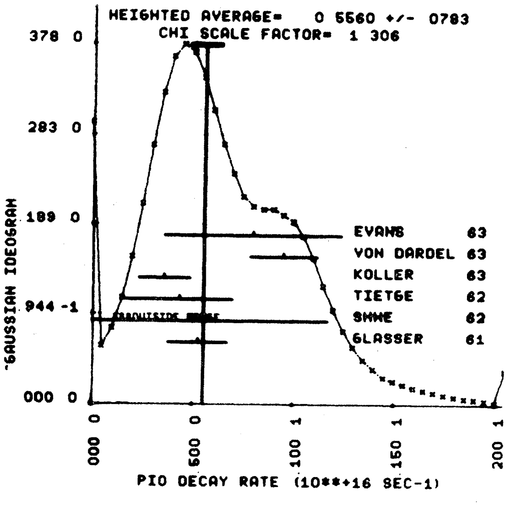
0         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

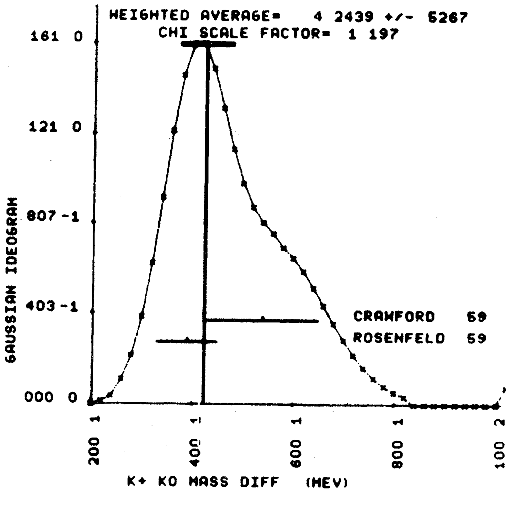
IDEOGRAMS WHICH HAD $\chi^2 > N - 1$

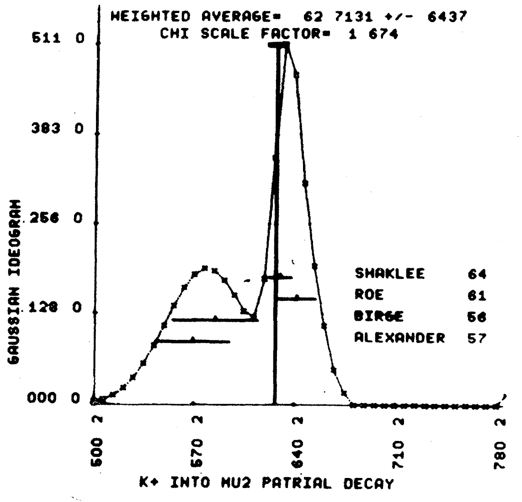
Vertical line and error flag above it show weighted mean and its statistical error

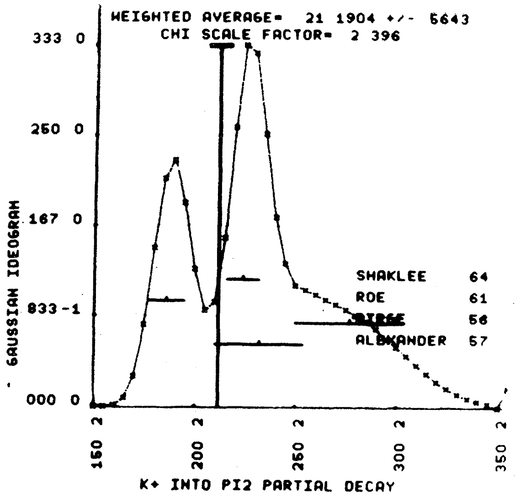


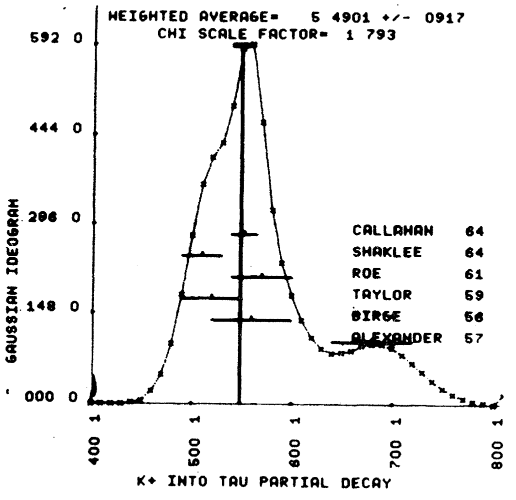


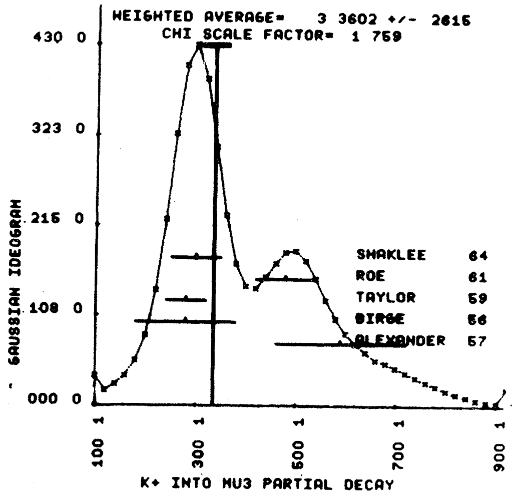


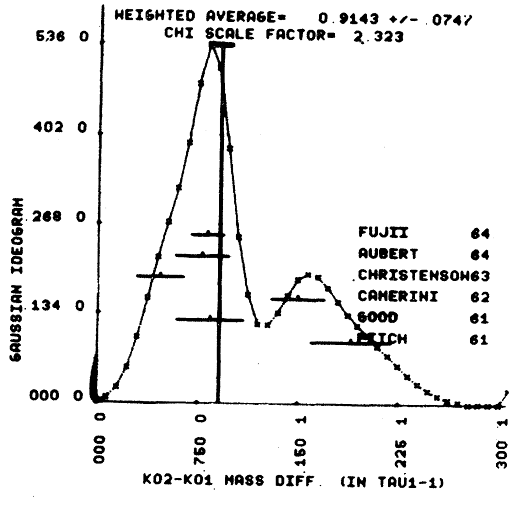


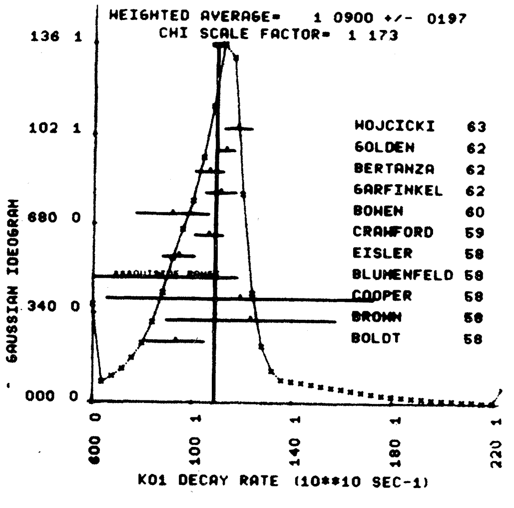

WEIGHTED AVERAGE= 62 7131 +/- 6437
CHI SCALE FACTOR= 1 674
511 0
383 0
256 0
128 0
000 0
GAUSSIAN IDEOGRAM
SHAKLEE 64
ROE 61
BIRGE 56
ALEXANDER 57
500 2
570 2
640 2
710 2
780 2
K+ INTO MU2 PATRIAL DECAY

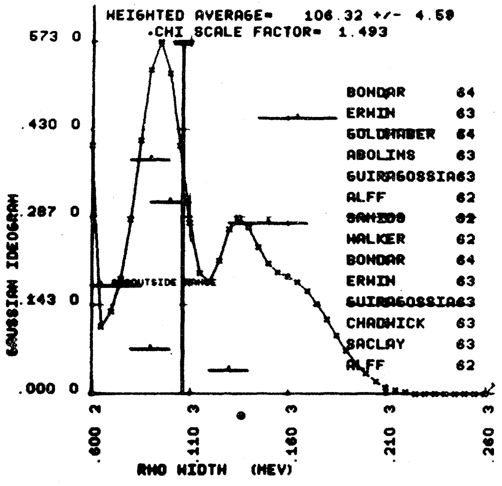

WEIGHTED AVERAGE= 21 1904 +/- 5643
CHI SCALE FACTOR= 2 396
333 0
250 0
167 0
833-1
000 0
GAUSSIAN IDEOGRAM
SHAKLEE 64
ROE 61
BIRGE 56
ALEXANDER 57
150 2
200 2
250 2
300 2
350 2
K+ INTO PI2 PARTIAL DECAY

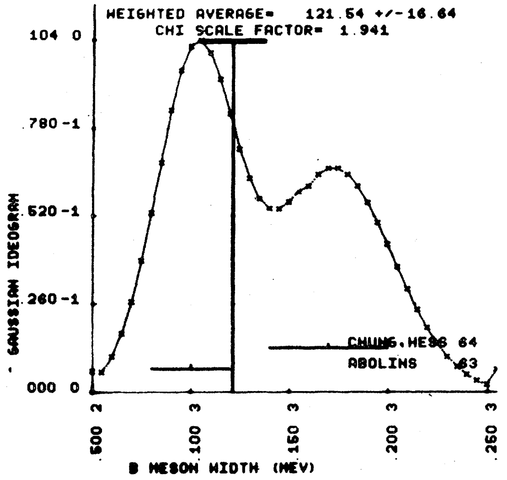

WEIGHTED AVERAGE= 5 4901 +/- 0917
CHI SCALE FACTOR= 1 793
592 0
444 0
296 0
148 0
000 0
GAUSSIAN IDEOGRAM
CALLAHAN 64
SHAKLEE 64
ROE 61
TAYLOR 59
BIRGE 56
ALEXANDER 57
400 1
500 1
600 1
700 1
800 1
K+ INTO TAU PARTIAL DECAY

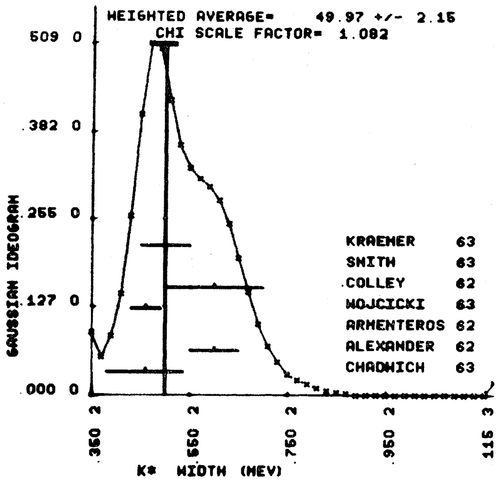

WEIGHTED AVERAGE= 3 3602 +/- 2616
CHI SCALE FACTOR= 1 759
430 0
323 0
215 0
108 0
000 0
GAUSSIAN IDEOGRAM
SHAKLEE 64
ROE 61
TAYLOR 59
BIRGE 56
ALEXANDER 57
100 1
300 1
500 1
700 1
900 1
K+ INTO MU3 PARTIAL DECAY

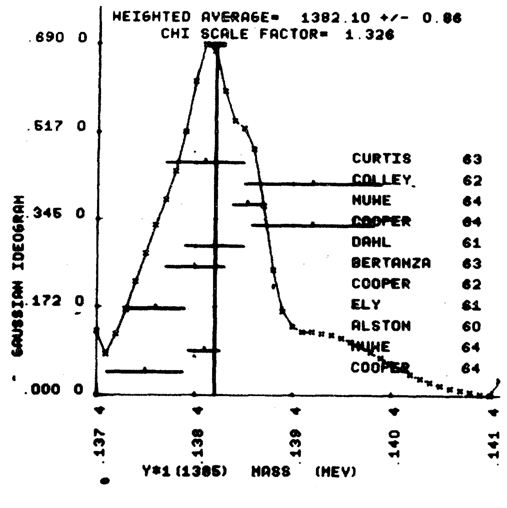

WEIGHTED AVERAGE= 0.9143 +/- .0747
CHI SCALE FACTOR= 2.323
536 0
402 0
268 0
134 0
000 0
GAUSSIAN IDEOGRAM
FUJII 64
AUBERT 64
CHRISTENSON63
CAMERINI 62
GOOD 61
FITCH 61
000 0
750 0
150 1
225 1
300 1
K02-K01 MASS DIFF. (IN TAU1-1)

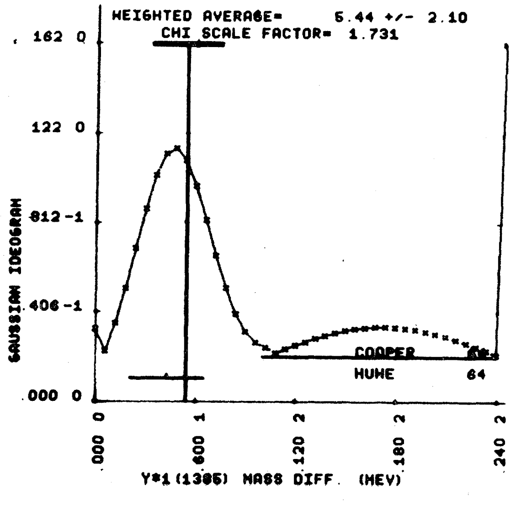

WEIGHTED AVERAGE= 1 0900 +/- 0197
CHI SCALE FACTOR= 1 173
136 1
102 1
680 0
340 0
000 0
GAUSSIAN IDEOGRAM
WOJCICKI 63
GOLDEN 62
BERTANZA 62
GARFINKEL 62
BOWEN 60
CRAWFORD 59
EISLER 58
BLUMENFELD 58
COOPER 58
BROWN 58
BOLDT 58
600 0
100 1
140 1
180 1
220 1
K01 DECAY RATE (10**10 SEC-1)

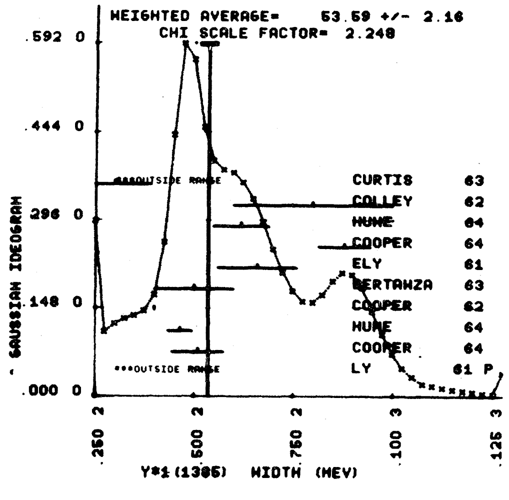

WEIGHTED AVERAGE= 106.32 +/- 4.59
CHI SCALE FACTOR= 1.493
.573 0
.430 0
.287 0
.143 0
.000 0
GAUSSIAN IDEOGRAM
BONDAR 64
ERWIN 63
GOLDHABER 64
ABOLINS 63
GUIRAGOSSIAN63
ALFF 62
~~SANIDO 62~~
WALKER 62
BONDAR 64
ERWIN 63
GUIRAGOSSIAN63
CHADWICK 63
SACLAY 63
ALFF 62
***OUTSIDE RANGE
.600 2
.110 3
.160 3
.210 3
.260 3
RHO WIDTH (MEV)

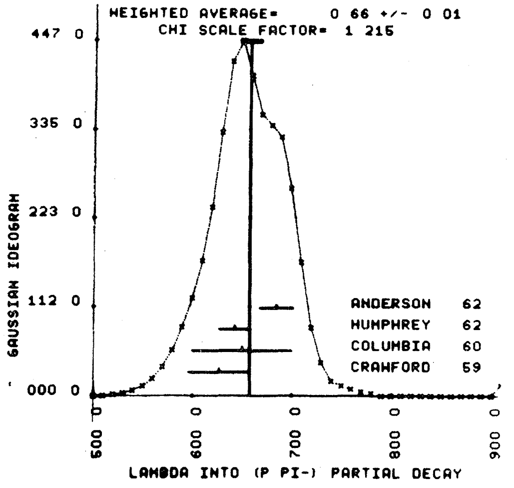

WEIGHTED AVERAGE= 121.54 +/-16.64
CHI SCALE FACTOR= 1.941
.104 0
.780 -1
.520 -1
.260 -1
.000 0
GAUSSIAN IDEOGRAM
CHUNG,HESS 64
ABOLINS 63
.500 2
.100 3
.150 3
.200 3
.250 3
B MESON WIDTH (MEV)

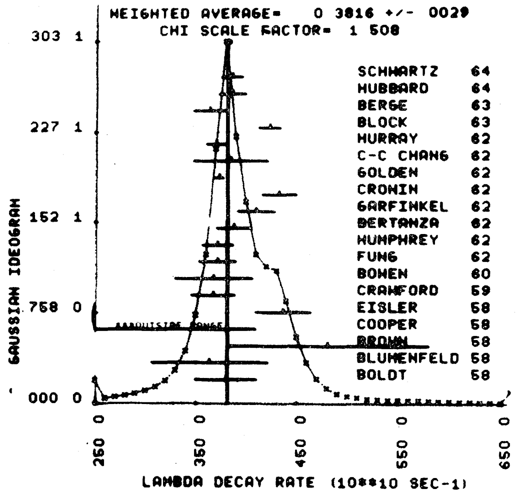

WEIGHTED AVERAGE= 49.97 +/- 2.15
CHI SCALE FACTOR= 1.082
.509 0
.382 0
.255 0
.127 0
.000 0
GAUSSIAN IDEOGRAM
KRAEMER 63
SMITH 63
COLLEY 62
WOJCICKI 63
ARMENTEROS 62
ALEXANDER 62
CHADWICK 63
.350 2
.550 2
.750 2
.950 2
.115 3
K* WIDTH (MEV)

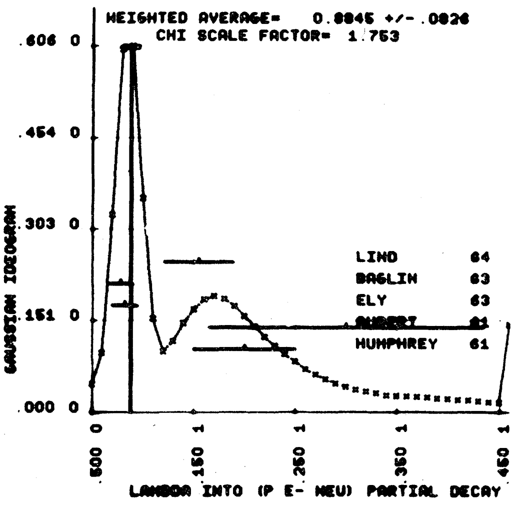

WEIGHTED AVERAGE= 1382.10 +/- 0.86
CHI SCALE FACTOR= 1.326
.690 0
.517 0
.345 0
.172 0
.000 0
GAUSSIAN IDEOGRAM
CURTIS 63
COLLEY 62
HUWE 64
COOPER 64
DAHL 61
BERTANZA 63
COOPER 62
ELY 61
ALSTON 60
HUWE 64
COOPER 64
.137 4
.138 4
.139 4
.140 4
.141 4
Y*1(1385) MASS (MEV)

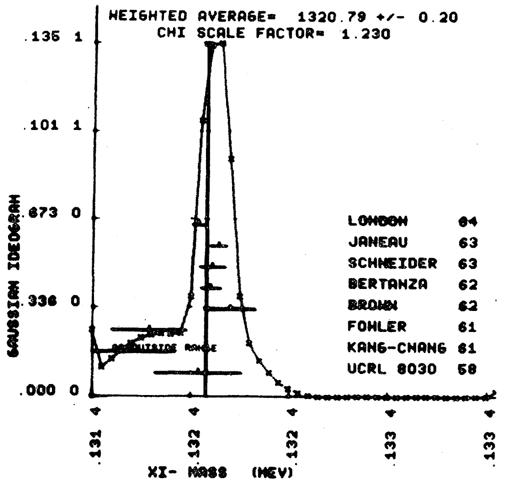

WEIGHTED AVERAGE= 5.44 +/- 2.10
CHI SCALE FACTOR= 1.731
.162 0
.122 0
.812 -1
.406 -1
.000 0
GAUSSIAN IDEOGRAM
COOPER 64
HUWE 64
.000 0
.600 1
.120 2
.180 2
.240 2
Y*1(1385) MASS DIFF. (MEV)


WEIGHTED AVERAGE= 53.59 +/- 2.16
CHI SCALE FACTOR= 2.248
.592 0
.444 0
.296 0
.148 0
.000 0
GAUSSIAN IDEOGRAM
***OUTSIDE RANGE
CURTIS 63
COLLEY 62
HUWE 64
COOPER 64
ELY 61
BERTANZA 63
COOPER 62
HUWE 64
COOPER 64
ELY 61 P
***OUTSIDE RANGE
.250 2
.500 2
.750 2
.100 3
.125 3
Y*1(1385) WIDTH (MEV)


HEIGHTED AVERAGE= 0 66 +/- 0 01
CHI SCALE FACTOR= 1 215
447 0
335 0
223 0
112 0
000 0
GAUSSIAN IDEOGRAM
ANDERSON 62
HUMPHREY 62
COLUMBIA 60
CRAHFORD 59
500 0
600 0
700 0
800 0
900 0
LAMBDA INTO (P PI-) PARTIAL DECAY


HEIGHTED AVERAGE= 0 3816 +/- 0029
CHI SCALE FACTOR= 1 508
303 1
227 1
152 1
758 0
000 0
GAUSSIAN IDEOGRAM
SCHHARTZ 64
HUBBARD 64
BERGE 63
BLOCK 63
HURRAY 62
C-C CHANG 62
GOLDEN 62
CRONIN 62
GARFINKEL 62
BERTANZA 62
HUMPHREY 62
FUNG 62
BOHEN 60
CRAHFORD 59
EISLER 58
COOPER 58
BROWN 58
BLUMENFELD 58
BOLDT 58
250 0
350 0
450 0
550 0
650 0
LAMBDA DECAY RATE (10**10 SEC-1)


HEIGHTED AVERAGE= 0.8845 +/- .0826
CHI SCALE FACTOR= 1.753
.606 0
.454 0
.303 0
.151 0
.000 0
GAUSSIAN IDEOGRAM
LIND 64
BAGLIN 63
ELY 63
AUBERT 61
HUMPHREY 61
500 0
150 1
250 1
350 1
450 1
LAMBDA INTO (P E- NEU) PARTIAL DECAY


HEIGHTED AVERAGE= 1320.79 +/- 0.20
CHI SCALE FACTOR= 1.230
.135 1
.101 1
.673 0
.336 0
.000 0
GAUSSIAN IDEOGRAM
LONDON 64
JANEAU 63
SCHNEIDER 63
BERTANZA 62
BROWN 62
FOHLER 61
KANG-CHANG 61
UCRL 8030 58
.131 4
.132 4
.132 4
.133 4
.133 4
XI- MASS (MEV)

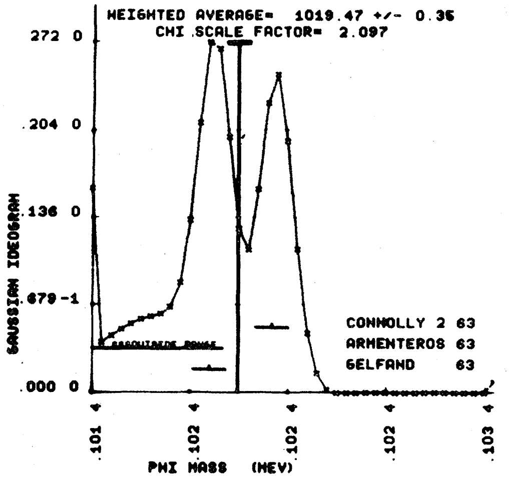

HEIGHTED AVERAGE= 1019.47 +/- 0.35
CHI SCALE FACTOR= 2.097
272 0
.204 0
.136 0
.679 -1
.000 0
GAUSSIAN IDEOGRAM
CONNOLLY 2 63
ARMENTEROS 63
GELFAND 63
.101 4
.102 4
.102 4
.102 4
.103 4
PHI MASS (MEV)

Table II. Atomic and nuclear properties (dE/dx, collision mean free path, radiation length, etc.) of materials used as absorbers and detectors

Material	Z	A	Cross section σ [a] (barns)	$-\frac{dE}{dx}$ min [b] Mev g/cm²	Collision[a] length g/cm²	L_{coll} cm	Radiation[c] length g/cm²	L_{rad} cm	Density ρ (g/cm³)
H_2	1	1.01	0.063	4.14	26.5	374	58	819.0	0.0708 boiling at 1 atmos
Li	3	6.94	0.23	1.72	50.4	94.3	77.5	145	0.534
Be	4	9.01	0.28	1.71	55.0	29.9	62.2	33.8	1.84
C	6	12.00	0.33	1.86	60.4	39.0	42.5	27.4	1.55 (variable)
Al	13	26.97	0.57	1.66	79.2	29.3	23.9	8.86	2.70
Cu	29	63.57	1.00	1.45	105.4	11.8	12.8	1.44	8.9
Sn	50	118.70	1.55	1.27	129.7	17.8	8.54	1.17	7.30
Pb	82	207.21	2.20	1.12	156.2	13.8	5.8	0.51	11.34
U	92	238.07	2.42	1.095	163.6	8.75	5.5	0.29	18.7
Hydrogen (bubble chamber, 27.6°K)				0.243 Mev/cm	26.5	452	58	990	0.0586
Propane (C_3H_8, bubble chamber)				0.935 Mev/cm	48.9	119.3	44.7	109.0	0.41
Freon CF_3Br				2.3	87.1	58.0	17.25	11.5	1.5
Polystyrene (CH scintillator)				2.14 Mev/cm	54.9	52.3	43.4	41.3	~ 1.05
Ilford emulsion				5.49 Mev/cm	103	27.0	11.2	2.91	3.815

[a] $\sigma_{natural} \equiv \pi \left(\frac{\hbar}{m_\pi c}\right)^2 \times A^{2/3} = 63 \text{ mb} \times A^{2/3}$; $L_{collision} \equiv \frac{A}{N_0 \sigma_{natural}} = \frac{A^{1/3}}{N_0 \pi \left(\frac{\hbar}{m_\pi c}\right)^2} = 26.4\, A^{1/3}$ g/cm².

[b] From range-energy tables of M. Rich and R. Madey, UCRL-2301, March 1954, and of Walter H. Barkas, UCRL-3769, April 1957.

[c] From Experimental Nuclear Physics, E. Segrè, Ed. (Wiley, New York, 1953), Table 8, p. 265. The radiation lengths have not been corrected for failure of the Born approximation and several additional small effects.

Table IIIa. Multiple Coulomb scattering and Lorentz transformation

The rms projected angle θ due to multiple Coulomb scattering (only) of a particle of charge z, momentum P, velocity V is

$$\theta_{\text{proj}} = z\,\frac{15(\text{MeV})}{PV(\text{MeV})}\sqrt{\frac{L}{L_{(\text{rad})}}}\,(1+\epsilon)\ \text{radians;}$$

L = Length in scatterer; L(radiation) from Table II. For $L \geqslant 1/10\ L(\text{rad})$ ϵ is generally $< 1/10$. The distribution of θ is not truly Gaussian. The rms projected displacement y on traversing an absorber of thickness L is

$$y_{\text{rms}} = L\theta_{\text{proj}}/\sqrt{3}$$

Lorentz transformations. Notation: Lower-case type for c.m. 4-momentum $(\vec{p}, w)$ and capitals for lab $(\vec{P}, W)$. $(c \equiv 1.)$ To transform from c.m. to lab write

$$\begin{pmatrix} \gamma & 0 & 0 & \eta \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ \eta & 0 & 0 & \gamma \end{pmatrix}\begin{pmatrix} p\cos\theta \\ p\sin\theta \\ 0 \\ w \end{pmatrix} = \begin{pmatrix} \gamma p\cos\theta + \eta w \\ p\sin\theta \\ 0 \\ \eta p\cos\theta + \gamma w \end{pmatrix} = \begin{pmatrix} P\cos\Theta \\ P\sin\Theta \\ 0 \\ W \end{pmatrix}$$

If two particles (1 and 2) collide, the invariant "mass" μ of the system is given by

$$\mu^2 = (W_1 + W_2)^2 - (\vec{P}_1 + \vec{P}_2)^2, \qquad (1)$$

$$\gamma = \frac{W_1 + W_2}{\mu}; \quad \eta = \left|\frac{\vec{P}_1 + \vec{P}_2}{\mu}\right| = \gamma\beta. \qquad (2)$$

Write T for lab kinetic energy, t for c.m.; thus $\mu = m_1 + m_2 + t_1 + t_2 = m_1 + m_2 + Q$. If the target is at rest $(0, m_2)$ μ simplifies:

$$\mu^2 = (m_1 + m_2)^2 + 2T_1 m_2. \qquad (3)$$

To get a threshold T_1, set μ = sum of masses of reaction products, then

$$[\Sigma m(\text{products})]^2 = (m_1 + m_2)^2 + 2T_1 m_2. \qquad (4)$$

Other invariants are: $w_1 w_2 - p_1 p_2 \cos\theta_{12}$ (5)

and

$$\frac{1}{p}\,\frac{d^2\sigma}{d\omega dw}\,. \qquad (6)$$

The max. lab angle that a particle of c.m. momentum p_i can have is given by

$$\sin\Theta_i = \frac{\eta_i}{\eta}\ \left(\eta_i = \frac{p_i}{m_i}\ \text{must be} < \eta\right); \qquad (7)$$

If $\eta_i > \eta$, then of course Θ_i can be π.

Crawford's mnemonic for extending nonrelativistic formulas to relativistic case: "To the rest energy of each moving particle add $Q/2$" where

Q = the total kinetic energy (c.m.) $= \mu - \Sigma m_i$.

Thus in the rest frame of a two-body decay the kinetic energy Q is shared between the two particles according to

$$t_1 = Q\,\frac{m_2 + Q/2}{\mu}, \quad t_2 = Q\,\frac{m_1 + Q/2}{\mu}\,. \qquad (8)$$

The above of course applies in the c.m. for the production of a two-body final state. To express t in terms of p, apply the mnemonic to a single particle (then $Q = t$). The non-rel. relation $p^2 = 2tm$ becomes

$$p^2 = 2t(m + t/2) = 2tm + t^2. \qquad (9)$$

Energy Transfer for elastic collisions of beam (P_1, W_1) with resting target $(0, m_2)$, is

$$T_2 = 2m_2\,\frac{P_1^2}{\mu^2}\,\sin^2(\theta_{\text{c.m.}}/2)\,. \qquad (10)$$

Note that for max T_2, $\theta_{\text{c.m.}} = \pi$, so

$$T_{2\text{max.}} = 2m_2\,P_1^2/\mu^2 \approx 2\,m_2\eta^2. \qquad (11)$$

TABLES FROM UCRL-8030(rev.) June 1964

Table IV. Atomic and nuclear constants in units of MeV, cm, and sec [a]

GENERAL ATOMIC CONSTANTS

$N = 6.02252 \times 10^{23}$ molecules/mole[b]

$c = 2.997925 \times 10^{10}$ cm/sec

$e = 4.80298 \times 10^{-10}$ esu $= 1.6021 \times 10^{-19}$ coulomb.

$1\ \text{MeV} = 1.6021 \times 10^{-6}$ erg [1 ev = e(10⁸/c)]

$\hbar = 6.5820 \times 10^{-22}$ MeV sec $= 1.05450 \times 10^{-27}$ erg sec.

$\hbar c = 1.9732 \times 10^{-11}$ MeV cm [$= \lambda\!\!\!^{-}$ for p = 1 MeV/c]

$k = 8.6171 \times 10^{-11}$ MeV/°C [Boltzmann constant]

$\alpha = \dfrac{e^2}{\hbar c} = 1/137.0388$; $e^2 = 1.4399 \times 10^{-13}$ MeV cm

QUANTITIES DERIVED FROM THE ELECTRON MASS, m

Mass and Energy

$m = 0.511006$ MeV $= 1/1836.10\ m_p = 1/273.19\ m_\pi$

Rydberg, $R_\infty = \dfrac{me^4}{2\hbar^2} = mc^2 \times \dfrac{\alpha^2}{2} = 13.605$ eV

Length (1 fermi = 10^{-13} cm; 1 A = 10^{-8} cm)

$r_e = e^2/mc^2 = 2.81777$ fermi

$\lambda\!\!\!^{-}_{\text{Compton}} = \dfrac{\hbar}{mc} = r_e\alpha^{-1} = 3.86144 \times 10^{-11}$ cm

$a_{\infty\ \text{Bohr}} = \dfrac{\hbar^2}{me^2} = r_e\alpha^{-2} = 0.52967$ A

Hydrogen-like atom (Non. Rel.; $\mu \equiv$ reduced mass).

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

QUANTITIES DERIVED FROM THE MASS OF THE CHARGED PION, m_π

Rest mass $= 139.60$ MeV/c² $= 273.19\ m_e = 0.14878\ m_p$

Length

$\dfrac{\hbar}{m_\pi c} = 1.4135$ fermi ($\sim \sqrt{2}$ fermi)

Natural (≈ "geometrical") Nucleon Cross Section

$\pi\left(\dfrac{\hbar}{m_\pi c}\right)^2 = 62.7655$ mb (1 mb = 10^{-27} cm²)

(3/2, 3/2)πp Resonance of mass 1237 MeV (Q = 159 MeV).

Center-of-mass momentum: $p_\pi = 230$ MeV/c

Lab-system momentum: $P_\pi = 303$ MeV/c ($T_\pi = 195$ MeV)

RADIOACTIVITY

1 curie $= 3.7 \times 10^{10}$ disintegrations/sec

1 R $= 87.8$ ergs/g air $= 5.49 \times 10^{7}$ MeV/g air

Fluxes (per cm²) to liberate 1 R in carbon:

3×10^{7} minimum ionizing singly charged particles
0.9×10^{9} photons of 1 MeV energy.

(These fluxes are actually correct to within a factor of two for all materials.)

Natural background: 100 mR/year

"Tolerance" 100 millirem/week [Note, 1 R may produce up to 10 "Rem" (R equivalent for man), depending on type of radiation.]

Cross Section

$\sigma_{\text{Thompson}} = \dfrac{8}{3}\,\pi r_e^{\,2} = 0.66516 \times 10^{-24}\,\text{cm}^2 = 0.66516$ barn

Magnetic Moment and Cyclotron Angular Frequency

$\mu_{\text{Bohr}} = \dfrac{e\hbar}{2mc} = 0.578815 \times 10^{-14}$ MeV/gauss

$\frac{1}{2}\omega_{\text{cyclotron}} = \dfrac{e}{2mc} = 8.79398 \times 10^{6}$ rad sec⁻¹/gauss

$g_{\text{electron}} = 2\left[1 + \dfrac{\alpha}{2\pi} - 0.328\left(\dfrac{\alpha}{\pi}\right)^2\right] = 2[1.001159615]^{c}$

$g_{\text{muon}} = 2\left[1 + \dfrac{\alpha}{2\pi} + 0.75\left(\dfrac{\alpha}{\pi}\right)^2\right] = 2[1.001165010]^{c}$

QUANTITIES DERIVED FROM THE PROTON MASS, m_p

Rest mass $= 938.256$ MeV/c² $= 1836.10\ m_e = 6.721\ m_\pi$
$= 1.0782522\ m_1$

where $m_1 = 1$ amu $= \frac{1}{12}\,C^{12} = 931.478$ MeV

Magnetic Moment and Cyclotron Angular Frequency

$\mu_p = \dfrac{e\hbar}{2m_pc} = 3.1524 \times 10^{-18}$ MeV/gauss

$\frac{1}{2}\omega_{\text{cyclotron}} = \dfrac{e}{2m_pc} = 4.7894 \times 10^{3}$ rad sec⁻¹/gauss

$\left.\dfrac{\mu}{\mu_p}\right)_{\text{proton}} = 2.79276$; $\left.\dfrac{\mu}{\mu_p}\right)_{\text{neutron}} = -1.9128$

MISCELLANEOUS

Physical Constants

1 year $= 3.1536 \times 10^{7}$ sec ($\approx \pi \times 10^{7}$ sec)

Density of air = 1.205 mg/cm³ at 20°C

Acceleration by gravity = 980.67 cm/sec²

1 calorie = 4.184 joules

1 atmosphere = 1033.2 g/cm²

Numerical Constants

1 radian = 57.29578 deg; e = 2.71828
ln 2 = 0.69315; $\log_{10} e = 0.43429$;
ln 10 = 2.30259; $\log_{10} 2 = 0.30103$.

Stirling's approximation

$$\sqrt{2\pi n}\left(\frac{n}{e}\right)^n < n! < \sqrt{2\pi n}\left(\frac{n}{e}\right)^n\left(1 + \frac{1}{12n-1}\right)$$

Gaussianlike Distributions

For n > -1 but not necessarily integral:

$$\int_0^\infty x^{2n+1} \exp\left[-\frac{x^2}{2\sigma^2}\right] dx = 2^n\, n!\ \sigma^{2n+2};\quad \left(\tfrac{1}{2}\right)! = \sqrt{\pi/2}$$

Relation between standard deviation σ and mean deviation α:

$2\sigma^2 = \pi\alpha^2$; σ = 1.4826 probable error.

Odds against exceeding one standard deviation = 2.15:1; two, 21:1; three, 370:1; four, 16,000:1; five, 1,700,000:1

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[a] Based mainly on E. Richard Cohen and J. W. M. DuMond, "Present Status of our Knowledge of the Numerical Values of the Fundamental Physical Constants," Second International Conference on Nuclidic Masses, Vienna, Austria, July 15-19, 1963.

[b] Based on atomic weight of C¹² being exactly 12.

[c] C. Sommerfield, Phys. Rev. 107, 328 (1957) and A. Petermans, Helv. Phys. Acta. 30, 407 (1957).

TABLE VII

CLEBSCH-GORDAN COEFFICIENTS AND SPHERICAL HARMONICS

1/2X1/2

J	1	1	0	1
M	+1	0	0	-1
m_1 m_2				
+1/2 +1/2	1			
+1/2 -1/2		$\sqrt{1/2}$	$\sqrt{1/2}$	
-1/2 +1/2		$\sqrt{1/2}$	$-\sqrt{1/2}$	
-1/2 -1/2				1

1X1/2

J	3/2	3/2	1/2	3/2	1/2	3/2
M	+3/2	+1/2	+1/2	-1/2	-1/2	-3/2
m_1 m_2						
+1 +1/2	1					
+1 -1/2		$\sqrt{1/3}$	$\sqrt{2/3}$			
0 +1/2		$\sqrt{2/3}$	$-\sqrt{1/3}$			
0 -1/2				$\sqrt{2/3}$	$\sqrt{1/3}$	
-1 +1/2				$\sqrt{1/3}$	$-\sqrt{2/3}$	
-1 -1/2						1

3/2X1/2

J	2	2	1	2	1	2	1	2
M	+2	+1	+1	0	0	-1	-1	-2
m_1 m_2								
+3/2 +1/2	1							
+3/2 -1/2		$\sqrt{1/4}$	$\sqrt{3/4}$					
+1/2 +1/2		$\sqrt{3/4}$	$-\sqrt{1/4}$					
+1/2 -1/2				$\sqrt{1/2}$	$\sqrt{1/2}$			
-1/2 +1/2				$\sqrt{1/2}$	$-\sqrt{1/2}$			
-1/2 -1/2						$\sqrt{3/4}$	$\sqrt{1/4}$	
-3/2 +1/2						$\sqrt{1/4}$	$-\sqrt{3/4}$	
-3/2 -1/2								1

2X1/2

J	5/2	5/2	3/2	5/2	3/2	5/2	3/2	5/2	3/2	5/2
M	+5/2	3/2	+3/2	+1/2	+1/2	-1/2	-1/2	-3/2	-3/2	-5/2
m_1 m_2										
+2 1/2	1									
+2 -1/2		$\sqrt{1/5}$	$\sqrt{4/5}$							
+1 +1/2		$\sqrt{4/5}$	$-\sqrt{1/5}$							
+1 -1/2				$\sqrt{2/5}$	$\sqrt{3/5}$					
0 +1/2				$\sqrt{3/5}$	$-\sqrt{2/5}$					
0 -1/2						$\sqrt{3/5}$	$\sqrt{2/5}$			
-1 +1/2						$\sqrt{2/5}$	$-\sqrt{3/5}$			
-1 -1/2								$\sqrt{4/5}$	$\sqrt{1/5}$	
-2 +1/2								$\sqrt{1/5}$	$-\sqrt{4/5}$	
-2 -1/2										1

$$Y_0^{\,0} = \sqrt{\frac{1}{4\pi}}$$

$$Y_1^{\,0} = \sqrt{\frac{3}{4\pi}}\ \cos\theta\,; \qquad Y_1^{\,1} = -\sqrt{\frac{3}{8\pi}}\ \sin\theta\, e^{i\phi}$$

$$Y_2^{\,0} = \sqrt{\frac{5}{4\pi}}\left(\frac{3}{2}\cos^2\theta - \frac{1}{2}\right)\,; \qquad Y_2^{\,1} = -\sqrt{\frac{15}{8\pi}}\,\sin\theta\cos\theta\, e^{i\phi}$$

$$Y_2^{\,2} = \frac{1}{4}\sqrt{\frac{15}{2\pi}}\ \sin^2\theta\, e^{2i\phi}$$

$$Y_3^{\,0} = \sqrt{\frac{7}{4\pi}}\left(\frac{5}{2}\cos^3\theta - \frac{3}{2}\cos\theta\right)\,; \qquad Y_3^{\,1} = -\frac{1}{4}\sqrt{\frac{21}{4\pi}}\ \sin\theta\left(5\cos^2\theta - 1\right) e^{i\phi}$$

$$Y_3^{\,2} = \frac{1}{4}\sqrt{\frac{105}{2\pi}}\ \sin^2\theta\cos\theta\, e^{2i\phi}\ ; \qquad Y_3^{\,3} = -\frac{1}{4}\sqrt{\frac{35}{4\pi}}\ \sin^3\theta\, e^{3i\phi}$$

$$\left(Y_\ell^{\,m}\right)^* = \left(-1\right)^m\ Y_\ell^{\,-m}$$

1X1

J	2	2	1	2	1	0	2	1	2
M	+2	+1	+1	0	0	0	-1	-1	-2
m_1 m_2									
+1 +1	1								
+1 0		$\sqrt{1/2}$	$\sqrt{1/2}$						
0 +1		$\sqrt{1/2}$	$-\sqrt{1/2}$						
+1 -1				$\sqrt{1/6}$	$\sqrt{1/2}$	$\sqrt{1/3}$			
0 0				$\sqrt{2/3}$	0	$-\sqrt{1/3}$			
-1 +1				$\sqrt{1/6}$	$-\sqrt{1/2}$	$\sqrt{1/3}$			
0 -1							$\sqrt{1/2}$	$\sqrt{1/2}$	
-1 0							$\sqrt{1/2}$	$-\sqrt{1/2}$	
-1 -1									1

3/2X1

J	5/2	5/2	3/2	5/2	3/2	1/2	5/2	3/2	1/2	5/2	3/2	5/2
M	+5/2	+3/2	+3/2	+1/2	+1/2	+1/2	-1/2	-1/2	-1/2	-3/2	-3/2	-5/2
m_1 m_2												
+3/2 +1	1											
+3/2 0		$\sqrt{2/5}$	$\sqrt{3/5}$									
+1/2 +1		$\sqrt{3/5}$	$-\sqrt{2/5}$									
+3/2 -1				$\sqrt{1/10}$	$\sqrt{2/5}$	$\sqrt{1/2}$						
+1/2 0				$\sqrt{3/5}$	$\sqrt{1/15}$	$-\sqrt{1/3}$						
-1/2 +1				$\sqrt{3/10}$	$-\sqrt{8/15}$	$\sqrt{1/6}$						
+1/2 -1							$\sqrt{3/10}$	$\sqrt{8/15}$	$\sqrt{1/6}$			
-1/2 0							$\sqrt{3/5}$	$-\sqrt{1/15}$	$-\sqrt{1/3}$			
-3/2 +1							$\sqrt{1/10}$	$-\sqrt{2/5}$	$\sqrt{1/2}$			
-1/2 -1										$\sqrt{3/5}$	$\sqrt{2/5}$	
-3/2 0										$\sqrt{2/5}$	$-\sqrt{3/5}$	
-3/2 -1												1

2X1

J	3	3	2	3	2	1	3	2	1	3	2	1	3	2	3
M	+3	+2	+2	+1	+1	+1	0	0	0	-1	-1	-1	-2	-2	-3
m_1 m_2															
+2 +1	1														
+2 0		$\sqrt{1/3}$	$\sqrt{2/3}$												
+1 +1		$\sqrt{2/3}$	$-\sqrt{1/3}$												
+2 -1				$\sqrt{1/15}$	$\sqrt{1/3}$	$\sqrt{3/5}$									
+1 0				$\sqrt{8/15}$	$\sqrt{1/6}$	$-\sqrt{3/10}$									
0 +1				$\sqrt{6/15}$	$-\sqrt{1/2}$	$\sqrt{1/10}$									
+1 -1							$\sqrt{1/5}$	$\sqrt{1/2}$	$\sqrt{3/10}$						
0 0							$\sqrt{3/5}$	0	$-\sqrt{2/5}$						
-1 +1							$\sqrt{1/5}$	$-\sqrt{1/2}$	$\sqrt{3/10}$						
0 -1										$\sqrt{6/15}$	$\sqrt{1/2}$	$\sqrt{1/10}$			
-1 0										$\sqrt{8/15}$	$-\sqrt{1/6}$	$-\sqrt{3/10}$			
-2 +1										$\sqrt{1/15}$	$-\sqrt{1/3}$	$\sqrt{3/5}$			
-1 -1													$\sqrt{2/3}$	$\sqrt{1/3}$	
-2 0													$\sqrt{1/3}$	$-\sqrt{2/3}$	
-2 -1															1

Note: When calculating terms which are linear in the above coefficients (e.g., interference, polarization), the sign convention becomes important. This table follows the one in Blatt and Weisskopf, Edmonds, Rose, Condon and Shortley, etc. Other authors (e.g., Schiff, Bethe and de Hoffmann) use different conventions.