Submitted to Reviews of Modern Physics

UCRL-8030, Pt. I
Jan. 1967 revision
(Preprint)

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

AEC Contract No. W-7405-eng-48

DATA ON PARTICLES AND RESONANT STATES

Arthur H. Rosenfeld, Angela Barbaro-Galtieri, William J. Podolsky,
LeRoy R. Price, Paul Soding, Charles G. Wohl,
Matts Roos and William J. Willis

January 1967

UCRL-8030, Pt. I
Jan. 1967 revision

DATA ON PARTICLES AND RESONANT STATES*

ARTHUR H. ROSENFELD, ANGELA BARBARO-GALTIERI,
WILLIAM J. PODOLSKY, LEROY R. PRICE, PAUL SODING,
CHARLES G. WOHL

Lawrence Radiation Laboratory, University of California, Berkeley, California

MATTS ROOS

CERN, Geneva, Switzerland

WILLIAM J. WILLIS

Dept. of Physics, Yale University, New Haven, Connecticut

January 1967

ABSTRACT

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

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

A. H. Rosenfeld, A. Barbaro-Galtieri, W. J. Podolsky, L. R. Price, Matts Roos, Paul Soding, W. J. Willis, C. G. Wohl

Particle	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) $c\tau$ (cm)	Mass^2 $(\text{GeV})^2$	Decays: Partial mode	Decays: Fraction	Q (MeV)	p or p_{max} (MeV/c)
γ	$0, 1(1^-)^-$	0		stable	0	stable			
ν_e / ν_μ	$J = \frac{1}{2}$	0(<0.2 keV) / 0(<2.1 MeV)		stable	0	stable			
$e^\mp$	$J = \frac{1}{2}$	0.511006 ±.000002		stable ($> 2\times10^{21}$ y)	0.000	stable	$\mu_e = 1.001159622 \pm .000000027 \frac{e\hbar}{2m_e c}$		
$\mu^\mp$	$J = \frac{1}{2}$	105.659 ±.002		2.199×10^{-6}	0.011	$e\nu\bar{\nu}$	100 %	105	53
				±.001, S=1.3*		$e\gamma\gamma$	(< 1.6)10^{-5}	105	53
	$\mu_\mu = 1.001164 \pm .000003 \frac{e\hbar}{2m_\mu c}$			$c\tau = 6.592\times10^4$		3e	(< 1.3)10^{-7}	104	53
			-33.920 ±.014			$e\gamma$	(< 6)10^{-9}	105	53
$\pi^\pm$	$1^-(0^-)^+$	139.579 ±.014		2.608×10^{-8}	0.019	$\mu\nu$	100 %	34	30
				±.015, S=3.5*		$e\nu$	(1.24± 0.03)10^{-4}	139	70
				$c\tau$ = 782		$\mu\nu\gamma$	(1.24± 0.25)10^{-4}	34	30
			4.6041 ±.0037	$(\tau^+ - \tau^-)/\bar{\tau}$ = (.4±.2)%		$\pi^0 e\nu$	(1.01± 0.09)10^{-8}	4	5
				(test of CPT)		$e\nu\gamma$	(3.0 ±0.5)10^{-8}	139	70
π^0	$1^-(0^-)^+$	134.975 ±.014		[b] 0.89×10^{-16}	0.018	$\gamma\gamma$	[c](98.8)%	135	67
				±.18, S=1.6*		γe^+e^-	(1.169)%	134	67
				$c\tau = 2.67\times10^{-6}$		$\gamma\gamma\gamma$	[c](< 5)10^{-6}	135	67
						$e^+e^-e^+e^-$	(3.47)10^{-5}	133	67
$K^\pm$	$\frac{1}{2}(0^-)$	493.82 ±.11		1.235×10^{-8}	0.244	$\mu\nu$	[b](63.4 ±0.5)% } S=1.5*	388	236
				±.006, S=2.4*		$\pi\pi^0$	(21.0 ±0.3)% } S=1.5*	219	205
				$c\tau$ = 3.70		$\pi\pi^-\pi^+$	(5.6 ±0.1)% } S=1.5*	75	126
				$(\tau^+ - \tau^-)/\bar{\tau}$ = (.09±.08)%		$\pi\pi^0\pi^0$	(1.71± 0.08)%, S=1.5*	84	133
				(test of CPT)		$\mu\pi^0\nu$	(3.41± 0.22)%, S=1.9*	253	215
						$e\pi^0\nu$	(4.79± 0.18)%, S=2.1*	358	229
						$\pi\pi^\mp e^\pm\nu$	(3.8 ±0.8)10^{-5}	214	204
			-4.05 ±.12			$\pi\pi^\pm e^\mp\nu$	(< 2)10^{-6}	214	204
						$\pi\pi^\mp\mu^\pm\nu$	(≤ 1.4)10^{-5}	109	151
						$\pi\pi^\pm\mu^\mp\nu$	(< 3)10^{-6}	109	151
						$e\nu$	(1.9 ±1.2)10^{-5}	493	247
						$\pi\pi^0\gamma$	(2.2 ±0.7)10^{-4}	219	205
						$\pi\pi^+\pi^-\gamma$	(10 ±4)10^{-5}	75	126
						πe^+e^-	(< 1.1)10^{-6}	353	227
						$\pi\mu^+\mu^-$	(< 3)10^{-6}	143	172
K^0	$\frac{1}{2}(0^-)$	497.87 ±0.16		50% K_{Short}, 50% K_{Long}					
K_{Short}	$\frac{1}{2}(0^-)$			0.87×10^{-10}	0.248	$\pi^+\pi^-$	(69.3 ±1.2)% S=1.25*	219	206
			$-0.48\times\frac{1}{\tau_S}$ ±.02	±.009, S=1.3*		$\pi^0\pi^0$	(30.7 ±1.2)%	228	209
				$c\tau$ = 2.61					
K_{Long}	$\frac{1}{2}(0^-)$			5.68×10^{-8}	0.248	$\pi^0\pi^0\pi^0$	(23.5 ±2.1)%	93	139
				±.26		$\pi^+\pi^-\pi^0$	(11.5 ± .4)%	84	133
				$c\tau$ = 1703		$\pi\mu\nu$	(27.5 ±1.8)%	253	216
						$\pi e\nu$	(37.4 ±1.8)%	358	229
						$\pi^+\pi^-$	(.153 ±.007)%	219	206
						$\pi^+\pi^-\gamma$	(< 0.3)%	219	206
						$\pi^0\pi^0$	(< 2.7)10^{-3}	228	209
						$e\mu$	(< 4)10^{-5}	392	238
						$\gamma\gamma$	(1.3 ±0.6)10^{-4}	498	249
						$\mu^+\mu^-$	(< 4)10^{-6}	287	225
						e^+e^-	(< 4)10^{-5}	497	249
η	$0^+(0^-)^+$	548.6 ±0.4		$1<\Gamma<10$ keV	Neutral decays	$\gamma\gamma$	(31.4 ±2.2)%	549	274
				$(2<c\tau<20)10^{-10}$	72.9%	$\pi^0\gamma\gamma$	(20.5 ±3.5)% S=1.3*	414	258
						$3\pi^0$	(21.0 ±3.2)% S=1.5*	144	179
					Charged decays	$\pi^+\pi^-\pi^0$	(22.4 ±1.8)%	135	174
					27.1%	$\pi^+\pi^-\gamma$	(4.6 ±0.8)% S=1.1*	269	236
						$\pi^0e^+e^-$	(< 0.2)%	413	258
						$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	268	236

Particle	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) $c\tau$ (cm)	Mass^2 $(\text{GeV})^2$	Partial mode	Fraction	Q (MeV)	p or p_{max} (MeV/c)	Magnetic moment ($e\hbar/2m_pc$)	Measured α	Measured Φ(degree)	Derived γ	Derived Δ(degree)
p	$\frac{1}{2}(\frac{1}{2}^+)$	938.256 ±0.005		stable ($> 6\times10^{27}$ y)	0.880					2.792763 ±.000030				
			-1.2933 ±.0001											
n	$\frac{1}{2}(\frac{1}{2}^+)$	939.550 ±0.005		$(1.01\pm.03)10^{-3}$	0.882	$pe^-\nu$	100 %	1	1	-1.913148 ±.000066				
				$c\tau = 3.03\times10^{13}$										
Λ	$0(\frac{1}{2}^+)$	1115.58 ±0.10		2.51×10^{-10}	1.245	$p\pi^-$	(66.4 ±1.1)% S=1.1*	38	100	-0.73 ±.16	.663±.022	(- 7±7)°	.74	(8±8)°
				±.04, S=1.4*		$n\pi^0$	(33.6 ±1.1)%	41	104		.73 ±.18	Sign of ϕ and Δ changed after		
				$c\tau$ = 7.52		$pe\nu$	(0.88±0.15)10^{-3}	177	163		.06 ±.19	RPM printing to correct for		
						$p\mu\nu$	(1.35±0.60)10^{-4}	72	131			wrong sign in listed data card.		
Σ^+	$1(\frac{1}{2}^+)$	1189.47 ±0.08		0.810×10^{-10}	1.412	$p\pi^0$	(52.8 ±1.5)%	116	189	2.3 ±.6	-.960±.067			
				±.013		$n\pi^+$	(47.2 ±1.5)%	110	185		+.008±.037	(180±30)°	-1.0	(0±85)°
				$c\tau$ = 2.43		$p\gamma$	(1.9 ±0.4)10^{-3}	251	225					
						$n\pi^+\gamma$	(≈ 0.2)10^{-4}	110	185					
						$\Lambda e^+\nu$	(1.5 ±0.9)10^{-5}	73	72					
						$n\mu^+\nu$	(< 1.1)10^{-4}	144	202					
			-7.97 ±.11			$ne^+\nu$	(< 5)10^{-5}	249	224					
Σ^0	$1(\frac{1}{2}^+)$	1192.56 ±0.11		$<1.0\times10^{-14}$	1.422	$\Lambda\gamma$	100 %	77	75					
			-4.88 ±.06	$c\tau<3\times10^{-4}$		Λe^+e^-	[c](5.45)10^{-3}							
Σ^-	$1(\frac{1}{2}^+)$	1197.44 ±0.09		1.65×10^{-10}	1.434	$n\pi^-$	100 %	118	193		-.010±.043			
				±.03, S=1.4*		$ne^-\nu$	(1.25±0.17)10^{-3}	257	230					
				$c\tau$ = 4.95		$n\mu^-\nu$	(0.62±0.12)10^{-3}	152	210					
						$\Lambda e^-\nu$	(0.61±0.16)10^{-4}	81	79					
						$n\pi^-\gamma$	(≈ 1)10^{-5}	118	193					
Ξ^0	$\frac{1}{2}(\frac{1}{2}^+)$?	1314.7 ±1.0		3.0×10^{-10}	1.728	$\Lambda\pi^0$	100 %	64	135		-.33 ±.10			
				±.5, S=1.3*		$p\pi^-$	(< .5)%	237	299					
				$c\tau$ = 8.99		$pe^-\nu$	(< .6)%	376	323					
						$\Sigma^+e^-\nu$	(< .7)%	125	119					
						$\Sigma^-e^+\nu$	(< .6)%	117	112					
			-6.5 ±.2			$\Sigma^+\mu^-\nu$	(< .7)%	20	64					
						$\Sigma^-\mu^+\nu$	(< .6)%	12	49					
						$p\mu^-\nu$	(< .6)%	271	309					
Ξ^-	$\frac{1}{2}(\frac{1}{2}^+)$?	1321.2 ±0.2		1.74×10^{-10}	1.746	$\Lambda\pi^-$	100 %	66	139		-.391±.032	(6±8)°	.92	(14±15)°
				±.05		$\Lambda e^-\nu$	(2.5 ±1.8)10^{-3}	205	190					
				$c\tau$ = 5.22		$n\pi^-$	(< 5)10^{-3}	242	303					
						$\Lambda\mu^-\nu$	(< 1.2)%	100	163					
						$\Sigma^0e^-\nu$	(< 0.3)%	128	122					
						$\Sigma^0\mu^-\nu$	(< 0.5)%	23	70					
						$ne^-\nu$	(< 1)%	381	327					
Ω^-	$0(3/2^+)$? ?	1674 ±3		1.5×10^{-10}	2.802	$\Xi\pi$	(~50)%	221	296					
				±.5, $c\tau$ = 4.5		$\Lambda\bar{K}$	(~50)%	66	216					

†The definition of these quantities is as follows

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

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

General Atomic and Nuclear Constants[a]

- N = 6.02252 × 10^{23} mole^{-1} (based on A_{C12} = 12)
- c = 2.997925 × 10^{10} cm sec^{-1}
- e = 4.80298 × 10^{-10} esu = 1.60210×10^{-19} coulomb
- 1 MeV = 1.60210 × 10^{-6} erg
- $\hbar$ = 6.5819 × 10^{-22} MeV sec
- = 1.05449 × 10^{-27} erg sec
- $\hbar c$ = 1.9732 × 10^{-11} MeV cm = 197.32 MeV fermi
- k = 8.6171 × 10^{-11} MeV deg^{-1} (Boltzmann const.)
- $\alpha = e^2/\hbar c$ = 1/137.0388
- m_e = 0.511006 MeV/c^2 = 1/1836.10 m_p
- m_p = 938.256 MeV/c^2 = 1836.10 m_e = 6.721 $m_{\pi\pm}$
- = 1.00727663 m_1 (where m_1 = 1 amu = $\frac{1}{12}$ m_{C12} = = 931.478 MeV/c^2)
- $r_e = e^2/m_ec^2$ = 2.81777 fermi (1 fermi = 10^{-13} cm)
- $\lambda\!\!\!^-_e = \hbar/m_ec = r_e\alpha^{-1} = 3.86144\times10^{-11}$ cm
- a_∞ Bohr $= \hbar^2/m_ee^2 = r_e\alpha^{-2}$ = 0.529167 A (1 A = 10^{-8} cm)
- $\sigma_{Thompson} = \frac{8}{3}\pi r_e^2 = 0.66516\times10^{-24}\ \text{cm}^2$ = 0.66516 barn
- $R_\infty = m_ee^4/2\hbar^2 = m_ec^2\alpha^2/2$ = 13.60535 eV (Rydberg)

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

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

- $\mu_{Bohr} = e\hbar/2m_e c = 0.578817\times10^{-14}$ MeV gauss^{-1}
- $\mu_{nucl} = e\hbar/2m_p c = 3.1524 \times 10^{-18}$ MeV gauss^{-1}
- $\frac{1}{2}\omega_{cyclotron}$ = $e/2m_e c$ = 8.79404 × 10^6 rad sec^{-1} gauss^{-1}; = $e/2m_p c$ = 4.7895 × 10^3 rad sec^{-1} gauss^{-1}
- $\sigma_{natural} = \pi(\hbar/m_{\pi\pm}c)^2$ = 62.768 mb

Other Physical Constants

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

Numerical Constants

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

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

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

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

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

MUB-13977

M E S O N S, November 1966

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

Nonets

	CP=-1 (0^-)	CP=+1 (0^+)	(1^-)	(1^+)	(2^+)
	η				
			ω		
	η'				
			φ		
		η_V			
					f
				D	
	?			E?	
					f'
	π				
			ρ		
		π_V			
				A_1	
					A_2
	K				
			K^*		
				K_A	
					K_V
		tentative		tentative	
$m_8 = \sqrt{K^2 + \frac{K^2-\pi^2}{3}}$ =	566.8 ±0.2		928.4 (i)±3.0	1391. ±13.	1444.3 ±6.9
$\sin^2\theta = \frac{\eta - m_8}{\eta - \eta'}$ =	0.033 ±0.001		0.414 (i)±0.013	0.25 ±0.10	0.29 ±0.06
θ =	10.4°		40.1°	29.7°	32.4°

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

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

Footnotes continued in right margin.

(a) ΓM is the half-width of the resonance when plotted against M^2.
(b) For decay modes into ≥ 3 particles p_{max} is the maximum momentum that any of the particles in the final state can have. The momenta have been calculated using the averaged central mass values, without taking into account the widths of the resonances.
(c) Reported values range between 1% and 10%, and depend on assumptions on ρ-ω interference.
(d) If A2 → both ρπ and $K\bar{K}$, then $J^P = 2^+$.
(e) S is ρ(V) if identified with $\pi^+\pi^-$ bump at 1910 MeV. See note on mesons.
(f) Empirical limits on fractions for other decay modes of η'(958): $\pi^+\pi^- < 7\%$, $3\pi < 7\%$, $4\pi < 1\%$, $6\pi < 1\%$, $\pi^+\pi^- e^+e^- < 0.6\%$, $\pi^0e^+e^- < 1.3\%$, $\eta e^+e^- < 1.1\%$, $\pi^0\rho^0 < 4\%$, $\pi^0\omega < 8\%$.
(g) Empirical limits on fractions for other decay modes of φ(1019): $\pi^+\pi^- < 20\%$, $\eta\gamma < 8\%$, η + neutrals < 13%, $\pi^+\pi^-\gamma < 4\%$, $e^+e^- < 0.2\%$, $\mu^+\mu^- < 0.5\%$, $\omega\gamma < 5\%$, $\rho\gamma < 2\%$.
(h) m_ρ, Γ_ρ from p-wave fit to compiled spectrum of 2-4 GeV/c $\pi^+p \to \Delta^{++}\rho^0$, $|t| < 10\ m_\pi^2$, and comparison of $\rho^\pm - \rho^0$ in similar reactions. Results depend on background and t-cut, hence real errors unknown, but larger than statistical errors ~ 5 MeV. (See Matts Roos, Phys. Letters, to be publ.) Note contrast between Roos' p-wave fit vs. weighted average of published results (see listings). m(±) 778 vs. 757; m(0) 770 vs. 760, Γ(±) 160 vs. 132, Γ(0) 140 vs. 116. This demonstrates present uncertainty.
(i) Error on m_ρ taken to be 10 MeV.

MUB 13978

BARYONS - January 1967

Group	Particle or resonance	I(J^P) (⊢⊣ = estab.)	Beam π,K (BeV) (BeV/c)	Mass (MeV)	Γ (MeV)	M²±ΓM (BeV²)	Partial decay modes: Mode	Fraction (%)	Q (MeV)	p or p_{max}[‡] (MeV/c)	$4\pi\lambda\!\!\!^{-2}$ (mb)
$N^*_{1/2}$	p n	1/2(1/2⁺)		938.3 939.6		0.880 0.883	See Table S				
	N'(1400)	1/2(1/2⁺) P_{11}	T=0.43πp p=0.55	~1400[a]	~200	1.96 ±0.28	Nπ	70	322	367	36.3
	N(1525)	1/2(3/2⁻) D_{13}	T=0.62 p=0.75	1525[a]	105	2.33 ±0.16	Nπ Nππ [Δ(1236)π][e]	65 35 [~ 20]	447 308 149	460 414 229	23.2
	N(1570)	1/2(1/2⁻) S_{11}	T=0.69 p=0.82	1570[a]	130	2.46 ±0.20	Nπ Nη	~ 30 ~ 70	492 82	491 242	20.3
	N(1670)	1/2(5/2⁻) D_{15}	T=0.87 p=1.00	1670[a]	140	2.79 ±0.23	Nπ Nππ [Δ(1236)π][e] ΛK Nη	40 dominant[a] [?] small small	592 453 294 57 182	560 526 357 200 368	15.6
	N(1688)	1/2(5/2⁺) F_{15}	T=0.90 p=1.03	1688[a]	110	2.85 ±0.19	Nπ Nππ [Δ(1236)π][e] ΛK Nη	65 dominant[a] [?] small small	610 471 312 75 200	572 538 372 231 388	14.9
	N'(1700)[c]	1/2(1/2⁻) S_{11}	T=0.92 p=1.05	1700[a]	240	2.89 ±0.41	Nπ	100	622	580	14.5
	N(2190)	1/2(7/2⁻)	T=1.94 p=2.07	2190	200	4.80 ±0.44	Nπ ΛK	30 ?	1112 577	888 710	6.21
	N(2650)	1/2(11/2⁻)[b]	T=3.12 p=3.26	2650 ± 10	~300	7.02 ±0.80	Nπ ΛK	7 ?	1572 1037	1154 1022	3.67
	→ N(3030)[c]	1/2(15/2⁻)[b]	T=4.26 p=4.40	3030	400	9.18 ±1.21	Nπ	0.7	1972	1377	2.62
$N^*_{3/2}$	Δ(1236)	3/2(3/2⁺) P_{33}	T=0.195 p=0.304	(++) 1236.0 ±0.6	120 ±2	1.53 ±0.15	Nπ Nπ⁺π⁻	100 0	158 18	231 89	91.9
	$m_0 - m_{++}$ = 0.45 ± 0.85 $m_- - m_{++}$ = 7.9 ± 6.8										
	Δ(1670)	3/2(1/2⁻) S_{31}	T=0.87 p=1.00	1670[a]	~180	2.79 ±0.30	Nπ Nππ	40 ?	592 453	560 526	15.6
	Δ(1920)	3/2(7/2⁺)	T=1.35 p=1.48	1920	200	3.69 ±0.38	Nπ ΣK	50 seen	842 229	722 423	9.37
	Δ(2420)	3/2(11/2⁺)[b]	T=2.51 p=2.65	2423 ±10	~275	5.87 ±0.67	Nπ ΣK	10 ?	1345 732	1024 830	4.66
	Δ(2850)	3/2(15/2⁺)[b]	T=3.71 p=3.85	2850 ±12	~300	8.12 ±0.86	Nπ	3	1772	1266	3.05
	→ Δ(3230)[c]	3/2(19/2⁺)[b]	T=4.94 p=5.08	3230	440	10.4 ±1.4	Nπ	0.6	2152	1475	2.24
Z^*_0	→ Z_0(1865)[c]	0(?)	p=1.15 K⁺p	1863	150	3.47 ±0.28	NK	55 (if J = 1/2)	432	579	14.6
Y^*_0	Λ	0(1/2⁺)		1115.6		1.24	See Table S				
	Λ(1405)[d]	0(1/2⁻)	p<0 K⁻p	1405	35	1.97 ±0.05	Σπ	100	68	142	
	Λ(1520)	0(3/2⁻)	p=0.392	1518.8 ±1.5	16 ±2	2.31 ±0.02	NK̄ Σπ S=1.7[*] → Λππ	39±5 51±6 10±2	81 182 124	235 258 251	83.6
	Λ'(1670)[a]	0(1/2⁻)	p=0.74	1670	18	2.79 ±0.03	Λη K⁻p→Λη seen NK̄	 6	6 233	66 410	28.5
	Λ'(1700)	0(3/2⁻)	p=0.80	1700 ±10	40 ±10	2.89 ±0.07	NK̄ Σπ	20 seen	263 363	438 411	25.0
	Λ(1820)	0(5/2⁺)	p=1.06	1819.5 ±3.5	83 ± 8	3.31 ±0.15	NK̄ Σπ Σ(1385)π Λη	70 11 18 ~ 1	382 482 295 155	541 502 362 349	16.5
	Λ(2100)	0(7/2⁻)	p=1.68	2100	160	4.41 ±0.34	NK̄ Σπ	29 seen.	663 763	748 699	8.68
	Λ(2340)	0(?)	p=2.27	2340 ±20	105	5.48 ±0.25	NK̄ seen in σ(total)	10 ↳ if J = 9/2	903	907	5.92
Y^*_1	Σ	1(1/2⁺)		(+)1189.5 (0)1192.6 (-)1197.4		1.41 1.42 1.43	See Table S				
	Σ(1385)	1(3/2⁺)	p<0 K⁻p	(+)1382.2±0.9 S=1.6[*] S=4.8[*]→(-)1388.0±3.0	(+)37±3 S=2.1[*] (-)38±8, S=3.7[*]	1.92 ±0.05	Λπ Σπ	91±3 9±3 S=1.4[*]	130 48	208 117	
	Σ(1660)[a]	1(3/2⁻)	p=0.72	1660	50	2.76 ±0.08	Λ(1405)π Σπ Λπ NK̄	large ? ? small	115 323 405 223	197 379 439 400	29.9
	Large contradictions among measured branching ratios.										
	→ Σ(1770)	1(5/2⁻)	p=0.95	1768 ±4 S=1.5[*]	89 ±12 S=2.0[*]	3.13 ±0.16	NK̄ Λπ Λ(1520)π Σ(1385)π Ση Σπ	49 17 19 12 2 < 1	331 517 110 243 27 431	498 520 192 318 143 463	19.4
	Σ(1910)[c]	1(5/2⁺)	p=1.25	1910 ±10	60	3.65 ±0.11	NK̄ Λπ Σπ	8 10 3	473 655 573	612 619 568	12.9
	Σ(2035)	1(7/2⁺)	p=1.53	2035 ±15	160	4.14 ±0.33	NK̄ Λπ Σπ	16 25 seen	598 784 698	703 703 655	9.83
	→ Σ(2260)[c]	1(?)	p=2.06	2260 ±20	180	5.11 ±0.41	NK̄ seen in σ(total)	14 ↳ if J = 9/2	823	855	6.66
$\Xi^*_{1/2}$	Ξ	1/2(1/2⁺)		(0)1314.7 (-)1321.2		1.73 1.75	See Table S				
	→ Ξ(1530)	1/2(3/2⁺) p-wave		(0)1528.9±1.1 (-)1533.8±1.9	7.3 ±1.7	2.34 ±0.01	Ξπ	100	69	145	
	Ξ(1815)	1/2(?)		1815 ±3	16 ±8 S=2.2[*]	3.29 ±0.03	ΛK̄ Ξπ Ξππ [Ξ(1530)π][e]	~ 65 ~ 10 ~ 25 [~ 20]	202 354 215 145	391 409 351 229	
	Branching ratios poorly known										
	→ Ξ(1930)	1/2(?)		1933 ±16	140 ±35	3.74 ±0.27	Ξπ ΛK̄	seen seen	472 320	501 504	
Ω^-	Ω⁻	0(3/2⁺)		1674		2.80	See Table S				

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

† (→) at left of Table indicates a candidate that has been omitted because the evidence for the existence of the effect and/or for its interpretation as a resonance is open to considerable question. See listings for information on the following: $N_?$(3245), N(3695), $N^*_{5/2}$(1560), Z^*_1(1910), Σ(1780), Σ(3000), Ξ(1705), and $\Xi_?$(2270).

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

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

MUB 13979

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

As always, we make two requests of our readers:

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

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

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

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

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

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

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

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

NOTES ON THE TABLES

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

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

Well-established quantum numbers are underlined (except in Table S, where most of the quantum 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 define antiparticles as the result of operating with CPT on particles; then both should share the same spins, masses, and mean lives.[2-4]

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

For broad resonances there is an inconsistency in the way the central value M_R is usually stated. For a well-studied resonance like

$N^*_{3/2}(1236)$ or $Y^*_0(1520)$, it is conventional to call M_R or E_R the energy at which the resonant amplitude would (in the absence of background) become pure imaginary. (For $N^*_{3/2}(1236)$ this corresponds to 1236 MeV, but for further discussion of this point see the note following the baryon listings.) But this does not mean that the peak in an observed cross section occurs at M_R, because kinematic factors enter into the relation between amplitude and cross section. Thus the peak in the πp cross section near 1236 MeV actually occurs at 1223 MeV. Nevertheless, it is conventional simply to report the energy of the peak in the observed cross section. For well-studied resonances, we have protected the averaging programs (by putting a star in the eighth column of the data cards) from masses and widths obtained without the proper kinematical factors or the proper background treatment. For the others, we have used whatever data was available.

Notes on Table S

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

Hyperon Decay Asymmetries

We adopt the following conventions for the decay asymmetries:

$$\alpha = \frac{2\,\mathrm{Re}(s^* p)}{|s|^2 + |p|^2}$$

$$\beta = \frac{2\,\mathrm{Im}(s^* p)}{|s|^2 + |p|^2}$$

$$\gamma = \frac{|s|^2 - |p|^2}{|s|^2 + |p|^2}$$

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

$$\underset{\sim}{P}_N = \frac{1}{1+\alpha P_Y \cos\theta} \left\{ [\alpha + P_Y \cos\theta (1-\gamma)]\hat{N} + \gamma \underset{\sim}{P}_Y + \beta(\hat{P}_Y \times \hat{N}) \right\} ,$$

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

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

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

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

$$\left.\begin{aligned} \beta &= \sqrt{1-\alpha^2}\,\sin\phi \\ \gamma &= \sqrt{1-\alpha^2}\,\cos\phi \end{aligned}\right\} \quad \tan\phi = \frac{\beta}{\gamma}$$

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

$$\tan \Delta = -\frac{\beta}{\alpha} .$$

Under time-reversal invariance, one should have

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

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

$$\delta_s - \delta_p \approx 7^\circ .$$ [7]

On the data cards, we list α and ϕ for each decay, since these are the most closely related to the experiment, and are essentially uncorrelated. In Table S we give α, ϕ, and Δ, with errors; and for convenience we also give the central value of γ, without an error.

Notes on the Meson Table

The Symbol-Minded Approach

In addition to the colloquial names for particles, we have used the names suggested by Chew, Gell-Mann, and Rosenfeld:[8, 9] atomic mass number A, hypercharge Y, and isospin I have been grouped into a single symbol. For mesons, A = 0, Matts Roos has suggested that the name should also reflect G, and sometimes J^P, so we now use

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

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

$Y = 1$, $I = 1/2$, K (called K_V if $K \rightarrow K\pi$, K_A if $\not\rightarrow K\pi$),

$Y = 1$, $I = 3/2$ (if ever firmly established), L.

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

K^*, $\bar{K}^*$, and ϕ'.

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

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

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

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

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

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

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

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

Quantum Numbers and the Symbol C_n

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

$$G = Ce^{\pi i I_y}. \tag{1}$$

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

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

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

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

Meson Decays into 2π or $\bar{K}K$

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

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

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

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

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

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

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

Whenever ℓ is even, neutral $\bar{K}K$ must appear as K_SK_S, K_LK_L, and K^+K^- in the ratio 1:1:2. If ℓ is odd, we can find only K_SK_L and K^+K^-, in equal numbers.[13]

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

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

1. A Breit-Wigner resonance occurring just above or below threshold. In the complex energy plane, this is represented by a pole adjacent to the physical region but with a small negative imaginary displacement. See Fig. 1.

2. A pole near threshold but on or adjacent to the real axis of an unphysical sheet of the energy surface. See Fig. 2. This is often called an "anti-bound state."

3. Finally, the effect of non-threshold branch points in the energy plane often can be parameterized by a single pole whose position depends on the range of the nuclear force. With data of finite accuracy, such a parameterization may yield an adequate fit even though no pole really exists at the position indicated, but a "fake pole" cannot produce a scattering length larger than the dominant force range.

Clearly we do not want to list in this compilation threshold bumps which are most probably effects of type 3. We do intend to list those in

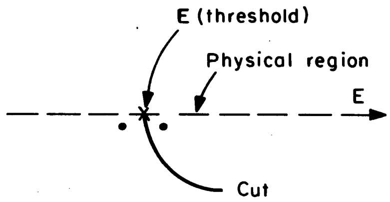


Fig. 1. The complex energy plane near threshold, showing possible poles (dots) corresponding to two ordinary Breit-Wigner resonances. The cut attached to the threshold branch point has been drawn so as to expose both the pole positions and the physical region.

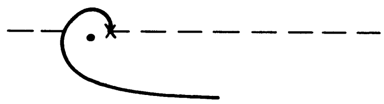


Fig. 2. The complex energy plane near threshold, showing the possible position of a pole corresponding to an "antibound state." Notice that in order to expose the pole in the figure the physical region just below threshold has been obscured from view.

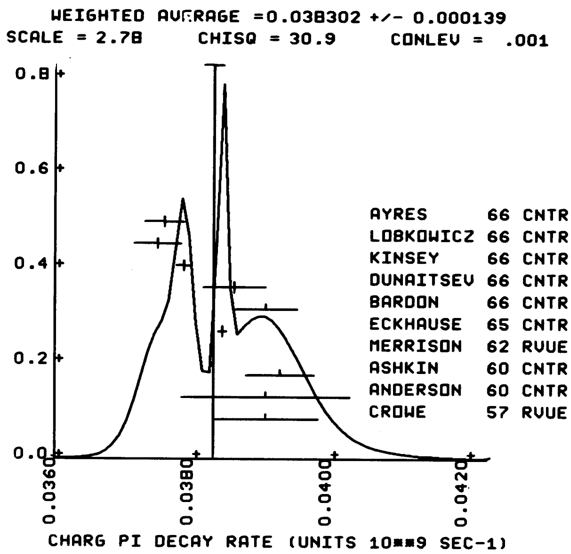


Fig. 3. Typical ideogram: $\pi^{\pm}$ decay rates. Results are usually published as mean lives τ, but we average rates, $\Gamma = 1/\tau$ because rates are more normally distributed. The rms average $\overline{\Gamma}$ = $(38.33 \pm 0.05) 10^{6}$ $\sec^{-1}$ is drawn as a vertical line, with an error flag at the top scaled up by a scale factor S = 3.5. (It is easily seen that even after scaling, this final result is not a satisfactory statement of the situation.) Only five experiments, indicated by + error flags, were precise enough to satisfy Eq. 6 and be accepted in the calculation of the scale factor. The less precise experiments were included in the calculation of $\overline{\Gamma}$ but not of scale, they have $\perp$ flags.

MUB 14095

which some kind of pole seems to be present, though it may not be clear whether it is of types 1 or 2. Roughly speaking, a true pole is indicated whenever the measured scattering length has a real part of the order of 1 Fermi or more.

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

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

Notes on the Baryon Table

S-Wave Bumps Near Threshold

This matter was discussed under Mesons.

Symbol-Minded Approach for Baryons (cf. Mesons)

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

PROCEDURES FOR TREATING THE DATA

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

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

When inequalities are reported from a particular experiment, we have on the first iteration ignored that experiment; we then checked to see if the weighted average of the others violates the inequality. If so, we change the input data: $< x \rightarrow 0 \pm x$, or $> x \rightarrow 2x \pm x$, and iterate once more. If there are cases of small statistics, we weight them according to the prescription of maximum likelihood. When no errors are reported, we merely list the data for inspection.

χ^2 Scale Factor

When we calculate the weighted average $\bar{x}$, we also calculate the χ^2 that all the measurements of x agree. If there are N experiments, each with properly estimated errors normally distributed, the average value of χ^2 should be N-1. If χ^2 is much larger than N-1, we average the data even though this may not be warranted. But we plot an ideogram (Fig. 3, pg. 12) to help the reader decide which data to reject, and 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, $(\sqrt{\chi^2/(N-1)} \equiv \text{SCALE})$. If this were true, then we could correct the calculated error of the mean simply by multiplying each of the reported errors by SCALE, and then recalculating the error of $\bar{x}$. Multiplying the original $\delta(\bar{x})$ by SCALE would obviously also give the same final result.

In fact, this is exactly what we have done. (This is a NEW CONVENTION, started August 1966. In the older editions we listed the SCALE factor but did not enlarge the errors. We made this change because we discovered that few people paid any attention to SCALE.) This scaling approach is already common practice in bubble chamber experiments, where track distortion is not fully understood. For bubble chamber data it can be justified. For this compilation, it has all of the disadvantages of penalizing a whole class of students because of one naughty child, but (like the schoolmaster) we sometimes know of no other simple solution.

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

$$\delta_0 = 3\sqrt{N}\ \delta(\bar{x}). \tag{6}$$

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

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

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

A slightly different approach must be taken when a number of different (but related) quantities enter the constrained averaging program AHR. Program AHR calculates not only the best simultaneous fit to all of the partial decay fractions, f_i, but also the contribution to χ^2 for each of the input ratios. If any of these individual contributions to χ^2 is considerably greater than the average expected χ^2 (a "ceiling" of $\chi^2 = 2.0$ is used at present), all of the measurements of that particular ratio have their errors increased by SCALE, with SCALE defined as before. (N and χ^2 are now, of course, the number, and the total contribution to χ^2, of only those experiments measuring that particular ratio.) Now, because of the many correlations induced by the constraint, it is not possible merely to multiply the output $\delta(\bar{f}_i)$'s by SCALE. Instead, one must actually rerun the program AHR on all of the data — those with errors unchanged as well as those with errors increased. We then get new values for $\delta(\bar{f}_i)$, i.e., the errors of the partial decay modes. These errors are the values given in our tables. (We list only the largest SCALE factor used for a particular particle. Thus it is not possible to recover the unscaled $\delta(\bar{f}_i)$'s from our reported values for particles which have constrained fits.) However, in line with our policy of not letting SCALE affect the central values, we give the values of $\bar{f}_i$ obtained from the original (unscaled) fits. (In all data processed so far, the differences between the $\bar{f}_i$'s calculated with either the scaled or the unscaled errors have been within the scaled errors, $\delta\bar{f}_i$).

Conversion of Mean Lives to Rates

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

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

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

Alternatively he can report a rate

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

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 data or making ideograms.

NOTES ON THE DATA CARDS

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

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

Partial Decay Modes: For two-body decays our computer program calculates the Q value, and the momentum of decay. For three-body decays, it calculates Q, and then calculates the maximum momentum that any of the three particles can have. The reader may wonder about the numbers S-- or U-- in the far right-hand fields; they are simply the mass codes of the decay products for this program.

Cross-Sections Cards (Coded CS)

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

EXPLANATION OF SYMBOLS USED ON DATA CARDS

The following abbreviations have been used:

1. Measurement Technique (TECH)

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

2. Journals

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

NC	Nuovo Cimento
NP	Nuclear Physics
PL	Physics Letters
PPSL	Proceedings of the Physical Society of London
PR	Physical Review
PRL	Physical Review Letters
PRSL	Proceedings of the Royal Society of London
RMP	Reviews of Modern Physics

The following abbreviations refer to proceedings of Conferences

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

Finally

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

Acknowledgments

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

FOOTNOTES AND REFERENCES

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

1. Arthur H. Rosenfeld, Angela Barbaro-Galtieri, Walter H. Barkas, Pierre L. Bastien, Janos Kirz, and Matts Roos, Rev. Mod. Phys. 37, 633-651 (1965).
2. T. D. Lee, R. Oehme, and C. Yang, Phys. Rev. 106, 340 (1957).
3. S. Okubo, Phys. Rev. 109, 984 (1958).
4. A. Pais, Phys. Rev. Letters 3, 342 (1959).
5. T. D. Lee and C. N. Yang, Phys. Rev. 108, 1645 (1957).
6. J. W. Cronin and O. E. Overseth, Phys. Rev. 129, 1795 (1963)
7. S. W. Barnes, B. Rose, G. Giacomelli, J. Ring, K. Miyake, and K. Kinsey, Phys. Rev. 117, 226 (1960).
8. A. H. Rosenfeld, in Proceedings of 1962 International Conference on High-Energy Physics at CERN (CERN, Geneva, 1962), p. 325.
9. G. F. Chew, M. Gell-Mann, and A. H. Rosenfeld, Sci. Am. 210, 74 (1964).
10. T. D. Lee and C. N. Yang, Nuovo Cimento 3, 749 (1956).
11. L. Michel, Nuovo Cimento 10, 319 (1953).
12. A. H. Rosenfeld, in Proceedings of the Varenna Summer School, Course 26, 1962 (Academic Press, New York, 1963).
13. M. Goldhaber, T. D. Lee, and C. N. Yang, Phys. Rev. 112, 1796 (1958); D. R. Inglis, Rev. Mod. Phys. 33, 1 (1961).
14. G. F. Chew, Resonances, Particles, and Poles from the Experimenter's Point of View, Lawrence Radiation Laboratory Report UCRL-16983, July 1966.

DATA FOR TABLES ON STABLE PARTICLES

STABLE MEANING IMMUNE TO STRONG DECAY

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

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

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

γ

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

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

ν_e

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

                         1  E-NEUTRINO  MASS (KEV)

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

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

                                   REFERENCES

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

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

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

ν_μ

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

                         2  MU-NEUTRINO  MASS (MEV)

M    *        3.5   OR LESS            BARKAS     56 EMUL
M    *        4.0   OR LESS            DUDZIAK    59 CNTR
M    *        3.6   OR LESS            FEINBERG   63 RVUE                      7/66
M    *        3.0   OR LESS            ALLCOCK    65 RVUE                      7/66
M    *        2.5   OR LESS            BARDON     65 SPRK
M    *        2.1   OR LESS            SHAFER     65 CNTR  CONF LEV = 68PCT    7/66

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

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

BARKAS   56 PR 101   778           W H BARKAS,W BIRNBAUM,F M SMITH ////  LRL
DUDZIAK  59 PR 114   336           W F DUDZIAK,R SAGANE,J VEDDER //////  LRL
FEINBERG 63 ARNS 13 431            G FEINBERG, L M LEDERMAN //////// COLUMBIA
ALLCOCK  65 PPSL  85  875          G R ALLCOCK ///////////////////// LIVERPOOL
BARDON   65 PRL  14 449            BARDON,NORTON,PEOPLES +//COLUM+STONY BROOK
SHAFER   65 PRL  14 923            R E SHAFER,CROWE,JENKINS ///////////  LRL

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

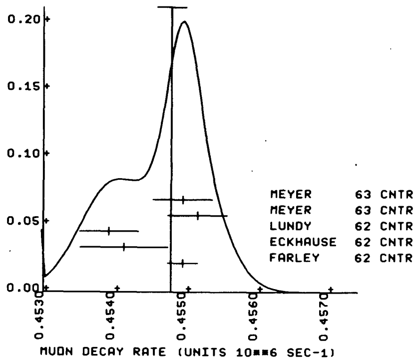
e

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

                         3  ELECTRON  MASS (MEV)

M           0.511006 0.000002          COHEN      65 RVUE

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

                3  ELECTRON LIFETIME (UNITS 10**21 YR)

T    *      OVER                2.0    MOE        65 CNTR                      6/66

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

                         3  ELECTRON MAGNETIC MOMENT(E/2ME)

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

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

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

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

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

μ

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

                         4  MUON  MASS (MEV)

M           105.659    0.002           FEINBERG  63 RVUE

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

                         4  MUON LIFETIME (UNITS 10**-6)

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

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

```
                WEIGHTED AVERAGE =0.454797 +/- 0.000203
                SCALE = 1.34      CHISQ =  7.2     CONLEV = 0.127
```




```
                    4  RATIO OF LIFETIME OF MU+ TO MU-

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

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

                    4  MUON PARTIAL DECAY MODES

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

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

                    4  MUON  BRANCHING RATIOS

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

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

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

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

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

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

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

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

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

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

BABAEV   63 JETP 16 1397           BABAEV,BALATS,KAFTANOV,LANDSBERG + // ITEP
ECKHAUSE 63 PR 132   422           M ECKHAUSE,T A FILIPPAS + /////// CARNEGIE
FEINBERG 63 ARNS 13 431            GERALD FEINBERG, L M LEDERMAN /// COLUMBIA
FRANKEL  63 NC   27   894          S FRANKEL,W FRATI,J HALPERN + ////// PENNA
FRANKEL  63 PR 130   351           S FRANKEL,W FRATI,J HALPERN + ////// PENNA
MEYER    63 PR   132  2693         S L MEYER,ANDERSON,BLESER,LEDERMAN+//COLUM
PARKER   64 PR 133B 768            S PARKER,H L ANDERSON,C REY //////// EFINS
FARLEY   66  BERKELEY CONF.        FARLEY,BAILEY,BROWN,GIESCH +       // CERN

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

$\pi^\pm$

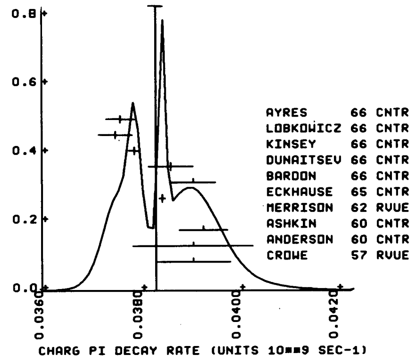
```
                         8  CHARGED PION  (140,JPG=0--)  I=1

                         8  CHARGED PI  MASS (MEV)

M             139.37     0.20             CROWE      54 CNTR -
M             139.68     0.15             BARKAS     56 EMUL +
M             139.577    0.014            SHAFER     65 CNTR                   6/66

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

                         8  PI+ MU+ MASS DIFFERENCE (MEV)

D              34.00     0.076            BARKAS     56 EMUL
D              33.89     0.076            BARKAS     56 EMUL

------ --------- --------- --------- --------- --------- --------- ---------
```

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

T		25.6	0.5	0.5	CROWE	57 RVUE		
T		25.6	0.8	0.8	ANDERSON	60 CNTR		
T	8000	25.46	0.32	0.32	ASHKIN	60 CNTR +		
T					MERRISON	62 RVUE		
T		26.02	0.04		ECKHAUSE	65 CNTR +	9/	6/66
T		25.6	0.3		BARDON	66 CNTR		6/66
T		25.9	0.3		DUNAITSEV	66 CNTR		9/66
T		26.40	0.08		KINSEY	66 CNTR +		6/66
T		26.67	0.24		LOBKOWICZ	66 CNTR		9/66
T		26.6	0.2		AYRES	66 CNTR		10/66

(Ideogram below)

WEIGHTED AVERAGE =0.038302 +/- 0.000139
SCALE = 2.78 CHISQ = 30.9 CONLEV = .001



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

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

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

8 CHARGED PION PARTIAL DECAY MODES

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

8 CHARGED PION BRANCHING RATIOS

R1	*	CHAR.PION INTO MU NEU GAMMA	(UNITS 10**-4)		(P3)/(P1)		
R1	26	1.24	0.25		CASTAGNOL 58 EMUL		
R2	*	CHAR.PION INTO E NEU	(UNITS 10**-4)		(P2)/(P1)		
R2		1.21	0.07		ANDERSON 60 CNTR		
R2		1.247	0.028		DI CAPUA 64 CNTR		
R3	*	CHAR.PION INTO PIO E NEU	(UNITS 10**-8)		(P4)/(P1)		
R3	36	0.97	0.20		BARTLETT 64 SPRK		
R3	38	1.07	0.21		BACASTOW 65 SPRK +		
R3		1.10	0.26		BERTRAM 65 SPRK		6/66
R3	43	1.1	0.2		DUNAITSEV 65 CNTR		7/66
R3		1.01	0.08	0.10	DEPOMMIER 66 CNTR		6/66
R4	*	CHAR.PION INTO E NEU GAMMA	(UNITS 10**-8)		(P5)/(P1)		
R4	143	3.0	0.5		DEPOMMIER 63 CNTR		6/66

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

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

CROWE	54 PR 96 470	K M CROWE,R H PHILLIPS /////////////// LRL
BARKAS	56 PR 101 778	W H BARKAS,W BIRNBAUM,F M SMITH ////// LRL
CROWE	57 NC 5 541	K M CROWE ////////////////// STANFORD HEPL
CASTAGNO	58 PR 112 1779	C CASTAGNOLI,M MUCHNIK ////////// ROME I F
ANDERSON	60 PR 119 2050	H L ANDERSON,T FUJII,R H MILLER + // EFINS
ASHKIN	60 NC 16 490	ASHKIN,FAZZINI,FIDECARO,LIPMAN + //// CERN
MERRISON	62 ADVP 11 1	A W MERRISON /////////////////// LIVERPOOL
SHAPIRO	62 PR 125 1022	G SHAPIRO,L M LEDERMAN ////////// COLUMBIA
CZIRR	63 PR 130 341	JOHN B CZIRR ///////////////////////// LRL
DEPOMMIE	63 PL 7 285	P DEPOMMIER,HEINTZE,RUBBIA,SOERGEL // CERN
BARTLETT	64 PR 136B 1432	BARTLETT,DEVONS,MEYER,ROSEN ///// COLUMBIA
DI CAPUA	64 PR 133B 1333	DI CAPUA,GARLAND,PONDROM,STRELZOFF //COLUM
BACASTOW	65 PR 139 B407	+GHESQUIERE,WIEGAND,LARSEN //LRL+SLAC
BERTRAM	65 PR 139 B 617	BERTRAM,MEYER,CARRIGAN+ //// MICH+CARNEGIE
CLINE	65 PL 15 293	A CLINE,W F FRY //////////////// WISCONSIN
DUNAITSE	65 JETP 20 58	DUNAITSEV,PETRUKHIN,PROKOSHKIN + /// DUBNA
ECKHAUSE	65 PL 19 348	ECKHAUSE,HARRIS,SHULER+// WILLIAM AND MARY
SHAFER	65 UCRL 16365 THESIS	ROBERT E SHAFER ////////////////////// LRL
REPLACES	65 PRL 14 923	R E SHAFER,K M CROWE,D A JENKINS ///// LRL
AYRES	66 PREPRINT	D.S.AYRES,CALDWELL,GREENBERG,KURZ+ // LRL
BARDON	66 PRL 16 775	BARDON,DORE,DORFAN,KRIEGER + //// COLUMBIA
DEPOMMIE	66 PRIV COMM	DEPOMMIER,SOERGEL ////////////////// CERN
DUNAITSE	66 PL 23 283	DUNAITSEV,KUTYIN,PROKOSHKIN + // SERPUKHOV
KINSEY	66 PR 144 1132	KINSEY,LOBKOWICZ,NORDBERG //ROCHESTER UNIV
LOBKOWIC	66 PRL 17 548	LOBKOWICZ,MELISSINOS,NAGASHIMA+ //ROCH+BNL

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

π^0

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

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

D	*	5.37	1.0	PANOFSKY 51 CNTR	-	
D		4.50	0.31	CHINOWSKY 54 CNTR	-	
D		4.62	0.05	HADDOCK 59 CNTR	-	
D		4.60	0.04	HILLMAN 59 CNTR		
D		4.55	0.07	CASSELS 59 CNTR		
D		4.6056	0.0055	CZIRR 63 CNTR		
D		4.59	0.03	PETRUKHIN 63 CNTR	-	
D		4.6034	0.0052	VASILEVSK 66 CNTR	-	9/66

9 PIO LIFETIME (UNITS 10**-16)

T	N	76	1.9	0.5	0.5	GLASSER	61 EMUL	
T	N	45	2.3	1.1	1.0	TIETGE	62 EMUL	
T	N	88	2.8	0.9	0.9	KOLLER	63 EMUL	
T			1.05	0.18	0.18	VON DARDE	63 CNTR	
T	N	75	1.7	0.5		SHWE	64 EMUL	
T			0.730	0.105		BELLETTIN	65 CNTR	6/66
T	N	67	1.6	0.6	0.5	EVANS	65 EMUL	6/66
T	N	EMULSION MEASUREMENTS NOT USED BECAUSE OF POSSIBLE SYSTEMATIC						
T	N	SHIFT TO LARGER LIFETIME VALUES						

9 NEUTRAL PION PARTIAL DECAY MODES

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

9 NEUTRAL PION BRANCHING RATIOS

R1	*	PIO INTO (GAMMA E+ E-)/(2GAMMA)			(P2)/(P1)		
R1	*	0.01196 THEORETICAL CALC.JOSEPH		61	QUANTUM ELECT.		9/66
R1	27	0.0117	0.0015	BUDAGOV 60 HBC			
R1	3071	0.01166	0.00047	SAMIOS 61 HBC	PI-P TO PIO N		
R1	S	SAMIOS VALUE USES PANOFSKY RATIO = 1.62					
R2	*	PIO INTO (3 GAMMA)/(2 GAMMA)	(UNITS 10**-6)		(P4)/(P1)		
R2	*	0	5.0 OR LESS	DUCLOS 65 CNTR	CL=90 PERCENT		6/66
R3	*	PIO INTO (E+E+E-E-)/(2 GAMMA)	(UNITS 10**-5)		(P3)/(P1)		
R3	*	3.47	THEORETICAL CAL. KROLL	55	QUANTUM ELECT.		9/66
R3	146	3.18	0.30	SAMIOS 62 HBC			6/66
R3	N	ABOVE VALUE USES PANOFSKY RATIO=1.62					

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

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

PANOFSKY	51 PR 81 565	W K H PANOFSKY,R L AAMODT,J HADLEY /// LRL
CHINOWSK	54 PR 93 586	W CHINOWSKY,J STEINBERGER /////// COLUMBIA
KROLL	55 PR 98 1355	N KROLL ,W WADA // COLUMBIA+NRL
CASSELS	59 PPS 74 92	CASSELS,JONES,MURPHY,O NEILL /// LIVERPOOL
HADDOCK	59 PRL 3 478	HADDOCK,ABASHIAN,CROWE,CZIRR ///////// LRL
HILLMAN	59 NC 14 887	HILLMAN,MIDDELKOOP,YAMAGATA,ZAVATTINI/CERN
BUDAGOV	60 JETP 11 755	BUDAGOV,VIKTOR,DZHELEPOV,ERMOLOV + //JINR
JOSEPH	60 NC 16 997	D W JOSEPH // EFI
GLASSER	61 PR 123 1014	R G GLASSER,N SEEMAN,B STILLER ////// NRL
SAMIOS	61 PR 121 275	N P SAMIOS //////////////// COLUMBIA+BNL
SAMIOS	62 PR 126 1844	SAMIOS,PLANO,PRODELL + ////// COLUMBIA+BNL
TIETGE	62 PR 127 1324	J TIETGE,W PUESCHEL ////// MAX PLANCK INST
CZIRR	63 PR 130 341	JOHN B CZIRR ///////////////////////// LRL
KOLLER	63 NC 27 1405	E L KOLLER,S TAYLOR,T HUETTER //// STEVENS
PETRUKHI	63 SIENA CONF 208	V I PETRUKHIN,YU D PROKOSHKIN /////// JINR
VONDARDE	63 PL 4 51	VON DARDEL,DEKKERS,MERMOD,VAN PUTTEN+/CERN
SHWE	64 PR 136B 1839	H SHWE,F M SMITH,W H BARKAS ////////// LRL
BELLETTI	65 NC 40 A 1139	BELLETTINI,BEMPORAD,BRACCINI+/PISA+FIRENZE
DUCLOS	65 PL 19 253	DUCLOS,FREYTAG,HEINTZE + //CERN+HEIDELBERG
EVANS	65 PR 139 B 982	D A EVANS ///////////////////////// OXFORD
VASILEVS	66 PL 23 281	VASILEVSKY,VISHNYAKOV,DUNAITSEV + // DUBNA

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

$K^{\pm}$

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

10 CHARGED K MASS (MEV)

M	493.9	0.2	COHEN	57 RVUE +	
M	493.7	0.3	BARKAS	63 EMUL -	
M	493.78	0.17	GREINER	65 EMUL + VIA TAU DECAY	7/66

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

T		0.95	0.36	0.25	ILOFF	56 EMUL		
T	52	1.60	0.3	0.3	EISENBERG	58 EMUL		
T		1.21	0.06	0.06	BURROWES	59 CNTR		
T	33	1.38	0.24	0.24	FREDEN	60 EMUL		
T		1.25	0.22	0.17	HARKAS	61 EMUL		
T	51	1.27	0.36	0.23	BHOWMIK	61 EMUL		
T	293	1.31	0.08	0.08	NORDIN	61 HBC	-	
T	*	1.24	0.07		NORDIN	61 RVUE	-	
T		1.231	0.011	0.011	BOYARSKY	62 CNTR	+	
T		1.2443	0.0038		FITCH	65 CNTR	+	6/66
T		1.2265	0.0036		LOBKOWICZ	66 CNTR	+	9/66

(Ideograms on next page)

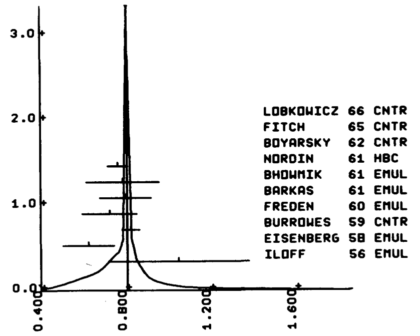
10 LIFETIME DIFFERENCE,(+)-(-)/AVGE. (PERCENT)

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

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

```
                    10  CHARGED K PARTIAL DECAY MODES

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

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

                    10  CHARGED K BRANCHING RATIOS

R    O      OLD DATA EXCLUDED

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

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

R3   *  CHAR. K INTO PI PI+ PI-(TAU)   (UNITS 10**-2)      (P3)/TOTAL
R3   O        5.6        0.4             BIRGE      56 EMUL +
R3   O        6.8        0.4             ALEXANDER 57 EMUL +
R3   O        5.2        0.3             TAYLOR     59 EMUL +
R3            5.7        0.3             ROE        61 XBC  +                       9/66
R3     2332   5.54       0.12            CALLAHAN  64 XBC  +
R3            5.1        0.2             SHAKLEE   64 XBC  +                        9/66
R3            5.71       0.15            DE MARCO  65 HBC                           6/66
R3            6.0        0.4             YOUNG      65 EMUL +                       6/66
                     (Ideogram on next page)
R4   *  CHAR. K INTO PI 2PIO (TAU PRIME)(UNITS 10**-2)     (P4)/TOTAL
R4   O        2.1        0.5             BIRGE      56 EMUL +
R4   O        2.2        0.4             ALEXANDER 57 EMUL +
R4   O        1.5        0.2             TAYLOR     59 EMUL +

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

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

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

R8   *  POSIT.K INTO PI+ PI+ E- NEU    (UNITS 10**-5)      (P8)/TOTAL
R8            0.2      OR LESS           BIRGE      65 FBC  +  95 PER CT CONF       8/66
```

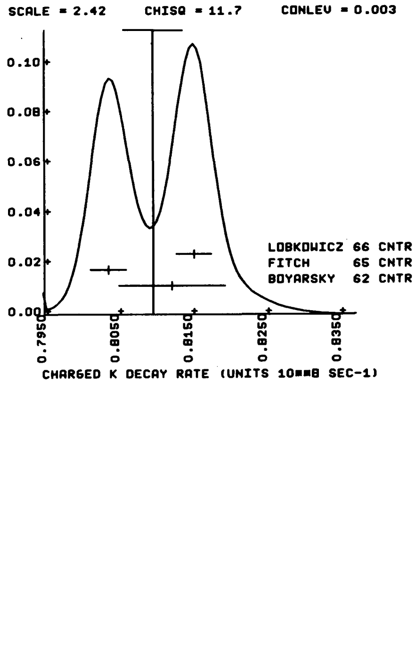
WEIGHTED AVERAGE =0.80971 +/- 0.00403
SCALE = 2.42   CHISQ = 11.7   CONLEV = 0.003



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

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

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



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

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

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

R11  *  CHAR. K INTO E NEU              (UNITS 10**-5)     (P11)/TOTAL
R11  *        16.0    OR LESS            BORREANI  64 HBC  +                        8/66
R11  *   4    1.9        1.2             BOWEN      66 SPRK +                       8/66

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

R13  *  CHAR. K INTO PI PIO GAMMA       (UNITS 10**-4)     (P13)/TOTAL
R13  *  18    2.2        0.7             CLINE      64 FBC  +  PI+ KE 55-90 MEV     8/66

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

R15  *  CHAR. K INTO PI E+ E-           (UNITS 10**-6)     (P15)/TOTAL
R15      1    1.1     OR LESS            CAMERINI  64 FBC  +                        8/66

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

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

R19  *  CHAR. K INTO (MU PIO NEU)/TAU                      (P5)/(P3)
R19 N         0.84       0.14            ROE        61 XBC  +                       8/66
R19 N   KMU RAD VS KMU3 SORTING DIFFICULTIES SUSPECTED BY AUTHORS                  9/66
R19           0.59       0.10            SHAKLEE   64 XBC  +                        8/66
R19   2175    0.632      0.035           BISI       65 H+HL +                       8/66
R19     38    0.90       0.16            YOUNG      65 EMUL +                       8/66
R19    650    0.525      0.032           CALLAHAN  66 FBC                           9/66
                     (Ideogram on next page)
R20  *  CHAR. K INTO (E PIO NEU)/TAU                       (P6)/(P3)
R20           0.88       0.11            ROE        61 XBC  +                       8/66
R20    230    0.90       0.06            BORREANI  64 HBC  +                        8/66
R20           0.92       0.08            SHAKLEE   64 XBC  +
R20     37    0.90       0.16            YOUNG      65 EMUL +                       8/66
R20    864    0.727      0.028           CALLAHAN  66 FBC                           9/66
                     (Ideogram on next page)
R21  *  POSIT.K INTO (PI+ PI- E+ NEU)/TAU(UNITS 10**-4)(P7)/(P3)
R21     69    6.7        1.5             BIRGE      65 FBC  +                       8/66

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

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

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

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

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

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

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

1. In a number of experiments, the $K\mu 2$ branching ratio is not determined from kinematically identified events, but essentially by subtracting the sum of other branching ratios from one. Since our averaging program applies this constraint, we omit those unmeasured branching ratios from the input.

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

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

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

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

BIRGE	56 NC 4 834	BIRGE,PERKINS,PETERSON,STORK,WHITEHEA//LRL
ILOFF	56 PR 102 927	ILOFF,GOLDHABER,LANNUTTI,GILBERT + /// LRL
ALEXANCE	57 NC 6 478	ALEXANDER,JOHNSTON,OCEALLAIGH//DUBLIN INST
COHEN	57 FUND.CONS.PHYS.	E R COHEN,K M CRCWE,J DUMOND // AI+LRL+CIT
EISENBER	58 NC. 8 663	EISENBERG,KOCH,LOHRMANN,NIKOLIC + /// BERN
BURROWES	59 PRL 2 117	BURROWES,CALDWELL,FRISCH,HILL + ////// MIT
TAYLOR	59 PR 114 359	S TAYLOR,HARRIS,OREAR,LEE,BAUMEL//COLUMBIA
FREDEN	60 PR 118 564	S C FREDEN,F C GILBERT,R S WHITE ///// LRL
BARKAS	61 PR 124 1209	BARKAS,DYER,MASON,NORRIS,NICKOLS,SMIT//LRL
BHOWMIK	61 NC 20 857	B BHOWMIK,P C JAIN,P C MATHUR //DELHI UNIV
NORDIN	61 PR 123 2166	PAUL NORDIN JR ////////////////////////// LRL
ROE	61 PRL 7 346	ROE,SINCLAIR,BROWN,GLASER + ///// MICH+LRL
BOYARSKI	62 PR 128 2398	BOYARSKI,LOH,NIEMELA,RITSON ////////// MIT
BARKAS	63 PRL 11 26	W H BARKAS,J N DYER,H H HECKMAN ////// LRL
BIRGE	63 PRL 11 35	BIRGE,ELY,GIDAL,CAMERINI + // LRL+WIS+BARI
BORREANI	64 PL 12 123	G BORREANI,G RINAUDO,A WERBROUCK /// TURIN
CALLAHAN	64 PR 136 B 1463	A CALLAHAN,R MARCH,R STARK ///// WISCONSIN
CAMERINI	64 PRL 13 318	CAMERINI,CLINE,FRY,POWELL // WISCONSIN+LRL
CLINE	64 PRL 13 101	D CLINE, W F FRY /////////////// WISCONSIN
GREINER	64 PRL 13 284	D GREINER, W OSBORNE, W BARKAS /////// LRL
SHAKLEE	64 PR 136 B 1423	SHAKLEE,JENSEN,ROE,SINCLAIR ///// MICHIGAN
BIRGE	65 PR 139 B 1600	BIRGE,ELY,GIDAL,CAMERINI,CLINE + //LRL+WIS
BISI	65 NC 35 768	BISI,BORREANI,CESTER,FERRARO + ///// TURIN
BISI	65 PR 139 B 1068	BISI,MARZARI-CHIESA,RINAUDO // TURINO,INFN
CALLAHAN	65 PRL 15 129	A CALLAHAN,D CLINE ///////////// WISCONSIN
CAMERINI	65 NC 37 1795	CAMERINI,CLINE,GIDAL,KALMUS,KERNAN/WIS+LRL
CLINE	65 PL 15 293	A CLINE,W F FRY //////////////// WISCONSIN
DE MARCO	65 PR 140 B 1430	DE MARCO,GROSSO,RINAUDO ////// TURINO+CERN
FITCH	65 PR 140 B 1088	FITCH,QUARLES,WILKINS //PRINCETON+MT HOLYK
GREINER	65 ARNS 15 67	QUOTED BY BARKAS // LRL
STAMER	65 PR 138 B 440	STAMER,HUETTER,KOLLER,TAYLOR,GRAUMAN//STEV
TRILLING	65 UCRL 16473	GEORGE H TRILLING //////////////////// LRL

(TRILLING 65 IS AN UPDATE OF HIS REPORT AT THE 1965 ARGONNE CONF, P 115)

YOUNG	65 UCRL 16362	POH-SHIEN YOUNG (THESIS,BERKELEY) //// LRL
AUERBACH	66 BERKELEY 2B	AUERBACH,MANN,WHITE,YOUNT+//PENN-PRINCETON
BOWEN	66 BERKELEY 2B	BOWEN,MANN,MC FARLANE,HUGHES+/PENN-PRINCET
CALLAHAN	66 NC 44A 90	A C CALLAHAN // WISCONSIN
CESTER	66 PL 21 343	CESTER,ESCHSTRUTH,ONEILL+ //PRINCETON-PENN
LOBKOWIC	66 PRL 17 548	LOBKOWICZ,MELISSINOS,NAGASHIMA+ //ROCH+BNL
TSIPIS	66 BERKELEY CONF	+MEYER,ROSEN+ //COLUMBIA+RUTGERS+ROCH+WISC

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

BLOCK	62 CERN CONF 371	BLOCK,LENDINARA,MONARI /////// NWU+BOLOGNA

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

K^0

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

11 KO MASS (MEV)

M		498.1	0.4	CHRISTENS	64 SPRK		
M	2223	497.44	0.33	KIM	65 HBC	KO FRCM PBAR P	6/66
M	4500	498.9	0.5	BALTAY	66 HBC	KO FROM PBAR P	6/66

(Ideogram below)

11 KO-K CH. MASS DIFFERENCE (MEV)

D		3.9	0.6	ROSENFELD	59 HBC	-		
D		5.4	1.1	CRAWFORD	59 HBC	+		
D	9	3.90	0.25	BURNSTEIN	65 HBC	-		
D	17	4.18	0.18	ENGELMANN	65 HBC			6/66
D	25	3.71	0.35	KIM	65 HBC	-	K- P TO KO N	6/66

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

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

CRAWFORD	59 PRL 2 112	CRAWFORD,CRESTI,GOOD,STEVENSON,TICHO //LRL
ROSENFEL	59 PRL 2 110	A H ROSENFELD,F SOLMITZ,R D TRIPP //// LRL
CHRISTEN	64 PRL 13 138	CHRISTENSON,CRONIN,FITCH,TURLAY//PRINCETON
BURNSTEI	65 PR 138 B 895	R A BURNSTEIN,H A RUBIN ///////// MARYLAND
ENGELMAN	65 PRI COMM	ENGLEMAN,FILTHUTH ///////////// HEIDELBERG
KIM	65 PR 140 B 1334	J K KIM,L KIRSCH,D MILLER /////// COLUMBIA
BALTAY	66 PR 142 932	BALTAY,SANDWEISS,STONEHILL + //YALE+BNL

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

K^0_1

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

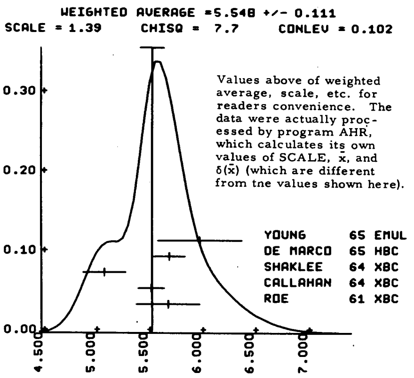
12 K01 LIFETIME (UNITS 10**-10)

T		90	1.07	0.13	0.13	BOLDT	58 CC	
T	U	62	0.81	0.23	0.15	BROWN	58 PBC	
T	U	29	0.84	0.35	0.19	COOPER	58 CC	
T	U	39	1.15	0.40	0.25	BLUMENFEL	58 CC	
T	U	259	1.06	0.08	0.06	EISLER	58 PBC	
T	U	UNPUBLISHED DATA EXCLUDED						
T		512	0.94	0.05	0.05	CRAWFORD	59 HBC	
T		63	1.09	0.18	0.15	BOWEN	60 CC	
T		378	0.94	0.05	0.05	BERTANZA	62 HBC	
T		503	0.87	0.05		CHRETIEN	63 PBC	
T		545	0.86	0.04		KREISLER	64 SPRK	
T		572	0.91	0.04		AUERBACH	65 SPRK	6/66
T			0.866	0.016		ALFF-STEI	66 SPRK	9/66
T		4500	0.92	0.04		BALTAY	66 HBC	6/66
T			0.904	0.024		BOTT-BODE	66 SPRK	9/66
T			0.858	0.014		HILL	66 DBC	9/66
T		5000	0.843	0.013		KIRSCH	66 HBC	6/66

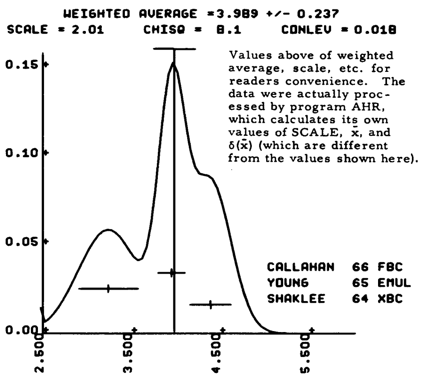
(Ideogram below)

12 K01 PARTIAL DECAY MODES

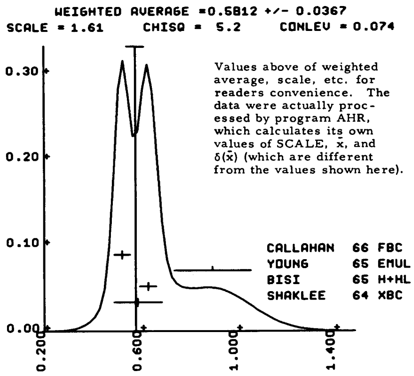
P1	K01 INTO PI+ PI-	S 8S 8
P2	K01 INTO PIO PIO	S 9S 9



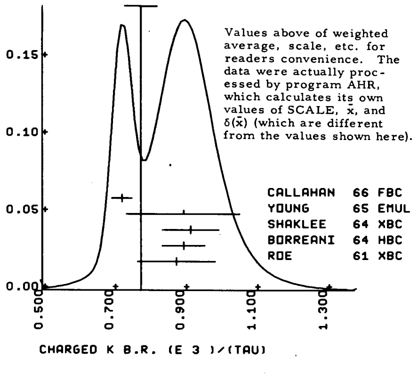
CHARGED K TAU B.F. PI+PI-PIO (UN 10**-2)



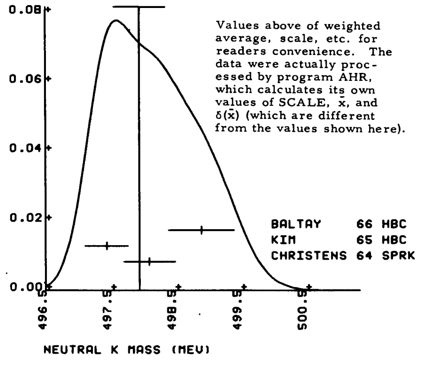
CHARGED K B.R. (2PI)/(TAU)



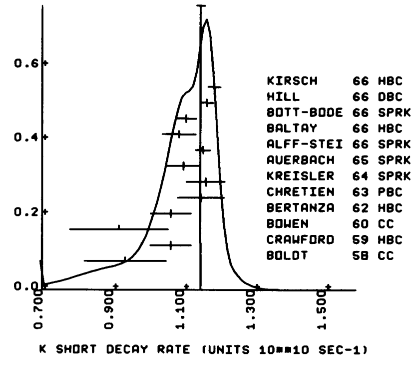
CHARGED K B.R. (MU 3)/(TAU)



CHARGED K B.R. (E 3)/(TAU)



NEUTRAL K MASS (MEV)



K SHORT DECAY RATE (UNITS 10**10 SEC-1)

12 K01 BRANCHING RATIOS

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

R2  *  K01 INTO (PI0 PI0)/TOTAL                              (P2)/TCTAL
R2           0.27      0.11            CRAWFORD  59 HBC
R2           0.26      0.06            BAGLIN    60 PBC
R2           0.30      0.035           BROWN     61 XBC
R2    1066   0.335     0.014           BROWN     63 XBC
R2     198   0.288     0.021           CHRETIEN  63 PBC
                     (Ideogram below)
R3  *   (K01 INTO PI+ PI- PI0)/(K02 INTO PI+ PI- PI0)
R3           0.45   OR LESS            BEHR      66 HLBC    90 PER CT CONF    8/66

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


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

```
BLUMENFE 58 CERN CONF 272      H BLUMENFELD,W CHINCNSKY,L LEDERMAN//COLUM
BOLDT    58 PRL    1  150      E BOLDT,D O CALDWELL,Y PAL /////////// MIT
BROWN    58 CERN CONF 272      J BROWN,D GLASER + ////////////// MICHIGAN
COOPER   58 CERN CONF 272      W A COOPER,H FILTHUTH + ///// JUNGFRAUJUCH
EISLER   58 CERN CONF 272      F EISLER,R PLANO + // BNL+COL+BOLOGNA+PISA
CRAWFORD 59 PRL    2  266      CRAWFORD,CRESTI,DOUGLASS,GOOD,TICHO +//LRL

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

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

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

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


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

K_2^0

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

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

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

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

D            0.445     0.034           ALFF-STEI 66 SPRK                       6/66
D            0.52      0.15      0.16  BALATZ    66 SPRK                       9/66
D            0.480     0.024           BOTT-BODE 66 SPRK                       9/66
D       72 + 0.64      0.18            CANTER    66 DBC     K0 SCATTER IN D2  11/66
D            0.55      0.1             CHRISTENS 66 SPRK                       6/66
D            0.72      0.15            FUJII     66 SPRK    IRON REGENERATOR   9/66

D          + 0.62      0.16            HILL      66 DBC     K0+D INTO HYPER.   9/66
D           +0.35      0.15            JOVANOVIC 66 SPRK    C+URANIUM REGEN.  11/66
D          + 0.44      0.06            MEHLHOP   66 SPRK                       9/66
D       59   0.65      0.30            MEISNER 1 66 HBC     SEE NOTE A         6/66
D   M     + SIGN FAVORED               MEISNER 2 66 HBC                        9/66
D            0.59      0.07            MISCHKE   66 SPRK                       9/66
                     (Ideogram below)
------ --------- --------- --------- --------- --------- --------- ---------
```

13 K02 LIFETIME (NANOSEC) (MICROSEC)

```
T   *    ASSUMED DS=DQ AND DELTA I=1/2 CRAWFORD  59 HBC
T       34   0.081     0.032    0.024  BARDON    58 CC
T       15   0.051     0.024    0.013  DARMON    62 FBC
T            0.054     0.06            FUJI      64 SPRK
T     1700   0.061     0.015    6.0    ASTBURY 3 65 CC

------ --------- --------- --------- --------- --------- --------- ---------
```

13 K02 PARTIAL DECAY MODES

```
P1        K02 INTO 3PI0                            S 9S 9S 9
P2        K02 INTO PI+ PI- PI0                     S 8S 8S 9
P3        K02 INTO PI MU NEUTRINO                  S 8S 4S 2
P4        K02 INTO PI E NEUTRINO                   S 8S 3S 1
P5        K02 INTO PI+ PI-                         S 8S 8
P6        K02 INTO MU+ MU-                         S 4S 4
P7          K02 INTO E+ E-                         S 3S 3
P8          K02 INTO E MU                          S 3S 4
P9          K02 INTO TWO GAMMAS                    S 0S 0
P10         K02 INTO PI+ PI- GAMMA                 S 8S 8S 0
P11         K02 INTO PI0 PI0                       S 9S 9

------ --------- --------- --------- --------- --------- --------- ---------
```

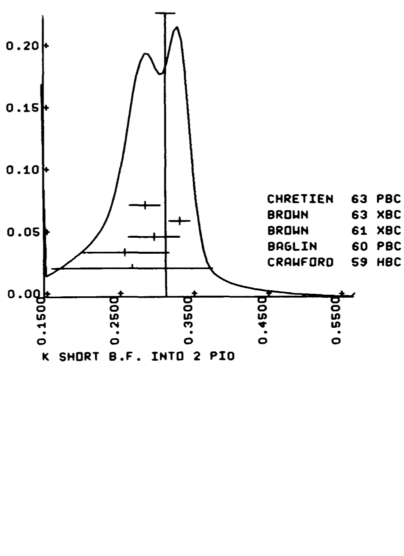
13 K02 DECAY RATES

```
W1  *  K02 INTO PI0 PI0 PI0          (UNITS 10**6 SEC-1)  (P1)
W1      54   5.22   1.03       C.84  BEHR      66 HLBC   ASSUMES CP         8/66

W2  *  K02 INTO PI+ PI- P0           (UNITS 10**6 SEC-1)  (P2)
W2      18   3.26     0.77           ANDERSON  65 HBC                       8/66
W2      14   1.4      0.4            FRANZINI  65 HBC                       6/66
W2     136   2.62     0.28     0.27  BEHR      66 HLBC   ASSUMES CP         8/66
W2           2.54     0.43           HILL      66 DBC                       9/66
                     (Ideogram below)
W3  *  K02 INTO PI E NEUTRINO        (UNITS 10**6 SEC-1)  (P4)
W3           8.1      1.0            AUBERT    65 HLBC                      8/66

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

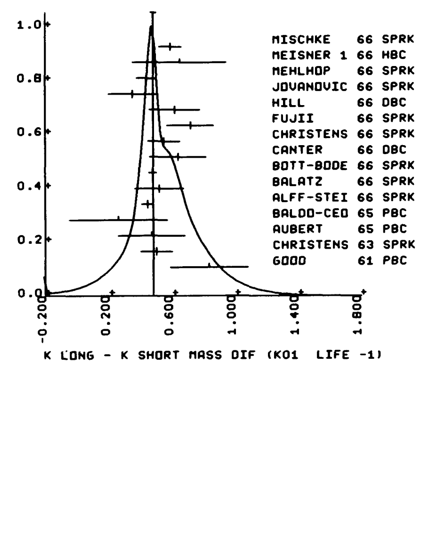
13 K02 BRANCHING RATIOS

```
R1  *  K02 INTO (PI0 PI0 PI0)/CHARGED                     (P1)/(P2+P3+P4)
R1      24   0.24     0.08           ANIKINA   64 CC                        6/66
R1           0.31     0.06           KULYUKINA 66 CC                        9/66

R2  *  K02 INTO (PI+ PI- PI0)/CHARGED                     (P2)/(P2+P3+P4)

R2      59   0.185    0.038          ASTIER    61 CC                        8/66
R2      79   0.151    0.020          ADAIR     64 HBC                       8/66
R2      75   0.157    0.03     0.04  LUERS     64 HBC                       8/66
R2      66   0.15     0.03     0.C4  ASTBURY 1 65 CC                        8/66
R2     326   0.159    0.015          ASTBURY 2 65 CC                        6/66
R2     566   0.178    0.017          GUIDONI   65 HBC                       6/66
R2    1729   0.144    0.004          HOPKINS   65 HBC                       6/66
R2     126   0.162    0.015          HAWKINS   66 HBC                       6/66
R2     180   0.17     0.03           KULYUKINA 66 CC                        9/66

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

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

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

R6  *  K02 INTO(PI+ PI- PI0)/TOTAL                        (P2)/TCTAL
R6      16   0.18     0.05           STERN     64 HBC

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

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

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

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

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

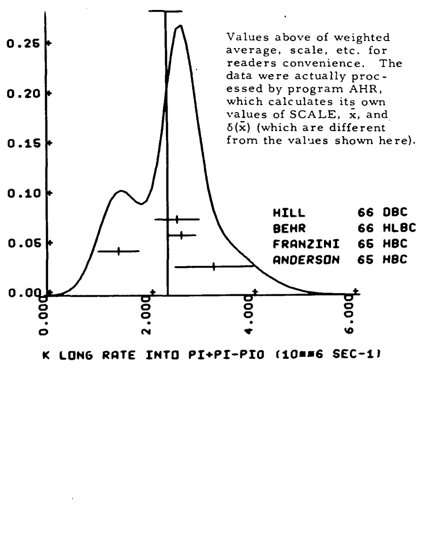
WEIGHTED AVERAGE =0.3161 +/- 0.0135
SCALE = 1.25 CHISQ = 4.7 CONLEV = 0.195



WEIGHTED AVERAGE =0.4834 +/- 0.0168
SCALE = 0.97 CHISQ = 9.4 CONLEV = 0.492



WEIGHTED AVERAGE =2.357 +/- 0.321
SCALE = 1.65 CHISQ = 8.2 CONLEV = 0.042



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

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

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

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

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

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

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

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

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

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


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

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

ADAIR    64 PL 12 67            R K ADAIR,L B LEIPUNER ////////// YALE+BNL
ALEKSANY 64 DUBNA 2 102         ALEKSANYAN,ALIKHANYAN,VARTAZARYAN+//EREVAN
  SEE ALSO  JETP 19 1019        ALEKSANYAN+/// LEBEDEV+MOS ENG PHYS+EREVAN
ANIKINA  64 JETP 19 42          ANIKINA,ZHURAVLEVA+//GEORG ACAD SCI+ DUBNA
CHRISTEN 64 PRL 13 138          CHRISTENSON,CRONIN,FITCH,TURLAY //PRINCETN
FUJII    64 PRL 13 253          FUJII,JOVANOVICH,TURKOT,ZORN //BNL+MARYLND
LUERS    64 PR 133 B 1276       LUERS,MITTRA,WILLIS,YAMAMOTO ///////// BNL
STERN    64 PRL 12 459          STERN,BINFORD,LIND,ANDERSON + /// WISC+LRL

ANIKINA  65 JINR P 2488         ANIKINA,VARDENGA,ZHURAVLEVA,KOTLYA+//DUBNA
ANDERSON 65 PRL 14 475          ANDERSON,CRAWFORD,GOLDEN,STERN +//LRL+WISC
ASTBURY1 65 PL 16 80            ASTBURY,FINOCCHIARO,BEUSCH + / CERN+ZURICH
ASTBURY2 65 PL 18 175           ASTBURY,MICHELINI,BEUSCH + /// CERN+ZURICH
ASTBURY3 65 PL 18 178           ASTBURY,MICHELINI,BEUSCH + /// CERN+ZURICH

AUBERT   65 PL 17 59            AUBERT,BEHR,CANAVAN,CHOUNET+///PARIS+ORSAY
AUERBACH 65 PRL 14 192          AUERBACH,LANDE,MANN,SCIULLI + ////// PENNA
BALDO-CE 65 NC 38 684           BALDO-CEOLIN,CALIMANI,CIAMPOLILLO + /PADVA
BEHR     65 ARGONNE CONF 59     BEHR,BRISSON,BELLOTTI+ // EP+MILANO+PADOVA
CHRISTEN 65 PR 140 B 74         CHRISTENSON,CRONIN,FITCH,TURLAY//PRINCETON
  (CHRISTENSON 65 HAS BEEN CORRECTED FOR INTERFERENCE BY FITCH 65, FOOTNOTE)

CRONIN   65   ARGONNE CONF 17 FITCH,ROTH,RUSS,VERNON-TO BE PUB/PRINCETON
DE BOUAR 65 PL  15  58          DE BOUARD,DEKKERS,SCHARFF+//CERN+ORSAY+MPI
FITCH    65 PRL 15 73           FITCH,ROTH,RUSS,VERNON ///////// PRINCETON
FRANZINI 65 PR 140 B 127        FRANZINI,KIRSCH,PLANO + / COLUMBIA+RUTGERS
GALBRAIT 65 PRL 14 383          GALBRAITH,MANNING,JONES +//AERE+BRIST+RHEL

GUIDONI  65 ARGONNE CONF 49     +BARNES,FOELSCHE,FERBEL,FIRESTO+//BNL+YALE
HOPKINS  65 ARGONNE CONF 67     H W K HOPKINS,BACON,EISLER // VAND+RUTGERS
MESTVIRI 65 JINR P 2449         MESTVIRISHVILI,NYAGU,PETROV,RUSAKOV+//JINR
TRILLING 65 UCRL 16473          GEORGE H TRILLING ///////////////////// LRL
   (THIS IS AN UPDATED VERSION OF REPORT AT 1965 ARGONNE CONF, PAGE 115)

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

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

GOLDEN   66  BERKELEY 2B        R.GOLDEN,F.CRAWFORD,D.STERN          // LRL
HAWKINS  66 PL 21 238           C J B HAWKINS /////////////////////// YALE
HILL     66     BERKELEY CONF.  HILL,ROBINSON,SAKITT +     // BNL+CARNEGIE
JOVANOVI 66 PRL 17 1075         JOVANOVICH,FUJII,TURKOT,ZORN +//BNL+MD+MIT
KULYUKIN 66  BERKELEY 2B        KULYUKINA,MESTVIRISHVILI,NEAGU,PETR+//JINR
MEISNER1 66 PRL 16 278          G W MEISNER,B B CRAWFORD,F CRAWFORD // LRL
MEISNER2 66 PRL  17  492        G MEISNER,B CRAWFORD,F CRAWFORD ////// LRL
MEHLHOP  66     BERKELEY CONF.  MEHLHOP,GOOD,PICCIONI +          // LA JOLLA
MISCHKE  66     BERKELEY CONF.  + ABASHIAN,ABRAMS,CARPENTER +  // ILLINOIS
NEFKENS  66 PL 19 706           NEFKENS,ABASHIAN,ABRAMS,CARPENTER+ /// ILL
```


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

η

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

14 ETA MASS (MEV)

```
M        53  549.0       1.2              BASTIEN   62 HBC
M        35  546.0       4.0              PICKUP    62 HBC
M        91  548.0       1.0              ALFF      62 HBC
M            549.3       2.9              DELCOURT  63 CNTR
M       148  549.0       0.7              FOELSCHE  64 HBC
M       325  552.0       3.0              KRAEMER   64 DBC
M            548.2       0.65             FOSTER3   65 HBC                  7/66
M       250  552.0       4.0              JAMES     66 HBC                  6/66

------ --------- --------- --------- --------- --------- --------- ---------
```

14 ETA WIDTH (MEV)

```
W    *   91   10.0    OR LESS             ALFF      62 HBC
W    *  325   16.0    OR LESS             KRAMER    64 DBC
W    *  148   10.0    OR LESS             FOELSCHE  64 HBC
W    *   31   12.0    OR LESS             JAMES     66 HBC                  6/66
W    *         4.0    OR LESS             BALTAY    66 DBC                  7/66

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

------ --------- --------- --------- --------- --------- --------- ---------
```

14 ETA PARTIAL DECAY MODES

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

------ --------- --------- --------- --------- --------- --------- ---------
```

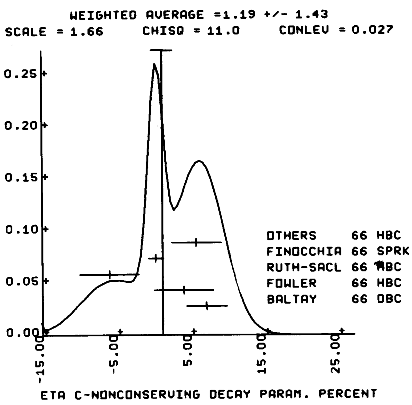
14 ETA BRANCHING RATIOS

(P9) IS ASSUMED = 0 IN ALL RATIOS

```
R1   *     ETA INTO NEUTRALS/CHARGED                      (P1+P2+P7)/(P3+P4)
R1   N   10     2.5        1.0            PICKUP    62 HBC
R1   N   53     3.20       1.26           BASTIEN   62 HBC
R1   N          2.7        0.8            SHAFER    62 HBC
R1              2.6         .9            BUSCHBECK 63 HBC                  7/66
R1   N  280     4.5        1.0            JAMES     66 HBC                  6/66
     N     THIS EXPERIMENT HAS NOT BEEN USED IN COMPUTING THE AVERAGES
     N   AS IT WAS UNABLE TO CLEARLY SEPARATE PARTIAL MODES (3) AND (4)
     N   FROM EACH OTHER.  THE REPORTED VALUE THUS PROBABLY CONTAINS
     N   SOME (UNKNOWN) FRACTION OF MODE (4), AS POINTED OUT BY E.C. FOWLER

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

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

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

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

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

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

R8   *     ETA INTO NEUTRAL/(PI+ PI- PIO)                 (P1+P2+P7)/(P3)
R8      280     3.6        0.8            KRAEMER   64 DBC
R8              3.8        1.1            PAULI     64 DBC                    7/66
R8              2.89       0.56           ALFF-STEI 66 HBC                    9/66

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

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

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

R12 *     ETA INTO 2 GAMMA/NEUTRALS                       (P1)/(P1+P2+P7)
R12             0.416      0.044          DI GIUGNO 66 CNTR    ERROR DOUBLED  6/66
R12              .47        .06           GRUNHAUS  66 SPRK                   7/66

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

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

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

14 ETA C-NONCONSERVING DECAY PARAMETER

```
A    DECAY ASYMMETRY PARAMETER FOR PI+ PI- PIO
A      1351     7.2        2.8            BALTAY    66 DBC                    8/66
A       565     4.1        4.1            FOWLER    66 HBC                    8/66
A       705    -6.0        4.0            RUTH-SACL 66 HBC                    8/66
A     10665     0.3        1.0            FINOCCHIA 66 SPRK                   8/66
A      1300     5.8        3.4            OTHERS    66 HBC                    8/66
                       (Ideogram on next page)
B    DECAY ASYMMETRY PARAMETER FOR PI+ PI- GAMMA
B        33    -0.02       0.17           CRAWFORD1 66 HBC                   11/66

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




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

PEVSNER   61 PRL 7 421          PEVSNER,KRAEMER,NUSSBAUM,RICHARDSON +//JHU
ALFF      62 PRL 9 322          ALFF,BERLEY,COLLEY,BRUGGER +///COL+RUTGERS
BASTIEN   62 PRL 8 114          BASTIEN,BERGE,DAHL,FERRO-LUZZI + ///// LRL
CHRETIEN  62 PRL 9 127          CHRETIEN+ //BRAND+BROWN+HARVARD+MIT+PADOVA
PICKUP    62 PRL 8 329          E PICKUP,ROBINSON,SALANT ///// NRC+CAN+BNL
SHAFER    62 CERN CONF 307      J SHAFER,FERRO-LUZZI,MURRAY + ///// UC+LRL

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

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

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

ALFF-STE  66 PR 145 1072        ALFF-STEINBERGER,BERLEY+//COLUMBIA+RUTGERS
BAGLIN    66  BERKELEY CONF     BAGLIN,BEZAGUET,DEGRANGE+  // EC.POLYT+LRL
  ALSO    66 PL 22 219          BAGLIN,BEZAGUET,DEGRANGE+  // EC.POLYT+LRL
BALTAY    66 PRL 16 1224        +FRANZINI,KIM,KIRSCH+/COLUMBIA+STONY BROOK
CRAWFRD1  66 PRL  16  333       F.S.CRAWFORD,L.R.PRICE               //LRL
CRAWFRD2  66 PRL 16 907         F S CRAWFORD,L LLOYD,E FOWLER   //LRL+DUKE

DIGIUGNO  66 PRL 16 767         DIGIUGNO,GIORGI,SILVESTRI+//NAP+TRST+FRASC
JAMES     66 PR 142   896       F E JAMES,H L KRAYBILL ////////// YALE+BNL
GROSSMAN  66 PR 146  993        R GROSSMAN,L PRICE,F CRAWFORD //////// LRL
GRUNHAUS  66 THESIS             J.GRUNHAUS                      //COLUMBIA
LUEBBELS  66  BERKELEY 8A       LUEBBELSMEYER+                     // BONN+
STRUGALS  66 BERK CONF          STRUGALSKI,CHUVILE,IVANOVSKAJA,+   //DUBNA
WAHLIG    66 PRL  17  221       WAHLIG,SHIBATA,MANNELLI         //MIT+PISA

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

            REFERENCES ON ETA ASYMMETRY PARAMETERS

BALTAY    66 PRL  16  1224      BALTAY,FRANZINI,KIM,KIRSCH+/COLUM+STONY BK
CRAWFRD1  66 PRL  16  333       F.S.CRAWFORD,L.R.PRICE               //LRL
OTHERS    66 PR 149  1044       COLUMBIA,LRL,PURDUE,WISCONSIN,YALE
FOWLER    66 BAPS 11  380       E.C.FOWLER                          //DUKE
FINOCCHI  66  BERKELEY CONF     FINOCCHIARO,CNOPS,MULLER+//CERN+ZUR+SACLAY
RUTH-SAC  66  BERKELEY CONF     RUTHEFORD-SACLAY COLLABORATION

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


p

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

                  16  PROTON  MASS (MEV)

M           938.256    0.005            COHEN      65 RVUE              7/66

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

                  16  PROTON LIFETIME  (UNITS 10**26 YR)

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

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

                  16 PROTON MAGNET. MOMENT(E/2MP)

MM          2.792763 0.000030           COHEN      65 RVUE              7/66

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


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

BACKENST 60 NC   16  749        BACKENSTOSS,FRAUENFELDER,HYAMS + //// CERN
COHEN     65 RMP 37 537         E R COHEN, J W M DUMOND //// NAASC+CALTECH
KROPP     65 PR 137 B 740       W R KROPP,F REINES ///CASE INST TECHNOLOGY

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


n

```
                  17  NEUTRON (939,J=1/2)  I=1/2
                  17  NEUTRON-PROTON MASS DIF.(MEV)

D             1.2939   0.0004          BONDELID  60 CNTR
D             1.2933   0.0001          SALGO     64 CNTR

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

                  17  NEUTRON LIFETIME (UNITS 10**3 SEC)

T             1.01       0.03       0.03  SOSNOVSKI 59 PILE

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

                  17  NEUTRON MAGNETIC MOMENT (MAGNETONS,938.2 MEV)

MM          -1.913148 0.000066          COHEN      56 SPECIAL             7/66

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


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

COHEN     56 PR 104 283         V W COHEN, CORNGOLD, RAMSEY // BNL+HARVARD
SOSNOVSK 59 JETP  9  717        SOSNOVSKII,SPIVAK,PROKOFEV + // IAE MOSCOW
BONDELID 60 PR  120  887        BONDELID,BUTLER,KENNEDY +//USNRL+CATH UNIV
SALGO     64 NP   53  457       R SALGO, STAUB, WINKLER, ZAMBONI // ZURICH
COHEN     65 RMP 37 537         E R COHEN,DUMOND ///// NAASC+CAL INST TECH

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


Λ

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

Hyperon Masses

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

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

```
                  18  LAMBDA  MASS (MEV)

M    *   25 1115.06     0.41            ARMENTERO 62 HBC     ERROR IS STATIS.
M    *      1115.27     0.36            BALTAY    62 HBC     ERROR IS STATIS.
M           1115.44     0.12            BHOWMIK   63 RVUE +  SEE NOTE L BELOW
M    L  ABOVE LAMBDA MASS HAS BEEN RAISED 35 KEV TO ACCOUNT FOR 46 KEV
     L  INCREASE IN PROTON MASS AND 11 KEV DECREASE IN CHARGED PION MASS.
M    *      1115.4      0.2             BADIER    64 HBC    ERROR IS STATIS.  6/66
M    *  635 1115.86     0.09            BALTAY    65 HBC    ERROR IS STATIS.  6/66
M    N      1115.61     0.07            SCHMIDT   65 HBC                      9/66
M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS
M           1115.6      0.4             LONDON    66 HBC                      6/66

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

                  18  LAMBDA LIFETIME (UNITS 10**-10)

T    U   74      2.75      0.45      0.38  BLUMENFEL 58 CC
T       188      2.63      0.21      0.21  BOLDT     58 CC
T    U   61      2.08      0.46      0.31  BROWN     58 PBC
T    U   40      3.04      0.78      0.51  COOPER    58 CC
T    U  454      2.29      0.15      0.13  EISLER    58 HBC
T       825      2.72      0.16      0.16  CRAWFORD  59 HBC
T       140      2.72      0.29      0.27  BOWEN     60 CC

T    U  748      2.58      0.11      0.11  BERTANZA  62 HBC
T       186      2.60      0.28      0.20  C-C CHANG 62 HBC
T    U 3447      2.52      0.08            FUNG      62 PBC                6/66
T       799      2.69      0.11      0.11  HUMPHREY  62 HBC

T      2239      2.36      0.06      0.06  BLOCK     63 HEBC
T       706      2.76      0.20            CHRETIEN  63 PBC
T       794      2.59      0.09            HUBBARD   64 HBC
T      2260      2.31      0.10            KREISLER  64 SPRK
T      1378      2.59      0.07            SCHWARTZ  64 HBC

T       635      2.51      0.16            BALTAY    65 HBC                6/66
T      2534      2.6       0.1             HILL      65 SPRK
T       916      2.35      0.09            BURAN     66 HLBC               6/66
T      2213      2.452     0.056     0.054 ENGELMANN 66 HBC                9/66

T    U  UNPUBLISHED MEASUREMENTS (EXCEPT THESES) NOT INCLUDED IN AVERAGE   7/66
```

(Ideogram on next page)

```
------ --------- --------- --------- --------- --------- --------- ---------

                  18  LAMBDA MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

MM              -1.5      0.5             COOL      62 SPRK
MM               0.0      0.6             KERNAN    63 CC
MM       8553   -1.37     0.72            ANDERSON  64 HBC
MM        151   -0.5      0.28            CHARRIERE 65 EMUL
MM              -0.75     0.19            HILL      66 SPRK               9/66

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

                  18  LAMBDA PARTIAL DECAY MODES

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

------ --------- --------- --------- --------- --------- --------- ---------
```

```
                     18  LAMBDA BRANCHING RATIOS

R1  *  LAMBDA INTO (P PI-)/((P PI-)+(N PIO))                 (P1)/(P1+P2)
R1           0.627    0.031           CRAWFORD  59 HBC
R1           0.65     0.05            COLUMBIA  60 HBC
R1     903   0.643    0.016           HUMPHREY  62 HBC
R1           0.685    0.017           ANDERSON  62 HBC
                           (Ideogram below)
R2  *  LAMBDA INTO (N PIO)/((P PI-)+(N PIO))                 (P2)/(P1+P2)
R2           0.23     0.09            EISLER    57 PBC
R2           0.43     0.14            CRAWFORD  59 HBC
R2           0.28     0.08            BAGLIN    60 PBC
R2           0.35     0.05            BROWN     63 XBC
R2     75    0.291    0.034           CHRETIEN  63 PBC

R3  *  LAMBDA INTO (P E- NEU)/TOTAL   (UNITS 10**-3)         (P4)/(P1+P2)
R3     15    2.0      0.5             HUMPHREY  61 RVUE
R3     8     2.9      1.5       1.2   AUBERT    62 FBC
R3     150   0.82     0.12      0.13  ELY       63 FBC
R3     20    1.55     0.34            LIND      64 HBC
R3     102   0.78     0.12            BAGLIN    64 FBC
                           (Ideogram below)
R4  *  LAMBDA INTO (P MU- NEU)/TOTAL  (UNITS 10**-4)         (P3)/(P1+P2)
R4  *  1     0.2      OR GREATER      GOOD      62 HBC
R4  *  1     1.0      OR LESS         ALSTON    63 HBC
R4  *  2     1.0      OR LESS         KERNAN    64 FBC
R4  *  BETWEEN 1.3 AND 6.0            LIND      64 HBC
R4     3     1.3      0.7             LIND      64 RVUE                        7/66
R4     2     1.5      1.2             RONNE     64 FBC

-------------------------------------------------------------------------------
                     18  LAMBDA DECAY PARAMETERS

A-  *  ALPHA LAMBDA- (LAMBDA INTO PI- PROTON)
A-           0.62     0.05            CRONIN    63 CNTR                        6/66
A-    2529   0.747    0.C86           MERRILL   66 HBC    FROM XI- DECAY       6/69
A-    4660   0.655    0.025           OVERSETH  66 SPRK   LAMBDA FROM PI-P     9/66
A-  *        0.663    0.022           BERGE     66 RVUE  INCLUDES ALL ABOVE    9/66

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

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

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

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

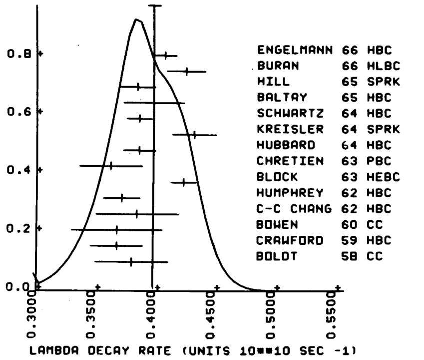

```
                              REFERENCES
                              18 LAMBDA (1115,JP=1/2+) I=0

EISLER   57 NC      5 1700     EISLER,PLANO,SAMIOS,SCHWARTZ + //COLUM+BNL
BLUMENFE 58 CERN CONF 270      H BLUMENFELD,W CHINOWSKY,L LEDERMAN//COLUM
BOLDT    58 PRL     1  148     E BOLDT,D O CALDWELL,Y PAL /////////// MIT
BROWN    58 CERN CONF 270      BROWN,GLASER,GRAVES,PERL,CRONIN + //  MICH
COOPER   58 CERN CONF 270      W A COOPER,H FILTHUTH + ///// JUNGFRAUJOCH
EISLER   58 CERN CONF 270      F EISLER,PLANO,BASSI + // BNL+COLUM+BOL+PI
CRAWFORD 59 PRL     2  266     CRAWFORD,CRESTI,DOUGLASS,GOOD + /////  LRL

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

ANDERSON 62 CERN CONF 832      ANDERSON,CRAWFORD,GOLDEN,LLOYD + ///// LRL
ARMENTER 62 CERN CONF 236      ARMENTEROS+/CERN+EP+LONDON+BIRM+CEN-SACLAY
AUBERT   62 NC     25  479     AUBERT,BRISSON,HENNESSY,SIX + /// PARIS-EP
BALTAY   62 CERN CONF 233      BALTAY,FOWLER,SANDWEISS,CULWICK+//YALE+BNL
BERTANZA 62 PREPRINT D105      BERTANZA,CONNOLLY,CULWICK,EISLER + /// BNL
CHANG    62 THESIS DUKE        CHUEN CHUEN CHANG /////////////////// DUKE
COOL     62 PR    127 2223     COOL,HILL,MARSHALL + ///// BNL+MIT+NYU+ANL
FUNG     62 BAPS    7  619     SUN YIU FUNG ///////////////////////// LRL
GOOD     62 PRL     9  518     M L GOOD,V G LIND ////////////// WISCONSIN
HUMPHREY 62 PR    127 1305     W E HUMPHREY,R R ROSS //////////////// LRL

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

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

BALTAY   65 PR 140 B 1027      BALTAY,SANDWEISS,CULWICK,KOPP + //YALE+BNL
BARLOW   65 PL   18   64       J BARLOW,BLAIR,DUKE,MANN+//CERN+RUTH+PENNA
CHARRIER 65 PL    15     66    CHARRIERE,GIBSON+ //// EPUL+BRIST+CERN+MPI
HILL     65 PRL   15     85    D A HILL,K K LI /////////////////////// MIT
SCHMIDT  65 PR 140 B 1328      P SCHMIDT /////////////////////// COLUMBIA

BERGE    66    BERKELEY CONF.  BERGE,CABIBBO                       // RVUE
BURAN    66 PL 20 318          BURAN,EIVINDSON,SKJEGGESTAD,TOFTE + //OSLO
ENGELMAN 66    BERKELEY CONF.  ENGELMANN,FILTHUTH,ALEXANDER+/HEIDBG+WEIZM
HILL     66  BERKELEY CONF     HILL,LI,JENKINS,KYCIA,RUDERMAN       // BNL
LONDON   66 PR 143 1034        LONDON,RAU,GOLDBERG,LICHTMAN+//BNL+SYRACUS
MERRILL  66  BERKELEY CONF     MERRILL,SHAFER,BERGE                 // LRL
     CF. 66 UCRL 16455         DEANE MERRILL (THESIS, BERKELEY) ///// LRL
OVERSETH 66  BERKELEY CONF     O.E OVERSETH, R F ROTH//MICHIGAN+PRINCETON
```


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

Σ^+

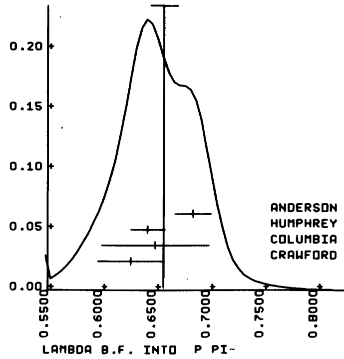
```
                  19  SIGMA+   (1189,JP=1/2+)  I=1

                  19  SIGMA+ MASS (MEV)

M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M       144 1189.38      0.15           BARKAS    63 EMUL +  SEE NOTE S BELOW
M        58 1189.48      0.22           BHOWMIK   64 EMUL +  SEE NOTE S BELOW
M    S  ABOVE SIGMA+ MASSES HAVE BEEN RAISED 30  KEV TO ACCOUNT FOR 46 KEV
     S  INCREASE IN PROTON MASS AND 21 KEV DECREASE IN PION MASS
M           1189.59      0.11           SCHMIDT   65 HBC                       9/66

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

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

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

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

T       203    0.84     0.12     0.C8   BHOWMIK    64 EMUL
T       181    0.84     0.09            BALTAY     65 HBC                      6/66
T       900    0.76     0.03            CARAYANNO  65 HBC                      6/66
T              0.83     0.018           CHANG      65 HBC                      6/66
T       381    0.80     0.07            COOK       66 SPRK                     7/66

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

                  19  SIGMA+ MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

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

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

                  19  SIGMA+ PARTIAL DECAY MODES

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

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

                  19  SIGMA+  BRANCHING RATIOS

R1  *  SIGMA+  INTO (NEUTRON PI+)/(NUCLEON PI)               (P2)/(P1+P2)
R1     308   0.490    0.024           HUMPHREY  62 HBC
R1           0.46     0.02            CHANG     65 HBC                         6/66

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

R3  *    SIGMA+ INTO (LAMBDA E+ NEU)/TOTAL (UNIT 10**-5) (P4)/TOTAL
R3  *    4    3.3      1.7            WILLIS    64 HBC    STOP. K-             9/66
R3       3    1.5      0.9            BAGGETT   66 RVUE   SEE NOTE B BELOW     9/66
R3  B  ABOVE EXP. CONTAINS 1 EVENT OF WILLIS + ASSUMES  S20R3=.00006           9/66

R4  *  SIGMA+  INTO (N MU+ NEU)/(PI+N)   (UNITS 10**-4) (P6)/(P2)
R4  *    1 EVENT SEEN,NO RATIO GIVEN. GALTIERI 62 EMUL
R4  *    0  LESS THAN             2.3  BURNSTEIN 63 HBC
```

WEIGHTED AVERAGE =0.39844 +/- 0.00561
SCALE = 1.36   CHISQ = 23.9   CONLEV = 0.032



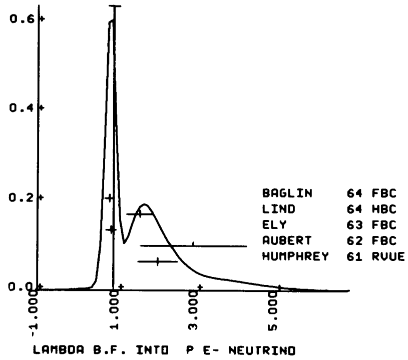
LAMBDA DECAY RATE (UNITS 10**10 SEC -1)

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



LAMBDA B.F. INTO P PI-

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



LAMBDA B.F. INTO P E- NEUTRINO

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

19 SIGMA+ DECAY PARAMETERS

```
A+   *    ALPHA+/ALPHAO FOR SIGMA+ (SIG+ TO PI+ N)/(SIG+ TO PIO P)
A+              +0.04      0.11          CORK       60 CNTR    SIG+ FROM PI+P
A+   *          +0.20      0.24          TRIPP      62 HBC  +  REPLAC.BY BANGER
A+    3500      -.014      0.052         BANGERTER 66 HBC  +  SIG+ FROM K-P      9/66
A+    2600      -.047       .07          BERLEY     66 HBC  +  SIG+ FROM K-P      9/66

AO   *  ALPHA SIGMAO (SIG+ INTO PIO PROTON)
AO             -0.80      0.16           BEALL      62 CNTR
AO   *         -0.90      0.25           TRIPP      62 HBC     REPLAC. BY BANGER
AO    5200     -0.986     0.072          BANGERTER 66 HBC     K-P TO SIG+ PI-    7/66

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

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

REFERENCES
19 SIGMA + (1189,JP=1/2+) I=1


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

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

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

BARKAS    63 PRL 11 26          W H BARKAS,J N DYER,H H HECKMANN ///// LRL
    ALSO  61 UCRL 9450          JOHN DYER (THESIS, BERKELEY)  ///////  LRL
COURANT   63 SIENA CONF  1 15   COURANT,FILTHUTH,BURNSTEIN+ // CERN+MD+NRL

BHOWMIK   64 NP 53 22           B BHOWMIK,P JAIN,P MATHUR,LAKSHMI // DELHI
BURNSTEI  64 PRL 13 66          BURNSTEIN,DAY,KEHOE,SECHI ZORN,SNOW /MARYL
CARRARA   64 PL 12 72           CARRARA,CRESTI,GRIGOLETTO,PERUZZC+//PADOVA
COURANT   64 PR 136 B 1791      COURANT,FILTHUTH+//CERN+HEIDLB+MD+NRL +BNL
MURPHY    64 PR 134 B 188       C THORNTON MURPHY ////////////// WISCONSIN
NAUENBER  64 PRL 12 679         NAUENBERG,MARATECK,BLUMENFELD+ /COL+RUT+PR
WILLIS    64 PRL 13 291         WILLIS,COURANT,ENGELMAN+//BNL+CERN+HEID+MD

BALTAY    65 PR 140 B 1027      BALTAY,SANDWEISS,CULWICK,KOPP + //YALE+BNL
BAZIN     65 PRL 14 154         BAZIN,BLUMENFELD,NAUENBERG +//PRINCE+COLUM
CARAYAN   65 PR 138 B 433       CARAYANNOPOULOS,TAUTFEST,WILLMANN// PURDUE
CHANG     65 NEVIS 145  THESIS  CHUNG YUN CHANG ///////////////// COLUMBIA
QUARENI   65 NC 40 A 928        QUARENI,CARTACCI + //////BOL+FIR+GEN+PARMA
SCHMIDT   65 PR 140 B 1328      P SCHMIDT //////////////////////// COLUMBIA

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

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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


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

Σ^-

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

20 SIGMA- MASS (MEV)

```
M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M    *        1197.47      0.11             SCHMIDT    65 HBC                 9/66

------ --------- --------- --------- --------- --------- --------- ---------
```

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

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

```
M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

DL              81.70      0.19             BURNSTEIN 64 HBC                 9/66

------ --------- --------- --------- --------- --------- --------- ---------
```

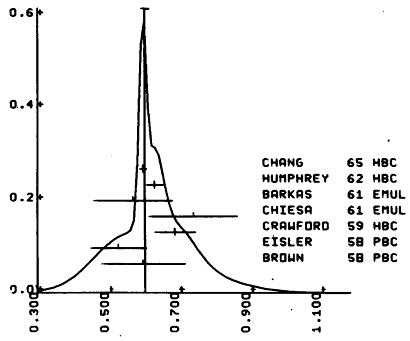
20 SIGMA- LIFETIME (UNITS 10**-10)

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

T       1208     1.58      0.06      0.06 HUMPHREY   62 HBC
T                1.666     0.026          CHANG      65 HBC                 6/66
```

(Ideogram below)

```
------ --------- --------- --------- --------- --------- --------- ---------
```

WEIGHTED AVERAGE =0.6060 +/- 0.0117
SCALE = 1.37   CHISQ = 3.7   CONLEV = 0.154



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

20 SIGMA- PARTIAL DECAY MODES

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

------ --------- --------- --------- --------- --------- --------- ---------
```

20 SIGMA- BRANCHING RATIOS

```
R1  *  SIGMA - INTO (N MU- NEU)/(N PI-) (UNITS 10**-3)  (P3)/(P1)
R1       22    0.66     0.15           COURANT   64 HBC
R1       11    0.56     0.20           BAZIN     65 HBC      FROM STOP. K-     6/66

R2  *  SIGMA - INTO (N E- NEU)/(N PI-)  (UNITS 10**-3)  (P4)/(P1)
R2        9    1.0      0.4       0.3  MURPHY    64 PBC
R2       16    1.37     0.34           NAUENBERG 64 HBC
R2       16    1.15     0.4            MILLER    64 FBC
R2       31    1.4      0.3            COURANT   64 HBC

R3  *  SIGMA - INTO (LAMBDA E- NEU)/(N PI-) (UNITS 10**-4)(P5)/(P1)
R3       11    0.75     0.28           COURANT   64 HBC     STOP. K-
R3       12    0.50                    BAGGETT   66 HBC   - STOP. K-             9/66
R3  *    23    0.61     0.16           BAGGETT   66 RVUE  - AVER. ABOVE 2 EX    9/66

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

------ --------- --------- --------- --------- --------- --------- ---------
```

20 SIGMA- DECAY PARAMETERS

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

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

REFERENCES

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


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

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

BARKAS    63 PRL 11 26          W H BARKAS,J N DYER,H H HECKMAN ////// LRL
COURANT   63 SIENA 1 15         COURANT,FILTHUTH,BURNSTEIN+/// CERN+MD+NRL
BURNSTEI  64 PRL 13 66          BURNSTEIN,DAY,KEHOE,SECHI ZORN,SNOW// MARY
COURANT   64 PR 136 B 1791      COURANT,FILTHUTH+///CERN+HEIDLB+MD+NRL+BNL
MILLER    64 PL 11 262          MILLER,STANNARD,BEZAGUET+ /LOND+PARIS+BERG
MURPHY    64 PR 134 B 188       C THORNTON MURPHY ////////////// WISCONSIN
NAUENBER  64 PRL 12 679         NAUENBERG,SCHMIDT,MARATECK+ /COL+RUT+PRINC

BAZIN     65 PR 140 B 1358      BAZIN,PLANO,SCHMIDT +    //PRINC+RUTG+COLUM
CHANG     65 NEVIS 145  THESIS  CHUNG YUN CHANG ////////////////  COLUMBIA
DOSCH     65 PL 14 239          DOSCH,ENGELMANN,FILTHUTH,HEPP,KLUGE+ /HEID
SCHMIDT   65 PR 140 B 1328      P SCHMIDT //////////////////////// COLUMBIA
BAGGETT   66         (PREPRINT) BAGGETT,DAY,GLASSER +            // MARYLAND
BANGERTE  66 PRL  17  495       BANGERTER,GALTIERI,BERGE,MURRAY+   // LRL
```


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

Σ^0

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

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

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

```
M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

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

------ --------- --------- --------- --------- --------- --------- ---------
```

21 SIGMAO LIFETIME (UNITS 10**-14)

```
T    *      1.0 OR LESS                    DAVIS     62 EMUL

------ --------- --------- --------- --------- --------- --------- ---------
```

```
             21  SIGMA O PARTIAL DECAY MODES

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

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

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

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



```
                              REFERENCES

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

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

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

ALFF     65 PR 137 B1105        ALFF,GELFAND,NAUENBERG+//COLUMBIA+RUTG+BNL  P

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


Ξ^-

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

                  22  XI-  MASS (MEV)

M    H   11 1317.0      2.2            WANG      61 PBC
M    H   18 1317.9      1.9            FOWLER    61 PBC
M    H (OLD DATA AND LOW STATISTICS DROPPED ON SUGGESTION OF J R HUBBARD)
M    *    1 1322.0      1.3            BROWN     62 HBC     ANTI-XI-          7/66

M        62 1321.1      0.65           SCHNEIDER 63 HBC
M       517 1321.4      0.4            JANEAU    63 FBC
M       241 1321.1      0.3            BADIER    64 HBC
M    *  ALL MASSES ABOVE MUST BE RAISED 0.09 MEV BECAUSE LAMBDA MASS RAISED
M       299 1321.4      1.1            LONDON    66 HBC                       6/66

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

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

T    H   11     3.5      3.4      1.23  WANG      61 PBC
T    H   18     1.28     0.41     0.25  FOWLER    61 PBC
T    H (OLD DATA AND LOW STATISTICS DROPPED ON SUGGESTION OF J R HUBBARD)
T       517     1.86     0.15     0.14  JAUNEAU   63 FBC
T        62     1.55     0.31     0.31  SCHNEIDER 63 HBC
T       356     1.77     0.12           CARMONY   64 HBC
T       794     1.69     0.07           HUBBARD   64 HBC
T       299     1.80     0.16           LONDON    66 HBC                      6/66

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

                  22  XI- PARTIAL DECAY MODES

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

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

                  22  XI- BRANCHING RATIOS

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

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

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

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

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

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

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

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

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

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

                  22  XI- DECAY PARAMETERS

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

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

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

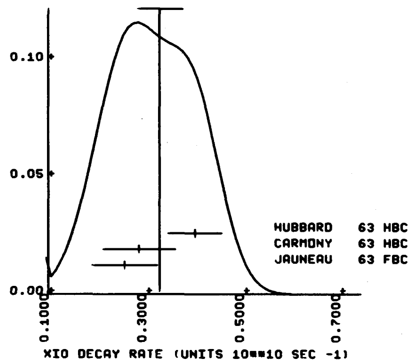


```
                              REFERENCES

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

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

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

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

BERGE    66 PR  147  945        BERGE,EBERHARD,HUBBARD,MERRILL + ///// LRL
BERGE 2  66    BERKELEY CONF.   BERGE,CABIBBO                        // RVUE
LONDON   66 PR 143 1034         LONDON,RAU,GOLDBERG,LICHTMAN+//BNL+SYRACUS
MERRILL  66  BERKELEY CONF      MERRILL,SHAFER,BERGE                  // LRL
     CF. 66 UCRL 16455          DEANE MERRILL (THESIS, BERKELEY) ///// LRL

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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


Ξ^0

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

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

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

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

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

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

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




```
                  23  XI 0  PARTIAL DECAY MODES

P1      XI 0 INTO LAMBDA PIO                                S18S 9
P2      XI 0 INTO PROTON PI-                                S16S 8
P3      XI 0 INTO PROTON E- NEU                             S16S 3S 1
P4      XI 0 INTO SIGMA+ E- NEU                             S19S 3S 1
P5      XI 0 INTO SIGMA- E+ NEU                             S20S 3S 1
P6          XI 0 INTO SIGMA+ MU- NEUTRINO                   S19S 4S 2
P7          XI 0 INTO SIGMA- MU+ NEUTRINO                   S20S 4S 2
P8          XI 0 INTO PROTON MU- NEUTRINO                   S16S 4S 2

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

                  23  XI 0  BRANCHING RATIOS

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

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

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

R4  *      XI 0 INTO (SIGMA- E+ NEUTRINO)/TOTAL             (P5)/TOTAL
R4  *    0     0.006  OR LESS         HUBBARD    66 HBC                       7/66
```

```
R5  *      X1 O INTO (SIGMA+ MU- NEUTRINO)/TOTAL          (P6)/TOTAL
R5  *   0     0.007  OR LESS           HUBBARD   66 HBC                       7/66

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

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

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

                    23  XI O DECAY PARAMETER

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

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

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

REFERENCES

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


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

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

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


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

Ω^-

```
                 24  OMEGA- (1675,JP=3/2+)   I=0
   *           QUANTUM NUMBERS ASSIGNED FROM SU3

                 24  OMEGA-  MASS (MEV)

M   *    1 1620.0     25.0      10.0 EISENBERG 54 EMUL
M   S    1 1673.0      8.0           ABRAMS    64 HBC     INTO XI- PI0      7/66
M   S    1 1686.0     12.0           BARNES 1  64 HBC     INTO XIO PI-      7/66
M   S    1 1674.0      3.0           BARNES 2  64 HBC     INTO LAMBDA K-    7/66
M   S    1 1666.0      8.0           COLLEY    65 HBC     INTO XIO PI-      6/66
M   S    1 1671.0      5.0           RICHARDSO 65 HBC     INTC LAMBDA K-    7/66
M   S      ABOVE EVENTS INCLUDED IN SAMIOS RVUE                             7/66
M        6 1674.0      3.0           SAMIOS    65 RVUE                      6/66

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

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

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

                 24 OMEGA- PARTIAL DECAY MODES

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

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

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


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


```
------ --------- --------- --------- --------- --------- --------- ---------
---------------------------------------------------------------------------
```

DATA ON MESON RESONANCES

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

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

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

σ (410)

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

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

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

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

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

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

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

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

REFERENCES FOR SIGMA


```
SAMICS   62 PRL 9 139           +BACHMAN,LEA+ ///////////// BNL+CCNY+CO+KY
BLOKHINT 63 JETP 17 80          BLOKHINTSEVA,GREIBINNIK,ZHUKOV +  // DUBNA
BOOTH    63 PR 132 2314         + ABASHIAN ///////////////////////////// LRL
KIRZ     63 PR 130 2481         +SCHWARTZ + TRIPP  ///////////////////// LRL
BARISH   64 PR 135 B 416        BARISH,KURZ,PEREZ-MENDEZ,SOLOMON      // LRL
CRAWFORD 64 PRL 13 421          +GROSSMAN,LLOYD,PRICE,FOWLER ///////// LRL
DEL FABR 64 PRL 12 674          DEL FABRO,DE PRETIS,JONES+        FRASCATI
KALMUS   64 PRL 13  99          +KERNAN,PU,POWELL,DOWD ///// LRL+WISCONSIN
BROWN    65 CORAL GABLES 219    BROWN+FAIER ////////////////// NORTHWESTERN
ANDERSON 66  BERKELEY CONF.     +FUKUI,KESSLER+ // CHIC+ARG+OTT+MCGILL+QMC
KOPELMAN 66 PL  22  118         +ALLEN,GOODEN,MARSHALL +  // COLORADO+IOWA
LOVELACE 66 PL  22  332         LOVELACE,HEINZ,DONNACHIE              // CERN

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

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


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

ϵ (700)

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

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

         14      EPSILON (700)  MASS (MEV)

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

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

         14      EPSILON (700)  WIDTH (MEV)

W.          50.0                   FELCMAN   65 SPRK
W           50.0                   HAGOPIAN  65 HBC
W   *       90.0                   WOLF      65 RVUE                      6/66

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

REFERENCES FOR EPSILON


```
COHN     65 PRL 15 906          P O COHN,BUGG+//ORNL+TENN+UNCAR+COLU+EFINS
CORBETT  65 NC 39 979           CORBETT,DAMERELL,MIDDLEMAS,CLEG+//OXF+RHEL
DURAND   65 PRL 14 329          L. DURAND AND Y.T. CHIU ////////////// YALE
FELDMAN  65 PRL 14 869          FELDMAN,FRATI,HALPERN,CHOLDRY+/PENNA+COLUM
FORINO   65 PL 19 65            +GESSAROLI,LENDINARA+ /// BOL+ORSAY+SACLAY
HAGCPIAN 65 PRL 14 1077         HAGOPIAN,SELOVE,ALIT+/PENNA+SACLAY+BOLOGNA
WOLF     65 PL 19 328           G WOLF //////////////////////////////// DESY
GOLDHABE 66  BERKELEY CONF      G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
GUTAY    66  PURDUE COO-1428    L.J.GUTAY,JOHNSON,CSONKA+ //// PURDUE+UCRL
OLSSCN   66  PREPRINT           MARTIN G. OLSSON //////////////// WISCONSIN
```


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

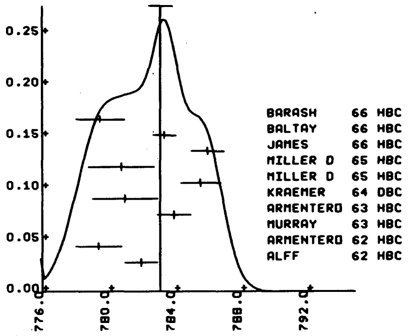
ω (783)   1 OMEGA (783,JPG=1--) I=C

1 OMEGA MASS (MEV)

	N	Value	Error	Author	Ref	Comment	Date
M	400	782.0	1.0	ALFF	62 HBC		
M	64	779.4	1.4	ARMENTERU	62 HBC		
M	650	782.0		MURRAY	63 HBC		
M	34	784.0	1.0	ARMENTERU	63 HBC		
M	220	781.0	2.0	KRAEMER	64 DBC		
M		785.6	1.2	MILLER D	65 HBC	SEEN WITH K+K-	
M		780.8	2.0	MILLER D	65 HBC	SEEN WITH K1 K2	8/66
M	333	786.0	1.0	JAMES	66 HBC		6/66
M	2198	783.4	0.7	BALTAY	66 HBC	0.0 PBAR P	9/66
M	155	779.5	1.5	BARASH	66 HBC	C PBAR P TO K1K2 CM	11/66

(Ideogram below)

WEIGHTED AVERAGE =783.164 +/- 0.723
SCALE = 1.94   CHISQ = 30.1   CONLEV = .001



OMEGA MESON MASS (MEV)

1 OMEGA FULL WIDTH (MEV)

		N	Value	Error	Author	Ref	Comment	Date
W		34	9.0	3.0	ARMENTERU	63 HBC		
W			13.4	2.0	MILLER D	65 HBC	SEEN WITH K+ K-	
W			11.6	3.0	MILLER D	65 HBC	SEEN WITH K1 K2	8/66
W		155	12.3	2.0	BARASH	66 HBC		
W	*	333	20.0	OR LESS	JAMES	66 HBC		6/66

1 OMEGA PARTIAL DECAY MODES

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

1 OMEGA BRANCHING RATIOS

		N	Value	Error		Author	Ref	Comment	Date
R1	*	OMEGA INTO NEUTRAL/(PI+ PI- PIO)						(P4+P5)/(P1)	
R1			0.17	0.04		ARMENTERO	63 HBC		
R1		20	0.11	0.02		BUSCHBECK	63 HBC		
R1		35	0.08	0.03		KRAEMER	64 DBC		
R1	*		0.13	0.035		MILLER D	65 HBC		
R1		65	0.10	0.04		ALFF-STEI	66 HBC	CORR.BY SCHULTZ(COL)	9/66
R1		19	0.10	0.03		BARASH	66 HBC		11/66
R1		850	0.134	0.026		DI GIUGNU.	66 CNTR		9/66
R1		348	0.097	0.016		FLATTE	66 HBC		9/66
R1			0.06	0.05	0.02	JAMES	66 HBC		6/66
R2	*	OMEGA INTO (PI+ PI-)/(PI+ PI- PIO)						(P2)/(P1)	
R2	*		0.010 OR LESS			BUTTON	61 HBC		
R2	*		0.07			ALITTI	63 HBC		
R2	*		0.05 OR LESS			ARMENTERO	63 HBC		
R2	*	100	0.05 OR GREATER			FICKINGER	63 HBC		
R2	*		0.02			JAMES	63 HBC		
R2	*		0.05 OR LESS			KRAEMER	64 DBC		
R2	*		0.005 OR LESS			LUTJENS	64 RVUE	NO INTERFERENCE	
R2	*		0.018	0.012	0.006	WALKER	64 RVUE		
R2	*		0.04 OR GREATER			PATON	65 HBC		
R2	*		0.010 OR LESS			CLARK	65 SPRK		6/66
R2	*		0.035 OR LESS			MILLER D	65 HBC		
R2	*		0.02 OR LESS			ALFF-STEI	66 HBC		11/66
R2	*		0.029	0.011	0.009	FLATTE	66 HBC	INTERFERENCE	9/66
R2	*		0.082	0.020		FLATTE	66 HBC	NO INTERFERENCE	9/66
R3	*	OMEGA INTO (PIO GAMMA) / (PI+ PI- PIO)						(P4)/(P1)	
R3	*		0.125	0.025		BARMIN	64 PXBC		
R3			0.10	0.03		BELYAKOV	64 PXBC		
R3		13	0.15	0.06		BAGLIN	66 HLBC		9/66
R4	*	OMEGA INTO (PI+ PI- GAMMA)/(PI+ PI- PIO)						(P3)/(P1)	
R4	*		0.05	OR LESS		FLATTE	66 HBC		9/66
R5	*	OMEGA INTO(E+ E-)/(PI+ PI- PIO) (UNITS 10**-3)						(P7)/(P1)	
R5	*		3.9	1.5	OR LESS	BARMIN	63 PBC		
R5	*	1	2.8	OR LESS		BEZAGUET	64 FBC		
R5		3	0.20	0.12		BINNIE	65 SPRK		6/66
R5	*		1.4	OR LESS		GALTIERI	65 HBC		
R5		20	0.11	0.03		AZIMOV	66 SPRK	MAY CONTAIN RHOS	9/66
R5			0.3 OR LESS			FLATTE	66 HBC		9/66
R5			0.11	0.19	0.08	HERTZBACH	66 SPRK	ASSUME SU(3)+MIXING	10/66
R6	*	OMEGA INTO (MU+ MU-)/(PI+ PI- PIO)(UNITS 10**-3)						(P6)/(P1)	
R6	*		1.2	OR LESS		GALTIERI	65 HBC		
R6			1.7 OR LESS			FLATTE	66 HBC		9/66
R7	*	OMEGA INTO (2PIO GAMM)/(PIO GAMMA)						(P5)/(P4)	
R7	*		0.1	OR LESS		BARMIN	64 PXBC		
R8	*	OMEGA INTO(ETA PIO +ETA GAM)/(PI+PI-PIO)						(P8+P9)/(P1)	
R8	*		0.017	OR LESS		FLATTE	66 HBC		9/66

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

REFERENCES FOR OMEGA

MAGLIC 61 PRL 7 178 — B MAGLIC,ALVAREZ,ROSENFELD,STEVENSON //LRL
PEVSNER 61 PRL 7 421 — PEVSNER,KRAEMER,NUSSBAUM,RICHARD+///JHU+NW
XUONG 61 PRL 7 327 — NGUYEN HUU XUONG,GERALD R LYNCH ///// LRL
ALFF 62 PRL 9 325 — ALFF,BERLEY,COLLEY,GELFAND +//COLU+RUTGERS
ARMENTER 62 CERN CONF 90 — R ARMENTEROS,R BUDDE + // CERN+COLL+FRANCE
BUTTON 62 PR 126 1858 — BUTTON,KALBFLEISCH,LYNCH,MAGLIC + /// LRL
STEVENSC 62 PR 125 687 — STEVENSON,ALVAREZ,MAGLIC,ROSENFELD /// LRL

ALITTI 63 NC 29 515 — ALITTI,BATON,BERTHELOT+//LPCHE+PAR+BARI+BO
ARMENTER 63 SIENA CONF 1 296 — ARMENTEROS,EDWARDS,JACOBSEN+ // CERN+PARIS
BARMIN 63 SIENA CONF 1 207 — BARMIN,DOLGOLENKO,KRESTNIKOV+ ////// ITEP
BERTHELC 63 SIENA CONF 2 60 — A BERTHELOT /////////////////// CEN-SACLAY
BUSCHBEC 63 SIENA CONF 1 166 — BUSCHBECK,CZAPP+ /// VIENNA+CERN+AMSTERDAM
FICKINGE 63 PRL 10 457 — W J FICKINGER,D K ROBINSON,E SALANT // BNL
GELFAND 63 PRL 11 436 — GELFAND,MILLER,NUSSBAUM,RATAU+ /COLUM+RUTG
JAMES 63 PREPR. TID-19082 — F E JAMES, H L KRAYBILL ///////////// YALE
MURRAY 63 PL 7 358 — MURRAY,FERROLUZZI,HUWE,SHAFER,SOLMITZ+/LRL

BARMIN 64 JETP 18 1289 — BARMIN,DOLGOLENKO,KRESTNIKOV + ///// ITEP
BELYAKOV 64 DUBNA CONF — BELYAKOV + /////////////// DUBNA+BUCHAREST
BEZAGUET 64 PL 12 70 — BEZAGUET,NGUYEN KHAC,ROUSSET+//PAR+BERG+LO
KRAEMER 64 PR 136 B 496 — KRAEMER,MADANSKY,MEER,FIELDS+//JHU+NW+WOOD
LUTJENS 64 PRL 12 517 — G LUTJENS,J STEINBERGER /////// COLUMBIA
WALKER 64 PL 8 208 — WALKER,BOYD,ERWIN,SATTERBLOM +// WISCONSIN

BATON 65 NC 35 713 — BATON,BERTHELOT,DELER,BENEDETTI+/SAC+BOLOG
BINNIE 65 PL 18 348 — BINNIE,DUANE,JANE,W JONES+//IC-LOND+MANCHS
CLARK 65 PR 139 B 1556 — CLARK,CHRISTENSON,CRONIN,TURLAY//PRINCETON
GALTIERI 65 PRL 14 279 — A BARBARO GALTIERI,R D TRIPP ///////// LRL
MILLER 65 CU-237 (NEVIS 131) — DAVID C MILLER (THESIS) //////// COLUMBIA
MILLER 65 INCLUDES DATA OF GELFAND 63 ABOVE
ZDANIS 65 PRL 14 721 — ZDANIS,MADANSKY,KRAEMFR,HERTZBACH+/JHU+BNL

ALFF-STE 66 PR 145 1072 — ALFF-STEINBERGER,BERLEY,BRUGGER+//COL+RUTG
AZIMOV 66 BERKELEY CONF. — AZIMOV,BALDIN,BELOUSOV,CHUVILO + // DUBNA
BAGLIN 66 PL 23 286 — +BEZAGUET,DEGRANGE,HAATUFT + // EP+BERGEN
BALTAY C 66 BERKELEY CONF — +FRANZINI,SEVERIENS,YEH,ZANELLO //BNL,CCNY
BARASH 66 CU258(NEVIS 154) — BARASH,KIRSCH,MILLER,TAN //////// COLUMBIA
DIGIUGNC 66 NC 44A 1272 — DI GIUGNO,PERUZZI,TROISE+ //NAPL+FRAS+TRST
FLATTE 66 PR 145 1050 — +HUWE,MURRAY,BUTTON-SHAFER,SOLMITZ+ // LRL
HERTZBAC 66 PREPRINT — HERTZBACH,KRAEMER,MADANSKI,ZDANIS+/JHU+BNL
(SEE ALSO ZDANIS 65)
JAMES 66 PR 142 896 — F E JAMES,KRAYBILL ////// YALE+BROOKHAVEN

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

η′(958)   2 ETA PRIME (958,JPG=0-+) I=C

KNOWN EARLIER AS XO OR ETA*

2 ETA PRIME MASS (MEV)

	N	Value	Error	Author	Ref	Comment	Date
M	85	957.0		DAUBER	64 HBC		
M		958.0	1.0	KALBFLEIS	64 HBC		6/66
M		957.0	3.0	BADIER	65 HBC		
M	8	960.0	2.0	TRILLING	65 HBC	3.65 PI+ P	9/66
M	7	955.0	10.0	COHN	66 DBC		6/66
M		959.0	3.0	LONDON	66 HBC		6/66

2 ETA PRIME WIDTH (MEV)

		N	Value	Author	Ref	Date
W	*	85	4.0 OR LESS	DAUBER	64 HBC	
W	*		7.0 OR LESS	KALBFLEIS	64 HBC	6/66
W	*		30.0 OR LESS	BADIER	65 HBC	
W	*		15.0 OR LESS	LONDON	66 HBC	6/66

2 ETA PRIME PARTIAL DECAY MODES

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

2 ETA PRIME BRANCHING RATIOS

PARTIAL MODES ADJUSTED BY PROGRAM AHR=12345

		N	Value	Error	Author	Ref		Date
R1	*	ETA PRIME INTO (PI+ PI- ETA (NEUTRAL DEC.)) / TOTAL					NUM 1 DEN 12345	
R1		68	0.36	0.05	KALBFLEIS	64 HBC		10/66
R2	*	ETA PRIME INTO (PI+ PI- NEUTRALS) / TOTAL					NUM 1 3 DEN 12345	
R2		39	0.4	0.1	LONDON	66 HBC		10/66
R2		33	0.35	0.06	BADIER	65 HBC		10/66
R3	*	ETA PRIME INTO (PI+ PI- ETA (CHRGD.DECAY)) / TOTAL					NUM 2 DEN 12345	
R3		10	0.1	0.04	LONDON	66 HBC		10/66
R3		7	0.07	0.04	BADIER	65 HBC		10/66
R3		44	0.12	0.02	KALBFLEIS	64 HBC		10/66
R4	*	ETA PRIME INTO (PI+ PI- NEUTRALS (EXCLUDING PI+ PI- ETA (NEUTR.DEC.))) / TOTAL					NUM 3 DEN 12345	
R4		10	0.05	0.04	KALBFLEIS	64 HBC		10/66
R5	*	ETA PRIME INTO (NEUTRALS) / TOTAL					NUM 4 DEN 12345	
R5		32	0.3	0.1	LONDON	66 HBC		10/66
R5		16	0.24	0.17	BADIER	65 HBC		10/66
R5		54	0.25	0.05	KALBFLEIS	64 HBC		10/66
R6	*	ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING RHO GAMMA)) / TOTAL					NUM 5 DEN 12345	
R6	*	THIS MODE SEEMS TO BE CONSISTENT WITH BEING ENTIRELY RHO GAMMA						
R6		20	0.2	0.1	LONDON	66 HBC		10/66
R6		42	0.22	0.04	KALBFLEIS	64 HBC		10/66
R6	B	35	0.34	0.09	BADIER	65 HBC		10/66
R6	B	CONTROVERSIAL BACKGROUND SUBTRACTION						

```
R7  *     ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING          NLM     5
R7  *                     RHO GAMMA)) /(PI PI ETA)          DEN 1234
R7           0.25       0.14          DAUBER    64 HBC                              10/66

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

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

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

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

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

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

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

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

η' Branching Ratios

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

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

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

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

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

                              REFERENCES FOR ETA PRIME
```


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

BADIER   65 PL 17 337         BADIER,CEMOULIN,BARLOUTAUD +/PAR+SAC+ZEEMA
KIENZLE  65 PL 19 438         KIENZLE,MAGLIC,LEVRAT,LEFEBVRES + /// CERN
RITTENBE 65 PRL 15 556        RITTENBERG,KALBFLEISCH //////////  LRL+BNL
TRILLING 65 PL 19 427         +BROWN,COLDHABERS,KADYK,SCANIU        // LRL

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

        QUANTUM NUMBER DETERMINATICNS NOT REFERRED TO IN THE DATA CARDS

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

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


H(975)

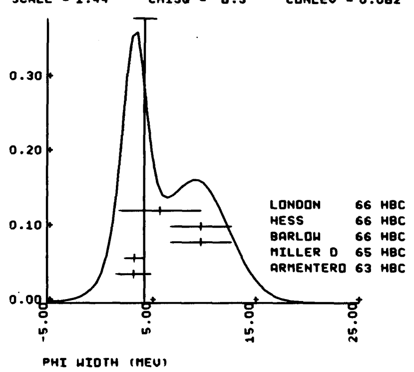
```
                35  H (975, JPG=  -)  I=0
     *          EVICENCE NOT YET COMPELLING, OMITTED FROM TABLE
     *          FOR COMPILATION SEE GOLDHABER MESON REVIEW
     *          1966 BERKELEY CONFERENCE
     *          ALSO COMPILED IN APPENDIX A.

                35  H (975)  MASS  (MEV)

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

                35  H (975) WIDTH  (MEV)

W  C  90  120.0                    BARTSCH   64 HBC      4.0 PI+ P        8/66
W  C  30   45.0    30.0            BENSUN    66 DBC      3.65 PI+ D      10/66
W     50   80.0   COMPILED BY      GOLDHABER 66 RVUE  C ONLY 3.65,4 PI P  9/66
------ --------- --------- --------- --------- --------- --------- ---------

                H MESON CROSS SECTION (MICROBARNS)

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

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

                      REFERENCES FOR H MESON
```


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

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


ϕ(1019)

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

              4  PHI  MASS (MEV)

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

              4  PHI  WIDTH (MEV)

W              3.4     1.7          ARMENTERO 63 HBC
W   *   34     5.0  OR LESS         SCHLEIN   63 HBC
W              3.5     1.0          MILLER D  65 HBC                       8/66
W             10.      3.           BARLOW    66 HBC     1.2 PBAR P       11/66
W             10.0     3.0          HESS      66 HBC     1-4 PI- P         9/66
W              6.0     4.0          LONDON    66 HBC                       6/66
                  (Ideogram below)
------ --------- --------- --------- --------- --------- --------- ---------
```

WEIGHTED AVERAGE =4.46 +/- 1.13
SCALE = 1.44   CHISQ = 8.3   CONLEV = 0.082




```
              4  PHI PARTIAL CECAY MODES

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

              4  PHI  BRANCHING RATIOS

              PARTIAL MODES ACJUSTED BY PROGRAM   AHR=123

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

R2  *       PHI INTO (K1 K2)/TOTAL                        NLM  2
R2  *                                                     DEN 123
R2  B   25    0.23     0.06        BADIER    65 HBC                        10/66
R2  B       CCNTROVERSIAL BACKGROUND SUBTRACTION
R2     167    0.40     0.04        LINDSEY   66 HBC                        10/66
```

```
R3  •     PHI INTO (PI+ PI- PIO (INCL.RHO PI))/TOTAL     NLM  3
R3  •                                                    DEN 123
R3  B  57    0.51   ' 0.09          BADIER    65 HBC                        10/66
R3  B     CONTROVERSIAL BACKGROUND SUBTRACTION
R3     30    0.12    0.08           LINDSEY   66 HBC                        10/66

R4  •     PHI INTO (K+ K-)/(K KBAR)                      NLM 1
R4  •                                                    DEN 12

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

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

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

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

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

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

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

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

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

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

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

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

REFERENCES FOR PHI


```
BERTANZA 62 PRL 9 180          BERTANZA,BRISSON,CONNOLLY,HART + //BNL+SYR
ARMENTER 63 SIENA CONF 2 70    ARMENTEROS,EDWARDS,ASTIER+//CERN+CDF-PARIS
SCHLEIN  63 PRL 10 368         SCHLEIN,SLATER,SMITH,STORK,TICHO //// UCLA

BADIER   65 PL 17 337          BADIER,DEMOULIN,BARLOUTAUD+//PAR+LPCHE+ZEE
BERLEY   65 PR 139 B 1097      D BERLEY,N GELFAND ////////// BNL+COLUMBIA
GALTIERI 65 PRL 14 279         A BARBARO GALTIERI,R D TRIPP ///////// LRL
MILLER   65 CU-237 (NEVIS 131) DAVID C MILLER  (THESIS) //////// COLUMBIA
  MILLER 65 INCLUDES DATA OF GELFAND 63 BELOW
GELFAND  63 PRL 11 438         GELFAND,MILLER,NUSSBAUM,KIRSCH+//COLU+RUTG

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

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

GRAY, L  66 PRL  17  501       +FAGERTY,BIZZARRI,CIAPETTI +   // SYR+ROME JPG
```


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

η_V (1050) $\to K_S K_S$

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

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

          3 ETA (1050) MASS (MEV)

M   •        1000.0    APPROX             BINGHAM   62 HBC
M   •        1000.0    APPROX             BIGI      62 HBC
M   •        1000.0                       ERWIN     62 HBC                  10/66
M   •     30 1030.0    APPROX.            BALTAY    64 HBC
M   •        1025.0    APPROX.            BARMIN    64 HLBC                  6/66
M        35 1045.      9.                 BARLOW    66 HBC   1.2 PBAR P     11/66
M       135 1056.0                        BEUSCH    66 SPRK                  9/66
M        20 1068.0     10.0               CRENNELL  66 HBC       6.0 PI- P   6/66
M   H   120  SCATT.LENGTH FITS BETTER.    HESS      66 HBC   1.6-4.2 PI- P  10/66
------ --------- --------- --------- --------- --------- --------- ---------

          3 ETA (1050) WIDTH (MEV)

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

          3 ETA (1050) PARTIAL DECAY MODES

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

          3 ETA (1050) BRANCHING RATIOS

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

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

REFERENCES FOR ETA(1050)


```
BIGI      62 CERN CONF 247      A BIGI,S BRANDT, R CARRARA + /////// CERN
BINGHAM   62 CERN CONF 240      H H BINGHAM,M BLOCH + //PARIS+EC POLY+CCRN
ERWIN     62 PRL 9 34           ERWIN,HOYER,MARCH,WALKER,WANGLER //WIS+BNL

BALTAY    64 DUBNA CONF 1 409   BALTAY,LACH,CRENNELL,OREN,STUMP +/YALE+BNL
BARMIN    64 DUBNA CONF 1 433   BARMIN,DOLGOLENKO,YEROFEEV,KRESTNI+// ITEP
BARLOW    66  CERN-TC66-22 -NC  BARLOW,C.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BEUSCH    66  BERKELEY CONF     BEUSCH,FISCHER,ASTBURY,MICHELINI+/ETH+CERN
CRENNELL  66 PRL 16 1025        CRENNELL,KALBFLEISCH,LAI,SCARR,SCHU+ //BNL
CRENNEL2  66  BERKELEY CONF     +KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL I,JP
  CRENNELL 2 HAS MORE DATA THAN CRENNELL  BUT SAME CONCLUSIONS
HESS      66 UCRL-16832         R I HESS (THESIS, BERKELEY)         // LRL
  HESS REPLACES  PRL 9 460      ALEXANDER,DAHL,JACOBS,KALBFLEISCH + // LRL
```


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

f (1250)

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

          5  F   MASS (MEV)

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

          5  F   WIDTH (MEV)

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

          5  F   PARTIAL DECAY MODES

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

          5  F   BRANCHING RATIOS

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

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

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

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

REFERENCES FOR F


```
SELOVE    62 PRL 9 272          SELOVE,HAGOPIAN,BRODY,BAKER,LEBOY // PENNA
BONDAR    63 PL 5 153           BONDAR+//AACHEN+BIRM+BONN+DESY+IC-LOND+MPI
VEILLET   63 PRL 10 29          VEILLET,HENNESSY,BINGHAM,BLOCH+//PAR+MILAN
LEE       64 PRL 12 342         LEE,ROE,SINCLAIR,VANDERVELDE //// MICHIGAN

BARMIN    65 SJNP 1 870         +DOLGOLENKO+EROFEEV+KRESTNIKOV+/ ITEP MOSC
CHUNG     65 PRL 15 325         CHUNG,DAHL,HARDY,HESS,JACOBS,KIRZ //// LRL
GUIRAGOS  65 PRL 11 85          Z G T GUIRAGOSSIAN  ////////////////// LRL
WANGLER   65 PR  137 B 414      T P WANGLER,A R ERWIN,W WALKER //WISCONSIN

ACCENSI   66 PL 20 557          ACCENSI,ALLES-BORELLI,FRENCH,FRISK+ //CERN
BARLOW    66  CERN-TC66-22 -NC  BARLOW,C.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BEUSCH    66   (PREPRINT)       BEUSCH,FISCHER,ASTBURY,MICHELINI+/ETH+CERN
BRANDT    66  BERKELEY CONF.    BRANDT,COCCONI,CZYZEWSKI+ //CERN+CRAC+WARS
DEUTSCHM  66 PL 20 82           DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
FISCHER   66  PRIVATE COMMUN.   W E FISCHER (BASED ON BEUSCH 66)//ETH+CERN
HESS      66 UCRL-16832         R I HESS (THESIS, BERKELEY)         // LRL
WAHLIG    66 PR  147  941       +SHIBATA,GORDON,FRISCH,MANNELLI //MIT+PISA  J

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

HAGOPIAN  63 PRL 10 533         V HAGOPIAN,W SELOVE /////////////// PENNA
ADERHOLZ  64 PL 10 240          AACHEN+BERLIN+BIRM+BONN+HAMBUR+IC-LOND+MPI  IJ
BRUYANT   64 PL 10 232          BRUYANT,GOLDBERG,HOLDER,FLECKY,HUC/CERN+PA  I
SODICKSC  64 PRL 12 485         SODICKSON,WAHLIG,MANNELLI,FRISCH+ //// MIT  I
BARMIN    65 SJNP 1 230         +DOLGOLENKO,ELENSKY,EROFEEV+ / ITEP MOSCOW  JP
```


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

D (1285)

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

     JPG DISCUSSED AT OXFORD, SEE ROSENFELD 65

          8  D MESON  MASS (MEV)

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

          8  D MESON WIDTH (MEV)

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

          8  D MESON PARTIAL DECAY MODES

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

```
                    8  D MESON BRANCHING RATIOS

R1   *      D MESCN INTO (PI PI RHU) / (K KBAR PI)        NLM  2
R1   *                                                    DEN 1
R1   *         2.0   OR LESS            HESS      66 HBC    C CHARGED PI CNLY 10/66

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

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

REFERENCES FOR D MESON


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


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

E (1420)

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

                    6 E MESON MASS (MEV)

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

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

                    6 E MESCN WIDTH (MEV)

W             80.     10.              BAILLON   66 HBC    0. PBAR P       11/66
W             60.0    20.0             HESS      66 HBC     1.6-4.2 PI- P  10/66

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

                    6 E MESON PARTIAL DECAY MODES

P1          E INTO K K*(890)                                S10U18
P2          E INTC K KBAR PI                                S12S12S 8
P3          E MESON INTO PI PI RHO                          S 9S 9U 9
P4          E INTO PI(1003) PI                              L16S 8

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

                    6   E MESON BRANCHING RATIOS

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

R2   *      E MESCN INTO (PI PI RHO) / (K KBAR PI)        NLM   3
R2   *                                                    DEN  2
R2   *         2.0   OR LESS            HESS      66 HBC    C CHARGED PI CNLY 10/66

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

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

REFERENCES FOR E MESON


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


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

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

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

EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE

                    29  KSKS ANC RHORHO MASS  (MEV)

M           1410.0                     BETTINI   66 DBC   C  0. PBARP TO 5PR  9/66
M           1439.0   SHOULDER ON A2    BEUSCH    66 SPRK    5-12 PI- P        9/66

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

                    29  KSKS ANC RHORHO WIDTH (MEV)

W             90.0                     BETTINI   66 DBC   C 0. PBAR P TO 5PR  9/66
W             43.0      40.0           BEUSCH    66 SPRK    5-12 PI- P        9/66

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

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


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


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

f′(1500)

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

                    13  F PRIME(1500) MASS (MEV)

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

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

                    13  F PRIME(1500) WIDTH (MEV)

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

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

                    13  F PRIME PARTIAL DECAY MODES

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

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

                    13  F PRIME BRANCHING RATIOS

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

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

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

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

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

REFERENCES FOR F PRIME


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

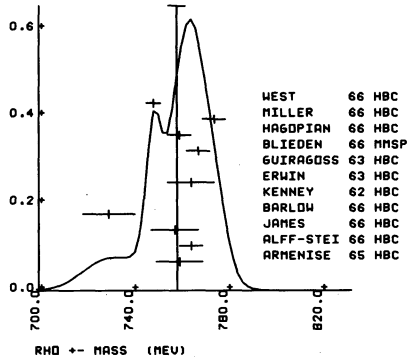

```
****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

ρ (760)

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

                    9 RHO  MASS (MEV)

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

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

M-  *        748.0                    KENNEY    62 HBC   -
M-           765.0    10.0            ERWIN     63 HBC   -
M-  *  130   775.0                    GUIRAGOSS 63 HBC   -
M-           768.0     5.0            BLIEDEN   65 MMSP  -  3-5 PI- P          6/66
M-           772.0    19.0            FIDECARO  66 SPRK  -  2.5 PI-,T CJT18  11/66
M-           760.0     5.0            HAGOPIAN. 66 HBC   -  3.0 PI- P          6/66
M-  *        777.0     6.0            MILLER    66 HBC   -  2.7 PI-,T CUT 5   9/66
M-           775.0     5.0            MILLER    66 HBC   -  2.7 PI-,T CJT10   9/66
M-  *        768.0     5.0            MILLER    66 HBC   -  2.7 PI-,T CJT20   9/66
M-           749.0     3.0            WEST      66 HBC   -  2.1 PI- P         10/66
```

(Ideogram below)

WEIGHTED AVERAGE =758.97 +/- 3.67
SCALE = 2.04   CHISQ = 33.4   CONLEV = .001




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

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

(Ideogram on next page)

```
M      290   755.0                    CHADWICK  63 HBC  +-0

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

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

                    9  RHO  WIDTH (MEV)

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

W+           150.0    30.0            BALTAY    66 HBC  +-  0.0 PBARP          6/66
W+           130.     25.             BARLOW    66 HBC  +- 1.2 PBAR P         11/66
```

W-	*		65.0	20.0		ERWIN	63	HBC	-		
W-	*	130	125.0			GUIRAGOSS	63	HBC	-		
W-		98	180.0			BONDAR	64	HBC	-		
W-			127.0	5.0		BLIEDEN	66	MMSP	-	3-5 PI- P	6/66
W-			150.0	20.0		HAGOPIAN	66	HBC	-	3.0 PI- P	6/66
W-	*		137.0	17.0		MILLER	66	HBC	-	2.7 PI-,T CJT 5	9/66
W-			145.0	12.0		MILLER	66	HBC	-	2.7 PI-,T CJT10	9/66
W-	*		153.0	13.0		MILLER	66	HBC	-	2.7 PI-,T CJT20	9/66
W-			149.0	13.0		WEST	66	HBC	-	2.1 PI- P	10/66
W0	*	190	150.0	20.0		SAMIOS	62	HBC	0		
W0	*	160	175.0			GUIRAGOSS	6	H			
W0		300	90.0	10.0		ABOLINS	63	HBC	0		
W0			165.0	20.0		ERWIN	63	HBC	0		
W0		96	210.0			BONDAR	64	HBC	0		
W0		500	130.0			GOLDHABER	64	HBC	0		
W0			110.0	20.0		ALYEA	65	DBC	0	2.2 K- P	6/66
W0			130.0			CLARK	65	SPRK	0		
W0			150.0			DERADO	65	HBC	0	4.0 PI- P	6/66
W0			80.0	15.0		GUTAY	65	HBC	0	2.0 PI- P	6/66
W0	*		150.0	10.0		LANZEROTT	65	CNTR	0		
W0			72.0	30.0		ACCENSI	66	HBC	0	5.7 PBARP	6/66
W0			100.0			ALFF-STEI	66	HBC	0	2-3 PI+ P	6/66
W0			146.0	17.0		BALTAY	66	HBC	0	0.0 PBARP	6/66
W0			92.	42.		BARLOW	66	HBC	0	1.2 PBAR P	11/66
W0	*		175.0			CAMBRIDGE	66	HBC	0	5-6 GAM P	9/66
W0			57.0	25.0	15.0	CASON	66	HBC	0	7.0 PI- P	9/66
W0			120.0	10.0		HAGOPIAN	66	HBC	0	3.0 PI- P	6/66
W0			103.0	13.0		JAMES	66	HBC	0	2.1 PI+ P	6/66
W0			160.0	15.0		MILLER	66	HBC	0	2.7 PI-,T CJT20	9/66
W0			173.0	13.0		WEST	66	HBC	0	2.1 PI- P	10/66

(Ideograms below)

W		290	110.0			CHADWICK	63	HBC	+-0		
W			120.0			WALKER	62	HBC	-0		
W			125.0	15.		LEE	65	HBC	-0		
W	*		170.0			WOLF	65	RVUE			6/66

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

9 RHO PARTIAL DECAY MODES

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

9 RHO BRANCHING RATIOS

R1	*	RHO INTO 4PI/2PI						(P2)/(P1)	
R1	*	RHO+- INTO (PI+- PI+ PI- PI0) / (PI+- PI0)							
R1	*	0.026 OR LESS	BLIEDEN	66	MMSP	-	3-5 PI- P		6/66
R1	*	0.01 OR LESS	DEUTSCHMA	66	HBC	+	8.0 PI+ P		6/66
R1	*	0.002 OR LESS	FERBEL	66	HBC	+-	PI+- P ABOVE 2.5		10/66
R1	*	0.0035 0.004	JAMES	66	HBC				11/66
R1	*	RHO 0 INTO (PI+ PI- PI+ PI-) / (PI+ PI-)							
R1	*	0.008 OR LESS	JAMES	66	HBC	+			6/66
R1	*	8 0.006 OR LESS	GERMAN CO	66	HBC	0	3.5-5.5 GAMMA P		10/66
R2	*	RHO INTO PI GAMMA/2PI						(P3/P1)	
R2	*	0.02 OR LESS	DAUDIN	64	HBC	+			
R2	N	0.02 OR LESS	LANZEROTT	65	CNTR				11/66
R2	N	ONE PION EXCHANGE MODEL USED IN THIS ESTIMATION							
R2	*	0.005 OR LESS	FIDECARO	66	SPRK	-	0.97 CONF LEV		10/66
R2	M	0.004 OR LESS	GERMAN CO	66	HBC	0	3.5-5.5 GAMMA P		10/66
R2	M	ONE PION EXCHANGE MODEL USED IN THIS ESTIMATION							
R2	*	0.007 OR LESS	HUSON	66	HLBC	-			6/66
R3	*	RHO INTO(E+ E-)/(PI+PI-) (UNITS 10**-4)						(P4)/(P1)	
R3		0.65 1.1 0.5	HERTZBACH	66	SPRK		ASSUME SU(3)+MIKING		10/66
R4	*	RHO INTO (PI ETA)/(2PI)						(P5)/(P1)	
R4	*	0.03 OR LESS	DEUTSCHMA	66	HBC	+	8.0 PI+ P		6/66
R5	*	RHO INTO (MU+ MU-)/(PI+ PI-) (UN 10**-4)						(P6)/(P1)	
R5		0.33 0.16 0.07	DE PAGTER	66	CNTR	0	5.2 GAM P		6/66
R5	*	14. OR LESS	HERTZBACH	66	SPRK				10/66

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

REFERENCES FOR RHO

ANDERSON 61 PRL 6 365 ANDERSON,BANG,BURKE,CARMONY,SCHMITZ // LRL
KENNEY 62 PR 126 736 V P KENNEY,W D SHEPHARD,C D GALL /KENTUCKY
SAMIOS 62 PRL 9 139 SAMIOS,BACHMAN,LEA+ // BNL+CCNY+COLUM+KENT
WALKER 62 CERN CONF 42 W D WALKER,E WEST A R ERWIN + // WISCONSIN
XUONG 62 PR 128 1849 NGUYEN HUU XUONG,GERALD R LYNCH ////// LRL

ABOLINS 63 PRL 11 381 ABOLINS,LANDER,MEHLHOP,NGUYEN,YAGER / UCSD
ALITTI 63 NC 29 515 ALITTI,BATON,ARMENISE+/SAC+ORSAY+BARI+BOLO
CHADWICK 63 PRL 10 62 CHADWICK,DAVIES,DERRICK,CRESTI + / OXF+PAD
GUIRAGOS 63 PRL 11 85 ZAVEN GUIRAGOSSIAN ////////////////// LRL
ERWIN 63 SIENA CONF 1 112 ERWIN,SATTERBLOM,WALKER,WEST /// WISCONSIN
SACLAY 63 SIENA CONF 1 239 SACLAY+ORSAY+BARI + BOLOGNA(COLLABORATION)

BATON 64 NC 35 713 BATON,BERTHELOT,ALLES,BORELLI + /CEN+BOLOG
BONDAR 64 NC 31 729 BONDAR+//AACHEN+BIRM+BONN+DESY+IMP-COL+MPI
CARMONY 64 DUBNA CONF 1 486 CARMONY,HOA,LANDER,NG H XUONG,YAGER //UCSD
DAUDIN 64 REPORT CEA-R-2525 DAUDIN,JABIOL,MONGELLI + ///// SACLAY+BARI
GOLCHABE 64 PRL 12 336 GOLDHABER,BROWN,KADYK,SHEN,TRILLING/LRL+UC

ALYEA 65 PL 15 82 ALYEA,CRITTENDEN,MARTIN,RHODE + // INDIANA
ARMENISE 65 NC 37 361 SACLAY+ORSAY+BARI+BOLOGNA (COLLABORATION)
BLIEDEN 65 PL 19 444 BLIEDEN,FREYTAG,GEIBEL,HASSAN + ///// CERN
CLARK 65 PR 139 B 1556 A CLARK,CHRISTENSON,CRONIN,TURLAY/PRINCETO
DERADO 65 PRL 14 872 DERADO,KENNEY,POIRIER,SHEPHARD//NOTRE DAME
GUTAY 65 NC 39 381 GUTAY,LANNUTTI,TULI ////////////// FLORIDA
LANZEROT 65 PRL 15 210 LANZEROTTI,BLUMENTHAL,EHN,FAISSLER +/HARVD
LEE 65 MICH 04938 YONG-YUNG LEE /////////////////// MICHIGAN
WOLF 65 PL 19 328 G WOLF //////////////////////////////// DESY
ZDANIS 65 PRL 14 721 ZDANIS,MADANSKY,KRAEMER + //////// JHU+BNL

ACCENSI 66 PL 20 557 ACCENSI,ALLES-BORELLI,FRENCH,FRISK+// CERN
ALFF-STE 66 PR 145 1072 ALFF-STEINBERGER,BERLEY,BRUGGER+//COL+RUTG
BALTAY 66 PR 145 1103 +FRANZINI,LUTJENS,SEVERINS,TYCKO+/COLUMBIA
BARLOW 66 CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
BLIEDEN 66 NC 43 71 +FREYTAG,GEIBEL,HASSAN,KIENZLE+ ///// CERN
CAMBRIDG 66 PR 146 994 CAMBRIDGE BUBBLE CHAMBER GROUP //MIT+HARV+
CASON 66 PR 148 1282 N M CASON // WISCONSIN
DE PAGTE 66 PRL 16 35 DE PAGTER+//CAM EL ACC+MIT+NORTHEAST+ SLAC
DEUTSCHM 66 PL 20 82 DEUTSCHMANN,STEINBERG +//AACH+BERLIN+ CERN
FERBEL 66 PL 21 111 FERBEL ////////////////////////// ROCHESTER
FIDECARO 66 PL 23 163 G+M FIDECARO,J POIRIER,P SCHIAVON // CERN
GERMAN C 66 BERKELEY CONF GERMAN COLL./ AACH+BERL+BONN+HAMB+HEID+MUN
HAGOPIAN 66 PR 145 1128 HAGOPIAN,SELOVE,ALITTI,BATON+//PENN+SACLAY
HERTZBAC 66 PREPRINT HERTZBACH,KRAEMER,MADANSKI,ZDANIS+/JHU+BNL
(SEE ALSO ZDANIS 65)
HUSON 66 PL 20 91 HUSON,ALLARD,DRIJARD,HENNESSY + //ORSAY+EP
JAMES 66 PR 142 896 F E JAMES,KRAYBILL /////// YALE+BROOKHAVEN
MILLER 66 BERKELEY CONF. MILLER,GUTAY,JOHNSON,LOEFFLER + // PURDUE
WEST 66 PR 149 1089 WEST,BOYD,ERWIN,WALKER ///////// WISCONSIN

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

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

COMPILATION AVAILABLE SEPARATELY IN UCRL-8030-SPECTRA

36 DELTA (963) MASS (MEV)

M SEE GOLDHABER MESON REVIEW, 1966 BERKELEY CONF

M			910.		TURKOT	63	MMS	+	3.3 PP TC D + MM	10/66
M		262	962.0	5.0	KIENZLE	65	MMS	-	3-5 PI- P	9/66
M	*	36	965.0		ALLEN	66	HBC	-	1.7 PI- P	9/66
M		106	965.0	COMPILATION BY	ALLEN	66	HBC	+-0	1-8 PI P	9/66
M			966.0	8.0	OOSTENS	66	MMS	+	3. P P TC D + MM	9/66

FOR RESULTS WHICH DO NOT SUPPORT ALLEN 66, SEE JACOBS 66 AND WEST 66

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

36 DELTA (963) WIDTH (MEV)

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

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

36 DELTA MESON PARTIAL DECAY MODES

P1		DELTA MESON INTO 2 PI	S 8S 8
P2		DELTA MESON INTO 3 PI	S 9S 9S 9
P3		DELTA MESON INTO 4 PI	S 9S 9S 9S 9
P4	*	DELTA MESON INTO 5 PI	
P5		DELTA MESON INTO ETA PI	S14S 9
P6		DELTA MESON INTO RHO PI	L 9S 9

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

36 DELTA MESON BRANCHING RATIOS

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

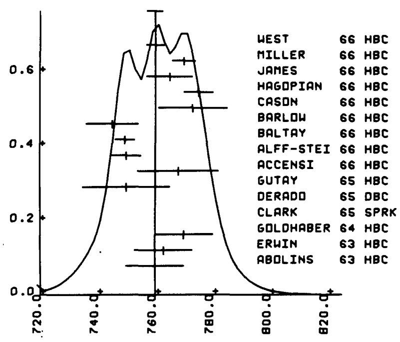
****** ********* ********* ********* ********* ********* ********* *********

REFERENCES FOR DELTA(963)

TURKOT 63 SIENNA CONF 1 661 +COLLINS,FUJII,KEMP+ ////// BNL+PITTSBURGH
KIENZLE 65 PL 19 438 + MAGLIC,LEVRAT,LEFEBVRES + // CERN
ALLEN D 66 PL 22 543 +GP FISHER,G GODDEN,L MARSHALL,SEARS//COLO G=+
JACOBS 66 DISS. BERKELEY L.D.JACOBS //////////////////////////// LRL
OOSTENS 66 PL 22 708 +CHAVANON,CROZON,TOCQUEVILLE // SACLAY,CF I=1
WEST 66 PR 149 1089 WEST,BOYD,ERWIN,WALKER ///////// WISCONSIN

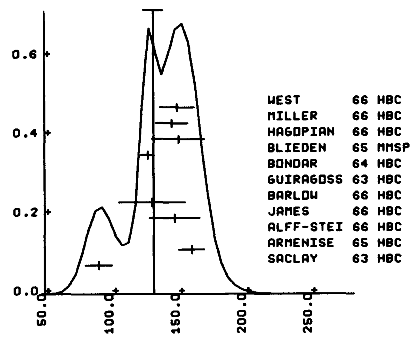
****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********

WEIGHTED AVERAGE =759.91 +/- 2.66
SCALE = 1.73 CHISQ = 35.8 CONLEV = .001



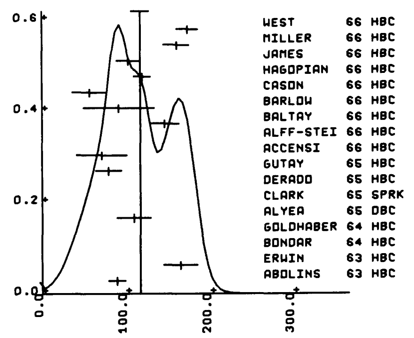
RHO 0 MASS (MEV)

WEIGHTED AVERAGE =131.17 +/- 7.42
SCALE = 2.10 CHISQ = 30.7 CONLEV = .001



RHO +- WIDTH (MEV)

WEIGHTED AVERAGE =117.4 +/- 10.3
SCALE = 2.37 CHISQ = 61.8 CONLEV = .001



RHO 0 WIDTH (MEV)

π_V (1003) $\rightarrow K\bar{K}$

```
16 PI(1003,JPG=   ) I=1

16 PI(1003) MASS  (MEV)

M  *       1060.0                     BELYAKOV  64 PBC       7.5 PI- P     6/66
M  *    50 1025.0   APPROX.           ARMENTERO 65 HBC  +-   0.0 PBAR P
M      143 1003.3      7.0+SYSTEMATIC ROSENFELD 65 RVUE +-                 8/66
M  *       SCAT. LENGTH 2 TO 6 FERMIS.BALTAY    66 HBC       3.7 PBAR P    8/66
M  *       SCAT. LENGTH 2.4+-.5 FERMI BARLOW    66 HBC  +-  1.2 PBAR P    11/66

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

16 PI(1003) WIDTH (MEV)

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

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

16 PI(1003) PARTIAL CECAY MODES

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

------ --------- --------- --------- --------- --------- --------- ---------
```

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

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

REFERENCES FOR PI(1CC3)

BELYAKOV 64 JINR P-1586 BELYAKOV,VIRYASUV,KLADNITSKAYA + /// DUBNA
ARMENTER 65 PL 17 344 ARMENTEROS,EDWARDS,JACOBSEN +///CERN+PARIS
ASTIER 65 CXFORC ABSTRACT 143 AND SUPPLEMENT P 13 // CERN+COLL DE FR.
BARASH 65 PR 139 B 1659 +FRANZINI,KIRSCH,MILLER,STEINBERGER+/COLUM
ROSENFEL 65 OXFORC CCNF 58 A H ROSENFELD ///////////////// LRL--RVUE
BALTAY 66 PR 142 B 932 +LACH,SANDWEISS,TAFT,YEH,STONEHILL+ //YALE
BARLCW 66 CERN-TC66-22 -NC BARLOW,D.ANDLAU+ //// CERN+PARIS+LIVERPOOL
MONTANET 66 PRIVATE COMM. L.MONTANET /////////////////////////// CERN


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

A1 (1080)

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

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

10  A1 MESON  MASS (MEV)

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

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

10  A1 MESON  WIDTH (MEV)

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

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

10  A1 PARTIAL CECAY MODES

P1       A1 INTO RHO PI                                    L 9S 8
P2       A1 INTO KBAR K                                    S1CS11
P3       A1 INTO ETA PI                                    S14S 8
P4       A1 INTO ETA PRIME PI                              L 2S 8

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

10  A1 BRANCHING RATIOS

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

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

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

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

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

REFERENCES FOR A1

BELLINI 63 NC 29 896 BELLINI,FIORINI,HERZ,NEGRI,RATTI /// MILAN
ADERHOLZ 64 PL 10 226 AACH+BERL+BIRM+BONN+DESY+HAMB+IMP.COL+ MPI
ALLARD 64 PL 12 143 ALLARD+ // PARIS+CERN+MILAN+CEA-SAC+UC-BKY
GOLDHABE 64 PRL 12 336 GOLDHABER,BROWN,KADYK,SHEN,TRILLING/LRL+UC
HESS 64 DUBNA CONF 1 422 HESS,CHUNG,DAHL,HARDY,KIRZ,MILLER //// LRL
LANDER 64 PRL 13 346 A LANDER,ABOLINS,CARMONY,HENDRICKS +/// UCSD JP

ABOLINS 65 ATHENS(OHIO)CONF +CARMONY,LANDER,XUONG,YAGER ///// LA JOLLA I=1
ALITTI 65 PL 15 69 ALITTI,BATON,DELER,CRUSSARD+ ///// SAC+BOL
DEUTSCH1 66 PL 20 82 DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
DEUTSCH2 66 PL 22 112 DEUTSCHMANN,STEINBERG + //AACH+BERLIN+CERN
GOLDHABE 66 BERKELEY CONF G.GOLCHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
HESS 66 UCRL-16832 R I HESS (THESIS, BERKELEY) // LRL


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

B (1210)

```
11  B MESON (1210,JPG=  +) I=1
```

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

```
11  B MESON  MASS (MEV)

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

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

11  B MESON  WIDTH (MEV)

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

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

11  B MESON PARTIAL DECAY MODES

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

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

11  B MESON  BRANCHING RATIOS

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

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

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

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

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

REFERENCES FOR B MESON

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

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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


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

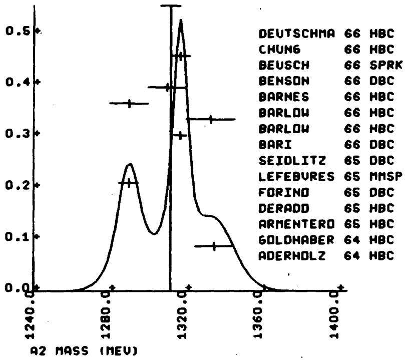
A2 (1300)

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

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

12  A2 MESON  MASS (MEV)

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

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

(Ideogram below)

```
------ --------- --------- --------- --------- --------- --------- ---------
```

WEIGHTED AVERAGE =1311.96 +/- 5.13
SCALE = 2.45 CHISQ = 35.9 CONLEV = .001



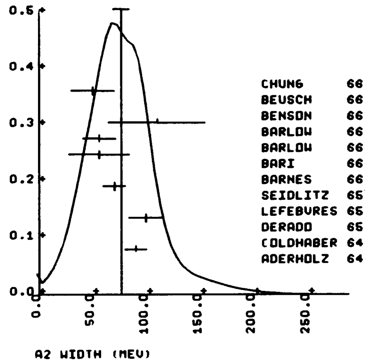
12 A2 MESON WIDTH (MEV)

W			100.0			ADERHOLZ	64	HBC		
W			90.0	10.0		GOLDHABER	64	HBC	+- 3.7 PI+- P	
W			150.0			DERADO	65	HBC		6/66
W		1425	99.0	15.0		LEFEBVRES	65	MMSP	-	6/66
W			140.0			SEIDLITZ	65	DBC	-	6/66
W			70.0	10.0		BARNES	66	HBC	-	6/66
W			120.0			BARI	66	DBC	C 5.1 PI+ D	10/66
W			56.	28.		BARLOW	66	HBC	+- (K KBAR MODE)	11/66
W			56.	15.		BARLOW	66	HBC	+- (K KBAR MODE)	11/66
W			110.0	45.0		BENSON	66	DBC		6/66
W			90.0			BEUSCH	66	SPRK	C 5-12 PI- P	10/66
W			50.0	20.0		CHUNG	66	HBC	-0 3-4 PI- P	10/66
W	*	1800	80.0	10.0	COMP.BY	FERBEL	66		+- PI+- P	10/66
W	S		26.0	OR LESS		LEVRAT	66	MMS	- FOR BOTH PEAKS	10/66

(Ideogram below)

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

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



12 A2 MESCN PARTIAL DECAY MODES

P1	A2 MESCN INTO RHO PI	L 9S 8
P2	A2 MESCN INTO KBAR K	S10S12
P3	A2 MESCN INTO ETA PI	S14S 8
P4	A2 MESCN INTO ETA PRIME PI	L 2S 8
P5	A2 MESON INTO PI+ PI- PIO	S 8S 8S 9

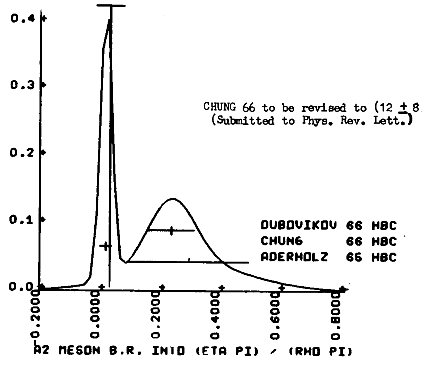
------ --------- --------- --------- --------- --------- --------- ---------

12 A2 MESON BRANCHING RATIOS

R1	*	A2 MESCN INTO (K KBAR) / (RHO PI)					(P2)/(P1)	
R1	*	0.08 OR LESS		LANDER	64	HBC	+	10/66
R1	*	0.04 OR LESS		ARMENTERO	65	HBC	-	
R1		0.053	0.021	CHUNG	66	HBC	-0	10/66
R1		0.03	0.02	DEUTSCHMA	66	HBC	+	6/66
R2	*	A2 MESON INTO (ETA PI)/TOTAL					(P3)/TOTAL	
R2	*	0.03 OR LESS		DEUTSCHMA	66	HBC	+	6/66
R3	*	A2 MESON INTO (ETA PI) / (RHO PI)					(P3)/(P1)	
R3		0.3	0.2	ADERHOLZ	65	HBC		
R3		0.022	0.018	CHUNG	66	HBC	-0	10/66
R3		0.24	0.08	DUBOVIKOV	66	HBC	-	11/66

(Ideogram below)

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



R4	*	A2 MESON INTO (ETA PRIME PI) / TOTAL					(P4)/TOTAL	
R4	*	0.1 OR LESS		CHUNG	65	HBC	-	
R4	*	0.015 OR LESS		DEUTSCHMA	66	HBC	+	6/66
R5	*	A2 MESON INTO (PI+ PI- PI0) / (RHO PI)					(P5)/(P1)	
R5	*	0.17 OR LESS		BENSON	66	DBC	0	

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

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

REFERENCES FOR A2

ADERHOLZ 64 PL 10 248 AACHEN+BERLIN+BIRM+BONN+HAMB+IC-LONDON+MPI
GOLDHABE 64 DUBNA CONF 1 480 G GOLDHABER,S GOLDHABER,OHALLORAN,SHEN/LRL
LANDER 64 PRL 13 346 +ABOLINS,CARMONY,HENDRIKS,XUONG+/ LA JOLLA

ABOLINS 65 ATHENS(OHIO)CONF +CARMONY,LANDER,XUONG,YAGER ///// LA JOLLA I=1
ARMENTER 65 PL 17 344 ARMENTEROS,EDWARDS,JACOBSEN + //CERN+CDEF
CHUNG 65 PRL 15 325 +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER // LRL
DERADO 65 PRL 14 872 DERADO,KENNEY,POIRIER,SHEPHARD//NOTRE DAME
FORINO 65 PL 19 68 +GESSAROLI+LENDINARA+/BOL+BARI+FIR+ORS+SAC
LEFEBVRE 65 PL 19 434 LEFEBVRES,LEVRAT,BLIEDEN,DUBAL + //CERN
SEIDLITZ 65 PRL 15 217 L SEIDLITZ,O I DAHL,D H MILLER /////// LRL

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

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

LANDER 64 PRL 13 346 A LANDER,ABOLINS,CARMONY,HENDRICKS +/// UCSD JP
ADERHOLZ 65 PR 138 B 897 AACHEN+BERLIN+BIRM+BONN+HAMB+LOND+MUENCHEN
ALITTI 65 PL 15 69 ALITTI,BATON,DELER,CRUSSARD+/ SACLAY+BOLOG JP

FOR QUANTUM NUMBERS OF NEUTRAL A2, SEE BENSON ABOVE

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

π (1640) → 3π

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

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

34 3 PI (1640) MASS (MEV)

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

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

34 3 PI (1640) WIDTH (MEV)

W		110	100.	20.	FERBEL	66	RVUE	+ 7-8 PI P	11/66
W	*	20	100.		VETLITSKY	66	HBC	-	6/66

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

34 PI (1640) PARTIAL DECAY MODES

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

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

34 PI (1640) BRANCHING RATIOS

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

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

REFERENCES FOR PI(1640)

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

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

ρ (1650) → 2π

15 RHO (1650, JPG= +) I=

FOR COMPILATION SEE GOLDHABER MESON REVIEW
1966 BERKELEY CONFERENCE.

15 RHO (1650) MASS (MEV)

M			1700.0	100.0		BELLINI	65	HLBC	0	6/66
M			1620.0	20.0		DEUTSCHMA	65	HBC	+	6/66
M			1640.0			FORINO	65	DBC	0	6/66
M			1670.0	30.0		GOLDBERG	65	HBC	0	
M		70	1700.			CRENNELL1	66	HBC	0 6.0 PI-P	10/66
M		25	1625.			CRENNELL1	66	HBC	- 6.0 PI-P	10/66
M	C		MOST OF DATA ABOVE COMPILED BY GOLDHABER							9/66
M	C	300	1650.0		COMP. BY	GOLDHABER	66	RVUE	0 5-8 PI P, PI D	9/66
M	C	50	1650.0		COMP. BY	GOLDHABER	66	RVUE	+- 5-8 PI P, PI D	9/66
			------ DECAY INTO FOUR PIONS ------							
M	*	23	1610.0	40.		KERNAN	65	HBC	0 2.7 PBAR P	10/66
M	*		1680.0	APPROX.		CONTE	66	HBC	- 11 PI- P	10/66

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

15 RHO (1650) WIDTH (MEV)

W		13	80.0	40.0		DEUTSCHMA	65	HBC	+	6/66
W			40.0			FORINO	65	DBC	0	6/66
W			180.0	40.0		GOLDBERG	65	HBC	0	
W		70	200.			CRENNELL1	66	HBC	0 6.0 PI-P	10/66
W		25	60.			CRENNELL1	66	HBC	- 6.0 PI-P	10/66
W	C	350	150.0	50.0	COMP. BY	GOLDHABER	66	RVUE	+-0 5-8 PI P, PI D	9/66
			------ DECAY INTO FOUR PIONS ------							
W	*		155.	85.		KERNAN	65	HBC	0 2.7 PBAR P	10/66
W	*		160.0	APPROX.		CONTE	66	HBC	- 11 PI- P	10/66

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

```
                    15  RHO (1650)      PARTIAL DECAY MODES
P1          RHO (1650) INTO PI PI                          S 8S 8
P2          RHO (1650) INTO PI PI PI PI                    S 8S 8S 8S 8
P3          RHO (1650) INTO PI PI RHO                      S 8S 8U 9
P4          RHO (1650) INTO RHO RHO                        U 9U 9

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

                    15  RHO (1650)  BRANCHING RATIOS

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

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

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

                              REFERENCES FOR RHO(1650)

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

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

R (1700)

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

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

                    30  R (1700)  MASS (MEV)

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

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

                    30  R (1700) WIDTH (MEV)

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

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

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

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

                    30  R1,R2,R3 BRANCHING RATIOS

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

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

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

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

                              REFERENCES FOR R(1700)

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

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

S (1930)

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

                    31  S (1930)  MASS (MEV)

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

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

                    31  S (1930) WIDTH (MEV)

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

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

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

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

                              REFERENCES FOR S(1930)

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

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

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

T (2195)

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

                    32 T(2200)  MASS (MEV)

M          2195.0     15.0           CHIKOVANI 66 MMSP  -                  8/66

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

                    32 T(2200) WIDTH (MEV)

W   *        13.0   OR LESS          CHIKOVANI 66 MMSP  -                  8/66

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

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

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

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

                              REFERENCES FOR T(2200)

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

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

U (2382)

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

                    33 U(2380)  MASS (MEV)

M          2382.0     24.0           CHIKOVANI 66 MMSP  -                  8/66

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

                    33 U(2380) WIDTH (MEV)

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

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

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

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

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

                    33  U MESON BRANCHING RATIOS

R1  *       U- MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R1  *         0.30 /   0.45 /   0.25  FOCACCI    66 MMS   -                  10/66

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

                              REFERENCES FOR U(2380)

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

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

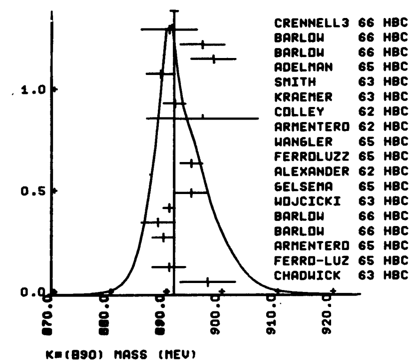
K (725)

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

    *               COMPILED IN APPENDIX A.

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

K* (892)

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

                    18  K* (890) MASS (MEV)

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

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

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

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

M          885.0                     ARMENTERO  62 HBC  +-0

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

                    18  K*(0) - K*(+) MASS DIFF. (MEV)

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

------ --------- --------- --------- --------- --------- --------- ---------
```

WEIGHTED AVERAGE =891.894 +/- 0.706
SCALE = 1.10   CHISQ = 13.4   CONLEV = 0.266



K*(890) MASS (MEV)

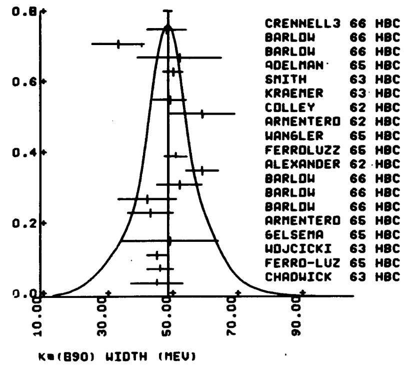
18 K* (890) WIDTH (MEV)

W		46.0	8.0	CHADWICK	63 HBC	+		
W		47.0	4.0	FERRO-LUZ	65 HBC	+		
W	3870	46.0	3.0	WOJCICKI	63 HBC	-		
W		50.0	15.0	GELSEMA	65 HBC	-		
W		31.0		ARMENTERO	65 HBC	+-		
W		44.	7.	BARLOW	66 HBC	+-	1.2 PBAR P	11/66
W		43.	9.	BARLOW	66 HBC	+-	1.2 PBAR P	11/66
W		53.	7.	BARLOW	66 HBC	+-	1.2 PBAR P	11/66
W	200	60.0	5.0	ALEXANDER	62 HBC	+ 0		
W		51.8	3.5	FERROLUZZ	65 HBC	+ 0		6/66
W		40.0		WANGLER	65 HBC	+ 0		6/66
W		55.0		ARMENTERO	62 HBC	+-0		
W	70	60.0	10.0	COLLEY	62 HBC	0		
W	200	50.0	5.0	KRAEMER	63 HBC	0		
W	150	50.0		SMITH	63 HBC	0		
W		51.0	3.0	ADELMAN	65 HBC			6/66
W		53.	13.	BARLOW	66 HBC	0	1.2 PBAR P	11/66
W		34.	8.	BARLOW	66 HBC	0	1.2 PBAR P	11/66
W	160	49.	6.	CRENNELL3	66 HBC	0	6.0 PI-P	10/66

(Ideogram below)

WEIGHTED AVERAGE =49.41 +/- 1.31

SCALE = 0.98 CHISQ = 13.4 CONLEV = 0.498



18 K* (890) PARTIAL DECAY MODES

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

18 K* (890) BRANCHING RATIOS

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

REFERENCES FOR K*

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

CHADWICK 63 PL 6 309 — CHADWICK,CRENNELL,DAVIES,BETTINI+/OXF+PADU
GOLDHABE 63 ATHENS CONF 92 — SULAMITH GOLDHABER //////////////////// LRL
KRAEMER 63 ATHENS CONF 130 — R KRAEMER L MADANSKY + //// JOHNS HOPKINS
SMITH 63 PRL 10 138 — SMITH,SCHWARTZ,MILLER,KALBFLEISCH,HUF+/LRL

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

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

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

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

K_V (1080)

19 KV (1080)

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

K_C (1215)

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

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

20 KC MASS (MEV)

M	1215.0	15.0	ARMENTERO 64 HBC

20 KC WIDTH (MEV)

W	60.0	15.0	ARMENTERO 64 HBC

20 KC PARTIAL DECAY MODES

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

20 KC BRANCHING RATIOS

R1	*	KC INTO (K RHO)/TOTAL		(UNITS OF 10**-2)	(P1)/TOTAL	
R1		75.0	10.0	ARMENTERO 64 HBC		6/66
R2	*	KC INTO (K* PI)/TOTAL		(UNITS OF 10**-2)	(P2)/TOTAL	
R2		25.0	10.0	ARMENTERO 64 HBC		6/66

REFERENCES FOR KC(1215)

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

K_A (1320)

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

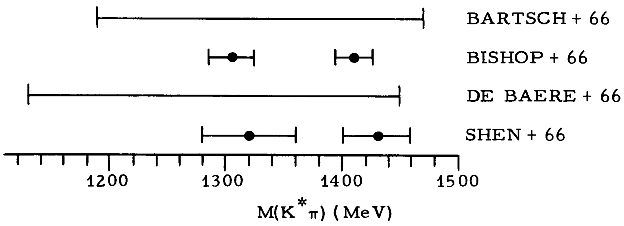
* THIS BUMP PARTLY DECK EFFECT BUT BISHOP+,
* SHEN+ SEE EVIDENCE FOR RESONANCE

21 KA (1320) MASS (MEV)

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

Mass of $K_A(1320)$

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



The bars show position and widths of bumps.

21 KA (1320) WIDTH (MEV)

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

21 KA (1320) PARTIAL DECAY MODES

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

21 KA (1320) BRANCHING RATIOS

R1	*	KA INTO K*(890) PI AND K RHO (OVERLAPPING BANDS)						
R1		70 1.0		SHEN	66 HBC	+		8/66
R2	*	KA INTO(K OMEGA)/(K*(890) PI)					(P3)/(P1)	
R2	*	0.1	OR LESS	SHEN	66 HBC	+		10/66
R3	*	KA (1320) INTO (K*(890) PI)/ TOTAL					(P1)/TOTAL	
R3	C	0.24	0.09	BISHOP	66 HBC			6/66
R4	*	KA(1320) INTO (K PI) / TOTAL					(P4)/TOTAL	
R4	C	0.68	0.12	BISHOP	66 HBC			6/66
R5	*	KA (1350) INTO (K RHO) / TOTAL					(P2)/TOTAL	
R5	C	0.06	0.06	BISHOP	66 HBC			6/66
R6	*	KA (1320) INTO (K ETA) / TOTAL					(P5)/TOTAL	
R6	C	0.0	0.030	BISHOP	66 HBC			6/66
R7	*	KA (1320) INTO (K OMEGA) / TOTAL					(P3)/TOTAL	
R7	C	0.020	0.020	BISHOP	66 HBC			6/66
R8	*	KA (1320) INTO (K PI) / (K*(890) PI)					(P4)/(P1)	
R8	*	0.30	OR LESS	SHEN	66 HBC	+		10/66
R8	*	0.21	OR LESS	DE BAERE	66 HBC			11/66

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

NOTE ON K OMEGA MODE

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

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

REFERENCES FOR KA(1320)

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

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

K_V (1420)

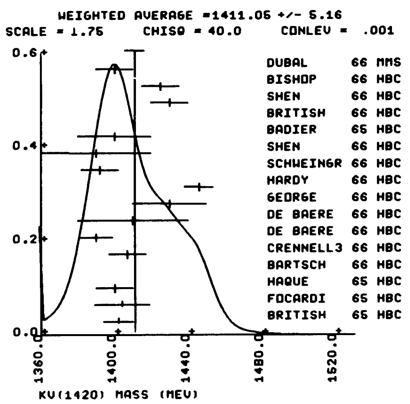
22 KV (1420,JP=) I=1/2

22 KV(1420) MASS (MEV)

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

(Ideogram below)

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



22 KV(1420) WIDTH (MEV)

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

(Ideogram at right)

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

22 KV (1420) PARTIAL DECAY MODES

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

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

U22 KV(1420) BRANCHING RATIOS

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

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

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

REFERENCES FOR KV(1420)

BADIER	65 PL 19 612	BADIER,DEMOULIN,GOLDBERG+//EP+SACLY+ZEEMAN
BRITISH	65 OXFORD CONF	BIRM,GLASGOW,IC--LONDON,MUNICH,OXFORD,RUTH
CHUNG	65 PRL 15 325	+DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER // LRL
FOCARDI	65 PL 16 351	FOCARDI,MINGUZZI RANZI,SERRA+ /BOLOGNA+CEN
HAQUE	65 PL 14 338	HAQUE,SCOTTER + /////BIRM,IMP COL+OXF+RUTH
BARTSCH	66 PL 22 357	+DEUTSCHMANN+GRUTE+MORRISON+ /// ABCL(IC)V
BISHOP	66 PRL 16 1069	BISHOP,GOSHAW,ERWIN,THOMPSON+ // WISCONSIN
BRITISH	66 BERKELEY CONF.	BIRM+GLASGOW+LONDON(IC)+MUNICH+OXFORD+RUTH
CRENNEL3	66 BERKELEY CONF	+KALBFLEISCH,LAI,SCARR,SCHUMANN+////// BNL I,JP
DE BAERE	66 BERK.CONF. - NC	DE BAERE,DEBAISIEUX,FILIPPAS+ // BRUX+CERN
DUBAL	66 BERKELEY CONF	+BAREYRE,BRICMAN,CHIKOVANI,MAGLIC+ // CERN
GEORGE	66 BERK.CONF. - NC	+GOLDSCHMIDT-CLERMONT+HENRI+ /// CERN+BRUX
HARDY L	66 UCRL 16788	LYNDON M HARDY (THESIS, BERKELEY) // LRL
SEE ALSO	65 PRL 14 401	HARDY,CHUNG,DAHL,HESS,KIRZ,MILLER //// LRL
SCHWEING	66 (PREPRINT)	SCHWEINGRUBER,SIMPSON,AMMAR+ // ARGONNE+NW
SHEN	66 BERKELEY CONF	+BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
ALSO SHEN	66 PRL 17 726	+BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
ALSO	66 (PRIVATE COMMUN)GERSON GOLDHABER	/// LRL

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

K_A (1800)

23 KA (1800, JP=) I = 1/2
NAMED L BY BARTSCH+

U23 KA (1800) MASS (MEV)

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

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

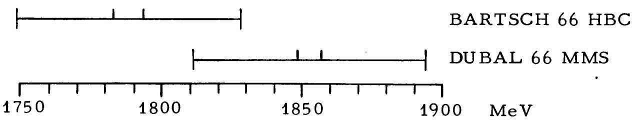
U23 KA (1800) WIDTH (MEV)

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

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

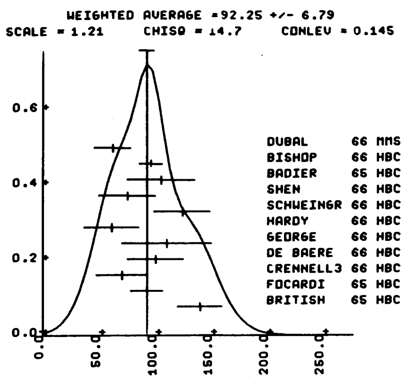
Mass and Width of $K_A(1800)$

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



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

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



```
              U23   KA (1800) PARTIAL DECAY MODES

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

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

              U23   KA (1800) BRANCHING RATIOS

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

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

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

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

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

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

R7   *  KA   INTO (K*(1420) PI) / TOTAL                 (P6)/TOTAL
R7             0.085     0.05          BARTSCH 2 66 HBC                        10/66

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

               NOTE ON KA (1800) - NEGATIVE EVIDENCE

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

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

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

                        REFERENCES FOR KA(1800)

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

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

K*3/2 (1175)

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

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

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

M    *   23 1175.0                   WANGLER    64 HBC
M    *   15 1160.0      10.0         MILLER     65 HBC        PURDUE
M    *      1180.0                   BISHOP     66 HBC   SUGGEST I=3/2       6/66

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

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

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

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

                        REFERENCES FOR K*3/2(1175)

WANGLER  64 PL 9 71             T P WANGLER,A R ERWIN,W D WALKER //WISCONS
MILLER   65 PL 15 74            MILLER,KOVACS,MCILWAIN,PALFREY +/// PURDUE
ROSENFEL 65 OXFORD CONF 58      A H ROSENFELD ////////////////// LRL--RVUE
            FOR SLIGHT EVID. FOR K*PI(1175) WITH I = 3/2 SEE BISHOP 66
BISHOP   66 PRL 16 1069         +GOSHAW,ERWIN,THOMPSON,WALKER,WEINBE//WISC I

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

K*? (1270)

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

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

              25  K*(1270) MASS (MEV)

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

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

              25  K*(1270) WIDTH (MEV)

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

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

              25  K*(1270) PARTIAL DECAY MODES

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

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

              25  K*(1270) BRANCHING RATIOS

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

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

                        REFERENCES FOR K*(1270)

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

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

DATA ON BARYON RESONANCES

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

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

------ --------- --------- --------- --------- --------- --------- ---------
```

N (1400)

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

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

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

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

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

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

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

P1          N*1/2(1400) INTO PI N                          S 8S16
P2          N*1/2(1400) INTO N SIGMA (SIGMA MESON)         S16U 7
P3          N*1/2(1400) INTO N*3/2(1236) PI                U81S 8

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

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

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

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

                        REFERENCES -- N*1/2(1400)

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

                 PAPERS NOT REFERRED TO IN DATA CARDS.

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

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

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

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

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

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

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

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

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

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

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

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

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

```
R2        N*1/2(1518) INTO (N*3/2(1236) PI)/TOTAL        (P4)/TOTAL
R2           DOMINANT  INEL DECAY       OLSSON    66 RVUE    PI P TO PI PI N  9/66
R2           0.20      0.05             KIRZ      66 HBC  C  ASSUMING R1=0.72 9/66

R3        N*1/2(1518) INTO (N PI)/(N PI PI)              (P1)/(P3)
R3           1.25      0.44     0.71  A-BORELLI 66 HBC  C  PBAR P 5.7 BEV/C   9/66

R4        N*1/2(1518) INTO (N*3/2(1236) PI)/(N PI PI)    (P2)/(P3)
R4           0.00      0.09            A-BORELLI 66 HBC                       9/66

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

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

REFERENCES -- N*1/2(1518)


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

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

```
KIRZ     63 PR 130 2481        J KIRZ, J SCHWARTZ, R D TRIPP         //LRL
CROUCH   65 DESY CONF II 21    + //BROWN,CEA,HARVARD,MIT,PADUVA,WEIZMANN
DERADO   65 ATHENS CONF 244    +KENNEY,LAMSA, +      //NOTRE DAME,KENTUCKY
MERLO    66 P ROY SOC 289 489 J P MERLO, G VALLADAS              //SACLAY
     -- THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE RESONANCE.
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
     --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.
```


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

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

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

```
                  63 N*1/2(1570) MASS (MEV) ---------------------------

M   *      1519.0                       HENDRY    65 RVUE   ETA N + S11 PI N  9/66
M          1570.0                       MICHAEL   66 RVUE   FITS BAREYRE S11  7/66
M   N      1557.0  OR  1565.0           UCHIYAMA- 66 RVUE   FITS N ETA DATA   9/66
    N      FITTING GIVES TWO SOLUTIONS.  PROBLEMS MATCHING PI P PHASE SHIFTS.
M   K      1561.0                       LOVELACE  66 RVUE   PHASE-SHIFT ANAL  9/66
    K      AS GIVEN.  WITHOUT ARGAND DIAGRAM WE DONT KNOW HOW DETERMINED.

----------------- 63 N*1/2(1570) WIDTH (MEV) --------------------------

W   *       130.0                       HENDRY    65 RVUE                     9/66
W           130.0                       MICHAEL   66 RVUE                     7/66
W   N       156.0  OR  144.0            UCHIYAMA- 66 RVUE   SEE NOTE ON MASS  9/66
W   K       180.0                       LOVELACE  66 RVUE   SEE NOTE ON MASS  9/66

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

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

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

R1        N*1/2(1570) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1  *        0.69                       HENDRY    65 RVUE                     9/66
R1           0.32                       MICHAEL   66 RVUE                     9/66
R1  N        0.71  OR  0.28             UCHIYAMA- 66 RVUE   SEE NOTE ON MASS  9/66
R1  K        0.40                       LOVELACE  66 RVUE   SEE NOTE ON MASS  9/66

R2        N*1/2(1570) INTO (N ETA)/TOTAL                 (P2)/TOTAL
R2           DOMINANT  INEL DECAY       HENDRY    65 RVUE                     9/66
R2           0.68                       MICHAEL   66 RVUE                     9/66
R2  N        0.29  OR  0.71             UCHIYAMA- 66 RVUE   SEE NOTE ON MASS  9/66

R3        N*1/2(1570) INTO (N PI PI)/TOTAL               (P3)/TOTAL
R3           SMALL TRACE                LOVELACE  66 RVUE                     9/66
```

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

REFERENCES -- N*1/2(1570)


```
HENDRY   65 PL 18 171          A W HENDRY, R G MOORHOUSE            //RTHFD
     --  REVIEWS EARLY PHASE-SHIFT-ANALYSIS RESULTS AND PI- P TO ETA N
         EXPERIMENTS.  WE TAKE NUMBERS FROM THE SOLUTION USING BRANDSEN 65.
BAREYRE  65 PL 18 342          + BRICMAN, STIRLING, VILLET       //SACLAY IJP
MICHAEL  66 PL 21 93           C MICHAEL                              //OXF
UCHIYAMA 66 PR 149 1220        F UCHIYAMA-CAMPBELL, R K LOGAN       //ILL IJP
LOVELACE 66 BERKELEY CONF      C LOVELACE                         //CERN IJP
```

PAPERS NOT REFERRED TO IN DATA CARDS.

```
BULOS    64 PRL 13 486         +       //BROWN,BRANDEIS,HARVARD,MIT,PADOVA  I
RICHARDS 66 PRL 16 1221        +CHIU,EANDI,HELMHOLZ,KENNEY,+ //LRL,HAWAII  IJ
     -- BULOS 64 AND RICHARDS 66 ARE EXPERIMENTS ON PI- P TO ETA N NEAR
         THRESHOLD.  THEY ARE IN SOME DISAGREEMENT.
BRANDSEN 65 PR 139 B1566       +ODONNELL, MOORHOUSE        //DURHAM,RTHFD IJP
     --  BASIS OF NUMBERS WE QUOTE FROM HENDRY 65.
PREPOST  65 DESY CONF II 152   R PREPOST, D LUNDQUIST, D QUINN //STANFORD
BACCI    66 PRL 16 157         +PENSO,SALVINI,MENCUCCINI,+//ROME,FRASCATI
     --  PREPOST 65 AND BACCI 66 ARE EXPERIMENTS ON ETA PHOTOPRODUCTION NEAR
         THRESHOLD.
      THE FOLLOWING THREE ARE ANALYSES OF ETA PRODUCTION NEAR THRESHOLD --
DOBSON   66 PR 146 1022        P N DOBSON                          //HAWAII
MINAMI   66 PR 147 1123        S MINAMI                             //OSAKA
BALL     66 PR 149 1191        J S BALL                              //UCLA
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
     --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.
```


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

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

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

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

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

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

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

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

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

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

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

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

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

REFERENCES -- N*1/2(1670)


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

PAPER NOT REFERRED TO IN DATA CARDS.

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


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

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

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

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

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

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

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

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

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

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

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

WE LIST MEASUREMENTS OF THE INELASTIC DECAY MODES OF THE 1688 MEV BUMP. SUCH MEASUREMENTS HAVE NOT UNTANGLED THE D15 AND F15 (AND POSSIBLE S11) COMPONENTS. IT IS CLEAR THAT BOTH D15 AND F15 DECAY ALOT INTO N PI PI. THERE IS SOME DISAGREEMENT ABOUT WHETHER THIS IS DOMINATED BY N*3/2(1236) PI. IN ANY CASE THE MEASUREMENTS OF THE BRANCHING RATIO TO THIS FINAL STATE ARE MODEL DEPENDENT AND OUGHT NOT BE TAKEN AS MORE THAN QUALITATIVE INDICATIONS OF TRUTH.

```
R2          N*1/2(1688) INTO (N ETA)/TOTAL                    (P2)/TOTAL
R2             0.025        OR LESS        KRAEMER   64 DBC  +  PI+D 1.23 BEV/C    9/66
R2             0.042 OR LESS (95PC CL) A-BORELLI 66 HBC  +  PBAR P 5.7 BEV/C   9/66

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

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

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

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

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

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

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

                           REFERENCES -- N*1/2(1688)

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

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

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

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

N(1700)

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

                EXISTENCE NOT CONCLUSIVE.  SEE LOVELACE 66.

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

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

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

W            240.0                          MICHAEL   66 RVUE                      7/66

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

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

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

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

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

                           REFERENCES -- N*1/2(1700)

BAREYRE   65 PL 18 342            + BRICMAN, STIRLING, VILLET       //SACLAY IJP
BRANDSEN  65 PL 19 420            +ODONNELL, MOORHOUSE         //DURHAM,RTHFD IJP
MICHAEL   66 PL 21 93             C MICHAEL                            //OXF
LOVELACE  66 BERKELEY CONF        C LOVELACE                           //CERN
      -- LOVELACE 66 QUESTIONS THE EXISTENCE OF THIS SECOND S11 RESONANCE.

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

N (2190)

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

                71   N*1/2(2190) MASS (MEV)    ---------------------------

M           2190.0                          DIDDENS   63 CNTR    PI+- P TOTAL
M           2210.0                          HOHLER    64 RVUE    DATA + DISP REL
M           2190.0            APPROX        YOKOSAWA  66 CNTR    PI- P DSIG + PCL  7/66

----------------   71   N*1/2(2190) WIDTH (MEV)     -------------------------

W            200.0                          DIDDENS   63 CNTR
W            200.0                          HOHLER    64 RVUE                      7/66
W            220.0            APPROX        YOKOSAWA  66 CNTR                      7/66

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

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

----------------   71   N*1/2(2190) BRANCHING RATIOS  ----------------------

R1          N*1/2(2190) INTO (PI N)/TOTAL                     (P1)/TOTAL
R1             0.3            APPROX        DIDDENS   63 CNTR                      7/66
R1             0.3            APPROX        YOKOSAWA  66 CNTR                      7/66

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

                           REFERENCES -- N*1/2(2190)

DIDDENS   63 PRL 10 262           +JENKINS, KYCIA, RILEY              //BNL   I
HOHLER    64 PL 12 149            G HOHLER, J GIESECKE           //KARLSRUHE   I
YOKOSAWA  66 PRL 16 714           +SUWA,HILL,ESTERLING,BOOTH         //ARG,CHI  JP

           QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

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

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

N (2650)

```
72   N*1/2(2650, JP=11/2-) I=1/2

                FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                72   N*1/2(2650) MASS (MEV)    ---------------------------

M    *      2700.0                          ALVAREZ   64 CNTR    PI PHOTOPROD
M    *      2600.0           APPROX         WAHLIG    64 SPRK C  PI-P CH EX
M           2660.0                          HOHLER    64 RVUE    DATA + DISP REL
M           2649.0     10.0                 CITRON    66 CNTR    PI+- P TOTAL      7/66

----------------   72   N*1/2(2650) WIDTH (MEV)     -------------------------

W    *       100.0                          ALVAREZ   64 CNTR
W            200.0                          HOHLER    64 RVUE                      7/66
W            360.0     20.0                 CITRON    66 CNTR                      7/66

----------------   72   N*1/2(2650) PARTIAL DECAY MODES    ------------------

P1          N*1/2(2650) INTO PI N                             S 8S16
P2          N*1/2(2650) INTO LAMBDA K                         S18S11

----------------   72   N*1/2(2650) BRANCHING RATIOS    --------------------

R1          N*1/2(2650) INTO (PI N)/TOTAL                     (P1)/TOTAL
R1             0.0703   0.0045              CITRON    66 CNTR    ASSUMING J=11/2   7/66

****** ********* ********* ********* ********* ********* ********* *********

                           REFERENCES -- N*1/2(2650)

ALVAREZ   64 PRL 12 710           +BAR-YAM,KERN,LUCKEY,OSBORNE, +  //MIT,CEA
WAHLIG    64 PRL 13 103           +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER    64 PL 12 149            G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON    66 PR 144 1101          +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER    66 PRL 16 913           V BARGER, D CLINE                    //WISC  P

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

N (3030)

```
73   N*1/2(3030, JP=15/2-) I=1/2

                EVIDENCE FOR EXISTENCE NOT COMPLETELY CONCLUSIVE.  FOR
                JP ASSIGNMENT SEE BARGER 66 AND NOTE FOLLOWING LISTINGS.

----------------   73   N*1/2(3030) MASS (MEV)    ---------------------------

M           3080.0                          HOHLER    64 RVUE    DATA + DISP REL   7/66
M           3030.0                          CITRON    66 CNTR    PI+- P TOTAL      7/66

----------------   73   N*1/2(3030) WIDTH (MEV)     -------------------------

W            400.0                          CITRON    66 CNTR                      7/66

----------------   73   N*1/2(3030) PARTIAL DECAY MODES    ------------------

P1          N*1/2(3030) INTO PI N                             S 8S16

----------------   73   N*1/2(3030) BRANCHING RATIOS    --------------------

R1          N*1/2(3030) INTO (PI N)/TOTAL                     (P1)/TOTAL
R1             0.0070                       CITRON    66 CNTR    ASSUMING J=15/2   7/66

------ --------- --------- --------- --------- --------- --------- ---------
****** ********* ********* ********* ********* ********* ********* *********

                           REFERENCES -- N*1/2(3030)

HOHLER    64 PL 12 149            G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON    66 PR 144 1101          +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER    66 PRL 16 913           V BARGER, D CLINE                    //WISC  P

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

N? (3245)

```
74   N* /2(3245, JP=     )

                EXISTENCE ONLY TENTATIVE.  I-SPIN NOT DETERMINED BUT
                NARROW WIDTH PRECLUDES IDENTIFICATION WITH N*3/2(3230).
                OMITTED FROM TABLE.

----------------   74   N* /2(3245) MASS (MEV)    ---------------------------

M           3245.0     10.0                 KORMANYOS 66 CNTR    PI-P EL AT 180 D  7/66

----------------   74   N* /2(3245) WIDTH (MEV)     -------------------------

W             35.0           OR LESS        KORMANYOS 66 CNTR                      7/66

----------------   74   N* /2(3245) PARTIAL DECAY MODES    ------------------

P1          N* /2(3245) INTO PI N                             S 8S16

****** ********* ********* ********* ********* ********* ********* *********

                           REFERENCES -- N* /2(3245)

KORMANYC  66 PRL 16 709           KORMANYOS,KRISCH,OFALLON, +      //MICH,ARG

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

N (3695)

```
75   N*1/2(3695, JP=     ) I=1/2

                EVIDENCE PRELIMINARY AND NOT COMPELLING.  OMITTED FROM
                TABLE.

----------------   75   N*1/2(3695) MASS (MEV)    ---------------------------

M           3694.0      7.0                 BARTKE    66 HBC  +  PI+P 8 PRONGS     9/66

----------------   75   N*1/2(3695) WIDTH (MEV)     -------------------------

W             46.0     23.0                 BARTKE    66 HBC  +                    9/66

****** ********* ********* ********* ********* ********* ********* *********

                           REFERENCES -- N*1/2(3695)

BARTKE    66 BERKELEY CONF        +CZYZEWSKI,DANYSZ,ESKREYS,+ //KRAKOW(CERN)  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (1236) 81 N*3/2(1236, JP=3/2+) I=3/2 P33

```
                         81  N*3/2(1236) MASS (MEV)   ---------------------------

M    *      1234.0                    ROPER      65 RVUE C++PHASE-SHIFT ANAL
M++         1236.0      0.55          OLSSON     65 RVUE ++ TOTAL-SIGMA DATA
M++  *      1232.0      6.0           FERRO-LUZ  65 HBC  ++ K+P TO KC P PI+
M++  *      1233.4      4.4           GIDAL      66 DBC  ++ D D TO NN(NN) PI  7/66
M++         1236.0                    DEANS      66 RVUE ++ PI+P TOTAL        7/66
MO          1236.45     0.65          OLSSON     65 RVUE C
M-   *      1241.3      5.1           GIDAL      66 DBC  -                    7/66

----------------  81  N*(0) - N*(++) MASS DIFFERENCE (MEV)   ------------

D    R        0.45      0.85          OLSSON     65 RVUE
     R      REDUNDANT WITH DATA IN MASS LISTING.

----------------  81  N*(-) - N*(++) MASS DIFFERENCE (MEV)   ------------

D             7.9       6.8           GIDAL      66 DBC

----------------  81  N*3/2(1236) WIDTH (MEV)   -------------------------

W++          120.0      2.0           OLSSON     65 RVUE ++
W++  *       125.0     30.0           FERRO-LUZ  65 HBC  ++
W++  *       124.0     14.0           GIDAL      66 DBC  ++                   7/66
W++          121.0                    DEANS      66 RVUE ++                   7/66
WO           119.6      2.4           OLSSON     65 RVUE C
W-   *       149.0     18.0           GIDAL      66 DBC  -                    7/66

----------------  81  N*3/2(1236) PARTIAL DECAY MODES   -----------------

P1          N*3/2(1236) INTO PI N                       S 8S16

****** ********* ********* ********* ********* ********* ********* *********
```

```
                      REFERENCES -- N*3/2(1236)

OLSSCN   65 PRL 14 118          M G OLSSON                        //WISC
FERRO-LU 65 NC 36 1101          FERRO-LUZZI,GEORGE, +             //CERN
ROPER    65 PR 138 B190         L D ROPER, R M WRIGHT, B T FELD  //LRL,MIT  JP
GIDAL    66 PR 141 1261         G GIDAL, A KERNAN, S KIM          //LRL
DEANS    66 PREPRINT            S R DEANS, W G HOLLADAY       //VANDERBILT

      FOR EXTENSIVE REFERENCES TO DATA AND PHASE-SHIFT ANALYSES TILL 1965,
      SEE ROPER 65, ESPECIALLY APPENDIX II.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (1670) 82 N*3/2(1670, JP=1/2-) I=3/2 S31

```
                         82  N*3/2(1670) MASS (MEV)   ---------------------------

M    *      1648.0     12.0           DEVLIN     65 CNTR   PI+- P TOTAL
M           1665.0                    BAREYRE    65 RVUE   PHASE SHIFT ANAL  7/66
M           1692.0                    LOVELACE   66 RVUE   PHASE-SHIFT ANAL  9/66

----------------  82  N*3/2(1670) WIDTH (MEV)   -------------------------

W    *       201.0     74.0           DEVLIN     65 CNTR   VERY ASYMMETRIC
W            130.0                    BAREYRE    65 RVUE                     7/66
W            230.0                    LOVELACE   66 RVUE                     9/66

----------------  82  N*3/2(1670) PARTIAL DECAY MODES   -----------------

P1          N*3/2(1670) INTO PI N                       S 8S16

----------------  82  N*3/2(1670) BRANCHING RATIOS   --------------------

R1          N*3/2(1670) INTO (PI N)/TOTAL               (P1)/TOTAL
R1   *        0.56                    DEVLIN     65 CNTR
R1            0.33                    BAREYRE    65 RVUE                     7/66
R1            0.44                    LOVELACE   66 RVUE                     9/66

****** ********* ********* ********* ********* ********* ********* *********
```

```
                      REFERENCES -- N*3/2(1670)

DEVLIN   65 PRL 14 1031         T J DEVLIN,J SOLOMON,G BERTSCH //PRINCETON  I
BAREYRE  65 PL 18 342           + BRICMAN, STIRLING, VILLET      //SACLAY IJP
LOVELACE 66 BERKELEY CONF       C LOVELACE                       //CERN IJP

                 PAPERS NOT REFERRED TO IN DATA CARDS.

CARRUTHE 60 PRL 4 303           P CARRUTHERS                     //CORNELL  I
DEVLIN   62 PR 125 690          T J DEVLIN, B J MOYER, V PEREZ-MENDEZ//LRL  I
HELLAND  64 PR 134 B1062        +DEVLIN,HAGGE,LONGO,MOYER,WOOD        //LRL  I
DONNACHI 66 BERKELEY CONF       DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
    --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (1920) 83 N*3/2(1920, JP=7/2+) I=3/2

```
                         83  N*3/2(1920) MASS (MEV)   ---------------------------

M           1922.0          APPROX    COOL       56 CNTR   PI+ P TOTAL       7/66
M           1912.0     15.0           BRISSON    61 CNTR   PI+ P TOTAL       7/66
M    N      1956.0                    LAYSON     63 RVUE   PI P TOTAL, EL    7/66
     N      ASSUMES AN N*3/2(1855).
M           1920.0                    HOHLER     64 RVUE   DATA + DISP REL   7/66
M           1900.0      9.0           DEVLIN     65 CNTR   PI+ P TOTAL
M           1920.0          APPROX    DUKE       65 CNTR   PI+- P EL, POLAR  7/66
M           1950.0          APPROX    YOKOSAWA   66 CNTR   PI- P DSIG + PCL  7/66
M           1950.0                    LOVELACE   66 RVUE   PHASE-SHIFT ANAL  9/66

----------------  83  N*3/2(1920) WIDTH (MEV)   -------------------------
W            170.0                    HOHLER     64 RVUE                     7/66
W            256.0     39.0           DEVLIN     65 CNTR
W            170.0                    DUKE       65 CNTR                     7/66
W            200.0          APPROX    YOKOSAWA   66 CNTR                     7/66
W.           250.0                    LOVELACE   66 RVUE                     9/66

----------------  83  N*3/2(1920) PARTIAL DECAY MODES   -----------------

P1          N*3/2(1920) INTO PI N                       S 8S16
P2          N*3/2(1920) INTO SIGMA K                    S20S10
P3          N*3/2(1920) INTO N*3/2(1236) PI             L81S 8

----------------  83  N*3/2(1920) BRANCHING RATIOS   --------------------

R1          N*3/2(1920) INTO (PI N)/TOTAL               (P1)/TOTAL
R1   N        0.33                    LAYSON     63 RVUE                     7/66
     N      ASSUMES AN N*3/2(1855).
R1            0.73      OR LESS       HOHLER     63 RVUE   DATA + DISP REL   7/66
R1            0.57      0.12          DEVLIN     65 CNTR
R1            0.41                    DUKE       65 CNTR   VERY ENERGY DEP   7/66
R1            0.4         APPROX      YOKOSAWA   66 CNTR                     7/66
R1            0.50                    LOVELACE   66 RVUE                     9/66

R2          N*3/2(1920) INTO (SIGMA K)/TOTAL            (P2)/TOTAL
R2            SEEN                    HOLLADAY   65 RVUE   PI+P DATA        11/66

R3          N*3/2(1920) INTO (N*3/2(1236) PI)/TOTAL     (P3)/TOTAL
R3          DOMINANT INEL DECAY       LOVELACE   66 RVUE                     9/66

****** ********* ********* ********* ********* ********* ********* *********
```

```
                      REFFRENCES -- N*3/2(1920)

COOL     56 PR 103 1082         R COOL, O PICCIONI, D CLARK           //BNL  I
BRISSON  61 NC 19 210           +CETOEUF,FALK-VAIRANT,VAN ROSSUM,+//SACLAY  I
LAYSCN   63 NC 27 724           W M LAYSON                           //CERN IJ
HOHLER   63 NP 48 470           G HOHLER, G EBEL                //KARLSRUHE  I
HOHLER   64 PL 12 149           G HOHLER, J GIESECKE            //KARLSRUHE  I
DEVLIN   65 PRL 14 1031         T J DEVLIN,J SOLOMON,G BERTSCH //PRINCETON  I
DUKE     65 PRL 15 468          +JONES,KEMP,MURPHY,PRENTICE, + //RTHFD,OXF IJP
HOLLADAY 65 PR 139 B1348        W G HOLLADAY                    //VANDERBILT
YOKCSAWA 66 PRL 16 714          +SUWA, HILL, ESTERLING, BOOTH   //ARG,CHI IJP
LOVELACE 66 BERKELEY CONF       C LOVELACE                          //CERN IJP

                 PAPERS NOT REFERRED TO IN DATA CARDS.

HELLAND  64 PR 134 B1062        +DEVLIN,HAGGE,LONGO,MOYER,WOOD       //LRL  IJ
AUVIL    64 NC 33 473           P AUVIL, C LOVELACE               //IMPCOL IJP
DONNACHI 66 BERKELEY CONF       DONNACHIE, KIRSOPP, LEA, LOVELACE  //CERN IJP
    --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (2420) 84 N*3/2(2420, JP=11/2+) I=3/2

```
                 FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                         84  N*3/2(2420) MASS (MEV)   ---------------------------

M           2360.0                    DIDDENS    63 CNTR   PI+ P TOTAL
M    *      2520.0     40.0           ALVAREZ    64 CNTR   PI PHOTOPROD      7/66
M    *      2400.0          APPROX    WAHLIG     64 SPRK C PI-P CH EX
M           2440.0                    HOHLER     64 RVUE   DATA + DISP REL
M           2423.0     10.0           CITRON     66 CNTR   PI+ P TOTAL       7/66

----------------  84  N*3/2(2420) WIDTH (MEV)   -------------------------

W            200.0                    DIDDENS    63 CNTR
W            245.0                    HOHLER     64 RVUE                     7/66
W            310.0     20.0           CITRON     66 CNTR                     7/66

----------------  84  N*3/2(2420) PARTIAL DECAY MODES   -----------------

P1          N*3/2(2420) INTO PI N                       S 8S16
P2          N*3/2(2420) INTO SIGMA K                    S20S10

----------------  84  N*3/2(2420) BRANCHING RATIOS   --------------------

R1          N*3/2(2420) INTO (PI N)/TOTAL               (P1)/TOTAL
R1            0.067         APPROX    DIDDENS    63 CNTR   ASSUMING J=11/2   7/66
R1            0.113     0.0036        CITRON     66 CNTR   ASSUMING J=11/2   7/66

****** ********* ********* ********* ********* ********* ********* *********
```

```
                      REFERENCES -- N*3/2(2420)

DIDDENS  63 PRL 10 262          +JENKINS, KYCIA, RILEY                //BNL  I
ALVAREZ  64 PRL 12 710          +BAR-YAM,KERN,LUCKEY,OSBORNE, +  //MIT,CEA
WAHLIG   64 PRL 13 103          +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149           G HOHLER, J GIESECKE            //KARLSRUHE  I
CITRCN   66 PR 144 1101         +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913          V BARGER, D CLINE                    //WISC  P

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (2850) 85 N*3/2(2850, JP=15/2+) I=3/2

```
                 FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                         85  N*3/2(2850) MASS (MEV)   ---------------------------

M    *      2700.0          APPROX    WAHLIG     64 SPRK C PI-P CH EX
M           2870.0                    HOHLER     64 RVUE   DATA + DISP REL
M           2850.0     12.0           CITRON     66 CNTR   PI+ P TOTAL       7/66
M           2850.0                    BARDADIN   66 HBC ++ N* TO P + 3 PIS   7/66

----------------  85  N*3/2(2850) WIDTH (MEV)   -------------------------

W            400.0     40.0           CITRON     66 CNTR                     7/66
W            150.0                    BARDADIN   66 HBC ++                   7/66

----------------  85  N*3/2(2850) PARTIAL DECAY MODES   -----------------

P1          N*3/2(2850) INTO PI N                       S 8S16
P2          N*3/2(2850) INTO P PI PI PI                 S16S 8S 8S 8

----------------  85  N*3/2(2850) BRANCHING RATIOS   --------------------

R1          N*3/2(2850) INTO (PI N)/TOTAL               (P1)/TOTAL
R1            0.0314    0.0025        CITRON     66 CNTR   ASSUMING J=15/2   7/66

****** ********* ********* ********* ********* ********* ********* *********
```

```
                      REFERENCES -- N*3/2(2850)

WAHLIG   64 PRL 13 103          +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149           G HOHLER, J GIESECKE            //KARLSRUHE  I
CITRCN   66 PR 144 1101         +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARDADIN 66 PL 21 357           BARDADIN-OTWINOWSKA,DANYSZ, +      //WARSAW
BARGER   66 PRL 16 913          V BARGER, D CLINE                    //WISC  P

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Δ (3230) 86 N*3/2(3230, JP=19/2+) I=3/2

```
                 EVIDENCE FOR EXISTENCE NOT COMPLETELY CONCLUSIVE.  FOR
                 JP ASSIGNMENT SEE BARGER 66 AND NOTE FOLLOWING LISTINGS.

----------------  86  N*3/2(3230) MASS (MEV)   --------------------------

M           3230.0                    CITRON     66 CNTR   PI+ P TOTAL       7/66

----------------  86  N*3/2(3230) WIDTH (MEV)   -------------------------

W            440.0                    CITRON     66 CNTR                     7/66

----------------  86  N*3/2(3230) PARTIAL DECAY MODES   -----------------

P1          N*3/2(3230) INTO PI N                       S 8S16
```

86 N*3/2(3230) BRANCHING RATIOS

R1	N*3/2(3230) INTO (PI N)/TOTAL				(P1)/TOTAL	
R1	0.0063		CITRON	66 CNTR	ASSUMING J=19/2	7/66

REFERENCES -- N*3/2(323C)

CITRCN 66 PR 144 1101 +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL I
BARGER 66 PRL 16 913 V BARGER, D CLINE //WISC P

$N^*_{5/2}$(1560) 91 N*5/2(1560, JP=) I=5/2

PROBABLE KINEMATIC EFFECT. SEE DASH 66, CONTE 66, AND ALEXANCER 66. OMITTED FROM TABLE.

91 N*5/2(1560) MASS (MEV)

M	1560.0	20.0	GOLDHABER	64 HBC	+++3.65 BEV/C PI+ P	7/66
M	1570.0		ALEXANDER	66 HBC	+++PP 4PI 5.5 BEV/C	9/66

91 N*5/2(1560) WIDTH (MEV)

W	220.0	20.0	GOLDHABER	64 HBC	+++	7/66
W	140.0		ALEXANDER	66 HBC	+++	9/66

91 N*5/2(156C) PARTIAL DECAY MODES

P1	N*5/2(1560) INTO N PI PI	S16S 8S 8
P2	N*5/2(1560) INTO N*3/2(1236) PI	L81S 8

REFERENCES -- N*5/2(156C)

GOLDHABE 64 DUBNA CONF I 480 G+S GOLDHABER,OHALLORAN,SHEN //LRL(BNL) I
DASH 65 LRL UCID-2752 J DASH, G GOLDHABER, J SWINHART //LRL
CONTE 66 BERKELEY CONF +CAMERI,RATTI,RUSSO, + //GENOVA,MILANO,UXF
ALEXANDE 66 BERKELEY CONF ALEXANDER,BENARY,CZAPEK,+ //WEIZMANN(CERN)

PAPER NOT REFERRED TO IN DATA CARDS.

ALEXANDE 65 PRL 15 207 ALEXANDER,BENARY,REUTER,+ //WEIZMANN(CERN) I
-- REPLACED BY ALEXANDER 66.

Z_0(1865) 96 Z*0(1865, JP=) I=C

IT IS NOT ESTABLISHED THAT THIS EFFECT IS A RESONANCE. HOWEVER IF SUCH A LARGE EFFECT APPEARED IN A PI N OR KBAR N CHANNEL IT WOULD IMMEDIATELY BE TAKEN AS A RESCNANCE. WE INCLUDE IT IN THE TABLE UNTIL A PLAUSIBLE ALTERNATE INTERPRETATION IS PUT FORTH.

96 Z*0(1865) MASS (MEV)

M	1863.0	COOL	66 CNTR +	K+P, D TCTAL	7/66

96 Z*0(1865) WIDTH (MEV)

W	150.0	COOL	66 CNTR +		7/66

96 Z*0(1865) PARTIAL DECAY MODES

P1	Z*0(1865) INTO K N	S1CS17
P2	Z*0(1865) INTO K*(892) N	L18S16

96 Z*0(1865) BRANCHING RATIOS

R1	Z*0(1865) INTO (K N)/TOTAL			(P1)/TOTAL	
R1	0.55	COOL	66 CNTR +	IF J=1/2	7/66

REFERENCES -- Z*C(1865)

COOL 66 PRL 17 102 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I

PAPER NOT REFERRED TO IN DATA CARDS.

BLAND 66 BERKELEY CONF +BOWLER,BROWN,G+S GOLDHABER,HIRATA,+ //LRL
-- PRELIMINARY RESULTS INDICATING THAT INELASTIC CHANNELS ARE NOT AS DCMINANT AS IN THE I=1 EFFECT (SEE THE Z*1(191C) BELOW).

Z_1(1910) 97 Z*1(1910, JP=) I=1

ESSENTIALLY ALL THE EFFECT IS DUE TO A BUMP IN THE KN* CHANNEL NEAR ITS THRESHOLD. ANGULAR DISTRIBUTIONS IN THIS CHANNEL INDICATE THE PREDOMINANCE OF THE P3/2 STATE IN THE K N* (AND THUS ALSO IN THE K N) SYSTEM. HOWEVER IT MAY BE POSSIBLE TO UNDERSTAND THIS CHANNEL WITHOUT INVOKING RESONANT BEHAVIOR -- SEE BLAND 66. OMITTED FROM TABLE.

97 Z*1(1910) MASS (MEV)

M	1910.0	20.0	COOL	66 CNTR ++	K+P TOTAL	7/66

97 Z*1(1910) WIDTH (MEV)

W	180.0	COOL	66 CNTR ++	7/66

97 Z*1(1910) PARTIAL DECAY MODES

P1	Z*1(1910) INTO K N	S1CS16
P2	Z*1(1910) INTO N*3/2(1236) K	L81S10

97 Z*1(1910) BRANCHING RATIOS

R1	Z*1(1910) INTO (K N)/TOTAL			(P1)/TOTAL	
R1	0.31	COOL	66 CNTR ++	IF J=1/2	7/66
R2	Z*1(1910) INTO (N*3/2(1236) K)/TOTAL			(P2)/TOTAL	
R2	DCMINANT DECAY	BLAND	66 HBC ++		9/66

REFERENCES -- Z*1(1910)

COOL 66 PRL 17 102 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I
BLAND 66 BERKELEY CONF +BOWLER,BROWN,G+S GOLDHABER,KADYK, + //LRL I

PAPER NOT REFERRED TO IN DATA CARDS.

LEA 66 PL 23 380 LEA, MARTIN, OADES //COPENHAGEN,NORDITA
-- PRELIMINARY PHASE-SHIFT ANALYSIS. THE ONLY WAVE WITH POSITIVE AND INCREASING PHASE IS THE P1/2.

Λ(1405) 37 Y*0(1405, JP=1/2-) I=C

THIS RESONANCE CAN BE IDENTIFIED WITH THE VIRTUAL BOUND STATE IN THE KBAR-N SYSTEM DEDUCED FROM THE I=0 SCATTERING LENGTH DETERMINED FROM LOW ENERGY K-P INTERACTIONS. THE DIFFICULTIES IN EXTRAPOLATING FROM THE PHYSICAL REGION TO THE RESCNANCE LCCATION ARE DISCUSSED BY DALITZ 66. THE PARAMETERS ARISING FROM ZERC-EFFECTIVE-RANGE FITS ARE MCDEL DEPENDENT AND SHOULD NOT BE TAKEN AS SERIOUSLY AS THE SMALL QUOTED ERRORS SUGGEST. SEE THE NOTE IN THE MAIN TEXT CN S-WAVE BUMPS NEAR THRESHOLD.

37 Y*0(1405) MASS (MEV)

M		1405.0		ALSTON	61 HBC	K-P 1.15 BEV/C	
M		1410.0		ALEXANDER	62 HBC	PI-P 2.1 BEV/C	
M		1405.0		ALSTON	62 HBC	K-P 1.2-.5 BEV/C	
M		1400.0	24.0	MUSGRAVE	65 HBC	PBAR P 3-4 BEV/C	7/66
M	*	1382.0	8.0	ENGLER	65 HDBC	PI-P, PI+D 1.68	7/66
M		1410.7	1.0	KIM	65 HBC	0-EFF-RANGE FIT	7/66
M	N	1409.6	1.7	SAKITT	65 HBC	0-EFF-RANGE FIT	7/66
	N	DATA CF SAKITT ARE USED IN FIT BY KITTEL.					
M		1407.5	1.2	KITTEL	66 HBC	0-EFF-RANGE FIT	7/66

37 Y*0(1405) WIDTH (MEV)

W		20.0		ALSTON	61 HBC	7/66
W		35.0	5.0	ALEXANDER	62 HBC	
W		50.0		ALSTON	62 HBC	
W		60.0	20.0	MUSGRAVE	65 HBC	7/66
W	*	89.0	20.0	ENGLER	65 HDBC	7/66
W		37.0	3.2	KIM	65 HBC	7/66
W	N	28.2	4.1	SAKITT	65 HBC	7/66
	N	DATA CF SAKITT ARE USED IN FIT BY KITTEL.				
W		34.1	4.1	KITTEL	66 HBC	7/66

37 Y*0(1405) PARTIAL DECAY MODES

P1	Y*0(1405) INTO SIGMA PI	S2CS 8

REFERENCES -- Y*C(14C5)

ALSTCN 61 PRL 6 698 +ALVAREZ,EBERHARD,GOOD,GRAZIANO, + //LRL I
ALEXANDE 62 PRL 8 447 ALEXANDER,KALBFLEISCH,MILLER,SMITH //LRL I
ALSTCN 62 CERN CONF 311 +ALVAREZ,FERRO-LUZZI,ROSENFELD, + //LRL I
MUSGRAVE 65 NC 35 735 +PETMEZAS,+//BIRMGHM,CERN,EP,IMPCOL,SACLAY
ENGLER 65 PRL 15 224 +FISK,KRAEMER,MELTZER,WESTGARD,+//CRNG,BNL IJ
KIM 65 PRL 14 29 J K KIM //COLUMBIA IJP
SAKITT 65 PR 139 B719 +DAY,GLASSER,SEEMAN,FRIEDMAN, + //MD,LRL IJP
KITTEL 66 PL 21 349 W KITTEL, G OTTER, I WACEK //VIENNA IJP
DALITZ 66 PREPRINT CALITZ, WONG, RAJASEKARAN //OXFORD,BOMBAY

PAPERS NOT REFERRED TO IN DATA CARDS.

ABRAMS 65 PR 139 B454 G S ABRAMS, B SECHI-ZORN //MD IJP
KADYK 66 PRL 17 599 +UREN, G+S GOLDHABER, TRILLING //LRL IJP
DONALD 66 PL 22 711 + EDWARDS, LYS, NISAR, MOORE //LIVERPOOL
-- ABRAMS 65, KADYK 66, AND DONALD 66 SUPPORT THOSE EFFECTIVE-RANGE-FIT SOLUTICNS GIVING AN I=0 S1/2 RESONANCE.

Λ(1520) 38 Y*0(152C, JP=3/2-) I=C

38 Y*0(1520) MASS (MEV)

M		1519.4	2.0	WATSON	63 HBC	K-P ALL CHANNELS	
M	145	1517.2	3.0	GALTIERI	63 DBC	K-D 1.51 BEV/C	
M	29	1520.0	4.0	ALMEIDA	64 HBC	K-P 1.45 BEV/C	
M		1511.0	15.0	MUSGRAVE	65 HBC	PBAR P 3-4 BEV/C	7/66

38 Y*0(1520) WIDTH (MEV)

W	16.4	2.0	WATSON	63 HBC	
W	19.0	19.0	MUSGRAVE	65 HBC	7/66
W	18.0	OR LESS	HARDY	66 HBC	9/66

38 Y*0(1520) PARTIAL DECAY MODES

P1	Y*0(1520) INTO KBAR N	S11S17
P2	Y*0(1520) INTO SIGMA PI	S20S 8
P3	Y*0(1520) INTO LAMBCA PI PI	S18S 8S 6

38 Y*0(1520) PARTIAL WIDTHS (MEV)

W1	Y*0(1520) INTO KBAR N				(P1)
W1	4.8	0.5	WATSON	63 HBC	
W2	Y*0(1520) INTO SIGMA PI				(P2)
W2	9.0	1.0	WATSON	63 HBC	

38 Y*0(1520) BRANCHING RATIOS

R1	Y*0(1520) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	0.47	0.09	HESS	66 HBC	PI-P 1.6-4 BEV/C	9/66
R2	Y*0(1520) INTO (SIGMA PI)/TOTAL				(P2)/TOTAL	
R2	0.45	0.04	HARDY	66 HBC		9/66
R3	Y*0(1520) INTO (KBAR N)/(SIGMA PI)				(P1)/(P2)	
R3	0.58	0.26	MUSGRAVE	65 HBC		7/66
R4	Y*0(1520) INTO (SIGMA PI)/(LAMBDA PI PI)				(P2)/(P3)	
R4	4.5	1.0	ARMENTERO	65 HBC		7/66
R4	4.8	1.2	UHLIG	66 HBC	K-P .9-1.0 BEV/C	9/66

REFERENCES -- Y*C(1520)

WATSCN 63 PR 131 2248 M B WATSON, M FERRO-LUZZI, R D TRIPP //LRL IJP
GALTIERI 63 PL 6 296 A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP//LRL
ALMEIDA 64 PL 9 204 S P ALMEIDA, G R LYNCH //CERN
MUSGRAVE 65 NC 35 735 +PETMEZAS,+//BIRMGHM,CERN,EP,IMPCOL,SACLAY
ARMENTER 65 PL 19 338 ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY
HARDY 66 UCRL-16788 THESIS L M HARDY //LRL
HESS 66 UCRL-16832 THESIS R I HESS //LRL
UHLIG 66 PR (ACCEPTED) +CHARLTON,CONDON,GLASSER,YODH,+ //MD,LSNRL

Λ (1670)

40 Y*0(1670, JP=1/2-) I=0

SEE NOTE IN MAIN TEXT ON S-WAVE BLMPS NEAR THRESHOLD.

40 Y*0(1670) MASS (MEV)

M	1680.0		Y-CHANG	64 PBC	PI-PRP 7-8 BEV/C	7/66
M	1670.0		BERLEY	65 HBC	K-P TO LAM ETA	7/66

40 Y*0(1670) WIDTH (MEV)

W	20.0	OR LESS	Y-CHANG	64 PBC	7/66
W	18.0		BERLEY	65 HBC	7/66

40 Y*0(1670) PARTIAL DECAY MODES

P1	Y*0(1670) INTO KBAR N	S11S17
P2	Y*0(1670) INTO LAMBDA ETA	S18S14
P3	Y*0(1670) INTO SIGMA PI	S20S 8

40 Y*0(1670) BRANCHING RATIOS

R1	*	Y*0(1670) INTO ((KBAR N)(LAM ETA))/TOTAL**2			(P1*P2)/TOTAL**2	
R1	*	0.046	BERLEY	65 HBC		7/66

REFERENCES -- Y*C(1670)

Y-CHANG 64 DUBNA CCNF I 615 YUNG-CHANG, IN, KLADNITSKAYA, + //DUBNA I
BERLEY 65 PRL 15 641 +CONNOLLY,HART,RAHM,STONEHILL, + //BNL IJP

PAPER NOT REFERRED TO IN DATA CARDS.

BANNIK 66 BERKELEY CONF +BUBELEV,CHADRAA, + //DUBNA,BUCHAREST,CERN I
-- SUPPORTS RESULT OF YUNG-CHANG 64.

Λ (1700)

55 Y*0(1700, JP=3/2-) I=C

SPIN-PARITY DETERMINATION TENTATIVE.

55 Y*0(1700) MASS (MEV)

M	1705.0	10.0	ARMENTERO	66 HBC	K-P EL, CH EX	9/66
M	1698.0	5.0	DAVIES	66 CNTR	K-P, D TOTAL	11/66

55 Y*0(1700) WIDTH (MEV)

W	30.0	APPROX	ARMENTERO	66 HBC	9/66
W	40.0	10.0	DAVIES	66 CNTR	11/66

55 Y*0(1700) PARTIAL DECAY MODES

P1	Y*0(1700) INTO KBAR N	S11S17
P2	Y*0(1700) INTO SIGMA PI	S20S 8

55 Y*0(1700) BRANCHING RATIOS

R1	Y*0(1700) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	0.18	APPROX	ARMENTERO	66 HBC		9/66
R1	0.24		DAVIES	66 CNTR	ASSUMING J=3/2	11/66

REFERENCES -- Y*C(17C0)

ARMENTER 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES 66 PRL (TO BE SUBM) +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD I

Λ (1815)

39 Y*0(1815, JP=5/2+) I=C

39 Y*0(1815) MASS (MEV)

M	*		1815.0		GALTIERI	63	K-P RVUE	7/66
M			1815.0		BIRGE	65 HBC	KBAR N,LAM PI PI	7/66
M	N		1811.0	4.0	LEVI SETT	66 RVUE	SOME REAL BGD	9/66
M	N	OR	1814.0	3.0	LEVI SETT	66 RVUE	BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.					
M			1820.0	5.0	ARMENTERO	66 HBC	2-BODY CHANNELS	9/66
M			1819.0	5.0	DAVIES	66 CNTR	K-P, D TCTAL	11/66

39 Y*0(1815) WIDTH (MEV)

W	*		70.0		GALTIERI	63		
W			60.0		BIRGE	65 HBC		7/66
W	N		73.0	10.0	LEVI SETT	66 RVUE	SOME REAL BGD	9/66
W	N	CR	70.5	9.0	LEVI SETT	66 RVUE	BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.					
W			80.0	10.0	ARMENTERO	66 HBC		9/66
W			90.0	15.0	DAVIES	66 CNTR		11/66

39 Y*0(1815) PARTIAL DECAY MODES

P1	Y*0(1815) INTO KBAR N	S11S17
P2	Y*0(1815) INTO SIGMA PI	S20S 8
P3	Y*0(1815) INTO LAMBCA ETA	S18S14
P4	Y*0(1815) INTO Y*1(1385) PI	L43S 8

39 Y*0(1815) BRANCHING RATIOS

R1			Y*0(1815) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	*		0.8		GALTIERI	63	K-P RVUE	
R1	N		0.67	0.08	LEVI SETT	66 RVUE	SOME REAL BGD	9/66
R1	N	OR	0.61	0.07	LEVI SETT	66 RVUE	BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.					
R1			0.60	0.05	ARMENTERO	66 HBC		9/66
R1			0.74		DAVIES	66 CNTR		11/66
R2			Y*0(1815) INTO (SIGMA PI)/TOTAL				(P2)/TOTAL	
R2			0.12	0.02	ARMENTERO	66 HBC		9/66
R3			Y*0(1815) INTO (LAMBCA ETA)/TOTAL				(P3)/TOTAL	
R3			0.01		ARMENTERO	66 HBC		9/66
R4			Y*0(1815) INTO (Y*1(1385) PI)/TOTAL				(P4)/TOTAL	
R4			0.20	0.05	BIRGE	65 HBC		7/66
R4			0.19	0.04	BARLOUTAU	66 HBC	ASSUMING R1=0.60	9/66

REFERENCES -- Y*C(1815)

GALTIERI 63 PL 6 296 A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP//LRL IJ
BIRGE 65 ATHENS CONF 296 +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA,+ //LRL IJP
LEVI SET 66 BERKELEY CONF R LEVI SETTI, E PREDAZZI //CHI
ARMENTER 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
BARLOUTA 66 BERKELEY CONF BARLOUTAUD,GRANET, + //SACLAY,HEIDEL,CERN IJP
DAVIES 66 PRL (TO BE SUBM) +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD I

PAPERS NOT REFERRED TO IN DATA CARDS.

CHAMBERL 62 PR 125 1696 CHAMBERLAIN,CROWE,KEEFE,KERTH, + //LRL I
-- FIRST SEEN IN CHAMBERLAIN 62 TOTAL CROSS SECTICN MEASUREMENTS.
SODICKSO 64 PR 133 B757 SODICKSON,MANNELLI,FRISCH,WAHLIG//MIT(BNL) J
HOLLEY 65 UCRL-16274 THESIS W R HOLLEY //LRL J
-- SCDICKSCN 64 AND HOLLEY 65 ELASTIC SCATTERING WORK INDICATED J=5/2.
GELFAND 66 BERKELEY CONF +HARMSEN,LEVI SETTI,RAYMUND, + //CHI,ARG
-- ELASTIC SCATTERING DATA FIT BY LEVI SETTI 66.

Λ (2100)

41 Y*0(2100, JP=7/2-) I=C

41 Y*0(2100) MASS (MEV)

M	*	2097.0	6.0		BOCK	65 HBC	PBAR P 5.7 BEV/C	7/66
M		2100.0	20.0		COOL	66 CNTR	K-P, D TOTAL	7/66
M	*	2120.0			WOHL	66 HBC	K-P CH EX	7/66

41 Y*0(2100) WIDTH (MEV)

W	*	24.0	14.0	24.0	BOCK	65 HBC	INTO KBAR N (PI)	7/66
W		160.0			COOL	66 CNTR		7/66
W		145.0			WOHL	66 HBC		7/66

41 Y*0(2100) PARTIAL DECAY MODES

P1	Y*0(2100) INTO KBAR N	S11S17
P2	Y*0(2100) INTO SIGMA PI	S20S 8
P3	Y*0(2100) INTO LAMBCA OMEGA	S18S 1
P4	Y*0(2100) INTO KBAR N PI	S11S17S 8

41 Y*0(2100) BRANCHING RATIOS

R1	Y*0(2100) INTO (KBAR N)/TOTAL				(P1)/TOTAL	
R1	0.29		COOL	66 CNTR		7/66
R1	0.25		WOHL	66 HBC		7/66
R2	Y*0(2100) INTO (LAMBCA OMEGA)/TOTAL				(P3)/TOTAL	
R2	0.1	OR LESS	FLATTE	66 HBC		9/66
R3	Y*0(2100) INTO (KBAR N PI)/TOTAL				(P4)/TOTAL	
R3	SEEN		BOCK	65 HBC		9/66

REFERENCES -- Y*C(21CC)

BOCK 65 PL 17 166 +COOPER,FRENCH,KINSON, + //CERN,SACLAY
COOL 66 PRL 16 1228 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I
WOHL 66 PRL 17 107 C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP
FLATTE 66 PRIVATE COMM S M FLATTE //LRL

Λ (2340)

42 Y*0(2340, JP=) I=C

42 Y*0(2340) MASS (MEV)

M	2340.0	20.0	COOL	66 CNTR	K-P, D TCTAL	7/66

42 Y*0(2340) WIDTH (MEV)

W	105.0	COOL	66 CNTR	7/66

42 Y*0(2340) PARTIAL DECAY MODES

P1	Y*0(2340) INTO KBAR N	S11S17

42 Y*0(2340) BRANCHING RATIOS

R1	Y*0(2340) INTO (KBAR N)/TOTAL			(P1)/TOTAL	
R1	0.102	COOL	66 CNTR	ASSUMING J=9/2	7/66

REFERENCES -- Y*C(234C)

COOL 66 PRL 16 1228 +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL I

Σ (1385)

43 Y*1(1385, JP=3/2+) I=1

FOR THE TABLES WE USE ONLY THE UNSTARRED DATA, WHICH ARE ATTEMPTS TO OBTAIN THE SEPARATE CHARGE-STATE MASSES AND WIDTHS. SEE HOWEVER THE IDEOGRAMS INSERTED IN LISTINGS. THESE INDICATE SERIOUS SYSTEMATICS, PERHAPS ARISING FROM INTERFERENCE EFFECTS THAT CHANGE WITH PRODUCTION MECHANISM AND BEAM MOMENTUM.

43 Y*1(1385) MASS (MEV)

M	*	141	1384.0		ALSTON	60 HBC	+-	K-P 1.15 BEV/C	
M	*	38	1384.0		MARTIN	61 HBC	C+	K20 P .98 BEV/C	
M	*		1385.0		BERGE	61 HBC	+-	K-P .4-.85 BEV/C	
M	*		1392.0	7.0	COLLEY	62 PBC	C-	PI- PRP 2. BEV/C	
MO	*	106	1381.0	4.0	CURTIS	63 SPRK	C	PI-P 1.5 BEV/C	
M	*		1392.0	10.0	MUSGRAVE	65 HBC	+-0	PBAR P 3-4 BEV/C	7/66
M	*		1389.0	3.0	BALTAY	65 HBC	+-	PBAR P 3.7 BEV/C	7/66
M+		154	1376.0	3.0	ELY	61 PBC	+	K-P 1.11 BEV/C	
M+		170	1375.0	3.9	COOPER	64 HBC	+	K-P 1.45 BEV/C	
M+		859	1381.0	1.6	HUWE	66 HBC	+	K-P 1.22 BEV/C	
M+			1382.0	1.0	ARMENTERO	65 HBC	+	K-P .9-1.2 BEV/C	
M+			1378.0	5.0	LONDON	66 HBC	+	K-P 2.24 BEV/C	7/66
M+			1384.3	1.1	COLTON	66 HBC	+	K-P 1.8 BEV/C	9/66
M+			1382.6	1.4	COLTON	66 HBC	+	K-P 1.95 BEV/C	9/66
M-		93	1382.0	3.0	DAHL	61 DBC	-	K-D 0.45 BEV/C	
M-		224	1376.0	3.0	ELY	61 PBC	-		
M-		200	1392.0	6.2	COOPER	64 HBC	-		
M-		1086	1385.3	1.5	HUWE	64 HBC	-		
M-			1384.0	1.0	ARMENTERO	65 HBC	-		
M-			1389.0	9.0	LONDON	66 HBC	-		7/66
M-			1391.5	1.8	COLTON	66 HBC	-	K-P 1.8 BEV/C	9/66
M-			1399.8	1.4	COLTON	66 HBC	-	K-P 1.95 BEV/C	9/66

(Ideograms on next page)

43 Y*(-) - Y*(+) MASS DIFFERENCE (MEV)

D	R	0.0	4.2	ELY	61 PBC	+-	K-P 1.11 BEV/C	8/66
D	R	4.3	2.2	HUWE	64 HBC	+-	K-P 1.22 BEV/C	8/66
D	R	2.0	1.5	ARMENTERU	65 HBC	+-	K-P .9-1.2 BEV/C	8/66
D	R	11.0	9.0	LONDON	66 HBC	+-	K-P 2.24 BEV/C	8/66
D	R	7.2	2.1	COLTON	66 HBC	+-	K-P 1.8 BEV/C	9/66
D	R	17.2	2.0	COLTON	66 HBC	+-	K-P 1.95 BEV/C	9/66
	R	REDUNDANT WITH DATA IN MASS LISTING.						
D		9.0	6.0	LONDON	66 HBC	+-	LAMBDA 3 PI EVTS	7/66

---------------- 43 Y*1(1385) WIDTH (MEV) ----------------

W	*	64.0		ALSTON	60	HBC	+-		
W	*	20.0	OR LESS	MARTIN	61	HBC	C+		
W	*	40.0		BERGE	61	HBC	+-		
W	*	80.0	10.0	COLLEY	62	PBC	C-		
W	*	30.0	9.0	CURTIS	63	SPRK	C		
W	*	38.0	9.0	MUSGRAVE	65	HBC	+-C		7/66
W	*	26.0	5.0	BALTAY	65	HBC	+-		7/66
W+		48.0	8.0	ELY	61	PBC	+		
W+		51.0	10.0	COOPER	64	HBC	+		
W+		46.5	3.0	HUWE	64	HBC	+		
W+		32.0	3.0	ARMENTERO	65	HBC	+		
W+		30.3	3.1	COLTON	66	HBC	+	K-P 1.8 BEV/C	9/66
W+		33.1	3.8	COLTON	66	HBC	+	K-P 1.95 BEV/C	9/66
W		40.0		DAHL	61	DBC	-		
W-		66.0	10.0	ELY	61	PBC	-		
W-		88.0	10.0	COOPER	64	HBC	-		
W-		62.0	7.0	HUWE	64	HBC	-		
W-		38.0	3.0	ARMENTERO	65	HBC	-		
W-		29.2	5.7	COLTON	66	HBC	-	K-P 1.80 BEV/C	9/66
W-		17.1	4.4	COLTON	66	HBC	-	K-P 1.95 BEV/C	9/66

(Ideograms below)

---------------- 43 Y*1(1385) PARTIAL DECAY MODES ----------------

P1	Y*1(1385) INTO LAMBDA PI	S18S 8
P2	Y*1(1385) INTO SIGMA PI	S20S 8

---------------- 43 Y*1(1385) BRANCHING RATIOS ----------------

R1 Y*1(1385) INTO (SIGMA PI)/(LAMBDA PI) (P2)/(P1)

R1	0.04	0.04	BASTIEN	61	HBC	+-	
R1	0.04	OR LESS	ALSTON	62	HBC	+-0	
R1	0.09	0.04	HUWE	64	HBC	+-	
R1	0.163	0.035	ARMENTERO	65	HBC	+-	7/66
R1	0.08	0.06	LONDON	66	HBC	+	7/66

(Ideogram below)

****** ********* ********* ********* ********* ********* ********* *********

REFERENCES -- Y*1(1385)

ALSTCN	60 PRL 5 520	+ALVAREZ,EBERHARD,GOOD,GRAZIANO, + //LRL	I
DAHL	61 PRL 6 142	+HORWITZ,MILLER,MURRAY,WHITE //LRL	
MARTIN	61 PRL 6 283	+LEIPUNER,CHINOWSKY,SHIVELY, + //BNL,YALE	
BERGE	61 PRL 6 557	+BASTIEN,DAHL,FERRO-LUZZI,KIRZ, + //LRL	
BASTIEN	61 PRL 6 702	P BASTIEN,M FERRO-LUZZI,A H ROSENFELD//LRL	
ELY	61 PRL 7 461	+FUNG,GIDAL,PAN,POWELL,WHITE //LRL	J
ALSTON	62 CERN CONF 311	+ALVAREZ,FERRO-LUZZI,ROSENFELD, + //LRL	
COLLEY	62 PR 128 1930	+GELFAND,NAUENBERG, + //COLUMBIA,RUTGERS	JP
CURTIS	63 PR 132 1771	+COFFIN,MEYER,TERWILLIGER //MICH	J
COOPER	64 PL 8 365	+FILTHUTH,FRIDMAN,MALAMUD, + //CERN,AMSTR	
HUWE	64 UCRL-11291 THESIS	D O HUWE //LRL	JP
MUSGRAVE	65 NC 35 735	+PETMEZAS,+//BIRMGHM,CERN,EP,IMPCOL,SACLAY	
ARMENTER	65 PL 19 75	ARMENTEROS, + //CERN,HEIDEL,SACLAY	
BALTAY	65 PR 140 B1027	+SANDWEISS,TAFT,CULWICK,KOPP, + //YALE,BNL	
LONDCN	66 PR 143 1034	+RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR	J
COLTCN	66 H E P MEMC 27	+TICHO,DAUBER,SCHLEIN,SLATER,SMITH,+//UCLA	

QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

SHAFER	64 PR 134 B1372	J B SHAFER, D O HUWE //LRL	JP
MALAMUD	64 PL 10 145	E MALAMUD, P E SCHLEIN //CERN,UCLA	JP

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********

Σ (1660)

44 Y*1(1660, JP=3/2-) I=1

THE Y*1(1660) IS DIFFICULT TO STUDY IN FORMATION EXPERIMENTS BECAUSE (1) IT COUPLES ONLY SLIGHTLY TO THE KBAR N CHANNEL, AND (2) THERE ARE NEIGHBORING RESONANCES, THE Y*0(1670) AND Y*0(1700) AND PERHAPS OTHERS YET UNDETECTED, TO COMPLICATE THE ANALYSIS. THE LAMBDA PI CHANNEL HAS INDICATED THE PROBABLE JP=3/2- ASSIGNMENT. THERE IS NOT MUCH AGREEMENT BETWEEN FORMATION AND PRODUCTION EXPERIMENTS ON BRANCHING RATIOS.

THERE IS ALSO DISAGREEMENT AMONG EXPERIMENTS PRODUCING CHARGED Y*1(1660) AT DIFFERENT ENERGIES. THUS EVEN WHEN THE I=1 STATE IS LOOKED AT ALONE THERE ARE PROBLEMS. HOWEVER, EXCEPT FOR LEVEQUE 65 THE EXPERIMENTS DO AGREE THAT THE MOST PROBABLE JP ASSIGNMENT IS 3/2-.

---------------- 44 Y*1(1660) MASS (MEV) ----------------

M	1685.0		ALEXANDER	62	HBC	C-	PI-P 2-2.2 BEV/C	
M	1660.0	10.0	ALVAREZ	63	HBC	+	K-P 1.51 BEV/C	
M	1660.0		BERLEY	64	HBC	0	K-P TO LAM PI0	7/66
M	1645.0	7.0	LEVEQUE	65	HBC	+	K-P TO Y*1660 PI	7/66
M	1662.0	5.0	DAVIES	66	CNTR		K-P, D TOTAL	11/66

---------------- 44 Y*1(1660) WIDTH (MEV) ----------------

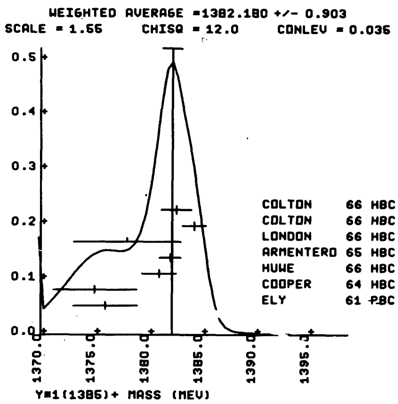
W	45.0		ALEXANDER	62	HBC	C-	
W	40.0	10.0	ALVAREZ	63	HBC	+	
W	60.0		BERLEY	64	HBC	C	7/66
W	55.0	10.0	LEVEQUE	65	HBC	+	7/66
W	45.0	15.0	DAVIES	66	CNTR		11/66

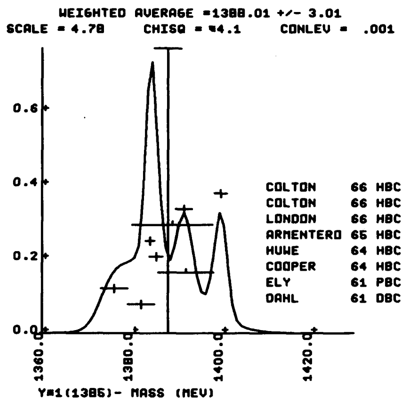
---------------- 44 Y*1(1660) PARTIAL DECAY MODES ----------------

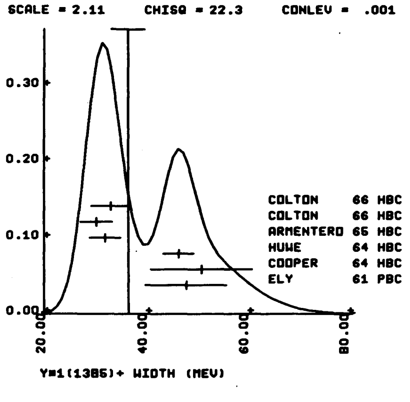
P1	Y*1(1660) INTO KBAR N	S11S1/
P2	Y*1(1660) INTO LAMBDA PI	S18S 8
P3	Y*1(1660) INTO SIGMA PI	S20S 8
P4	Y*1(1660) INTO LAMBDA PI PI	S18S 8S 8
P5	Y*1(1660) INTO SIGMA PI PI	S20S 8S 8
P6	Y*1(1660) INTO Y*1(1385) PI	U43S 8
P7	Y*1(1660) INTO Y*0(1405) PI	U37S 8

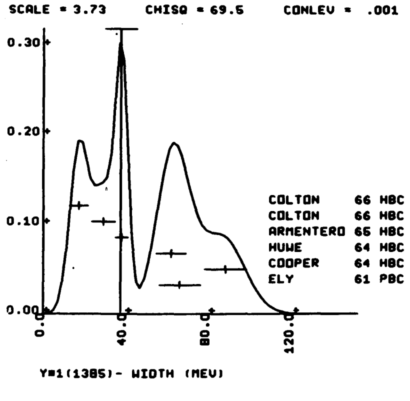
---------------- 44 Y*1(1660) BRANCHING RATIOS ----------------

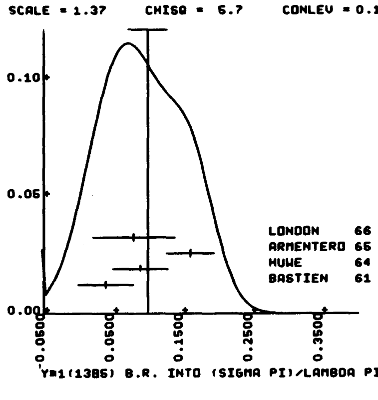
R1		Y*1(1660) INTO (KBAR N)/TOTAL						(P1)/TOTAL	
R1		0.05	OR LESS	ALVAREZ	63	HBC	+		
R1	*	0.16	OR MORE	BASTIEN 2	63	HBC	C		
R1		0.2	OR LESS	LONDON	66	HBC	+		7/66
R1		0.065		DAVIES	66	CNTR		ASSUMING J=3/2	11/66
R2		Y*1(1660) INTO (LAMBDA PI)/TOTAL						(P2)/TOTAL	
R2		0.32		ALVAREZ	63	HBC	+		
R2		0.09	OR LESS	BASTIEN 2	63	HBC	C		
R2		0.2	OR LESS	LONDON	66	HBC	+		7/66
R2		0.06	0.06	SMART	66	DBC	-	ASSUMING R1=0.15	7/66
R2		0.45		ARMENTERO	66	HBC	0	ASSUMING R1=0.15	9/66
R3		Y*1(1660) INTO (SIGMA PI)/TOTAL						(P3)/TOTAL	
R3		0.27		ALVAREZ	63	HBC	+		
R3	*	0.22	0.06	BASTIEN 2	63	HBC	C		
R3		0.25	0.15	LONDON	66	HBC	+		7/66
R3		0.15		ARMENTERO	66	HBC	C	ASSUMING R1=0.15	9/66
R4		Y*1(1660) INTO (LAMBDA PI PI)/TOTAL						(P4)/TOTAL	
R4		0.18		ALVAREZ	63	HBC	+		
R4	*	0.16	0.05	BASTIEN 2	63	HBC	C		
R4		0.2	OR LESS	LONDON	66	HBC	+		7/66











R5		Y*1(1660) INTO (SIGMA PI PI)/TOTAL						(P5)/TOTAL	
R5		0.18			ALVAREZ	63 HBC	+		
R5	*	0.25	0.06		BASTIEN 2	63 HBC	0		
R6		Y*1(1660) INTO (Y*0(1405) PI)/TOTAL						(P7)/TOTAL	
R6		0.75	0.25		LONDON	66 HBC	+		7/66
R7		Y*1(1660) INTO (KBAR N)/(LAMBDA PI)						(P1)/(P2)	
R7		0.43	OR MORE		SMITH	63 HBC	C-		
R8		Y*1(1660) INTO (SIGMA PI)/(LAMBDA PI)						(P3)/(P2)	
R8		0.86			SMITH	63 HBC	C-		
R8		6.8	3.0		HUWE	64 HBC	+		
R9		Y*1(1660) INTO (LAMBCA PI PI)/(LAMBDA PI)						(P4)/(P2)	
R9		0.14			SMITH	63 HBC	C-		
R10		Y*1(1660) INTO (Y*0(1405) PI)/(SIGMA PI PI)						(P7)/(P5)	
R10		0.90	0.10	0.16	EBERHARD	65	+		7/66
R11		Y*1(1660) INTO (Y*0(1405) PI)/(Y*1(1385) PI)						(P7)/(P6)	
R11		0.8	OR MORE		EBERHARD	65	+		7/66

****** ********* ********* ********* ********* ********* ********* *********

REFERENCES -- Y*1(1660)

ALEXANDE 62 CERN CONF 320 ALEXANDER,JACOBS,KALBFLEISCH,MILLER,+//LRL I

ALVAREZ 63 PRL 10 184 +ALSTON,FERRO-LUZZI,HUWE, + //LRL I

BASTIEN2 63 UCRL-10779 THESIS P L BASTIEN //LRL IJ

SMITH 63 ATHENS CCNF 67 G A SMITH //LRL

HUWE 64 UCRL-11291 THESIS C O HUWE //LRL

BERLEY 64 DUBNA CONF I 565 +CONNULLY,HART,RAHM,STONEHILL, + //BNL IJP

EBERHARD 65 PRL 14 466 +SHIVELY,ROSS,SIEGAL,FICENEC, + //LRL,ILL I

LEVEQUE 65 PL 18 69 + //SACLAY,EP,GLASGOW,IMPCOL,OXF,RTHFD JP

LONDCN 66 PR 143 1034 +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR IJ

SMART 66 PRL 17 556 W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP

ARMENTER 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP

DAVIES 66 PRL (TO BE SUBM) +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD I

PAPERS NOT REFERRED TO IN DATA CARDS.

BASTIEN1 63 PRL 10 188 P L BASTIEN, J P BERGE //LRL IJ
-- REPLACEC BY BASTIEN 2, BUT SIMILAR AND MORE READILY AVAILABLE.

T-ZADEH 63 PRL 11 470 TAHER-ZADEH,PROWSE,SCHLEIN,SLATER,+ //UCLA JP
-- SEE NOTE FOLLOWING SCHLEIN 66.

EBERHARD 65 BAPS 10 478 P EBERHARD //LRL IJP

SLATER 65 BAPS 10 1196 +CAUBER, SCHLEIN, STORK, TICHO //UCLA JP

LEE 66 PRL 17 45 Y Y LEE, D D REEDER, R W HARTUNG //WISC JP

SCHLEIN 66 UCLA-1016 P E SCHLEIN, T G TRIPPE //UCLA JP
-- REANALYZES CATA OF TAHER-ZADEH 63 AND BASTIEN 63 AND ALL PUBLISHED LAMBDA PI CROSS SECTION DATA IN THE LIGHT OF THE NOW KNOWN Y*1(1765) AND REVERSES THE MODEL-DEPENDENT CONCLUSION OF TAHER-ZADEH ON THE PREFERREC JP ASSIGNMENT (FROM 3/2+ TO 3/2-).

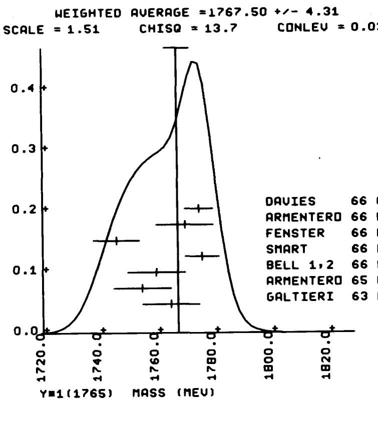
****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********

Σ (1765) 45 Y*1(1765, JP=5/2-) I=1

45 Y*1(1765) MASS (MEV) -----------------------------

M			1765.0	10.0	GALTIERI	63 DBC	C	K-D 1.51 BEV/C	
M			1755.0	10.0	ARMENTERC	65 HBC	C	K-P TO Y*1520 PI	7/66
M			1760.0	10.0	BELL 1,2	66 DBC	-	K-N TO Y*1520 PI	7/66
M			1776.0	6.0	SMART	66 DBC	-	K-N TO LAM PI-	7/66
M			1746.0	8.0	FENSTER	66 HBC	C	K-P TO Y*1520 PI	9/66
M	N		1758.0	11.0	LEVI SETT	66 RVUE		SOME REAL BGD	9/66
M	N	CR	1770.0	11.0	LEVI SETT	66 RVUE		BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.						
M			1770.0	10.0	ARMENTERO	66 HBC	C	2-BODY CHANNELS	9/66
M			1775.0	5.0	DAVIES	66 CNTR		K-P, D TCTAL	11/66

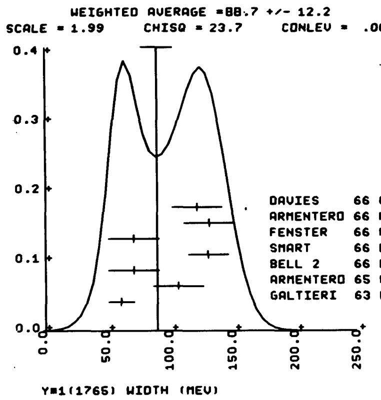
(Ideogram below)



----------------- 45 Y*1(1765) WIDTH (MEV) -----------------------------

W			60.0	10.0	GALTIERI	63 DBC	C		
W			105.0	20.0	ARMENTERO	65 HBC	C		7/66
W			70.0	20.0	BELL 2	66 DBC	-		7/66
W			129.0	16.0	SMART	66 DBC	-		7/66
W			70.0	20.0	FENSTER	66 HBC	C		9/66
W	N		113.0	25.0	LEVI SETT	66 RVUE		SOME REAL BGD	9/66
W	N	OR	158.0	38.0	LEVI SETT	66 RVUE		BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.						
W			130.0	20.0	ARMENTERO	66 HBC	C		9/66
W			120.0	20.0	CAVIES	66 CNTR			11/66

(Ideogram below)



----------------- 45 Y*1(1765) PARTIAL DECAY MODES ---------------------

P1	Y*1(1765) INTO KBAR N	S11S17
P2	Y*1(1765) INTO LAMBCA PI	S18S 9
P3	Y*1(1765) INTO SIGMA PI	S20S 8
P4	Y*1(1765) INTO SIGMA ETA	S21S14
P5	Y*1(1765) INTO Y*1(1385) PI	L43S 8
P6	Y*1(1765) INTO Y*0(1520) PI	L38S 8

----------------- 45 Y*1(1765) BRANCHING RATIOS ----------------------

R1			Y*1(1765) INTO (KBAR N)/TOTAL					(P1)/TOTAL	
R1	*		0.6		GALTIERI	63 HBC	C	K-P RVUE	
R1			0.53	0.09	UHLIG	66 HBC	C		9/66
R1	N		0.46	0.05	LEVI SETT	66 RVUE		SOME REAL BGD	9/66
R1	N	OR	0.46	0.04	LEVI SETT	66 RVUE		BGD PURE IMAG	9/66
	N		RES + CIFFRACTIVE BGC FOR K-P EL. DATA ARE IN ARMENT 66 FITS TCC.						
R1			0.45	0.05	ARMENTERO	66 HBC	C		9/66
R1			0.43		DAVIES	66 CNTR			11/66
R2			Y*1(1765) INTO (LAMBCA PI)/TOTAL					(P2)/TOTAL	
R2			0.14	0.02	SMART	66 DBC	-	ASSUMING R1=0.5	7/66
R2			0.17	0.02	UHLIG	66 HBC	C		9/66
R2			0.20	0.05	ARMENTERO	66 HBC	C	ASSUMING R1=0.44	9/66
R3			Y*1(1765) INTO (SIGMA PI)/TOTAL					(P3)/TOTAL	
R3			0.01	0.01	UHLIG	66 HBC	C		9/66
R3			0.01	OR LESS	ARMENTERO	66 HBC	C		9/66
R4			Y*1(1765) INTO (SIGMA ETA)/TOTAL					(P4)/TOTAL	
R4			0.02	APPROX	ARMENTERO	66 HDBC	C-		9/66
R5			Y*1(1765) INTO (Y*1(1385) PI)/TOTAL					(P5)/TOTAL	
R5			0.14	0.05	UHLIG	66 HBC	C		9/66
R5			0.12	0.02	BARLOUTAU	66 HBC	C	ASSUMING R1=0.44	9/66
R6			Y*1(1765) INTO (Y*1(1520) PI)/TOTAL					(P6)/TOTAL	
R6			0.15	0.03	ARMENTERO	65 HBC	C	R1=0.5, HYPERONS	7/66
R6			0.24	0.06	FENSTER	66 HBC	0	R1=0.5, KBAR N	9/66
R6			0.15	0.02	UHLIG	66 HBC	C		9/66

****** ********* ********* ********* ********* ********* ********* *********

REFERENCES -- Y*1(1765)

GALTIERI 63 PL 6 296 A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP//LRL IJ

ARMENTER 65 PL 19 338 ARMENTEROS, + //CERN,HEIDELBERG,SACLAY IJP

BELL 1 66 PRL 16 203 R B BELL, R W BIRGE, Y-L PAN, R T PU //LRL IJP

BELL 2 66 UCRL-16936 THESIS R B BELL //LRL IJP

SMART 66 PRL 17 556 W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP

FENSTER 66 PRL 17 841 +GELFAND,HARMSEN,L-SETTI,+ //CHI,ARG(CERN) IJP

UHLIG 66 PR (ACCEPTED) +CHARLTON,CONDON,GLASSER,YODH,+ //MD,LSNRL IJ

LEVI SET 66 BERKELEY CONF R LEVI SETTI, E PREDAZZI //CHI

ARMENTER 66 BERKELEY CONF ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP

BARLOUTA 66 BERKELEY CONF BARLOUTAUD,GRANET, + //SACLAY,HEIDEL,CERN IJP

DAVIES 66 PRL (TO BE SUBM) +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD I

PAPERS NOT REFERRED TO IN DATA CARDS.

YODH 65 ATHENS CCNF 269. G B YODH //MARYLAND IJ

BIRGE 65 ATHENS CONF 296 +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA, + //LRL IJP
-- YODH 65 AND BIRGE 65 ARE PRECURSORS OF UHLIG 66 AND BELL 66.

GELFAND 66 BERKELEY CONF +HARMSEN,LEVI SETTI,RAYMUND, + //CHI,ARG
-- ELASTIC SCATTERING CATA FIT BY LEVI SETTI 66.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********

Σ (1780) 57 Y*1(178C, JP=) I=1

SIGMA ETA THRESHOLD EFFECT. INTERPRETATION AS RESONANCE NOT CONCLUSIVE. SEE FERRO-LUZZI 66. OMITTED FROM TABLE

----------------- 57 Y*1(1780) MASS (MEV) -----------------------------

M	1780.0	CLINE	66 DBC	-	K-N TO SIG- ETA	9/66

----------------- 57 Y*1(1780) WIDTH (MEV) ----------------------------

W	100.0	CLINE	66 DBC	-		9/66

----------------- 57 Y*1(1780) PARTIAL DECAY MODES --------------------

P1	Y*1(1780) INTO KBAR N	S11S17
P2	Y*1(1780) INTO SIGMA ETA	S20S14

****** ********* ********* ********* ********* ********* ********* *********

REFERENCES -- Y*1(178C)

CLINE 66 BERKELEY CONF D CLINE, M OLSSON //WISC(LRL) I

F-LUZZI 66 BERKELEY CONF M FERRO-LUZZI //CERN

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********

Σ (1915)

```
46  Y*1(1915, JP=5/2+) I=1

    PERHAPS SOME SLIGHT RESERVATION SHOULD BE HELD AGAINST
    COMPLETE ACCEPTANCE OF THE INTERPRETATION OF THIS EFFECT
    AS (1) BEING A RESONANCE (2) HAVING JP = 5/2+.

----------------- 46  Y*1(1915) MASS (MEV)  ------------------------------

M    *     1942.0      9.0              BOCK      65 HBC     PBAR P 5.7 BEV/C
M          1915.0     20.0              COOL      66 CNTR 0- K-P, D TOTAL      7/66
M          1905.0      5.0              DAVIES    66 CNTR    K-P, D TOTAL     11/66

----------------- 46  Y*1(1915) WIDTH (MEV)  ----------------------------

W    *       36.0     20.0      36.0    BOCK      65 HBC
W            65.0                       COOL      66 CNTR 0-                   7/66
W            60.0     20.0              DAVIES    66 CNTR                     11/66

----------------- 46  Y*1(1915) PARTIAL DECAY MODES  --------------------

P1         Y*1(1915) INTO KBAR N                         S11S17
P2         Y*1(1915) INTO LAMBCA PI                      S18S 8
P3         Y*1(1915) INTO SIGMA PI                       S20S 8

----------------- 46  Y*1(1915) BRANCHING RATIOS  -----------------------

R1         Y*1(1915) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1            0.103                     COOL      66 CNTR    ASSUMING J=5/2    7/66
R1            0.06     0.02             ARMENTERO 66 HBC  C  K-P EL, CH EX     9/66
R1            0.1                       DAVIES    66 CNTR    ASSUMING J=5/2   11/66

R2         Y*1(1915) INTO (LAMBCA PI)/TOTAL              (P2)/TOTAL
R2            0.12     0.08             SMART     66 DBC  -  ASSUMING R1=0.10  7/66
R2            0.10                      ARMENTERO 66 HBC  C  ASSUMING R1=0.06  9/66

R3         Y*1(1915) INTO (SIGMA PI)/TOTAL               (P3)/TOTAL
R3            0.03     0.02             ARMENTERO 66 HBC  C  ASSUMING R1=0.06  9/66

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- Y*1(1915)

BOCK     65 PL 17 166          +COOPER,FRENCH,KINSON, +     //CERN,SACLAY  I
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMLS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF      ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)   +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Σ (2035)

```
47  Y*1(2035, JP=7/2+) I=1

                   47  Y*1(2035) MASS (MEV)  ------------------------------

M    *     2022.0     20.0              BLANPIED  65 CNTR C  GAMMA P TO K+ Y*
M          2040.0     20.0              COOL      66 CNTR C- K-P, D TOTAL      7/66
M          2030.0     20.0              WOHL      66 HBC  C  K-P TO LAM PIO    7/66

----------------- 47  Y*1(2035) WIDTH (MEV)  -----------------------------

W    *      120.0     20.0              BLANPIED  65 CNTR C
W           150.0                       COOL      66 CNTR C                    7/66
W           170.0                       WOHL      66 HBC  C                    7/66

----------------- 47  Y*1(2035) PARTIAL DECAY MODES  ---------------------

P1         Y*1(2035) INTO KBAR N                         S11S17
P2         Y*1(2035) INTO LAMBCA PI                      S18S 9
P3         Y*1(2035) INTO SIGMA PI                       S20S 8

----------------- 47  Y*1(2035) BRANCHING RATIOS  ------------------------

R1         Y*1(2035) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1            0.155                     COOL      66 CNTR C  K-P TOTAL         7/66
R1            0.25                      WOHL      66 HBC  0  K-P CH EX         7/66

R2         Y*1(2035) INTO (LAMBCA PI)/TOTAL              (P2)/TOTAL
R2            0.16                      WOHL      66 HBC  C  ASSUMING R1=0.25  7/66

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- Y*1(2035)

BLANPIED 65 PRL 14 741         +GREENBERG,HUGHES,KITCHING,LU,+//YALE(CEA)
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
WOHL     66 PRL 17 107         C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP

                 PAPERS NOT REFERRED TO IN DATA CARDS.

SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF      ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
     --  SMART 66 AND ARMENTEROS 66 TEND TO CONFIRM THE JP ASSIGNMENT.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Σ (2260)

```
48  Y*1(2260, JP=     ) I=1

    EVIDENCE NOT COMPLETELY CONCLUSIVE.  THE BUMP IS SMALL
    ANC SENSITIVE TO DETAILS OF THE UNFOLDING OF THE EFFECTS
    OF INTERNAL MOMENTA OF THE NUCLEONS IN THE DEUTERON.

----------------- 48  Y*1(2260) MASS (MEV)  ------------------------------

M    *     2245.0                       BLANPIED  65 CNTR    GAMMA P TO K+ Y*
M    *     2299.0      6.0              BOCK      65 HBC     PBAR P 5.7 BEV/C
M          2260.0     20.0              COOL      66 CNTR    K-P, D TOTAL      7/66

----------------- 48  Y*1(2260) WIDTH (MEV)  -----------------------------

W    *      150.0                       BLANPIED  65 CNTR
W    *       21.0     17.0      21.0    BOCK      65 HBC
W           180.0                       COOL      66 CNTR                      7/66

----------------- 48  Y*1(2260) PARTIAL DECAY MODES  ---------------------

P1         Y*1(2260) INTO KBAR N                         S11S17
P2         Y*1(2260) INTO KBAR N PI                      S11S17S 8

----------------- 48  Y*1(2260) BRANCHING RATIOS  ------------------------

R1         Y*1(2260) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1            0.14                      COOL      66 CNTR    ASSUMING J=9/2    7/66

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- Y*1(2260)

BLANPIED 65 PRL 14 741         +GREENBERG,HUGHES,KITCHING, +  //YALE(CEA)
BOCK     65 PL 17 166          +COOPER,FRENCH,KINSON, +     //CERN,SACLAY
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I

                 PAPER NOT REFERRED TO IN DATA CARDS.

DAUBER   66 PL 23 154          +SCHLEIN, SLATER, STORK, TICHO //UCLA(LRL)  J
     --  SUGGESTS J=9/2 RESONANT BEHAVIOR IN SIGMA- PI+, BUT APPEARS
         INCONSISTENT WITH COOL 66 PARAMETERS.

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Σ (3000)

```
59  Y*1(3000, JP=     ) I=1

    ENHANCEMENT IN LAMBDA PI AND KBAR N INVARIANT MASS
    SPECTRA ANC IN MISSING MASS OF NEUTRALS RECOILING
    AGAINST KO.  EVIDENCE NOT CONCLUSIVE.  OMITTED FROM
    TABLE.

----------------- 59  Y*1(3000) MASS (MEV)  ------------------------------

M          3000.0                       EHRLICH   66 HBC  C  PI-P 7.91 BEV/C   9/66

----------------- 59  Y*1(3000) PARTIAL DECAY MODES  ---------------------

P1         Y*1(3000) INTO KBAR N                         S11S17
P2         Y*1(3000) INTO LAMBCA PI                      S18S 8

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- Y*1(30C0)

EHRLICH  66 PR (SUBMITTED)     R EHRLICH, W SELOVE, H YUTA     //PENN(BNL)  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Ξ (1530)

```
49  XI*1/2(1530, JP=3/2+) I=1/2

                   49  XI*1/2(1530) MASS (MEV)  ---------------------------

M    *     1529.0      5.0              PJERROU   62 HBC  C- K-P 1.8 BEV/C
M    *     1532.0      2.0              BADIER    64 HBC  C- K-P 3 BEV/C
M-         1535.7      3.2              LONDON    66 HBC  -  K-P 2.24 BEV/C    7/66
MO         1528.7      1.1              LONDON    66 HBC  C                    7/66

----------------- 49  XI*(-)-XI*(0) MASS DIFFERENCE (MEV)  ---------------

D             5.7      3.0              PJERROU   65 HBC  0- K-P 1.8-1.95 B/C  7/66
D    R        7.0      4.0              LONDON    66 HBC  0                    7/66
     R     REDUNDANT WITH DATA IN MASS LISTING.
D             2.0      3.2              MERRILL   66 HBC  C- K-P 1.7-2.7 BE/C  7/66

----------------- 49  XI*1/2(1530) WIDTH (MEV)  --------------------------

W             7.0      2.0              SCHLEIN   63 HBC  C  K-P 1.8-1.95 B/C
W             8.5      3.5              LONDON    66 HBC  C                    7/66
W             7.0      7.0              BERGE     66 HBC  C  K-P 1.5-1.7 BE/C  7/66

----------------- 49  XI*1/2(1530) PARTIAL DECAY MODES  ------------------

P1         XI*1/2(1530) INTO XI PI                       S22S 8

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- XI*1/2(153C)

PJERROU  62 PRL 9 114          +PROWSE,SCHLEIN,SLATER,STORK,TICHO  //UCLA  I
SCHLEIN  63 PRL 11 167         +CARMONY,PJERROU,SLATER,STORK,TICHO //UCLA IJP
BADIER   64 DUBNA I 593        +DEMOULIN,GOLDBERG, +     //EP,SACLAY,AMSTR  I
PJERROU  65 PRL 14 275         +SCHLEIN,SLATER,SMITH,STORK,TICHO   //UCLA
LONDON   66 PR 143 1034        +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR  IJ
BERGE    66 PR 147 945         +EBERHARD,HUBBARD,MERRILL,B-SHAFER,+ //LRL  I
MERRILL  66 UCRL-16455 THESIS  D W MERRILL                         //LRL   JP

        QUANTUM NUMBER DETERMINATION NOT REFERRED TO IN DATA CARDS.

SHAFER   66 PR 142 883         BUTTON-SHAFER,LINDSEY,MURRAY,SMITH  //LRL   JP

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Ξ (1705)

```
51  XI*1/2(1705, JP=     ) I=1/2

            EVIDENCE NOT COMPELLING.  OMITTED FROM TABLE.

                   51  XI*1/2(1705) MASS (MEV)  ---------------------------

M          1705.0         APPROX        SMITH     65 HBC  C- K-P 2.1-.7 BEV/C

----------------- 51  XI*1/2(1705) WIDTH (MEV)  --------------------------

W            20.0         APPROX        SMITH     65 HBC  C-

----------------- 51  XI*1/2(1705) PARTIAL DECAY MODES  ------------------

P1         XI*1/2(1705) INTO XI PI                       S22S 8
P2         XI*1/2(1705) INTO LAMBDA KBAR                 S18S11

****** ********* ********* ********* ********* ********* ********* *********

                         REFERENCES -- XI*1/2(17C5)

SMITH    65 ATHENS CONF 251    G A SMITH, J S LINDSEY                //LRL  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Ξ (1815)

```
50  XI*1/2(1815, JP=     ) I=1/2

                   50  XI*1/2(1815) MASS (MEV)  ---------------------------

M    *     1770.0                       HALSTEINS 63 FBC  C- K-FR 3.5 BEV/C
M          1817.0      7.0              SMITH 1   65 HBC  C- K-P 2.4-.7 BEV/C
M          1814.0      4.0              BADIER    65 HBC  C  K-P 3 BEV/C

----------------- 50  XI*1/2(1815) WIDTH (MEV)  --------------------------

W    *       80.0        OR LESS        HALSTEINS 63 FBC  C-
W            12.0      4.0              BADIER    65 HBC  C
W            30.0      7.0              SMITH 2   65 HBC  C-
```

```
-----------------   50  XI*1/2(1815) PARTIAL DECAY MODES   ------------------

P1          XI*1/2(1815) INTO LAMBDA KBAR                      S18S11
P2          XI*1/2(1815) INTO XI PI                            S22S 8
P3          XI*1/2(1815) INTO XI*1/2(1530) PI                  U49S 8
P4          XI*(1815) INTO XI PI PI (XI PI NOT XI*(1530)) S22S 8S 8

-----------------   50  XI*1/2(1815) BRANCHING RATIOS   --------------------

R1          XI*1/2(1815) INTO (LAMBDA KBAR)/TOTAL          (P1)/TOTAL
R1   *        LARGE                      BADIER     65 HBC                    7/66
R1   *        LARGE                      SMITH 2    65 HBC                    7/66

R2          XI*1/2(1815) INTO (XI PI)/(LAMBDA KBAR)        (P2)/(P1)
R2            0.20       0.20            BADIER     65 HBC                    7/66
R2   *        SMALL                      SMITH 2    65 HBC    IF XI*1933 EXIST 7/66

R3          XI*1/2(1815) INTO (XI*(1530) PI)/(LAM KBAR)    (P3)/(P1)
R3            0.26       0.13            SMITH 1    65 HBC
R3   *        SMALL                      BADIER     65 HBC                    7/66

R4          XI*1/2(1815) INTO (XI PI PI)/(LAMBDA KBAR)     (P4)/(P1)
R4            0.1          OR MORE       SMITH 1    65 HBC
R4   *        SMALL                      BADIER     65 HBC                    7/66

****** ********* ********* ********* ********* ********* ********* *********

                        REFERENCES -- XI*1/2(1815)

HALSTEIN 63 SIENA CCNF 173    HALSTEINSLID,+//BERGEN,CERN,EP,RTHF,UNICOL  I
SMITH 1  65 PRL 14 25         +LINDSEY,BUTTON-SHAFER,MURRAY          //LRL IJP
BADIER   65 PL 16 171         +CEMOULIN,GOLDBERG, +    //CP,SACLAY,AMSTR  I
SMITH 2  65 ATHENS CONF 251   G A SMITH, J S LINDSEY                 //LRL

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

```
Ξ (1935) 52  XI*1/2(1935, JP=    ) I=1/2

                 52  XI*1/2(1935) MASS (MEV)    --------------------------

M          1933.0     16.0                BADIER    65 HBC  C  K-P 3 BEV/C

-----------------   52  XI*1/2(1935) WIDTH (MEV)   --------------------------

W           140.0     35.0                BADIER    65 HBC  C

-----------------   52  XI*1/2(1935) PARTIAL DECAY MODES   ------------------

P1          XI*1/2(1935) INTO XI PI                           S22S 8
P2          XI*1/2(1935) INTO LAMBDA KBAR                     S18S11

****** ********* ********* ********* ********* ********* ********* *********

                        REFERENCES -- XI*1/2(1935)

BADIER   65 PL 16 171         +CEMOULIN,GOLDBERG, +     //CP,SACLAY,AMST  I

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
Ξ? (2270) 53  XI* /2(2270, JP=    ) I= /2

              EVIDENCE PRELIMINARY.  OMITTED FROM TABLE.

                 53  XI* /2(2270) MASS (MEV)    --------------------------

M          2270.0                         ABRAMS    66 HBC    K-P 4.25 BEV/C    9/66

****** ********* ********* ********* ********* ********* ********* *********

                        REFERENCES -- XI* /2(227C)

ABRAMS   66 BERKELEY CONF     +CAY,GLASSER,KEHOE,SECHI-ZORN, + //MD(BNL)

****** ********* ********* ********* ********* ********* ********* *********
****** ********* ********* ********* ********* ********* ********* *********
```

Eta Decay Into Neutrals (Price, Nov. '66)

Certain HBC and DBC experiments report the mode "$\eta \to 3\pi^0$", but actually they detect both $\eta \to 3\pi^0$ plus $\eta \to \pi^0 2\gamma$, and they cannot distinguish them (we ignore the mode $\eta \to 2\pi^0\gamma$). Since the detection efficiencies are different for the various modes, one may not merely substitute the combined rate $(3\pi^0 + \pi^0 2\gamma)$ for the reported $3\pi^0$ rate in these experiments. MULLER+ 63 (DBC) state that their detection efficiency per γ ray is about the same regardless of the mode of decay ($3\pi^0$ or $\pi^0 2\gamma$). CRAWFORD2 66 (HBC) has shown that the same is true for the HBC experiments listed. Thus for all these experiments (assuming $\eta \to 2\pi^0\gamma$ to be equal to zero)

$$3\pi^0_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{1}{1 + \frac{4}{6} r} \qquad (1)$$

and

$$\pi^0 2\gamma_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{r}{1 + \frac{4}{6} r}, \qquad (2)$$

where

$$r \equiv \frac{\pi^0 2\gamma}{3\pi^0} \qquad (3)$$

CRAWFORD2 gives values for $3\pi^0/\pi^+\pi^-\pi^0$, using (1) and assuming $r = 1.79 \pm 0.58$, from DIGIUGNO+ 66 (CNTR).

Now in principle it would be possible for us to include "r" in our least-squares fitting, recalculating it at every step. In reality, however, this would require a major programming change in program AHR. Thus we have not included these particular HBC and DBC experiments in our present constrained fitting. For the purposes of comparison, we note that our over-all best fits to all data (excluding the particular HBC and DBC experiments) gives

$$R \equiv \frac{3\pi^0}{\pi^+\pi^-\pi^0} = 0.94 \pm 0.16.$$

If we now use the experimental results from the BC experiments along with our best-fit values for the partial modes $\pi^0 2\gamma$ and $3\pi^0$, we have [Eqs. (1) and (3)]:

$$R = 0.50 \pm 0.12.$$

The agreement is not good (it is about 2 standard deviations). If such a discrepancy persists, we will recode program AHR to accept all of the data next time.

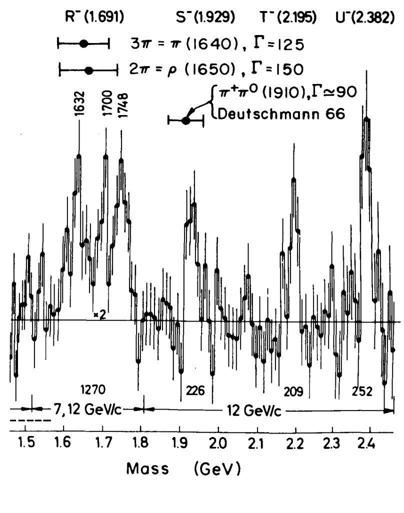
Relationship between peaks seen in missing mass spectrometer and in bubble chamber experiments

a) Relationship between:
   1. Narrow R^- peaks seen by MMS.
   2. Broad 3π peak, $\pi(1640)$ seen by HBC
   3. Broad 2π peak, $\rho(1650)$ seen by HBC

The figure below shows the R^- data of the MMS group (LEVRAT + 66). We have added the average mass and width of the HBC bumps (GOLDHABER + 66RVUE). The observations must be related, but there is not yet enough information to apportion them.

b) Relationship between:
   1. Narrow S^- peak seen by MMS
   2. $\Gamma = 90 \pm 40$ MeV $\pi^+\pi^0$ peak seen in HBC

It is hard to relate these, since MMS bump has 3 charged tracks, HBC is $\pi^+\pi^0$. See fig. below.



Notes on Baryon Resonances

Parameters of the lower N^*'s (Rosenfeld, Wohl)

We take masses, widths, and elasticities of the lower N^*'s [except for the $\Delta(1236)$] from phase-shift analyses of BAREYRE 65 and LOVELACE 66. These are the latest of a number of such analyses and appear to be the most complete and comprehensive. However it should be kept in mind that even these are only in qualitative agreement with one another.

The Argand diagrams of BAREYRE 65 are shown in Fig. 4. Those of Donnachie et al. have not yet appeared; their best estimates of resonance parameters are given by LOVELACE 66. We would be happy to include their diagrams (as well as anyone else's) in future editions. Argand diagrams are clearly the most succinct form for presenting and comparing results of phase-shift analyses.

A resonating partial-wave elastic-scattering amplitude with no background has the simple Breit-Wigner form

$$T(E) = x/(\epsilon - i), \qquad (1)$$

where x is elasticity and ϵ is $(M-E)/(\Gamma/2)$. This amplitude traces a circle of diameter x and becomes entirely imaginary at $E = M$. The amplitude also has greatest velocity $|dT/dE|$ at $E = M$, for it is easy to show that

$$\left|\frac{dT}{dE}\right| = \frac{x}{\epsilon^2+1} = \text{Im } T, \qquad (2)$$

which is a maximum at $E = M$. The $P_{33}\,\Delta(1236)$ is a good example of a resonant partial wave with no background until E is well above M.

If the resonance is superimposed on a varying background, the resonant circle may be translated, rotated, and distorted. The S_{31} amplitude shows these effects well. Since this amplitude never becomes entirely imaginary, we must choose another criterion for the resonant energy. If the background varies only slowly, it is reasonable to choose the point at which the velocity of the amplitude is greatest.

The S_{11} amplitude is obviously quite complex. MICHAEL 66 has visually fitted the solution of BAREYRE 65 to two resonant circles plus no background. We use his results.

The influence of background on the P_{11} amplitude is less apparent. The clue is that the amplitude varies most rapidly somewhat below the energy at which it becomes entirely imaginary. This behavior suggests that the resonant circle is rotated, an interpretation supported by the fact that the phase shift starts off negative before commencing its counterclockwise rotation and recrossing the origin at 1175 MeV. Maximum velocity is reached at about 1400 MeV or slightly lower.

Let us consider the P_{11} amplitude to be the result of two opposite forces, a repulsive force responsible for a negative scattering length A, and an attractive resonant interaction. The scattering length will produce a phase shift $2i\delta'$ and a contribution to the T matrix

$$T' = \frac{e^{2i\delta'}-1}{2i}. \qquad (3)$$

The resonant term T will be given by (1). The total amplitude, obtained by multiplying the S-matrix elements[1] (S is related to T by $S = 2iT + 1$), will now start out negative, and then superimposed on its clockwise motion will be the counterclockwise circular resonant behavior.

How far around this resonant circle is 1400 MeV? To solve this simple problem, assume that the repulsive phase shift $2\delta'$ is related to a scattering length by

$$k^3 \cot \delta' = 1/A,$$

or more precisely, using McKinley's phase shifts,[2]

$$(k/m_\pi)^3 \cot \delta' = -(.015)^{-1}.$$

Then, at 1400 MeV, δ' has reached -15 deg. We have plotted the corresponding point on Fig. 4. It is encouraging that this point lies almost diametrically across the resonant circle from 1400 MeV.

The other resonating amplitudes, the D_{13}, the D_{15}, and the F_{15}, appear to have little background; the variation is most rapid approximately where the amplitude becomes imaginary. Therefore the resonant parameters may be chosen as follows: M is where T(E) is entirely imaginary; x is the length of T at this point; and $\Gamma/2$ is $(M - E')$, where E' is the energy at which Im T is $x/2$.

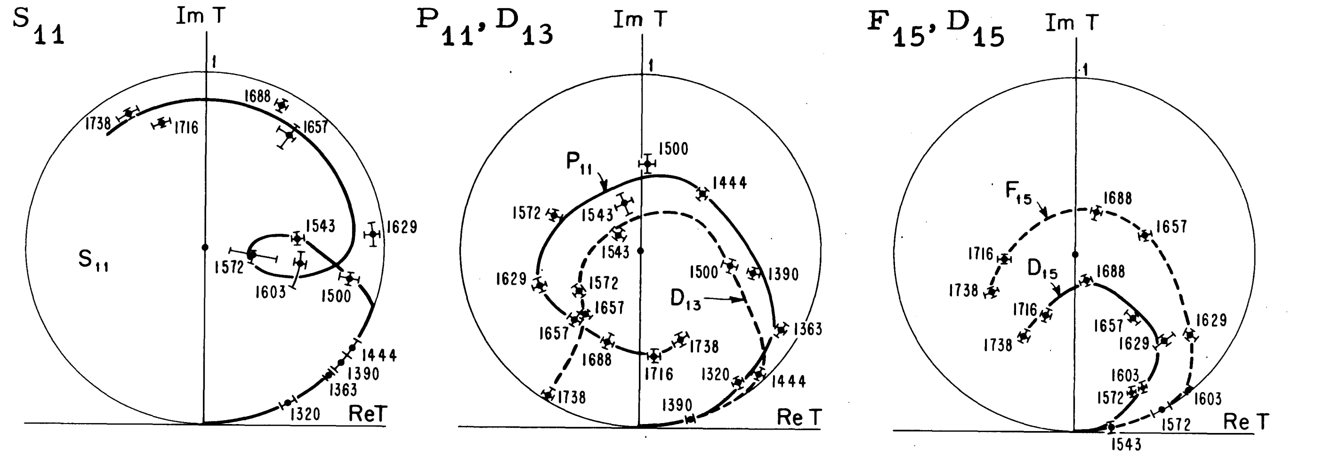
---

1. By multiplying S matrices we get

$$S'' = S'\,S = \eta' e^{2i\delta'}\,\eta e^{2i\delta} = 2iT'' + 1.$$

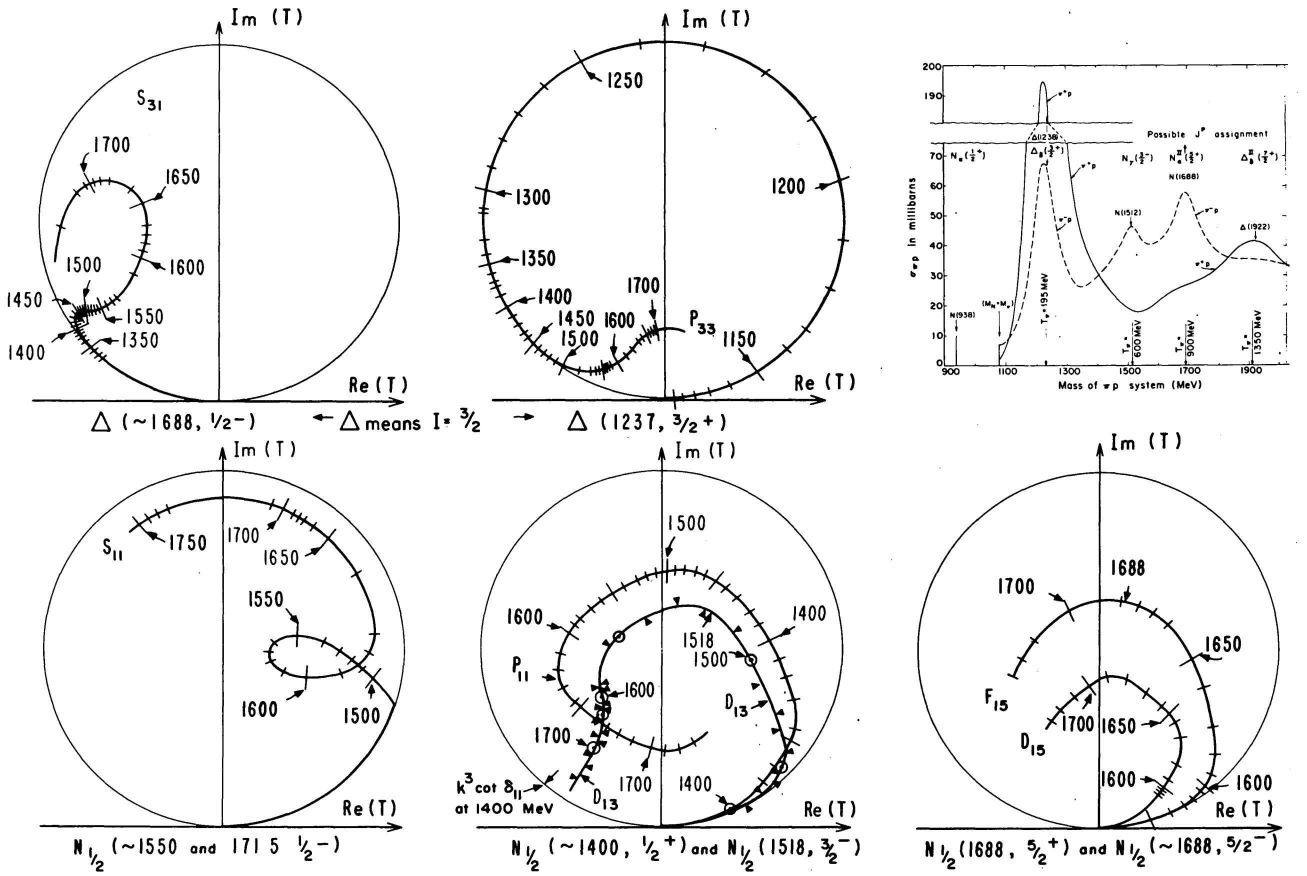
Hence $T'' = \dfrac{\eta'\eta\, e^{2i(\delta'+\delta)}-1}{2i}$ which rotates the clockwise resonant circle by $2i\delta'$, keeping it tangent to the unit circle.

2. J. M. McKinley, Rev. Mod. Phys. 35, 788 (1963).



MUB-

Solutions of Bareyre et al. to I-spin 1/2 resonant partial waves. The crosses show the amplitudes and errors computed from the data at various energies. The smooth connecting lines are guesses.



The smooth guessed curves above are replotted with the actual calculated amplitudes replaced by hatch marks interpolated every 10 MeV. For a resonance they should be spaced proportionally to $\mathrm{Im}(T) = (1+\epsilon^2)^{-1}$. The I-spin 3/2 resonant partial waves have been added at the top, along with a summary of the total cross section for π^+p and π^-p.

Fig. 4

MUB-14051

Spin-parity assignments of the higher mass N^*'s

Spins and parities of the higher mass N^*'s are taken from Barger and Cline (BARGER 66). They classify all the N^*'s as Regge recurrences on three straight-line trajectories [namely, recurrences of N(938), N(1525), and Δ(1236)] in a Chew-Frautchi plot. In addition they construct a model for $\pi^- p$ elastic scattering, near and at 180°, based on interference of the resonance amplitude with an amplitude due to Regge exchange of Δ(1236) in the crossed channel. The predictions compare well with the existing experimental data on the energy dependence of the $\pi^- p$ differential cross section at 180° and the general shape of the $\pi^- p$ angular distribution near 180°.[1] This result confirms the consistency of the Regge recurrence parity assignments with the scattering data. In addition to the N^* reported in the Table on Baryons, they predict two more states: one at ≈ 2200 MeV ($J^P = 9/2+$) and another one at ≈2630 MeV ($J^P = 13/2+$) which they can accomodate in the prediction of the backward πp scattering by changing the elasticities of the neighboring resonances. We do not list these two resonances since they have not yet been experimentally observed.

1. V. Barger and D. Cline, Regge Recurrence Parity Assignments for the S = 0 Recurrences, paper submitted to the XIII International Conference on High Energy Physics, August 31 through September 7, 1966, Berkeley (proceedings to be published by the Univ. of Calif. Press).

Appendix A. Compiled Spectra Relevant to H and κ Mesons

In an attempt to confirm or deny the existence of certain tentative bumps, we have started compiling the relevant published spectra. It would be better to compile events, rather than spectra, but the former entails collecting data summary tapes, whereas the latter involves only key-punching published data. Perhaps this simpler procedure will stimulate experimental groups to combine their data more effectively.

The compiling is done with a Fortran program SCHISM, written by Alan Rittenberg. SCHISM rebins the input data into common intervals, then outputs the combined histograms. An alphameric character is assigned to each input histogram and is displayed on output, permitting the reader to identify the source of the data. To facilitate reading of the histograms, certain rows and columns of letters have been changed to dots.

Our latest compilations will be continuously available from the Lawrence Radiation Laboratory as UCRL-8030 Spectra. However, we present here two examples, partly as an advertisement for help; we hope readers will call to our attention omitted data and send us new relevant data. The two mesons investigated are H and κ. The results for both are inconclusive. The H spectra show that there is not enough data for us to rely on histograms alone (we will have to go to combined events): the κ spectra discredit but do not kill the κ. In any case, we try to present enough spectra that the reader can form his own opinion on these bumps.

1. The κ(725) (Lynch, Rittenberg, Rosenfeld, Söding, Dec. 1966)

We are beginning to think that κ should be classified along with flying saucers, the Loch Ness Monster, and the Abominable Snowman. We have heard of several experiments which were supposed to confirm it, and each one has either failed completely or failed to find it in the sought-for channel, but found instead a small Kπ peak near 725 MeV in some other channel.

We present here a collection of 19 histograms, some of which represent the results of particular experiments in which the experimenters have claimed to have found the κ; the rest summarize experiments relevant for confirmation or rejection of the κ as a resonance. In Table A-I we list the various reactions and experiments which are discussed and compiled in this appendix, and give numbers of events, incident momenta, and references.

a. $\pi^- p \to (K\pi)\, Y$

The κ was first reported by ALEXANDER+ 62 and MILLER+ 63 in the reaction $\pi^- p \to \Sigma^{-,0} (\pi K)^{+,0}$ at 1.9 to 2.4 GeV/c. Figure A1, taken from MILLER+ 63 (which incorporates events from ALEXANDER+ 62), shows an enhancement of 55 "κ mesons" just at the peak of phase space. These data have now more than doubled, and appear in the thesis of HARDY 66, from which we have gathered two histograms to make Fig. A2. The enhancement has become considerably less impressive and, if present, corresponds to ≤ 40 events. The corresponding plot at higher primary energy, Fig. A3 (also from HARDY 66), also shows no evidence for κ.

The data of Fig. A2 included only Σ^- events, although the original paper of ALEXANDER+ 62 (see Fig. A4) included also Σ^0. Improved Σ^0 statistics have failed to produce any evidence for κ, either near the threshold range shown in Fig. A5 or at higher energy, as shown in Fig. A6.

Table A-I. Experiments on κ discussed in Appendix A.

Reaction	Beam momentum (GeV/c)	Decay products studied	Number of combinations	Published as evidence for κ	Reference	m_κ (MeV)	Γ_κ (MeV)	κ Prod. Cross Section (μb)	Plot symbol	Figure
$\pi^-p\to(K\pi)^{+,0}\Sigma^{-,0}$	1.9 -2.0	$(K^+\pi^0)+(K^0\pi^+)+(K^+\pi^-)$		+	Alexander 62[a] Fig. 3 (incl. in Hardy below)	≈730	≤ 20			A4
$\pi^-p\to(K\pi)^+\Sigma^-$	1.8 - 2.2	$K^+\pi^0$	736		Hardy 66[b] Fig. 12(g)				K	A2
	1.9 - 2.4	$K^+\pi^0$	520	+	Miller 63[c] Fig. 2(b) (incl. in Hardy above)	726±3§	≤ 20§	6-3§		A1
	1.8 - 2.2	$K^0\pi^+$	1602		Hardy 66[b] Fig. 13(g)				N	A2
	1.9 - 2.4	$K^0\pi^+$	1202	+	Miller 63[c] Fig. 2(c) (incl. in Hardy above)	726±3§	≤ 20§	6-3§		A1
	2.9 - 3.3	$K^+\pi^0$	299		Hardy 66[b] Fig. 12(h)				L	
	2.9 - 3.3	$K^0\pi^+$	732		Hardy 66[b] Fig. 13(h)				P	A3
	3.8 - 4.2	$K^+\pi^0$	123		Hardy 66[b] Fig. 12(i)				M	
	3.8 - 4.2	$K^0\pi^+$	223		Hardy 66[b] Fig. 13(i)				Q	
$\pi^-p\to(K\pi)^0\Sigma^0$	1.8 - 2.2	$K^+\pi^-$	670		Hardy 66[b] Fig. 11(g)				H	A5
	2.9 - 3.3	$K^+\pi^-$	314		Hardy 66[b] Fig. 11(h)				I	A6
	3.8 - 4.2	$K^+\pi^-$	104		Hardy 66[b] Fig. 11(i)				J	
$\pi^-p\to(K\pi)^0\Lambda$	1.5	$K^0\pi^0$	154	+	Kim 65[d] Fig. 3	735±5†	< 20		A	
	1.59	$K^0\pi^0+K^+\pi^-$	104		Sene [e] Fig. 2. 10				Z	A7
	1.8	$K^0\pi^0$	259	+	Kim 65[d] Fig. 4	735±5†	< 20		B	
	1.8 - 2.2	$K^0\pi^0$	522		Hardy 66[b] Fig. 15(g)				U	A8
	1.8 - 2.2	$K^+\pi^-$	1590		Hardy 66[b] Fig. 14(g)				R	
	2.9 - 3.3	$K^0\pi^0$	208		Hardy 66[b] Fig. 15(h)				V	
	2.9 - 3.3	$K^+\pi^-$	688		Hardy 66[b] Fig. 14(h)				S	A9
	3.8 - 4.2	$K^0\pi^0$	72		Hardy 66[b] Fig. 15(i)				W	
	3.8 - 4.2	$K^+\pi^-$	263		Hardy 66[b] Fig. 14(i)				T	
$\pi^+p\to(K\pi)^+\pi^+\Lambda$ (4-body)	3.2	$K^+\pi^0+K^0\pi^+$	314	+	Cason 66[f] Fig. 1 (213 events)	731±2	≲ 12		C	A10
$K^-p\to(\bar{K}\pi)^-p$ (3-body)	0.78-0.99	$K^-\pi^0$	220		Gelfand 66[g] Fig. 10				C	
	0.8 -1.05	$K^-\pi^0$	203		Kalmus 66[h]				N	
	0.78-0.99	$\bar{K}^0\pi^-$	79		Gelfand 66[g] Fig. 10				G	
	0.8 -1.05	$\bar{K}^0\pi^-$	143		Kalmus 66[h]				L	
	1.02-1.18	$K^-\pi^0$	300		Gelfand 66[g] Fig. 10				D	A11
	1.05-1.2	$K^-\pi^0$	180		Kalmus 66[h]				K	
	1.02-1.18	$\bar{K}^0\pi^-$	270		Gelfand 66[g] Fig. 10				H	
	1.05-1.2	$\bar{K}^0\pi^-$	186		Kalmus 66[h]				I	
	1.2	$K^-\pi^0$	894		Lynch 66[i]				O	
	1.2	$\bar{K}^0\pi^-$	891		Lynch 66[i]				Q	
	1.0 -1.7	$\bar{K}^0\pi^-$	4296	+	Wojcicki 63[j] Fig. 1	723±3	< 12	30-0	B	A13
	1.4 -1.7	$K^-\pi^0$	2543		Lynch 66[i]				R	
	1.4 -1.7	$\bar{K}^0\pi^-$	2166		Lynch 66[i]				T	
	1.8 -2.1	$K^-\pi^0$	2925		Lynch 66[i]				U	
	1.8 -2.1	$\bar{K}^0\pi^-$	2584		Lynch 66[i]				W	A14
	2.4 -2.7	$K^-\pi^0$	1950		Lynch 66[i]				X	
	2.1 -2.7	$\bar{K}^0\pi^-$	5833		Friedman 66[k]				A	
	2.4 -2.7	$\bar{K}^0\pi^-$	1833		Lynch 66[i]				Z	
$K^-p\to(\bar{K}\pi)^0n$	0.78-0.99	$K^-\pi^+$	114		Gelfand 66[g] Fig. 10				E	
	0.8 -1.05		194		Kalmus 66[h]				M	
	1.02-1.18		314		Gelfand 66[g] Fig. 10				F	A12
	1.05-1.2		215		Kalmus 66[h]				J	
	1.2		1068		Lynch 66[i]				P	
	1.4 -1.7		3732		Lynch 66[i]				S	
	1.8 -2.1		4554		Lynch 66[i]				V	A15
	2.4 -2.7		2834		Lynch 66[i]				Y	
$K^-p\to(K\pi)^{+,0}\Xi^{-,0}$	2.24	$K^+\pi^0+K^0\pi^++K^+\pi^-$	413	+	London 66[ℓ] Fig. 28	730	≲ 15		L	A16
$K^-p\to$ $(\bar{K}\pi)^0\pi^-p$ / $(\bar{K}\pi)^-\pi^+n$ / $(\bar{K}\pi)^-\pi^0p$	1.2 -1.7	$K^-\pi^++\bar{K}^0\pi^-$	1523	+	Wojcicki 64[m] Fig. 5	≈ 725	< 12		W	A17
$K^-p\to(\bar{K}\pi)^0\pi^-p$ (4-body)	1.45	$K^-\pi^+$	101		Almeida 64[n] Fig. 4			< 3±1.7	A	
	2.0	$K^-\pi^+$	4519		Dauber 66[o] Fig. 45(b)	≈ 690	≲ 30		D	
	2.1 -2.7	$\bar{K}^0\pi^0$	4367		Friedman 66[k]				F	
	2.68	$K^-\pi^+$	1857		Pripstein 66[p] Fig. 8				P	A18
$K^-p\to(\bar{K}\pi)^-\pi^0p$	2.1 - 2.7	$\bar{K}^0\pi^-$	4338		Friedman 66[k]				G	
$K^-p\to(\bar{K}\pi)^-\pi^+n$	2.1 - 2.7	$\bar{K}^0\pi^-$	3909		Friedman 66[k]				H	
$K^+p\to(K\pi)^+\pi^+\pi^-p$ (5-body)	3.0	$K^+\pi^0$	312	+	Ferro-Luzzi 64[q] Fig. 2(a)	725±5*	< 30*	85	F	
	3.0	$K^0\pi^+$	226	+	Ferro-Luzzi 64[q] Fig. 2(c) (113 events)				F	A19
	3.52	$K^0\pi^+$	1144	-	Goshaw 66[r] Fig. 2 (572 events)			<3	G	
$K^+p\to(K\pi)^0\pi^+\pi^0p$	3.0	$K^+\pi^-$	312	+	Ferro-Luzzi 64[q] Fig. 2b	725±5*	< 30*	65	F	
		total number	≈ 60 000							

§Values obtained from the combined $(K^+\pi^0)$ and $(K^0\pi^+)$ mass distributions.

†Values obtained from the combined 1.5 and 1.8 GeV/c data.

*Values obtained from the combined $(K^+\pi^0)$, $(K^0\pi^+)$, and $(K^+\pi^-)$ mass distributions.

a. G. Alexander et al., Phys. Rev. Letters 8, 447 (1962).
b. L. Hardy, Analysis of Strange-Particle Resonant States from π^-p Interactions, (Ph. D. Thesis), Lawrence Radiation Laboratory Report UCRL-16788, July 1966 (unpublished).
c. D. Miller et al., Phys. Letters 5, 299 (1963).
d. Y. S. Kim et al., Phys. Letters 19, 350 (1965).
e. M. Sene (Univ. of Paris Thesis), unpublished.
f. N. M. Cason et al., Phys. Rev. Letters 17, 838 (1966).
g. N. Gelfand et al., Formation and Production of Resonant States in Two-Prong K^-p Interactions between 0.8 and 1.2 GeV/c, Enrico Fermi Institute for Nuclear Studies Report EFINS-66-81, August 1966 (unpublished).
h. G. Kalmus (LRL), private communication.
i. G. R. Lynch (LRL), private communication.
j. S. Wojcicki et al., Phys. Letters 5, 283 (1963); Phys. Rev. 135, B484 (1964).
k. J. Friedman (LRL), private communication.
ℓ. G. W. London et al., Phys. Rev. 143, 1034 (1966).
m. S. Wojcicki et al., Phys. Rev. 135, B495 (1964).
n. S. Almeida and G. R. Lynch, Phys. Letters 9, 204 (1964).
o. P. M. Dauber et al., Phys. Rev. (to be published).
p. M. Pripstein (LRL), private communication.
q. M. Ferro-Luzzi et al., Phys. Letters 12, 255 (1964).
r. A. T. Goshaw et al., Phys. Letters 22, 347 (1966).

MUB-13980

Miller, claim.

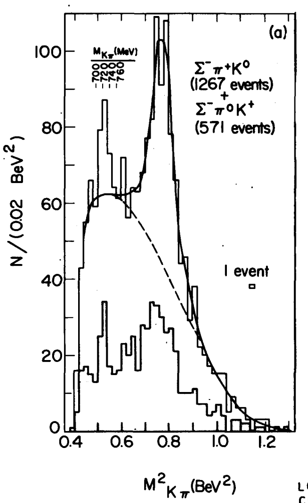


Fig. A1. $M^2(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 1.9 to 2.4 GeV/c. From MILLER+ 63.

Miller decreased

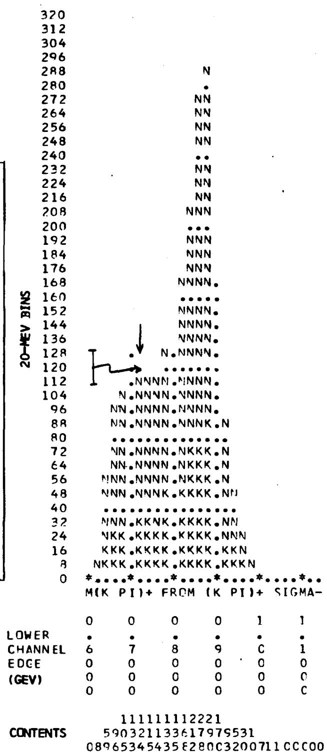


Fig. A2. $M(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 1.8 to 2.2 GeV/c.

Same channel, higher energy.

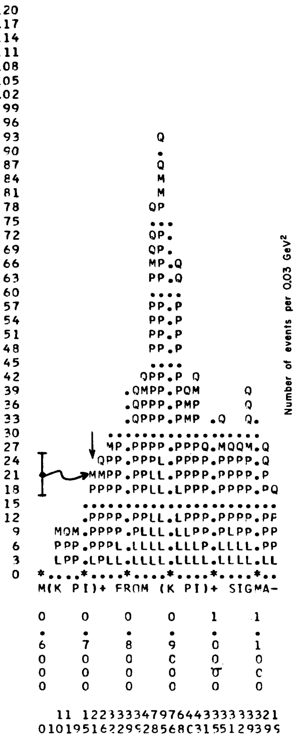


Fig. A3. $M(K\pi)$ from $\pi^-p\to(K\pi)^+\Sigma^-$, P_{inc} = 2.9 to 4.2 GeV/c.

Alexander $\Sigma^-, \Sigma^0, \Lambda$.

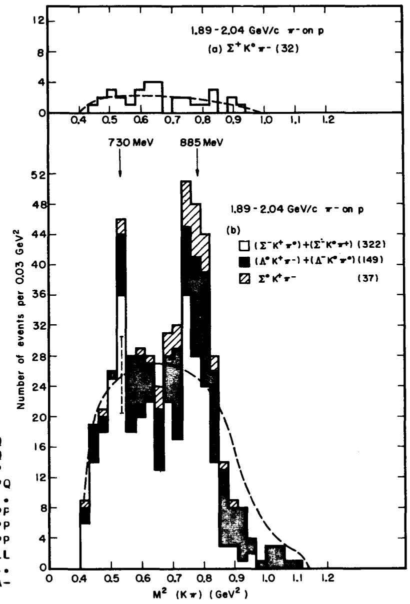


Fig. A4. $M^2(K\pi)$ from $\pi^-p\to(K\pi)^{+,0}\ \Sigma^{-,0}$, and $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.9 to 2.0 GeV/c. From ALEXANDER+ 62.

Alexander Σ^0 disappeared.

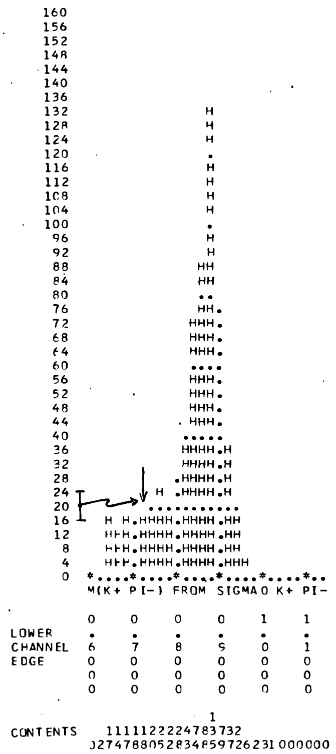


Fig. A5. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Sigma^0$, P_{inc} = 1.8 to 2.2 GeV/c.

Same channel, higher energy.

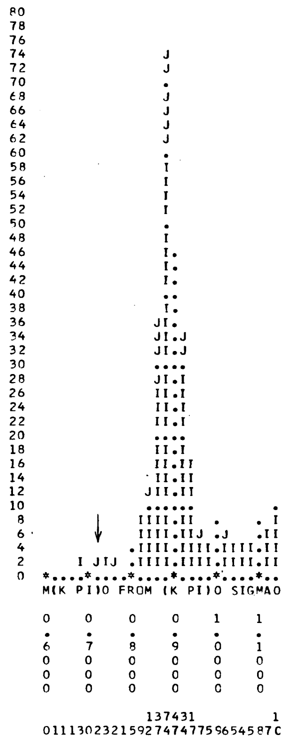


Fig. A6. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Sigma^0$, P_{inc} = 2.9 to 4.2 GeV/c.

Kim claim (A+B) + other (Z), strong uncorroborated peak.

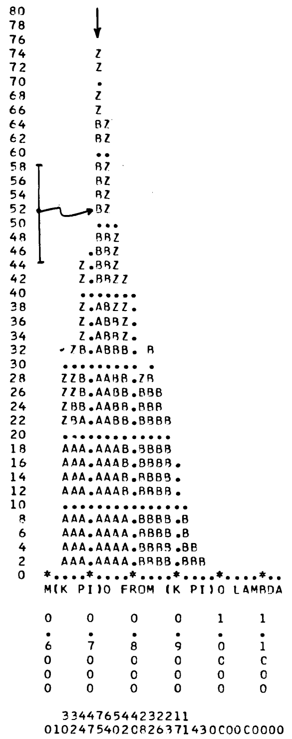


Fig. A7. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.5 to 1.8 GeV/c.

Same channel, higher energy.

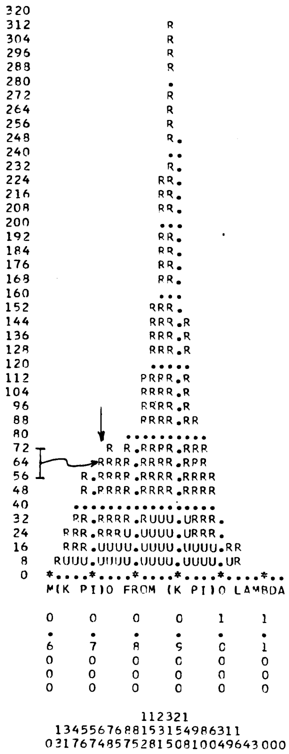


Fig. A8. $M(K\pi)$ from $\pi^-p\to(K\pi)^0\Lambda$, P_{inc} = 1.8 to 2.2 GeV/c.

MUB-13962

On the other hand, some positive evidence for an enhancement at 735 MeV comes from studies of $(K\pi)^0\Lambda$ final states! This evidence is shown in Fig. A7, which is a compilation of 517 events from two experiments (KIM+ 65, SENE 66) with incident momenta of 1.5 to 1.8 GeV/c, partly below the K^* production threshold. In an experiment with 6X better statistics (3342 events), HARDY 66 has found no evidence for the κ (Figs. A8 and A9), but his experiment covers only the momentum range well above K^* threshold (1.66 MeV) and therefore does not invalidate the positive results of KIM+ 65 and SENE 66.

b. $\pi^+p \rightarrow (K\pi)^+\pi^+\Lambda$

From a recent experiment involving 314 events of this type (Fig. A10), CASON+ 66 claim to have found evidence for the κ. To our knowledge, there is no similar experiment with comparable statistics to either support or weaken the conclusion of CASON+ 66.

c. $K^-p \rightarrow (K\pi)\ N$

Historically, the second experiment to report the κ was that of WOJCICKI+ 63, in which 4296 events of the reaction $K^-p \rightarrow \bar{K}^0\pi^-p$ were studied. In agreement with the original κ evidence, their κ has a mass of 723±3 MeV and a width of < 12 MeV. Wojcicki's largest effect was at 1.08 GeV/c.

There are now several other experiments measuring $(\bar{K}\pi)^-p$ final states in this region of incident K^- momenta. Figure A11 is a compilation of 3367 events (not including Wojcicki's); it represents an independent confirmation of Wojcicki's observation of a peak in the $(\bar{K}\pi)^-$ mass at about 725 MeV. Moreover, a compilation of recent results from $(K\pi)^0n$ final states in the same energy region (1882 events) also shows an enhancement (see Fig. A12), perhaps at a slightly higher mass value. Although the statistical significance of each of these peaks is not larger than 1 to 2 standard deviations, it is hard to deny that some peculiar effect seems to be present here.

Again, larger statistics is available at higher energies, but no peak is observed (see compilation in Figs. A13, A14, and A15).

d. $K^-p \rightarrow (K\pi)^{+,0}\ \Xi^{-,0}$

Evidence for the κ was reported by LONDON+ 66 on the basis of 413 events of this type (see Fig. A16). This is still waiting for confirmation or disproval.

e. $K^-p \rightarrow (\bar{K}\pi)^{0,-}\ \pi N$

The κ was also reported, with $m \approx 725$ MeV and $\Gamma < 12$ MeV, by WOJCICKI+ 64 in 1523 events with 4-body final states, for incident momenta between 1.2 and 1.7 GeV/c. A compilation of 6152 events presently available for this reaction (including the data of WOJCICKI+ 64) in the range of 1.2 to 2 GeV/c (Fig. A17) shows, instead, a broad maximum around 700 MeV. However 700 MeV is just the peak of phase space and we would not take such a broad maximum as evidence for an enhancement in the 725-MeV mass region. A compilation of 14 467 events at 2.1 to 2.7 GeV/c similarly shows no κ (see Fig. A18).

f. $K^+p \rightarrow (K\pi)^{0,+}\ \pi^{0,-}\ \pi^+ p$

Finally, the κ was reported from a CERN experiment by FERRO-LUZZI+ 64, who saw a peak in the reaction $K^+p \rightarrow NK\pi\pi\pi$. This κ was at 725 MeV and had a width of < 30 MeV. The effect was found in the 3 GeV/c data, but was absent in the 3.5 GeV/c data. An experiment at Wisconsin at 3.6 GeV/c with three times as many events as the CERN experiment also indicated no evidence for a κ.

The combined distribution of the $(K\pi)^{+,0}$ mass from these experiments is shown in Fig. A19. There is no peak at ≈ 730 MeV; although a broad enhancement centered at about 750 MeV can be seen, this is where phase space also peaks.

The κ has also been looked for in other experiments--e.g., the CERN group (V. Henri, private communication) has looked for the κ_+ below K^* threshold in the reaction $K^+p \rightarrow K^0\pi^+p$, but did not find it.

What can we conclude from this study? If the κ is real, then each claim for its existence should be strengthened when combined with later data. We now summarize the discussion above for each claim:

§. The MILLER 63 signal has decreased from 53 to < 40 events, and the signal of FERRO-LUZZI 64 has disappeared.

§. There are no new data to compare with the claims of KIM 65, CASON 66, or LONDON 66; they are of course still impressive.

§. The fate of the claim of WOJCICKI 63 is undecided. His data suggested a κ produced by K^- between 1 and 1.7 GeV/c. When combined with new data over this entire range, the signal has disappeared. On the other hand, with limited statistics, Wojcicki's best signal/noise ratio was at 1.08 GeV/c. We have compiled events produced by K^- between 0.78 and 1.2 GeV/c, and indeed see a 1 to 2-σ signal for both κ and κ^0.

Same channel, still higher energy.

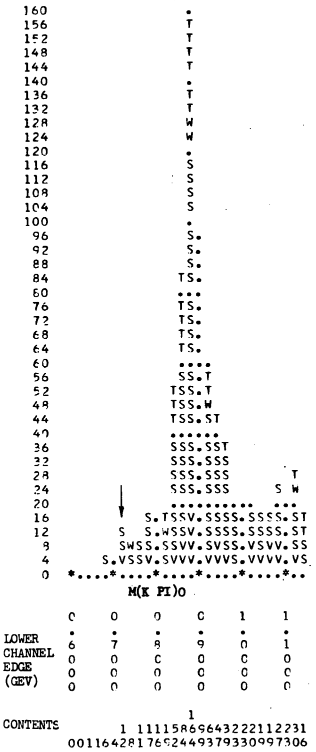


Fig. A9. $M(K\pi)$ from $\pi^- p \to (K\pi)^0 \Lambda$, P_{inc} = 2.9 to 4.2 GeV/c.

Cason claim, strong uncorroborated peak.

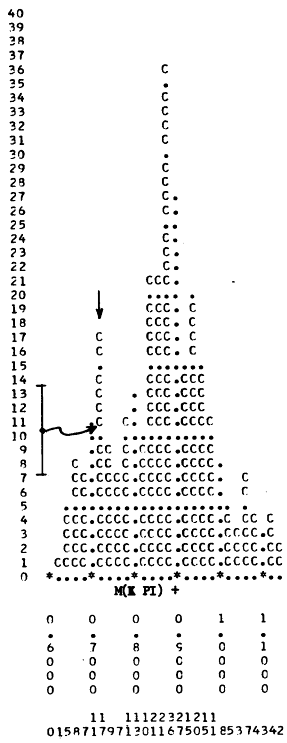


Fig. A10. $M(K\pi)$ from $\pi^- p \to (K\pi)^+ \pi^+ \Lambda$, P_{inc} = 3.2 GeV/c.

No claim, but κ near threshold, supports Wojcicki.

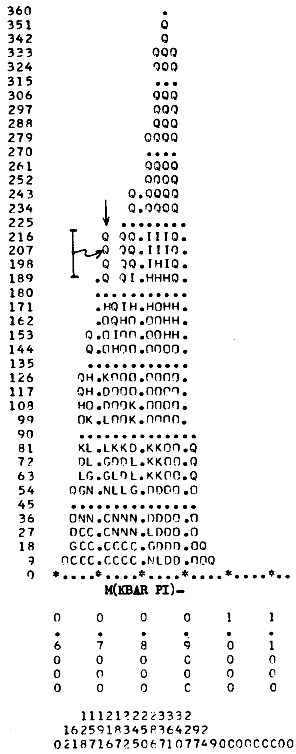


Fig. A11. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 0.78 to 1.2 GeV/c.

Same reactions, different charge, supports Wojcicki.

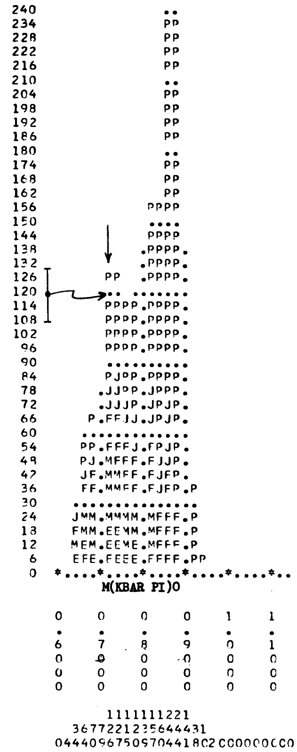


Fig. A12. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^0 n$, P_{inc} = 0.78 to 1.2 GeV/c.

Wojcicki claim (B), + others, up to 1.7 GeV/c, Signal decreased.

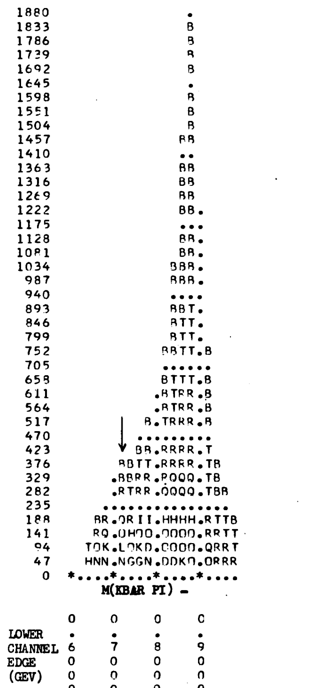


Fig. A13. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 0.78 to 1.7 GeV/c.

Same channel, higher energy. No κ.

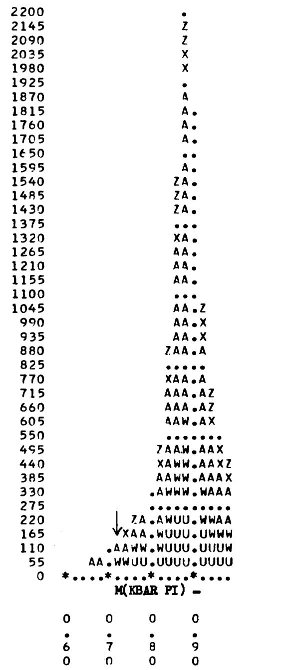


Fig. A14. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^- p$, P_{inc} = 1.8 to 2.7 GeV/c.

Same reactions, different charge. No κ.

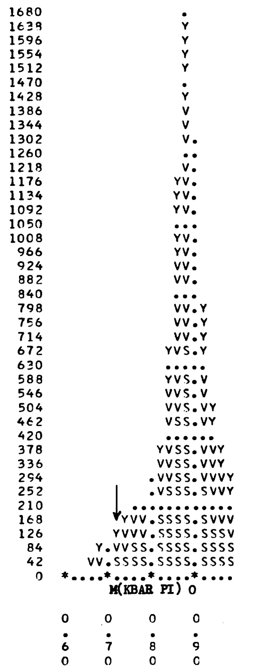


Fig. A15. $M(\bar{K}\pi)$ from $K^- p \to (\bar{K}\pi)^0 n$, P_{inc} = 1.4 to 2.7 GeV/c.

London claim, strong uncorroborated peak.

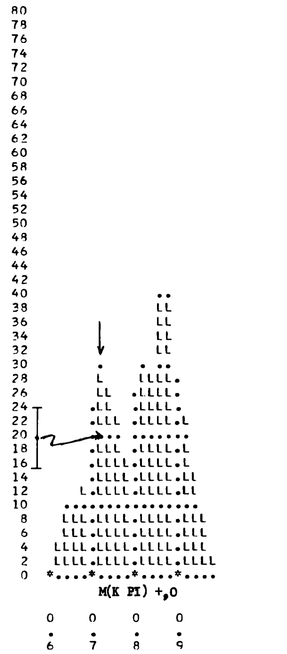


Fig. A16. $M(K\pi)$ from $K^- p \to (K\pi)^{+0} \Xi^{-,0}$, P_{inc} = 2.24 GeV/c.

MUB-13963

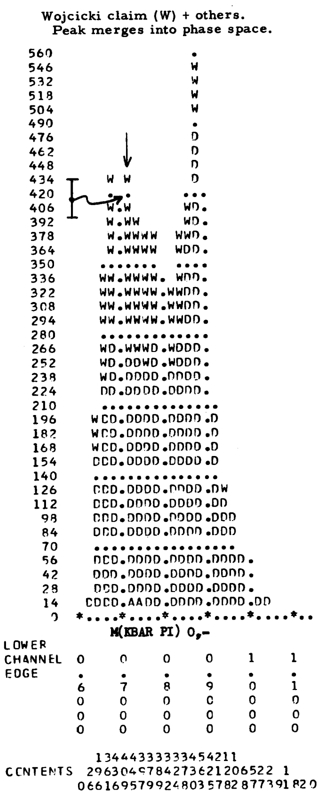


Fig. A17. $M(\bar{K}\pi)$ from $K^-p \to (\bar{K}\pi)^{0,-}\pi N$, P_{inc} = 1.2 to 2 GeV/c.

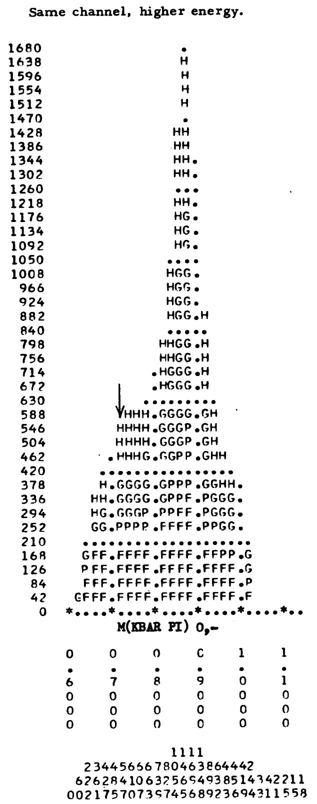


Fig. A18. $M(\bar{K}\pi)$ from $K^-p \to (\bar{K}\pi)^{0,-}\pi N$; P_{inc} = 2.1 to 2.7 GeV/c.

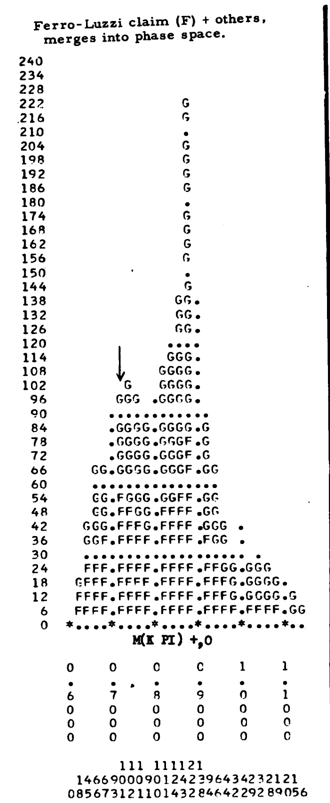


Fig. A19. $M(K\pi)$ from $K^+p \to (K\pi)^{+,0}\pi^{-,0}\pi^+p$, P_{inc} = 3 to 3.5 GeV/c.

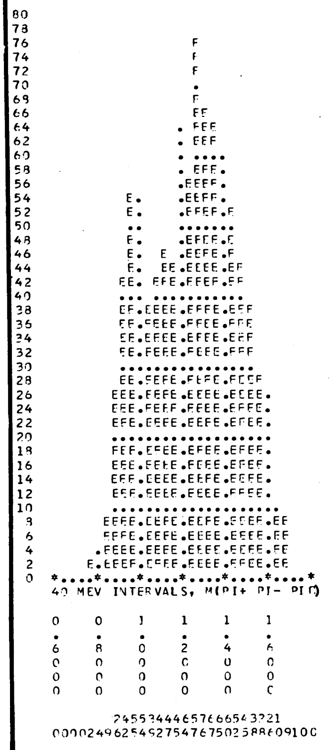


Fig. A20. $M(\rho\pi)^0$ from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc} = 4 GeV/c. From BARTSCH+64.

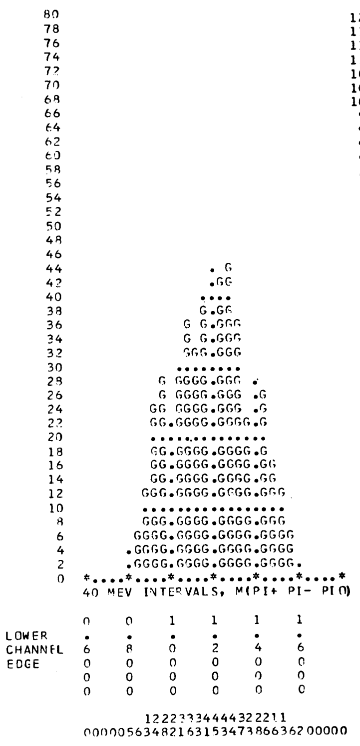


Fig. A21. $M(\rho\pi^0)$ from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc}=3.65 GeV/c. From G. GOLDHABER 65.

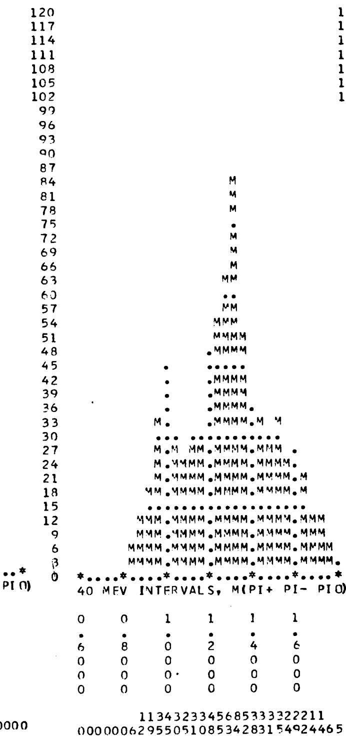


Fig. A22. $M(\rho\pi)^0$ from $\pi^+d \to (\rho\pi)^0pp$, P_{inc} = 3.65 GeV/c. From BENSON+ 66.

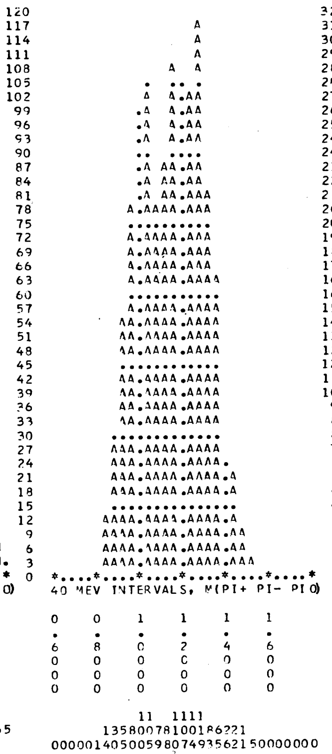


Fig. A23. $M(\rho\pi)^0$ from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc}=3.2 and 3.5 GeV/c. From ABOLINS+ 66.

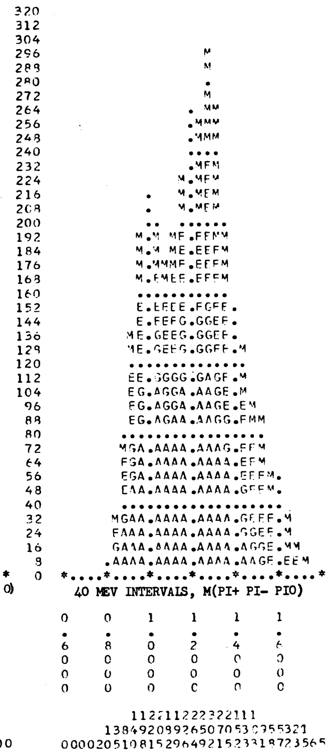


Fig. A24. $M(\rho\pi)^0$ from $\pi^+p \to (\rho\pi)^0\Delta^{++}$ and $\pi^+d \to (\rho\pi)^0pp$, 3.2 to 4 GeV/c.

MUB 13964

This behavior could be that of a real κ, but it is more what one would expect of statistical fluctuations.

The fact remains that we compiled 19 histograms (representing 60 000 events) and found 5 (6000 events) which show surprising peaks apparently not statistical fluctuations. We now try to explain it as a bias. We have keypunched any spectrum associated with a positive κ claim, but stopped at 60 000 total events simply because of the work involved. (We shall next automate the preparation of input data.) We estimate that 1.5 to 2 million events have been measured, each of which yields a Kπ mass value. Our reasoning is as follows:

Last year ≈ 2 million events were measured in the United States,[1] and we guess ≈ 3 million events for the world-wide annual rate. This rate has been roughly doubling every two years,[2] so the time integral of the number of bubble-chamber events measured must be ≈ 10 million. By comparing the number[3] of pictures exposed to $K^{\pm}$ with the number exposed to $\pi^{\pm}$ and p, we see that a quarter of these 10 million events were produced by $K^{\pm}$ with enough energy to produce Kπ events in the final state (with Kπ mass > 725 MeV).

So physicists have looked at Kπ spectra from ≈ 2.5 million events. We guess that 1.5 to 2 million events have been assembled in large collections and looked at carefully. If a κ peak is seen, it is published, and we keypunch. If nothing surprising is seen, one may not even publish the data, and we may not punch it. (But if readers will send us large relevant spectra, we will enter them from now on.) Then, at 1000 events/histogram, 2 million events yield 200 uninteresting histograms. Then the five surprising ones (only three from $K^{\pm}$ experiments) are perhaps to be expected.

So we restate our conclusion. We have not killed the κ but we do feel that we have further discredited it.

2. The H Meson (Ferbel, Rosenfeld, Soding)

The "H meson" is a supposed $I^G = 0^-$ state with a mass $m_H \approx 1000$ MeV, decaying into $(\rho\pi)^0$. Table A-II lists the experiments in which evidence was observed for a bump near 1000 MeV in the $(\rho\pi)^0$ mass spectrum. Figures A20 through A23 show the distributions of $M(\rho\pi)^0$ from these experiments. Goldhaber[4] discussed the H meson and compiled the data of Figs. A20 and A21, plus 1705 events from the reaction $\pi^+ d \to (\rho\pi)^0 pp$ from Benson et al.[5] After consultation with Benson et al., however, we have decided that it would be better to use only 790 events remaining in their sample after $p\pi^+$ combinations in the Δ band have been excluded. We have also added 1204 events that were contributed by the La Jolla group[6] but not used by Goldhaber because they were not yet available.

Table A-II. Experiments on H meson discussed in Appendix A.

Reaction	Beam momentum (GeV/c)	Number of events	Constraints	Reference	Plot symbol	Figure
$\pi^+ p \to (\rho\pi)^0 \Delta^{++}$	3.2 and 3.5	1204		Abolins 66[a]	A	A23
	3.65	519	no ω	Goldhaber 66[b]	G	A21
	4.0	975		Bartsch 64[c]	E	A20
$\pi^+ d \to (\rho\pi)^0 pp$	3.65	790	no Δ^{++}	Benson 66[d]	M	A22
	Total	3488				

a. See Ref. 6

b. Gerson Goldhaber, Experimental Study of Multiparticle Resonance Decays, in Proceedings of the 1965 Coral Gables Conference on Symmetry Principles at High Energies, University of Miami, Florida, 1965 (W. H. Freeman and Co., San Francisco, Calif., 1965), p. 34.

c. J. Bartsch et al., Phys. Letters 11, 167 (1964).

d. See Ref. 5.

The combined spectrum (Fig. A24) shows a peak extending from 960 to 1080 MeV, with an estimated significance of at least four standard deviations. Note, however, that its mean mass is about 1020 MeV, only about 50 MeV below that of the A1 meson. And its width, $\Gamma \approx 120$ MeV, is the same as Γ(A1).

This peak is presently seen only in experiments in the beam momentum range 3.2 GeV/c $\leq p(\pi^+) \leq 4$ GeV/c. It is not seen in similar experiments in the range 5.1 GeV/c $\leq p(\pi^+) \leq$ 8.5 GeV/c. This means that whatever the H phenomenon is, its production cross section drops rapidly at energies greater than $p(\pi^+) =$ 4 GeV/c. Note that 4 GeV/c is already high above the threshold, which is at $p(\pi^+) = 2.18$ GeV/c for $\pi^+ p \to H\Delta^{++}$ and even lower for $\pi^+ d \to Hpp$. Moreover, the data for $p(\pi^+) \leq 4$ GeV/c presented above are incomplete; we estimate that at least ≈ 1000 events from other experiments exist but are not yet accessible to us.

Let us accept the evidence for a neutral A1-like peak 50 MeV below the mass of A1. Is it a new meson, H, or is it the neutral A1, displaced to low energy by one half-width through interference with background? We know that the A1 is seen only when enhanced by the Deck effect, i. e., A1 seems to be produced weakly, and needs to interfere positively with background in order to be seen. But the interference could also displace its peak upwards by ≈ 25 MeV. The $A1^{\pm}(\rho\pi)^{\pm}$ is seen recoiling against a proton; the $H(\rho\pi)^0$ is seen recoiling against a Δ^{++}. Could the background phases differ enough between these two experiments that the $(\rho\pi)^0$ peak is displaced downwards by about 25 MeV? We do not know how to answer this question until more work is done.

The Michigan group [5] has suggested that as a next step one should look for an H peak in $\rho^0\pi^0$ only, where the A1, having isopin I = 1, cannot contribute. One can do this in two ways:

1) Compile $\rho^0\pi^0$ spectra, or 2) compile events from data-summary tapes. The latter procedure seems more likely to give us the information we want, for the following considerations. The $\pi^+\pi^-\pi^0$ Dalitz plot has three ρ bands (ρ^0, ρ^+, and ρ^-) which overlap partly at 1000 MeV, and overlap three deep at $\sqrt{3}m_\rho \approx 1300$ MeV. As the Michigan group shows in Fig. 2 of their paper, $\rho^0\pi^0$ spectra are contaminated with overlapping $\rho^{\pm}\pi^{\mp}$, but if one selects out the overlapping, double-ρ events, one produces an artificial bump at 1000 MeV. One can get around this difficulty by compiling the actual events and doing a maximum-likelihood fit to the population of the ρ^0 band. We shall do this.

A final difficulty with the H bump is contamination from the radiative decay of another meson, $\eta' \to \rho^0\gamma$, which will often fit the interpretation $\rho^0\pi^0$. The Michigan group [5] estimates that 6 ± 3 of their events are such intruders; their spectrum, Fig. A22, seems to contain about 36 H mesons from all the ρ bands; about half might come from $\rho^0\pi^0$.

In summary, the compilation of spectra carried out so far shows a bump but seems inadequate to distinguish between H and a neutral A1 peak. We feel that a compilation of very carefully selected $\rho^0\pi^0$ events is the most promising next step.

APPENDIX REFERENCES

1. E. C. Fowler, R. Plano, and A. H. Rosenfeld, Survey and Analysis of Bubble Chamber Pictures, in Proceedings of the 1966 International Conference on Instrumentation for High-Energy Physics, SLAC, Stanford, California, Sept. 9, 10, 1966; also Lawrence Radiation Laboratory Report UCRL-17097 (in preparation).
2. We assume that the world growth rate is the same as that of the Alvarez group, which has been doubling its rate every 2 years for 6 to 8 years. See L. W. Alvarez, Round-Table Discussion on Bubble Chambers, in Proceedings of the 1966 International Conference on Instrumentation for High Energy Physics, SLAC, Stanford, California, Sept. 9, 10, 1966; also Lawrence Radiation Laboratory Report UCRL-17096 (Sept. 1966) (unpublished).
3. L. Piekenbrock, Annual Survey of Bubble Chamber Film, University of Colorado, Boulder, Colorado.
4. Gerson Goldhaber, Rapporteur's talk, Session 7, in Proceedings of the XIIIth Conference on High-Energy Physics, August 31 through September 7, 1966, Berkeley, California (proceedings to be published by the University of California Press, Berkeley).
5. G. Benson et al., Phys. Rev. Letters 16, 1177 (1966), and private communication from D. Sinclair (Univ. of Michigan).
6. M. Abolins, R. Lander, N. Xuong, and P. Yager (private communication), University of California, San Diego, at La Jolla.