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Data on Particles and Resonant States*

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

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

As always, we make two requests of our readers:

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

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

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

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

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

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

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

These three tables, along with other useful information, appear at the end of this article on perforated sheets. These are the new "wallet cards": the paper is now thinner and more durable, and the reader can fold them according to his needs.

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

NOTES ON THE TABLES

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

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

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

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

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

bers are established). We have used flimsy evidence to guess many of the remaining ones, and we have indicated with ? the ones for which there is almost no evidence.

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

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

For broad resonances there is an inconsistency in the way the central value M_R is usually stated. For a well-studied resonance like $N_{3/2}^*(1236)$ or $Y_0^*(1520)$, it is conventional to call M_R or E_R the energy at which the resonant amplitude would (in the absence of background) become pure imaginary. [For $N_{3/2}^*(1236)$ this corresponds to 1236 MeV, but for further discussion of this point see the note following the baryon listings.] But this does not mean that the peak in an observed cross section occurs at M_R, because kinematic factors enter into the relation between amplitude and cross section. Thus the peak in the πp cross section near 1236 MeV actually occurs at 1223 MeV. Nevertheless, it is conventional simply to report the energy of the peak in the observed cross section. For well-studied resonances, we have protected the averaging programs (by putting a star in the eighth column of the data cards) from masses and widths obtained without the proper kinematical factors or the proper background treatment. For the others, we have used whatever data was available.

NOTES ON TABLE S

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

Hyperon Decay Asymmetries

We adopt the following conventions for the decay asymmetries:

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

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

$$\gamma = (|s|^2-|p|^2)/(|s|^2+|p|^2),$$

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

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

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

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

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

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

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

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

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

Under time-reversal invariance, one should have

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

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

$$\delta_s - \delta_p \approx 7°.^7$$

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

NOTES ON THE MESON TABLE

The Symbol-Minded Approach

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

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

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

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

[5] T. D. Lee and C. N. Yang, Phys. Rev. **108**, 1645 (1957).

[6] J. W. Cronin and O. E. Overseth, Phys. Rev. **129**, 1795 (1963).

[7] S. W. Barnes, B. Rose, G. Giacomelli, J. Ring, K. Miyake, and K. Kinsey, Phys. Rev. **117**, 226 (1960).

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

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

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

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

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

$Y=1$, $I=\frac{1}{2}$, K (called K_V if $K\to K\pi$, K_A if $\not\to K\pi$),

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

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

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

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

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

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

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

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

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

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

Quantum Numbers and the Symbol C_n

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

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

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

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

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

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

Meson Decays into 2π or $\bar{K}K$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

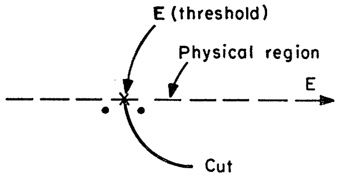

FIG. 1. The complex energy plane near threshold, showing possible poles (dots) corresponding to two ordinary Breit-Wigner resonances. The cut attached to the threshold branch point has been drawn so as to expose both the pole positions and the physical region.

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

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

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

NOTES ON THE BARYON TABLE

S-Wave Bumps Near Threshold

This matter was discussed under Mesons.

Symbol-Minded Approach for Baryons (cf. Mesons)

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

PROCEDURES FOR TREATING THE DATA

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

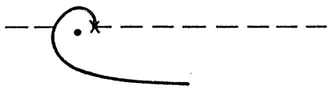

FIG. 2. The complex energy plane near threshold, showing the possible position of a pole corresponding to an "antibound state." Notice that in order to expose the pole in the figure the physical region just below threshold has been obscured from view.

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

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

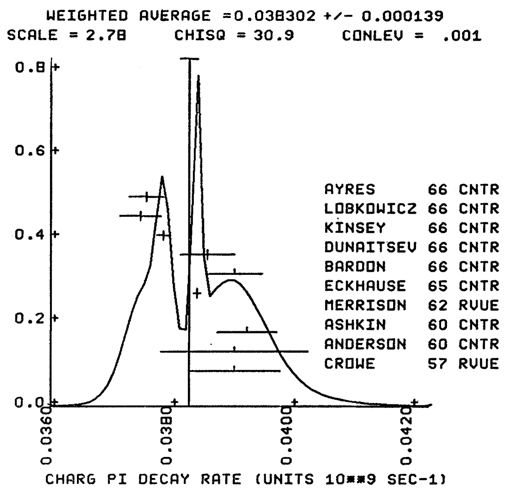

FIG. 3. Typical ideogram: $\pi^{\pm}$ decay rates. Results are usually published as mean lives τ, but we average *rates*, $\Gamma=1/\tau$ because rates are more normally distributed. The rms average $\bar{\Gamma}=(38.33\pm0.05)10^6\ \mathrm{sec}^{-1}$ is drawn as a vertical line, with an error flag at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

χ^2 Scale Factor

When we calculate the weighted average $\bar{x}$, we also calculate the χ^2 that all the measurements of x agree. If there are N experiments, each with properly estimated errors normally distributed, the average value of χ^2 should be $N-1$. If χ^2 is much larger than $N-1$, we average the data even though this may not be warranted. *But we plot an ideogram* (Fig. 3) *to help*

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

the reader decide which data to reject. He can then make his own selected average. However, if χ^2 is not much greater than $N-1$, and we cannot select a single bad experiment, we can still be conservative by the following approach: Instead of rejecting one culprit, we can assume that all experimentalists underestimated their errors by the same factor (which is, of course, $[\chi^2/(N-1)]^{1/2} \equiv \text{SCALE}$). If this were true, then we could correct the calculated error of the mean simply by multiplying each of the reported errors by SCALE, and then recalculating the error of $\bar{x}$. Multiplying the original $\delta(\bar{x})$ by SCALE would obviously also give the same final result.

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

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

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

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

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

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

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

Conversion of Mean Lives to Rates

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

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

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

Alternatively he can report a rate

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

If his errors are large it is probably because N is small. In that case one can see that the distribution of rate Γ, with N in the numerator, should be fairly Poisson. But the distribution of mean life τ, with N in the denominator, will be badly skewed. Accordingly, we have inverted all mean lives before averaging data or making ideograms.

NOTES ON THE DATA CARDS

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

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

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

Cross-Sections Cards (Coded CS)

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

Note added in proof. Overseth *et al.* have called our attention to a mistake in sign in the Λ phi-parameter card in the data listings. On Table S the Λ decay parameter angles should be changed to read: $\phi = (-6 \pm 7)^\circ$, $\Delta = (7 \pm 8)^\circ$.

Other mistakes are:

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

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

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

given by Chung +66 has been changed to 0.12+0.08. Hence in the table, the following fractions should be changed: $A2 \rightarrow \rho\pi = (91 \pm 8)\%$, $A2 \rightarrow \eta\pi = (5 \pm 8)\%$, $S = 2.9$.

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

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

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

EXPLANATION OF SYMBOLS USED ON DATA CARDS

The following abbreviations have been used:

1. *Measurement Technique* (TECH)

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

2. *Journals*

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

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

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	$I^G(J^P)C_n$	Mass (MeV)	Mass difference (MeV)	Mean life (sec) $c\tau$ (cm)	Mass^2 (GeV)^2	Decays: Partial mode	Decays: Fraction	Q (MeV)	p or p_{max} (MeV/c)
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 (> 2×10^{21} y)	0.000	stable	$\mu_e = \begin{matrix}1.001159622\\ \pm.000000027\end{matrix} \frac{e\hbar}{2m_ec}$		
$\mu^\mp$	$J=\frac{1}{2}$ $\mu_\mu = \begin{matrix}1.001164\\ \pm.000003\end{matrix} \frac{e\hbar}{2m_\mu c}$	105.659 ±.002	-33.920 ±.014	2.199×10^{-6} ±.001, S=1.3* $c\tau = 6.592\times10^4$	0.011	$e\nu\bar{\nu}$	100 %	105	53
						$e\gamma\gamma$	(< 1.6)10^{-5}	105	53
						3e	(< 1.3)10^{-7}	104	53
						$e\gamma$	(< 6)10^{-9}	105	53
$\pi^\pm$	$1^-(0^-)^+$	139.579 ±.014	4.6041 ±.0037	2.608×10^{-8} ±.015, S=3.5* $c\tau$ = 782 $(\tau^+-\tau^-)/\bar{\tau}$ = (.4±.2)% (test of CPT)	0.019	$\mu\nu$	100 %	34	30
						$e\nu$	(1.24± 0.03)10^{-4}	139	70
						$\mu\nu\gamma$	(1.24± 0.25)10^{-4}	34	30
						$\pi^0e\nu$	(1.01± 0.09)10^{-8}	4	5
						$e\nu\gamma$	(3.0 ±0.5)10^{-8}	139	70
π^0	$1^-(0^-)^+$	134.975 ±.014		[b] 0.89×10^{-16} ±.18, S=1.6* $c\tau = 2.67\times10^{-6}$	0.018	$\gamma\gamma$	[c](98.8)%	135	67
						γe^+e^-	(1.169)%	134	67
						$\gamma\gamma\gamma$	[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	-4.05 ±.12	1.235×10^{-8} ±.006, S=2.4* $c\tau$ = 3.70 $(\tau^+-\tau^-)/\bar{\tau}$ = (.09±.08)% (test of CPT)	0.244	$\mu\nu$	[b](63.4 ±0.5)% } S=1.5*	388	236
						$\pi\pi^0$	(21.0 ±0.3)% } S=1.5*	219	205
						$\pi\pi^-\pi^+$	(5.6 ±0.1)% } S=1.5*	75	126
						$\pi\pi^0\pi^0$	(1.71± 0.08)%, S=1.5*	84	133
						$\mu\pi^0\nu$	(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
						$\pi\pi^\pm e^\mp\nu$	(< 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}	$\frac{1}{2}(0^-)$		$-0.48\times\frac{1}{\tau_S}$ ±.02	0.87×10^{-10} ±.009, S=1.3* $c\tau$ = 2.61	0.248	$\pi^+\pi^-$	(69.3 ±1.2)% S=1.25*	219	206
						$\pi^0\pi^0$	(30.7 ±1.2)% S=1.25*	228	209
K_{Long}	$\frac{1}{2}(0^-)$			5.68×10^{-8} ±.26 $c\tau$ = 1703	0.248	$\pi^0\pi^0\pi^0$	(23.5 ±2.1)%	93	139
						$\pi^+\pi^-\pi^0$	(11.5 ± .4)%	84	133
						$\pi\mu\nu$	(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<Γ<10 keV $(2<c\tau<20)10^{-10}$	Neutral decays 72.9%	$\gamma\gamma$	(31.4 ±2.2)%	549	274
						$\pi^0\gamma\gamma$	(20.5 ±3.5)% S=1.3*	414	258
						$3\pi^0$	(21.0 ±3.2)% S=1.5*	144	179
					Charged decays 27.1%	$\pi^+\pi^-\pi^0$	(22.4 ±1.8)%	135	174
						$\pi^+\pi^-\gamma$	(4.6 ±0.8)% S=1.1*	269	236
						$\pi^0e^+e^-$	(< 0.2)%	413	258
						$\pi^+\pi^-e^+e^-$	(0.1 ±0.1)%	268	236
p	$\frac{1}{2}(\frac{1}{2}^+)$	938.256 ±0.005	-1.2933 ±.0001	stable (> 6×10^{27} y)	0.880				
n	$\frac{1}{2}(\frac{1}{2}^+)$	939.550 ±0.005		$(1.01\pm.03)10^3$ $c\tau = 3.03\times10^{13}$	0.882	$pe^-\nu$	100 %	1	1
Λ	$0(\frac{1}{2}^+)$	1115.58 ±0.10		2.51×10^{-10} ±.04, S=1.4* $c\tau$ = 7.52	1.245	$p\pi^-$	(66.4 ±1.1)% S=1.1*	38	100
						$n\pi^0$	(33.6 ±1.1)% S=1.1*	41	104
						$pe\nu$	(0.88± 0.15)10^{-3}	177	163
						$p\mu\nu$	(1.35± 0.60)10^{-4}	72	131
Σ^+	$1(\frac{1}{2}^+)$	1189.47 ±0.08	-7.97 ±.11	0.810×10^{-10} ±.013 $c\tau$ = 2.43	1.412	$p\pi^0$	(52.8 ±1.5)%	116	189
						$n\pi^+$	(47.2 ±1.5)%	110	185
						$p\gamma$	(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
						$ne^+\nu$	(< 5)10^{-5}	249	224
Σ^0	$1(\frac{1}{2}^+)$	1192.56 ±0.11	-4.88 ±.06	$<1.0\times10^{-14}$ $c\tau<3\times10^{-4}$	1.422	$\Lambda\gamma$	[c]100 %	77	75
						Λe^+e^-	[c](5.45)10^{-3}		
Σ^-	$1(\frac{1}{2}^+)$	1197.44 ±0.09		1.65×10^{-10} ±.03, S=1.4* $c\tau$ = 4.95	1.434	$n\pi^-$	100 %	118	193
						$ne^-\nu$	(1.25± 0.17)10^{-3}	257	230
						$n\mu^-\nu$	(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	-6.5 ±.2	3.0×10^{-10} ±.5, S=1.3* $c\tau$ = 8.99	1.728	$\Lambda\pi^0$	100 %	64	135
						$p\pi^-$	(< .5)%	237	299
						$pe^-\nu$	(< .6)%	376	323
						$\Sigma^+e^-\nu$	(< .7)%	125	119
						$\Sigma^-e^+\nu$	(< .6)%	117	112
						$\Sigma^+\mu^-\nu$	(< .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} ±.05 $c\tau$ = 5.22	1.746	$\Lambda\pi^-$	100 %	66	139
						$\Lambda e^-\nu$	(2.5 ±1.8)10^{-3}	205	190
						$n\pi^-$	(< 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} ±.5, $c\tau$ = 4.5	2.802	$\Xi\pi$	(~50)%	221	296
						$\Lambda\bar{K}$	(~50)%	66	216

General Atomic and Nuclear Constants[a]

N = 6.02252 × 10^{23} mole^{-1} (based on A_{C12} = 12)
c = 2.997925 × 10^{10} cm sec^{-1}
e = 4.80298 × 10^{-10} esu = 1.60210×10^{-19} coulomb
1 MeV = 1.60210 × 10^{-6} erg
ħ = 6.5819 × 10^{-22} MeV sec
= 1.05449 × 10^{-27} erg sec
ħc = 1.9732 × 10^{-11} MeV cm = 197.32 MeV fermi
k = 8.6171 × 10^{-11} MeV deg^{-1} (Boltzmann const.)
$\alpha = e^2/\hbar c$ = 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)
$\sigma_{Thompson} = \frac{8}{3}\pi r_e^2 = 0.66516\times10^{-24}$ 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)

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

$\mu_{Bohr} = e\hbar/2m_ec = 0.578817\times10^{-14}$ MeV gauss^{-1}
$\mu_{nucl} = e\hbar/2m_pc = 3.1524\times10^{-18}$ MeV gauss^{-1}
$\frac{1}{2}\omega_{cyclotron}$ $\begin{cases} = e/2m_ec = 8.79404\times10^6 \text{ rad sec}^{-1}\text{ gauss}^{-1} \\ = e/2m_pc = 4.7895\times10^3 \text{ rad sec}^{-1}\text{ gauss}^{-1}, \end{cases}$
$\sigma_{natural} = \pi(\hbar/m_{\pi^\pm}c)^2$ = 62.768 mb

Other Physical Constants

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

Numerical Constants

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

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

	Magnetic moment ($e\hbar/2m_pc$)	Decay Parameters[†] Measured: α	Measured: Φ(degree)	Derived: γ	Derived: Δ(degree)
p	2.792763 ±.000030				
n	-1.913148 ±.000066				
Λ	-0.73 ±.16	.663±.022 .73 ±.18 .06 ±.19	(7±7)°	.74	(-8±8)°
Σ^+	2.3 ±.6	-.960±.067 +.008±.037	(180±30)°	-1.0	(0±85)°
Σ^0					
Σ^-		-.010±.043			
Ξ^0		-.33 ±.10			
Ξ^-		-.391±.032	(6±8)°	.92	(14±15)°

[†] The definition of these quantities is as follows

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

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

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* 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, $\overline{p}_{max}$ is the maximum momentum that *any* particle can have.

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

$m_8 = \sqrt{K^2 + \frac{K^2-\pi^2}{3}}$ =	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 $\rho\rho$ (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 $\rho\pi$ 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.

BARYONS - January 1967

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

---

a. See note in data listings.

b. J^P assignment based on straight-line Regge-trajectory-recurrence hypothesis and supported by fits to πp elastic scattering at 180°. See note following data listings.

c. Evidence for the existence of the effect and/or for its interpretation as a resonance is open to some question.

d. A virtual bound state of the $\bar{K}N$ system with negative scattering length $[a_0 = (-1.6 + 0.6i)F]$; i.e., a pole in the S matrix below the elastic threshold. See notes in main text and data listings.

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

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

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

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

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

The following abbreviations refer to proceedings of Conferences

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

Finally

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

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

DATA FOR TABLES ON STABLE PARTICLES

STABLE MEANING IMMUNE TO STRONG DECAY

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

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

       1         2         3         4         5         6         7         8
*45678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678
```

γ

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

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

ν_e

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

                1  E-NFUTRINO  MASS (KEV)

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

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


                       REFERENCES

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

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

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```

ν_μ

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

                2  MU-NEUTRINO  MASS (MEV)

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

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


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

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

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****** ********* ********* ********* ********* ********* ********* *********
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e

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

                3  ELECTRON  MASS (MEV)

M         0.511006 0.000002          COHEN    65 RVUE

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            3  ELECTRON LIFETIME (UNITS 10**21 YR)

T   *     OVER                2.0   MOE       65 CNTR                    6/66

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

                3  ELECTRON MAGNETIC MOMENT(E/2ME)

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

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


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

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

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μ

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                4  MUON  (106,J=1/2)

                4  MUON  MASS (MEV)

M         105.659   0.002            FEINBERG 63 RVUE

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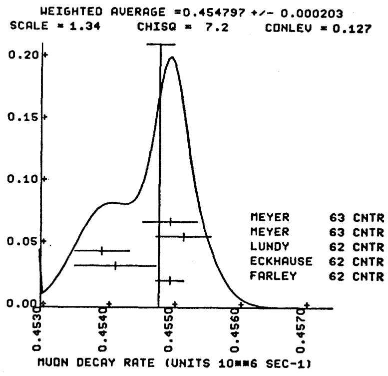
                4  MUON LIFETIME (UNITS 10**-6)

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)
------ --------- --------- --------- --------- --------- --------- ---------
```



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

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

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

                4  MUON PARTIAL DECAY MODES

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

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

                4  MUON  BRANCHING RATIOS

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

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

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

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

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

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

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


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

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

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

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

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

                8  CHARGED PI  MASS (MEV)

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

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                8  PI+ MU+ MASS DIFFERENCE (MEV)

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

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

T              25.6      0.5       0.5   CROWE      57 RVUE
T              25.6      0.8       0.8   ANDERSON   60 CNTR
T      8000    25.46     0.32      0.32  ASHKIN     60 CNTR +
T                                        MERRISON   62 RVUE

T              26.02     0.04            ECKHAUSE   65 CNTR +             9/  6/66
T              25.6      0.3             BARDON     66 CNTR                   6/66
T              25.9      0.3             DUNAITSEV  66 CNTR                   9/66
T              26.40     0.08            KINSEY     66 CNTR +                 6/66
T              26.67     0.24            LOBKOWICZ  66 CNTR                   9/66
T              26.6      0.2             AYRES      66 CNTR                  10/66
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(Ideogram below)

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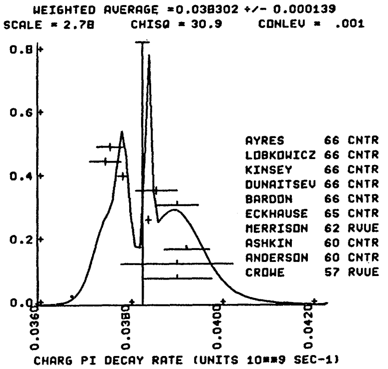

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                 8 MEANLIFE DIFFERENCE,(+)-(-)/AVGE. (PERCENT)

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

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

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                 8  CHARGED PION PARTIAL DECAY MODES

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

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                 8  CHARGED PION BRANCHING RATIOS

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

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

R3  *  CHAR.PION INTO PIO E NEU     (UNITS 10**-8)      (P4)/(P1)
R3      36    0.97     0.20           BARTLETT  64 SPRK
R3      38    1.07     0.21           BACASTOW  65 SPRK +
R3            1.10     0.26           BERTRAM   65 SPRK                  6/66
R3      43    1.1      0.2            DUNAITSEV 65 CNTR                  7/66
R3            1.01     0.08     0.10  DEPOMMIER 66 CNTR                  6/66

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

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

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

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

CZIRR    63 PR 130  341         JOHN B CZIRR ///////////////////////// LRL
DEPOMMIE 63 PL  7 285           P DEPOMMIER,HEINTZE,RUBBIA,SOERGEL // CERN
BARTLETT 64 PR 136B 1432        BARTLETT,DEVONS,MEYER,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

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

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

D   *         5.37     1.0            PANOFSKY  51 CNTR  -
D             4.50     0.31           CHINOWSKY 54 CNTR  -
D             4.62     0.05           HADDOCK   59 CNTR  -
D             4.60     0.04           HILLMAN   59 CNTR
D             4.55     0.07           CASSELS   59 CNTR

D             4.6056   0.0055         CZIRR     63 CNTR
D             4.59     0.03           PETRUKHIN 63 CNTR  -
D             4.6034   0.0052         VASILEVSK 66 CNTR  -                9/66

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                 9  PIO  LIFETIME (UNITS 10**-16)

T   N   76    1.9      0.5      0.5   GLASSER   61 EMUL
T   N   45    2.3      1.1      1.0   TIETGE    62 EMUL
T   N   88    2.8      0.9      0.9   KOLLER    63 EMUL
T             1.05     0.18     0.18  VON DARDE 63 CNTR

T   N   75    1.7      0.5            SHWE      64 EMUL
T             0.730    0.105          BELLETTIN 65 CNTR                   6/66
T   N   67    1.6      0.6      0.5   EVANS     65 EMUL                   6/66
T   N      EMULSION MEASUREMENTS NOT USED BECAUSE OF POSSIBLE SYSTEMATIC
T   N      SHIFT TO LARGER LIFETIME VALUES

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                 9  NEUTRAL PION PARTIAL DECAY MODES

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

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                 9  NEUTRAL PION BRANCHING RATIOS

R1  *  PIO INTO (GAMMA E+ E-)/(2GAMMA)                 (P2)/(P1)

R1  *       0.01196 THEORETICAL CALC.JOSEPH    61        QUANTUM ELECT.    9/66

R1      27    0.0117   0.0015         BUDAGOV   60 HBC
R1    3071    0.01166  0.00047        SAMIOS    61 HBC       PI-P TO PIO N
R1  S      SAMIOS VALUE USES PANOFSKY RATIO = 1.62

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

R3  *    PIO INTO (E+E+E-E-)/(2 GAMMA) (UNITS 10**-5)  (P3)/(P1)

R3  *         3.47   THEORETICAL CAL. KROLL    55        QUANTUM ELECT.    9/66

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

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

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

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

CZIRR    63 PR  130  341        JOHN B CZIRR ///////////////////////// LRL
KOLLER   63 NC   27 1405        E L KOLLER,S TAYLOR,T HUETTER //// STEVENS
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

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$K^{\pm}$

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

                 10  CHARGED K  MASS (MEV)

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

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

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

T             0.95     0.36     0.25  ILOFF     56 EMUL
T       52    1.60     0.3      0.3   EISENBERG 58 EMUL
T             1.21     0.06     0.06  BURROWES  59 CNTR
T       33    1.38     0.24     0.24  FREDEN    60 EMUL

T             1.25     0.22     0.17  BARKAS    61 EMUL
T       51    1.27     0.36     0.23  BHOWMIK   61 EMUL
T      293    1.31     0.08     0.08  NORDIN    61 HBC   -
T   *         1.24     0.07           NORDIN    61 RVUE  -
T             1.231    0.011    0.011 BOYARSKY  62 CNTR +
T             1.2443   0.0038         FITCH     65 CNTR +                 6/66
T             1.2265   0.0036         LOBKOWICZ 66 CNTR +                 9/66
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(Ideograms on next page)

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

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

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

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              10  CHARGED K PARTIAL DECAY MODES

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

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              10  CHARGED K BRANCHING RATIOS

R   O       OLD DATA EXCLUDED

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

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

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

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

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

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

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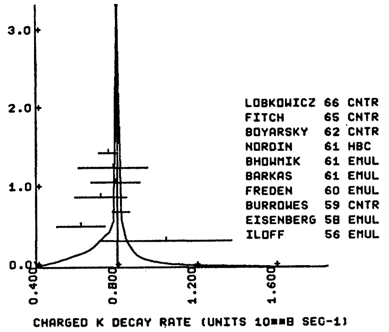
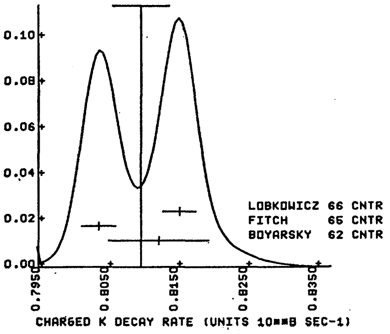
WEIGHTED AVERAGE =0.80971 +/- 0.00403
SCALE = 2.42   CHISQ = 11.7   CONLEV = 0.003



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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BIRGE     56 NC    4    834       BIRGE,PERKINS,PETERSON,STORK,WHITEHEA//LRL
ILOFF     56 PR 102    927        ILOFF,GOLDHABER,LANNUTTI,GILBERT + /// LRL
ALEXANDE  57 NC    6    478       ALEXANDER,JOHNSTON,OCEALLAIGH//DUBLIN INST
COHEN     57 FUND.CONS.PHYS.      E R COHEN,K M CROWE,J DUMOND // AI+LRL+CIT
EISENBER  58 NC    8   663        EISENBERG,KOCH,LOHRMANN,NIKOLIC + /// BERN
BURROWES  59 PRL   2   117        BURROWES,CALDWELL,FRISCH,HILL + ////// MIT
TAYLOR    59 PR 114   359         S TAYLOR,HARRIS,OREAR,LEE,BAUMEL//COLUMBIA

FREDEN    60 PR 118   564         S C FREDEN,F C GILBERT,R S WHITE ///// LRL
BARKAS    61 PR 124 1209          BARKAS,DYER,MASON,NORRIS,NICKOLS,SMIT//LRL
BHOWMIK   61 NC   20   857        B BHOWMIK,P C JAIN,P C MATHUR //DELHI UNIV
NORDIN    61 PR 123 2166          PAUL NORDIN JR ///////////////////////// LRL
ROE       61 PRL   7   346        ROE,SINCLAIR,BROWN,GLASER + ///// MICH+LRL
BOYARSKI  62 PR 128 2398          BOYARSKI,LOH,NIEMELA,RITSON ////////// MIT

BARKAS    63 PRL 11    26         W H BARKAS,J N DYER,H H HECKMAN ////// LRL
BIRGE     63 PRL  11   35         BIRGE,ELY,GIDAL,CAMERINI + // LRL+WIS+BARI
BORREANI  64 PL    12 123         G BORREANI,G RINAUDO,A WERBROUCK /// TURIN
CALLAHAN  64 PR   136 B 1463      A CALLAHAN,R MARCH,R STARK ///// WISCONSIN
CAMERINI  64 PRL   13 318         CAMERINI,CLINE,FRY,POWELL // WISCONSIN+LRL
CLINE     64 PRL   13 101         D CLINE, W F FRY //////////////// WISCONSIN
GREINER   64 PRL   13 284         D GREINER, W OSBORNE, W BARKAS /////// LRL
SHAKLEE   64 PR   136 B 1423      SHAKLEE,JENSEN,ROE,SINCLAIR ///// MICHIGAN

BIRGE     65 PR 139 B 1600        BIRGE,ELY,GIDAL,CAMERINI,CLINE + //LRL+WIS
BISI      65 NC    35  768        BISI,BORREANI,CESTER,FERRARO + ///// TURIN
BISI      65 PR 139 B 1068        BISI,MARZARI-CHIESA,RINAUDO // TURINO,INFN
CALLAHAN  65 PRL   15  129        A CALLAHAN,D CLINE ///////////// WISCONSIN
CAMERINI  65 NC    37 1795        CAMERINI,CLINE,GIDAL,KALMUS,KERNAN/WIS+LRL
CLINE     65 PL    15  293        A CLINE,W F FRY ///////////////// WISCONSIN
DE MARCO  65 PR 140 B 1430        DE MARCO,GROSSO,RINAUDO ////// TURINO+CERN
FITCH     65 PR 140 B 1088        FITCH,QUARLES,WILKINS //PRINCETON+MT HOLYK
GREINER   65 ARNS  15  67         QUOTED BY BARKAS                    // LRL
STAMER    65 PR  138 B 440        STAMER,HUETTER,KOLLER,TAYLOR,GRAUMAN//STEV
TRILLING  65 UCRL 16473           GEORGE H TRILLING ///////////////////// LRL
  (TRILLING 65 IS AN UPDATE OF HIS REPORT AT THE 1965 ARGONNE CONF, P 115)
YOUNG     65 UCRL 16362           POH-SHIEN YOUNG (THESIS,BERKELEY) //// LRL

AUERBACH  66  BERKELEY 2B         AUERBACH,MANN,WHITE,YOUNT+//PENN-PRINCETON
BOWEN     66  BERKELEY 2B         BOWEN,MANN,MCFARLANE,HUGHES+/PENN-PRINCETO
CALLAHAN  66 NC 44A 90            A C CALLAHAN                  // WISCONSIN
CESTER    66 PL 21 343            CESTER,ESCHSTRUTH,ONEILL+ //PRINCETON-PENN
LOBKOWIC  66 PRL  17  548         LOBKOWICZ,MELISSINOS,NAGASHIMA+ //ROCH+BNL
TSIPIS    66  BERKELEY CONF       +MEYER,ROSEN+ //COLUMBIA+RUTGERS+ROCH+WISC

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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K^0

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

              11  KO MASS  (MEV)

M            498.1      0.4           CHRISTENS 64 SPRK
M      2223  497.44     0.33          KIM       65 HBC     KO FRCM PBAR P    6/66
M      4500  498.9      0.5           BALTAY    66 HBC     KO FROM PBAR P    6/66
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(Ideogram below)
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              11  KO-K CH. MASS DIFFERENCE (MEV)

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

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

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

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K^0_1

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

              12  KO1 LIFETIME (UNITS 10**-10)

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

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

T      572    0.91      0.04            AUERBACH   65 SPRK                   6/66
T             0.866     0.016           ALFF-STEI  66 SPRK                   9/66
T     4500    0.92      0.04            BALTAY     66 HBC                    6/66
T             0.904     0.024           BOTT-BODE  66 SPRK                   9/66
T             0.858     0.014           HILL       66 DBC                    9/66
T     5000    0.843     0.013           KIRSCH     66 HBC                    6/66
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(Ideogram below)
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              12  KO1 PARTIAL DECAY MODES

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

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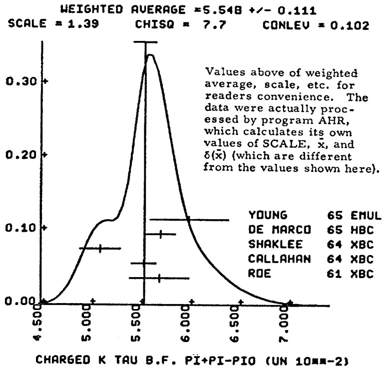
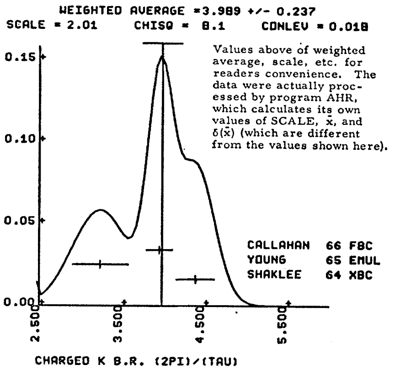


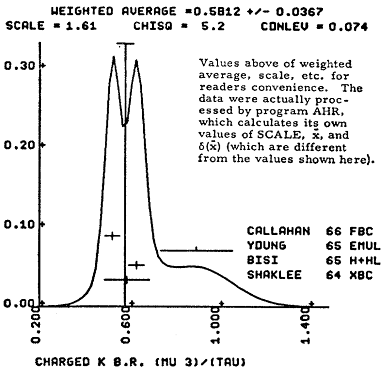
Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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



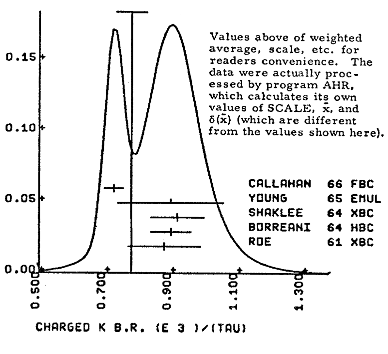
Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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



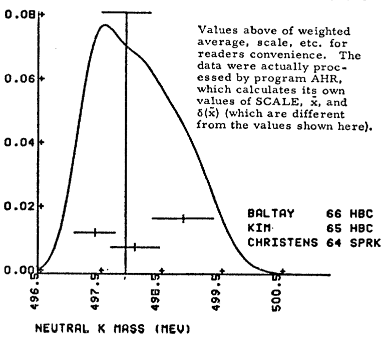
Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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



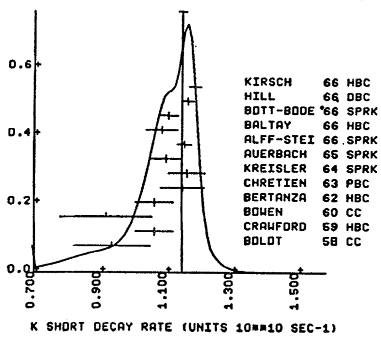
Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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



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).

NEUTRAL K MASS (MEV)



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

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                     12  K01  BRANCHING RATIOS

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

R2  *  K01 INTO (PIO PIO)/TOTAL                             (P2)/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- PIO)/(K02 INTO PI+ PI- PIO)
R3           0.45   OR LESS         BEHR      66 HLBC   90 PER CT CONF    8/66

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

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

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

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

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

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

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K_2^0

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

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

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

D             0.47     0.21            AUBERT    65 PBC                    6/66
D             0.26     0.36     0.26 BALDO-CEO 65 PBC      ASS.CP CONS.
D   *         0.60   OR LESS           FITCH     65 SPRK     CF. MEISNER 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      KO SCATTER IN D2 11/66
D             0.55     0.1             CHRISTENS 66 SPRK                   6/66
D             0.72     0.15            FUJII     66 SPRK     IRON REGENERATOR  9/66

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

T   *  ASSUMED DS=DQ AND DELTA I=1/2 CRAWFORQ  59 HBC
T      34   0.081    0.032    0.024 BARDON    58 CC
T      15   0.051    0.024    0.013 DARMON    62 FBC
T           0.054    0.06           FUJI      64 SPRK
T    1700   0.061    0.015    6.0   ASTBURY 3 65 CC
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                     13  K02 PARTIAL DECAY MODES

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

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                     13  K02 DECAY RATES

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

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

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

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

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                     13  K02 BRANCHING RATIOS

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

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

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

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

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

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

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

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

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

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

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

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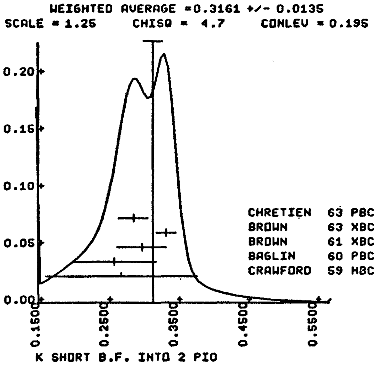

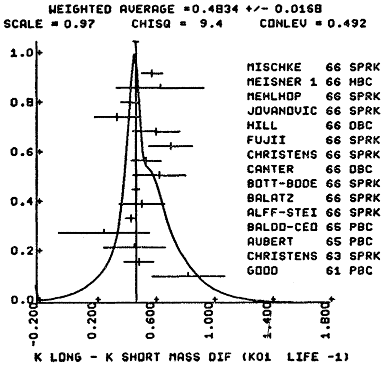

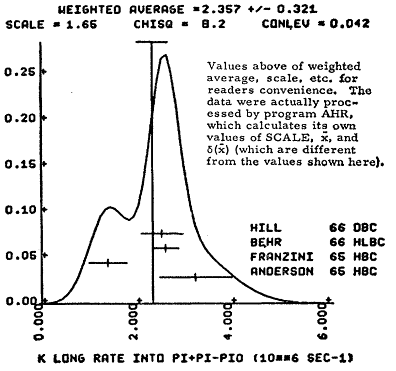

Values above of weighted average, scale, etc. for readers convenience. The data were actually processed by program AHR, which calculates its own values of SCALE, $\bar{x}$, and $\delta(\bar{x})$ (which are different from the values shown here).

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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

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                          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

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

              14  ETA MASS  (MEV)

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

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                 14  ETA  WIDTH (MEV)

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

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

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                 14  ETA PARTIAL DECAY MODES

P1      ETA INTO 2GAMMA                                     S 0S 0
P2      ETA INTO 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

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                 14 ETA   BRANCHING RATIOS

          (P9) IS ASSUMED = 0 IN ALL RATIOS

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

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

R3   *    ETA INTO 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

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                 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

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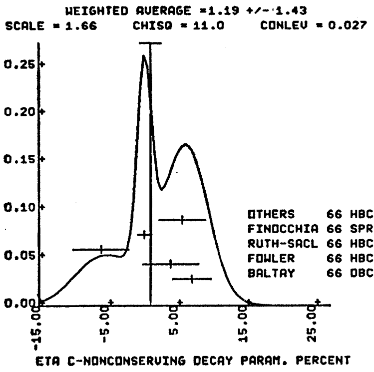

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                                  REFERENCES
                                  14 ETA(549,JPG=0-+)I=0

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

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

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

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

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

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

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

            REFERENCES ON ETA ASYMMETRY PARAMETERS

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

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

                    16  PROTON  MASS (MEV)

M          938.256    0.005          COHEN     65 RVUE                    7/66

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                    16  PROTON LIFETIME  (UNITS 10**26 YR)

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

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                    16 PROTON MAGNET. MOMENT(E/2MP)

MM         2.792763 0.000030         COHEN     65 RVUE                    7/66

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

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

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                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

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                17  NEUTRON LIFETIME (UNITS 10**3 SEC)

T            1.01      0.03     0.03  SOSNOVSKI 59 PILE

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                17  NEUTRON MAGNETIC MOMENT (MAGNETONS,938.2 MEV)

MM         -1.913148 0.000066        COHEN     56 SPECIAL                7/66

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

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

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Λ

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

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                    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

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                    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)
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                    18  LAMBDA MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

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

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                    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

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                          18  LAMBDA BRANCHING RATIOS

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

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


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                          18  LAMBDA DECAY PARAMETERS

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


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

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

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

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

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

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

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

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

ANDERSON 64 PRL   13  167          J A ANDERSON,F S CRAWFORD //////////// LRL
BADIER   64 DUBNA CONF 1 593       BADIER,BARLOUTAUD + //////EP+SACLAY+AMSTOM
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
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KREISLER 64 PR 136 B 1074      M N KREISLER,O OVERSETH,J CRONIN ///PRINCE
LIND     64 PR  135 B 1483     LIND,BINFORD,GOOD,STERN //////// WISCONSIN
RONNE    64 PL   11   357      RONNE+ /// CERN+EP+UCOL-LONDON+UNIV.BERGEN
SCHWARTZ 64 UCRL 11360 THESIS JOSEPH ADAM SCHWARTZ ////////////////// LRL

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

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

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    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

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

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

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

T      203    0.84      0.12      0.08   BHOWMIK   64 EMUL
T      181    0.84      0.09             BALTAY    65 HBC                   6/66
T      900    0.76      0.03             CARAYANNO 65 HBC                   6/66
T             0.83      0.018            CHANG     65 HBC                   6/66
T      381    0.80      0.07             COOK      66 SPRK                  7/66

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                    19  SIGMA+ MAGNETIC MOMENT (MAGNETONS,938.26 MEV)

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

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                    19  SIGMA+ PARTIAL DECAY MODES

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

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                    19  SIGMA+  BRANCHING RATIOS

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

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

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

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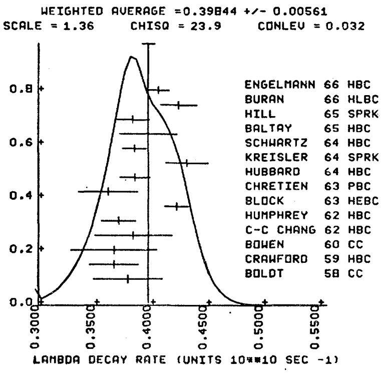

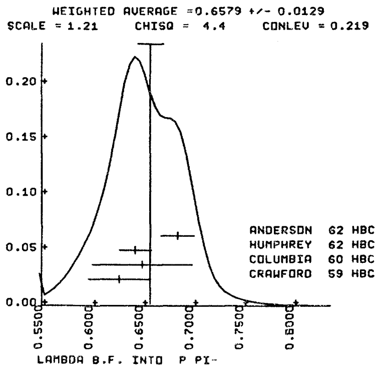

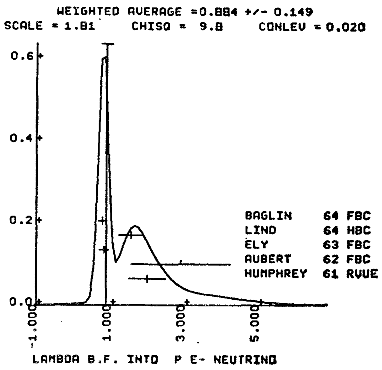

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R5  *  SIGMA+  INTO (N E+ NEU)/(N PI+)  (UNITS 10**-4)  (P7)/(P2)
R5  *    0  LESS THAN            2.6  BURNSTEIN 63 HBC
R5  *       LESS THAN       4.0       MURPHY    64 PBC
R5  *    1  LESS THAN           1.03  NAUENBERG 64 HBC

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

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                  19 SIGMA+ DECAY PARAMETERS

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

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

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

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

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

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

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

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

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

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

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

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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

                  20  SIGMA-   MASS (MEV)

M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

M   *      1197.47     0.11           SCHMIDT   65 HBC                    9/66

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

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

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

M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

DL           81.70     0.19           BURNSTEIN 64 HBC                    9/66

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

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)
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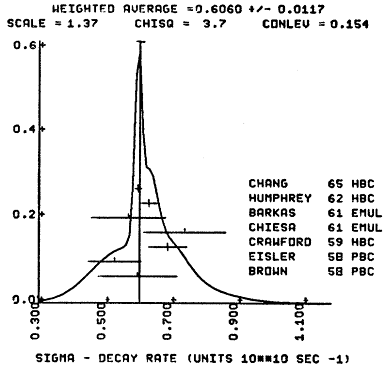

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                  20  SIGMA- PARTIAL DECAY MODES

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

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                  20  SIGMA-  BRANCHING RATIOS

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

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

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

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

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                  20 SIGMA- DECAY PARAMETERS

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

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                          REFERENCES

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

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

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

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

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

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

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

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

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

M    N SEE NOTE PRECEDING LAMBDA MASS LISTINGS

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

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                  21  SIGMAO LIFETIME (UNITS 10**-14)

T   *     1.0 OR LESS                 DAVIS     62 EMUL

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          21  SIGMA O PARTIAL DECAY MODES

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

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

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

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                                REFERENCES

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

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

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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

                   22  XI-  MASS (MEV)

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

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

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

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

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                   22  XI- PARTIAL DECAY MODES

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

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                   22  XI- BRANCHING RATIOS

R1  *  XI- INTO (LAMBDA E- NEU)/(LAMBDA PI-)               (P2)/(P1)
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We have arrived at a new world average using the following input:

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

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

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

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

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

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

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

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                   22  XI- DECAY PARAMETERS

A   *  ALPHA XI-
A              -0.44     0.11          JAUNEAU   63 FBC
A      240     -0.5      0.35          BADIER    64 HBC                      7/66
A      356     -0.62     0.12          CARMONY   64 HBC
A       62     -0.73     0.21          SCHNEIDER 64 HBC
A   * 1004     -0.368    0.057         BERGE     66 HBC    - REPL. BY MERRILL  7/66
A     2529     -0.342    0.044         MERRILL   66 HBC      USED ALPHAL=.747  9/66
A      364     -0.47     0.12          LONDON    66 HBC   USING A-LAMB =0.62   6/66
A   *          -0.391    0.032         BERGE 2   66 RVUE   INCLUDES ALL ABOVE  9/66
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F   *  PHI ANGLE (TAN(PHI)=BETA/GAMMA)  (DEGREE)
F           -16.       37.             JAUNEAU   63 FBC
F      356   54.0      25.0            CARMONY   64 HBC
F       62   45.0      30.0            SCHNEIDER 64 HBC
F    * 1004   0.45     10.7            BERGE     66 HBC    - REPL. BY MERRILL  7/66
F      364    0.0      17.0            LONDON    66 HBC      USED ALPHAL=.62   9/66
F     2529    1.2       7.5            MERRILL   66 HBC      USED ALPHAL=.747  9/66

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                                REFERENCES

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

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

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

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

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

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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

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

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

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

T         24    3.9       1.4       0.80  JAUNEAU   63 FBC
T         45    3.5       1.0        0.8  CARMONY   63 HBC
T        101    2.5       0.4       '0.3  HUBBARD   63 HBC
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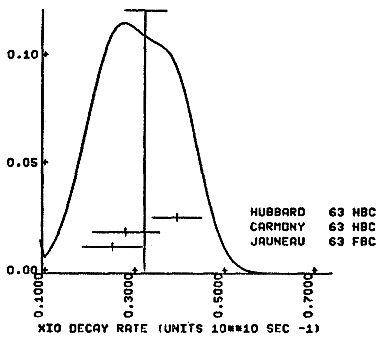
(Ideogram below)

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



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                   23  XI O  PARTIAL DECAY MODES

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

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                   23  XI O  BRANCHING RATIOS

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

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

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

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

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

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

A   *  ALPHA XI 0
A            -0.09      0.42          PJERROU   65 HBC
A   *        -0.149     0.154         BERGE     66 HBC                        7/66
A      46    -0.2       0.4           LONDON    66 HBC  USING A-LAMB=0.62     6/66
A     490    -0.33      0.10          MERRILL   66 HBC  A-LAM=0.690+-.048     8/66

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

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                         REFERENCES

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

ALVAREZ  59 PRL 2 215        ALVAREZ,EBERHARD,GOOD,GRAZIANO,TICHO+//LRL
JAUNEAU  63 SIENA CONF 1 1   JAUNEAU+ ///// PARIS+CERN+LOND+RUTH+BERGEN
   ALSO  63 PL 4 49          JAUNEAU+ ///// PARIS+CERN+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
HUBBARC  66 UCRL 11510       J RICHARD HUBBARD (THESIS,BERKELEY) // LRL
LONDON   66 PR 143 1034      LONDON,RAU,GOLDBERG,LICHTMAN+//BNL+SYRACUS
MERRILL  66  BERKELEY CONF   MERRILL,SHAFER,BERGE                 // LRL
     CF. 66 UCRL 16455       DEANE MERRILL (THESIS, BERKELEY) ///// LRL

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

                24  OMEGA-  MASS (MEV)

M   *    1 1620.0     25.0      10.0  EISENBERG 54 EMUL
M   S    1 1673.0      8.0            ABRAMS    64 HBC      INTO XI- PI0      7/66
M   S    1 1686.0     12.0            BARNES 1  64 HBC      INTO XIO PI-      7/66
M   S    1 1674.0      3.0            BARNES 2  64 HBC      INTO LAMBDA K-    7/66
M   S    1 1666.0      8.0            COLLEY    65 HBC      INTO XIO PI-      6/66
M   S    1 1671.0      5.0            RICHARDSO 65 HBC      INTC LAMBDA K-    7/66
M   S      ABOVE EVENTS INCLUDED IN SAMIOS RVUE                               7/66
M        6 1674.0      3.0            SAMIOS    65 RVUE                       6/66
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                24  OMEGA- LIFETIME  (UNITS 10**-10 SEC)

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

                24 OMEGA- PARTIAL DECAY MODES

P1  OMEGA- INTO LAMBDA K-                                   S18S10
P2  OMEGA- INTO XI 0 PI-                                    S23S 8

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

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

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DATA ON MESON RESONANCES

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

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

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σ (410)

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

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

There are four kinds of information concerning a ππ, 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.

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                         REFERENCES FOR SIGMA

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

    FOR NEGATIVE 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 DISCUSSION BY G. GOLDHABER, BERKELEY CONF. 1966, MESCN REVIEW

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ϵ (700)

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

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

               14     EPSILON (700)  MASS (MEV)

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

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               14     EPSILON (700)  WIDTH (MEV)

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

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                         REFERENCES FOR EPSILON

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

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ω (783)

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

              1  OMEGA  MASS (MEV)

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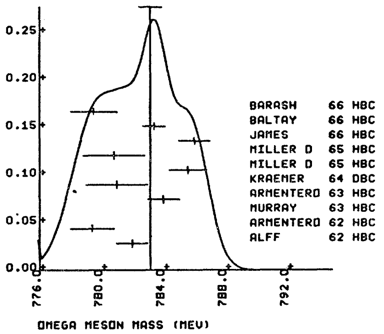

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              1  OMEGA FULL WIDTH (MEV)

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

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              1  OMEGA PARTIAL DECAY MODES

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

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              1  OMEGA  BRANCHING RATIOS

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

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

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

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

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

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

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

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                          REFERENCES FOR OMEGA

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

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

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

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

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

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η′ (958)

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            2  ETA PRIME (958,JPG=0-+)  I=0
               KNOWN EARLIER AS X0 OR ETA*

            2  ETA PRIME MASS (MEV)

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

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            2  ETA PRIME WIDTH (MEV)

W   *  85    4.0 OR LESS            DAUBER    64 HBC
W   *        7.0 OR LESS            KALBFLEIS 64 HBC                      6/66
W   *       30.0 OR LESS            BADIER    65 HBC
W   *       15.0 OR LESS            LONDON    66 HBC                      6/66

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            2  ETA PRIME PARTIAL DECAY MODES

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

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            2  ETA PRIME BRANCHING RATIOS

            PARTIAL MODES  ADJUSTED BY PROGRAM  AHR=12345

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

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

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

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

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

R6  *      ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING     NUM    5
R6  *                    RHO GAMMA)) / TOTAL            DEN 12345
R6  *      THIS MODE SEEMS TO BE CONSISTENT WITH BEING ENTIRELY RHO GAMMA
R6     20    0.2      0.1           LONDON    66 HBC                     10/66
R6     42    0.22     0.04          KALBFLEIS 64 HBC                     10/66
R6  B  35    0.34     0.09          BADIER    65 HBC                     10/66
R6  B      CONTROVERSIAL BACKGROUND SUBTRACTION
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R7   *     ETA PRIME INTO (PI+ PI- GAMMA (INCLUDING     NUM     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             NUM      6
R8   *      0.013  OR LESS          RITTENBER 65 HBC   DEN 12345             10/66

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

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

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

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

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

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

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

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

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η' Branching Ratios

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

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

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

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

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                        REFERENCES FOR ETA PRIME

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

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

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

        QUANTUM NUMBER DETERMINATICNS NOT REFERRED TO IN THE DATA CARDS

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

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H(975)

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

              35  H (975)  MASS  (MEV)

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

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

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

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                      REFERENCES FOR H MESON

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

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φ(1019)

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

              4  PHI  MASS (MEV)

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

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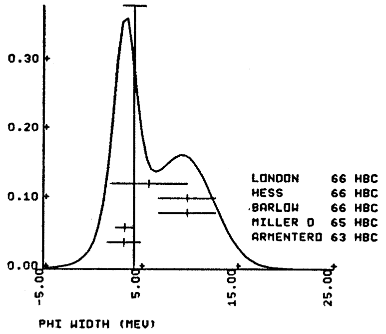
WEIGHTED AVERAGE =4.46 +/- 1.13
SCALE = 1.44 CHISQ = 8.3 CONLEV = 0.082



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              4  PHI PARTIAL DECAY MODES

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

              PARTIAL MODES ACJUSTED BY PROGRAM   AHR=123

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

R2   *        PHI INTO (K1 K2)/TOTAL                     NUM  2
R2   *                                                   DEN 123
R2   B   25    0.23     0.06        BADIER    65 HBC                     10/66
R2   B        CCNTROVERSIAL BACKGROUND SUBTRACTION
R2      167    0.40     0.04        LINDSEY   66 HBC                     10/66
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R3  *      PHI INTO (PI+ PI- PI0 (INCL.RHO PI))/TOTAL   NUM  3
R3  *                                                   DEN 123
R3  B  57    0.51     0.09          BADIER    65 HBC                     10/66
R3  B      CONTROVERSIAL BACKGROUND SUBTRACTION
R3     30    0.12     0.08          LINDSEY   66 HBC                     10/66

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

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

R6  *      PHI INTO (PI+ PI- PI0 (INCL.RHO PI))/(K KBAR)NUM  3
R6  *                                                   DEN 12
R6           0.30     0.15          LONDON    66 HBC                     10/66

R7  *      PHI INTO (PI+ PI- PI0 (INCL.RHO PI))/(K1 K2) NUM  3
R7  *                                                   DEN  2
R7  *        0.3    OR LESS         BERLEY    65 HBC                     10/66

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

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

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

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

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

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

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

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

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                            REFERENCES FOR PHI

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

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

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

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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η_V (1050)

$\rightarrow K_S K_S$

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

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

                3 ETA (1050) MASS (MEV)

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

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                3 ETA (1050) WIDTH (MEV)

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

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                3 ETA (1050) PARTIAL DECAY MODES

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

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                3 ETA (1050) BRANCHING RATIOS.

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

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                          REFERENCES FOR ETA(1050)

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

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

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f (1250)

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

                5  F   MASS (MEV)

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

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                5  F   WIDTH (MEV)

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

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                5  F  PARTIAL DECAY MODES

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

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                5  F   BRANCHING RATIOS

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

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

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

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                          REFERENCES FOR F

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

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

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

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS

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

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D (1285)

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

                JPG DISCUSSED AT OXFORD, SEE ROSENFELD 65

                8  D MESON  MASS (MEV)

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

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                8  D MESON WIDTH (MEV)

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

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                8   D MESON PARTIAL DECAY MODES

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

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                 8  D MESON BRANCHING RATIOS

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

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

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                            REFERENCES FOR D MESON

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

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E (1420)

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

                 6 E MESON MASS (MEV)

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

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                 6 E MESCN WIDTH (MEV)

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

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                 6 E MESON PARTIAL DECAY MODES

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

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                 6  E MESON BRANCHING RATIOS

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

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

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

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                            REFERENCES FOR E MESON

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

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

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

                 EVIDENCE NOT YET COMPELLING, OMITTED FROM TABLE

                 29  KSKS ANC RHORHO MASS  (MEV)

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

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                 29  KSKS ANC RHORHO WIDTH (MEV)

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

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

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

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f'(1500)

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

                 13  F PRIME(1500) MASS (MEV)

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

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                 13  F PRIME(1500) WIDTH (MEV)

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

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                 13  F PRIME PARTIAL DECAY MODES

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

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                 13  F PRIME BRANCHING RATIUS

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

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

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

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

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                            REFERENCES FOR F PRIME

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

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ρ (760)

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

                 9 RHO  MASS (MEV)

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

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

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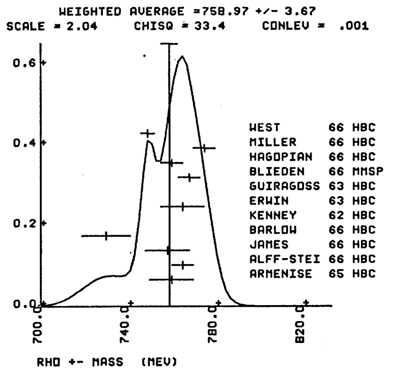
(Ideogram below)



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

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

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M      290   755.0                     CHADWICK  63 HBC  +-0

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

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                 9  RHO  WIDTH (MEV)

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

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

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

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

W   *     170.0                     WOLF      65 RVUE                        6/66

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                9  RHO PARTIAL DECAY MODES

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- PIO) / (PI+- PIO)
R1  *          0.026 OR LESS            BLIEDEN   66 MMSP  -  3-5 PI- P      6/66
R1  *          0.01 OR LESS             DEUTSCHMA 66 HBC  +   8.0 PI+ P      6/66
R1  *          0.002 OR LESS            FERBEL    66 HBC  +- PI+- P ABOVE 2.5 10/66
R1  *          0.0035   0.004           JAMES     66 HBC                    11/66

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

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

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

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

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

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                              REFERENCES FOR RHO

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+BOLD
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)
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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
CAMBRIOG 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

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δ (965)

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

              COMPILATION AVAILABLE SEPARATELY IN UCRL-8030-SPECTRA

              36  DELTA (963) MASS (MEV)

M        SEE GOLDHABER MESCN REVIEW, 1966 BERKELEY CCNF

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

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              36  DELTA (963) WIDTH (MEV)

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

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              36  DELTA MESON PARTIAL DECAY MODES

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                           U 9S 9

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              36  DELTA MESON BRANCHING RATIOS

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

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                         REFERENCES FOR DELTA(963)

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

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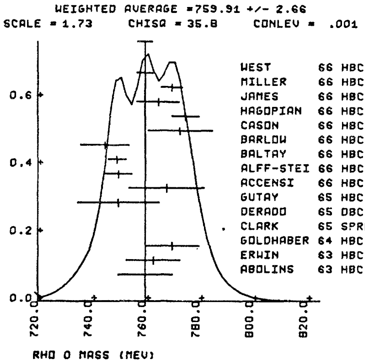

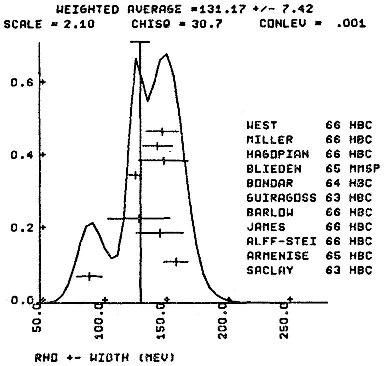

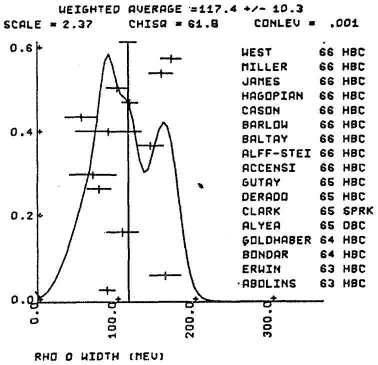

π_V(1003) $\to K\bar{K}$

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                16 PI(1003,JPG=   ) I=1

                16 PI(1003) MASS  (MEV)
M   *       1060.0                       BELYAKOV  64 PBC        7.5 PI- P        6/66
M   *    50 1025.0   APPROX.             ARMENTERO 65 HBC  +-  .0.0 PBAR P
M      143 1003.3      7.0+SYSTEMATIC ROSENFELD 65 RVUE +-                        8/66
M   *       SCAT. LENGTH 2 TO 6 FERMIS.BALTAY     66 HBC       3.7 PBAR P         8/66
M   *       SCAT. LENGTH 2.4+-.5 FERMI BARLOW     66 HBC  +- 1.2 PBAR P          11/66

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                16 PI(1003) WIDTH (MEV)

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

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            16 PI(1003) PARTIAL DECAY MODES

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

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

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                         REFERENCES FOR PI(10C3)

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

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AI (1080)

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

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

            10  A1 MESON  MASS (MEV)

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

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            10  A1 MESON  WIDTH (MEV)

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

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            10  A1 PARTIAL DECAY MODES

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

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            10  A1 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 OR LESS          HESS      66 HBC  -   4.0 PI- P      10/66

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

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

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

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                         REFERENCES FOR A1

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

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

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B (1210)

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

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            11  B MESON  MASS (MEV)

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

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            11  B MESON  WIDTH (MEV)

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

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            11  B MESON PARTIAL DECAY MODES

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

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            11  B MESON  BRANCHING RATIOS

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

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

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

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

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                         REFERENCES FOR B MESON

ABOLINS  63 PRL 11 381          ABOLINS,LANDER,MEHLHOP,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 CONF 1 422  HESS,CHUNG,DAHL,HARDY,KIRZ,MILLER //// LRL
   SEE ALSC CHUNG 66
GOLDHABE 65 PRL 15 118          G GOLDHABER,S GOLDHABER,KADYK,SHEN /// LRL
BALTAY C 66  BERKELEY CONF      +FRANZINI,SEVERIENS,YEH,ZANELLO //BNL,CCNY
CHUNG S  66 PRL 16 481          +NEVEU,DAHL,KIRZ,MILLER,GUIRAGOSIAN // LRL
HESS     66 UCRL-16832          R I HESS (THESIS, BERKELEY)         // LRL

       QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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A2 (1300)

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

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

            12  A2 MESON  MASS (MEV)

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

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

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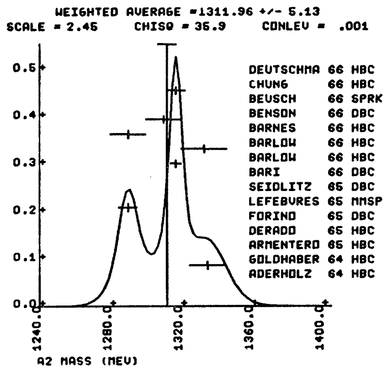

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                12  A2 MESON  WIDTH (MEV)

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

W            70.0     10.0                BARNES    66 HBC   -                6/66
W           120.0                         BARI      66 DBC   0 5.1 PI+ D     10/66
W            56.      28.                 BARLOW    66 HBC  +- (K KBAR MODE) 11/66
W            56.      15.                 BARLOW    66 HBC  +- (K KBAR MODE) 11/66
W           110.0     45.0                BENSON    66 DBC                    6/66
W            90.0                         BEUSCH    66 SPRK  0 5-12 PI- P    10/66
W            50.0     20.0                CHUNG     66 HBC  -0 3-4 PI- P     10/66
W   * 1800   80.0     10.0      COMP.BY   FERBEL    66      +-  PI+- P       10/66
W     S      26.0   OR LESS               LEVRAT    66 MMS  -  FOR BOTH PEAKS 10/66
                          (Ideogram below)
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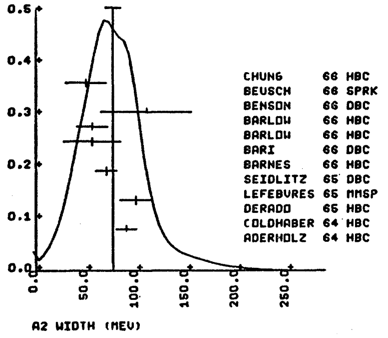
              WEIGHTED AVERAGE =76.59 +/- 7.23
        SCALE = 1.32     CHISQ =  8.7     CONLEV = 0.124
```



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                12  A2 MESON PARTIAL DECAY MODES

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

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                12  A2 MESON  BRANCHING RATIOS

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

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

R3   *   A2 MESON INTO (ETA PI) / (RHO PI)                (P3)/(P1)
R3            0.3       0.2         ADERHOLZ   65 HBC
R3            0.022     0.018       CHUNG      66 HBC  -0                10/66
R3            0.24      0.08        DUBOVIKOV  66 HBC  -                 11/66
                          (Ideogram below)
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              WEIGHTED AVERAGE =0.0346 +/- 0.0466
        SCALE = 2.66     CHISQ =  7.1     CONLEV = 0.008
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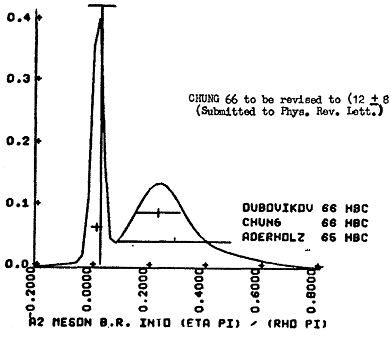

CHUNG 66 to be revised to (12 ± 8)%.
(Submitted to Phys. Rev. Lett.)

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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

R6   *   A2 MESON INTO (PI+ PI- PI0) / (RHO PI)           (P5)/(P1)
R5   *        0.17  OR LESS         BENSON     66 DBC   0

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

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                                REFERENCES FOR A2

ADERHOLZ 64 PL 10 248          AACHEN+BERLIN+BIRM+BONN+HAMB+IC-LONDON+MPI
GOLDHABE 64 DUBNA CONF  1 480 G GOLDHABER,S GOLDHABER,OHALLORAN,SHEN/LRL
LANDER   64 PRL 13 346         +ABOLINS,CARMONY,HENDRIKS,XUONG+/ LA JOLLA

ABOLINS  65  ATHENS(OHIO)CONF +CARMONY,LANDER,XUONG,YAGER ///// LA JOLLA I=1
ARMENTER 65 PL 17 344          ARMENTEROS,EDWARDS,JACOBSEN +  //CERN+CDEF
CHUNG    65 PRL  15  325       +DAHL,HARDY,HESS,JACOBS,KIRZ,MILLER // LRL
DERADO   65 PRL 14 872         DERADO,KENNEY,POIRIER,SHEPHARD//NOTRE DAME
FORINO   65 PL 19 68           +GESSAROLI+LENDINARA+/BOL+BARI+FIR+ORS+SAC
LEFEBVRE 65 PL 19 434          LEFEBVRES,LEVRAT,BLIEDEN,DUBAL +    //CERN
SEIDLITZ 65 PRL 15 217         L SEIDLITZ,O I DAHL,D H MILLER /////// LRL

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

      QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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π (1640) → 3π

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

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

                34   3 PI (1640) MASS  (MEV)

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

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                34  3 PI (1640) WIDTH  (MEV)

W      110  100.       20.              FERBEL    66 RVUE +   7-8 PI P       11/66
W   *   20  100.                        VETLITSKY 66 HBC   -                  6/66

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                34  PI (1640) PARTIAL DECAY MODES

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

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                34  PI (1640)  BRANCHING RATIOS

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

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                            REFERENCES FOR PI(1640)

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

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ρ (1650) • → 2π

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                15  RHO (1650, JPG=  +) I=

                FOR COMPILATION SEE GOLDHABER MESON REVIEW
                1966 BERKELEY CONFERENCE.

                15  RHO (1650)  MASS (MEV)

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

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

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                15  RHO (1650)  WIDTH (MEV)

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

           ------ DECAY INTO FOUR PIONS ------
W   *       155.      85.               KERNAN    65 HBC   0 2.7 PBAR P     10/66
W   *       160.0   APPROX.             CONTE     66 HBC   -  11 PI- P      10/66

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                 15  RHO (1650)     PARTIAL DECAY MODES
P1          RHO (1650) INTO PI PI                        S 8S 8
P2          RHO (1650) INTO PI PI PI PI                  S 8S 8S 8S 8
P3          RHO (1650) INTO PI PI RHO                    S 8S 8U 9
P4          RHO (1650) INTO RHO RHO                      U 9U 9

------ --------- --------- --------- --------- --------- --------- ---------.

                 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
CRENNELl 66  BERKELEY CONF    +HOUGH,KALBFLEISCH,LAI,BACHMAN+// BNL,CCNY
GOLDHABE 66  BERKELEY CONF    G.GOLDHABER,SAMIOS,ASTIER,SHEN,LAI.MESON REVIEW
KERNAN   65 PRL 15 803        +LYON+CRAWLEY ///////////////////////// IOWA
   KERNAN+  SEE DECAY ONLY INTO NEUTRAL 4 PION STATE

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R (1700)

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

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

                 30  R (1700)  MASS (MEV)

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

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                 30  R (1700) WIDTH (MEV)

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

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

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

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                 30  R1,R2,R3 BRANCHING RATIOS

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

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

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

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

                            REFERENCES FOR R(1700)

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

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S (1930)

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

                 31  S (1930)  MASS (MEV)

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

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                 31  S (1930) WIDTH (MEV)

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

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

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

                            REFERENCES FOR S(1930)

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

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

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T (2195)

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

                 32 T(2200)  MASS (MEV)

M           2195.0     15.0             CHIKOVANI 66 MMSP  -                  8/66

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                 32 T(2200) WIDTH (MEV)

W             13.0    OR LESS           CHIKOVANI 66 MMSP  -                  8/66

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

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

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

                            REFERENCES FOR T(2200)

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

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U (2382)

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

                 33 U(2380)  MASS (MEV)

M           2382.0     24.0             CHIKOVANI 66 MMSP  -                  8/66

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                 33 U(2380) WIDTH (MEV)

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

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

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

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                 33  U MESON BRANCHING RATIOS

R1   *      U- MESON FRACTION INTO ONE / THREE / FIVE OR MORE CHARGED TRACKS
R1   *         0.30 /    0.45 /    0.25  FOCACCI    66 MMS   -                10/66

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

                            REFERENCES FOR U(2380)

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

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K (725)

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

   *                COMPILED IN APPENDIX A.

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K* (892)

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

                 18  K* (890) MASS (MEV)

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

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

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

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

M             885.0                     ARMENTERO 62 HBC  +-0

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

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

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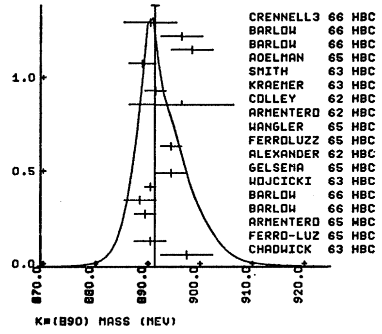
```

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



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

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

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

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

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

W             55.0                         ARMENTERO 62 HBC  +-0

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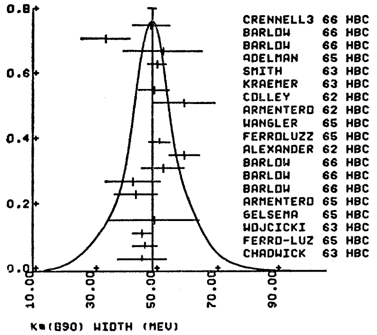
```

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



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

P1       K* INTO K PI                                           S1OS 8
P2       K*(890) INTO (K PI PI)                                 S1OS 8S 8

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                  18  K* (890) BRANCHING RATIOS

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

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                                  REFERENCES FOR K*

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

CHADWICK 63 PL 6 309            CHADWICK,CRENNELL,DAVIES,BETTINI+/OXF+PADU
GOLDHABE 63 ATHENS CONF 92      SULAMITH GOLDHABER /////////////////// LRL
KRAEMER  63 ATHENS CONF 130     R KRAEMER L MADANSKY + ////  JOHNS HOPKINS
SMITH    63 PRL 10 138          SMITH,SCHWARTZ,MILLER,KALBFLEISCH,HUF+/LRL

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

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

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

        QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN THE DATA CARDS

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

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K_V (1080)

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                 19  KV (1080)

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

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K_C (1215)

```
                 20 KC MESON (1215,JP=  ) I=1/2
    *            SEEN ONLY IN ANNIHILATIONS AT REST.
    *            NO COMPELLING EVIDENCE FOR RESONANCE
    *            OMITTED FROM TABLE.

                 20  KC MASS  (MEV)

M          1215.0     15.0               ARMENTERO 64 HBC

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                  20  KC WIDTH (MEV)

W            60.0     15.0               ARMENTERO 64 HBC

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                  20  KC PARTIAL DECAY MODES

P1       KC INTO K RHO                                        S1OU 9
P2       KC INTO K* PI                                        U18S 8
P3       KC INTO K PI PI                                      S11S 6S 8

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                  20  KC BRANCHING RATIOS

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

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

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

                             REFERENCES FOR KC(1215)

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

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K_A (1320)

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

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

                 21  KA (1320) MASS (MEV)

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

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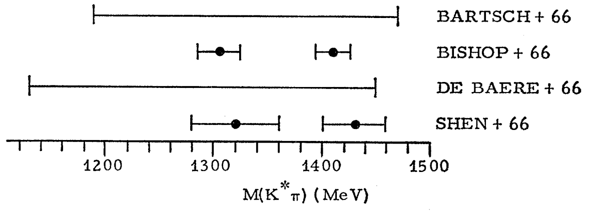
Mass of $K_A(1320)$

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



The bars show position and widths of bumps.

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                 21  KA (1320) WIDTH (MEV)

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

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                 21  KA (1320) PARTIAL DECAY MODES

P1          KA INTO K*(890) PI                            U18S08
P2          KA INTO K RHO                                 S11U09
P3          KA INTO K OMEGA                               S11U01
P4          KA INTO K PI                                  S1OS 8
P5          KA INTO K ETA                                 S1OS14

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                 21  KA (1320) BRANCHING RATIOS

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

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

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

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

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

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

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

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

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

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                    NOTE ON K OMEGA MODE

 BESIDES A WIDE PEAK IN THE (K* PI) MASS DISTRIBUTION, BARTSCH+ SEE A SIMI-
 LAR 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,DUFUUR,JUNGEJANS+ // CERN+BRUX
BARTSCH  66 PL 22 357           +DEUTSCHMANN,GROTE,MORRISON,+ // ABCL(IC)V
BISHOP   66 PRL 16 1069         +GOSHAW,ERWIN,THOMPSON,WALKER,WEINBE//WISC
DE BAERE 66  BERK.CONF. - NC    DE BAERE,DEBAISIEUX,FILIPPAS+ // BRUX+CERN
   AND PRIVATE COMMUNICATION BY B. JONGEJANS
SHEN     66 PRL  17  726        +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL
  ALSO SHEN  BERKELEY CONF      +BUTTERWORTH,FU,GOLDHABERS,TRILLING // LRL

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K_V (1420)

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

                 22  KV(1420) MASS (MEV)

M  *       1480.0     20.0               BRITISH   65 HBC  -  6. K-P    (K PI) 10/66
M          1402.0      8.0               BRITISH   65 HBC  -0 3.5 K- P (K PI) 10/66
M          1404.0     15.0               FOCARDI   65 HBC  -0 3.  K- P (K PI) 10/66
M       21 1400.0     10.0               HAQUE     65 HBC  -  3.5 K- P (K PI) 10/66
M       40 1440.0                        BARTSCH   66 HBC  - 10.  K- P (K PI)
M       35 1407.0     10.0               CRENNELL3 66 HBC   0 6. PI- P (K PI) 10/66
M          1390.       9.0               DE BAERE  66 HBC  +  3.5 K+P (K0 PI+) 10/66
M          1410.      20.0      40.      DE BAERE  66 HBC  +  3.5 K+P (K+ PI0) 10/66
M          1430.0     20.0               GEORGE    66 HBC   0 5.  K+ P (K PI) 10/66
M          1446.0      7.9               HARDY     66 HBC   0 4. PI- P (K PI) 10/66
M          1392.0     10.0               SCHWEINGR 66 HBC   0 4.1+5.5 K- P    10/66
                                                                  (K PI)
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    10/66
                                                                  (K*PI)
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
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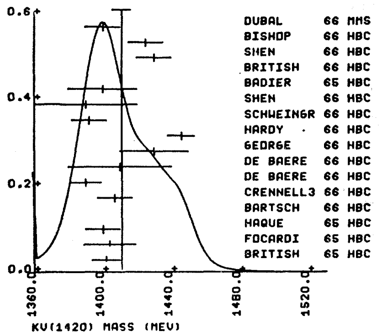
(Ideogram below)

WEIGHTED AVERAGE =1411.05 +/- 5.16
SCALE = 1.75   CHISQ = 40.0   CONLEV = .001



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                 22  KV(1420) WIDTH (MEV)

W           140.0     20.0               BRITISH   65 HBC  -0 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
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(Ideogram at right)

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                 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

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                U22  KV(1420) BRANCHING RATIOS

R1  *    KV(1420) INTO (K PI)/TOTAL                        (P1)/TOTAL
R1           0.37      0.19           BADIER    65 HBC                          6/66
R1           0.33      0.07           BISHOP    66 HBC                          6/66

R2  *    KV(1420) INTO (K*(890) PI) / TOTAL                (P2)/TOTAL
R2           0.41      0.14           BADIER    65 HBC                          6/66
R2           0.56      0.10           BISHOP    66 HBC                          6/66

R3  *    KV(1420) INTO (K RHO)/TOTAL                       (P3)/TOTAL
R3           0.14      0.05           BADIER    65 HBC                          6/66
R3           0.10      0.05           BISHOP    66 HBC                          6/66

R4  *    KV(1420) INTO (K OMEGA)/TOTAL                     (P4)/TOTAL
R4           0.07      0.04           BADIER    65 HBC                          6/66
R4           0.007     0.008          BISHOP    66 HBC                          6/66

R5  *    KV(1420) INTO (K ETA)/TOTAL                       (P5)/TOTAL
R5           0.02      0.02           BADIER    65 HBC                          6/66
R5           0.017     0.020          BISHOP    66 HBC                          6/66

R6  *    KV(1420) INTO (K*(890) PI) / (K PI)               (P2)/(P1)
R6       6   0.33      0.33           CHUNG     65 HBC  + 0  3.9-4.2 PI- P      8/66
R6           0.56      0.11           SCHWEINGR 66 HBC    0 4.1+5.5 K- P       9/66
R6           0.65      0.20           SHEN      66 HBC    0  N* PRODUCED      10/66
R6           0.63      0.20           SHEN      66 HBC  +    NO N* PRODUCED   10/66

R7  *    KV(1420) INTO (K OMEGA) / K PI                    (P4)/(P1)
R7           0.08  OR LESS            SHEN      66 HBC                          8/66

R8  *    KV(1420) INTO (K RHO) / (K PI)                    (P3)/(P1)
R8  *        0.09  OR LESS            CHUNG     65 HBC  + 0  3.9-4.2 PI- P      8/66
R8           0.35      0.20           SCHWEINGR 66 HBC    0 4.1+5.5 K- P       9/66

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

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                            REFERENCES FOR KV(1420)

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

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

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K_A (1800)

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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

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              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

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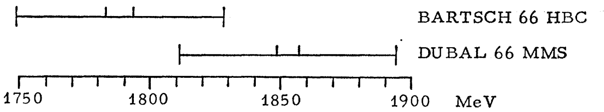
Mass and Width of K_A(1800)

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



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

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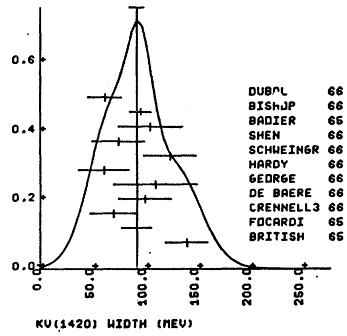
WEIGHTED AVERAGE =92.25 +/- 6.79
SCALE = 1.21   CHISQ = 14.7   CONLEV = 0.145



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                 U23   KA (1800) PARTIAL DECAY MODES

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

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                 U23   KA (1800) BRANCHING RATIOS

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

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

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

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

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

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

R7   *  KA    INTO (K*(1420) PI) / TOTAL                    (P6)/TOTAL
R7              0.085     0.05          BARTSCH 2 66 HBC                       10/66

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                  NOTE ON KA (1800) - NEGATIVE EVIDENCE

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

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

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                             REFERENCES FOR KA(1800)

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

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

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

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

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

M    *   23 1175.0                      WANGLER    64 HBC
M    *   15 1160.0      10.0            MILLER     65 HBC         PURDUE
M    *      1180.0                      BISHOP     66 HBC    SUGGEST I=3/2      6/66

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

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

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                          REFERENCES FOR K*3/2(1175)

WANGLER   64 PL 9 71            T P WANGLER,A R ERWIN,W D WALKER //WISCONS
MILLER    65 PL 15 74           MILLER,KOVACS,MCILWAIN,PALFREY +/// PURDUE
ROSENFEL 65 OXFORD CONF 58      A H ROSENFELD ////////////////// LRL--RVUE
            FOR SLIGHT EVID.    FOR K*PI(1175) WITH I = 3/2 SEE BISHOP 66
BISHOP    66 PRL 16 1069        +GOSHAW,ERWIN,THOMPSON,WALKER,WEINBC//WISC I

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$K^*_?$ (1270)

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

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

                 25  K*(1270) MASS (MEV)

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

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                 25  K*(1270) WIDTH (MEV)

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

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                 25  K*(1270) PARTIAL DECAY MODES

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

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                 25  K*(1270) BRANCHING RATIOS

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

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                          REFERENCES FOR K*(1270)

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

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DATA ON BARYON RESONANCES

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

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

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N (1400)

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

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

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

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

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

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

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

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

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                          REFERENCES -- N*1/2(1400)

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

                   PAPERS NOT REFERRED TO IN DATA CARDS.

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

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N (1518)

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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 INDICA-
    TIONS OF TRUTH.  ONLY OLSSON 66 AND KIRZ 66 DEFINITELY ASSOCIATED THE
    OBSERVED EFFECT WITH THE D13 WAVE.

R2          N*1/2(1518) INTO (N*3/2(1236) PI)/TOTAL        (P4)/TOTAL
R2            DOMINANT  INEL DECAY    OLSSON    66 RVUE     PI P TO PI PI N   9/66
R2            0.20      0.05          KIRZ      66 HBC   0  ASSUMING R1=0.72  9/66

R3          N*1/2(1518) INTO (N PI)/(N PI PI)              (P1)/(P3)
R3            1.25      0.44      0.71  A-BORELLI 66 HBC  0  PBAR P 5.7 BEV/C  9/66

R4          N*1/2(1518) INTO (N*3/2(1236) PI)/(N PI PI)    (P2)/(P3)
R4            0.00      0.09            A-BORELLI 66 HBC                       9/66

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

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                      REFERENCES -- N*1/2(1518)

ROPER    65 PR 138 B190        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
OLSSON   66 PR 145 1309        M G OLSSON, G B YODH                //WISC,MD
ALLES-BO 66 NC (SUBMITTED)     ALLES-BORELLI,FRENCH,FRISK,MICHEJDA //CERN
LOVELACE 66 BERKELEY CONF      C LOVELACE                           //CERN IJP
ALEXANDE 66 BERKELEY CONF      ALEXANDER,BENARY,CZAPEK,+ //WEIZMANN(CERN)
KIRZ     66 PRIVATE COMM       J KIRZ                                //LRL
      --  NUMBER EXTRACTED FROM DATA DISCUSSED IN KIRZ 63.

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

KIRZ     63 PR 130 2481        J KIRZ, J SCHWARTZ, R D TRIPP         //LRL
CROUCH   65 DESY CONF II 21    +  //BROWN,CEA,HARVARD,MIT,PADOVA,WEIZMANN
DERADO   65 ATHENS CONF 244    +KENNEY,LAMSA, +      //NOTRE DAME,KENTUCKY
MERLO    66 P ROY SOC 289 489 J P MERLO, G VALLADAS                //SACLAY
     -- THE ABOVE PAPERS DISCUSS INELASTIC CHANNELS NEAR THE RESONANCE.
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE   //CERN IJP
      --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1570)

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

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

                63  N*1/2(1570) MASS (MEV)    -------------------------

M    *      1519.0                   HENDRY    65 RVUE    ETA N + S11 PI N  9/66
M           1570.0                   MICHAEL   66 RVUE    FITS BAREYRE S11  7/66.
M    N      1557.0  OR  1565.0       UCHIYAMA- 66 RVUE    FITS N ETA DATA   9/66
     N      FITTING GIVES TWO SOLUTIONS.  PROBLEMS MATCHING PI P PHASE SHIFTS.
M    K      1561.0                   LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66
     K      AS GIVEN.  WITHOUT ARGAND DIAGRAM WE DONT KNOW HOW DETERMINED.

----------------   63  N*1/2(1570) WIDTH (MEV)    -------------------------

W    *       130.0                   HENDRY    65 RVUE                      9/66
W            130.0                   MICHAEL   66 RVUE                      7/66
W    N       156.0  OR  144.0        UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66
W    K       180.0                   LOVELACE  66 RVUE    SEE NOTE ON MASS  9/66

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

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

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

R1          N*1/2(1570) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1   *        0.69                   HENDRY    65 RVUE                      9/66
R1            0.32                   MICHAEL   66 RVUE                      9/66
R1   N        0.71  OR  0.28         UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66
R1   K        0.40                   LOVELACE  66 RVUE    SEE NOTE ON MASS  9/66

R2          N*1/2(1570) INTO (N ETA)/TOTAL                 (P2)/TOTAL
R2            DOMINANT  INEL DECAY   HENDRY    65 RVUE                      9/66
R2            0.68                   MICHAEL   66 RVUE                      9/66
R2   ·N       0.29  OR  0.71         UCHIYAMA- 66 RVUE    SEE NOTE ON MASS  9/66

R3          N*1/2(1570) INTO (N PI PI)/TOTAL               (P3)/TOTAL
R3            SMALL TRACE            LOVELACE  66 RVUE                      9/66

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                      REFERENCES -- N*1/2(1570)

HENDRY   65 PL 18 171          A W HENDRY, R G MOORHOUSE           //RTHFD
      --  REVIEWS EARLY PHASE-SHIFT-ANALYSIS RESULTS AND PI- P TO ETA N
          EXPERIMENTS.  WE TAKE NUMBERS FROM THE SOLUTION USING BRANDSEN 65.
BAREYRE  65 PL 18 342          + BRICMAN, STIRLING, VILLET        //SACLAY IJP
MICHAEL  66 PL 21 93           C MICHAEL                            //OXF
UCHIYAMA 66 PR 149 1220        F UCHIYAMA-CAMPBELL, R K LOGAN       //ILL IJP
LOVELACE 66 BERKELEY CONF      C LOVELACE                          //CERN IJP

                 PAPERS NOT REFERRED TO IN DATA CARDS.

BULOS    64 PRL 13 486         +       //BROWN,BRANDEIS,HARVARD,MIT,PADOVA  I
RICHARDS 66 PRL 16 1221        +CHIU,EANDI,HELMHOLZ,KENNEY,+ //LRL,HAWAII  IJ
      -- BULOS 64 AND RICHARDS 66 ARE EXPERIMENTS ON PI- P TO ETA N NEAR
          THRESHOLD.  THEY ARE IN SOME DISAGREEMENT.
BRANDSEN 65 PR 139 B1566       +ODONNELL, MOORHOUSE         //DURHAM,RTHFD IJP
      --  BASIS OF NUMBERS WE QUOTE FROM HENDRY 65.
PREPOST  65 DESY CONF II 152  R PREPOST, D LUNDQUIST, D QUINN //STANFORD
BACCI    66 PRL 16 157         +PENSO,SALVINI,MENCUCCINI,+//ROME,FRASCATI
      --  PREPOST 65 AND BACCI 66 ARE EXPERIMENTS ON ETA PHOTOPRODUCTION NEAR
          THRESHOLD.
     THE FOLLOWING THREE ARE ANALYSES OF ETA PRODUCTION NEAR THRESHOLD --
DOBSON   66 PR 146 1022        P N DOBSON                          //HAWAII
MINAMI   66 PR 147 1123        S MINAMI                             //OSAKA
BALL     66 PR 149 1191        J S BALL                              //UCLA
DONNACHI 66 BERKELEY CONF      DONNACHIE, KIRSOPP, LEA, LOVELACE   //CERN IJP
      --  NUMBERS OF LOVELACE 66 ARE BASED ON THIS PHASE-SHIFT ANALYSIS.

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N (1670)

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

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

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

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

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

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

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

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

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

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

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

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                      REFERENCES -- N*1/2(1670)

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

                 PAPER NOT REFERRED TO IN DATA CARDS.

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

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N (1688)

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

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

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

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

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

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

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

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

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

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

    WE LIST MEASUREMENTS OF THE INELASTIC DECAY MODES OF THE 1688 MEV BUMP.
    SUCH MEASUREMENTS HAVE NOT UNTANGLED THE D15 AND F15 (AND POSSIBLE S11)
    COMPONENTS.  IT IS CLEAR THAT BOTH D15 AND F15 DECAY ALOT INTO N PI PI.
    THERE IS SOME DISAGREEMENT ABOUT WHETHER THIS IS DOMINATED BY N*3/2(1236)
    PI.  IN ANY CASE THE MEASUREMENTS OF THE BRANCHING RATIO TO THIS FINAL
    STATE ARE MODEL DEPENDENT AND OUGHT NOT BE TAKEN AS MORE THAN QUALITATIVE
    INDICATIONS OF TRUTH.
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R2         N*1/2(1688) INTO (N ETA)/TOTAL               (P2)/TOTAL
R2            0.025      OR LESS      KRAEMER   64 DBC  +  PI+D 1.23 BEV/C    9/66
R2            0.042 OR LESS (95PC CL) A-BORELLI 66 HBC  +  PBAR P 5.7 BEV/C   9/66

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

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


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

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

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

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

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                        REFERENCES -- N*1/2(1688)

KRAEMER  64 PR 136 B496        +MACANSKY,+ //J HOPKINS,NWESTERN,WOODSTOCK  I
DUKE     65 PRL 15 468         +JONES,KEMP,MURPHY,PRENTICE, + //RTHFD,OXF IJP
BAREYRE  65 PL 18 342          + BRICMAN, STIRLING, VILLET        //SACLAY IJP
BRANDSEN 65 PL 19 420          +ODONNELL, MOORHOUSE         //DURHAM,RTHFD IJP
LOVELACE 66 BERKELEY CONF      C LOVELACE                           //CERN IJP
HEUSCH   66 PRL 17 1019        C A HEUSCH, C Y PRESCOTT, R F DASHEN //CIT
ALLES-BO 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.

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N(1700)

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

                 EXISTENCE NOT CONCLUSIVE.  SEE LOVELACE 66.

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

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

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

W           240.0                      MICHAEL   66 RVUE                     7/66

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

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

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

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

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                        REFERENCES -- N*1/2(1700)

BAREYRE  65 PL 18 342          + BRICMAN, STIRLING, VILLET       //SACLAY IJP
BRANDSEN 65 PL 19 420          +ODONNELL, MOORHOUSE        //DURHAM,RTHFD IJP
MICHAEL  66 PL 21 93           C MICHAEL                             //OXF
LOVELACE 66 BERKELEY CONF      C LOVELACE                            //CERN
     --  LOVELACE 66 QUESTIONS THE EXISTENCE OF THIS SECOND S11 RESONANCE.

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N (2190)

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

                 71  N*1/2(2190) MASS (MEV)    ---------------------------

M          2190.0                      DIDDENS   63 CNTR   PI+- P TOTAL
M          2210.0                      HOHLER    64 RVUE   DATA + DISP REL
M          2190.0         APPROX       YOKOSAWA  66 CNTR   PI- P DSIG + PCL  7/66

---------------- 71  N*1/2(2190) WIDTH (MEV)   ---------------------------

W           200.0                      DIDDENS   63 CNTR
W           200.0                      HOHLER    64 RVUE                     7/66
W           220.0         APPROX       YOKOSAWA  66 CNTR                     7/66

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

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

---------------- 71  N*1/2(2190) BRANCHING RATIOS    -------------------

R1         N*1/2(2190) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1            0.3         APPROX       DIDDENS   63 CNTR                     7/66
R1            0.3         APPROX       YOKOSAWA  66 CNTR                     7/66

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                        REFERENCES -- N*1/2(2190)

DIDDENS  63 PRL 10 262         +JENKINS, KYCIA, RILEY               //BNL  I
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE           //KARLSRUHE  I
YOKOSAWA 66 PRL 16 714         +SUWA,HILL,ESTERLING,BOOTH       //ARG,CHI  JP

          QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

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

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N (2650)

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

                 FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

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

M   *      2700.0                      ALVAREZ   64 CNTR   PI PHOTOPROD
M   *      2600.0         APPROX       WAHLIG    64 SPRK C PI-P CH EX
M          2660.0                      HOHLER    64 RVUE   DATA + DISP REL
M          2649.0    10.0              CITRON    66 CNTR   PI+- P TOTAL      7/66

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

W   *       100.0                      ALVAREZ   64 CNTR
W           200.0                      HOHLER    64 RVUE                     7/66
W           360.0    20.0              CITRON    66 CNTR                     7/66

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

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

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

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

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                        REFERENCES -- N*1/2(2650)

ALVAREZ  64 PRL 12 710         +BAR-YAM,KERN,LUCKEY,OSBORNE, +  //MIT,CEA
WAHLIG   64 PRL 13 103         +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149          G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913         V BARGER, D CLINE                   //WISC  P

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N (3030)

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

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

---------------- 73  N*1/2(3030) MASS (MEV)    ---------------------------

M          3080.0                      HOHLER    64 RVUE   DATA + DISP REL   7/66
M          3030.0                      CITRON    66 CNTR   PI+- P TOTAL      7/66

---------------- 73  N*1/2(3030) WIDTH (MEV)   ---------------------------

W           400.0                      CITRON    66 CNTR                     7/66

---------------- 73  N*1/2(3030) PARTIAL DECAY MODES   -----------------

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

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

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

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                        REFERENCES -- N*1/2(3030)

HOHLER   64 PL 12 149          G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON   66 PR 144 1101        +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913         V BARGER, D CLINE                   //WISC  P

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N? (3245)

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                 74  N* /2(3245, JP=    )

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

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

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

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

W            35.0      OR LESS         KORMANYOS 66 CNTR                     7/66

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

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

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                        REFERENCES -- N* /2(3245)

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

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N (3695)

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

                 EVIDENCE PRELIMINARY AND NOT COMPELLING.  OMITTED FROM
                 TABLE.

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

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

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

W            46.0    23.0              BARTKE    66 HBC  +                   9/66

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                        REFERENCES -- N*1/2(3695)

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

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Δ (1236)

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

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

M    *     1234.0                       ROPER     65 RVUE C++PHASE-SHIFT ANAL
M++        1236.0     0.55              OLSSON    65 RVUE ++ TOTAL-SIGMA DATA
M++  *     1232.0     6.0               FERRO-LUZ 65 HBC  ++ K+P TO K0 P PI+
M++  *     1233.4     4.4               GIDAL     66 DBC  ++ D D TO NN(NN) PI   7/66
M++        1236.0                       DEANS     66 RVUE ++ PI+P TOTAL         7/66
MO         1236.45    0.65              OLSSON    65 RVUE C
M-   *     1241.3     5.1               GIDAL     66 DBC  -                     7/66

----------------  81  N*(0) - N*(++) MASS DIFFERENCE (MEV)    ------------

D    R       0.45     0.85              OLSSON    65 RVUE
     R     REDUNDANT WITH DATA IN MASS LISTING.

----------------  81  N*(-) - N*(++) MASS DIFFERENCE (MEV)    ------------

D            7.9      6.8               GIDAL     66 DBC

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

W++         120.0     2.0               OLSSON    65 RVUE ++
W++  *      125.0    30.0               FERRO-LUZ 65 HBC  ++
W++  *      124.0    14.0               GIDAL     66 DBC  ++                    7/66
W++         121.0                       DEANS     66 RVUE ++                    7/66
WO          119.6     2.4               OLSSON    65 RVUE C
W-   *      149.0    18.0               GIDAL     66 DBC  -                     7/66

----------------  81  N*3/2(1236) PARTIAL DECAY MODES    -----------------

P1         N*3/2(1236) INTO PI N                          S 8S16

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                        REFERENCES -- N*3/2(1236)

OLSSON   65 PRL 14 118        M G OLSSON                          //WISC
FERRO-LU 65 NC 36 1101        FERRO-LUZZI,GEORGE, +               //CERN
ROPER    65 PR 138 B190       L D ROPER, R M WRIGHT, B T FELD  //LRL,MIT   JP
GIDAL    66 PR 141 1261       G GIDAL, A KERNAN, S KIM             //LRL
DEANS    66 PREPRINT          S R DEANS, W G HOLLADAY        //VANDERBILT

     FOR EXTENSIVE REFERENCES TO DATA AND PHASE-SHIFT ANALYSES TILL 1965,
     SEE ROPER 65, ESPECIALLY APPENDIX II.

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Δ (1670)

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82  N*3/2(1670, JP=1/2-) I=3/2     S31

                  82  N*3/2(1670) MASS (MEV)    ---------------------------

M    *     1648.0    12.0               DEVLIN    65 CNTR    PI+- P TOTAL
M          1665.0                       BAREYRE   65 RVUE    PHASE SHIFT ANAL  7/66
M          1692.0                       LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66

----------------  82  N*3/2(1670) WIDTH (MEV)    -------------------------

W    *      201.0    74.0               DEVLIN    65 CNTR    VERY ASYMMETRIC
W           130.0                       BAREYRE   65 RVUE                      7/66
W           230.0                       LOVELACE  66 RVUE                      9/66

----------------  82  N*3/2(1670) PARTIAL DECAY MODES    -----------------

P1         N*3/2(1670) INTO PI N                          S 8S16

----------------  82  N*3/2(1670) BRANCHING RATIOS    --------------------

R1         N*3/2(1670) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1   *       0.56                       DEVLIN    65 CNTR
R1           0.33                       BAREYRE   65 RVUE                      7/66
R1           0.44                       LOVELACE  66 RVUE                      9/66

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                        REFERENCES -- N*3/2(1670)

DEVLIN   65 PRL 14 1031       T J DEVLIN,J SOLOMON,G BERTSCH //PRINCETON  I
BAREYRE  65 PL 18 342         + BRICMAN, STIRLING, VILLET       //SACLAY IJP
LOVELACE 66 BERKELEY CONF     C LOVELACE                          //CERN IJP

                   PAPERS NOT REFERRED TO IN DATA CARDS.

CARRUTHE 60 PRL 4 303         P CARRUTHERS                     //CORNELL  I
DEVLIN   62 PR 125 690        T J DEVLIN, B J MOYER, V PEREZ-MENDEZ//LRL  I
HELLAND  64 PR 134 B1062      +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.

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Δ (1920)

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83  N*3/2(1920, JP=7/2+) I=3/2

                  83  N*3/2(1920) MASS (MEV)    ---------------------------

M          1922.0          APPROX       COOL      56 CNTR    PI+ P TOTAL       7/66
M          1912.0    15.0               BRISSON   61 CNTR    PI+ P TOTAL       7/66
M    N     1956.0                       LAYSON    63 RVUE    PI P TOTAL, EL    7/66
     N     ASSUMES AN N*3/2(1855).
M          1920.0                       HOHLER    64 RVUE    DATA + DISP REL   7/66
M          1900.0     9.0               DEVLIN    65 CNTR    PI+ P TOTAL
M          1920.0          APPROX       DUKE      65 CNTR    PI+- P EL, POLAR  7/66
M          1950.0          APPROX       YOKOSAWA  66 CNTR    PI- P DSIG + PCL  7/66
M          1950.0                       LOVELACE  66 RVUE    PHASE-SHIFT ANAL  9/66

----------------  83  N*3/2(1920) WIDTH (MEV)    -------------------------
W           170.0                       HOHLER    64 RVUE                      7/66
W           256.0    39.0               DEVLIN    65 CNTR
W           170.0                       DUKE      65 CNTR                      7/66
W           200.0          APPROX       YOKOSAWA  66 CNTR                      7/66
W           250.0                       LOVELACE  66 RVUE                      9/66

----------------  83  N*3/2(1920) PARTIAL DECAY MODES    -----------------

P1         N*3/2(1920) INTO PI N                          S 8S16
P2         N*3/2(1920) INTO SIGMA K                       S20S10
P3         N*3/2(1920) INTO N*3/2(1236) PI                L81S 8

----------------  83  N*3/2(1920) BRANCHING RATIOS    --------------------

R1         N*3/2(1920) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1   N       0.33                       LAYSON    63 RVUE                      7/66
     N     ASSUMES AN N*3/2(1855).
R1           0.73       OR LESS         HOHLER    63 RVUE    DATA + DISP REL   7/66
R1           0.57     0.12              DEVLIN    65 CNTR
R1           0.41                       DUKE      65 CNTR    VERY ENERGY DEP   7/66
R1           0.4           APPROX       YOKOSAWA  66 CNTR                      7/66
R1           0.50                       LOVELACE  66 RVUE                      9/66

R2         N*3/2(1920) INTO (SIGMA K)/TOTAL               (P2)/TOTAL
R2            SEEN                      HOLLADAY  65 RVUE    PI+P DATA        11/66

R3         N*3/2(1920) INTO (N*3/2(1236) PI)/TOTAL        (P3)/TOTAL
R3         DOMINANT INEL DECAY          LOVELACE  66 RVUE                      9/66

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                        REFERENCES -- N*3/2(1920)

COOL     56 PR 103 1082       R COOL, O PICCIONI, D CLARK          //BNL  I
BRISSON  61 NC 19 210         +CETOEUF,FALK-VAIRANT,VAN ROSSUM,+//SACLAY  I
LAYSON   63 NC 27 724         W M LAYSON                          //CERN  IJ
HOHLER   63 NP 48 470         G HOHLER, G EBEL               //KARLSRUHE  I
HOHLER   64 PL 12 149         G HOHLER, J GIESECKE           //KARLSRUHE  I
DEVLIN   65 PRL 14 1031       T J DEVLIN,J SOLOMON,G BERTSCH //PRINCETON  I
DUKE     65 PRL 15 468        +JONES,KEMP,MURPHY,PRENTICE, + //RTHFD,OXF IJP
HOLLADAY 65 PR 139 B1348      W G HOLLADAY                  //VANDERBILT
YOKOSAWA 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.

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Δ (2420)

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84  N*3/2(2420, JP=11/2+) I=3/2

                  FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                  84  N*3/2(2420) MASS (MEV)    ---------------------------

M          2360.0                       DIDDENS   63 CNTR    PI+ P TOTAL
M    *     2520.0    40.0               ALVAREZ   64 CNTR    PI PHOTOPROD      7/66
M    *     2400.0          APPROX       WAHLIG    64 SPRK C  PI-P CH EX
M          2440.0                       HOHLER    64 RVUE    DATA + DISP REL
M          2423.0    10.0               CITRON    66 CNTR    PI+ P TOTAL       7/66

----------------  84  N*3/2(2420) WIDTH (MEV)    -------------------------

W           200.0                       DIDDENS   63 CNTR
W           245.0                       HOHLER    64 RVUE                      7/66
W           310.0    20.0               CITRON    66 CNTR                      7/66

----------------  84  N*3/2(2420) PARTIAL DECAY MODES    -----------------

P1         N*3/2(2420) INTO PI N                          S 8S16
P2         N*3/2(2420) INTO SIGMA K                       S20S10

----------------  84  N*3/2(2420) BRANCHING RATIOS    --------------------

R1         N*3/2(2420) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1           0.067         APPROX       DIDDENS   63 CNTR    ASSUMING J=11/2   7/66
R1           0.113    0.0036            CITRON    66 CNTR    ASSUMING J=11/2   7/66

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                        REFERENCES -- N*3/2(2420)

DIDDENS  63 PRL 10 262        +JENKINS, KYCIA, RILEY               //BNL  I
ALVAREZ  64 PRL 12 710        +BAR-YAM,KERN,LUCKEY,OSBORNE, +  //MIT,CEA
WAHLIG   64 PRL 13 103        +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149         G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON   66 PR 144 1101       +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913        V BARGER, D CLINE                   //WISC  P

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Δ (2850)

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85  N*3/2(2850, JP=15/2+) I=3/2

                  FOR JP ASSIGNMENT SEE BARGER 66 AND NOTE AFTER LISTINGS.

                  85  N*3/2(2850) MASS (MEV)    ---------------------------

M    *     2700.0          APPROX       WAHLIG    64 SPRK C  PI-P CH EX
M          2870.0                       HOHLER    64 RVUE    DATA + DISP REL
M          2850.0    12.0               CITRON    66 CNTR    PI+ P TOTAL       7/66
M          2850.0                       BARDADIN  66 HBC  ++ N* TO P + 3 PIS   7/66

----------------  85  N*3/2(2850) WIDTH (MEV)    -------------------------

W           400.0    40.0               CITRON    66 CNTR                      7/66
W           150.0                       BARDADIN  66 HBC  ++                   7/66

----------------  85  N*3/2(2850) PARTIAL DECAY MODES    -----------------

P1         N*3/2(2850) INTO PI N                          S 8S16
P2         N*3/2(2850) INTO P PI PI PI                    S16S 8S 8S 8

----------------  85  N*3/2(2850) BRANCHING RATIOS    --------------------

R1         N*3/2(2850) INTO (PI N)/TOTAL                  (P1)/TOTAL
R1           0.0314   0.0025            CITRON    66 CNTR    ASSUMING J=15/2   7/66

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                        REFERENCES -- N*3/2(2850)

WAHLIG   64 PRL 13 103        +MANNELLI,SODICKSON,FACKLER,WARD, +  //MIT
HOHLER   64 PL 12 149         G HOHLER, J GIESECKE           //KARLSRUHE  I
CITRON   66 PR 144 1101       +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARDADIN 66 PL 21 357         BARDADIN-OTWINOWSKA,DANYSZ, +      //WARSAW
BARGER   66 PRL 16 913        V BARGER, D CLINE                   //WISC  P

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Δ (3230)

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86  N*3/2(3230, JP=19/2+) I=3/2

                  EVIDENCE FOR EXISTENCE NOT COMPLETELY CONCLUSIVE.  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
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-----------------   86  N*3/2(3230) BRANCHING RATIOS    ---------------------

R1          N*3/2(3230) INTO (PI N)/TOTAL                    (P1)/TOTAL
R1            0.0063                      CITRON    66 CNTR    ASSUMING J=19/2   7/66

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                                REFERENCES -- N*3/2(3230)

CITRCN   66 PR 144 1101         +GALBRAITH,KYCIA,LEONTIC,PHILLIPS, + //BNL  I
BARGER   66 PRL 16 913          V BARGER, D CLINE                  //WISC  P

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$N^*_{5/2}$(1560)

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                  91  N*5/2(1560, JP=     ) I=5/2

                      PROBABLE KINEMATIC EFFECT.  SEE DASH 66, CONTE 66, AND
                      ALEXANDER 66.  OMITTED FROM TABLE.

-----------------   91  N*5/2(1560) MASS (MEV)   ----------------------------

M           1560.0     20.0            GOLDHABER 64 HBC  +++3.65 BEV/C PI+ P  7/66
M           1570.0                     ALEXANDER 66 HBC  +++PP 4PI 5.5 BEV/C  9/66

-----------------   91  N*5/2(1560) WIDTH (MEV)   ---------------------------

W            220.0     20.0            GOLDHABER 64 HBC  +++                  7/66
W            140.0                     ALEXANDER 66 HBC  +++                  9/66

-----------------   91  N*5/2(1560) PARTIAL DECAY MODES   ------------------

P1          N*5/2(1560) INTO N PI PI                     S16S 8S 8
P2          N*5/2(1560) INTO N*3/2(1236) PI              L81S 8

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                                REFERENCES -- N*5/2(1560)

GOLDHABE 64 DUBNA CONF I 480  G+S GOLDHABER,OHALLORAN,SHEN     //LRL(BNL)  I
DASH     65 LRL UCID-2752     J DASH, G GOLDHABER, J 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.

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Z_0(1865)

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                  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                             S10S17
P2          Z*0(1865) INTO K*(892) N                       L18S16

-----------------   96  Z*0(1865) BRANCHING RATIOS   -----------------------

R1          Z*0(1865) INTO (K N)/TUTAL                   (P1)/TOTAL
R1            0.55                     COOL       66 CNTR +  IF J=1/2        7/66

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                                REFERENCES -- Z*C(1865)

COOL     66 PRL 17 102          +GIACUMELLI,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).

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Z_1(1910)

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                  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 TUTAL       7/66

-----------------   97  Z*1(1910) WIDTH (MEV)   ----------------------------

W            180.0                     COOL       66 CNTR ++                 7/66

-----------------   97  Z*1(1910) PARTIAL DECAY MODES   --------------------

P1          Z*1(1910) INTO K N                             S10S16
P2          Z*1(1910) INTO N*3/2(1236) K                   U81S10

-----------------   97  Z*1(1910) BRANCHING RATIOS   -----------------------

R1          Z*1(1910) INTO (K N)/TOTAL                   (P1)/TOTAL
R1            0.31                     COOL       66 CNTR ++ IF J=1/2        7/66

R2          Z*1(1910) INTO (N*3/2(1236) K)/TOTAL         (P2)/TOTAL
R2            DOMINANT DECAY           BLAND      66 HBC  ++                 9/66

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                                REFERENCES -- Z*1(1910)

COOL     66 PRL 17 102          +GIACOMELLI,KYCIA,LEUNTIC,LI,LUNDBY,+//BNL  I
BLAND    66 BERKELEY CONF       +BOWLER,BROWN,G+S GOLDHABER,KADYK, + //LRL  I
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                    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.

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Λ (1405)

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                  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 SCATTER-
                      ING LENGTH DETERMINED FROM LOW ENERGY K-P INTERACTIONS.
   THE DIFFICULTIES IN EXTRAPOLATING FROM THE PHYSICAL REGION TO THE RESC-
   NANCE LCCATION ARE DISCUSSED BY DALITZ 66.  THE PARAMETERS ARISING FROM
   ZERC-EFFECTIVE-RANGE FITS ARE MODEL DEPENDENT AND SHOULD NOT BE TAKEN AS
   SERIOUSLY AS THE SMALL QUOTED ERRORS SUGGEST.  SEE THE NOTE IN THE MAIN
   TEXT 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                       S20S 8

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                                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        +CAY,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.

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Λ (1520)

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                  38  Y*0(1520, 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 LAMBDA PI PI                   S18S 8S 8

-----------------   38  Y*0(1520) PARTIAL WIDTHS (MEV)   -------------------

W1          Y*0(1520) INTO KBAR N                         (P1)
W1            4.8      0.5             WATSON    63 HBC

W2          Y*0(1520) INTO SIGMA PI                       (P2)
W2            9.0      1.0             WATSON    63 HBC

-----------------   38  Y*0(1520) BRANCHING RATIOS   -----------------------

R1          Y*0(1520) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1            0.47     0.09            HESS      66 HBC    PI-P 1.6-4 BEV/C  9/66

R2          Y*0(1520) INTO (SIGMA PI)/TOTAL               (P2)/TOTAL
R2            0.45     0.04            HARDY     66 HBC                      9/66

R3          Y*0(1520) INTO (KBAR N)/(SIGMA PI)            (P1)/(P2)
R3            0.58     0.26            MUSGRAVE  65 HBC                      7/66

R4          Y*0(1520) INTO (SIGMA PI)/(LAMBDA PI PI)      (P2)/(P3)
R4            4.5      1.0             ARMENTERO 65 HBC                      7/66
R4            4.8      1.2             UHLIG     66 HBC    K-P .9-1.0 BEV/C  9/66

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                                REFERENCES -- Y*C(1520)

WATSCN   63 PR 131 2248        M B WATSON, M FERRU-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

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Λ (1670)

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                 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

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                            REFERENCES -- Y*C(1670)

Y-CHANG  64 DUBNA CCNF I 615  YUNG-CHANG, IN, KLADNITSKAYA, +    //DUBNA  I
BERLEY   65 PRL 15 641        +CONNOLLY,HART,RAHM,STONEHILL, +     //BNL IJP

                        PAPER NOT REFERRED TO IN DATA CARDS.

BANNIK   66 BERKELEY CONF     +BUBELEV,CHADRAA, + //DUBNA,BUCHAREST,CERN  I
    -- SUPPORTS RESULT OF YUNG-CHANG 64.

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Λ (1700)

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                 55  Y*0(1700, JP=3/2-) I=0

                  SPIN-PARITY DETERMINATION TENTATIVE.

                 55  Y*0(1700) MASS (MEV)     ----------------------------

M        1705.0     10.0             ARMENTERO 66 HBC     K-P EL, CH EX     9/66
M        1698.0      5.0             DAVIES    66 CNTR    K-P, D TOTAL     11/66

----------------  55  Y*0(1700) WIDTH (MEV)    ----------------------------

W          30.0        APPROX        ARMENTERO 66 HBC                       9/66
W          40.0     10.0             DAVIES    66 CNTR                     11/66

----------------  55  Y*0(1700) PARTIAL DECAY MODES   --------------------

P1       Y*0(1700) INTO KBAR N                          S11S17
P2       Y*0(1700) INTO SIGMA PI                        S20S 8

----------------  55  Y*0(1/00) BRANCHING RATIOS   ----------------------

R1       Y*0(1700) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1          0.18       APPROX        ARMENTERO 66 HBC                       9/66
R1          0.24                     DAVIES    66 CNTR    ASSUMING J=3/2   11/66

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                            REFERENCES -- Y*C(17C0)

ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

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Λ (1815)

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                 39  Y*0(1815, JP=5/2+) I=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 TOC.
M        1820.0      5.0             ARMENTERO 66 HBC     2-BODY CHANNELS   9/66
M        1819.0      5.0             DAVIES    66 CNTR    K-P, D TOTAL     11/66

----------------  39  Y*0(1815) WIDTH (MEV)    ----------------------------

W    *     70.0                      GALTIERI  63
W          60.0                      BIRGE     65 HBC                       7/66
W    N     73.0     10.0             LEVI SETT 66 RVUE    SOME REAL BGD     9/66
W    N  CR 70.5      9.0             LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
     N   RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TCC.
W          80.0     10.0             ARMENTERO 66 HBC                       9/66
W          90.0     15.0             DAVIES    66 CNTR                     11/66

----------------  39  Y*0(1815) PARTIAL DECAY MODES   --------------------

P1       Y*0(1815) INTO KBAR N                          S11S17
P2       Y*0(1815) INTO SIGMA PI                        S20S 8
P3       Y*0(1815) INTO LAMBCA ETA                      S18S14
P4       Y*0(1815) INTO Y*1(1385) PI                    U43S 8

----------------  39  Y*0(1815) BRANCHING RATIOS   ----------------------

R1       Y*0(1815) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1   *      0.8                      GALTIERI  63          K-P RVUE
R1   N      0.67     0.08            LEVI SETT 66 RVUE    SOME REAL BGD     9/66
R1   N   OR 0.61     0.07            LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
     N   RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TOO.
R1          0.60     0.05            ARMENTERO 66 HBC                       9/66
R1          0.74                     DAVIES    66 CNTR                     11/66

R2       Y*0(1815) INTO (SIGMA PI)/TOTAL                (P2)/TOTAL
R2          0.12     0.02            ARMENTERO 66 HBC                       9/66

R3       Y*0(1815) INTO (LAMBCA ETA)/TOTAL              (P3)/TOTAL
R3          0.01                     ARMENTERO 66 HBC                       9/66

R4       Y*0(1815) INTO (Y*1(1385) PI)/TOTAL            (P4)/TOTAL
R4          0.20     0.05            BIRGE     65 HBC                       7/66
R4          0.19     0.04            BARLOUTAU 66 HBC      ASSUMING R1=0.60 9/66

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                            REFERENCES -- Y*C(1815)

GALTIERI 63 PL 6 296          A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP//LRL IJ
BIRGE    65 ATHENS CONF 296   +ELY,KALMUS,KERNAN,LOUIE,SAHOURIA, + //LRL IJP
LEVI SET 66 BERKELEY CONF     R LEVI SETTI, E PREDAZZI            //CHI
ARMENTER 66 BERKELEY CONF     ARMENTEROS,F-LUZZI, + //CERN,HEIUEL,SACLAY IJP'
BARLCUTA 66 BERKELEY CONF     BARLOUTAUD,GRANET, +  //SACLAY,HEIDEL,CERN IJP
DAVIES   66 PRL (TO BE SUBM)  +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

                        PAPERS NOT REFERRED TO IN DATA CARDS.

CHAMBERL 62 PR 125 1696       CHAMBERLAIN,CROWE,KEEFE,KERTH, +     //LRL  I
    -- FIRST SEEN IN CHAMBERLAIN 62 TOTAL CROSS SECTION MEASUREMENTS.
SODICKSO 64 PR 133 B757       SODICKSON,MANNELLI,FRISCH,WAHLIG//MIT(BNL)  J
HOLLEY   65 UCRL-16274 THESIS W R HOLLEY                           //LRL  J
    -- SODICKSCN 64 AND HOLLEY 65 ELASTIC SCATTERING WORK INDICATED J=5/2.
GELFAND  66 BERKELEY CONF     +HARMSEN,LEVI SETTI,RAYMUND, +   //CHI,ARG
    -- ELASTIC SCATTERING DATA FIT BY LEVI SETTI 66.

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Λ (2100)

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                 41  Y*0(2100, JP=7/2-) I=C

                 41  Y*0(2100) MASS (MEV)     ----------------------------

M    *   2097.0      6.0             BOCK      65 HBC     PBAR P 5.7 BEV/C  7/66
M        2100.0     20.0             COOL      66 CNTR    K-P, D TOTAL      7/66
M    *   2120.0                      WOHL      66 HBC     K-P CH EX         7/66

----------------  41  Y*0(2100) WIDTH (MEV)    ----------------------------

W    *     24.0     14.0     24.0    BOCK      65 HBC     INTO KBAR N (PI)  7/66
W         160.0                      COOL      66 CNTR                      7/66
W         145.0                      WOHL      66 HBC                       7/66

----------------  41  Y*0(2100) PARTIAL DECAY MODES   --------------------

P1       Y*0(2100) INTO KBAR N                          S11S17
P2       Y*0(2100) INTO SIGMA PI                        S20S 8
P3       Y*0(2100) INTO LAMBCA OMEGA                    S18S 1
P4       Y*0(2100) INTO KBAR N PI                       S11S17S 8

----------------  41  Y*0(2100) BRANCHING RATIOS   ----------------------

R1       Y*0(2100) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1          0.29                     COOL      66 CNTR                      7/66
R1          0.25                     WOHL      66 HBC                       7/66

R2       Y*0(2100) INTO (LAMBCA OMEGA)/TOTAL            (P3)/TOTAL
R2          0.1        OR LESS       FLATTE    66 HBC                       9/66

R3       Y*0(2100) INTO (KBAR N PI)/TOTAL               (P4)/TOTAL
R3             SEEN                  BOCK      65 HBC                       9/66

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                            REFERENCES -- Y*C(2100)

BOCK     65 PL 17 166         +COOPER,FRENCH,KINSON, +      //CERN,SACLAY
COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
WOHL     66 PRL 17 107        C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP
FLATTE   66 PRIVATE COMM      S M FLATTE                           //LRL

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Λ (2340)

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                 42  Y*0(2340, JP=    ) I=0

                 42  Y*0(2340) MASS (MEV)     ----------------------------

M        2340.0     20.0             COOL      66 CNTR    K-P, D TOTAL      7/66

----------------  42  Y*0(2340) WIDTH (MEV)    ----------------------------

W         105.0                      COOL      66 CNTR                      7/66

----------------  42  Y*0(2340) PARTIAL DECAY MODES   --------------------

P1       Y*0(2340) INTO KBAR N                          S11S17

----------------  42  Y*0(2340) BRANCHING RATIOS   ----------------------

R1       Y*0(2340) INTO (KBAR N)/TOTAL                  (P1)/TOTAL
R1          0.102                    COOL      66 CNTR     ASSUMING J=9/2   7/66

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                            REFERENCES -- Y*C(2340)

COOL     66 PRL 16 1228       +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I

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Σ (1385)

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

                      FOR THE TABLES WE USE ONLY THE UNSTARRED DATA, WHICH ARE
                      ATTEMPTS TO OBTAIN THE SEPARATE CHARGE-STATE MASSES AND
                      WIDTHS.  SEE HOWEVER THE IDEOGRAMS INSERTED IN LISTINGS.
   THESE INDICATE SERIOUS SYSTEMATICS, PERHAPS ARISING FROM INTERFERENCE EF-
   FECTS THAT CHANGE WITH PRODUCTION MECHANISM AND BEAM MOMENTUM.

----------------  43  Y*1(1385) MASS (MEV)     ----------------------------

M    *  141 1384.0                   ALSTON    60 HBC  +- K-P 1.15 BEV/C
M    *   38 1384.0                   MARTIN    61 HBC  C+ K20 P .98 BEV/C
M    *      1385.0                   BERGE     61 HBC  +- K-P .4-.85 BEV/C
M    *      1392.0      7.0          COLLEY    62 PBC  C- PI- PRP 2. BEV/C
MO   *  106 1381.0      4.0          CURTIS    63 SPRK C  PI-P 1.5 BEV/C
M    *      1392.0     10.0          MUSGRAVE  65 HBC  +-OPBAR P 3-4 BEV/C  7/66
M    *      1389.0      3.0          BALTAY    65 HBC  +- PBAR P 3.7 BEV/C  7/66

M+      154 1376.0      3.0          ELY       61 PBC  +  K-P 1.11 BEV/C
M+      170 1375.0      3.9          COOPER    64 HBC  +  K-P 1.45 BEV/C
M+      859 1381.0      1.6          HUWE      66 HBC  +  K-P 1.22 BEV/C
M+          1382.0      1.0          ARMENTERO 65 HBC  +  K-P .9-1.2 BEV/C
M+          1378.0      5.0          LONDON    66 HBC  +  K-P 2.24 BEV/C    7/66
M+          1384.3      1.1          COLTON    66 HBC  +  K-P 1.8 BEV/C     9/66
M+          1382.6      1.4          COLTON    66 HBC  +  K-P 1.95 BEV/C    9/66
M-       93 1382.0      3.0          DAHL      61 DBC  -  K-D 0.45 BEV/C
M-      224 1376.0      3.0          ELY       61 PBC  -
M-      200 1392.0      6.2          COOPER    64 HBC  -
M-     1086 1385.3      1.5          HUWE      64 HBC  -
M-          1384.0      1.0          ARMENTERO 65 HBC  -
M-          1389.0      9.0          LONDON    66 HBC  -                    7/66
M-          1391.5      1.8          COLTON    66 HBC  -  K-P 1.8 BEV/C     9/66
M-          1399.8      1.4          COLTON    66 HBC  -  K-P 1.95 BEV/C    9/66
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(Ideograms on next page)

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----------------  43  Y*(-) - Y*(+) MASS DIFFERENCE (MEV)   ---------------

D    R         0.0      4.2          ELY       61 PBC  +- K-P 1.11 BEV/C    8/66
D    R         4.3      2.2          HUWE      64 HBC  +- K-P 1.22 BEV/C    8/66
D    R         2.0      1.5          ARMENTERO 65 HBC  +- K-P .9-1.2 BEV/C  8/66
D    R        11.0      9.0          LONDON    66 HBC  +- K-P 2.24 BEV/C    8/66
D    R         7.2      2.1          COLTON    66 HBC  +- K-P 1.8 BEV/C     9/66
D    R        17.2      2.0          COLTON    66 HBC  +- K-P 1.95 BEV/C    9/66
     R      REDUNDANT WITH DATA IN MASS LISTING.
D              9.0      6.0          LONDON    66 HBC  +- LAMBDA 3 PI EVTS  7/66
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-----------------   43  Y*1(1385) WIDTH (MEV)   ----------------------------

W   *      64.0                       ALSTON    60 HBC  +-
W   *      20.0         OR LESS       MARTIN    61 HBC  C+
W   *      40.0                       BERGE     61 HBC  +-
W   *      80.0     10.0              COLLEY    62 PBC  C-
W   *      30.0      9.0              CURTIS    63 SPRK C
W   *      38.0      9.0              MUSGRAVE  65 HBC  +-0                 7/66
W   *      26.0      5.0              BALTAY    65 HBC  +-                  7/66

W+         48.0      8.0              ELY       61 PBC  +
W+         51.0     10.0              COOPER    64 HBC  +
W+         46.5      3.0              HUWE      64 HBC  +
W+         32.0      3.0              ARMENTERO 65 HBC  +
W+         30.3      3.1              COLTON    66 HBC  +  K-P 1.8 BEV/C    9/66
W+         33.1      3.8              COLTON    66 HBC  +  K-P 1.95 BEV/C   9/66
W          40.0                       DAHL      61 DBC  -
W-         66.0     10.0              ELY       61 PBC  -
W-         88.0     10.0              COOPER    64 HBC  -
W-         62.0      7.0              HUWE      64 HBC  -
W-         38.0      3.0              ARMENTERO 65 HBC  -
W-         29.2      5.7              COLTON    66 HBC  -  K-P 1.80 BEV/C   9/66
W-         17.1      4.4              COLTON    66 HBC  -  K-P 1.95 BEV/C   9/66
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(Ideograms below)

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-----------------   43  Y*1(1385) PARTIAL DECAY MODES   --------------------

P1        Y*1(1385) INTO LAMBCA PI                      S18S 8
P2        Y*1(1385) INTO SIGMA PI                       S20S 8

-----------------   43  Y*1(1385) BRANCHING RATIOS   ------------------------

R1        Y*1(1385) INTO (SIGMA PI)/(LAMBDA PI)         (P2)/(P1)
R1           0.04      0.04           BASTIEN   61 HBC  +-
R1  *        0.04        OR LESS      ALSTON    62 HBC  +-0
R1           0.09      0.04           HUWE      64 HBC  +-
R1           0.163     0.035          ARMENTERO 65 HBC  +-                  7/66
R1           0.08      0.06           LONDON    66 HBC  +                   7/66
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(Ideogram below)

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                        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
LONDON   66 PR 143 1034         +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR  J
COLTCN   66 H E P MEMO 27       +TICHO,DAUBER,SCHLEIN,SLATER,SMITH,+//UCLA

         QUANTUM NUMBER DETERMINATIONS NOT REFERRED TO IN DATA CARDS.

SHAFER   64 PR 134 B1372        J B SHAFER, D O HUWE                 //LRL  JP
MALAMUD  64 PL 10 145           E MALAMUD, P E SCHLEIN         //CERN,UCLA  JP

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Σ (1660)

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44  Y*1(1660, JP=3/2-) I=1

                THE Y*1(1660) IS DIFFICULT TO STUDY IN FORMATION EXPER-
                IMENTS 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 EXPERI-
MENTS DO AGREE THAT THE MOST PROBABLE JP ASSIGNMENT IS 3/2-.

-----------------   44  Y*1(1660) MASS (MEV)   -----------------------------

M          1685.0                     ALEXANDER 62 HBC  0- PI-P 2-2.2 BEV/C
M          1660.0    10.0             ALVAREZ   63 HBC  +  K-P 1.51 BEV/C
M          1660.0                     BERLEY    64 HBC  0  K-P TO LAM PIO    7/66
M          1645.0     7.0             LEVEQUE   65 HBC  +  K-P TO Y*1660 PI  7/66
M          1662.0     5.0             DAVIES    66 CNTR    K-P, D TOTAL     11/66

-----------------   44  Y*1(1660) WIDTH (MEV)   ----------------------------

W            45.0                     ALEXANDER 62 HBC  0-
W            40.0    10.0             ALVAREZ   63 HBC  +
W            60.0                     BERLEY    64 HBC  0                    7/66
W            55.0    10.0             LEVEQUE   65 HBC  +                    7/66
W            45.0    15.0             DAVIES    66 CNTR                     11/66

-----------------   44  Y*1(1660) PARTIAL DECAY MODES   --------------------

P1        Y*1(1660) INTO KBAR N                         S11S1/
P2        Y*1(1660) INTO LAMBCA PI                      S18S 8
P3        Y*1(1660) INTO SIGMA PI                       S20S 8
P4        Y*1(1660) INTO LAMBCA PI PI                   S18S 8S 8
P5        Y*1(1660) INTO SIGMA PI PI                    S20S 8S 8
P6        Y*1(1660) INTO Y*1(1385) PI                   U43S 8
P7        Y*1(1660) INTO Y*0(1405) PI                   U37S 8

-----------------   44  Y*1(1660) BRANCHING RATIOS   -----------------------

R1        Y*1(1660) INTO (KBAR N)/TOTAL                 (P1)/TOTAL
R1           0.05       OR LESS       ALVAREZ   63 HBC  +
R1  *        0.16       OR MORE       BASTIEN 2 63 HBC  C
R1           0.2        OR LESS       LONDON    66 HBC  +                    7/66
R1           0.065                    DAVIES    66 CNTR   ASSUMING J=3/2   11/66

R2        Y*1(1660) INTO (LAMBCA PI)/TOTAL              (P2)/TOTAL
R2           0.32                     ALVAREZ   63 HBC  +
R2           0.09       OR LESS       BASTIEN 2 63 HBC  0
R2           0.2        OR LESS       LONDON    66 HBC  +                    7/66
R2           0.06      0.06           SMART     66 DBC  -  ASSUMING R1=0.15  7/66
R2           0.45                     ARMENTERO 66 HBC  0  ASSUMING R1=0.15  9/66

R3        Y*1(1660) INTO (SIGMA PI)/TOTAL               (P3)/TOTAL
R3           0.27                     ALVAREZ   63 HBC  +
R3  *        0.22      0.06           BASTIEN 2 63 HBC  C
R3           0.25      0.15           LONDON    66 HBC  +                    7/66
R3           0.15                     ARMENTERO 66 HBC  C  ASSUMING R1=0.15  9/66

R4        Y*1(1660) INTO (LAMBCA PI PI)/TOTAL           (P4)/TOTAL
R4           0.18                     ALVAREZ   63 HBC  +
R4  *        0.16      0.05           BASTIEN 2 63 HBC  C
R4           0.2        OR LESS       LONDON    66 HBC  +                    7/66
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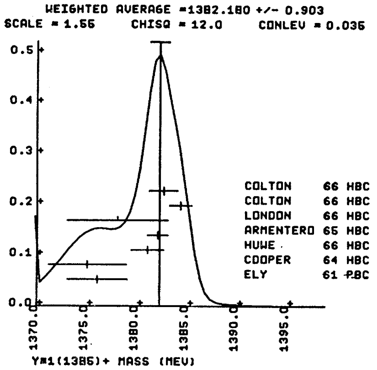

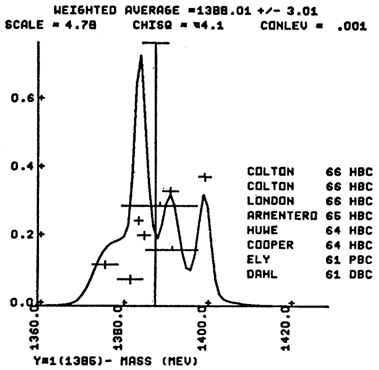

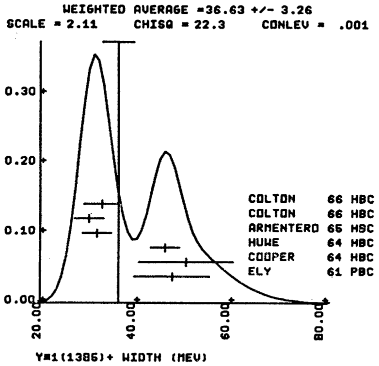

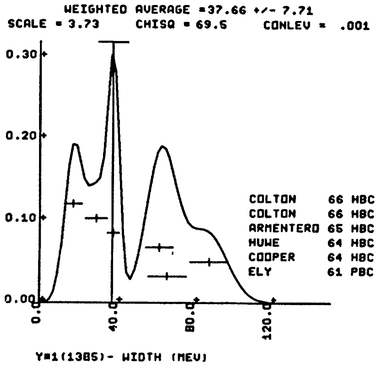

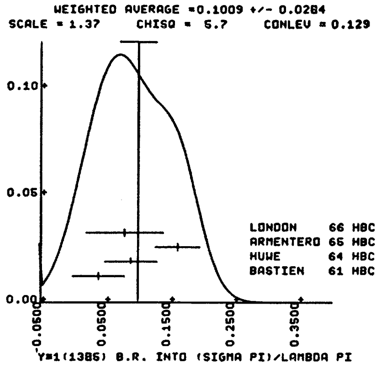

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R5          Y*1(1660) INTO (SIGMA PI PI)/TOTAL              (P5)/TOTAL
R5             0.18                         ALVAREZ   63 HBC  +
R5   *         0.25      0.06               BASTIEN 2 63 HBC  0

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  0-
R8             6.8       3.0                HUWE      64 HBC  +

R9          Y*1(1660) INTO (LAMBCA PI PI)/(LAMBDA PI)       (P4)/(P2)
R9             0.14                         SMITH     63 HBC  C-

R10         Y*1(1660) INTO (Y*0(1405) PI)/(SIGMA PI PI)     (P7)/(P5)
R10            0.90      0.10      0.16     EBERHARD  65      +                    7/66

R11         Y*1(1660) INTO (Y*0(1405) PI)/(Y*1(1385) PI)    (P7)/(P6)
R11            0.8          OR MORE         EBERHARD  65      +                    7/66

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                          REFERENCES -- Y*1(1660)

ALEXANDE 62 CERN CONF 320      ALEXANDER,JACOBS,KALBFLEISCH,MILLER,+//LRL  I
ALVAREZ  63 PRL 10 184         +ALSTON,FERRO-LUZZI,HUWE, +          //LRL  I
BASTIEN2 63 UCRL-10779 THESIS  P L BASTIEN                          //LRL  IJ
SMITH    63 ATHENS CONF 67     G A SMITH                            //LRL
HUWE     64 UCRL-11291 THESIS  D O HUWE                             //LRL
BERLEY   64 DUBNA CONF I 565   +CONNOLLY,HART,RAHM,STONEHILL, +     //BNL IJP
EBERHARD 65 PRL 14 466         +SHIVELY,ROSS,SIEGAL,FICENEC, +  //LRL,ILL  I
LEVEQUE  65 PL 18 69            +    //SACLAY,EP,GLASGOW,IMPCOL,OXF,RTHFD  JP
LONDCN   66 PR 143 1034        +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR  IJ
SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF      ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)   +COWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

                   PAPERS NOT REFERRED TO IN DATA CARDS.

BASTIEN1 63 PRL 10 188         P L BASTIEN, J P BERGE               //LRL  IJ
      --  REPLACED BY BASTIEN 2, BUT SIMILAR AND MORE READILY AVAILABLE.
T-ZADEH  63 PRL 11 470         TAHER-ZADEH,PROWSE,SCHLEIN,SLATER,+ //UCLA  JP
      --  SEE NOTE FOLLOWING SCHLEIN 66.
EBERHARD 65 BAPS 10 478        P EBERHARD                           //LRL IJP
SLATER   65 BAPS 10 1196       +CAUBER, SCHLEIN, STORK, TICHO      //UCLA  JP
LEE      66 PRL 17 45          Y Y LEE, D D REEDER, R W HARTUNG    //WISC  JP
SCHLEIN  66 UCLA-1016          P E SCHLEIN, T G TRIPPE             //UCLA  JP
      --  REANALYZES DATA OF TAHER-ZADEH 63 AND BASTIEN 63 AND ALL PUBLISHED
          LAMBDA PI CROSS SECTION DATA IN THE LIGHT OF THE NOW KNOWN
          Y*1(1765) AND REVERSES THE MODEL-DEPENDENT CONCLUSION OF TAHER-
          ZADEH ON THE PREFERREC JP ASSIGNMENT (FROM 3/2+ TO 3/2-).

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Σ (1765)

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

                 45  Y*1(1765) MASS (MEV)     ----------------------------

M          1765.0     10.0            GALTIERI  63 DBC  0. K-D 1.51 BEV/C
M          1755.0     10.0            ARMENTERO 65 HBC  C  K-P TO Y*1520 PI  7/66
M          1760.0     10.0            BELL 1,2  66 DBC  -  K-N TO Y*1520 PI  7/66
M          1776.0      6.0            SMART     66 DBC  -  K-N TO LAM PI-    7/66
M          1746.0      8.0            FENSTER   66 HBC  0  K-P TO Y*1520 PI  9/66
M   N      1758.0     11.0            LEVI SETT 66 RVUE    SOME REAL BGD     9/66
M   N   OR 1770.0     11.0            LEVI SETT 66 RVUE    BGD PURE IMAG     9/66
    N      RES + CIFFRACTIVE BGC FOR K-P EL.  DATA ARE IN ARMENT 66 FITS TCO.
M          1770.0     10.0            ARMENTERO 66 HBC  C  2-BODY CHANNELS   9/66
M          1775.0      5.0            DAVIES    66 CNTR    K-P, D TOTAL     11/66
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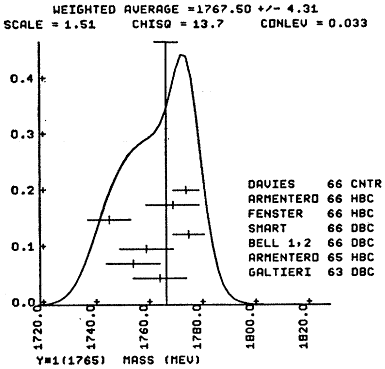
(Ideogram below)



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-----------------  45  Y*1(1765) WIDTH (MEV)  ------------------------------

W            60.0      10.0           GALTIERI  63 DBC  C
W           105.0      20.0           ARMENTERO 65 HBC  C                     7/66
W            70.0      20.0           BELL 2    66 DBC  -                     7/66
W           129.0      16.0           SMART     66 DBC  -                     7/66
W.           70.0      20.0           FENSTER   66 HBC  C                     9/66
W   N       113.0      25.0           LEVI SETT 66 RVUE    SOME REAL BGD      9/66
W   N   OR  158.0      38.0           LEVI SETT 66 RVUE    BGD PURE IMAG      9/66
    N      RES + 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           DAVIES    66 CNTR                      11/66
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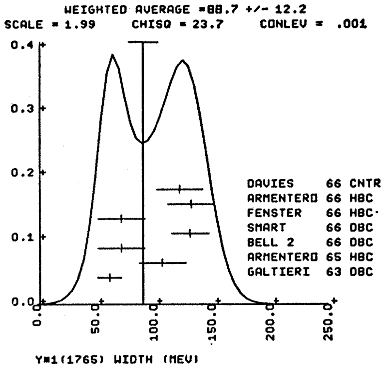
(Ideogram below)



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-----------------  45  Y*1(1765) PARTIAL DECAY MODES  ---------------------

P1          Y*1(1765) INTO KBAR N                             S11S17
P2          Y*1(1765) INTO LAMBDA PI                          S18S 9
P3          Y*1(1765) INTO SIGMA PI                           S20S 8
P4          Y*1(1765) INTO SIGMA ETA                          S21S14
P5          Y*1(1765) INTO Y*1(1385) PI                       U43S 8
P6          Y*1(1765) INTO Y*0(1520) PI                       L38S 8

-----------------  45  Y*1(1765) BRANCHING RATIOS  ------------------------

R1          Y*1(1765) INTO (KBAR N)/TOTAL                   (P1)/TOTAL
R1   *         0.6                          GALTIERI  63 HBC  0  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  0  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

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                          REFERENCES -- Y*1(1765)

GALTIERI 63 PL 6 296            A BARBARO-GALTIERI,A HUSSAIN,RD TRIPP//LRL IJ
ARMENTER 65 PL 19 338           ARMENTEROS, +     //CERN,HEIDELBERG,SACLAY IJP
BELL 1   66 PRL 16 203          R B BELL, R W BIRGE, Y-L PAN, R T PU //LRL IJP
BELL 2   66 UCRL-16936 THESIS   R B BELL                              //LRL IJP
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,USNRL  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
      --  YCDH 65 AND BIRGE 65 ARE PRECURSORS OF UHLIG 66 AND BELL 66.
GELFAND  66 BERKELEY CONF      +HARMSEN,LEVI SETTI,RAYMUND, +    //CHI,ARG
      --  ELASTIC SCATTERING CATA FIT BY LEVI SETTI 66.

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Σ (1780)

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57  Y*1(178C, JP=    ) I=1

                 SIGMA ETA THRESHOLD EFFECT.  INTERPRETATION AS RESONANCE
                 NOT CONCLUSIVE.  SEE FERRO-LUZZI 66.  OMITTED FROM TABLE

-----------------  57  Y*1(1780) MASS (MEV)   ----------------------------

M            1780.0                    CLINE      66 DBC  -  K-N TO SIG- ETA   9/66

-----------------  57  Y*1(1780) WIDTH (MEV)   ---------------------------

W             100.0                    CLINE      66 DBC  -                    9/66

-----------------  57  Y*1(1780) PARTIAL DECAY MODES   -------------------

P1          Y*1(1780) INTO KBAR N                           S11S17
P2          Y*1(1780) INTO SIGMA ETA                        S20S14

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                          REFERENCES -- Y*1(178C)

CLINE    66 BERKELEY CONF     D CLINE, M OLSSON                 //WISC(LRL)  I
F-LUZZI  66 BERKELEY CONF     M FERRO-LUZZI                        //CERN

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Σ (1915)

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46  Y*1(1915, JP=5/2+) I=1

    PERHAPS SOME SLIGHT RESERVATION SHOULD BE HELD AGAINST
    COMPLETE ACCEPTANCE OF THE INTERPRETATION OF THIS EFFECT
    AS (1) BEING A RESONANCE (2) HAVING JP = 5/2+.

-----------------  46  Y*1(1915) MASS (MEV)  -----------------------------

M   *    1942.0     9.0              BOCK      65 HBC     PBAR P 5.7 BEV/C
M        1915.0    20.0              COOL      66 CNTR 0- K-P, D TOTAL      7/66
M        1905.0     5.0              DAVIES    66 CNTR    K-P, D TOTAL     11/66

-----------------  46  Y*1(1915) WIDTH (MEV)  ----------------------------

W   *      36.0    20.0      36.0    BOCK      65 HBC
W          65.0                      COOL      66 CNTR 0-                   7/66
W          60.0    20.0              DAVIES    66 CNTR                     11/66

-----------------  46  Y*1(1915) PARTIAL DECAY MODES  --------------------

P1       Y*1(1915) INTO KBAR N                        S11S17
P2       Y*1(1915) INTO LAMBDA PI                     S18S 8
P3       Y*1(1915) INTO SIGMA PI                      S20S 8

-----------------  46  Y*1(1915) BRANCHING RATIOS  -----------------------

R1       Y*1(1915) INTO (KBAR N)/TOTAL                (P1)/TOTAL
R1          0.103                    COOL      66 CNTR    ASSUMING J=5/2    7/66
R1          0.06       0.02          ARMENTERO 66 HBC  C  K-P EL, CH EX     9/66
R1          0.1                      DAVIES    66 CNTR    ASSUMING J=5/2   11/66

R2       Y*1(1915) INTO (LAMBCA PI)/TOTAL             (P2)/TOTAL
R2          0.12       0.08          SMART     66 DBC  -  ASSUMING R1=0.10  7/66
R2          0.10                     ARMENTERO 66 HBC  C  ASSUMING R1=0.06  9/66

R3       Y*1(1915) INTO (SIGMA PI)/TOTAL              (P3)/TOTAL
R3          0.03       0.02          ARMENTERO 66 HBC  C  ASSUMING R1=0.06  9/66

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                        REFERENCES -- Y*1(1915)

BOCK     65 PL 17 166          +COOPER,FRENCH,KINSON, +     //CERN,SACLAY  I
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF      ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
DAVIES   66 PRL (TO BE SUBM)   +DOWELL,HATTERSLEY,+ //BIRMGHM,CAMBR,RTHFD  I

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Σ (2035)

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47  Y*1(2035, JP=7/2+) I=1

                   47  Y*1(2035) MASS (MEV)  -----------------------------

M   *    2022.0    20.0              BLANPIED  65 CNTR C  GAMMA P TO K+ Y*
M        2040.0    20.0              COOL      66 CNTR 0- K-P, D TOTAL      7/66
M        2030.0    20.0              WOHL      66 HBC  0  K-P TO LAM 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  0                    7/66

-----------------  47  Y*1(2035) PARTIAL DECAY MODES  --------------------

P1       Y*1(2035) INTO KBAR N                        S11S17
P2       Y*1(2035) INTO LAMBDA PI                     S18S 9
P3       Y*1(2035) INTO SIGMA PI                      S20S 8

-----------------  47  Y*1(2035) BRANCHING RATIOS  -----------------------

R1       Y*1(2035) INTO (KBAR N)/TOTAL                (P1)/TOTAL
R1          0.155                    COOL      66 CNTR C  K-P TOTAL         7/66
R1          0.25                     WOHL      66 HBC  0  K-P CH EX         7/66

R2       Y*1(2035) INTO (LAMBCA PI)/TOTAL             (P2)/TOTAL
R2          0.16                     WOHL      66 HBC  C  ASSUMING R1=0.25  7/66

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                        REFERENCES -- Y*1(2035)

BLANPIED 65 PRL 14 741         +GREENBERG,HUGHES,KITCHING,LU,+//YALE(CEA)
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I
WOHL     66 PRL 17 107         C G WOHL, F T SOLMITZ, M L STEVENSON //LRL IJP

                 PAPERS NOT REFERRED TO IN DATA CARDS.

SMART    66 PRL 17 556         W M SMART,A KERNAN,G E KALMUS,R P ELY//LRL IJP
ARMENTER 66 BERKELEY CONF      ARMENTEROS,F-LUZZI, + //CERN,HEIDEL,SACLAY IJP
     --  SMART 66 AND ARMENTEROS 66 TEND TO CONFIRM THE JP ASSIGNMENT.

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Σ (2260)

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48  Y*1(2260, JP=    ) I=1

    EVIDENCE NOT COMPLETELY CONCLUSIVE.  THE BUMP IS SMALL
    AND SENSITIVE TO DETAILS OF THE UNFOLDING OF THE EFFECTS
    OF INTERNAL MOMENTA OF THE NUCLEONS IN THE DEUTERON.

-----------------  48  Y*1(2260) MASS (MEV)  -----------------------------

M   *    2245.0                      BLANPIED  65 CNTR    GAMMA P TO K+ Y*
M   *    2299.0     6.0              BOCK      65 HBC     PBAR P 5.7 BEV/C
M        2260.0    20.0              COOL      66 CNTR    K-P, D TOTAL      7/66

-----------------  48  Y*1(2260) WIDTH (MEV)  ----------------------------

W   *     150.0                      BLANPIED  65 CNTR
W   *      21.0    17.0      21.0    BOCK      65 HBC
W         180.0                      COOL      66 CNTR                      7/66

-----------------  48  Y*1(2260) PARTIAL DECAY MODES  --------------------

P1       Y*1(2260) INTO KBAR N                        S11S17
P2       Y*1(2260) INTO KBAR N PI                     S11S17S 8

-----------------  48  Y*1(2260) BRANCHING RATIOS  -----------------------

R1       Y*1(2260) INTO (KBAR N)/TOTAL                (P1)/TOTAL
R1          0.14                     COOL      66 CNTR    ASSUMING J=9/2    7/66

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                        REFERENCES -- Y*1(2260)

BLANPIED 65 PRL 14 741         +GREENBERG,HUGHES,KITCHING, +  //YALE(CEA)
BOCK     65 PL 17 166          +COOPER,FRENCH,KINSON, +     //CERN,SACLAY
COOL     66 PRL 16 1228        +GIACOMELLI,KYCIA,LEONTIC,LI,LUNDBY,+//BNL  I

                 PAPER NOT REFERRED TO IN DATA CARDS.

DAUBER   66 PL 23 154          +SCHLEIN, SLATER, STORK, TICHO //UCLA(LRL)  J
     --  SUGGESTS J=9/2 RESONANT BEHAVIOR IN SIGMA- PI+, BUT APPEARS
         INCONSISTENT WITH COOL 66 PARAMETERS.

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Σ (3000)

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59  Y*1(3000, JP=    ) I=1

    ENHANCEMENT IN LAMBDA PI AND KBAR N INVARIANT MASS
    SPECTRA AND IN MISSING MASS OF NEUTRALS RECOILING
    AGAINST KO.  EVIDENCE NOT CONCLUSIVE.  OMITTED FROM
    TABLE.

-----------------  59  Y*1(3000) MASS (MEV)  -----------------------------

M        3000.0                      EHRLICH   66 HBC  C  PI-P 7.91 BEV/C   9/66

-----------------  59  Y*1(3000) PARTIAL DECAY MODES  --------------------

P1       Y*1(3000) INTO KBAR N                        S11S17
P2       Y*1(3000) INTO LAMBCA PI                     S18S 8

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                        REFERENCES -- Y*1(3000)

EHRLICH  66 PR (SUBMITTED)     R EHRLICH, W SELOVE, H YUTA    //PENN(BNL)  I

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Ξ (1530)

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

                   49  XI*1/2(1530) MASS (MEV)  --------------------------

M   *    1529.0     5.0              PJERROU   62 HBC  C- K-P 1.8 BEV/C
M   *    1532.0     2.0              BADIER    64 HBC  C- K-P 3 BEV/C
M-       1535.7     3.2              LONDON    66 HBC  -  K-P 2.24 BEV/C    7/66
M0       1528.7     1.1              LONDON    66 HBC  0                    7/66

-----------------  49  XI*(-)-XI*(0) MASS DIFFERENCE (MEV)  --------------

D           5.7     3.0              PJERROU   65 HBC  0- K-P 1.8-1.95 B/C. 7/66
D   R       7.0     4.0              LONDON    66 HBC  0                    7/66
    R    REDUNDANT WITH DATA IN MASS LISTING.
D           2.0     3.2              MERRILL   66 HBC  C- K-P 1.7-2.7 BE/C  7/66

-----------------  49  XI*1/2(1530) WIDTH (MEV)  -------------------------

W           7.0     2.0              SCHLEIN   63 HBC  C  K-P 1.8-1.95 B/C
W           8.5     3.5              LONDON    66 HBC  0                    7/66
W           7.0     7.0              BERGE     66 HBC  0  K-P 1.5-1.7 BE/C  7/66

-----------------  49  XI*1/2(1530) PARTIAL DECAY MODES  -----------------

P1       XI*1/2(1530) INTO XI PI                      S22S 8

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                        REFERENCES -- XI*1/2(1530)

PJERROU  62 PRL 9 114          +PROWSE,SCHLEIN,SLATER,STORK,TICHO  //UCLA  I
SCHLEIN  63 PRL 11 167         +CARMONY,PJERROU,SLATER,STORK,TICHO //UCLA IJP
BADIER   64 DUBNA I 593        +DEMOULIN,GOLDBERG, +     //EP,SACLAY,AMSTR  I
PJERROU  65 PRL 14 275         +SCHLEIN,SLATER,SMITH,STORK,TICHO   //UCLA
LONDON   66 PR 143 1034        +RAU,SAMIOS,YAMAMOTO,GOLDBERG,+ //BNL,SYCR  IJ
BERGE    66 PR 147 945         +EBERHARD,HUBBARD,MERRILL,B-SHAFER,+ //LRL  I
MERRILL  66 UCRL-16455 THESIS D W MERRILL                          //LRL  JP

      QUANTUM NUMBER DETERMINATION NOT REFERRED TO IN DATA CARDS.

SHAFER   66 PR 142 883         BUTTON-SHAFER,LINDSEY,MURRAY,SMITH  //LRL  JP

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Ξ (1705)

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51  XI*1/2(1705, JP=    ) I=1/2

            EVIDENCE NOT COMPELLING.  OMITTED FROM TABLE.

                   51  XI*1/2(1705) MASS (MEV)  --------------------------

M        1705.0       APPROX       SMITH     65 HBC  C- K-P 2.1-.7 BEV/C

-----------------  51  XI*1/2(1705) WIDTH (MEV)  -------------------------

W          20.0       APPROX       SMITH     65 HBC  C-

-----------------  51  XI*1/2(1705) PARTIAL DECAY MODES  -----------------

P1       XI*1/2(1705) INTO XI PI                      S22S 8
P2       XI*1/2(1705) INTO LAMBDA KBAR                S18S11

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                        REFERENCES -- XI*1/2(1705)

SMITH    65 ATHENS CONF 251   G A SMITH, J S LINDSEY              //LRL  I

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Ξ (1815)

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50  XI*1/2(1815, JP=    ) I=1/2

                   50  XI*1/2(1815) MASS (MEV)  --------------------------

M   *    1770.0                      HALSTEINS 63 FBC  0- K-FR 3.5 BEV/C
M        1817.0     7.0              SMITH 1   65 HBC  C- K-P 2.4-.7 BEV/C
M        1814.0     4.0              BADIER    65 HBC  0  K-P 3 BEV/C

-----------------  50  XI*1/2(1815) WIDTH (MEV)  -------------------------

W   *      80.0          OR LESS     HALSTEINS 63 FBC  0-
W          12.0     4.0              BADIER    65 HBC  0
W          30.0     7.0              SMITH 2   65 HBC  C-
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-----------------   50  XI*1/2(1815) PARTIAL DECAY MODES   -----------------

P1          XI*1/2(1815) INTO 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

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                              REFERENCES -- XI*1/2(1815)

HALSTEIN 63 SIENA CCNF 173    HALSTEINSLID,+//BERGEN,CERN,EP,RTHF,UNICOL  I
SMITH 1  65 PRL 14 25         +LINDSEY,BUTTON-SHAFER,MLRRAY          //LRL IJP
BADIER   65 PL 16 171         +CEMOULIN,GOLDBERG, +     //CP,SACLAY,AMSTR  I
SMITH 2  65 ATHENS CONF 251   G A SMITH, J S LINDSEY                 //LRL

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Ξ (1935) 52  XI*1/2(1935, JP=    ) I=1/2
         52  XI*1/2(1935) MASS (MEV)    ---------------------------

M          1933.0     16.0              BADIER    65 HBC  C  K-P 3 BEV/C

-----------------   52  XI*1/2(1935) WIDTH (MEV)    --------------------------

W           140.0     35.0              BADIER    65 HBC  0

-----------------   52  XI*1/2(1935) PARTIAL DECAY MODES   -----------------

P1          XI*1/2(1935) INTO XI PI                            S22S 8
P2          XI*1/2(1935) INTO LAMBDA KBAR                      S18S11

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

                              REFERENCES -- XI*1/2(1935)

BADIER   65 PL 16 171          +CEMOULIN,GULDBERG, +     //EP,SACLAY,AMST  I

****** ********* ********* ********* ********* ********* ********* *********
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Ξ? (2270) 53  XI* /2(2270, JP=    ) I= /2

           EVIDENCE PRELIMINARY.  OMITTED FROM TABLE.

          53  XI* /2(2270) MASS (MEV)    --------------------------

M          2270.0                       ABRAMS    66 HBC    K-P 4.25 BEV/C    9/66

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

                              REFERENCES -- XI* /2(227C)

ABRAMS   66 BERKELEY CONF     +CAY,GLASSER,KEHOE,SECHI-ZORN, + //MD(BNL)

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Eta Decay Into Neutrals (Price, Nov. '66)

Certain HBC and DBC experiments report the mode "$\eta\to 3\pi^0$", but actually they detect both $\eta\to 3\pi^0$ plus $\eta\to\pi^0 2\gamma$, and they cannot distinguish them (we ignore the mode $\eta\to 2\pi^0\gamma$). Since the detection efficiencies are different for the various modes, one may not merely substitute the combined rate $(3\pi^0+\pi^0 2\gamma)$ for the reported $3\pi^0$ rate in these experiments. MULLER+ 63 (DBC) state that their detection efficiency per γ ray is about the same regardless of the mode of decay ($3\pi^0$ or $\pi^0 2\gamma$). CRAWFORD 2 66 (HBC) has shown that the same is true for the HBC experiments listed. Thus for all these experiments (assuming $\eta\to 2\pi^0\gamma$ to be equal to zero)

$$3\pi^0_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{1}{1+\frac{4}{6}r} \tag{1}$$

and

$$\pi^0 2\gamma_{\text{true}} = 3\pi^0_{\text{reported}} \times \frac{r}{1+\frac{4}{6}r}, \tag{2}$$

where

$$r \equiv \frac{\pi^0 2\gamma}{3\pi^0}. \tag{3}$$

CRAWFORD2 gives values for $3\pi^0/\pi^+\pi^-\pi^0$, using (1) and assuming $r = 1.79\pm0.58$, 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

$$R \equiv \frac{3\pi^0}{\pi^+\pi^-\pi^0} = 0.94\pm0.16.$$

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)]:

$$R = 0.50\pm0.12.$$

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.

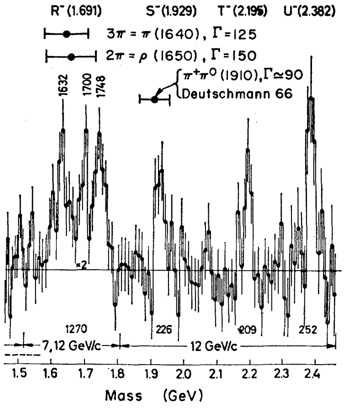
Relationship between peaks seen in missing mass spectrometer and in bubble chamber experiments

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. $\Gamma = 90\pm40$ 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

$$T(E) = x/(\epsilon - i), \tag{1}$$

where x is elasticity and ϵ is $(M-E)/(\Gamma/2)$. This amplitude traces a circle of diameter x and becomes entirely imaginary at $E = M$. The amplitude also has greatest velocity $|d\underset{\sim}{T}/dE|$ at $E = M$, for it is easy to show that

$$\left|\frac{d\underset{\sim}{T}}{dE}\right| = \frac{x}{\epsilon^2+1} = \mathrm{Im}\ T, \tag{2}$$

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

$$T' = \frac{e^{2i\delta'}-1}{2i}. \tag{3}$$

The resonant term T will be given by (1). The total amplitude, obtained by multiplying the S-matrix elements[1] (S is related to T by $S = 2iT + 1$), will now start out negative, and then superimposed on its clockwise motion will be the counterclockwise circular resonant behavior.

How far around this resonant circle is 1400 MeV? To solve this simple problem, assume that the repulsive phase shift $2\delta'$ is related to a scattering length by

$$k^3 \cot\delta' = 1/A,$$

or more precisely, using McKinley's phase shifts,[2]

$$(k/m_\pi)^3 \cot\delta' = -(.015)^{-1}.$$

Then, at 1400 MeV, δ' has reached -15 deg. We have plotted the corresponding point on Fig. 4. It is encouraging that this point lies almost diametrically across the resonant circle from 1400 MeV.

The other resonating amplitudes, the D_{13}, the D_{15}, and the F_{15}, appear to have little background; the variation is most rapid approximately where the amplitude becomes imaginary. Therefore the resonant parameters may be chosen as follows: M is where T(E) is entirely imaginary; x is the length of T at this point; and $\Gamma/2$ is $(M - E')$, where E' is the energy at which Im T is $x/2$.

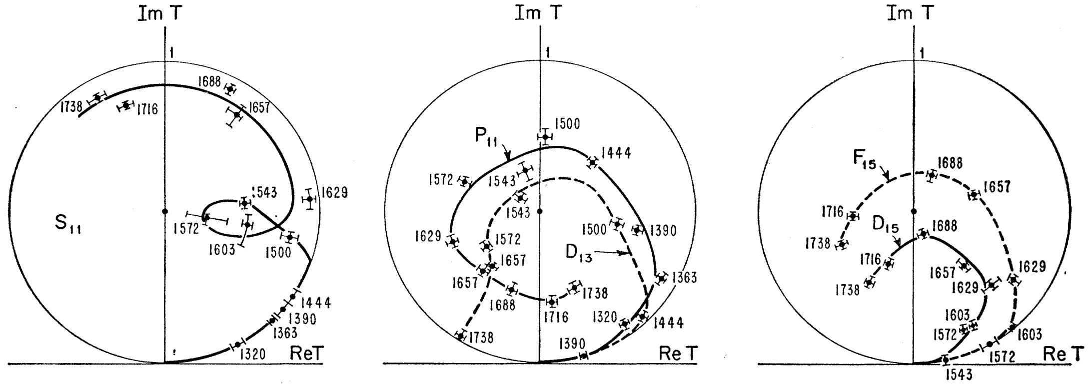
---

[1] By multiplying S matrices we get

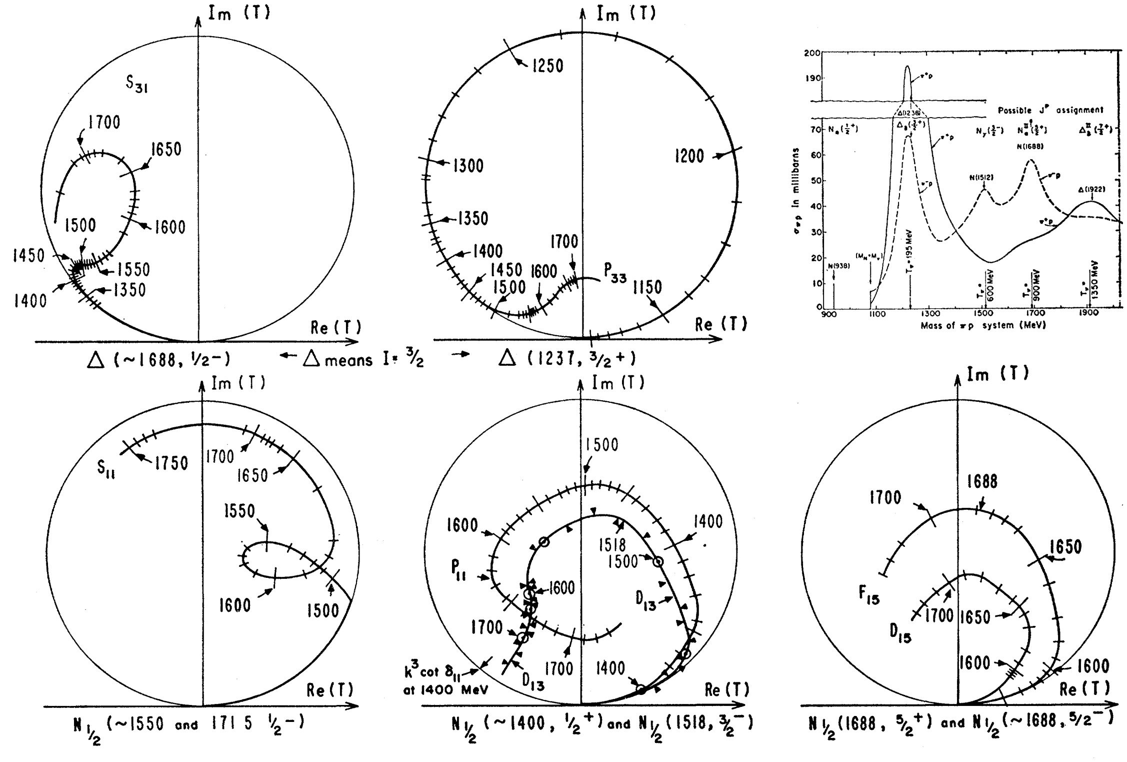
$$S'' = S'S = \eta' e^{2i\delta'}\ \eta e^{2i\delta} = 2iT'' + 1.$$

Hence $T'' = \dfrac{\eta'\eta\, e^{2i(\delta'+\delta)} - 1}{2i}$ which rotates the clockwise resonant circle by $2i\delta'$, keeping it tangent to the unit circle.

[2] J. M. McKinley, Rev. Mod. Phys. 35, 788 (1963).



Solutions of Bareyre et al. to I-spin 1/2 resonant partial waves. The crosses show the amplitudes and errors computed from the data at various energies. The smooth connecting lines are guesses.



The smooth guessed curves above are replotted with the actual calculated amplitudes replaced by hatch marks interpolated every 10 MeV. For a resonance they should be spaced proportionally to $\text{Im}(T) = (1+\epsilon^2)^{-1}$. The I-spin 3/2 resonant partial waves have been added at the top, along with a summary of the total cross section for π^+p and π^-p.

Fig. 4

Spin-parity assignments of the higher mass N^*'s

Spins and parities of the higher mass N^*'s are taken from Barger and Cline (BARGER 66). They classify all the N^*'s as Regge recurrences on three straight-line trajectories [namely, recurrences of N(938), N(1525), and Δ(1236)] in a Chew-Frautchi plot. In addition they construct a model for π^-p elastic scattering, near and at 180°, based on interference of the resonance amplitude with an amplitude due to Regge exchange of Δ(1236) in the crossed channel. The predictions compare well with the existing experimental data on the energy dependence of the π^-p differential cross section at 180° and the general shape of the π^-p angular distribution near 180°.[1] This result confirms the consistency of the Regge recurrence parity assignments with the scattering data. In addition to the N^* reported in the Table on Baryons, they predict two more states: one at ≈ 2200 MeV($J^P = 9/2+$) and another one at ≈ 2630 MeV($J^P = 13/2+$) which they can accomodate in the prediction of the backward πp scattering by changing the elasticities of the neighboring resonances. We do not list these two resonances since they have not yet been experimentally observed.

---

[1] V. Barger and D. Cline, Regge Recurrence Parity Assignments for the S = 0 Recurrences, paper submitted to the XIII International Conference on High Energy Physics, August 31 through September 7, 1966, Berkeley (proceedings to be published by the Univ. of Calif. Press).

Appendix A. Compiled Spectra Relevant to H and κ Mesons

In an attempt to confirm or deny the existence of certain tentative bumps, we have started compiling the relevant published spectra. It would be better to compile events, rather than spectra, but the former entails collecting data summary tapes, whereas the latter involves only key-punching published data. Perhaps this simpler procedure will stimulate experimental groups to combine their data more effectively.

The compiling is done with a Fortran program SCHISM, written by Alan Rittenberg. SCHISM rebins the input data into common intervals, then outputs the combined histograms. An alphameric character is assigned to each input histogram and is displayed on output, permitting the reader to identify the source of the data. To facilitate reading of the histograms, certain rows and columns of letters have been changed to dots.

Our latest compilations will be continuously available from the Lawrence Radiation Laboratory as UCRL-8030 Spectra. However, we present here two examples, partly as an advertisement for help; we hope readers will call to our attention omitted data and send us new relevant data. The two mesons investigated are H and κ. The results for both are inconclusive. The H spectra show that there is not enough data for us to rely on histograms alone (we will have to go to combined events): the κ spectra discredit but do not kill the κ. In any case, we try to present enough spectra that the reader can form his own opinion on these bumps.

1. The κ(725) (Lynch, Rittenberg, Rosenfeld, Söding, Dec. 1966)

We are beginning to think that κ should be classified along with flying saucers, the Loch Ness Monster, and the Abominable Snowman. We have heard of several experiments which were supposed to confirm it, and each one has either failed completely or failed to find it in the sought-for channel, but found instead a small Kπ peak near 725 MeV in some other channel.

We present here a collection of 19 histograms, some of which represent the results of particular experiments in which the experimenters have claimed to have found the κ; the rest summarize experiments relevant for confirmation or rejection of the κ as a resonance. In Table A-I we list the various reactions and experiments which are discussed and compiled in this appendix, and give numbers of events, incident momenta, and references.

a. $\pi^-p \rightarrow (K\pi)\, Y$

The κ was first reported by ALEXANDER+ 62 and MILLER+ 63 in the reaction $\pi^-p \rightarrow \Sigma^{-,0}(\pi K)^{+,0}$ 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	A3
	2.9 - 3.3	$K^0\pi^+$	732		Hardy 66[b] Fig. 13(h)				P	
	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	A7
	1.59	$K^0\pi^0+K^+\pi^-$	104		Sene[e] Fig. 2. 10				Z	
	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	A9
	2.9 - 3.3	$K^+\pi^-$	688		Hardy 66[b] Fig. 14(h)				S	
	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	A11
	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	
	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	A14
	1.8 -2.1	$\bar{K}^0\pi^-$	2584		Lynch 66[i]				W	
	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	A12
	0.8 -1.05		194		Kalmus 66[h]				M	
	1.02-1.18		314		Gelfand 66[g] Fig. 10				F	
	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	A15
	1.8 -2.1		4554		Lynch 66[i]				V	
	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	A18
	2.68	$K^-\pi^+$	1857		Pripstein 66[p] Fig. 8				P	
$K^-p\to(\bar{K}\pi)^-\pi^0p$	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	A19
	3.0	$K^0\pi^+$	226	+	Ferro-Luzzi 64[q] Fig. 2(c) (113 events)				F	
	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.

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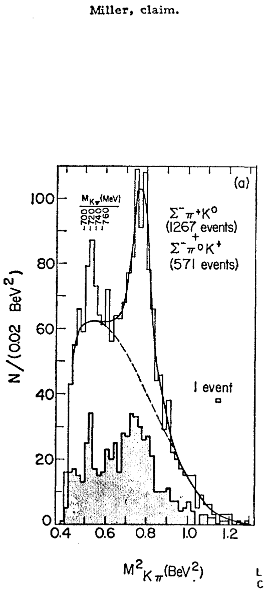

Fig. A1. $M^2(K\pi)$ from $\pi^-p\rightarrow(K\pi)^+\Sigma^-$, P_{inc} = 1.9 to 2.4 GeV/c. From MILLER+ 63.

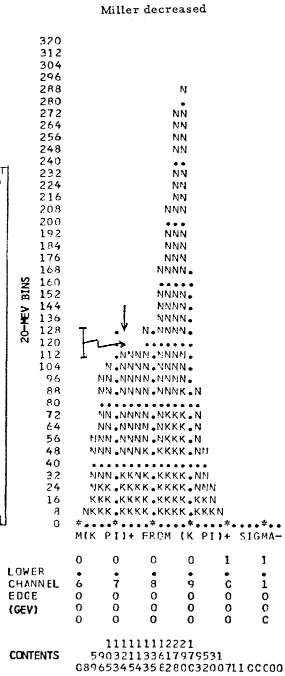

Fig. A2. M(Kπ) from $\pi^-p\rightarrow(K\pi)^+\Sigma^-$, P_{inc} = 1.8 to 2.2 GeV/c.

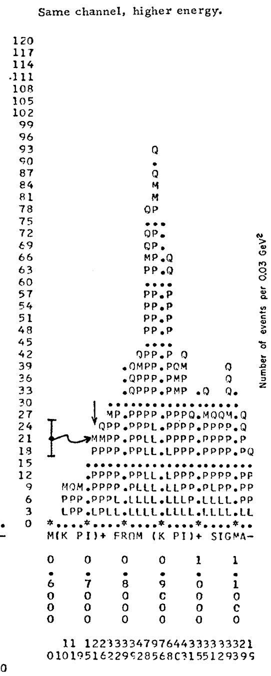

Fig. A3. M(Kπ) from $\pi^-p\rightarrow(K\pi)^+\Sigma^-$, P_{inc} = 2.9 to 4.2 GeV/c.

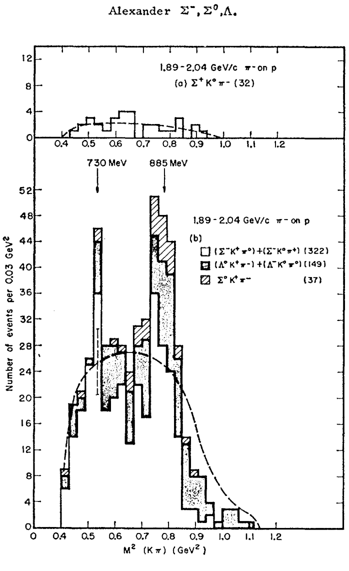

Fig. A4. $M^2(K\pi)$ from $\pi^-p\rightarrow(K\pi)^{+,0}\ \Sigma^{-,0}$, and $\pi^-p\rightarrow(K\pi)^0\Lambda$, P_{inc} = 1.9 to 2.0 GeV/c. From ALEXANDER+ 62.

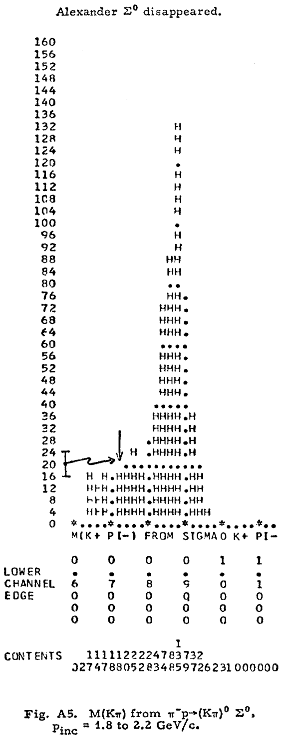

Fig. A5. M(Kπ) from $\pi^-p\rightarrow(K\pi)^0\Sigma^0$, P_{inc} = 1.8 to 2.2 GeV/c.

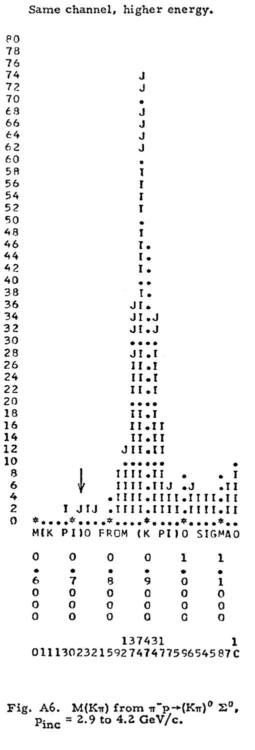

Fig. A6. M(Kπ) from $\pi^-p\rightarrow(K\pi)^0\Sigma^0$, P_{inc} = 2.9 to 4.2 GeV/c.

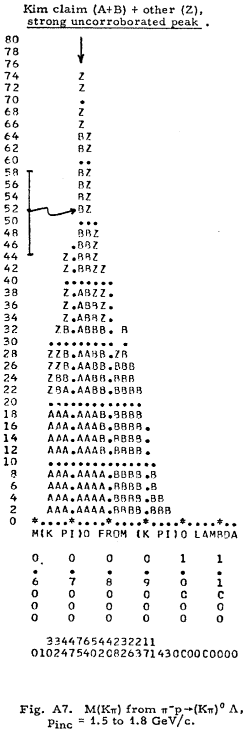

Fig. A7. M(Kπ) from $\pi^-p\rightarrow(K\pi)^0\Lambda$, P_{inc} = 1.5 to 1.8 GeV/c.

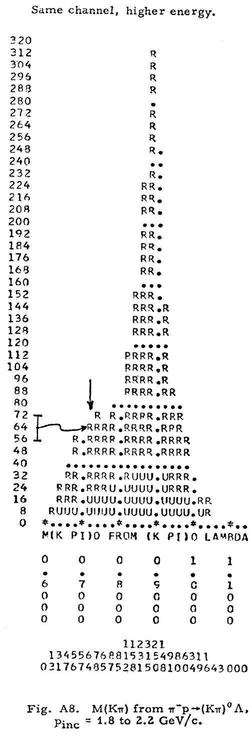

Fig. A8. M(Kπ) from $\pi^-p\rightarrow(K\pi)^0\Lambda$, P_{inc} = 1.8 to 2.2 GeV/c.

On the other hand, some positive evidence for an enhancement at 735 MeV comes from studies of $(K\pi)^0\Lambda$ final states! This evidence is shown in Fig. A7, which is a compilation of 517 events from two experiments (KIM+ 65, SENE 66) with incident momenta of 1.5 to 1.8 GeV/c, partly below the K^* production threshold. In an experiment with 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 14467 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.

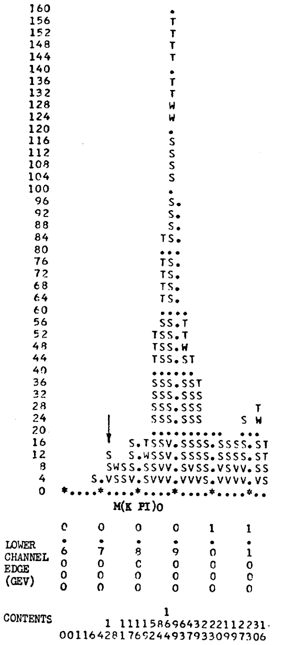

Fig. A9. $M(K\pi)$ from $\pi^-p\rightarrow(K\pi)^0\Lambda$, P_{inc} = 2.9 to 4.2 GeV/c.

Cason claim, strong uncorroborated peak .

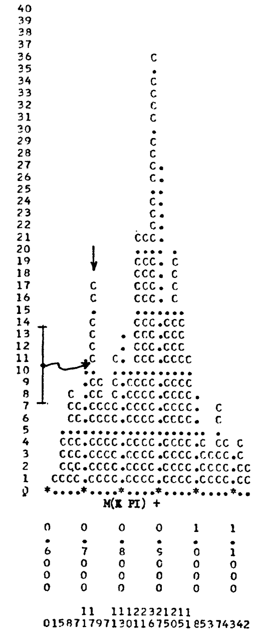

Fig. A10. $M(K\pi)$ from $\pi^-p\rightarrow(K\pi)^+\pi^+\Lambda$, P_{inc} = 3.2 GeV/c.

No claim, but κ near threshold, supports Wojcicki.

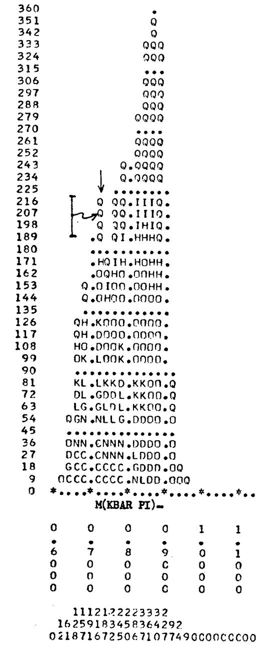

Fig. A11. $M(\bar{K}\pi)$ from $K^-p\rightarrow(\bar{K}\pi)^-p$, P_{inc} = 0.78 to 1.2 GeV/c.

Same reactions, different charge, supports Wojcicki.

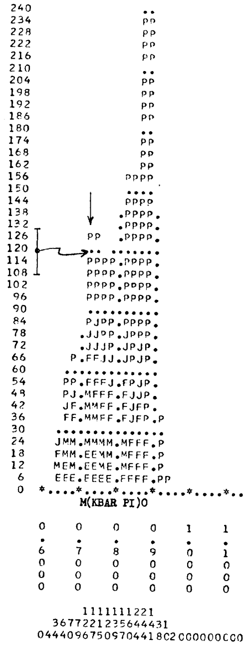

Fig. A12. $M(\bar{K}\pi)$ from $K^-p\rightarrow(\bar{K}\pi)^0n$, P_{inc} = 0.78 to 1.2 GeV/c.

Wojcicki claim (B), + others, up to 1.7 GeV/c, Signal decreased.

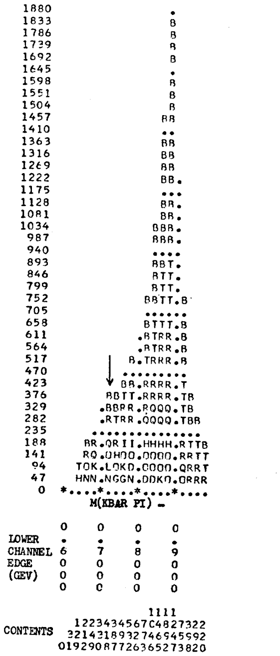

Fig. A13. $M(\bar{K}\pi)$ from $K^-p\rightarrow(\bar{K}\pi)^-p$, P_{inc} = 0.78 to 1.7 GeV/c.

Same channel, higher energy. No κ.

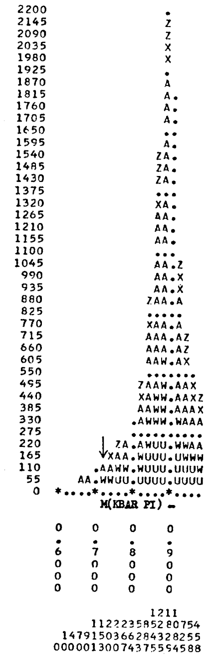

Fig. A14. $M(\bar{K}\pi)$ from $K^-p\rightarrow(\bar{K}\pi)^-p$, P_{inc} = 1.8 to 2.7 GeV/c.

Same reactions, different charge. No κ.

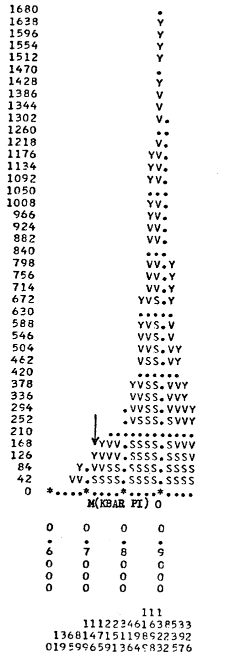

Fig. A15. $M(\bar{K}\pi)$ from $K^-p\rightarrow(\bar{K}\pi)^0n$, P_{inc} = 1.4 to 2.7 GeV/c.

London claim, strong uncorroborated peak.

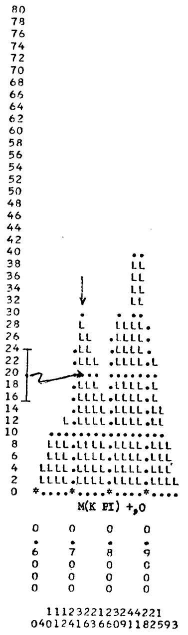

Fig. A16. $M(K\pi)$ from $K^-p\rightarrow(K\pi)^{+0}\Xi^{-,0}$, P_{inc} = 2.24 GeV/c.

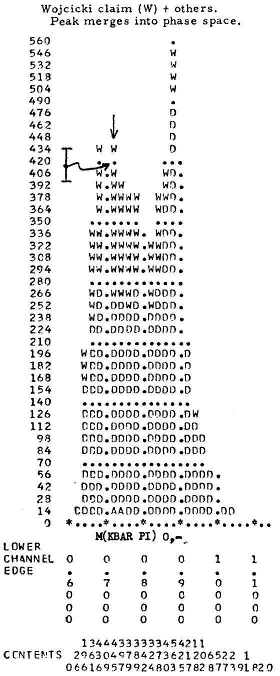
Wojcicki claim (W) + others.
Peak merges into phase space.

Fig. A17. M($\bar{K}\pi$) from $K^-p \to (\bar{K}\pi)^{0,-}\pi N$, P_{inc} = 1.2 to 2 GeV/c.

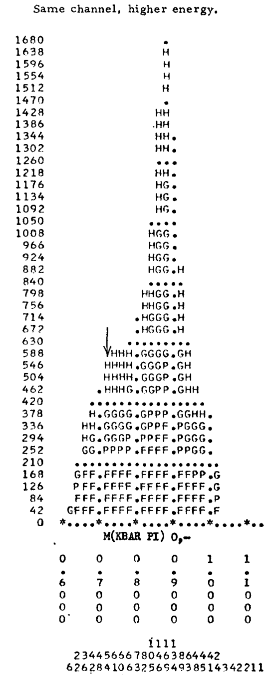
Same channel, higher energy.

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.

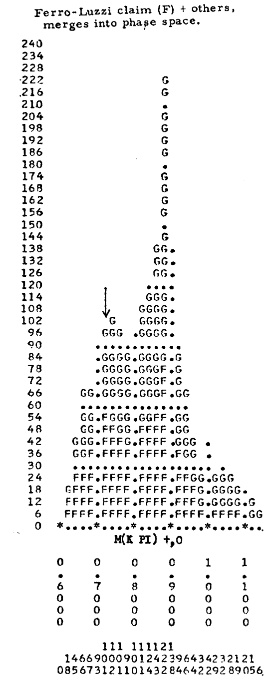
Ferro-Luzzi claim (F) + others, merges into phase space.

Fig. A19. M($K\pi$) from $K^+p \to (K\pi)^{+,0}\pi^{-,0}\pi^+p$, P_{inc} = 3 to 3.5 GeV/c.

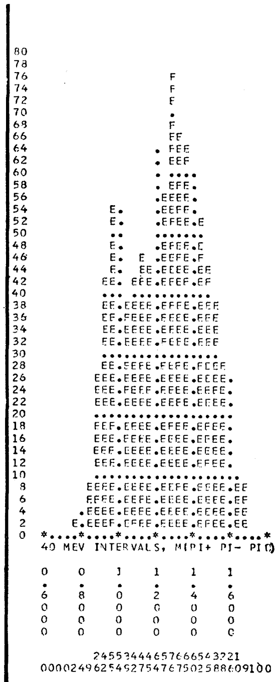

Fig. A20. M($\rho\pi$)^0 from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc} = 4 GeV/c. From BARTSCH+64.

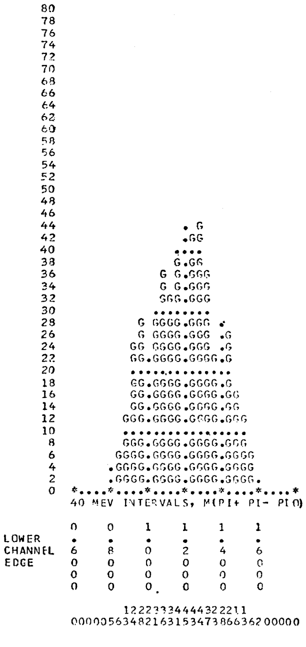

Fig. A21. M($\rho\pi^0$) from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc}=3.65 GeV/c. From G. GOLDHABER 65.

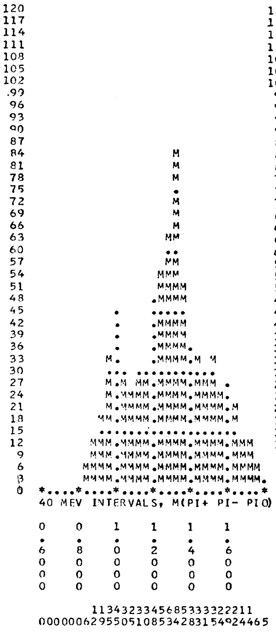

Fig. A22. M($\rho\pi$)^0 from $\pi^+d \to (\rho\pi)^0pp$, P_{inc} = 3.65 GeV/c. From BENSON+ 66.

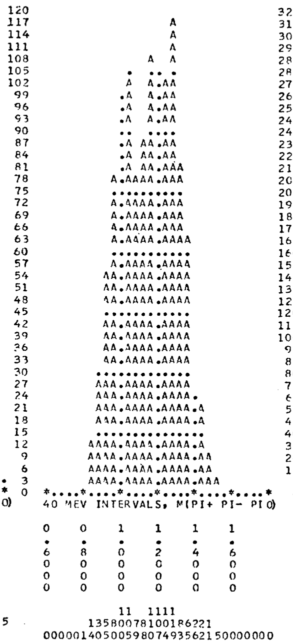

Fig. A23. M($\rho\pi$)^0 from $\pi^+p \to (\rho\pi)^0\Delta^{++}$, P_{inc}=3.2 and 3.5 GeV/c. From ABOLINS+ 66.

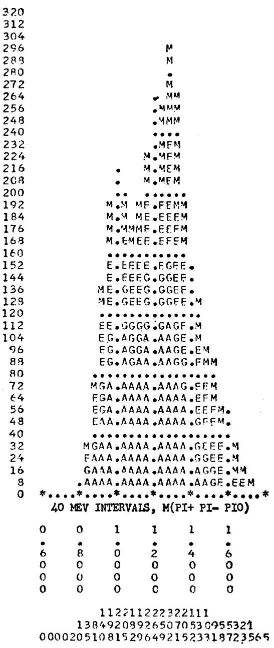

Fig. A24. M($\rho\pi$)^0 from $\pi^+p \to (\rho\pi)^0\Delta^{++}$ and $\pi^+d \to (\rho\pi)^0pp$, 3.2 to 4 GeV/c.

This behavior could be that of a real κ, but it is more what one would expect of statistical fluctuations.

The fact remains that we compiled 19 histograms (representing 60 000 events) and found 5 (6000 events) which show surprising peaks apparently not statistical fluctuations. We now try to explain it as a bias. We have keypunched any spectrum associated with a positive κ claim, but stopped at 60 000 total events simply because of the work involved. (We shall next automate the preparation of input data.) We estimate that 1.5 to 2 million events have been measured, each of which yields a Kπ mass value. Our reasoning is as follows:

Last year ≈ 2 million events were measured in the United States,[1] and we guess ≈ 3 million events for the world-wide annual rate. This rate has been roughly doubling every two years,[2] so the time integral of the number of bubble-chamber events measured must be ≈10 million. By comparing the number[3] of pictures exposed to $K^\pm$ with the number exposed to $\pi^\pm$ and p, we see that a quarter of these 10 million events were produced by $K^\pm$ with enough energy to produce Kπ events in the final state (with Kπ mass > 725 MeV).

So physicists have looked at Kπ spectra from ≈ 2.5 million events. We guess that 1.5 to 2 million events have been assembled in large collections and looked at carefully. If a κ peak is seen, it is published, and we keypunch. If nothing surprising is seen, one may not even publish the data, and we may not punch it. (But if readers will send us large relevant spectra, we will enter them from now on.) Then, at 1000 events/histogram, 2 million events yield 200 uninteresting histograms. Then the five surprising ones (only three from $K^\pm$ experiments) are perhaps to be expected.

So we restate our conclusion. We have not killed the κ but we do feel that we have further discredited it.

2. The H Meson (Ferbel, Rosenfeld, Soding)

The "H meson" is a supposed $I^G = 0^-$ state with a mass $m_H \approx 1000$ MeV, decaying into $(\rho\pi)^0$. Table A-II lists the experiments in which evidence was observed for a bump near 1000 MeV in the $(\rho\pi)^0$ mass spectrum. Figures A20 through A23 show the distributions of $M(\rho\pi)^0$ from these experiments. Goldhaber[4] discussed the H meson and compiled the data of Figs. A20 and A21, plus 1705 events from the reaction $\pi^+d \to (\rho\pi)^0pp$ 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 $\leqslant p(\pi^+) \leqslant$ 4 GeV/c. It is not seen in similar experiments in the range 5.1 GeV/c $\leqslant p(\pi^+) \leqslant$ 8.5 GeV/c. This means that whatever the H phenomenon is, its production cross section drops rapidly at energies greater than $p(\pi^+) =$ 4 GeV/c. Note that 4 GeV/c is already high above the threshold, which is at $p(\pi^+)$ = 2.18 GeV/c for $\pi^+ p \rightarrow H\Delta^{++}$ and even lower for $\pi^+ d \rightarrow Hpp$. Moreover, the data for $p(\pi^+) \leqslant 4$ GeV/c presented above are incomplete; we estimate that at least $\approx$ 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 $\approx$ 25 MeV. The $A1^{\pm} (\rho\pi)^{\pm}$ is seen recoiling against a proton; the $H(\rho\pi)^0$ is seen recoiling against a Δ^{++}. Could the background phases differ enough between these two experiments that the $(\rho\pi)^0$ peak is displaced downwards by about 25 MeV? We do not know how to answer this question until more work is done.

The Michigan group [5] has suggested that as a next step one should look for an H peak in $\rho^0\pi^0$ only, where the A1, having isopin I = 1, cannot contribute. One can do this in two ways:

1) Compile $\rho^0\pi^0$ spectra, or 2) compile events from data-summary tapes. The latter procedure seems more likely to give us the information we want, for the following considerations. The $\pi^+\pi^-\pi^0$ Dalitz plot has three ρ bands (ρ^0, ρ^+, and ρ^-) which overlap partly at 1000 MeV, and overlap three deep at $\sqrt{3}m_\rho \approx$ 1300 MeV. As the Michigan group shows in Fig. 2 of their paper, $\rho^0\pi^0$ spectra are contaminated with overlapping $\rho^{\pm}\pi^{\mp}$, but if one selects out the overlapping, double-ρ events, one produces an artificial bump at 1000 MeV. One can get around this difficulty by compiling the actual events and doing a maximum-likelihood fit to the population of the ρ^0 band. We shall do this.

A final difficulty with the H bump is contamination from the radiative decay of another meson, $\eta' \rightarrow \rho^0\gamma$, which will often fit the interpretation $\rho^0\pi^0$. The Michigan group[5] estimates that 6 ± 3 of their events are such intruders; their spectrum, Fig. A22, seems to contain about 36 H mesons from all the ρ bands; about half might come from $\rho^0\pi^0$.

In summary, the compilation of spectra carried out so far shows a bump but seems inadequate to distinguish between H and a neutral A1 peak. We feel that a compilation of very carefully selected $\rho^0\pi^0$ events is the most promising next step.

APPENDIX REFERENCES

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.