$0.88\hbar/\mu c$; finally, the reaction width was adjusted to agree with the total observed cross section at 700 Mev. The resultant variation of the total excitation of the $(\frac{1}{2},\frac{3}{2})$ level with photon energy is shown in Fig. 1. It can be seen to be large in comparison with the excitation of the $(\frac{3}{2},\frac{3}{2})$ level which is also shown. Of course, at such high energies the resonance formula is but an approximation. The formula also makes an absolute prediction for $\pi^- p$ scattering; this has been computed with the above constants and compared to the experiments of Cool, Piccioni, and Clark.[10] Their measurements are not inconsistent with the presence of the $(\frac{1}{2},\frac{3}{2})$ level but in $\pi^- p$ scattering the $(\frac{1}{2},\frac{3}{2})$ level is not resolved from their higher $(\frac{1}{2},\frac{5}{2})$ level; it should appear in differential measurements, however.

The branching ratios for decay into the various modes (1) to (9) have been roughly approximated on the basis of momentum space,[11] together with the statistical weight in isotopic spin space.[12] The quantity shown in brackets in the above list of decay modes, Eqs. (1)–(9), is proportional to the statistical weight in isotopic spin space. The result of multiplying the branching ratio by the total excitation of the state is plotted in Fig. 1 for some of the observable decay modes; the qualitative agreement with the measured meson photoproduction cross sections[1–8] is rather striking. The prediction of $\pi^-\pi^+$ multiple production is somewhat low but could be raised by assuming a smaller isobaric radius. Furthermore, direct electric-dipole production of the final state $\pi^- + p^+$ can occur in an S wave with a fuzzy threshold at about 450 Mev. This can augment and interfere with the P-wave production of π^- through the $(\frac{1}{2},\frac{3}{2})$ state, i.e., decay mode (5).

The measured photoproduction of K particles[13,14] is about ten times less than a simple momentum-space argument would allow, showing that the coupling into the $K^+ - \Lambda^0$ decay mode is considerably weaker than for decay into meson-nucleon systems. If the $(\frac{1}{2},\frac{3}{2})$ state is important in K^+ production, then the angular distribution should be of the form $2+3\sin^2\theta$, if the $K^+ - \Lambda^0$ system is pseudoscalar.

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Photoproduction of K^+ Particles in Hydrogen at Forward Angles*

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The method of Donoho and Walker[1] for measuring K^+-particle photoproduction in hydrogen has been improved in order to provide a clearer identification of the K particles and to allow measurements at a more forward angle, 10° in the lab system. The apparatus used is very similar to that shown in Fig. 1 of the Letter of Donoho and Walker.[1] It consists of a magnetic spectrometer with a counter telescope placed at the rear focus. The telescope is composed of three scintillation counters, a Čerenkov counter, and sufficient absorber to prevent protons from entering the last scintillator. A special thin counter is used to define the aperture of the magnet and as the first counter in a time-of-flight measurement. This aperture counter is designed to avoid the possibility of protons (or other particles) emitted from the hydrogen scattering from the pole pieces or lead slits and hitting the scintillation counters. Such scattered protons had been found previously, and were easily confused with K particles. Unfortunately, protons from other sources, such as the target walls and air path, could pass through this counter and scatter into the detectors.

The Čerenkov counter proved to be better than 98% efficient in eliminating pions with $\beta=0.95$, but also eliminated 8% of the protons with $\beta=0.5$, presumably because of weak scintillation in the U. V. T. Lucite used.

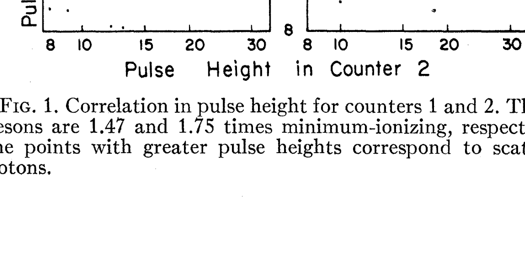

FIG. 1. Correlation in pulse height for counters 1 and 2. The K^+ mesons are 1.47 and 1.75 times minimum-ionizing, respectively. The points with greater pulse heights correspond to scattered protons.

TABLE I. Summary of data. E_0 is the bremsstrahlung upper limit. The K particles observed at these angles and momenta, were produced by 1000-Mev photons in the reaction $\gamma+p\rightarrow K^{+}+\Lambda^{0}$.

E_0 Mev	P_{lab} Mev/c	θ_{lab}	H_2 target	K counts per 10^{15} Mev	Scattered protons per 10^{15} Mev
1070	520	10°	Full	14.4±1.3	8.0±0.9
1070	520	10°	Empty	4.4±0.8	8.7±1.5
900	520	10°	Full	2.2±0.8	5.1±1.2
1070	428	25°	Full	6.1±0.5	1.6±0.3
1070	428	25°	Empty	0.8±0.3	1.2±0.3
900	428	25°	Full	0.2±0.2	2.1±0.8

A detection efficiency of 5% was estimated for K particles with $\beta=0.7$ and this will be tested experimentally in the future.

An event consisting of a count in the three scintillation counters and a time-of-flight count, but no signal from the Čerenkov counter, is used to trigger an oscilloscope on which are displayed the pulses from the three scintillation counters and the output of the time-of-flight coincidence circuit. These pulses are photographed individually for each event.

Events are analyzed by plotting the correlated pulse heights from two of the counters on log paper as shown in Fig. 1. To calibrate the equipment, several thousand minimum-ionizing particles were counted and the corresponding pulse-height data obtained. From these data the K^+ pulse-height limits, shown as dotted lines in Fig. 1, were predicted. The pulse height in the third counter is correlated in a similar manner, leading to a self-consistent method for identifying the K mesons.

Figure 1 shows a small number of minimum-ionizing particles compared with that shown by Donoho and Walker. This is because the Čerenkov counter combined with the time-of-flight requirement has eliminated all but one per thousand of the fast particles going through the system.

Scattered protons are not as well eliminated, although they are clearly separated at the 10° point where the K pulse heights are lower. If, as we believe, these protons come from the target walls and the air path, they should remain when empty target runs are taken, and this is indeed the case.

The data are summarized in Table I.

In calculating cross sections, the empty-target runs are used as backgrounds rather than below-threshold runs, since we believe the background consists mainly of K particles produced in the target walls and the air path, rather than events produced by pions and protons. Inspection of the pulse-height plots for runs made with full and empty target and low synchrotron energy seem to justify this belief.

The cross sections are $\sigma(28.5°)=(1.72\pm0.26)\times10^{-31}$ cm^2/sterad and $\sigma(72°)=(1.80\pm0.20)\times10^{-31}$ cm^2/sterad in the c.m. system. They are compared to the other published data[2,3] at 1000 Mev in Fig. 2.

The values of the cross sections of Donoho[2] shown in Fig. 2, are different from those reported by Donoho and Walker.[1] This is because additional data were gathered at 42° and 72° in the c.m. system, and an experimentally determined bremsstrahlung spectrum[4] was used, which is more like a thin-target spectrum than the thick-target spectrum assumed originally by Donoho and Walker.

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† Commonwealth Fund Fellow.

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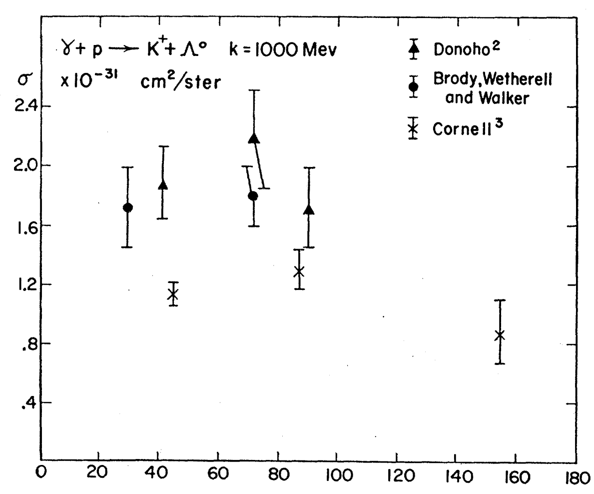

FIG. 2. Angular distribution at 1000 Mev. The Cornell points at 45° and 85° were sent to us by R. R. Wilson as preliminary values on February 27, 1958.

Measurements of Asymmetries in the Decay of Polarized Neutrons*

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IN an earlier publication,[1] measurements on the decay of polarized neutrons were reported which showed that the decay was not isotropic with respect to the neutron spin. The coefficient for the correlation between the direction of emission of the beta particles and the neutron spin given therein was subsequently shown to be too large in absolute value because of an interference from the correlation of the neutrino direction with the neutron spin.[2] As is clear from the analysis of Jackson, Treiman, and Wyld,[3] the latter correlation might be