FRIDAY MORNING AT 10:00

Horace Mann Auditorium

(J. STEINBERGER presiding)

Production, Decay and Interactions of Pi-Mesons

M1. Production of Photomesons from Deuterium.* JAMES KECK AND RAPHAEL LITTAUER, *Cornell University.*—The reaction $\gamma+d\rightarrow\pi^-+p+p$ is being investigated by bombarding targets of D_2O and H_2O with bremsstrahlung from the Cornell 310-Mev electron synchrotron. π-mesons emitted at 90° are identified in a counter telescope by specific ionization and range and are counted in coincidence with protons emitted at approximately 30°. The energy and angular distributions of the protons are measured for a known meson energy. These parameters determine the energy of the photon and also the initial momentum of the neutron within the target nucleus. The background due to the oxygen is about 30 percent of the total count. The observed angular distribution of the protons is compatible with reasonable assumptions about the internal momentum of the deuteron. The cross section of the elastic interaction (that in which only one of the residual protons carries away momentum) has been found to be of the order of 10^{-29} cm^2 sterad^{-1} at a photon energy of 220 Mev. This is comparable to the cross section for $\gamma+p\rightarrow\pi^++n$ at the same energy.[1]

* This work was performed under contract with the ONR.
[1] Bishop, Steinberger, and Cook, Phys. Rev. **80**, 291 (1950).

M2. Dependence of Charged Pion Production on Incident Proton Energy.* S. PASSMAN, M. M. BLOCK, AND W. W. HAVENS, JR., *Columbia University.*—The 90° differential cross section for production of charged pions has been measured for several elements at proton energies of 345, 365, and 380 Mev. The technique, utilizing nuclear emulsions as detectors for mesons produced in targets bombarded by the internal beam of the Nevis cyclotron, has been previously described.[1] The proton energy is varied by changing the distance of the target from the center of the cyclotron magnetic field. Preliminary results for the integrated 90° cross section for π^+ production in hydrogen (by subtraction of carbon from polyethylene) are $(d\sigma)/(d\omega)=(2.9\pm30\%)\times10^{-29}$ cm^2/sterad for a proton energy of 345 Mev, and $(d\sigma)/(d\omega)=(3.9\pm30\%)\times10^{-29}$ cm^2/sterad for a proton energy of 365 Mev. The total cross sections for meson production in hydrogen are calculated by assuming the reaction $P+P\rightarrow\pi^++D$ with a $\cos^2\theta$ angular dependence in the center-of-mass system.[2] Combined with the previously reported cross section for hydrogen at 381 Mev,[1] the ratios of the production cross sections are: (σ_{total} at 381 Mev):(σ_{total} at 365 Mev):(σ_{total} at 345 Mev) = 2.1:1.6:1.

* This research was assisted by the joint program of the AEC and ONR.
[1] Block, Passman, and Havens, Jr., Phys. Rev. **83**, 167 (1951).
[2] Peterson, Iloff, and Sherman, UCRL-1405 (1951); Cartwright, Richman, Whitehead, and Wilcox, UCRL-1278 (1951).

M3. Photoproduction of Mesons on Nuclei. T. R. PALFREY, JR., AND R. R. WILSON, *Cornell University.**—We are measuring the relative differential meson energy cross sections for the photoproduction of charged mesons from various targets. Preliminary results have been obtained for mesons of energy 40–80 Mev produced from C and Pb at 135° to the 310-Mev synchrotron brehmsstrahlung gamma-ray beam. The detector is a scintillation counter telescope of one NaI(Tl) crystal and one terphenyl-xylene liquid scintillator, each 10 cm in diameter and 1 cm thick. Mesons are identified by their pulse height in the second (NaI) crystal. Their charge and momenta are determined by the magnet system of Camac, *et al.*,[1] use of which also helps minimize corrections for nuclear interaction of the mesons in absorbers. The decay in flight correction is made theoretically, with the aid of a range-measurement estimate of the mu-meson contamination. Work is in progress on other targets. An inhomogeneous 90° sector magnet of the betatron type, with $n=\frac{1}{2}$, is being constructed. After calibration it should permit measurement of absolute cross sections at variable angles and at lower meson energies.

* Work supported by ONR.
[1] Camac, Corson, Littauer, Shapiro, Silverman, Wilson, and Woodward, Phys. Rev. **82**, 745 (1951).

M4. Relative Production of Neutral Mesons by 310-Mev γ-Rays in Hydrogen and Deuterium. A. SILVERMAN AND G. COCCONI, *Cornell University.*—The neutral mesons produced in various targets by 310-Mev bremsstrahlung radiation were detected by observing one of the decay gamma-rays at 90° to the primary beam. This method increases the counting rate by at least a factor of 10 in comparison to detecting the two decay γ-rays in coincidence. This is done at the expense of information concerning the angular distribution. The observed counts have the following characteristics: (a) they are due to γ-rays of energy greater than 40 Mev, (b) the threshold is approximately 150 Mev, (c) the excitation function, as determined by changing the maximum beam energy, is in reasonable agreement with published results for hydrogen,[1] (d) the observed rates correspond to those expected assuming the known cross sections for π° production.[1] The targets used were H_2O, D_2O, CH_2, and C. For γ-rays energies of about 300 Mev, the ratio of deuterium to hydrogen cross section for π° production is: $\sigma_D/\sigma_H=1.90\pm0.24$. This indicates that the cross sections for production of π° by γ-rays on neutrons and protons are approximately equal. The following relative cross sections have also been obtained: $\sigma_C/\sigma_H=10.1\pm1.8$, $\sigma_O/\sigma_H=12.7\pm2.5$.

[1] Panofsky, Steinberger, and Stellar, UCRL, 1495, October, 1951; A. Silverman and M. Stearns, Phys. Rev. **83**, 206 (1951).

M5. Production of 40-Mev π-Mesons by 240-Mev Protons in Seven Elements.* DONALD L. CLARK, *University of Rochester.*—The relative differential cross section for production of 40-Mev π^+ and π^- mesons by 240-Mev protons has been measured in Be, C, Al, Cu, Ag, W, and Pb. The π^+ mesons were observed in the angular range 130° to 150° with respect to the incident protons, and the π^- mesons in the range 30° to 50°. The relative cross section per nucleus was found to vary generally as the geometric cross section, but with significant departures for both positive and negative mesons. The departures from geometric cross section appear to correlate to some extent with the average binding energy per nucleon. The variation of the cross section for π^+ mesons differs significantly from that for π^- mesons. The ratio of the cross section for production of π^+ mesons to that for π^- mesons, at the angles indicated, varies qualitatively as the *a priori* ratio $A+Z/A-Z$ but considerably more strongly.

* This work was sponsored by the AEC.

M6. Measurement of the Production Cross Section of Negative Mesons in Carbon by 341-Mev Protons. WALTER F. DUDZIAK, *University of California, Berkeley.*—Meson production cross sections from carbon ($pC^{12}\rightarrow\pi^-$) in the forward direction to a 341-Mev incident proton-beam, have been measured. The produced charged mesons were magnetically