Title
LARGE ANGLE SCATTERING OF Pi- MESONS

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H. Bradner and B. Rankin

September 12, 1950

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LARGE ANGLE SCATTERING OF π^- MESONS

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Berkeley, California

September 12, 1950

An investigation is being made of the mean free path for large angle scattering and nuclear interaction of π^- mesons in G-5 emulsion. Mesons entering the edge of a plate with approximately 38 Mev energy are identified by measurement of grain density vs. small angle scattering. These mesons are then followed for several millimeters until they leave the 600μ thick emulsion or reach an energy of 30 Mev. In a scan of 404 cm of meson track the scatters tabulated in Table 1 have been observed. There was also one case in which an energetic meson produced a star, and one case in which a meson ended abruptly with no visible star or scatter.

The average nuclear area for the elements in a G-5 emulsion is equivalent to a mean free path of 23 cm. Within the limits of the poor statistics it appears that the cross section for large angle scattering of 20 - 38 Mev π^- mesons in emulsion is roughly equal to 1/2 nuclear area, while the cross sections for star production is smaller. A systematic scan of stars in the plates has yielded 3 more cases of disintegrations produced by mesons in flight, so that there is no doubt of the validity of the observed stars. The disappearance of one meson may be evidence for charge exchange scattering on a proton, although we cannot rule out the possibility that there was a star in which only a neutron was emitted, or a large angle scatter in which we were unable to follow the outgoing meson.

Scatters less than 30° for 30 Mev π mesons can certainly not be considered as "nuclear", since either Coulomb scatter or decay in flight could result in nearly that angle. Grain density vs. scattering measurements cannot distinguish with certainty between a π scatter and a π-μ decay in our energy region. The mean free path for decay in flight is approximately 230 cm. A frequency plot of scatters between 5° and 30° is in agreement with single Coulomb scattering.

We wish to express our appreciation to O. Piccioni who originally suggested the experiment, and to L. W. Alvarez for helpful discussion. Edith Goodwin has done much of the plate scanning. This work was performed under the auspices of the Atomic Energy Commission.

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TABLE I

Scatters Observed for 20 - 40 Mev π^- Mesons in Emulsion

Scattering Angle		No. events	Meson Energy (Mev)	
Horizontal projection	Actual		by position in plate	by grain count (± 5 Mev)
5° - 9.9°	1 @ 46°	96	1@36.0	40
10° - 19.9°		29		
20° - 29.9°	1@30.5	2	1@35.0	35
30°	35	1	26.5	40
40°	48	1	37.0	40
47°	76	1	36.0	25
108°	105	1	28.5	30
119°	112	1	32.0	25
143°	123	1	37.0	< 20*
158°	154	1	26.0	30
171°	155	1	36.0	25

* Definitely inelastic scatter.