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SUMMARY OF THE RESEACRH PROGRESS MEETING OF AUGUST 2, 1951

Bonnie E. Cushman

October 25, 1951

Berkeley, California

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I. Scattering by Hydrogen - Experiment by Fermi. J. Lepore

Data on π^- scattering by hydrogen obtained by Fermi at the Chicago cyclotron have been analyzed at the University of California Radiation Laboratory. Absorption and scattering cross sections were measured with the experimental arrangement shown in Fig. 1. Fig. 2 gives the result: an extremely rapid rise, linear within the limits of experimental error. The analysis of the data postulates an interaction between the proton and meson which is very sensitive to the meson energy. If the coupling is weak and if there is a momentum dependant coupling then it follows that

$$H_{int} \sim f \sigma \frac{8}{mc}$$

and $$\sigma_{\text{weak coupling}} \sim \left(\frac{f^2}{4\hbar c}\right)^2 \left(\frac{q}{mc}\right)^4 \left(\frac{mc^2}{E}\right)^2 \left(\frac{\hbar}{mc}\right)^2 \sim q^2$$

However this point of view would not give the rapid rise indicated by Fermi's data. This sharp rise in the cross section suggests that there may be some sort of resonance involved due to the formation of a metastable nucleon isobar. If this idea is adopted one can fit the shape of Fermi's curve if the resonance energy is chosen to be $E_o \sim 250$ Mev. The existence of such a metastable state has been suggested earlier by Brueckner and Case in order to explain the observed equality of cross sections for charged and neutral mesons. The isobar picture seems to fit better here than it does in connection with V particles.

II. Spin of the π^+ Meson. K. Watson

Studies of the work done by Durbin, Loar and Steinberger at Columbia on the $\pi^+ + d \rightarrow p + p$ and by Richman, Cartwright and Whitehead on the reverse reaction indicate that the π^+ meson has 0 spin. A review of previous work gives the following evidence:

1. The π meson has an integral spin as shown by both production and absorption experiments.
2. The π^0 meson does not have spin 1.
3. Charged mesons and neutral mesons probably have the same spin.
4. Aamodt et al have shown experimentally that the π^- meson is not scalar.
5. There is good evidence that the π^- meson is pseudoscalar.
6. There is no good evidence that the spin is greater than one.

Theoretically the total cross section for the $\pi^+ + d \rightarrow p + p$ reaction should be three times larger if the spin is one than if the spin is zero. This fact is compared with the experimental results in Fig. 5. The experimental arrangement at Columbia and cross section at 45° are given in Figs. 3 and 4, respectively.

The experimental facts from the direct and inverse reactions do not fit spin 1 and favors spin 0.

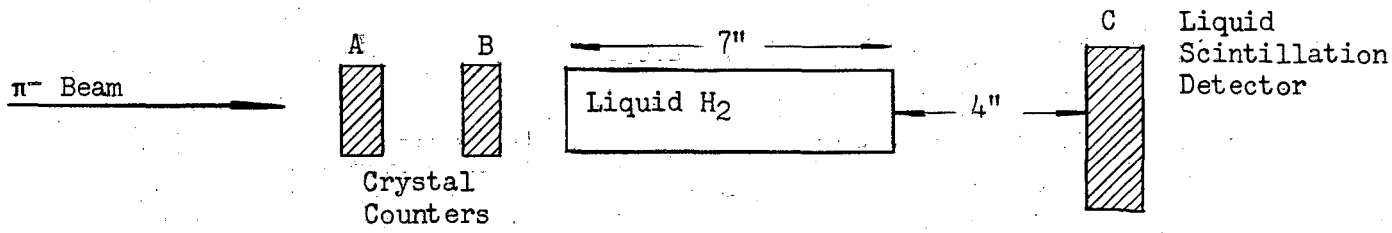
π⁻ Beam
A
B
Crystal Counters
7"
Liquid H_2
4"
C
Liquid Scintillation Detector

Fig. 1

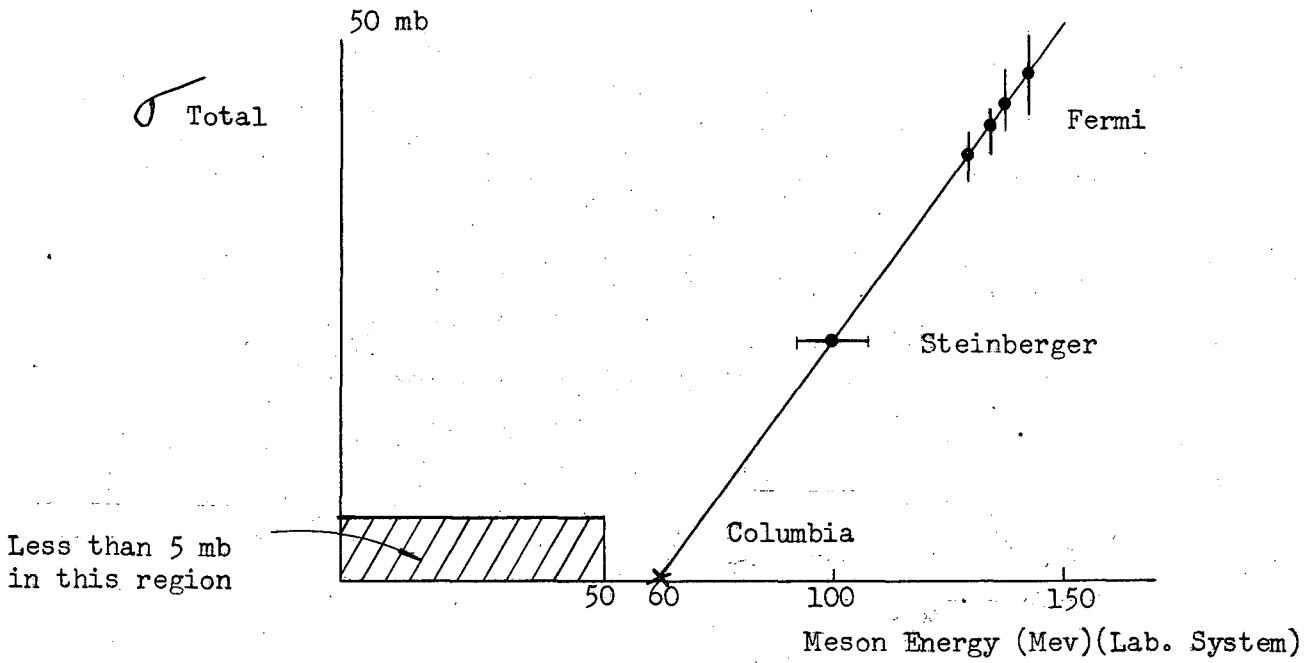
50 mb
σ Total
Fermi
Steinberger
Columbia
Less than 5 mb in this region
50
60
100
150
Meson Energy (Mev)(Lab. System)

Fig. 2

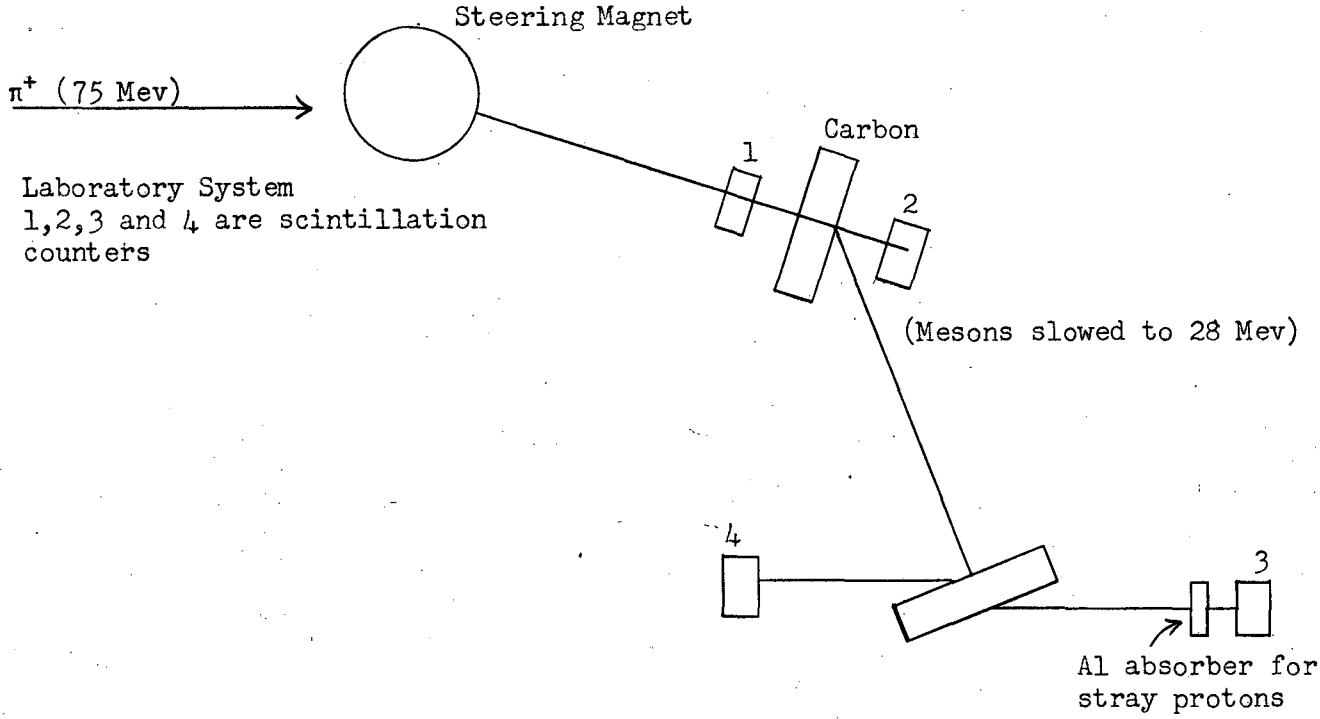

Fig. 3

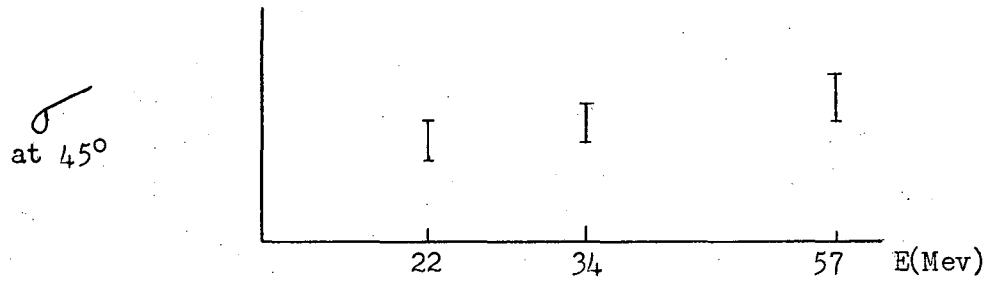

Fig. 4

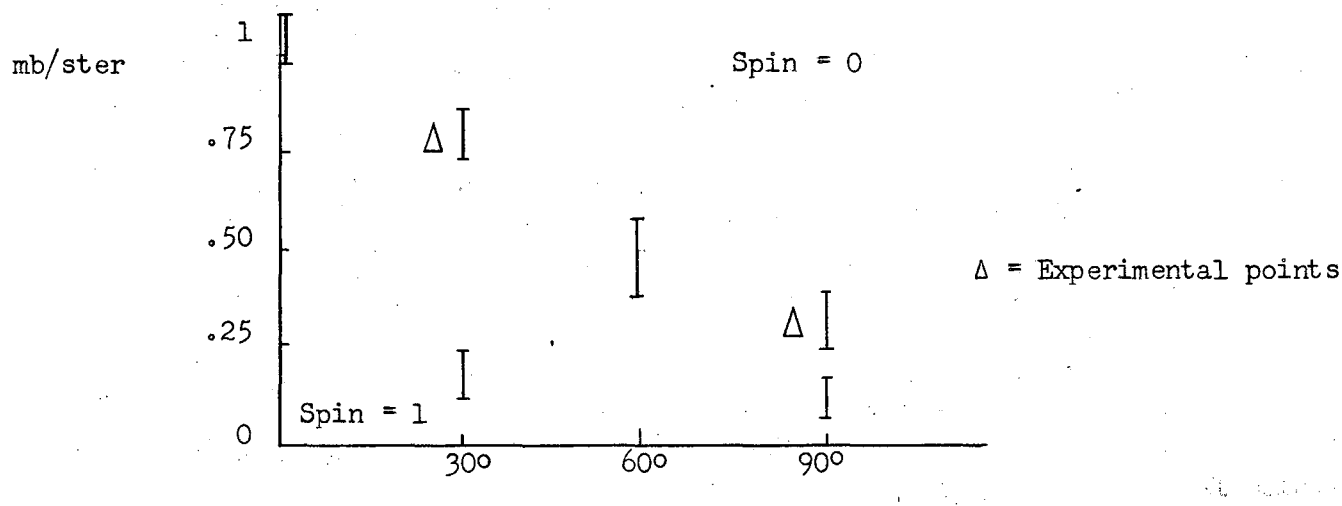

Fig. 5