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IN THE DIRECTION OF THE BEAM

W. F. Cartwright, C. Richman, M. N. Whitehead, H. A. Wilcox

April 19, 1950

Berkeley, California

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THE PRODUCTION OF π^+ -MESONS BY PROTONS ON PROTONS
IN THE DIRECTION OF THE BEAM

W. F. Cartwright, C. Richman, M. N. Whitehead, H. A. Wilcox

Radiation Laboratory, Department of Physics
University of California, Berkeley, California

April 19, 1950

A simple method¹ has recently been developed for measuring the differential production cross sections of positive and negative π -mesons when various nuclei are struck by high energy charged particles from the 184-inch synchrocyclotron. In this method mesons and other particles leave a target and lodge in suitably arranged absorber blocks. Nuclear emulsions are embedded in these blocks to sample the population of stopped positive and negative π -mesons of all energies. The method is not very desirable for extreme forward angles, however, because the number of scattered beam particles relative to the number of mesons leaving the target rises very rapidly in the forward direction.

We have consequently been concerned with developing the following technique for making easy and reliable observations in the extreme forward directions. A magnetic field is produced in the region about the target (see Fig. 1). The external beam from the cyclotron traverses this target after being integrated by a calibrated ionization chamber. Positive and negative π -mesons leaving the target in the forward direction circle out and away from the beam on opposite sides, as indicated by the dotted trajectories in the diagram. Broad channels are cut symmetrically in massive Cu shielding blocks as shown in the figure, and positive and negative mesons possessing appropriate momenta are able to traverse these channels and to lodge in the absorber blocks. Nuclear emulsions are embedded in these blocks, as in our previous method. Some

¹C. Richman and H. A. Wilcox, Phys. Rev., in press.

protons and other heavy charged particles also are able to traverse the channel on the positive side, but those which do so must necessarily possess roughly the same momenta as do the mesons. Hence their ranges will be much smaller than the meson ranges, and a complete separation is obtained between the positive π -mesons and the "background" of heavy charged particles coming from the target. On the negative side no trouble is to be expected from electrons because they do not ionize sufficiently heavily to leave background tracks in the nuclear emulsions employed.

This technique for measuring meson production cross sections can easily be adapted for use over the entire meson energy and angular spectrum.

In our first application of this method we have used the 345 Mev external proton beam from the cyclotron. Two different targets were used, of which one was pure carbon and the other was $(\text{CH}_2)_n$ (polyethylene). The angle of observation was $0^\circ \pm 5^\circ$. By subtracting the carbon production cross section from that of the CH_2 molecule, we obtain the production from the two "free" protons. The preliminary results on the p-p differential production cross section are presented in Fig. 2. These results are based upon 231 π^+ -mesons from the CH_2 and 176 π^+ -mesons from the C. The errors indicated are statistical probable errors, and are valid for the relative values. The absolute scale is uncertain by ± 15 percent.

The strikingly high peak in this curve in the neighborhood of $E_\pi = 70$ Mev was the first feature to be discovered. G. F. Chew has suggested² that the presence of this peak may be due to the attractive n-p resonance interaction in the final states following the collision. We are now engaged in an improvement of the energy resolution of the experiment in order to see whether

²G. F. Chew, private communication

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or not this large peak has fine-structure, as might be expected if Chew's explanation is correct.

We wish to thank Professor E. O. Lawrence for his interest and encouragement. We wish also to thank Mr. J. Vale and the cyclotron crew for making the bombardments. This work was sponsored by the Atomic Energy Commission.

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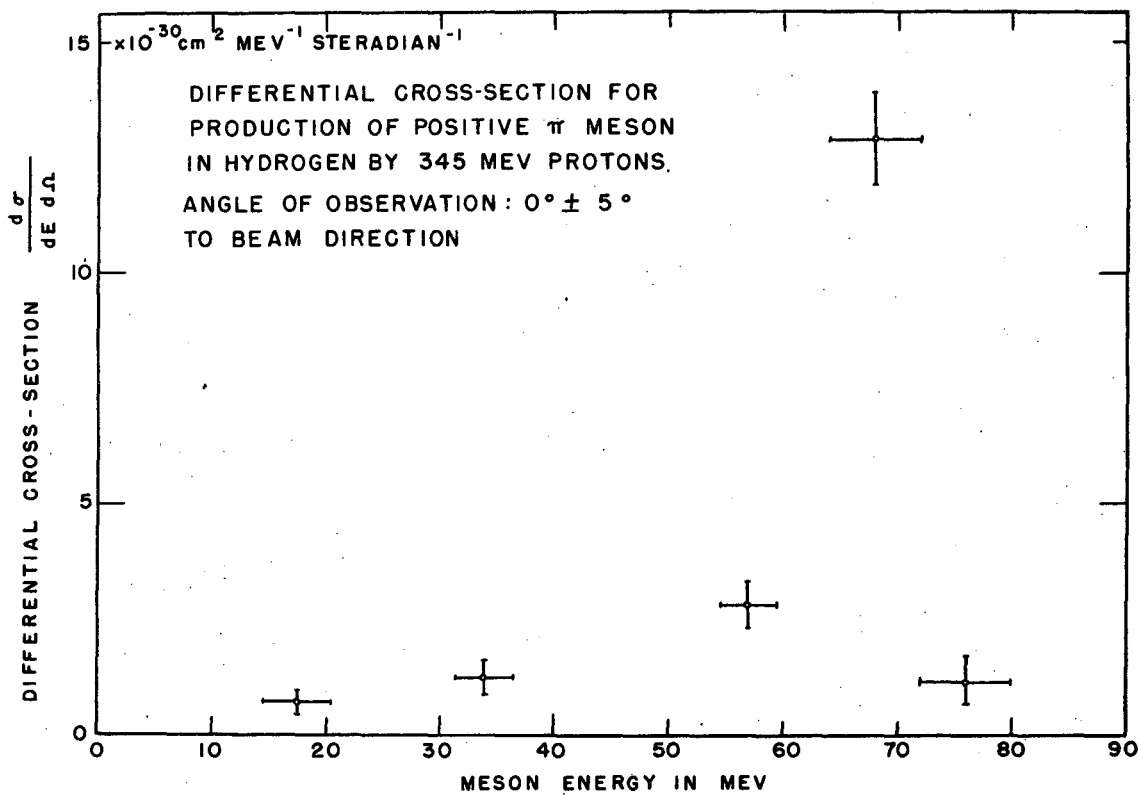


FIG. 2

Mu 133