65/44

S-65

October 4, 1965

S53

Memorandum

To : Members of the EEC and NPRC

From : W.F. Baker, P.J. Carlson, F. Krienen, A. Lundby and R. Nierhaus

Subject : Large Momentum Transfer Meson-Proton Scattering Experiment using Wire Chambers

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We expect that the digitized wire spark chamber system will become operative early in the spring of 1966. We would then like to perform an experiment to measure the large angle elastic scattering of mesons by protons. The aim is to measure the complete angular distribution of the scattering processes with an on-line computer technique. Because of the rapid decrease with energy of the large angle elastic cross-section and the competition from inelastic processes, it is necessary to apply magnetic analysis to the particles involved.

With the two C-magnets which were designed for this experiment and which will be delivered at the end of October, the angular region can be covered in four or five steps.

Next to the forward diffraction region, the region about 180^{o} is easiest to cover in this experiment because of the large peaks observed there. After some preliminary tests with forward scattering at high rates ($\sim$ 100 per burst), we intend to measure backward scattering in order to establish the energy dependence of the shape and the magnitude of these backward peaks. From our data [1] at 3.5 GeV/c and the Brookhaven-Cornell data at 8 GeV/c, the $\pi^{+}p$ cross-section appears to vary as

$$d\sigma/d\Omega = As^{-1.5}e^{Bu}$$

where s is the center-of-mass energy squared and u is the four-momentum transfer squared in the cross channel. B is $11^{+}{}_{-}3$ $(GeV/c)^{-2}$ at 3.5 GeV/c and $17^{+}{}_{-}3$ at 8 GeV/c. Thus there is an indication of energy dependence of the slope (shrinkage), but the data are by no means conclusive. At 180^{o} the differential cross-section seems to vary slightly faster than 1/s, and is expected to be about 10 μbarns/ster at 12 GeV/c. With the geometry indicated on the enclosed figure the rate of elastic scatterings is expected to be about 10 per hour for an incident intensity of 10^{5} per burst. We cover a region with $\Delta u = 0.1$ $(GeV/c)^{2}$ with this geometry, where $d\sigma/d\Omega$ is expected to vary by a factor of five.

Our requirements are as follows :

Testing time : About 100 shifts on a parasite basis.

Running time : For the experiment described above, 100 shifts to do π^+ and π^- at four momenta.

Beam required: d-beam or secondary beam from the slow extracted proton beam (under study).

1) See "Oxford International Conference on Elementary Particles", Abstract 62.

Large angle elastic scattering