Fermilab Proposal No. 359

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PROPOSAL TO OBSERVE THE PION PRODUCED DI MUON MASS SPECTRUM

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We propose to observe muon pairs produced by

$$\pi + A \rightarrow \mu^+ + \mu^- + - - - -$$

utilizing the M2 pion beam in the meson lab. The geometry is shown in Fig. 1.

All data will be recorded and analyzed by the PDP9 system presently used for E51A. The beam detectors of E51A in the M2 beam will also be used as will several of its chambers. The beam detectors and electronics will reject one form of background, that due to 2 beam particles arriving together. The large area scintillation counters which act as muon triggers, were constructed and used for a series of di muon experiments at CEA by the E51A group, and are available for this experiment.

The experiment requires approximately 100 hours of beam time at 175 GeV. The only other significant support needed for this experiment concerns the magnet needed to momentum analyze the muons. We see three possibilities. The most favorable possibility, experimentally, is a modification of the E8 magnet, presently in the M2 beam. We would temporarily fill the gap of that magnet with iron, but not to modify it in any other way. (Instead of inserting iron in the E8 gap it may be possible to leave the material now in the gap as is; but we would need more information on this present gap material than we have now to be sure that we could use it.)

A second possibility is to construct a "solid iron" magnet especially for this experiment. We would need a field x length of at least 180 kilogauss feet, and preferably 270 kilogauss feet. eg 18' @

10 kilogauss is a minimum. The momentum resolution depends directly upon this quantity, and we seek an overall resolution of about 12%. The magnetized region would have to have a cross section transverse to the beam of about 4' x 3'.

Finally, we could use the E8 magnet with an air gap, followed by an iron absorber approximately 10' long. This would result in a lower yield of di muons with an improved mass resolution.

Taking the first possibility for example, the filled gap of the E-8 magnet, plus 8" of yoke above and below the gap, will act as a magnetized block of iron with which the di muons will be momentum analyzed. The angle of the muons will be measured by chambers upstream of the magnet. The di muon invarient mass range investigated will extend from about 300 MeV to above 5000 MeV.

The number of muon pairs observed depends upon the physical processes producing them, and upon the dependence of these processes, compared to pion producing processes, on $p_{\perp}$. We expect to observe approximately 5000 muon pairs.

The background is due mainly to π and K decays in flight. This background should be about 1% of the direct di muon pair signal. In addition it will be measured directly during the experiment by varying the gap between the target and the first absorber.

If the E8 magnet can be modified we would expect to be prepared to take data in less than two months.

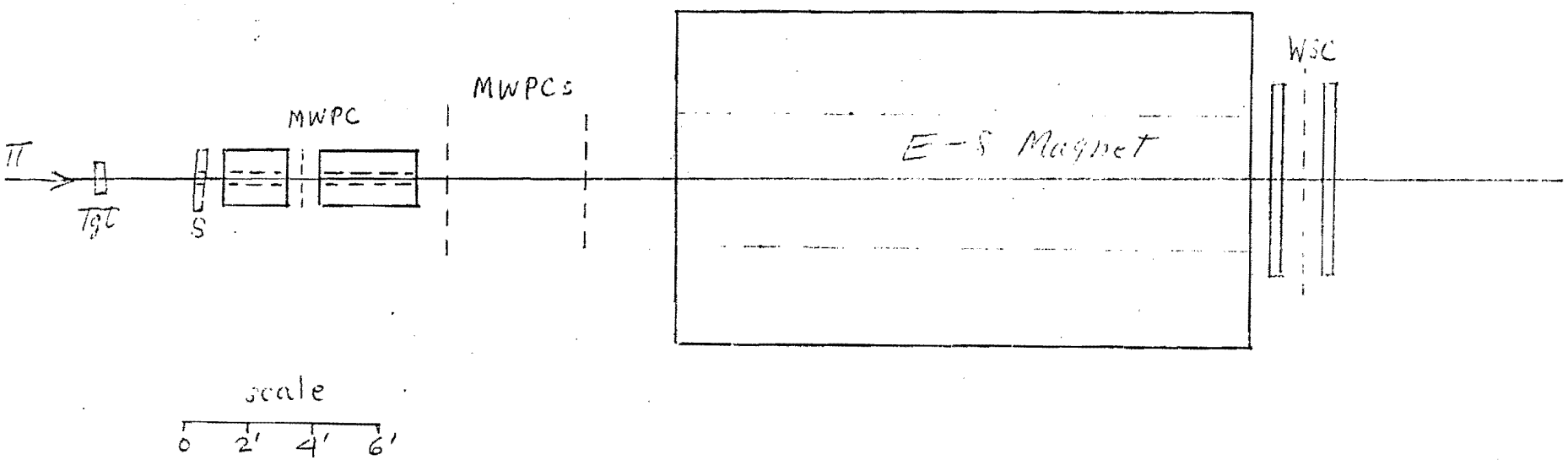

Figure 1 Layout