Rutherford Laboratory

Technical Leaflet

B2

## Π2 BEAM LINE AND EXPERIMENT

(University College London and Westfield College, London)

The experiment in this beam line is designed to produce information on two of the resonance effects that occur when positive or negative pi-mesons are scattered from protons. The two resonances occur at pion energies of 2.4 Gev for $\pi^+$ and 1.95 Gev for $\pi^-$.

The reactions studied are the elastic scattering processes

$$\pi^{\pm} + p \rightarrow \pi^{\pm} + p.$$

The pions are produced from a target introduced into the circulating beam in NIMROD at the appropriate time in the acceleration cycle. As in many high energy experiments, the protons for the scattering process are in the form of liquid hydrogen which has a boiling point of -253°C. This involves cryogenic techniques and rigorous safety measures, due to the extremely explosive nature of hydrogen and air mixtures. Liquid hydrogen target systems can be seen in exhibit A13.

The pions are transported to the hydrogen target by a system of quadrupole magnetic lenses and bending magnets, which during transport select the sign of the charge and the momentum range of the pions, and minimise loss of pions along the beam line. Since pions of both charges are required, the beam line and target geometry in NIMROD has been designed to provide positive or negative pions at the hydrogen target by altering the direction of the current flowing in all the magnets.

Pions which scatter from protons in the liquid hydrogen lose some of their momenta to the protons, and both scattered pions and recoil protons can be detected leaving the target. The incoming pions and scattered particles are detected by scintillation counters which switch on spark chambers when it is required to record the scattering event. Spark chambers reveal the track of a charged particle by a series of small sparks along the path of the particle in space. Mirrors near each spark chamber allow stereo-photographs to be taken with a triggered camera. These photographs can be analysed later and each scattering event reconstructed.

The array of counters and spark chambers around the hydrogen target is designed to detect and record only scattering events of interest that come from the target. The geometry of the counters causes many of the unwanted particles or events to be rejected.