Rutherford Laboratory

Technical Leaflet

B3

π-3 EXPERIMENT AND BEAM LINE

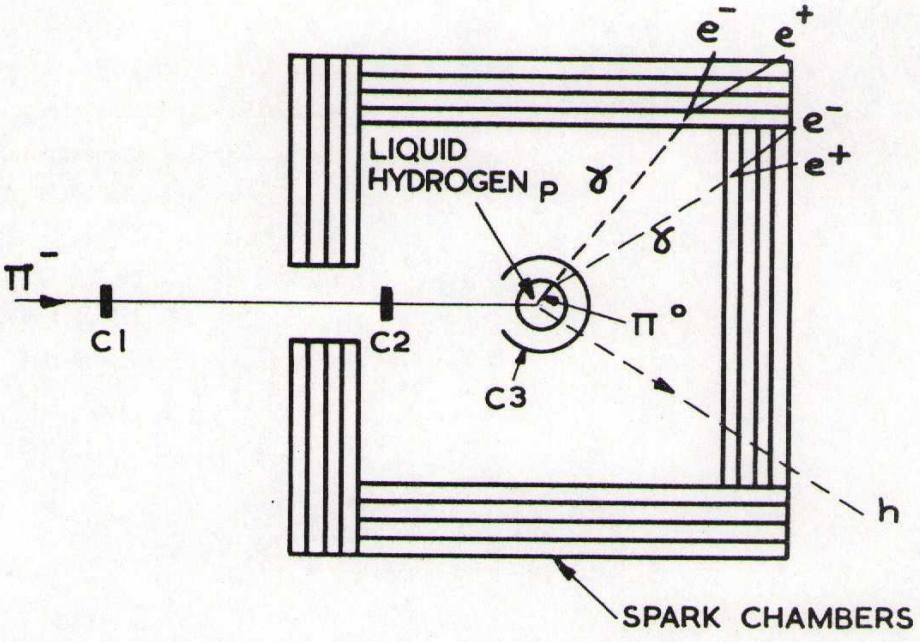
(Oxford University)

This experiment is designed to produce more information on the resonance or peak in the total cross section that occurs when 1.95 GeV negative pions (π-mesons) are scattered by protons.

The reaction studied is the charge-exchange process ($\pi^- + p \rightarrow n + \pi^o$, $\pi^o \rightarrow 2\gamma$). The results from this experiment can be combined with the results from the π2 experiment on elastic scattering at the same energy to give a more complete understanding of the resonance.

The π3 experiment is set up behind the π2 experiment, and uses those pions which have traversed the π2 liquid hydrogen target without undergoing a scattering. A system of five quadrupole magnets transport and refocus these pions to a 0.8 inch diameter spot on the π3 liquid hydrogen target.

In the charge exchange reaction shown schematically in the figure below, negatively charged pions (π^-) in the beam scatter from the protons (p) of the liquid hydrogen target. At the momentum of collision the pion and proton exchange electrical charges so that the two outgoing particles, the neutral pion (π^o) and the neutron (n), are both electrically neutral. The neutral pion decays almost immediately (within 0.00003 inches) into two gamma rays (γ) i.e. high energy x-rays. If the γ-rays strike the brass plates of the spark chambers surrounding the hydrogen target on 5 of the 6 sides of a cube, they have a large probability of creating pairs of negatively and positively charged electrons (e^- and e^+). The neutron does not leave a track in the chambers.



The scintillation counters C1 and C2 indicate when a charged beam pion enters the liquid hydrogen target. The absence of any signal from the counter, C3, surrounding the target, indicates that only neutral particles have emerged from the scattering. When the electronic circuits indicate that this sequence of events has occurred, a ten thousand volt pulse of electricity is rapidly applied to alternate plates of the spark chamber. The paths of the electrons are indicated by a series of sparks which are photographed stereographically by means of a complicated set of 28 mirrors. Measurements of the electron tracks provide the γ-ray directions, and from these directions the angular distribution of neutral pions can be deduced.