Rutherford Laboratory

Technical Leaflet

B.4

NI BEAM LINE AND EXPERIMENT

(A.E.R.E., Bristol University, Birmingham University and N.I.R.N.S.).

The NI experiment is designed to study neutron proton interactions at high energy. It will give direct information on the forces acting between these particles and the results will be compared with current theories. The aim of the experiment is to detect events in which a high energy neutron collides with a stationary target proton, resulting in a proton travelling in the same direction as the original neutron and with nearly the full energy of that neutron.

A target is placed in the internal proton beam of NIMROD and neutrons produced at 0° are collimated to form a beam in the experimental hall. γ-rays originally in the beam are removed by lead absorbers and charged particles are swept to one side by a magnetic field. The resulting neutron beam is passed through a liquid hydrogen target. A system of scintillation counters and a Cerenkov counter detect the protons produced in the correct angular range with the correct energy, and trigger spark chambers. These spark chambers are positioned on either side of a ten foot long magnet and measure the path of the proton to an accuracy of $\pm$ 1/100 inch enabling the angle of emission from the hydrogen target and the energy of the proton to be accurately determined. These measurements enable events to be selected in which no additional particles are produced in the collision between neutrons and protons.

The position of the proton in the spark chambers is marked by a spark along its path. The position of the spark could be recorded by photography but this necessitates a long delay before the results of the experiment can be evaluated. In this experiment the spark position is found by sound ranging.

4 microphones placed around the sparking area pick up the sound wave emitted by the spark. The time delay for the sound to reach each microphone is proportional to the distance of the sparking point from that microphone. These 4 time delays are recorded in digital form electronically, by gating an 8 mc/s oscillator. Thus 4 numbers are obtained, and subsequently punched onto data tape, which give the spark position to a precision of $\pm$ 1/100th inch. The data tape containing the position of a particles trajectory in several spark chambers, can be fed into a computer, and the particle trajectory computed and analysed in a few seconds.

In the demonstration given, small radio-active sources are used to simulate the passage of high energy particles through the spark chambers.