CALIBRATION OF THE LARGE SOLID ANGLE DETECTOR

P.T. Debevec, P.D. Harty, R.T. Jones, D.A. Simon and B.D. Fox
University of Illinois, Champaign, Illinois 61820

D.A. Jenkins
Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061

For the accurate measurement of proton cross sections over a wide angular range it is necessary to know the angular acceptance and efficiency of the detector. These can be calculated from the known geometry, and the detection efficiency as a function of proton energy can be estimated using a Monte Carlo code. In order to check the accuracy of this treatment a measurement of a well-known cross section was required. The reaction chosen was ^{1}H(p,p)^{1}H, for which the cross section is well known.

The experiment was performed using a 45 MeV beam of protons, which was produced by stripping a H_2^- beam that was also being used for a Cooler run. The flux of incident protons was measured using an 20-cm wide plastic scintillator paddle in the beam at the downstream end of the detector. The singles rate in this scintillator was recorded, as well as coincidences between this scintillator in adjacent beam cycles. In this way it was possible to calculate the number of times there was more than one proton in a beam cycle, and hence the flux could be determined.

A schematic diagram of the detector is shown in Fig. 1. It consists of 3 concentric rings of grounded sense wires at radii of 12, 23 and 34 cm, enclosed in a cylindrical chamber 37 cm in radius and 105 cm long. Each sense wire is surrounded by field wires at high negative potential. The chamber is filled with a gas mixture of 90% helium and 10% methane, which

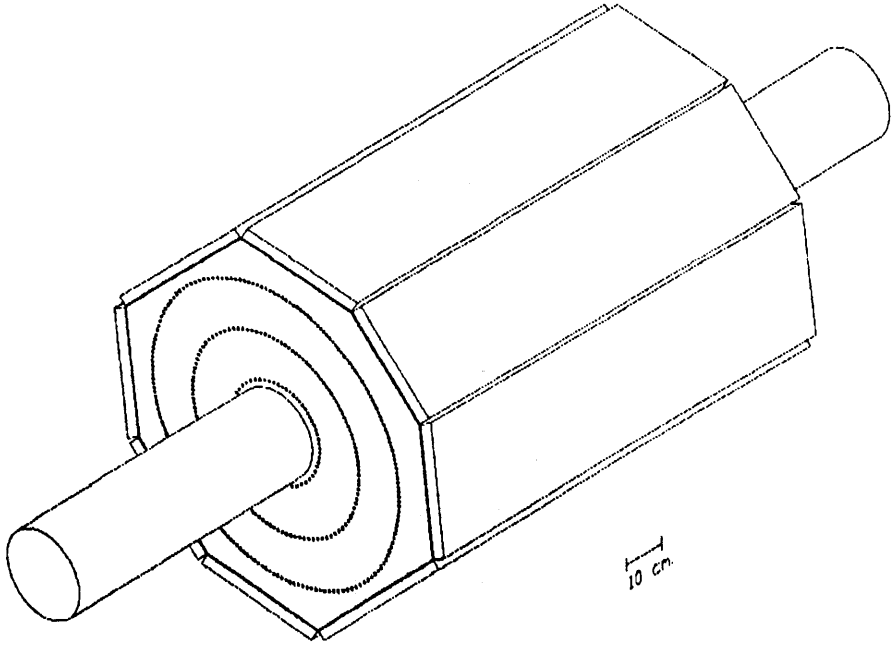

Figure 1. A schematic diagram of the Large Solid Angle Detector.

has been found to provide high efficiency and gain, as well as stable operation for high voltages of about -2 kV. The chamber is surrounded by 8 ΔE scintillators (0.32 cm thick) and 8 E scintillators (2.54 cm). An "OR" of the 8 ΔE counters formed the trigger for the experiment. The target consists of an aluminized nylon bag 20.3 cm in diameter and 2.4 m long, which was filled with hydrogen gas at atmospheric pressure.

Preliminary analysis of the data using the calculated acceptance and efficiency has been completed. The measured cross section included a small contribution from elastic proton scattering off nitrogen and helium, since these were detected in the target gas in concentrations of 0.5% and 6% respectively. These impurities were detected using a Gas Chromatograph. The preliminary result shows agreement with previous measurements to within 3% over most of the angular range. The acceptance used to determine the cross section is expected to change once some small differences in scintillator positions are taken into account. The measured cross section is very sensitive to any small change in the acceptance, thus the comparison between the two will provide a good test of its accuracy. The final stage of analysis is in progress.

In June 1989 the detector described above will be taken to the Saskatchewan Accelerator Laboratory in Canada for proton measurements using a tagged photon beam. The reactions to be investigated are ^{2}H(γ,p)n and ^{4}He(γ,p)^{3}H up to about 100 MeV photon energy.