AN AD-HOC FACILITY FOR FORWARD ANGLE NEUTRON TIME-OF-FLIGHT EXPERIMENTS: THE $^{12}C(p,n)^{12}N$ REACTION

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A temporary facility for neutron time-of-flight studies is operational. The beam from the energy analysis slits is transported without deflection through a shielding wall by two quadrupole doublets to a target placed near the entrance of a large dipole magnet (BNL 18 D 36). The beam spot at the target is 1.7 mm horizontal by 4.9 mm vertical with horizontal and vertical divergences of 3.2 mr and 3.8 mr, respectively. The total effective path length difference due to the beam line is 1.2 cm or about 80 ps for β=0.5. After passing through the target, the beam is deflected by the dipole through an angle of 38^{o} and is transported 7.5 m to a Faraday cup buried in the west wall of the building. Collection of multiply scattered beam is excellent as the acceptance of the dump is $\gtrsim$ 5 θrms for a 250 keV carbon target. Scintillators monitor scattered beam at $\pm$ 10^{o} through 4 mil Kapton windows. These scintillators monitor both beam spot shifts, which are negligible, and beam arrival time shifts, which are significant. Neutrons pass between the pole faces of the dipole and through another 4 mil Kapton window. The 8" gap of the dipole reduces pole face scattering. Vertical collimation is achieved with a graduated horizontal slot in a four-foot thick shielding wall of steel, lead, and concrete; this slot permits a remote detector to view only the target. Horizontal collimation is achieved by a scheme of modular shielding, namely one foot cubes of lead on movable carts. The shelf by which the costs are supported and the floor of the time-of-flight path have been surveyed to allow reproducable placement of the modular horizontal collimation and the detector. With the target at the entrance of the dipole, the time-of-flight path is a maximum of 30 m with an angular range of -3^{o} to 28^{o}. Placement of the target in the dipole could double the possible angular range.

The detector and its ancillary electronics are placed in a movable house. The detector consists of three parts: a <u>1/4</u>" x 10" x 20" sheet of NE102 which serves as a charged-particle trigger, two or three <u>1.75</u>" dia x 18" Pilot U rods in which the neutron interacts and which act in parallel to increase the solid angle; and a <u>6</u>" x 10" x 20" vat of NE213 which collects recoiling charged particles from the rods and permits discrimination of low energy neutrons from the previous beam burst. The underlined dimension is parallel to the entrant particles. Efficiency calibration of this detector with tagged neutrons is planned. Calculations show the efficiency to be $\sim$ 4%.

The beam line appears to be suitable for high-energy neutron time-of-flight studies. Essentially no high energy neutrons are detected with the beam passing through a blank target frame. In-scattering, determined by shadowing the detector from the target, is at about the 5% level. Pulse selection at 1/n, where n is the harmonic number, produces a satellite peak at the 0.01%-0.1% level. Beam arrival time shifts are significant, but continuous monitoring allows off-line correction. Schemes for on-line correction are under development. The fastest shift, however, is only 10 ps/sec and is probably due to poor magnetic field regulation of the injector and main stage cyclotrons.

Data for the $^{12}C(p,n)^{12}N$ reaction at Ep=144 MeV have been collected and are under analysis. A time-of-flight spectrum including beam arrival time correction but without energy discrimination is shown in Figure 1. The resolution herein is limited by beam arrival time shifts. An angular distribution (without low energy background subtracted) is shown in Figure 2. The ground state is forward peaked, continuing the trend evident from inelastic proton scattering.

Theoretical analysis of this angular distribution in terms of the DWBA with an effective nucleon-nucleon potential and in terms of the absorption model with one pion exchange is underway. It is hoped that the strength of the isovector spin dependent components of the effective interaction can be determined and the possibility of determining the pion-nucleus-nucleus coupling constant can be explored.

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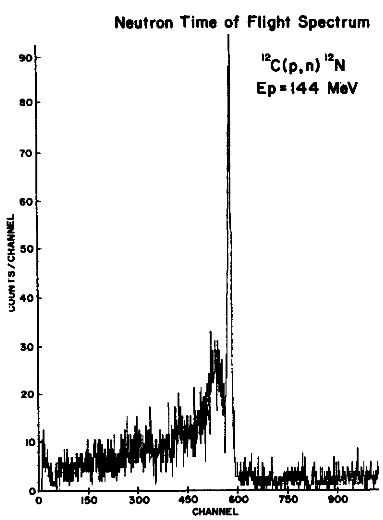

Figure 1.

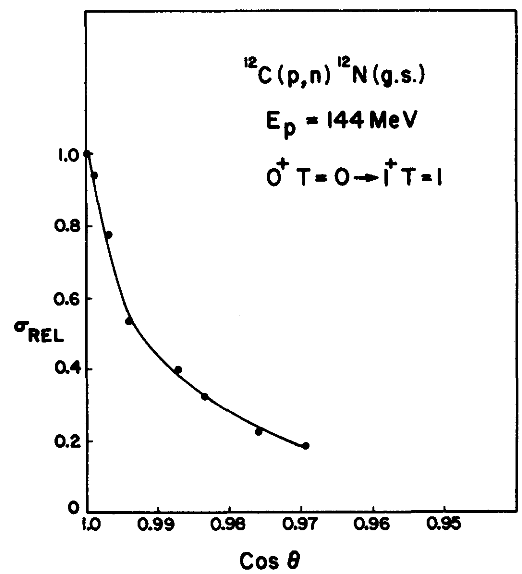

Figure 2.