DETECTOR DEVELOPMENT

HIGH-EFFICIENCY NEUTRON DETECTORS

R. Madey, R.N. Sellers, A.R. Baldwin, B.D. Anderson, and J.W. Watson
Kent State University, Kent, Ohio 44242

During the past year, we compared the performance at the IUCF of a high-density (ρ = 4.88 g/cm^3) barium-fluoride (BaF_2) scintillator with a liquid $(CH_2)_n$ scintillator (ρ = 0.858 g/cm^3). By comparing the counts observed in the ^{12}N(g.s.) peak from the ^{12}C(p,n) reaction at 135 MeV, the efficiency per unit volume of the BaF_2 (as extracted on-line) appeared to be 3.3 times that of the $(CH_2)_n$ scintillator. Since 86% of the neutrons interact in traversing two mean-free-paths, it appears that a high-efficiency (~86%) neutron detector can be achieved with a BaF_2 thickness of about 40 cm. The observed efficiency ratio of about 3.3 is consistent with that expected on the basis of geometric neutron interaction cross sections. We made a few measurements of the light output of the BaF_2 and $(CH_2)_n$ scintillators in response to proton energy losses from about 40 to 90 MeV. Preliminary results show that light output from BaF_2 is higher than that from NE-102 plastic, whereas the light output from the $(CH_2)_n$ scintillator is lower than that from NE-102 plastic. The overall time resolution for neutrons of about 118 MeV in the ^{12}N(g.s.) peak was broader for the BaF_2 than for the $(CH_2)_n$; however, at this time it is not clear whether this result was caused by degradation of the fast component in the BaF_2 or whether neutrons do not excite the fast component as effectively as photons. Further tests are needed.

USE OF AXIAL GAS-IONIZATION CHAMBERS TO STUDY INTERMEDIATE-MASS-FRAGMENT PRODUCTION IN NUCLEAR REACTIONS

D. Bonser, K. Kwiatkowski, S. Rose, and V.E. Viola
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

Two new designs for gas ionization chambers were constructed and tested. They are both based on an axial anode configuration. Figure 1 is a schematic of a multi-anode design. The anodes and electrodes are annular rings. The anode is operated at a high voltage and every other electrode is grounded. Because of the short distance an ionization electron travels to the collecting electrode (anode) in this design, the detector produces very rapid electron collection. Resolution (full-width at half-maximum, FWHM) of an ^{241}Am source (5.48 MeV alpha) was found to be .31 MeV at a gas pressure of 45 Torr (CF_4) and an applied voltage on the anode of 450 volts. In a run with a 200 MeV ^4He beam incident on a ^{nat}Ag target this detector yielded an overall charge resolution of 0.43 Z units, permitting mass identification of ^7Be and ^9Be (see Fig. 2).

A second design included shaping electrodes which produce a more uniform electric field (Fig. 1b). Again, the single anode as well as the shaping electrodes are annular rings. The anode is in the middle and is operated at a high voltage. The entrance