INCREASED STOPPING POWER FOR THE "CE01" DETECTOR STACK

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A large plastic scintillation detector for the Cooler is nearing completion. This new detector layer (designated the "K" detector) will fit around the beam pipe and in either of the detector stands which now occupy the G and A straight sections of the Cooler. Designed for general use, this detector is primarily intended for the approved experiment CE44, to increase the energy range of previous studies of neutral pion production in proton-proton collisions near threshold (CE01, CE23).[1] Polarized beam and target will be required for CE44 to sort out the additional partial waves. However, before that experiment runs, this detector will be used in CE42, a measurement of pp spin correlation parameters in the energy range between 100 and 500 MeV, which is scheduled to get beam in July of 1995. The availability of this detector may also allow a postponed experimental search for dibaryon production to be scheduled in the coming year.[2]

The detector itself is very similar to the "E" detector which has served many Cooler measurements since CE01. It is roughly a disk-shaped piece of plastic scintillator 15-cm thick that completely surrounds the beam pipe (see Fig. 1). The outer diameter of the active area is about 85 cm, and it is divided into four equal segments. It is thicker and slightly larger in diameter than the E detector. Mounted together, back-to-back, these two scintillators can be combined to stop protons with kinetic energies up to about 200 MeV and measure their energies with a resolution of 7% or better. Combined with existing aluminum degrader layers, the stopping power of this stack can be increased to over 300 MeV for protons.

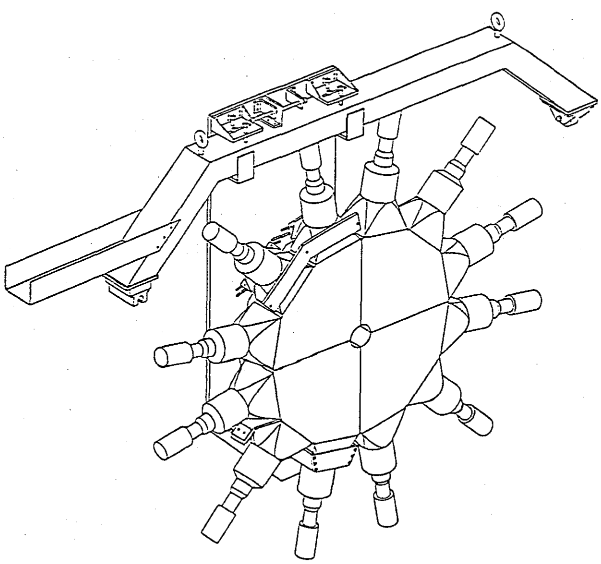

Figure 1. Perspective view of the new 6-inch thick scintillation detector being constructed at IUCF showing all four quadrants and part of the mechanical support structure.

At the time of this report, the four segments with their light guides and phototubes have been polished, glued and wrapped in the IUCF scintillator shop. Hardware for the support frame has also been machined at IUCF and is now being assembled, and the detector will be mounted in the A region of the Cooler during the next access period. One quadrant has already been tested with cosmic rays and with 430-MeV beam protons, and preliminary results show the expected performance.

1. H. O. Meyer, IUCF proposal #92-108 (CE44), 1992.
2. P. V. Pancella, *et al.*, IUCF proposal #88-103 (CE13), October 1988, updated 1992.

GAMMA-RAY ESCAPE-PEAK RESPONSE FROM A RADIATION-DAMAGED REVERSE-ELECTRODE COAXIAL GERMANIUM DETECTOR

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The effects of radiation-damage induced-hole trapping on the resolution of escape peaks compared to ordinary, multiple Compton and photoelectrically interacting, full-energy gamma-ray peaks from a reverse-electrode (n-type) germanium detector are studied. Coaxial detector geometry is the dominant factor, causing charge collection to be dramatically better near the outer periphery of the detector, as well as increasing the probability of escape events occurring in this region. It follows that the resolution of escape peaks is better than that of ordinary gamma-ray peaks. This is experimentally verified. A nearly identical, but undamaged, detector shows the effect of Doppler broadening in single-escape peaks.

Radiation damage has long been known to cause energy-resolution degradation in germanium detectors. This damage creates disordered regions in the germanium lattice that predominantly trap holes, resulting in a low-energy tail on gamma-ray peaks.[1] When gamma rays having sufficient energy to produce e^{+}-e^{-} pairs in germanium are incident on a radiation-damaged coaxial germanium detector, the energy resolution of the double and single escape peaks is consistently better than the resolution of the full-energy gamma-ray peaks. The amount of trapping caused by radiation damage is affected by factors such as electric field, ionization density, temperature, and geometry. By considering these and other factors independently we have gained a perspective on radiation damage in germanium detectors that enables us to explain this escape-peak phenomenon.

The IUCF/LBL experimental program to study the effects of radiation damage on high-purity germanium detectors and the subsequent annealing of these detectors has been