

The HyBall Charged-Particle Detector System

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Construction of a small Hybrid 4π array of charged-particle detectors to operate as an inner ball inside the CLARION array of clover Ge detectors is in progress. The first phase of the project, which consists of an array of 96 CsI(Tl) crystals coupled to photodiodes, is near completion. Its use with CLARION and the RMS will allow excellent channel selection by simultaneous detection of light charged particles emitted in heavy-ion fusion-evaporation reactions. In addition it will allow kinematic reconstruction of the recoil momenta and, thus, correction of the γ -ray spectra event-by-event for the Doppler broadening introduced by particle emission.

The requirements to minimize the attenuation of gamma-rays prohibit the use of massive detectors. The combination of CsI(Tl) coupled to large area photodiodes provides a thin compact detector. This technology has been successfully used with the 8π -Miniball [1] and the Gammasphere-Microball [2]. Particle identification will be achieved by pulse shape discrimination with electronic gates on CsI(Tl) output pulses. Initially the detector will consist of a 96-element CsI(Tl) array mounted in 9 concentric rings. In the second phase, 80 of the CsI detectors will be used to cover angles greater than 25° and will be complemented, without loss of efficiency, with large-area, segmented, silicon microstrip detectors in the forward direction. Proton- α discrimination in the Si detectors may be achieved using either a single layer in the transmission mode, or two layers of Si detectors in a ΔE -E configuration. We are presently exploring different options to implement the electronics for the silicon detectors.

Currently, fabrication of the CsI elements of the array is in progress. The electronics processor modules for the CsI detectors, which are based on the Washington University Microball design, have been successfully tested. The HyBall array will be housed in an aluminum target chamber with a forward funnel that will accommodate the microstrip Si detectors. The geometry of this chamber minimizes the exposure of the Ge and CsI detectors to the γ -rays and positrons resulting from the decay of the scattered radioactive ions.

[1] A. Galindo-Uribarri, Prog. Part. Nucl. Phys. 28, 463 (1992).

[2] D.G. Sarantites et al., Nucl. Instr. and Meth. A 381, 418 (1996).