

Tests of the GRETINA 3-crystal prototype detector: I. Acceptance

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The realization that multi-segmented HPGe detectors can provide information on the position of the interactions of a gamma-ray led to the concept of gamma-ray tracking. This position information is derived from the pulse shapes of the main and induced signals, with a resolution of ~ 2 mm. The improved position resolution translates directly to a better energy resolution for most of the in-beam work, as a Doppler reconstruction can be done with better precision. An array with 4π coverage of Ge material will have large gain in efficiency and its resolving power is expected to be of several orders of magnitude greater than current systems like Gammasphere or Euroball.

GRETINA, will be one of the first implementations of a tracking array, covering 1π of solid angle. GRETINA is a major equipment initiative supported by the US-DOE Nuclear Physics Office and is being constructed at LBNL with active participation from other national laboratories and universities. The GRETINA prototype detector consists of a cluster of 3 tapered regular hexagonal HPGe capsules in a common cryostat. Each crystal is 9cm long and 8cm in diameter, as shown in the following figure:

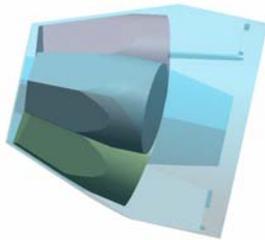


Fig. 1 3D Drawing of the capsules assembly inside the cryostat.

This detector was fabricated by Canberra/Eurisys and was delivered to LBNL in June of 2004. The Ge crystals have 36 segments (6 longitudinal x 6 transverse) and a central contact for a total of 111 channels, each instrumented with a cold FET stage and Eurisys PSC823 preamps.

A number of acceptance tests have been performed including: mechanical dimensions, liquid nitrogen holding time, and energy resolution.

For the mechanical acceptance, a total of 366 points on the outside cap were measured at room and liquid nitrogen temperatures with a CMM machine at LBNL to confirm the design specifications. An RMS deviation of 0.12mm with a maximum of 0.25mm were determined. These values are

within the tolerances required for the close packed geometry. The liquid nitrogen holding time is about 12 hours when the detector is powered up. This time extends to 15 hours with the power off. Energy resolution measurements were carried out for all channels using the LBNL signal digitizer board. Average values of 2.35keV FWHM at 1.33MeV and 1.15keV at 60keV were obtained. A wide band noise level better than 4keV was measured for all the channels. These results are within the specification requirements of GRETINA.

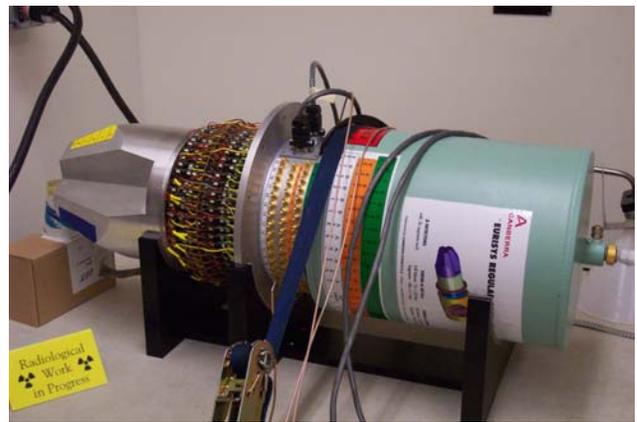


Fig. 2 Picture of the triple cluster prototype. The preamp housing is open allowing the view of the preamp boards.

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