

# AN IN-BEAM MEASUREMENT OF THE POSITION RESOLUTION IN A HIGHLY SEGMENTED COAXIAL GE DETECTOR

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Gamma-ray energy tracking detector arrays that are based on multiple highly-segmented coaxial Ge crystals (e.g. GRETINA/GRETA or AGATA) have the capability to resolve individual  $\gamma$ -ray interactions within the crystal and to track these interactions both within and across crystal boundaries. By analyzing the signal shapes from the segments it is possible to determine the interaction location to a far greater accuracy than the segment size and achieve millimeter position resolutions from centimeter size segments.

We report on an in-beam measurement of the position resolution of the 36-fold segmented GRETA II prototype detector. A 385 MeV  $^{82}\text{Se}$  beam provided by the Lawrence Berkeley National Laboratory 88-Inch Cyclotron bombarded a thin  $^{12}\text{C}$  target producing  $^{90}\text{Zr}$  with  $\beta=8.76\%$ . The detector was at 90 degrees to the beam direction and 4 cm from the target center. Three LBNL 8-channel digital signal processing boards instrumented 24 segments. The position of the first  $\gamma$ -ray interaction was determined by comparing the measured signals to a set of pre-calculated basis signals (signal decomposition) and the  $\gamma$ -ray energy spectrum was Doppler corrected event-by-event. The measured peak width of a  $\gamma$ -ray emitted in flight is then directly related to how well the location of the first interaction is determined.

Fig. 1 shows Doppler corrected spectra for the 2055 keV  $\gamma$ -ray in  $^{90}\text{Zr}$  (a) assuming the interaction occurred at the center of a segment, and (b) after signal decomposition. These gave peak widths of 29 keV and 14.5 keV respectively. Fig. 2 shows the calculated peak width for a 2055 keV  $\gamma$ -ray as a function of position resolution. The observed width of 14.5 keV corresponds to a position resolution  $\sigma < 2.5$  mm (RMS value in 3-dimensions). Fig. 2 assumes the peak broadening is solely associated with position resolution and the quoted value is an upper limit.

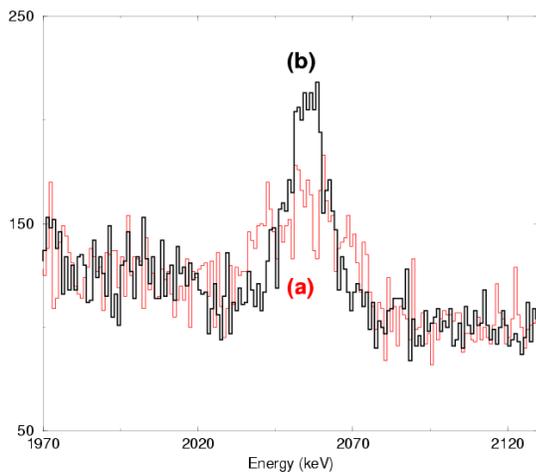


Figure 1

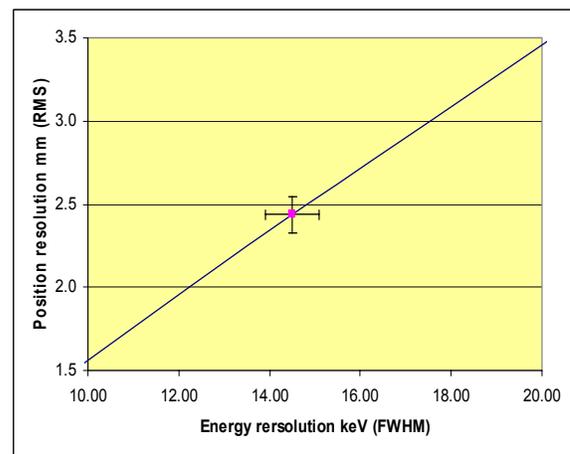


Figure 2

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