LAnthanum Bromide Detector array of ATOMKI (LABDA)

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Scintillator crystals are among the most commonly used detectors in gamma-ray spectroscopy measurements. Earlier BaF_2, then NaI, while more recently $LaBr_3$ and GAGG detectors were introduced. These detectors offer good timing properties and high detection efficiency, the latter feature making them suitable for studying low-probability phenomena. Among scintillators, $LaBr_3$ crystals provide the best energy resolution [1].

During the last five years at ATOMKI, a $LaBr_3$ γ-ray spectrometer called LABDA has been designed and built primarily for research on the hypothetical X17 boson [2,3]. More recently, the detectors have also been employed in other nuclear spectroscopy and nuclear astrophysics experiments. For the LABDA array, 15 $LaBr_3$ crystals of 3"×3" have been procured, and two detector geometries using 12 crystals have been implemented: a hemispherical and a planar geometry.

To facilitate the use of the LABDA detector system, we have characterized key performance parameters of the array, including energy resolution, energy non-linearity, detection efficiency, and time resolution. Due to the manufacturing process of lanthanum bromide detectors, intrinsic radioactive contamination from ^{227}Ac is present in the crystals. This contamination contributes to the alpha background, particularly above 1.6 MeV. To reduce this background, we investigated the use of pulse shape discrimination (PSD) techniques [4,5]. The performance characteristics of the LABDA detector array and a more in-depth description of the applied PSD methods will be presented.

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