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Study of Linearity and Internal Background for LaBr3(Ce) Gamma-Ray Scintillation Detector

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Cerium-doped lanthanum bromide, LaBr3(Ce), crystal is the latest among the family of scintillation counters and shows same attracting properties for γ spectroscopy that makes it a suitable solution for security, medical, geophysics and high energy physics applications. Among these properties are good density (5.1 g/cm^3), brightness (>65000 photon/MeV), time resolution and excellent energy resolution (<3% FWHM at E_γ=662 keV). LaBr3(Ce) crystal could become an interesting alternative to HpGe detectors. LaBr3(Ce) exhibits a proportional light yield response to γ-ray energy. Often this property is hampered at higher energies (>5 MeV) by instantaneous current limitation of PMT: fast and bright can have drawbacks for high energy applications. Very good linearity was seen up to 2 MeV. LaBr3(Ce) has also relatively high intrinsic radiation background due to naturally occurring ^{138}La radioisotope. A good use of LaBr3(Ce) requires an accurate determination of the self activity, particularly when low background is required or when events are collected at extremely low trigger rates (both situations are the usual standard in the case of underground nuclear astrophysics experiments where we plan to test the LaBr3(Ce) crystal). Although ^{138}La background is entirely below the energy of 1500 keV, additional background was seen in the region between 1500 and 2750 keV. The impact of internal background on energy resolution and linearity is discussed.

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