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Parameterization Measurements of a 963 cm^3 LaBr$_3$:Ce Crystal[1]

J.C. MARSH, ORAU/ARL, M.S. LITZ, US Army Research Laboratory, C.J. CHIARA, ORAU/ARL, J.J. CARROLL, US Army Research Laboratory — LaBr$_3$:Ce is a relatively new scintillator with characteristics that surpass more commonly used radiation detection scintillators. Published results for small (<10 cm^3) LaBr$_3$ detectors (NIMA 683, 46, 2012) describe improved time resolutions (∼35 ps), energy resolutions (∼3.5% at 662 keV), and optical yields (∼63,000 photons/MeV) compared to NaI and BGO. Here it was possible to assess the characteristics of a 963 cm^3 (7.6 cm length, 12.7 cm diameter) cylindrical crystal optically coupled to an ET9390KB photomultiplier tube optimized for crystal emissions at 380 nm. A 3×3 array of crystals will be used for neutron-stimulated evaluations of materials for elemental and chemical composition. A custom bleeder chain was designed to minimize current saturation and optimize the energy linearity over a 2-12 MeV energy range. Because large volume crystal characteristics do not always scale linearly, energy resolution, detector efficiency, crystal homogeneity, timing resolution, pulse shape, peak-to-Compton ratios, energy linearity, and self activity were all measured and compared to published results on other LaBr$_3$ detectors. Advantages and disadvantages of such large LaBr$_3$ crystals will be discussed, and future plans will be described.

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