Development of novel LaBr3(Ce) Detector Modules for Nuclear Astrophysics Applications

Sulagna Dutta[1], Cameron Cassells[1], B.S. Nara Singh[1], M. Bowry[1], D. O'Donnell[1], J.F. Smith[1], P. Joshi[2], J. Bordes[2], J.R. Brown[2], D.G. Jenkins[2], O. Tengblad[3], M.J.G. Borge[3], and J.A. Briz[4]
[1]University of the West of Scotland, Paisley, UK, [2]University of York, UK, [3]Instituto de Estructura de la Materia, CSIC, Spain, [4]Universidad Complutense de Madrid, Spain

A LaBr3(Ce) clover detector system combining compact geometry with good energy resolution and improved detection efficiency is being developed at the University of the West of Scotland. This work represents the first clover-like detector system based on scintillator crystals specifically designed to implement the add-back technique [1]. By reconstructing full-energy γ-ray events through the summation of energy deposited in neighbouring crystals, an improvement of approximately 33% in the peak-to-total (P/T) ratio was achieved for a 137Cs source.

The detector consists of LaBr3(Ce) crystals directly coupled to SiPM readout, with only optical gel between the crystal and photosensor. This direct optical coupling improves light collection and results in enhanced energy resolution. Compared to typical LaBr3(Ce) detector systems, a reduction of about 12% in the full width at half maximum (FWHM) was observed, improving from approximately 3.3% to 2.9% at 662 keV [2].

The detector's capability for high-energy γ-ray detection in the 5 -7 MeV range has also been investigated through light nuclear reaction experiments carried out in Madrid. Preliminary results are promising and demonstrate the system's potential for nuclear astrophysics measurements, including reactions such as 3He(α,γ) related to the long-standing 7Li abundance problem [3]. The detector design, add-back methodology, analysis techniques, and performance results will be presented.

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