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Compton suppressed γ-spectrometer based on CeBr₃-Nal(Tl) phoswich detector cluster

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The scintillation spectrometer based on a cluster of 9xCeBr₃–NaI(Tl) phoswich detectors, additionally equipped by 4xCsI(Tl) detectors of Compton shield was built as a part of MULTI setup [1] to carry out the experiments to study the reactions with radioactive neutron-rich nuclei produced by fragment separator ACCULINNA [2] of the accelerator U400M, FLNR JINR, Dubna.

The results characterizing the efficiency and functionality of the phoswich detector cluster are presented. Parameters such as Compton suppression coefficient (CSC), peak detection efficiency and energy dependence on neutron detection efficiency at neutron energy range $E_n \approx 1.4 \div 5.6$ MeV were measured for each individual phoswich-detector and for the cluster system. The measurements were carried out using various γ - and n- sources. A comparative analysis of the developed spectrometer with Compton suppressed HPGe clover systems [3] is presented.

The Compton suppression coefficient was measured across energy interval of $E\gamma<1.4$ MeV using two trigger modes and demonstrating significant reduction of the Compton part of the γ -spectra. The maximum suppression coefficient reached ~ 65%, showing the high efficiency of the shielding configuration. The additional equipment of the cluster by CsI(Tl) detectors has improved the CSC parameter.

The measurements with n- γ source have shown that CeBr3 detectors have a relatively high neutron detection efficiency which is weakly dependent on the energy at $E_n \approx 1.4 \div 5.6$ MeV and can be used for neutron detection by TOF method [4]. CeBr3 detector (5×5×5 cm³)

has neutron detection efficiency $\varepsilon(E_n)$ about ~30% in energy range $E_n = 1.4 \div 5.6$ MeV at detection threshold E_{th} ~60 eekeV.

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