

## CLUSTER of PHOSWICH $\gamma$ -DETECTORS for "MULTI" FACILITY

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The array of 8 CeBr<sub>3</sub>–NaI(Tl) phoswich detectors coupled to 6-12 CsI(Tl) MULTI 4 $\pi$   $\gamma$ -spectrometer (Fig.1 Left) of MULTI [1-3] setup was designed at FLNR JINR for studying reaction cross sections with neutron-rich nuclei [4, 5]. The array of 9 CeBr<sub>3</sub>–NaI(Tl) phoswich detectors (Fig.1 Right) can be used as PARIS cluster [6] for study of  $\beta$ -decay process accompanied by  $\gamma$ -rays from high-lying collective Giant Dipole Resonances (GDR) and low-lying collective Pygmy Dipole Resonances (PDR) from the daughter nuclei.

The cluster of 9 phoswich detectors has been tested with neutrons and  $\gamma$ -rays at various  $\gamma$ -ray energies using radioactive sources. The investigation results of the response functions of phoswich detectors to  $\gamma$ -radiation at the low energy range (efficiency, pick efficiency, Compton-suppression coefficient, etc.) in depending on the detector-source distance and  $\gamma$ -ray energy are presented. The measurements were carried-out within  $\gamma$ -tagged method. The experimental results are compared with GEANT4 calculations. The complex scintillation waveforms of phoswich detectors have been investigated both the digital (Mesytec Digital Pulse Processor MDPP-16) and analog (Mesytec MADC-32, MQDC-32) electronics [7].

Two-dimensional waveform analysis of phoswich pulses based on the digital electronics were compared to the analog discrimination methods. Both approaches allow to separate clearly the CeBr<sub>3</sub> and NaI(Tl) scintillation components of phoswich detectors.

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