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A Pulse Height Response Spectrometer for neutron detection based on digital signal processing

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Pulse Height Response Spectrometry (PHRS) is a tool of neutron physics and several applications performed with fast neutrons with En > 0.1 MeV energy. We have built and characterized a PHRS system based on a scintillation detector with EJ-301 liquid scintillator and Digital Signal Processing (DSP). The system will be used for characterization of mixed neutron-gamma fields to be used for applications at MTA Atomki (testing new types of neutron detectors, radiation hardness tests, etc.). The photomultiplier of the scintillation detector is connected to a CAEN DT5751 digitizer (1 GS/s, 10 bit). Time stamp, short integration value, long integration value and the PSD (Pulse Shape Discrimination) value [1] are recorded in list mode. 2D plot of the PSD value is used for separating the events induced by protons and gamma photons. The gamma and neutron responses of the system are studied experimentally and via Monte Carlo simulations. The Eg = 0 – 3 MeV gamma and the En = 1 - 12 MeV neutron energy ranges are covered. Irradiations are done with quasi-monoenergetic d+D neutrons at the MGC-20E cyclotron of MTA Atomki. The measured and simulated gamma and neutron response functions will be presented with the neutron spectra unfolded from the measured proton spectra via a derivative unfolding method [2].

[1] D. Cester, M. Lunardon, Nucl. Instr. and Methods 748, 33 (2014).
[2] D. Slaughter, R. Strout, Nucl. Instr. and Methods 198, 349 (1982).

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