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Design and development of a real-time readout electronics system to retrieve data from a square multi-anode photomultiplier tube for neutron gamma pulse shape discrimination

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Pulse Shape Discrimination (PSD) algorithms can reliably separate neutrons and gamma-ray photons interacting in a scintillation detector. When implemented in the digital domain, the PSD algorithms allow real-time discrimination of neutron sources from gamma sources. This paper presents a design of a readout electronics system to retrieve data from a multi-anode photomultiplier tube (MAPMT) for a scintillator based coded-aperture neutron imager. The scintillator was coupled with Hamamatsu H9500, a square MAPMT, where each anode of the MAPMT was linked to a resistor network to infer the position of incidence of radiation within the scintillant. Additionally, the resistor network output signals were filtered through a novel noise reduction circuit to preserve the data corresponding to each pulse. Localised pulses were digitised using 12-bit 500 MSPS Analogue to Digital Converter (ADC). Sampled signals were temporarily stored in a local ping-pong buffer, before being processed by the customised application developed on a field programmable gate array (FPGA). Initial results suggest that the high ADC sampling rate provides sufficient information for neutron gamma source discrimination using PSD. Parallel real-time signal processing, implemented on the FPGA, enables multi-channel functioning to generate an array of interactions within the scintillator in terms of gamma rays and neutrons.

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