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Realising real-time capabilities of an embedded control system for fast-neutron scintillation detectors

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Scintillation detectors offer a single-step detection method for fast neutrons and necessitate real-time acquisition, whereas this is redundant in two-stage thermal detection systems using helium-3 and lithium-6. The affordability of scintillation detectors and the associated fast digital acquisition systems have enabled entirely new measurement setups that can consist of sizeable detector arrays. These detectors in most cases rely on photo-multiplier tubes which have significant tolerances and result in variations in detector response functions. The detector tolerances and other environmental instabilities must be accounted for in measurements that depend on matched detector performance.

This paper presents recent advances made to a high speed FPGA-based digitiser technology developed by Aston University (UK), Hybrid Instruments Ltd (UK) and Lancaster University (UK), with support from the European Joint Research Centre (Ispra) and the International Atomic Energy Association (Vienna). The technology described offers a complete solution for fast-neutron scintillation detectors by integrating multichannel high-speed data acquisition technology with dedicated detector high-voltage supplies. This unique configuration has significant advantages for large detector arrays that require uniform detector responses. We report on bespoke control software and firmware techniques that exploit real-time functionality to reduce setup and acquisition time, increase repeatability and reduce statistical uncertainties.

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