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Development of a digital data acquisition system for neutron metrology

Fast neutron fields are found in a wide variety of contexts, for example at accelerator and medical radiation facilities, around nuclear power plants, in airplanes in flight and space stations. These fields often vary widely with respect to both energy and intensity which complicates measurements of energy dependent fluence. Bonner sphere systems remain widely in use, although systems based on scintillator detectors offer distinct advantages including improved energy resolution on the fast neutron energy range (above 1 MeV). Since scintillators are typically sensitive to all types of radiation, including gamma rays, it is necessary to select neutron-only events, and pulse shape discrimination capabilities of selected scintillators is typically used for this purpose. Digital pulse processing electronics offer several distinct advantages over analogue systems, including being more cost effective and compact, but most importantly the flexibility of analyzing raw pulses in list mode.

Within the neutron metrology and spectrometry community digital pulse processing systems are being developed for a variety of purposes. New digital data acquisition systems need to be benchmarked against the current metrology standards, typically based on analogue systems. We present a comparison between the IRSN fast neutron metrology analogue acquisition system to an off-the-shelf CAEN desktop digitizer. Measurements were made using a BC-501A scintillator detector at IRSN AMANDE accelerator based facility. Uncertainty budgets for measurements of neutron energy dependent fluence distributions are compared for the analogue and digital acquisition systems. The broader aim of this project is to further the development of a digital data acquisition system for fast neutron metrology using advanced scintillator technology for use in neutron fields where time-of-flight may or may not be available.

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