A Digital Pulse Shape Discriminator for the Nuclear Materials Identification System

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Discrimination between neutrons and gamma rays in organic scintillators by pulse shape is complicated by the pulse height dependence of the pulse shape for neutrons. Normally, hardware discrimination ignores the pulse height dependence of the pulse shape, leading to an identified neutron component that either selectively excludes high-energy neutrons or includes low-energy gamma rays. This is acceptable provided that subsequent cleanup can be performed via software. Often, in multiplicity counting applications for nuclear material control and accountability, it is desirable to have the best possible answer while accommodating high detector rates and eliminating the need for subsequent analysis of the spectra. For this purpose, a digital pulse shape discriminator based on a free-running 200-MHz flash ADC and a field programmable gate array has been designed and built for the Nuclear Materials Identification System. The discriminator allows for programmable compensation for pulse shape with pulse height that is performed in real time, and is easily set up.