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Fast Neutron Induced Nuclear Counter Effect in Hamamatsu Silicon PIN Diodes and APDs

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Neutron induced nuclear counter effect in Hamamatsu silicon PIN diodes and APDs was measured by irradiating fast neutrons from a pair of Cf-252 sources directly to these devices. It was found that the entire kinetic energy of these neutrons may be converted into electron signals in these devices, leading to anomalous signals of up to a few million electrons in a single isolated calorimeter readout channel. Signals of such amplitude represent equivalent energy of several hundred GeV and a few GeV for PWO and LSO/LYSO crystals respectively assuming the corresponding light yields of 4 and 800 p.e./MeV. The overall rate of the neutron induced nuclear counter effect in APDs is found to be more than an order of magnitude less than that in PIN diodes. Increasing the APD gain was also found to reduce the neutron induced nuclear counter effect. An intelligent front-end chip capable of selecting un-contaminated signal is proposed to eliminate completely the nuclear counter effect without significant cost increase.

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