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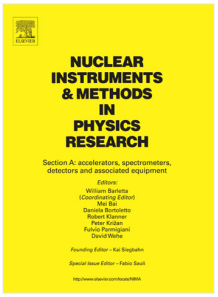

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Development of pulse shape analysis for noise reduction in Si-based neutron detectors

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Abstract

The application of Si sensors coupled to Gd converters as thermal neutron counters is assessed in a series of test experiments on the neutron beam, among which scattering from standard samples. The prototype 1d detector is a Si microstrip sensor directly coupled to natural Gd converter and equipped with standard front-end electronics. The raw scattering data, collected by interfacing the detector with the data acquisition system available at the neutron source, show advantages and limits of this technology when applied to neutron detection. To improve the performances of the Si-based detector by means of an optimized discrimination of the neutron signals from noise and background radiation, a pulse shape analysis method is proposed. The effectiveness of this method is then explored by experimental tests on the neutron beam of two more prototype detectors, namely a PIN diode coupled to $^{157}Gd_2O_3$ converters, and a Silicon photo-multiplier (SiPM) coupled to neutron scintillators. This study is aimed to real time applications and single event storage of the neutron information in time of flight instrumentation.

Keywords: Neutron detection, silicon sensors, pulse shape analysis, FPGA

1. Introduction

The enormous growth of the experimental opportunities [1] at neutron sources, despite the limited increase of the source brightness since the 1960s, has been enabled by the development of instrumentation like large position-sensitive detectors, new focusing optics and innovative exploitation of neu-