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Signal Processing Scheme for a Low Cost LiF:ZnS(Ag) Neutron Detector with Silicon Photomultiplier

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The NIST Center for Neutron Research is finalizing the design of a novel scintillating neutron detector for its CANDOR neutron scattering instrument. The detectors in the chromatic analyzer must be extremely thin (˜1.5 mm) and highly efficient (˜90% sensitivity for 3.3 meV neutrons. To that end the detectors consist of 6LiF:ZnS(Ag) plastic scintillator in which wavelength shifting (WLS) fibers have been embedded. Scintillation light collected in the WLS fibers is read out using a silicon photomultiplier (SiPM). The signal from the SiPM is digitized and processed by a field programmable gate array using a pulse shape discrimination algorithm. Discriminating neutron capture events from other phenomena presents a number of challenges for both raw sensitivity and count rate. We describe our efforts to cope with these issues.
At the present time the detectors exhibit a neutron sensitivity of ˜90% for 3.3 meV neutrons with a gamma rejection ratio of ˜10E-7 at count rates exceeding 10000 counts per second.

Author: Mr PRITCHARD, Kevin (NCNR)

Co-authors: Dr OSOVIZKY, Alon (NCNR, Rotem Industries Ltd.); Dr MAJKRZAK, Charles (NCNR); Mr ZIEGLER, Jeff (NCNR); Dr MALISZEWSKYJ, Nicholas (NCNR); Mr TSAI, Peter (NCNR)

Presenter: Mr PRITCHARD, Kevin (NCNR)

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