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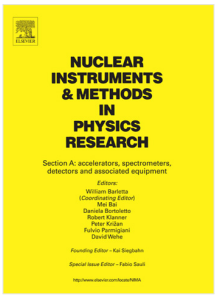

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Pulse shape discrimination of $Cs_2LiYCl_6:Ce^{3+}$ detectors at high count rate based on triangular and trapezoidal filters

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Abstract

$Cs_2LiYCl_6:Ce^{3+}$ (CLYC) detectors have demonstrated the capability to simultaneously detect γ-rays and thermal and fast neutrons with medium energy resolution, reasonable detection efficiency, and substantially high pulse shape discrimination performance. A disadvantage of CLYC detectors is the long scintillation decay times, which causes pulse pile-up at moderate input count rate. Pulse processing algorithms were developed based on triangular and trapezoidal filters to discriminate between neutrons and γ-rays at high count rate. The algorithms were first tested using low-rate data. They exhibit a pulse-shape discrimination performance comparable to that of the charge comparison method, at low rate. Then, they were evaluated at high count rate. Neutrons and γ-rays were adequately identified with high throughput at rates of up to 375 kcps. The algorithm developed using the triangular filter exhibits discrimination capability marginally higher than that of the trapezoidal filter based algorithm irrespective of low or high rate. The algorithms exhibit low computational complexity and are executable on an FPGA in real-time. They are also suitable for application to other radiation detectors whose pulses are piled-up at high rate owing to long scintillation decay times.

Keywords: CLYC; high rate; pulse shape discrimination; triangular filtering; trapezoidal filtering;

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1. Introduction