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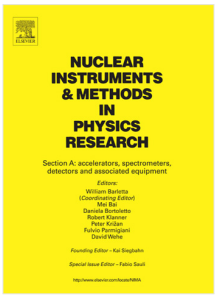

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Modeling charge transport in photon-counting detectors

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Abstract

The purpose of this study is to review and compare simulation methods for describing the transport of charge clouds in silicon based semiconductor detectors and investigate the effects on energy spectrum for silicon based photon-counting strip detectors. Charge clouds and detailed carrier transport are simulated and compared using two different approaches including analytical and Monte Carlo schema. The results of the simulations are evaluated using pulse-height spectra (PHS) for a silicon strip detector with edge on geometry at two energies (25 and 75 keV) at various x-ray absorption locations relative to the pixel boundary and detector depth. The findings confirm carrier diffusion plays a large role in the charge sharing effect in photon counting detectors, in particular when the photon is absorbed near the pixel boundary far away from the pixel electrode. The results are further compared in terms of the double-counting probability for x-ray photons absorbed near the pixel boundary as a function of the threshold energy. Monte Carlo and analytical models show reasonable agreement (2% relative error in swank factor) for charge sharing effects for a silicon strip detector with edge-on geometry. For 25 keV mono-energetic photons absorbed at 5 μm from the pixel boundary, the theoretical threshold