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## Modeling charge transport in photon-counting detectors

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### Abstract

1 The purpose of this study is to review and compare simulation methods for  
2 describing the transport of charge clouds in silicon based semiconductor detec-  
3 tors and investigate the effects on energy spectrum for silicon based photon-  
4 counting strip detectors. Charge clouds and detailed carrier transport are sim-  
5 ulated and compared using two different approaches including analytical and  
6 Monte Carlo schema. The results of the simulations are evaluated using pulse-  
7 height spectra (PHS) for a silicon strip detector with edge on geometry at two  
8 energies (25 and 75 keV) at various x-ray absorption locations relative to the  
9 pixel boundary and detector depth. The findings confirm carrier diffusion plays  
10 a large role in the charge sharing effect in photon counting detectors, in par-  
11 ticular when the photon is absorbed near the pixel boundary far away from  
12 the pixel electrode. The results are further compared in terms of the double-  
13 counting probability for x-ray photons absorbed near the pixel boundary as a  
14 function of the threshold energy. Monte Carlo and analytical models show rea-  
15 sonable agreement (2% relative error in swank factor) for charge sharing effects  
16 for a silicon strip detector with edge-on geometry. For 25 keV mono-energetic  
17 photons absorbed at 5  $\mu\text{m}$  from the pixel boundary, the theoretical threshold

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