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The Impact of Incorporating Shell-corrections to Energy Loss in Silicon

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Modern tracking detectors based on hybrid or fully integrated CMOS technology are continuing to push to thinner sensors. The energy fluctuations in very thin silicon sensors significantly deviates from the Landau distribution. Therefore, we have developed a digitization setup that implements the Bichsel straggling function, which accounts for shell-effects. This enhanced simulation is important for comparing with testbeam or collision data with thin sensors as is demonstrated by a significant degradation in the position resolution compared with the standard Geant4 EM physics list. Our implementation of the Bichsel model agrees well with the multipurpose photo absorption ionization (PAI) model in Geant4 and is significantly faster. The code is made publicly available as part of the Allpix software package in order to facilitate predictions for new detector designs and comparisons with testbeam data.

Authors: Ms WANG, Fuyue (Tsinghua University); Dr NACHMAN, Benjamin (Lawrence Berkeley National Laboratory); GARCIA-SCIVERES, Maurice (Lawrence Berkeley National Lab. (US))

Presenter: Ms WANG, Fuyue (Tsinghua University)

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