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Time Resolution Simulations for 4H-SiC PiN Detectors

Tuesday 23 May 2023 14:15 (25 minutes)

Silicon Carbide (SiC) is a wide-bandgap semiconductor that has recently become a topic of intensified interest in the HEP instrumentation community due to the availability of high-quality wafers from the power electronics industry. SiC features multiple advantageous material properties over silicon. It is insensitive to visible light, hypothesized to be more radiation hard, and has much lower leakage currents, even after irradiation. As the impact ionization coefficient for electrons is larger than for holes in SiC, this would enable a Low Gain Avalanche Diode (LGAD) based on electron multiplication, suitable for high precision timing applications.

Using the transient current technique (TCT), which uses an ultra-violet LASER to induce electron-hole pairs, we investigated 4H-SiC samples in terms of charge collection and timing performance. Due to the deterministic nature of TCT measurements, they can serve as a basis for validating detector simulations.

In order to reproduce the measurements, an AllPix² simulation has been performed. The extended Canali model has been used to describe the charge carrier mobility, and electric and weighting fields have been imported from Synopsys Sentaurus TCAD. Transients waveforms were obtained by using the CSADigitizer module together with a measured transfer function of the front-end electronics. The simulation results are compared to measurements, and finally, some challenges specific to simulating transient waveforms and non-silicon detector materials are highlighted.

Will the talk be given in person or remotely?

In person

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