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TANGERINE Project: Transient Studies using a Technology Computer-Aided Design and Allpix Squared combination approach

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The goal of the TANGERINE project is to develop the next generation of monolithic silicon pixel detectors using a 65 nm CMOS imaging process, which offers a higher logic density and overall lower power consumption compared to previously used processes. In order to understand the processes that are involved in the development in the new 65 nm technology, a combination of Technology Computer-Aided Design (TCAD) and Monte Carlo (MC) simulations are used.

Transient simulations allow for studying the response of the sensor over time, such as the signal produced after a particle passes through the sensor. The study of these signals is important to understand the magnitude and timing of the response from the sensors and improve upon them. While TCAD simulations are accurate, the time required to produce a single pulse is large compared to an MC and TCAD combination approach, which reduces the simulation time and allows for studies that are not possible with TCAD alone such as Landau fluctuations or secondary production. In this approach, electrostatic fields from TCAD are imported into the Allpix Squared framework, a simulation framework for semiconductor radiation detectors, and through the use of the Shockley-Ramo Theorem, the pulses induced from charges moving through the sensor are calculated.

In this contribution, the advantages of this approach and the resulting pulses obtained from the MC and TCAD simulations used as validation between the two methods will be presented.

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