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Radiation damage modeling: TCAD simulation

The exceptional performance of the silicon sensors in the radiation environment has led to their extensive usability in high energy physics. Even so, the future experiments foresee these sensors to be exposed to higher radiation levels. Radiation induces a change in the macroscopic properties of the sensor, thus, severely affecting the sensor performance and ultimately becoming the limiting factor for its operation. With an aim to extend the radiation hardness capabilities of the silicon sensors for the future experiments there has been a growing interest in sensors with novel designs and unique characteristic of intrinsic charge multiplication. However, it is important to understand the effect of radiation damage on these sensors, before employing them in the main detector system. The RD50 collaboration extensively employs TCAD simulation tools for an in-depth understanding and structural optimization of the newly proposed sensor technologies, complementing the measurement results. The simulation tools also provide an insight into the sensor operation both in the non-irradiated and the irradiated scenario by predicting the leakage current, full depletion voltage, charge collection, electric field, etc behavior. This has required the development of a radiation damage model within the simulation tools such that the measurements are well complemented. The details of the radiation damage modeling using two commercial TCAD tools –Silvaco and Synopsys, are discussed in this work.

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