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TCAD Simulation of Electrical Characteristics and Irradiation Modeling for ATLAS ITk-Strip Sensors

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The ATLAS ITk strip sensors are n-on-p sensors with thousands of strips, designed for the ATLAS tracker upgrade for the High-Luminosity LHC and built to withstand extreme radiation levels, up to a 1 MeV neutron equivalent fluence of 1.6×1016/cm2. Developing precise models to understand sensor performance at the device level throughout their operational lifespan is essential for optimizing electronics operation settings and ensuring accurate particle tracking and physics performance.
To achieve this, TCAD simulations are used to model the sensors' electrical properties and behavior both before and after irradiation. Given the computational challenges of simulating the entire sensor geometry, we leverage the symmetry and periodic structure of the strip sensors to create an efficient 2D TCAD simulation pipeline. This approach simulates individual strip elements and edge structures separately, then scales and combines them to replicate the full sensor. The simulation results are validated using data from testing main sensor wafers and MD test diodes. Additionally, irradiation effects are assessed by implementing the Perugia radiation damage model and comparing it with recent DLTS-based models, with simulated charge collection directly compared to data from irradiated MD test diodes.

Type of presentation (in-person/online)

online presentation (zoom)

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

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