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3D Simulation and Dopping Profile Measurements of Planar Pixel Sensors

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Innovative edgeless planar pixel sensors for the High Luminosity LHC upgrade are under production. Through 3D TCAD simulation of the production process and electric field at the inside of the detector, combined with SiMS measurements, a calibration and complete insight of the new structures is achieved. Comparison between simulated data and experimental measurements allow a calibration of the process and a better understanding of the production. In addition, innovative bias grid geometries in classical planar pixel structures are studied a 3D approach while the question of efficiency drop in the region of the bias grid is addressed.

Summary

In the context of improved design for the next generation of planar pixel detectors, the issues of geometrical efficiency, radiation hardness and dead regions have to be addressed in order to achieve the highest possible granularity in occupancies that are estimated in the order of 5x1034 cm-2s-1. The edgeless technology provides a strong mean to eliminate boarder inefficiencies through implantation of the border regions. Using SYNOPSYS TCAD 3D simulations, the electrical field in these regions is being investigated to validate the design. Essential to the filed structure is the dopants distribution in the interior of the structures. In this direction, Secondary Ion mass Spectroscopy measurements are being performed and compared with relevant results obtained from the simulation framework using well defined process parameters.
While treating boarder inefficiencies minimizes dead regions, the inefficiencies associated with the presence of a bias grid are also investigated. Using traditional IBL structures (FEI4 compatible), varied geometries of bias rail and bias dot are being tested and simulated in a 3D approach. Having a database of well know parameters concerning the devices in question ensures comparability versus traditional structures already in use in high energy experiments. Simulation and experimental measurements are being presented to validate the different proposed geometries.

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