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Characterization and simulation of radiation effects on active edges n-on-p planar pixel sensors

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Pixelated silicon sensors are the most precise detector for charged particle tracking currently in use at high-energy physics experiments. Located closely to the interaction point, they are required to function in a radiation harsh environment. It is hence necessary for such sensors to demonstrate an increased radiation tolerance as well as to maintain a good performance in high beam luminosity conditions (l=1035cm−2s-1) and for fluences that could exceed 1016neq/cm2 1MeV equivalent neutrons at the inner layers. A major concern is to increase overall sensitive detection area while maintaining high charge collection efficiency in high radiation conditions. Several technologies exist to address these issues, mainly by combining a p-bulk process sensor with active edges and optimized bias rail geometries.
The main objective of this simulation work is to study a new detector structure implementing n-on-p active edges and analyze the electrical characteristics. ATLAS simulator of SilvacoTM Technology Computer Aided Design (TCAD) software is used for the simulation and for the study of the electrical field characteristics of the pixel device. For the simulator algorithm input, we used doping profile data extracted from the technique of Secondary Ion Mass Spectroscopy (SIMS). Breakdown voltage, leakage current, charge carrier distributions (holes, electrons), electric field distributions and charge collection efficiency (CCE) after irradiation are presented.

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