TCAD Simulation of n-Fz Double Sided Silicon Microstrip Detector Irradiated by Protons for the R3B Experiment

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**Abstract**

Radiation hard n-Fz Double Sided Silicon Microstrip Detectors are used in the Silicon Tracker for the detection of two-dimensional position and energy loss measurement of the incident protons in the R3B experiment at FAIR, Darmstadt, Germany.

For the development of the detectors in the R3B Silicon Tracker, the macroscopic analysis is conducted on the available test structure of n-Fz Double Sided Silicon Microstrip Detector, which was fabricated by BEL, Bengaluru, India, and the SRH results on the non-irradiated test structure detectors are compared with the experimental data. The SRH and CCE modeling is used to extrapolate the results up to the proton fluence of 5-8×1014 neq cm-2 for the proton irradiated detectors. This experience is used in the designing of the Double Sided Silicon Microstrip Detector equipped with Wider Guard Ring design for the phase 1 upgrade of the experiment. The inner and the outer sides (towards the cut edge) of the detector are simulated by Silvaco ATLAS device TCAD tool to extract the electric field distribution inside the irradiated detectors.

Depending on the performance of the detector in the phase 1 radiation environment, this radiation hard 200 μm ac coupled Double Sided Silicon Microstrip Detector equipped with an intra guard ring and an outer edge wider guard ring structure has been proposed for the phase 1 upgrade of the R3B Silicon Tracker.

**Keywords:** Double Sided Si Microstrip Detector; bulk damage; TCAD simulation; Electric field distribution; SRH