Contribution ID: **154** Type: **Poster presentation only**

Comparing different bulk radiation damage models in TCAD simulations of small-pitch 3D Si sensors

Small-pitch, thin 3D Si sensors have been developed for the ATLAS and CMS experiment upgrades at the High-Luminosity (HL) LHC. The pixel sizes are 50×50 μm^2 with 1 readout column, and 25×100 μm^2 with 1 or 2 readout columns (1E and 2E). Owing to the small inter-electrode distance, ranging from ~28 μm to ~51 μm in the considered layouts, these devices are extremely radiation hard. Beam test results for pixel modules based on the new RD53A readout chip have shown a very good hit efficiency of almost 99% at less than 150 V bias after an irradiation fluence of 1×10^{16} n$_{eq}$ cm^{-2}, and further tests are under way to assess the performance up to the ~2× larger fluences of interest for the experiments.
TCAD simulations by Synopsys Sentaurus, incorporating advanced radiation damage models, have been used for the design/optimization of new 3D pixel sensors. In this study we have compared the accuracy of different bulk damage models in predicting the leakage current, capacitance, and charge collection efficiency (CCE) of small-pitch 3D sensors irradiated at different fluences in the range of interest for HL-LHC. Selected simulation results will be reported in comparison to experimental data. As an example, Figure 1 shows the experimental and simulated CCE of 3D diodes of different geometries irradiated with reactor neutrons at 2×10^{16} n$_{eq}$ cm^{-2} and measured with a position sensitive IR laser setup [1]. Simulations shown in Fig. 1 are based on the bulk radiation damage model proposed in [2], and yield a good agreement with experimental data, correctly predicting also the onset of charge multiplication effects observed in the measurements of sensors with the smaller inter-electrode distances (25×100.2E and 50×50) at high voltage.

[1] R. Mendicino et al., JINST 14 (2019) C01005
[2] Å. Folkestad et al., Nuclear Instrum. Methods A 874 (2017) 94-102

The authors acknowledge funding from: INFN (Research Project CSN1 FASE2_ATLAS) and European Union's Horizon 2020 Research and Innovation programme (Grant Agreement no. 654168).

Primary authors: BOUGHEDDA, Abderrezak (Université des Frère Mentouri Constantine 1); Prof. LAKHDARA, Maya (University of Constantine 1); LATRECHE, Saida (université frères mentouri constantine1); MENDICINO, Roberto; Prof. DALLA BETTA, Gian Franco (Universita degli Studi di Trento and INFN (IT))

Presenter: BOUGHEDDA, Abderrezak (Université des Frère Mentouri Constantine 1)

Session Classification: Poster session 2

Track Classification: Sensor Materials, Device Processing & Technologies