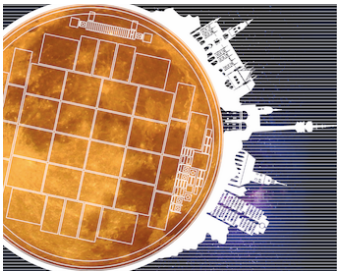

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A TCAD based model of double metal layer effects and a review of the radiation damage and monitoring of LHCb Velo

Wednesday, 21 February 2018 09:25 (15 minutes)

The VErtex LOcator (VELO) is a silicon-strip detector located around the interaction region of LHCb.
It is placed as close as 8 mm from the LHC beams undertaking a very high radiation damage.The sensors have been exposed to fluences up to $3.5 \times 10^{14} 1MeV - neq/cm^2$. The digital processing performed on back-end boards requires approximately 1 million parameters.
Dedicated runs are performed to calibrate the processing algorithms. Regular voltage scans are taken to measure the collected charge and Cluster Finding Efficiency (CFE), determining the depletion voltage. An analysis over the whole calibration parameters history, the data quality assessment and the overall performance of the VELO and will be presented. The detectors are constructed with two metal layers to cover the R/ϕ strips and route the signal to the front-end chips. A loss of signal amplitude is observed with a dependency on the distance to the routing lines. A TCAD simulation was implemented with the detailed detector geometry.
Using the Perugia n-type bulk model and the Peltola surface damage model it is shown that up to 60\% of the charge is collected by routing lines. This is caused by trapping of the otherwise mobile electron accumulation layer at the oxide-silicon interface, causing the shielding effect on the routing lines to be reduced. The observed drop in CFE can be explained by the angular dependence of charge loss to the second metal layer. The efficiency drop as function of track radius and angle is reproduced combining 2D and 3D TCAD simulations.

Primary author: MAJEWSKI, Maciej Witold (AGH University of Science and Technology (PL))

Presenter: MAJEWSKI, Maciej Witold (AGH University of Science and Technology (PL))

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