Simulation of Silicon detectors using TCAD and Monte-Carlo methods

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Silicon detectors used in High Energy physics are complex devices that cannot always easily be modelized using analytical models. In this seminar, a series of simulation tools is presented that can be used to gain better understanding of silicon detectors.

Technology Computer-Assisted-Design (TCAD) software can be used to obtain static and transient electrical characteristics of complex detector topologies by solving the Poisson's equation and Boltzmann transport equation in its domain using Finite-Element Method (FEM).

Monte-Carlo charge transport methods allow to study detector response to radiation in a statistical way by modeling stochastic phenomena occuring in silicon detectors such as diffusion, trapping, electrostatic and energy deposition fluctuations.

Finally, GEANT4 modeling of detector systems can be used to develop simple digitization models incorporating lesson learned from the aforementioned modeling methods. These simple fast models can be validated against experimental data and deployed to predict detector system behavior on a larger scale, such as a vertex detector.

The presentation of the different models will be highlighted with practical example for ATLAS, CLIC and Timepix/Medipix HVCMOS and Planar pixel detectors.