Contribution ID: **228**   Type: **Talk**

Semiconductor Detector End-to-end Simulations with Allpix Squared: Latest Features and Ongoing Developments

Tuesday 18 February 2025 17:20 (20 minutes)

Allpix Squared is a versatile open-source simulation framework for semiconductor detectors, enabling detailed end-to-end simulations for both single sensors and more complex setups. While originally developed for silicon pixel detectors in HEP, the framework is capable of simulating several detector types, semiconductor materials, and geometries for a variety of applications in e.g. space and synchrotrons. It also takes advantage of multi-processor architectures for fully parallel event simulation.

The framework is based on an extensible system of modules that implement simulation steps. Modules include an interface to Geant4 for describing the interaction of particles with matter, various algorithms for charge transport in the sensor, and digitisation of the signals in the front-end electronics. A new interface to SPICE is being developed for more sophisticated front-end simulations. Detailed field, potential, and doping maps imported from TCAD simulations can be used to accurately model the motion and recombination behaviour of charge carriers. In addition new physical models such as impact ionization and trapping have been integrated. Simulation of gain layers and 3D sensors are possible, and actively used in the community.

This contribution will give an overview of the framework and its components, and highlight recent additions and ongoing developments. Example simulations carried out with the framework will be shown to demonstrate its versatility and predictive power.

Primary experiment

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Session Classification: Semiconductor General 2

Track Classification: Semiconductor Detectors