Contribution ID: **0**   Type: **not specified**

Allpix Squared - A Generic Pixel Detector Simulation Framework

Thursday 18 January 2018 11:00 (15 minutes)

Allpix Squared is a generic open-source simulation framework for pixel detectors. Its goal is to ease the implementation of detailed simulations for both single detectors and more complex setups such as beam telescopes. Predefined detector types can be automatically constructed from simple model files describing the detector parameters.

The simulation chain is arranged with the help of intuitive configuration files and an extensible system of modules, which implement the separate simulation steps. Currently available modules include realistic charge carrier deposition using the Geant4 toolkit, propagation of charge carriers in silicon either using a drift-diffusion model or a projection onto the sensor implants, and a simulation of the detector front-end electronics including noise, threshold, and digitization. Detailed electric field maps imported from TCAD simulations can be used to precisely model the drift behavior of the charge carriers, bringing a new level of realism to the simulation of particle detectors.

The history of every simulated object, including the Monte Carlo truth information of the original ionizing radiation, is preserved and can be stored to file, allowing for a direct comparison with reconstructed position information.

The framework is written in modern C++ and comes with fully documented source code as well as an extensive user manual. Its modular approach allows for a flexible set-up of the simulation and facilitates the reuse of independent, well-tested algorithms.

This contribution provides an overview of the framework and its different simulation modules, and presents first comparisons with test beam data.

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Session Classification: Software & Simulation