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org.lcsim: A Java-based tracking toolkit

We describe a software toolkit for full event simulation and reconstruction in silicon tracking detectors. It features modular packages providing sophisticated simulations of the response of silicon detectors to the passage of charged particles. Sensor classes allow very detailed descriptions of charge carrier movement in silicon detectors: one can list the collecting, absorbing and reflecting regions, properties of silicon (doping, mobility, diffusion length, etc.), and electric and magnetic fields (including TCAD maps). After the charge carriers are generated and collected, the electronics simulation processes this into digital signals. We have defined an interface to specify how any such simulation should communicate with other parts of the package. Since details of signal processing are very sensor specific, it is anticipated that any sensor option will have its own class handling such processing, but we have implemented a number of readout technologies of interest to HEP detectors, such as CCDs and active pixel devices. Common to all the specific electronics simulation are the addition of electronics noise, propagation of the signal to readout, thresholding, and digitization of the signal. The final output is then a list of electronics channels with their corresponding ADC counts, and optionally the time for the signal, replicating the readout from a real detector. We also provide code for cluster finding, pattern recognition, track-finding and fitting, and analysis. The detector is defined by the same xml input files used for the Geant4 detector response simulation, ensuring that simulation and reconstruction geometries are always commensurate by construction.
We describe an easy-to-use software toolkit used to fully simulate all aspects of silicon trackers, from signal development in pixels and microstrips, through pattern recognition and track fitting, to analysis. Originally developed within the context of collider detector development for the ILC, it is being used by the Heavy Photon Search Detector, a fixed-target experiment at the Thomas Jefferson National Laboratory. We will describe its use and performance in a running experiment.

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