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Charge Transport Methods

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Charge transport simulation is at the heart of reproducing the response of pixel detectors. In the Allpix Squared framework charge transport is also considered as the primary component where the framework has been constructed around. This contribution aims to give an overview of the current capabilities for charge transport in Allpix Squared. The main goal is to show the different charge transport methods the frameworks offers, their configuration options and how to integrate those in various simulation flows. Furthermore, several visualization techniques are demonstrated that are helpful in gaining an understanding of the simulation. Finally, some parts of the design and implementation are discussed in more detail, to show the flexibility the framework offers for adaption to various applications.

Charge transport in a Monte-Carlo setting requires a balance between sufficient precision of the results and a reasonable computing time for a single event. For this purpose the framework provides two different propagation methods at the module level. First a projection propagation module, producing fast results under the constraints of a linear electric field and at the cost of precision, and a much more powerful and wider applicable generic propagation module that uses a fourth-order Runge-Kutta method to perform a drift-diffusion simulation with support for user-provided electric and magnetic fields. The generic propagation module has been highly optimized for fast simulations, without losing sight of usability and flexibility for both users and developers.

To support different simulation scenarios the framework allows using multiple propagation methods at the same time for different detectors in the setup. Some dummy configurations are discussed to display the power of this approach. And even if the current capabilities are not sufficient, the framework allows to easily add modifications as shown in a simple example.

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