Contribution ID: **6**   Type: **not specified**

Extending Allpix Squared to Optimise a Minimum Ionising Particle Generator

Friday 24 May 2024 10:50 (25 minutes)

Access to a source of minimum ionising particles (MIPs) is essential when developing detectors for particle physics. Efforts by MPhys students at Oxford's OPMD group have led to a low-cost functioning MIP generator, built from a strontium-90 beta source and magnetic dipole filter.

Allpix Squared was an obvious choice to model optimising changes, for instance varying the magnetic field strength, or the filtering chamber's entrance and exit collimation. However, the framework's interface with other elements of our open-source simulation chain was mixed. Whilst geometry definitions from FreeCAD could already be imported in GDML format, the ability to load a spacially-varying magnetic field did not exist.

We extended the framework's MagneticFieldReader module to allow this functionality, along with making modifications to the DepositionGeant4 module to store a particle's energy as it arrives at (or is created within) a sensor. Modifications to bias the emission direction of a radioactive source were also used to reduce compute time.

Results of simulating the MIP generator match our broad expectations from a basic analytic evaluation, whilst preliminary experimental comparisons using a Timepix3 detector have shown some agreement, but need further investigation. Overall, this work has enabled modifications to the MIP generator that resulted in an improved output purity, and a greatly-increased throughput.

Will the talk be given in person or remotely?

In person

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Session Classification: New features and developments

Track Classification: Developments