APSQ BTTB12 Tutorial

Introduction

This is a set of training tasks/milestones we invite you to accomplish during this tutorial to explore features of the Allpix^2 framework. For detailed follow-along instructions for each step, please refer to slides.

Task 0: preparation

Have a working installation of Allpix^2 on your machine.

1. Install the framework in one of the suggested ways.
2. Run the `allpix` executable without any flags to see if it is properly installed. A short help message in the terminal will be displayed if the installation is present.

Task 1: basic simulation setup

Build a basic simulation of a Timepix detector, exposed to a 5 GeV electron beam.

1. Familiarize yourself with the structure and syntax of framework configuration files.
2. Review the setup geometry file (`tutorial-geometry.conf`) and the built-in description of the Timepix detector (`/path/to/allpix/models/timepix.conf`).
3. Review the template for the main configuration file for your simulation (`first-simulation.conf`).
4. Complete the main configuration with all the required parameters that describe the simulation. Refer to the slides and to the docs: allpix-squared.docs.cern.ch/docs/08_modules/
5. Run the simulation!
6. Look through the simulation results with a ROOT browser (`$ rootbrowse output/modules.root`). Discuss with tutors and/or peers.

Task 2: optimizing spatial resolution

Use the simulation from Task 1 to see how detector resolution is affected by external factors, such as the angle of particle incidence and magnetic field.

1. Find out how to determine spatial resolution of the detector based on the framework outputs.
2. Study how the resolution is affected if particles traverse it at an angle by running the simulation several times, varying the beam incidence angle. You can change the angle by either changing detector orientation in the geometry file or by changing beam parameters in the main configuration file.
3. Study how the resolution is affected if magnetic field persists. You can add magnetic field by introducing a `[MagneticFieldReader]` section in the main configuration.
   See allpix-squared.docs.cern.ch/docs/08_modules/magneticfieldreader
4. Discuss your results with tutors and/or peers.

Task 3: TCAD Interface

Learn how to import and use TCAD electric fields in the Allpix^2 framework. Study the behaviour of charge carriers in a custom electric field.

1. Convert the TCAD mesh into a regular mesh using the mesh_converter tool (`convert.conf`).
2. Plot the resulting fields using the mesh_plotter.
3. Fix any issues in the field orientation by modifying the `convert.conf` file and using the mesh_converter again.
4. Add the fields into your new configuration: `tcad-field-simulation.conf` and enable linegraphs in the `GenericPropagation` module.
5. Plot the linegraphs and discuss what is being shown. Make changes in the `GenericPropagation` module accordingly, run the simulation again and plot the results.

Task 4: running your simulation in parts

Learn how to optimize running and rerunning your simulation pipeline by executing only selected parts and storing progress in between.

1. Review Part 1 of the pipeline: `tutorial-store.conf`. It stops right after simulating raw electric signal on detector electrodes.
2. Review the template of Part 2: `tutorial-replay.conf`. It picks up intermediate results from Part 1 and runs simulation of signal digitization on this data.
3. Complete the configuration for Part 2 with all the required parameters that describe the simulation.
4. Run Part 1 and Part 2 consequently. Compare execution time.