Charged particle tracking and event reconstruction for the IR3 test

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22-09-27

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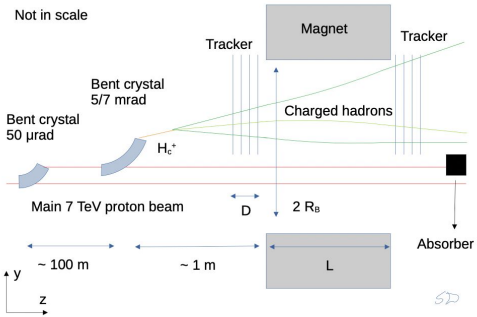
IR3 Setup

- extract protons from LHC beam using first crystal
- channel charm hadrons with second crystal
- use available correction magnet at IR3 as a spectrometer
- put tracking stations in front and behind the magnet

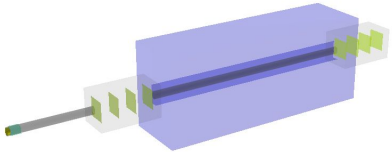


taken from Elisabetta's slides

IR3 Simulation

- large amount of work already put into design studies of the setup using parametric simulations
- next step is a full simulation of the setup with realistic description of effects from material interactions and reconstruction effects (see also Han Miao's talk)
- can detector concept cope with backgrounds from
  - ghost tracks
  - combinatorial background
  - misidentified decays
  - decays with missing particles

to check this, we need to simulate the full chain from particle production over detector response to event reconstruction



Track Reconstruction Framework

Our Reconstruction Framework needs as input

- the detector hits
- the tracking geometry (and its resolution)
- the magnetic field configuration
- the detector material

In order to process these information into tracks and vertices of the reconstructed particles, it needs

- a track model for propagation
- a track fitter to extract track parameters from the hits
- a vertex fitter to reconstruct the primary and secondary vertices

Two candidates for track reconstruction framework

GenFit

- developed for Belle2, focussed purely on the track fitting itself
- tracking geometry by hand or from TGeo
- track propagation and fitting
- no seed finding implementation
- no vertexing

Acts

- developed from ATLAS tracking, providing high-level reconstruction modules "usable in any tracking detector"
- different options to implement tracking geometry (by hand, from TGeo or via DD4hep)
- track propagation and fitting
- seed finding
- vertexing

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but the devil is in the details!
°requires dd4hep description to have endcap-barrel-endcap structure of general purpose detectors
† assumes cylindrical setup
††not looked into yet

Acts

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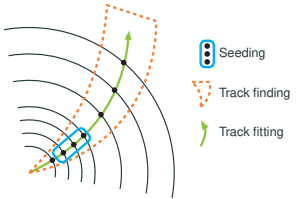
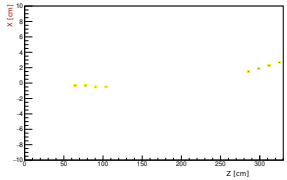
- different options to implement tracking geometry (by hand, from TGeo or via DD4hep)°
- track propagation and fitting
- seed finding †
- vertexing ††

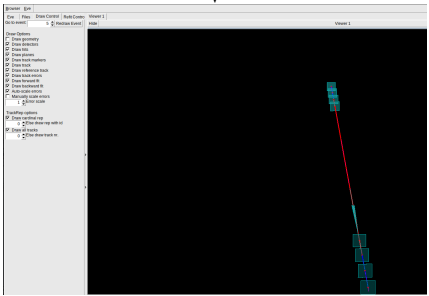


GenFit First Test

- implement track fitting of truthmatched events (can skip seed-finding step)
- use minimum bias events from full IR3 detector simulation
- build from Miao's IR3 test analysis framework
- implement very basic tracking geometry and ignore material effects

first fits are working!
but still a lot of things to do





Conclusion

- Need full detector simulation to check detector setup
- Framework for particle reconstruction is being developed
- Two tracking frameworks considered, both have pros and cons
- Acts
  - DD4hep plugin of Acts would be very convenient (same geometry in tracking and simulation), but seems to be too fixated on ATLAS-like geometry
  - lots of functionality, but do we need all these features for our relatively simple setup?
- GenFit
  - easier start
  - less functionality

Decision not final yet, need to investigate what is really needed