

# PndPropagator

A propagator interface for PandaROOT

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# Motivation

- Issues with GEANE (see Tobias Stockmanns' presentation)
- Refactoring of PndPidCorrelator: possibility to exchange propagation mechanism in correlation of tracks and hits
  - For **each** pid detector propagator can be set **separately**
  - Started work on helix propagator for EMC: parts already existed but not well documented
- Problem: FairPropagator cannot be used as base class for propagator
  - Update of FairPropagator but no subsequent update of FairGeanePro
  - Missing some functions used in FairGeanePro, most importantly SetPoint()

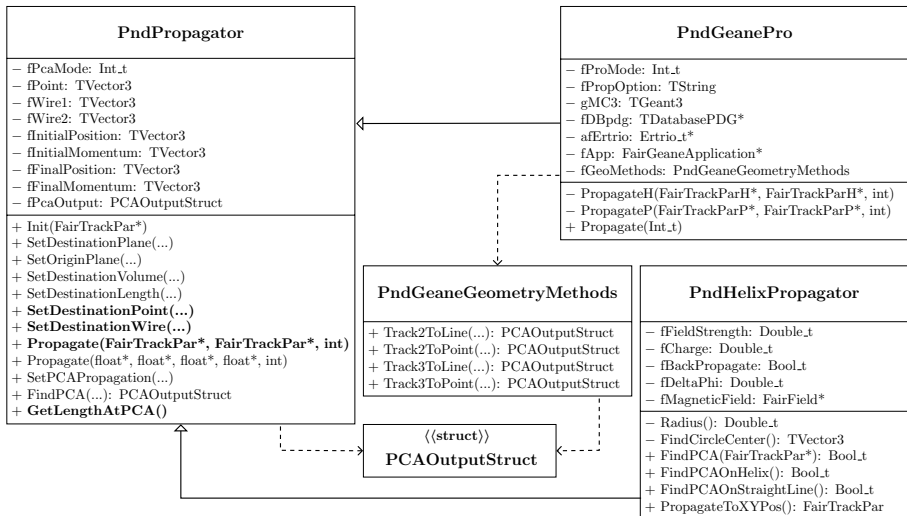


# General idea of PndPropagator

- Easier to work on stand-alone PndPropagator than to redesign FairPropagator
  - Risk of breaking anything minimized: no influence on other experiments using FairROOT
  - Independent of FairROOT: previous changes in FairPropagator made it very complicated to use as base class
- Refactor FairPropagator and FairGeanePro and call them PndPropagator and PndGeanePro, respectively
  - Add attributes and methods to PndPropagator
  - Cleanup PndGeanePro and make it more readable
  - Add PndHelixPropagator class (derived from PndPropagator)
- Idea: PndPropagator used as interface, can be replaced by any propagator
  - PndGeanePro, PndHelixPropagator, PndAnotherFancyNewPropagator, ...



# PndPropagator



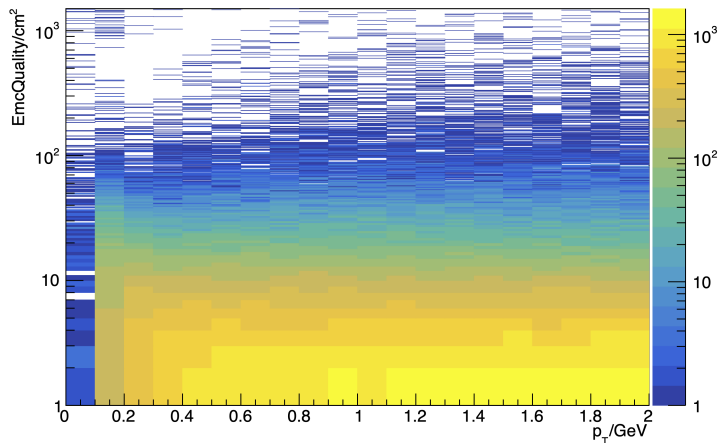
# PndHelixPropagator

- PndHelixPropagator assumes simple helix shape of track
  - Finds point of closest approach (PCA) on helix to target point
  - Transforms momentum vector to match orientation on helix in PCA
  - Compare to GEANE: considers energy loss, has different approach to finding PCA
- Enable new propagators in PndPidCorrelator
  - Use PndGeanePro and PndHelixPropagator in EMC and compare
  - Simulate electrons (box generator), run digitization and reconstruction (in ideal mode)
  - Run PndPidCorrelator on simulated data, check precision and performance of propagation methods
- **Important:** PndHelixPropagator still work in progress, the following results are preliminary



# Results for simulated electrons - EmcQuality distribution

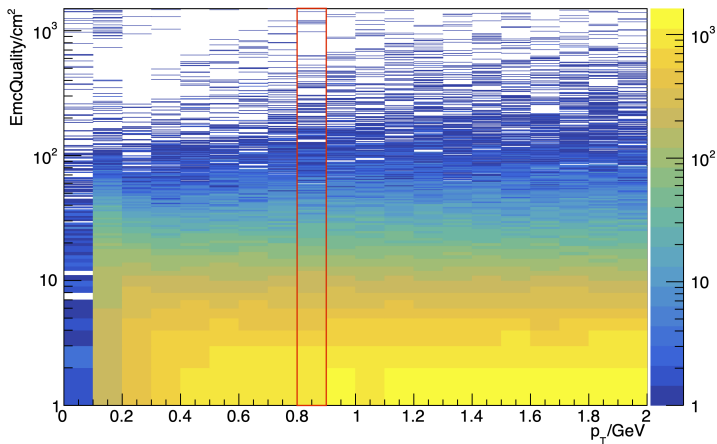
EMC quality distribution for electrons and helix propagator



- $\text{EmcQuality} = (\vec{r}_{\text{prop}} - \vec{r}_{\text{hit}})^2$

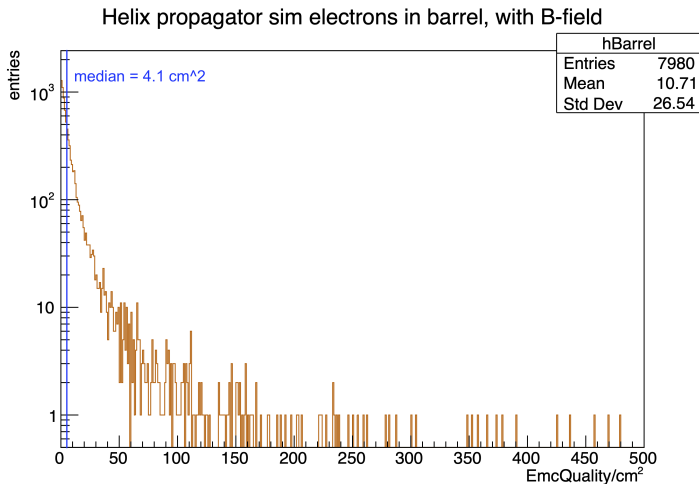
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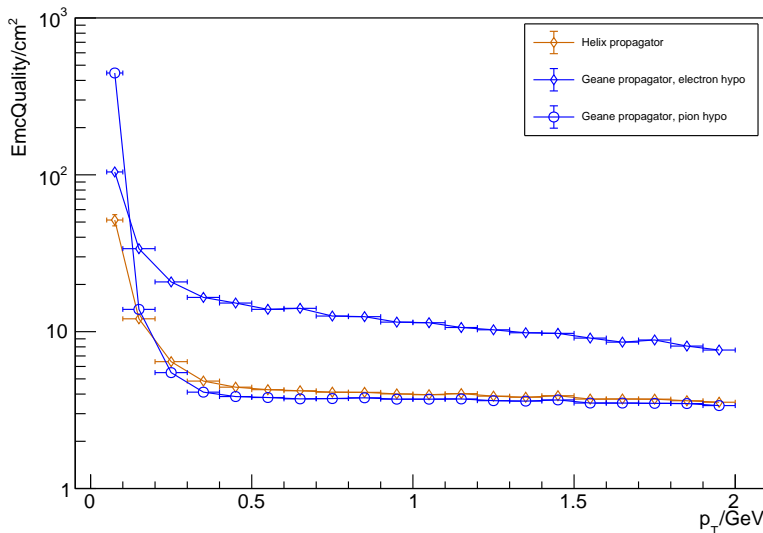


- $$\text{EmcQuality} = (\vec{r}_{\text{prop}} - \vec{r}_{\text{hit}})^2$$

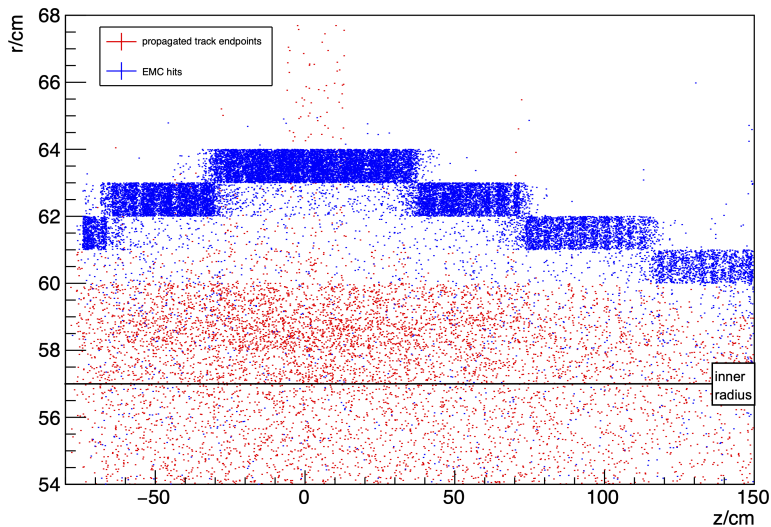


# Results for simulated electrons - Median distribution

Median of EMC quality distribution for simulated electrons in barrel, with B-field

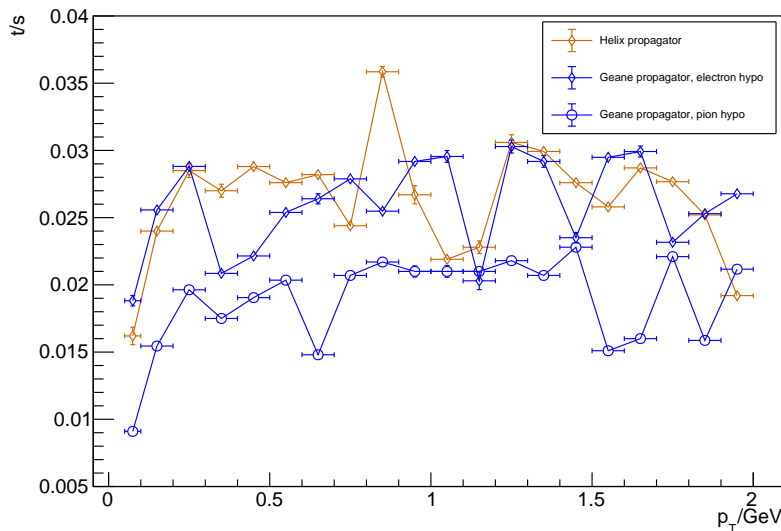


# Geane propagation with electron hypothesis



# Performance

Average runtime: sim electrons, with B-field

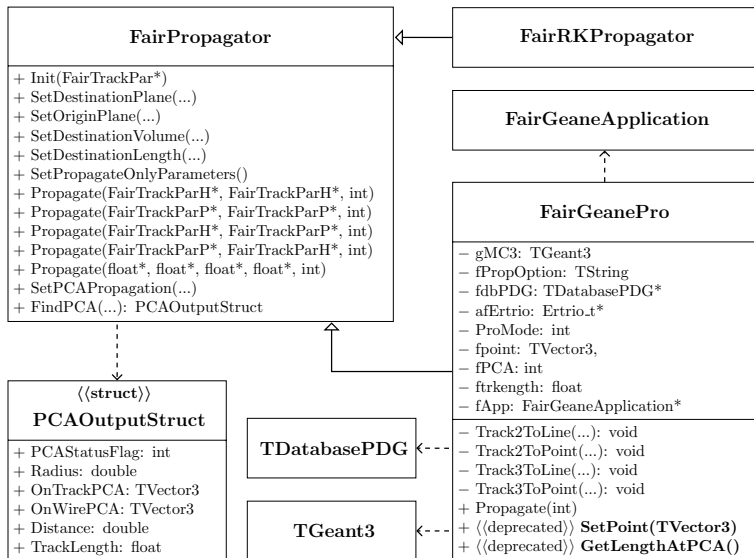


# Summary

- `PndHelixPropagator` needs to be optimized for speed
  - Root finding algorithm used in calculation of PCA too slow
  - Investigate other components of propagator
- Advice on using `FairPropagator` or `PndPropagator`
  - Use `PndGeanePro` with pion hypothesis or `PndHelixPropagator` with electron hypothesis for electrons
  - If you need very quick propagator: straight line propagator
- Out of context: I tried to use code from `RhoVtxPoca` in `PndHelixPropagator` to find PCA but it was very complicated to reuse.
  - General problem in PandaROOT: code without documentation, code not reusable, doubling of code, ...

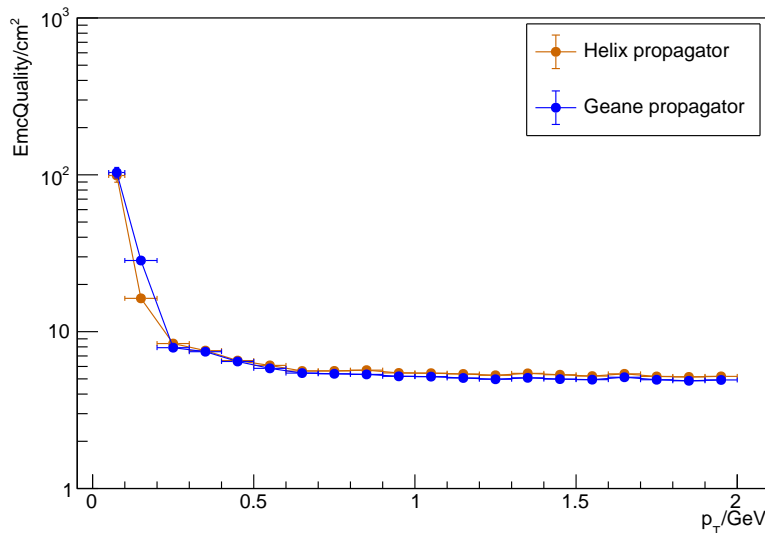


# FairPropagator



# Results

Median of EMC quality distribution for simulated pions in barrel, with B-field



# Performance

Average runtime: sim pions, with B-field

