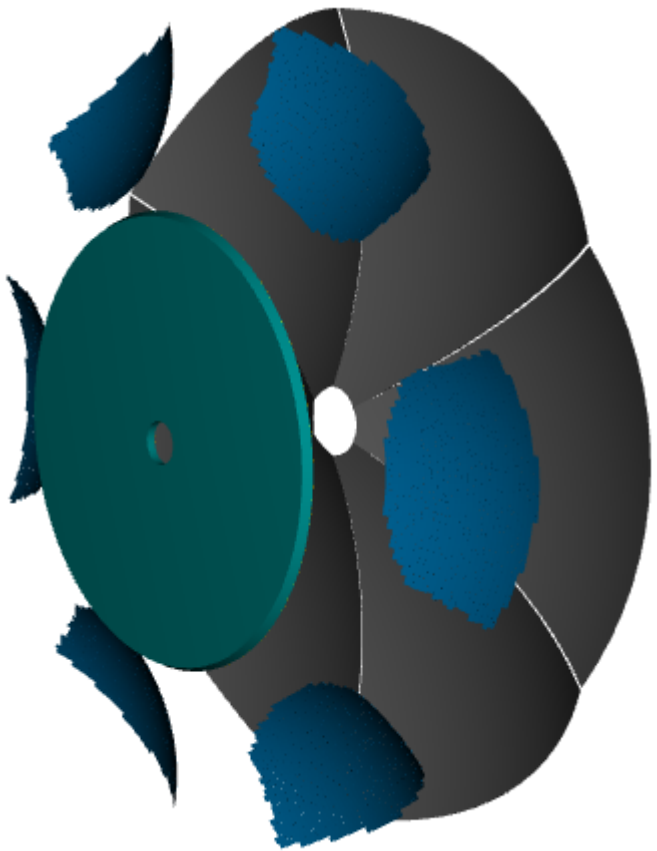
EPIC dRICH Simulation Status

- October production readiness
  - Geometry + Simulation
  - Reconstruction
- Reconstruction status
  - IRT
  - EICrecon integration plan
  - Track reconstruction
- pfRICH Status

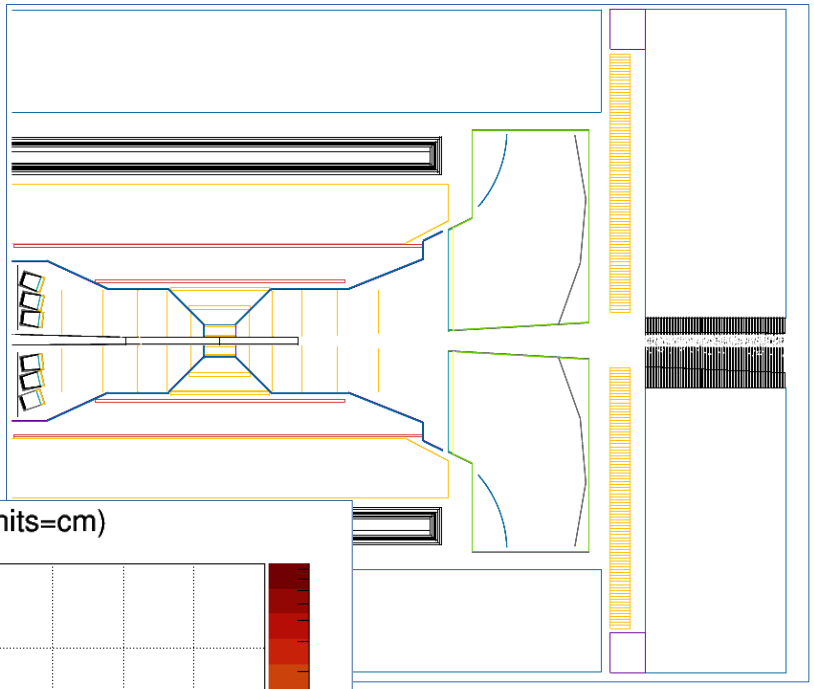
Christopher Dilks
dRICH Simulation Meeting
19 October 2022

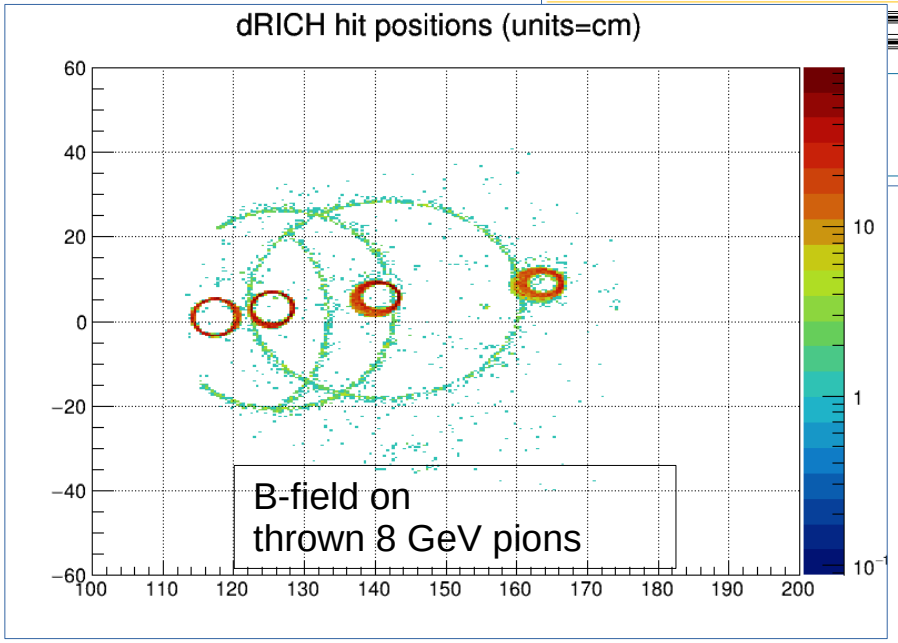
October Production Readiness: Simulation



Ready!

- Geometry consistent with menagerie
- Optics as good as ATHENA was





October Production Readiness: Reconstruction

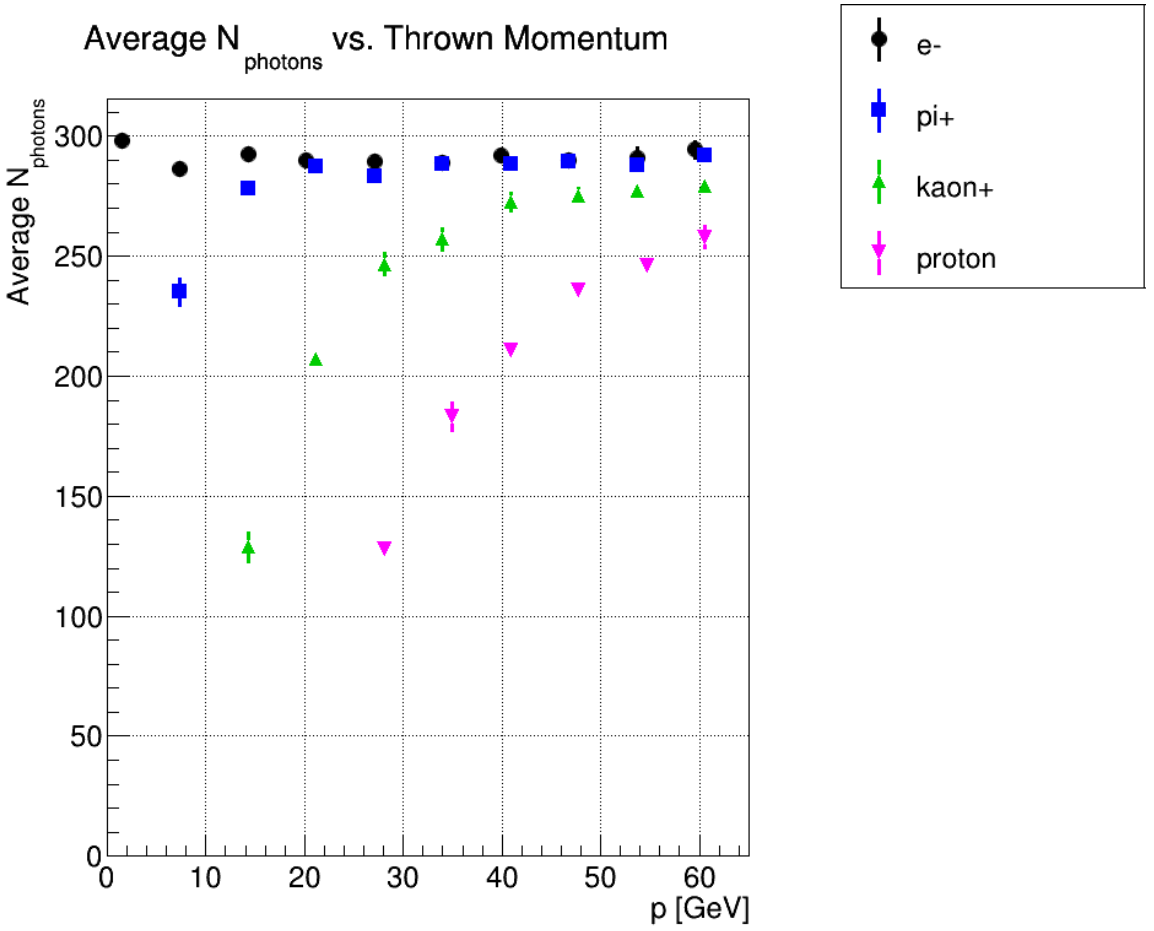
Two “modules” for reconstruction:

- Standalone Indirect Ray Tracing (IRT) library – **Ready!**
- Bindings of IRT to Reconstruction Framework
  - Working well, but with “**scaffolding**”:
    - Reliance on true photons → very large output files
    - TODO: use reconstructed tracks, rather than MC truth
  - TODO: In Juggler,, needs to be in EICRecon
    - High priority, if we want PID in the full campaign
    - Short term: parameterizations (see later slide)

- **Reconstruction Readiness Readiness:**
  - In good shape for small-statistics studies and benchmarks
  - For a full campaign, we need to take down the scaffolding, and bind to EICRecon (in progress...)

Reconstruction: Indirect Ray Tracing

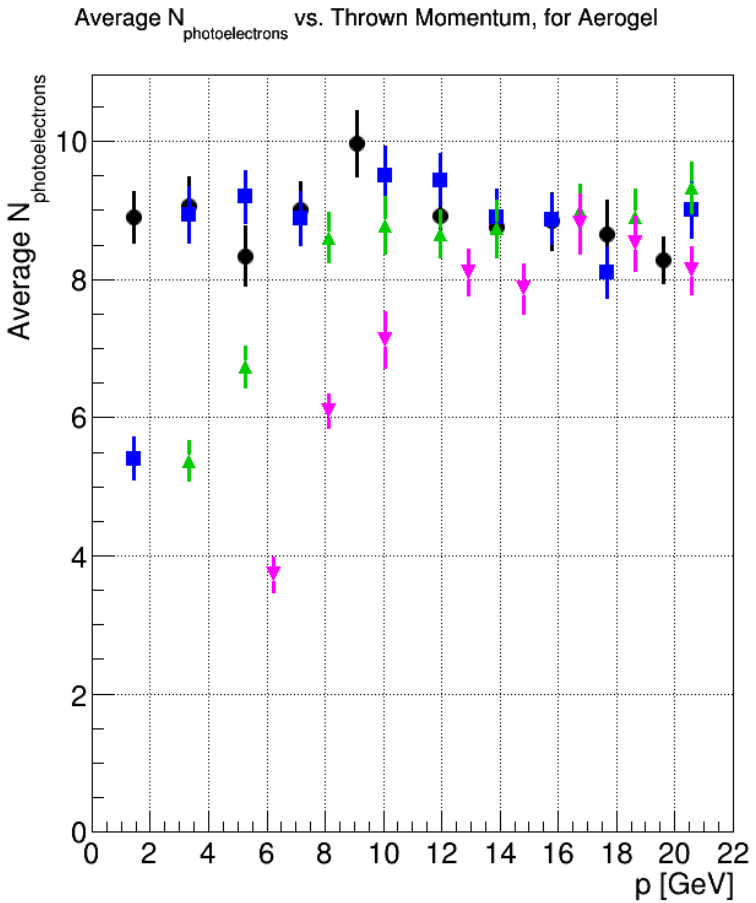
$N_{photon\text{-}hits}$
Total number of photons incident on sensors

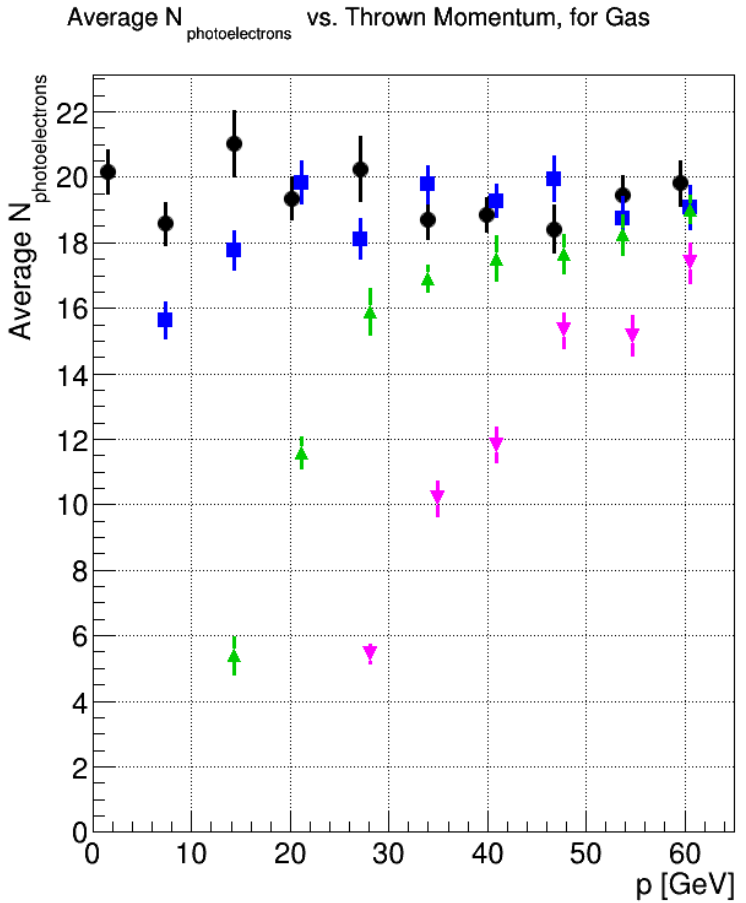


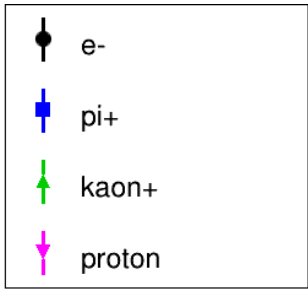
Reconstruction: Indirect Ray Tracing

$N_{photoelectrons} = N_{photon\text{-}hits}$, reduced by:

- Quantum Efficiency
- Safety factor of 70%
- Gaps between sensor pixels



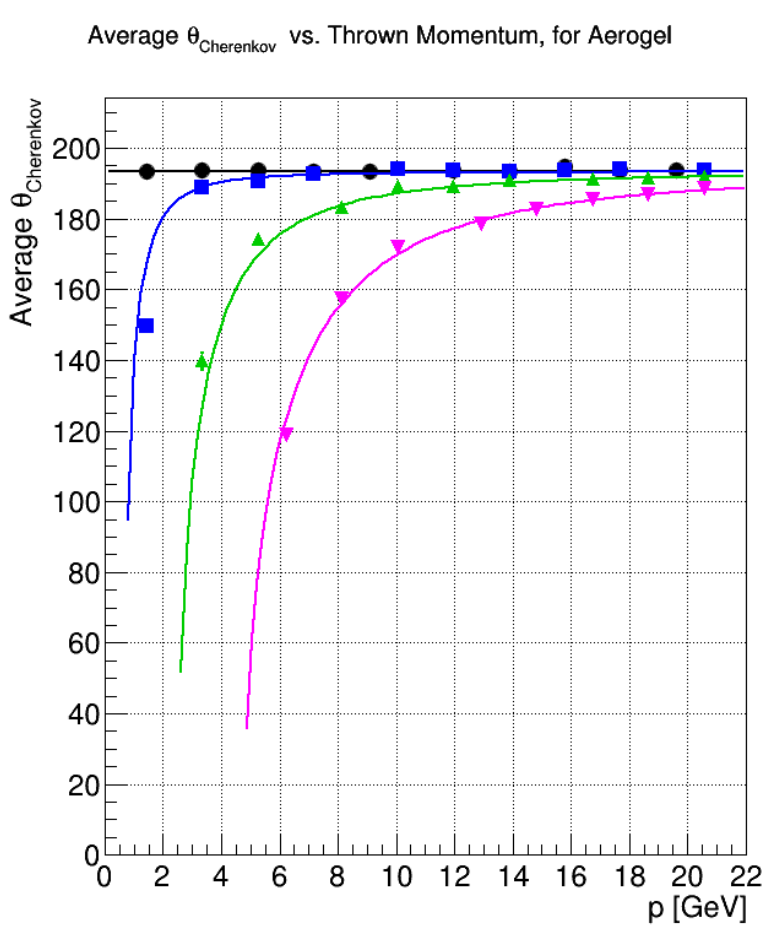


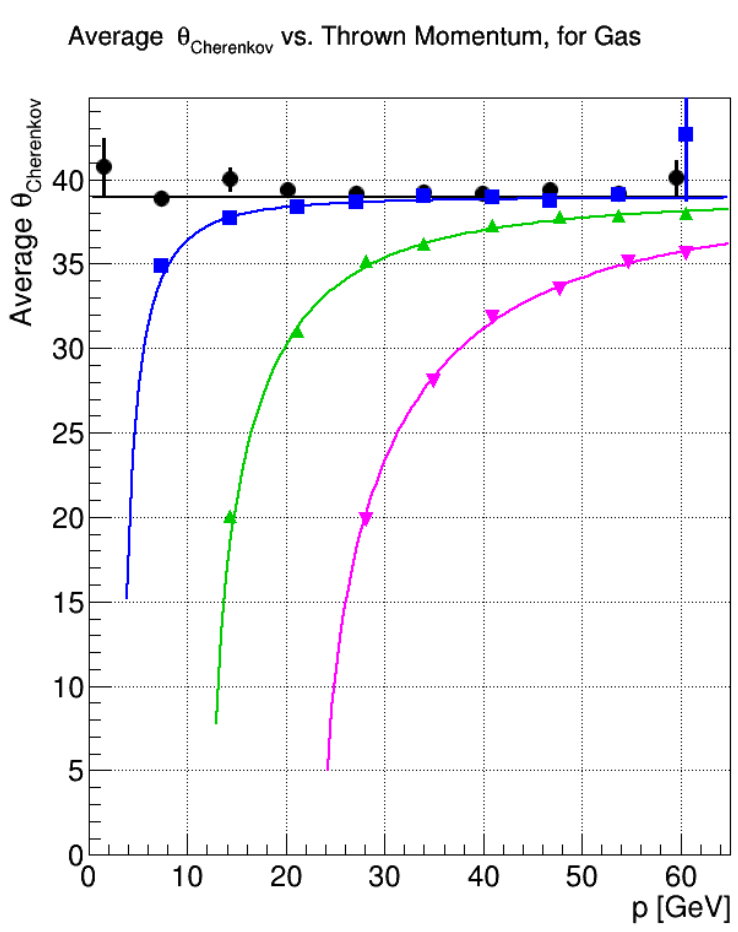


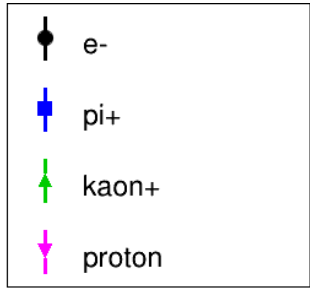
Reconstruction: Indirect Ray Tracing

Points: reconstructed Cherenkov Angle

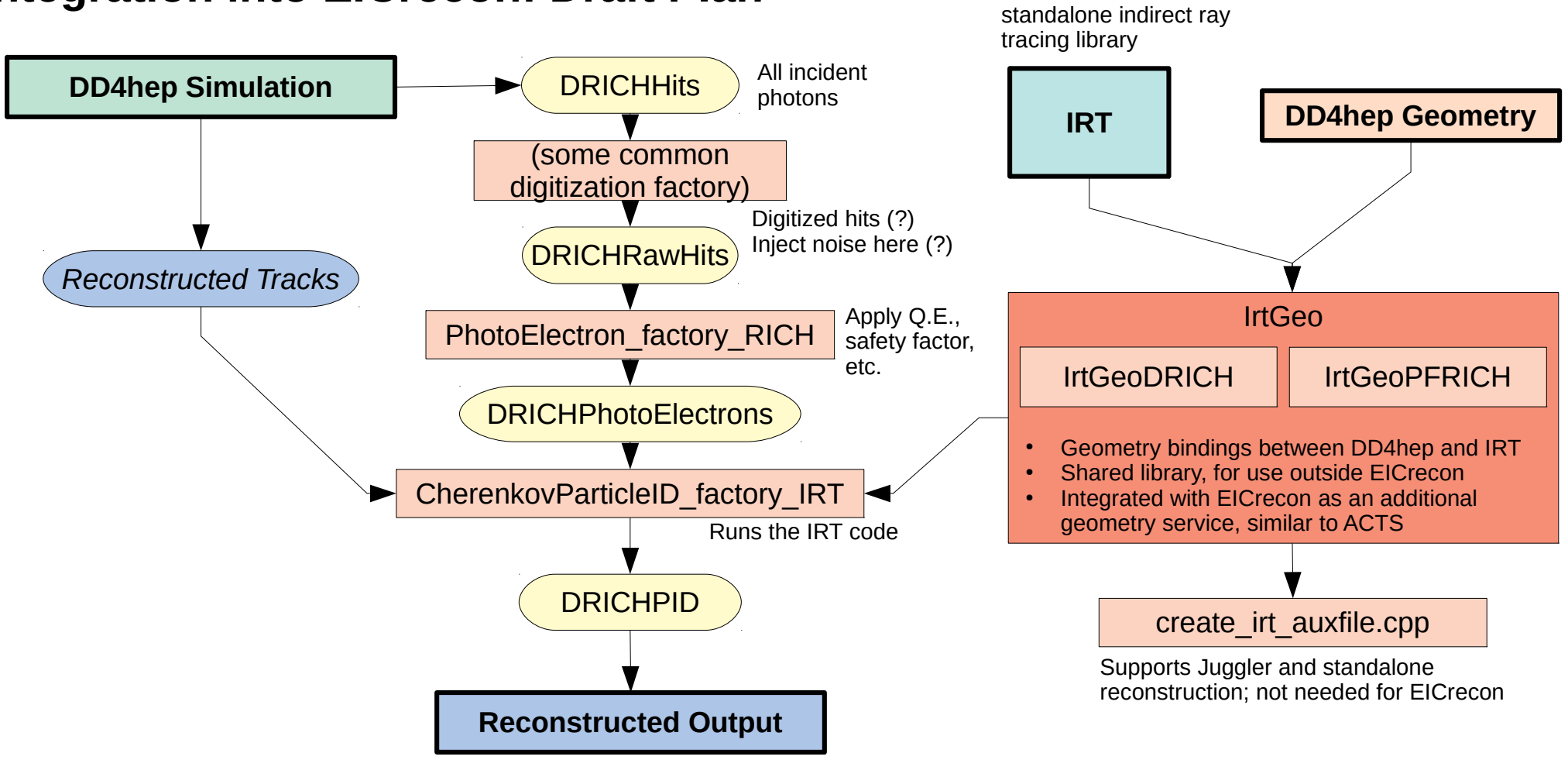
Curves: expected Cherenkov angle







Integration into EICrecon: Draft Plan



Tracking Information

- **Use track reconstruction**
  - Ideal, and realistic
  - Need to figure out how to use tracking information

- **Radiator hits in Z-slices**
  - Seems useful, in absence of track reconstruction
  - Surprisingly easier said than done, would need to split the dRICH into 2 detectors, with 2 different sensitivity types https://github.com/eic/epic/pull/230

- **MCParticles**
  - Use “photon pinning” to get their emission vertices
  - Issues with magnetic field?
  - This is the current method in the Juggler implementation

Parameterizations, e.g., for Delphes

- We have some code to generate Delphes cards (TCL) for dRICH, pfRICH, BTOF, and DIRC, maintained by Alexander
- This is “easy to update” for EPIC
- Would automatically be usable in fast simulations, and could be integrated into full simulation analysis code
  - But it would be better to have the PID integrated in EICrecon!

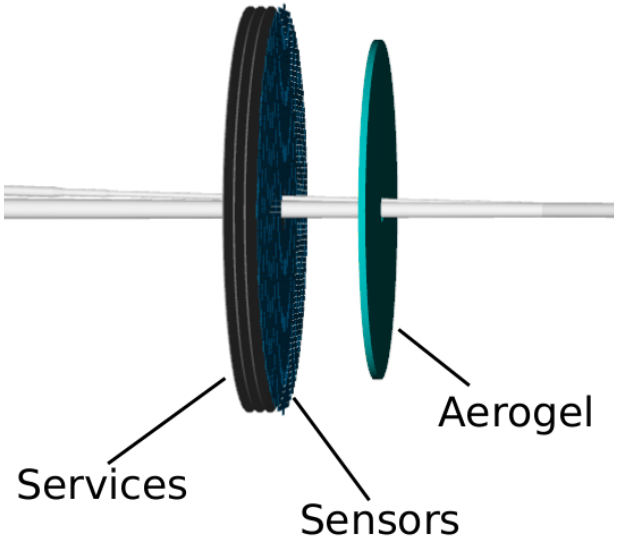
```
module IdentificationMap dualRICH_aerogel {
  set InputArray TrackMerger/tracks
  set OutputArray tracks

    add EfficiencyFormula {211} {211} {
      (eta<  1.20 || eta>=  3.60 || pt * cosh(eta) <    0.90 || pt * cosh(eta) >=   27.00) * (  0.00 ) +
      (  1.20 <= eta && eta <   1.60) * (   0.90 <= pt * cosh(eta) && pt * cosh(eta) <    1.40) * (1.000000) +
      (  1.20 <= eta && eta <   1.60) * (   1.40 <= pt * cosh(eta) && pt * cosh(eta) <    2.90) * (1.000000) +
      (  1.20 <= eta && eta <   1.60) * (   2.90 <= pt * cosh(eta) && pt * cosh(eta) <    4.20) * (1.000000) +
      (  1.20 <= eta && eta <   1.60) * (   4.20 <= pt * cosh(eta) && pt * cosh(eta) <    5.50) * (1.000000) +
      (  1.20 <= eta && eta <   1.60) * (   5.50 <= pt * cosh(eta) && pt * cosh(eta) <   10.00) * (1.000000) +
      (  1.20 <= eta && eta <   1.60) * (  10.00 <= pt * cosh(eta) && pt * cosh(eta) <   15.00) * (0.998910) +
      (  1.20 <= eta && eta <   1.60) * (  15.00 <= pt * cosh(eta) && pt * cosh(eta) <   20.00) * (0.957014) +
      (  1.20 <= eta && eta <   1.60) * (  20.00 <= pt * cosh(eta) && pt * cosh(eta) <   27.00) * (0.830642) +
      (  1.60 <= eta && eta <   2.00) * (   0.90 <= pt * cosh(eta) && pt * cosh(eta) <    1.40) * (1.000000) +
      (  1.60 <= eta && eta <   2.00) * (   1.40 <= pt * cosh(eta) && pt * cosh(eta) <    2.90) * (1.000000) +
      (  1.60 <= eta && eta <   2.00) * (   2.90 <= pt * cosh(eta) && pt * cosh(eta) <    4.20) * (1.000000) +
      (  1.60 <= eta && eta <   2.00) * (   4.20 <= pt * cosh(eta) && pt * cosh(eta) <    5.50) * (1.000000) +
      (  1.60 <= eta && eta <   2.00) * (   5.50 <= pt * cosh(eta) && pt * cosh(eta) <   10.00) * (1.000000) +
      (  1.60 <= eta && eta <   2.00) * (  10.00 <= pt * cosh(eta) && pt * cosh(eta) <   15.00) * (0.999636) +
      (  1.60 <= eta && eta <   2.00) * (  15.00 <= pt * cosh(eta) && pt * cosh(eta) <   20.00) * (0.955691) +
      (  1.60 <= eta && eta <   2.00) * (  20.00 <= pt * cosh(eta) && pt * cosh(eta) <   27.00) * (0.821828) +
      (  2.00 <= eta && eta <   2.40) * (   0.90 <= pt * cosh(eta) && pt * cosh(eta) <    1.40) * (1.000000) +
      (  2.00 <= eta && eta <   2.40) * (   1.40 <= pt * cosh(eta) && pt * cosh(eta) <    2.90) * (1.000000) +
      (  2.00 <= eta && eta <   2.40) * (   2.90 <= pt * cosh(eta) && pt * cosh(eta) <    4.20) * (1.000000) +
```

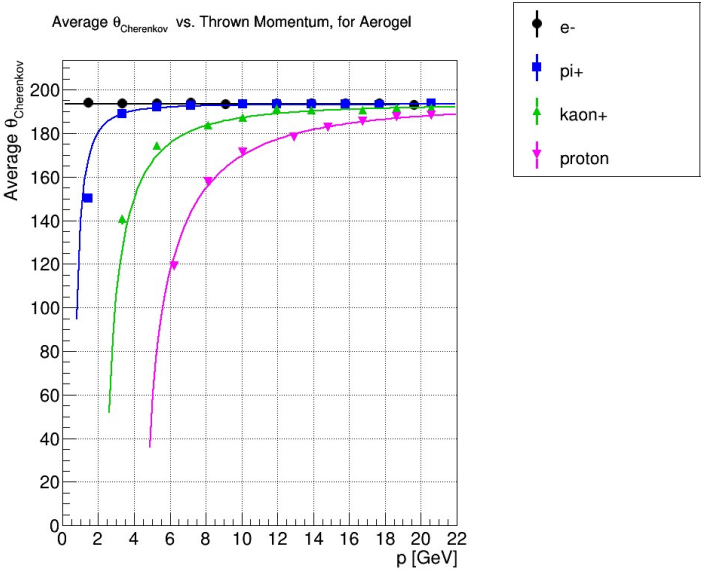
pfRICH

- ***Significant*** **code overlap between pfRICH and dRICH**
  - Synergy opportunity with pfRICH group
  - From the code, the pfRICH is just a much simpler dRICH
  - dRICH devs should focus on the dRICH, but many tasks are common between the two detectors

- **Recent work: Synchronized all development with dRICH**
  - Rescaled Geometry
  - Checked all material properties
  - Updated readout
  - Connected geometry and IRT code → reconstruction works (for aerogel, not yet for gas blobs)
  - Generalized our development helper scripts in drich-dev

- **Current issue**
  - We will run EPIC with 2 configurations: one with mRICH and another with pfRICH
  - Getting both to work is a bit of a challenge (see our long, draft PR)





EPIC Configurations*

- **Version A “Arches”:**
  - Standard silicon tracker
  - **2 MPGD barrel planes** (second behind DIRC)
  - **No MPGD plane behind dRICH**
  - Standard dRICH & DIRC
  - **mRICH**
  - Standard forward/backward calorimetry and barrel HCal
  - **SciGlass bECal**
  - Standard FF and FB
  - Standard TOF?
  - **No calorimeter insert**

- **Version B “BryceCanyon”:**
  - Standard silicon tracker
  - **1 MPGD barrel plane** (no plane behind DIRC)
  - **+ MPGD plane behind dRICH**
  - Standard dRICH & DIRC
  - **pfRICH**
  - Standard forward/backward calorimetry and barrel HCal
  - **Imaging bECal**
  - Standard FF and FB
  - Standard TOF? Or no TOF?
  - **+Calorimeter insert?**

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* might not be the most up-to-date configuration, but this gives the idea

The dRICH is in both, but the pfRICH is only in BryceCanyon

Project Page

https://github.com/orgs/eic/projects/4/

Where all the EPIC dRICH (and pfRICH) simulation software activity has been happening…

New Meeting Time Poll

https://www.when2meet.com/?17174145-urUaG