EPIC dRICH Reconstruction Update

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dRICH Reconstruction Meeting

7 September 2022

dRICH Sensitive Detector type

- **December 2021**
  - Type: photoncounter
  - Action: PhotoMultiplierSDAction
- **Interim between ATHENA/ECCE & EPIC**
  - Type changed to: tracker
  - Action: TrackerAction
    - Compatibility with upstream data model and DD4hep actions: everything is tracker or calorimeter
- **Now: EPIC**
  - Type remains as: tracker
  - Action OpticalTrackerAction
    - “NEW” for the upstream, but it’s basically what we had in December: PhotoMultiplierSDAction

DD4hep PR: https://github.com/AIDASoft/DD4hep/pull/967/files
Already in `eic-shell` (?)

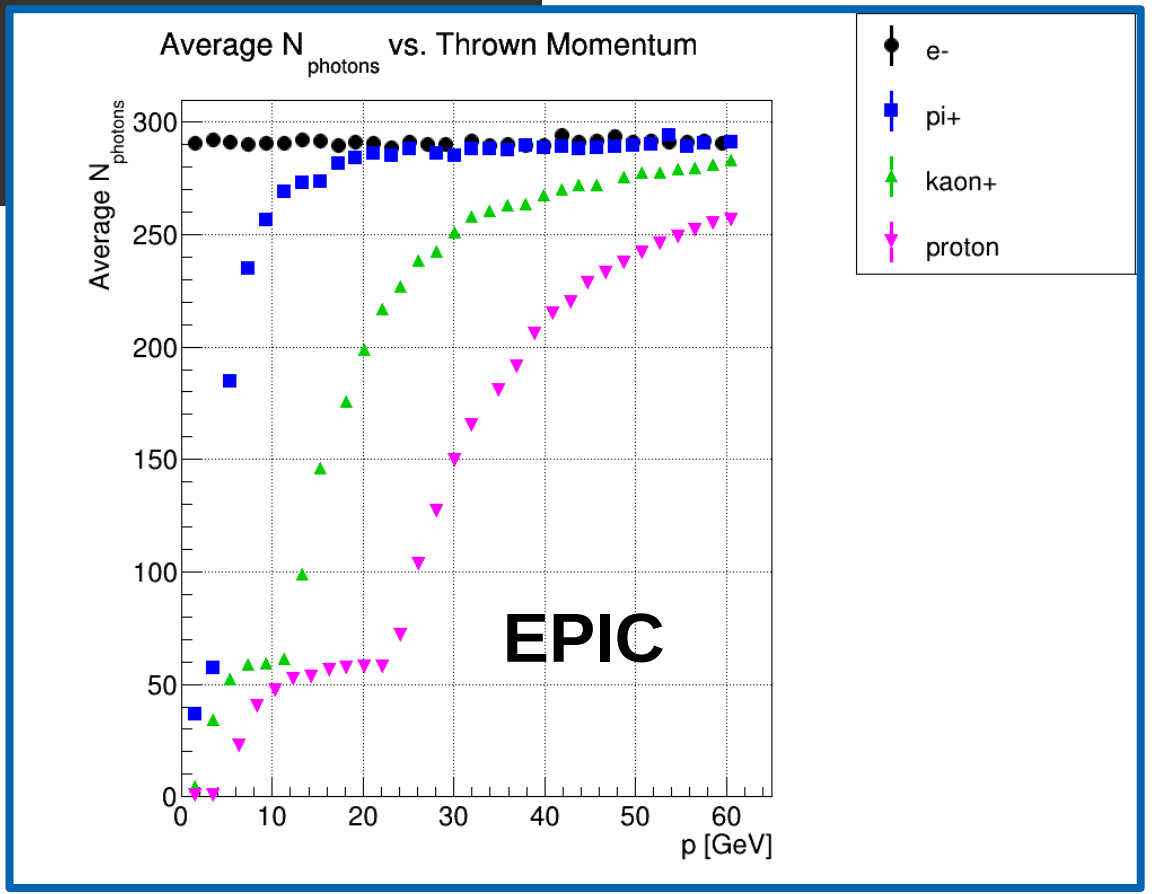
```
 29    template <> bool
 28    Geant4SensitiveAction<Geant4OpticalTracker>::process(const G4Step* step,G4TouchableHistory* /* hist */) {
 27      G4Track * track =  step->GetTrack();
 26      typedef Geant4Tracker::Hit Hit;
 25      Geant4StepHandler h(step);
 24      Position prePos    = h.prePos();
 23      Position postPos   = h.postPos();
 22      Position direction = postPos - prePos;
 21      Position position  = mean_direction(prePos,postPos);
 20      double   hit_len   = direction.R();
 19
 18      Hit* hit = new Hit(h.trkID(), h.trkPdgID(), h.deposit(), h.track->GetGlobalTime());
 17      HitContribution contrib = Hit::extractContribution(step);
 16      hit->cellID        = cellID(step);
 15      hit->energyDeposit = contrib.deposit;
 14      hit->position      = position;
 13      hit->momentum      = 0.5*( h. preMom() + h.postMom() ) ;
 12      hit->length        = hit_len;
 11
 10      ///// main difference from TrackerAction ////////////////////////////////////
  9      if (track->GetDefinition() != G4OpticalPhoton::OpticalPhotonDefinition()) {
  8        track->SetTrackStatus(fStopAndKill);
  7      }
  6      ////////////////////////////////////////////////////////////////////////////
  5
  4      collection(m_collectionID)->add(hit);
  3      mark(h.track);
  2      if ( 0 == hit->cellID )  {
  1        hit->cellID      = volumeID( step ) ;
197        except("+++ Invalid CELL ID for hit!");
DDG4/plugins/Geant4SDActions.cpp [+]                                  197,1         21%
```

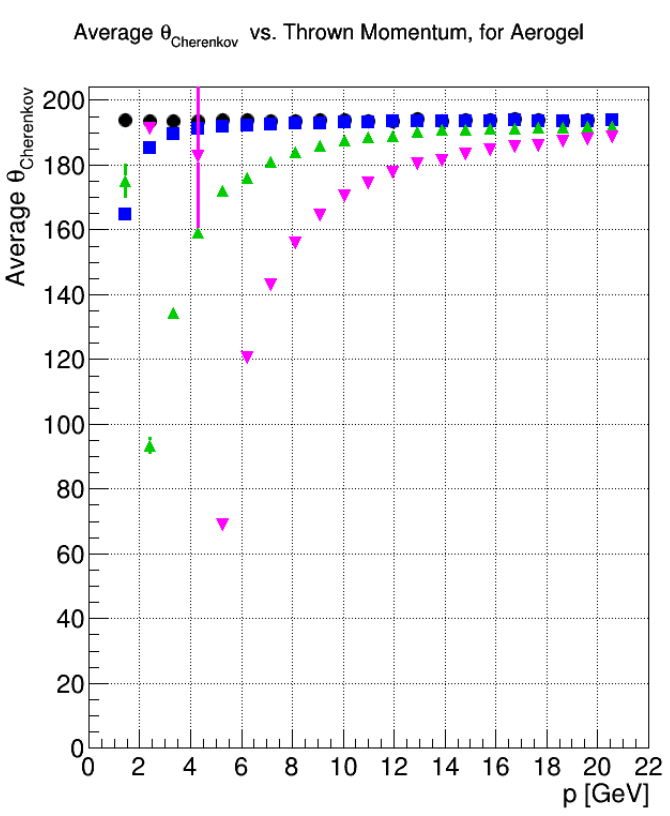
So we have it written down in another place, for a 40 GeV pion aimed at the center of the acceptance, we get the following approximate average numbers of RAW dRICH hits:

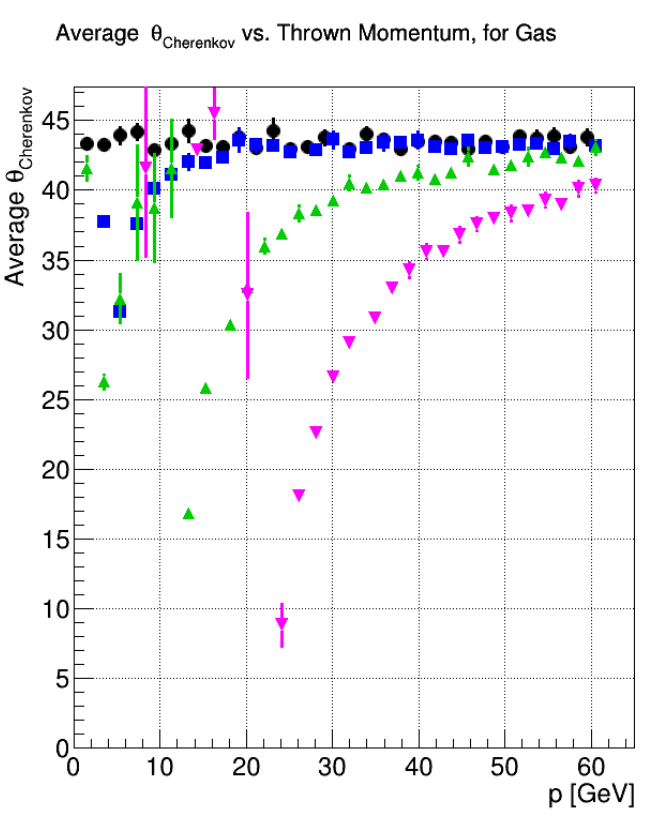
- EPIC: 290

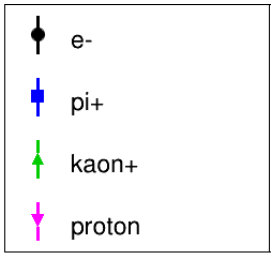
- ATHENA: 320

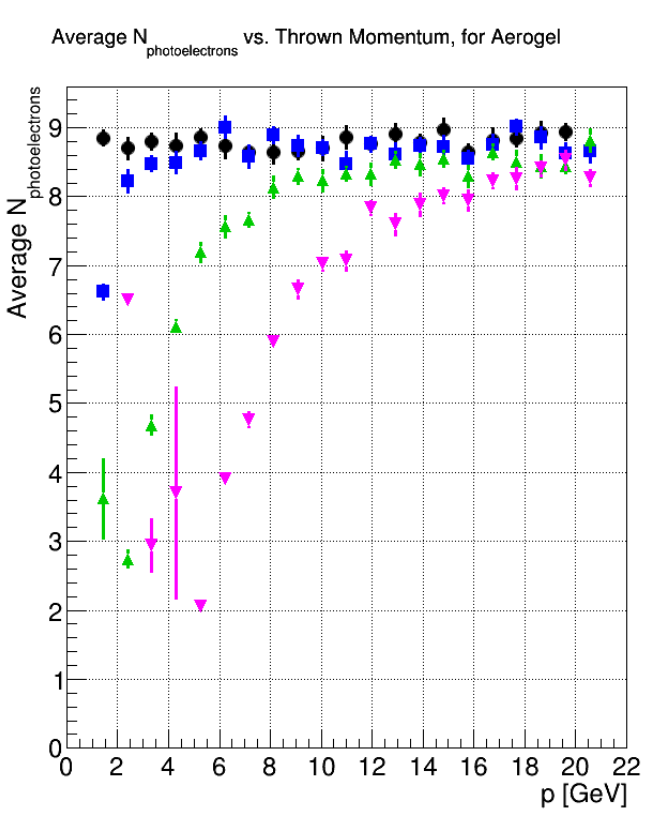
Finally seeing the “expected” number of hits… maybe too many!

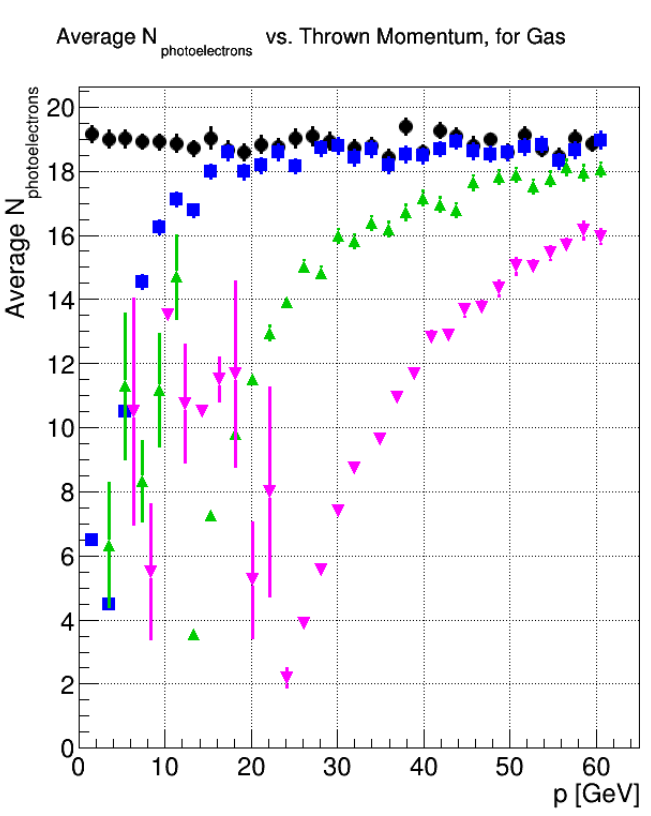


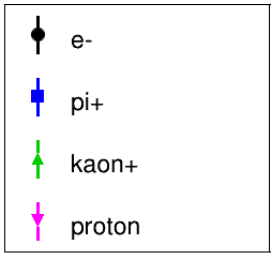

Average θCherenkov vs. Thrown Momentum, for Aerogel
Average θCherenkov
p [GeV]
0
20
40
60
80
100
120
140
160
180
200
0
2
4
6
8
10
12
14
16
18
20
22


Average θCherenkov vs. Thrown Momentum, for Gas
Average θCherenkov
p [GeV]
0
5
10
15
20
25
30
35
40
45
0
10
20
30
40
50
60


e-
pi+
kaon+
proton


Average N photoelectrons vs. Thrown Momentum, for Aerogel
Average N photoelectrons
p [GeV]
0
1
2
3
4
5
6
7
8
9
0
2
4
6
8
10
12
14
16
18
20
22


Average N photoelectrons vs. Thrown Momentum, for Gas
Average N photoelectrons
p [GeV]
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60


e-
pi+
kaon+
proton

Next steps for Reconstruction

- More debugging, testing and development (Chandra found a new bug today)
- Performance plots: 3σ PID separation, single photon RMS, …
  - Impacts on performance from materials, B-fields, …
- Migrate to EICrecon/algorithms (coordinate with CompSW group)
  - Already started connecting IRT with geometry service…
  - Be ready for the next simulation production