Simultaion studies update dRICH

Chandradoy Chattejee
on behalf of dRICH simulation team

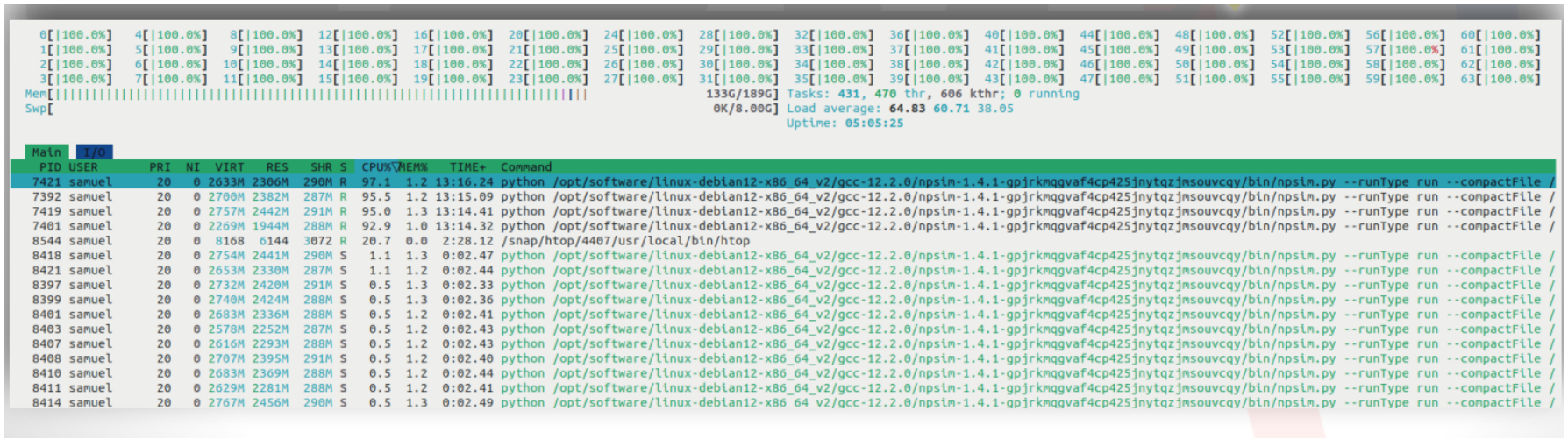
https://indico.bnl.gov/event/25662/

dRICH performance: input

- PIDs: [2212, 321, 211, 11]
- Momentum (74 bins): [0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5, 31.0, 32.0, 34.0, 36.0, 38.0, 40.0, 42.0, 44.0, 46.0, 48.0, 50.0, 55.0, 60.0]
- Pseudorapidity: [1.5-3.5] in 0.1 steps
  - Example 1.5 ⇒ bin of 1.499 to 1.501
- Bin details in Google Sheet and analysis root files at link
- Negative pions simulated for charge independence study for fewer kinematic values

GPU Specifications

CPU	Intel(R) Xeon(R) Gold 6130 CPU @ 2.10GHz
CPU Max	3.7 GHz
CPUs	64
Phys. Mem	188 GB
Storage	1.8 TB x 2
GPU	Tesla V100 with 32 GB memory



12 hours/day available for EIC and ePIC related activities.
All 64 cores are in use.

All analysis files are stored (some simulation and reconstruction files are also saved).

dRICH performance: input

Summary of dRICH analysis for EIC

Deepak Samuel, Ramandeep Kumar, Meenu Thakur, Chandradoy Chatterjee

November 21, 2024

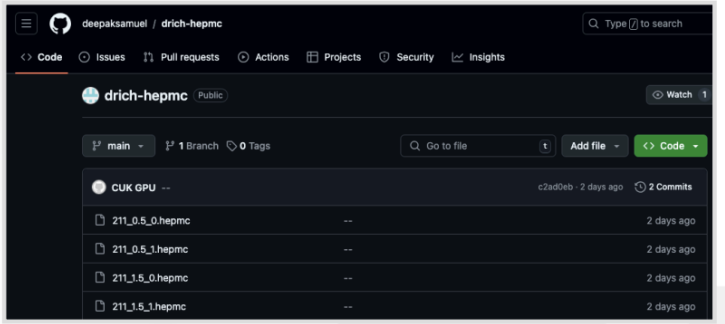
Abstract: This document contains the scope, results and the summary of the dRICH analysis work in the context of EIC, which was jointly performed by the teams at Central University of Karnataka and Central University of Haryana, under the active guidance of Chandra. This also contains links to documents and datasets used or generated in the analysis. This document is expected to evolve as results keep coming in.

Contents

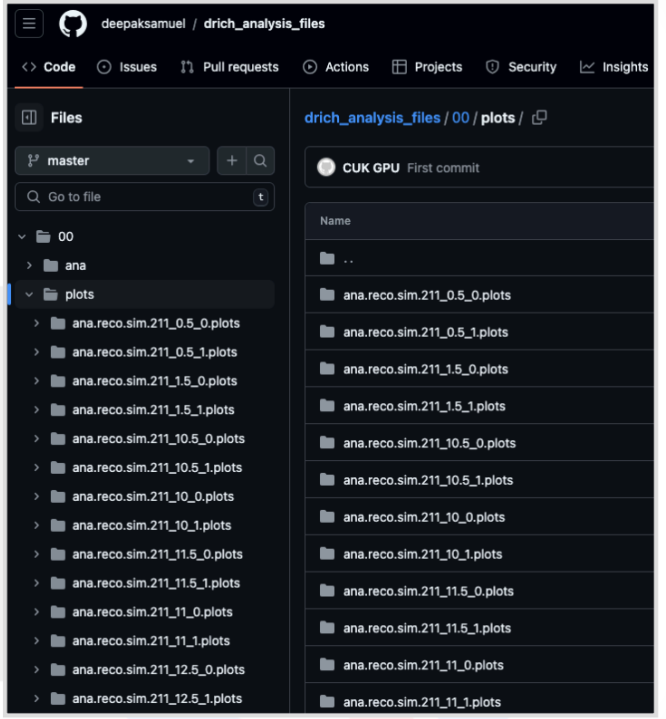
Version	by	Date	Comments
1.0	D.Samuel	12 Nov 2024	First results including separation power analysis for different aerogels, photon statistics, charge dependence

Use of GPU for Simulation

https://github.com/deepaksamuel/drich-hepmc

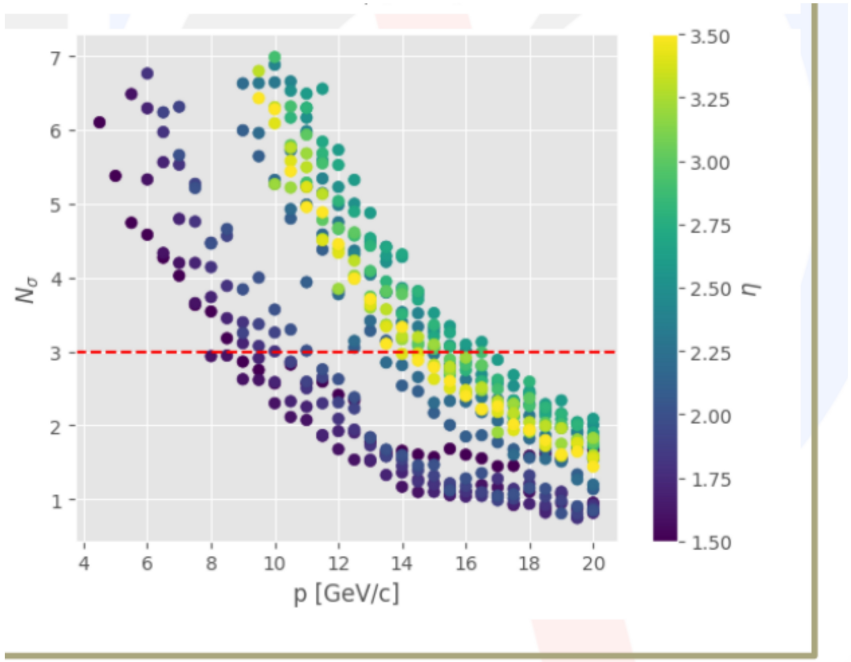


https://github.com/deepaksamuel/drich_analysis_files



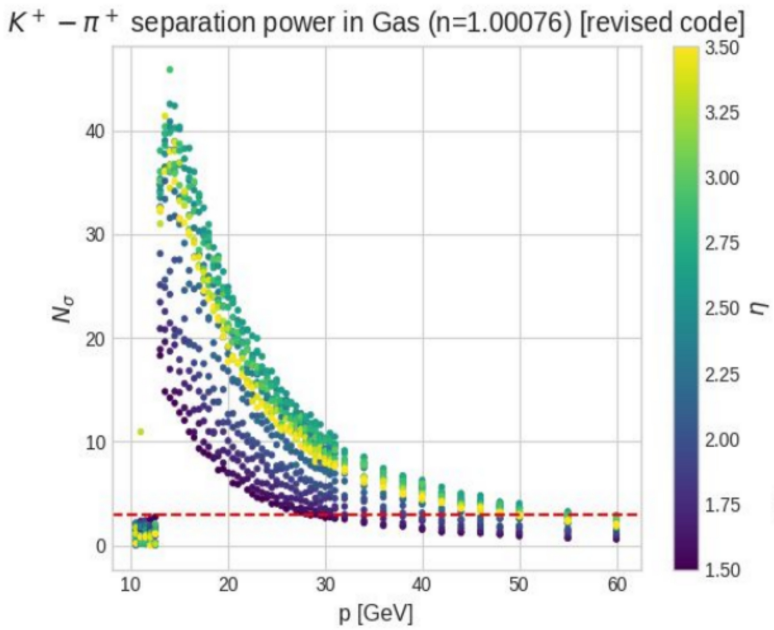
- Use of GPU for event simulation
- Production of HEPMC files
- Thanks to basis script & guidance from Chandra & significant efforts from Deepak
- *Event generation is being done (for pions, kaons, protons and electrons)*
- The HEPMC files are also accessible to other members of the group for their use

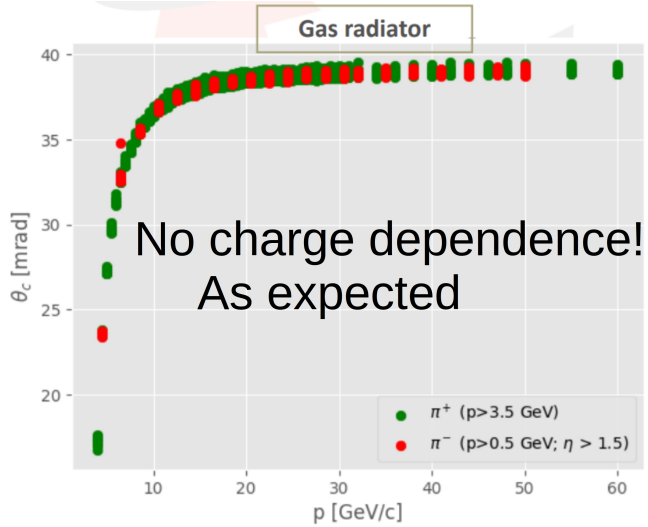
dRICH separation power : gas

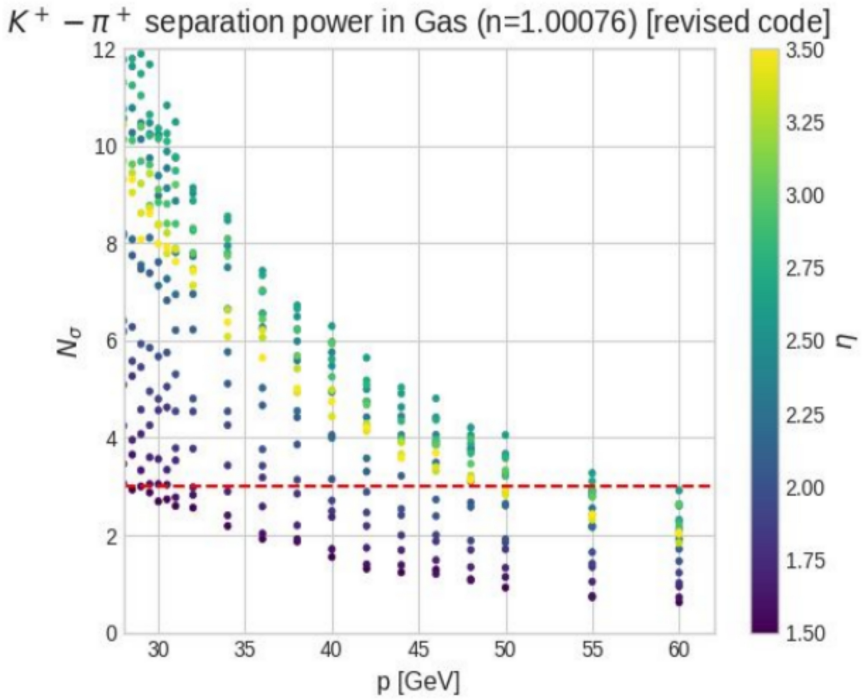


electron/pion separation

Credits: Rohit, Tanya

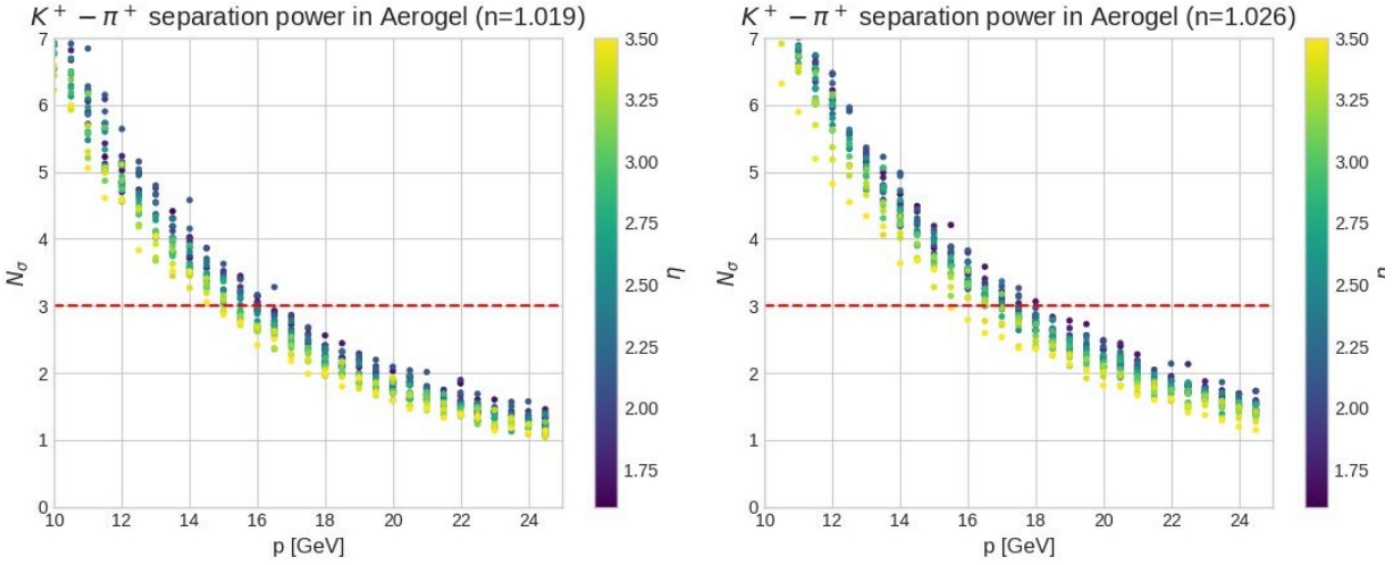


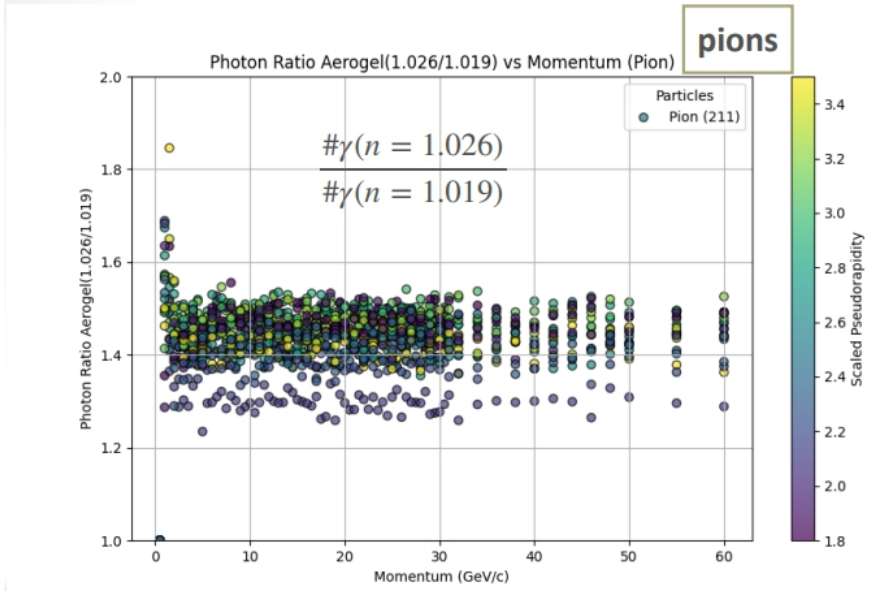


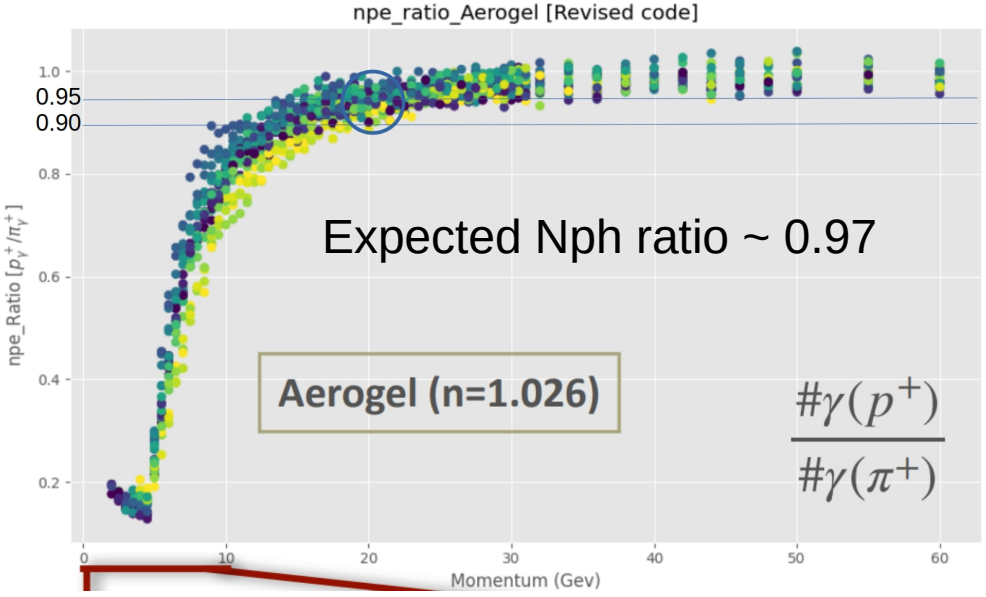


1. No charge dependence.
2. Newest geometry, mag. Field; pi/K upto 50 GeV 3-sigma for most of highest eta values.
3. LUT and contours are under preparation.
4. <14-16GeV> for e/pi seperation in gas

dRICH separation power : Aerogel





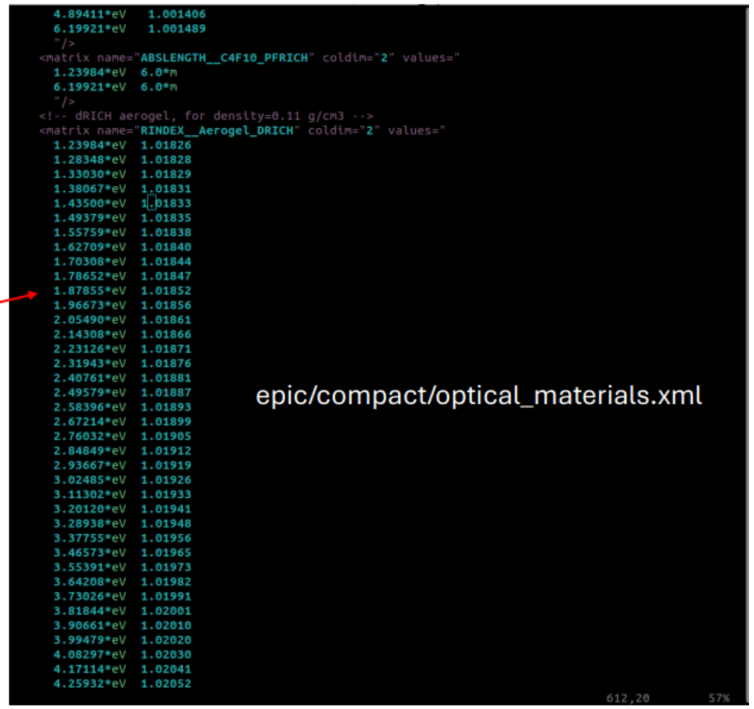


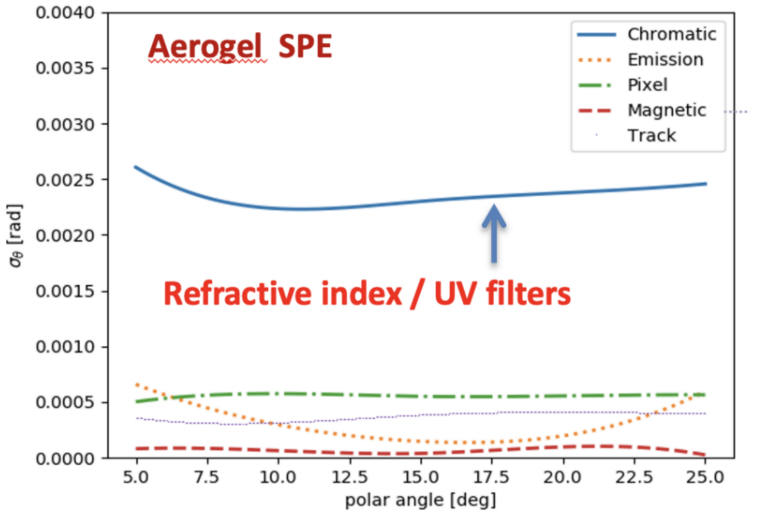
1. T.Boasso suggested aerogel 1.026 performs better than 1.019. Large data set studies validated such observations.
2. Almost 2 GeV improvement. No noise added so far (will be checked).
3. Aerogel 1.026 has at higher photon count, ~ 50%
4. Photon ratio of pions and protons follows F&T law, way to cross-check the simulation and beam test results.

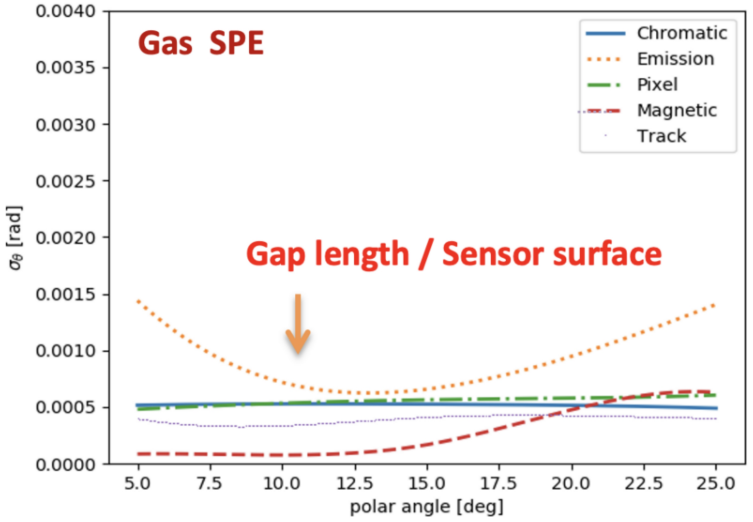
Single photon resolution: Chromatic error

Analysis details

- To calculate the contribution of chromatic aberration I ran simulations both with the refractive index fixed and with the lambda dependency.
- 1000 events.
- PID: 211
- Momentum fixed:
  - For gas @ 50 GeV/c.
  - For aerogel @ 15 GeV/c.
- Different bins of η.



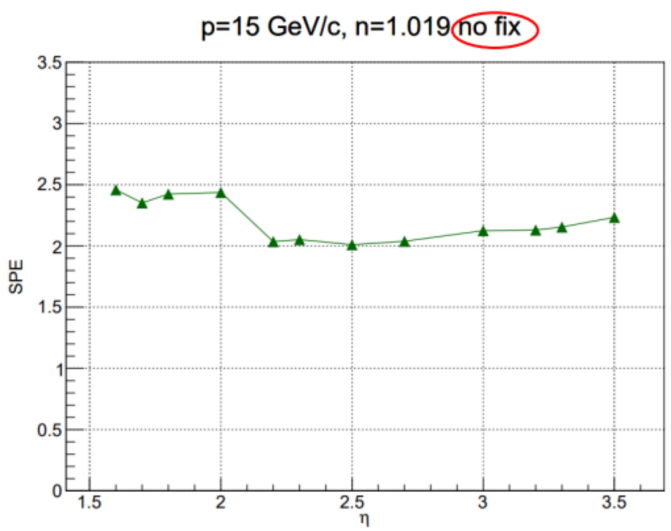


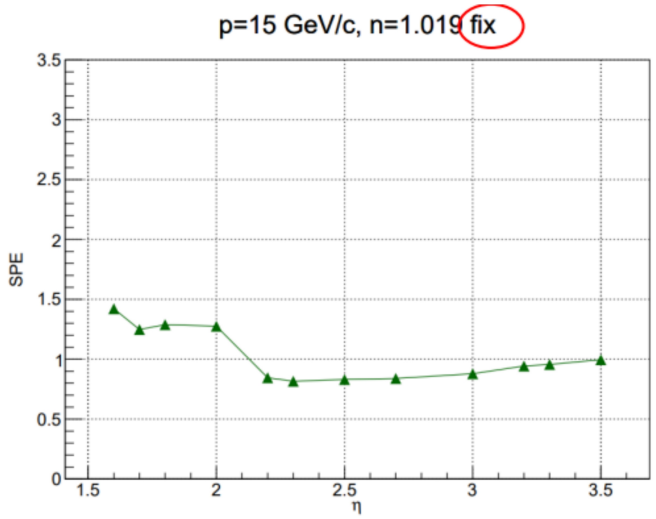


Studies by Luisa

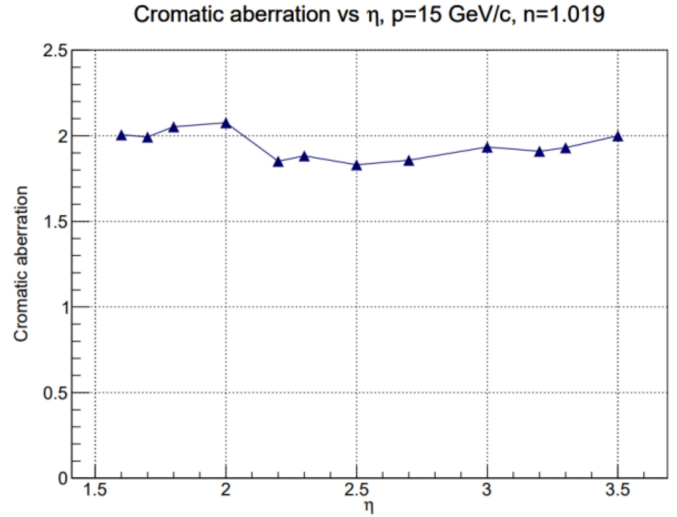
Single photon resolution: Chromatic error

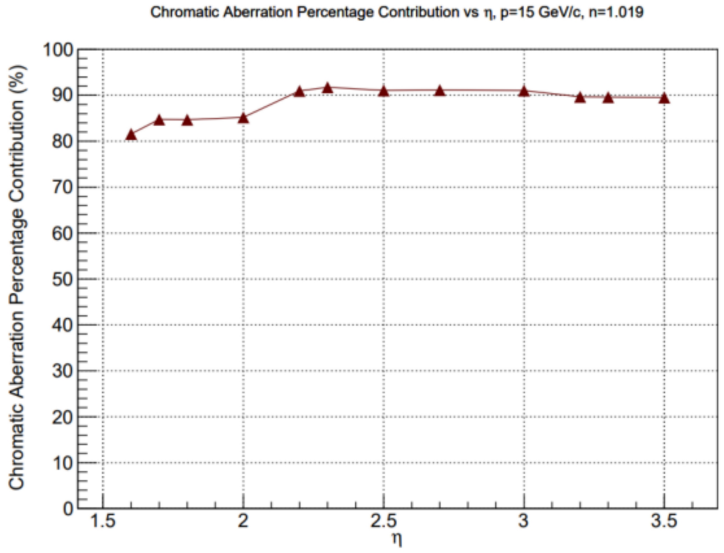
Aerogel 1.019





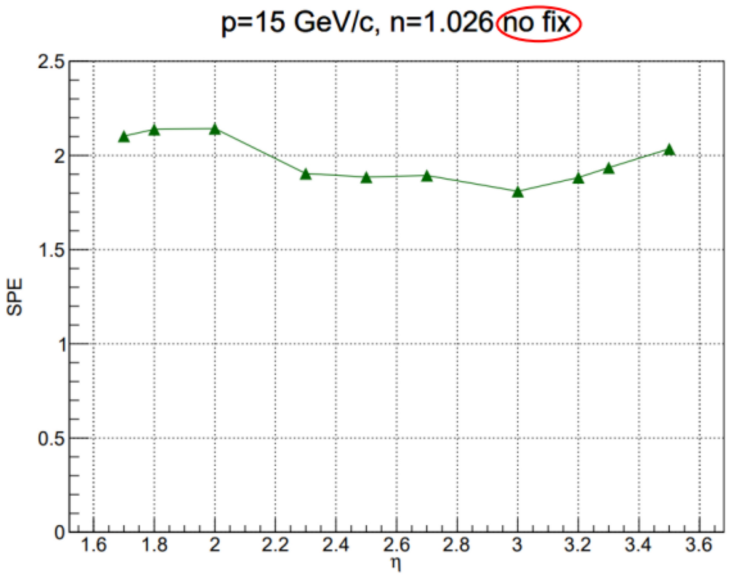
Studies by Luisa

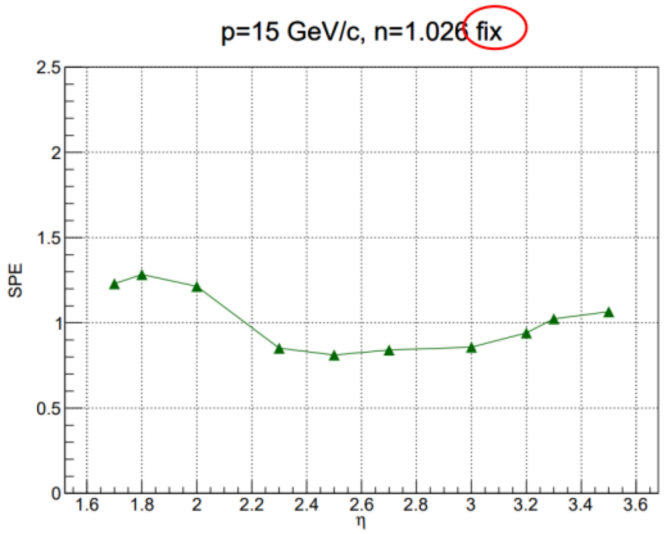


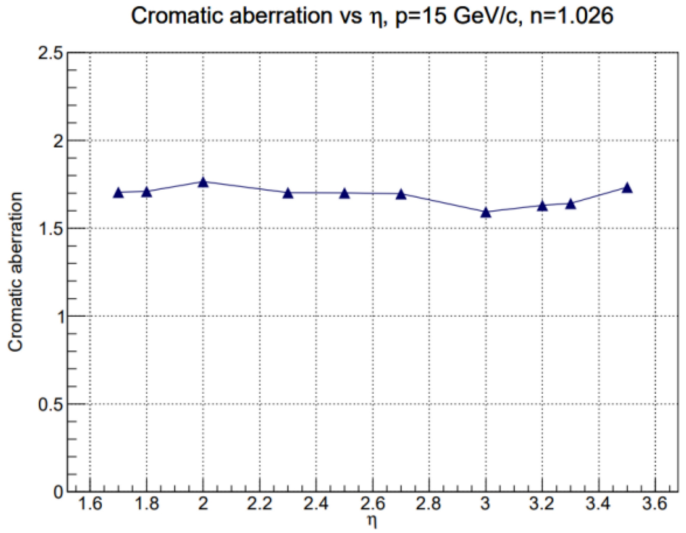


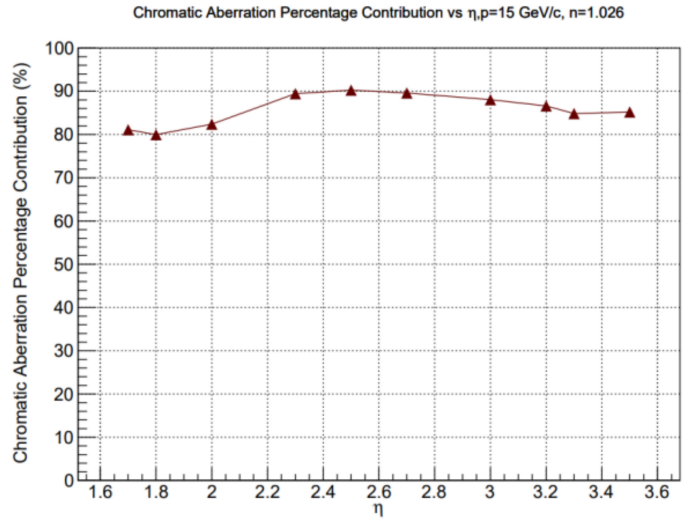
Single photon resolution: Chromatic error

Aerogel 1.026





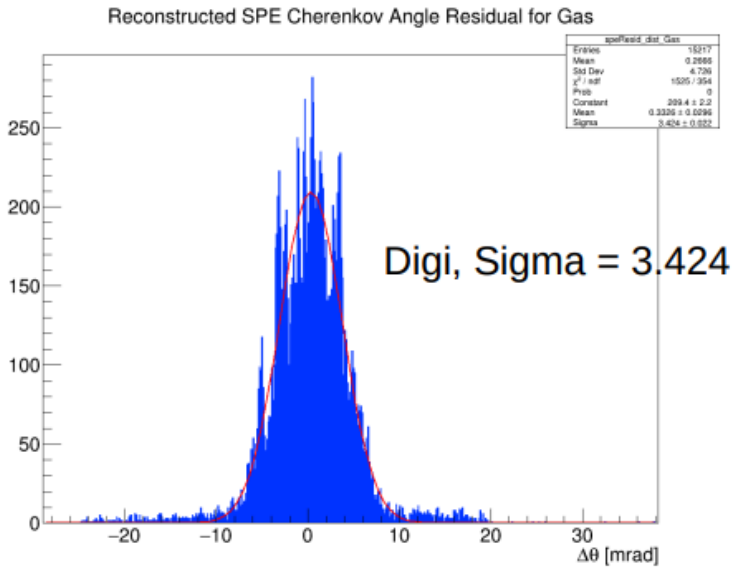


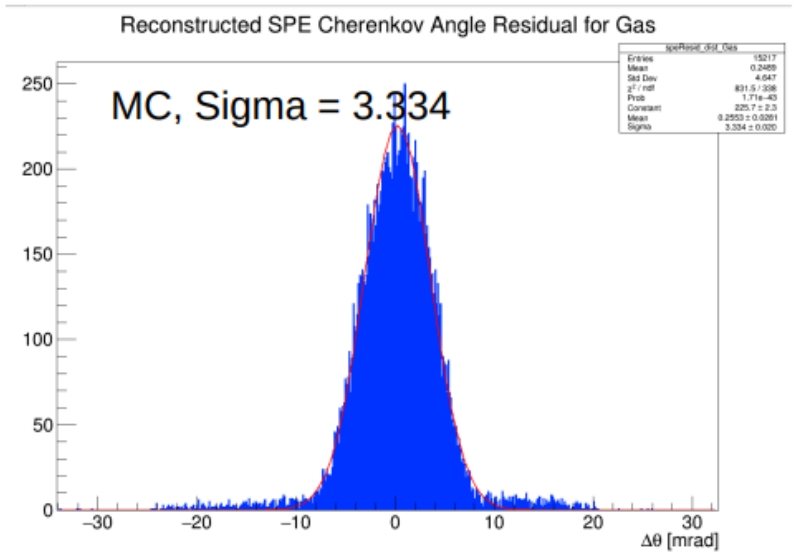


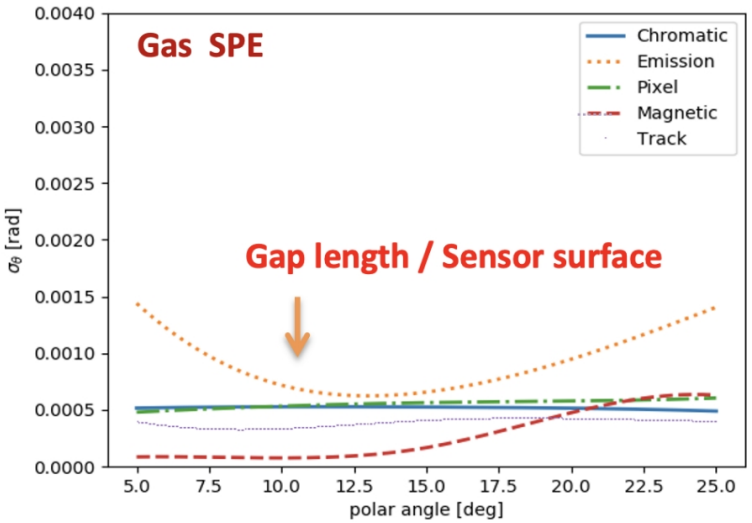
Studies by Luisa

Effect of acrylic filter will be studied.

Single photon resolution: Pixelization





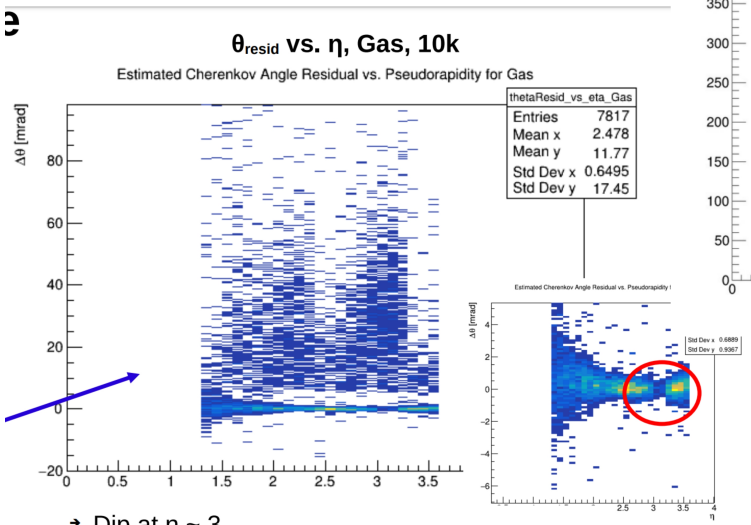


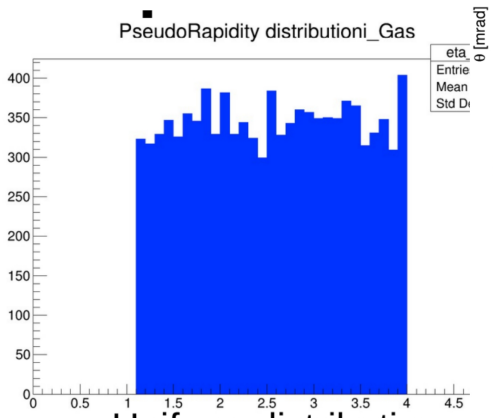
Pixel contribution: 0.78 mrad ~ 0.00078 rad

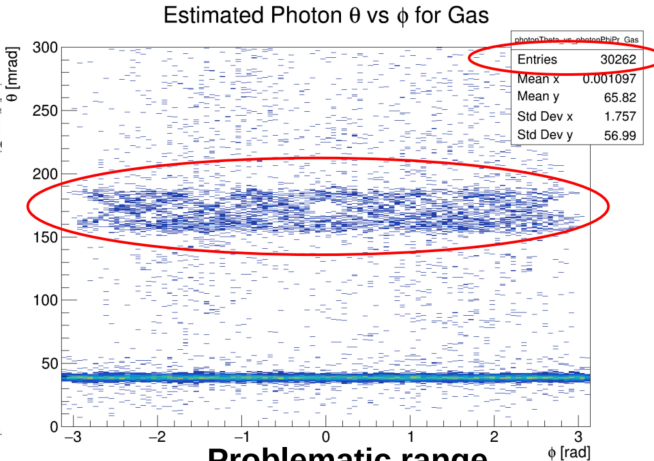
Seems compatible!

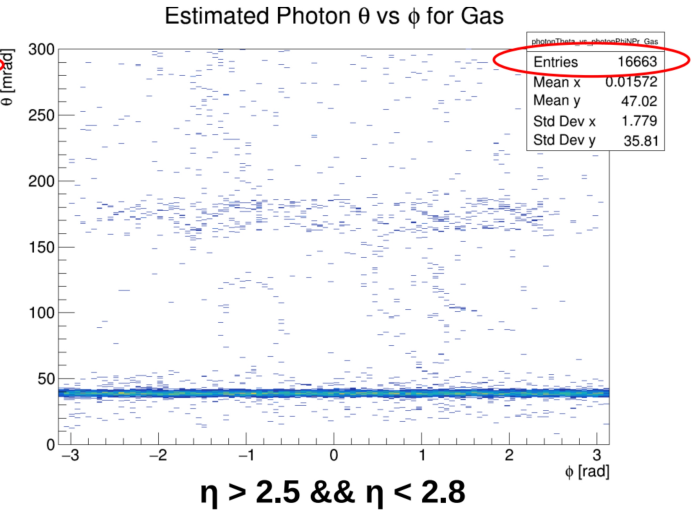
Further studies will be made.

Resolution









- Dip at η ~ 3
- Events scattered at +Δθ upto 100 mrad

Studies by Jinky

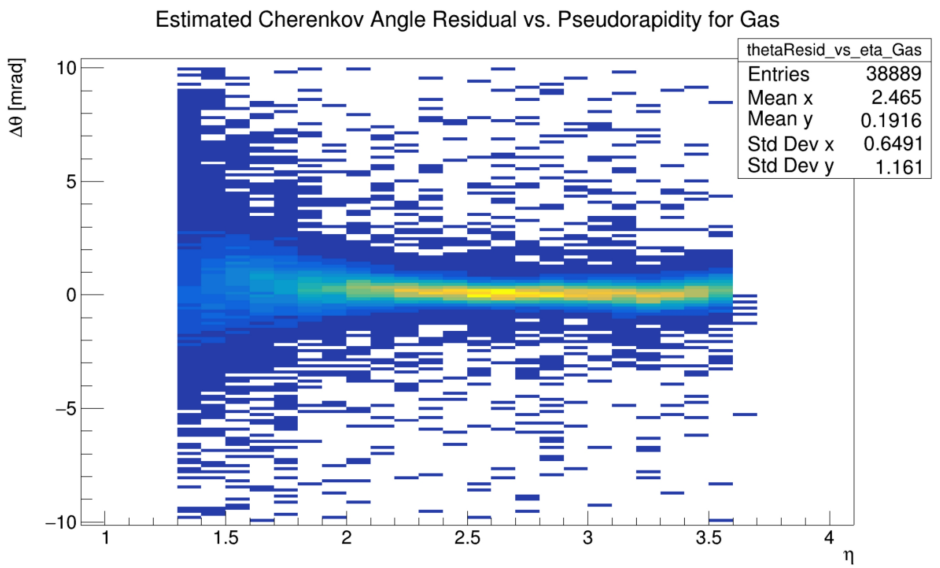
Before

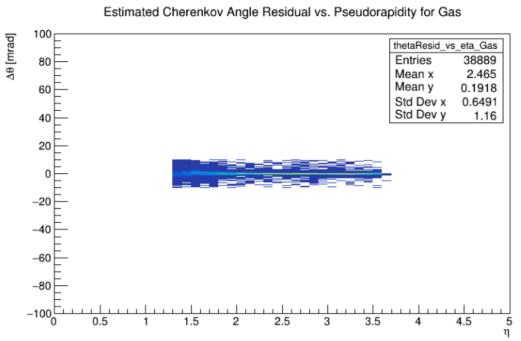
```
for(const auto& [theta,phi] : cherenkov_pid.getThetaPhiPhotons()){//UNCOMM
    theta_rec += theta;
  }
  theta_rec /= cherenkov_pid.getNpe();  ----------> θRing
```

After

```
for(const auto& [theta,phi] : cherenkov_pid.getThetaPhiPhotons()){
    if(TMath::Abs(theta-theta_exp)<0.010){   //modified, in rad
        theta_rec += theta;
        Npe++;
    }
        else theta_rec+=0;
  }
  theta_rec /= Npe;   ----------> θRing
```

Gas, 50k

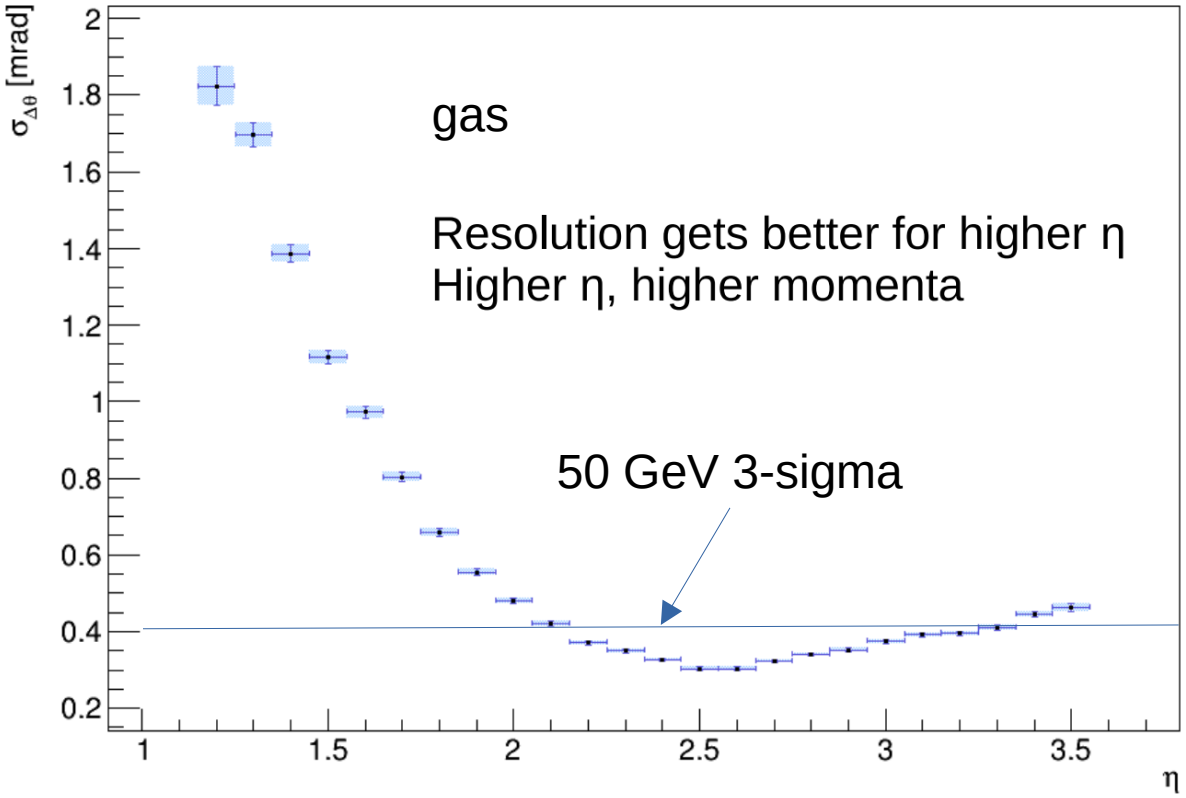


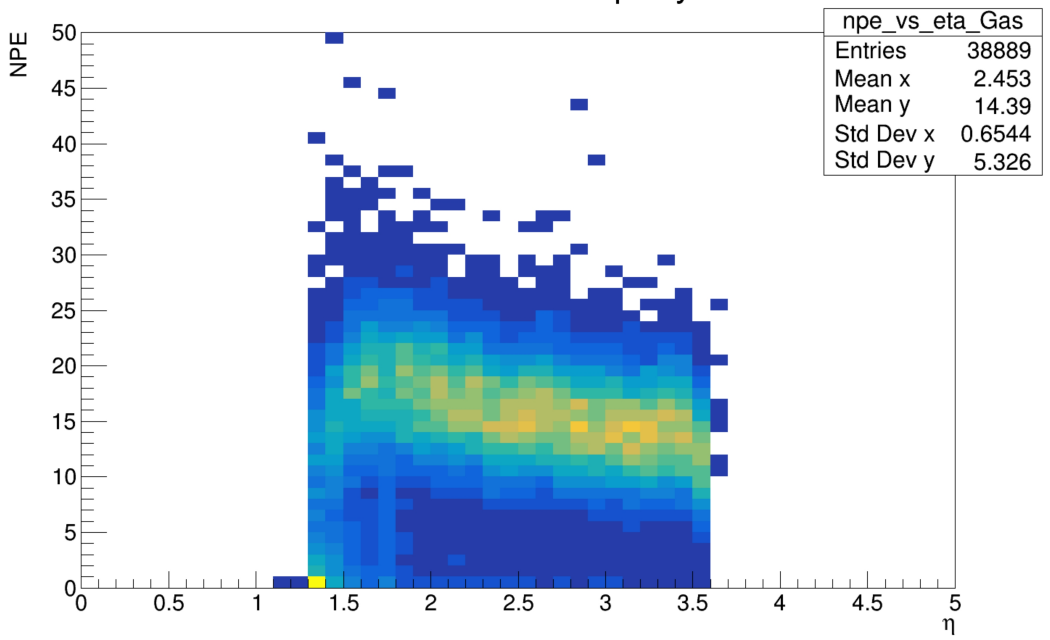


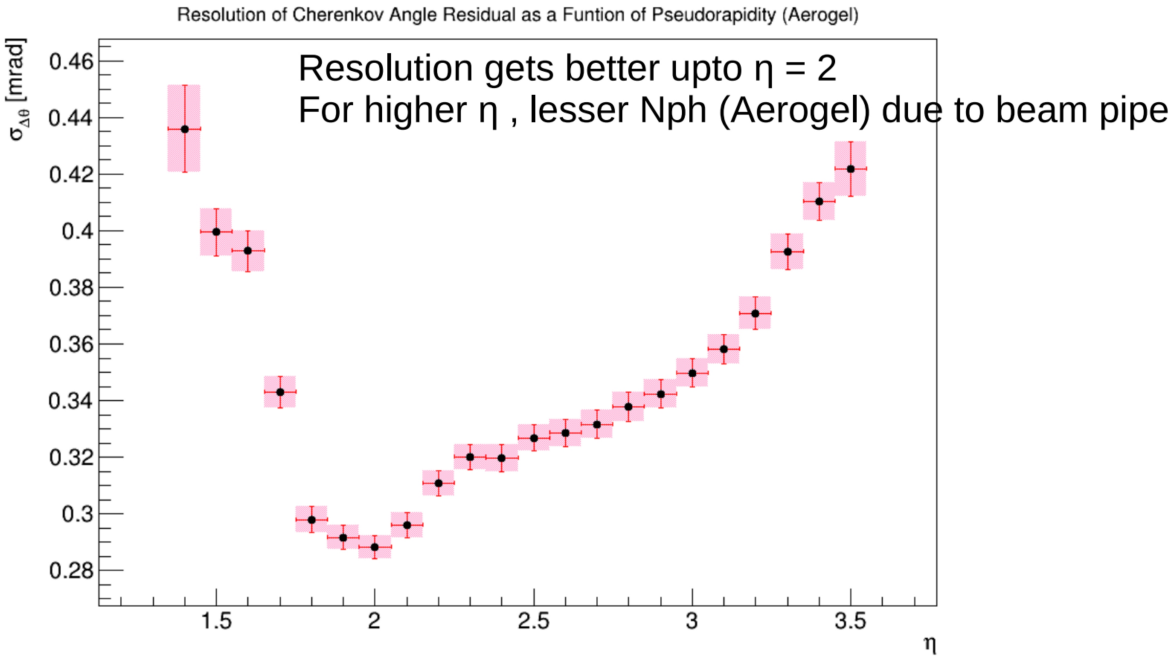
- Scatter plot of Cherenkov angle residual, Δθ and η
- $\Delta\theta = \theta_{resid} = (\theta_{Ring} - \theta_{exp})$
- Δθ broad for η < 1.8

Resolution

Studies by Jinky







Summary

1)We are progressing with the simulation studies.

2)For the TDR we will update the plots soon.

3)We will soon start the IRT reconstruction updates.