EIC dRICH simulation
Preliminary studies

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Outline

- Cherenkov angle residual vs. eta
  - Gas
  - Aerogel
- Resolution of Cherenkov angle residual vs. eta
  - Gas
  - Aerogel

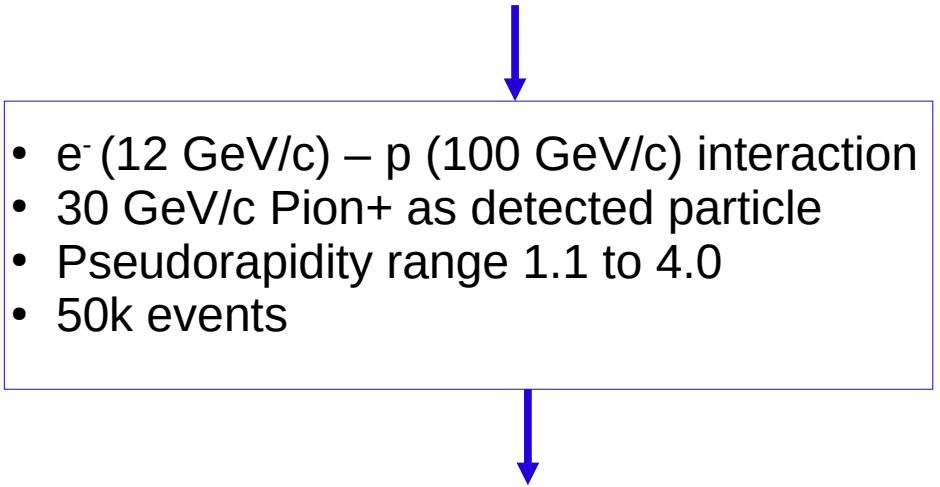
Definition of θ

- $\theta_{resid} = \theta_{Ring.} - \theta_{exp.}$; (event by event)
- $\theta_{Ring,\ Gas} = \Sigma\ \theta_{rec} / \text{Nph}$; (event by event)
- $\theta_{Ring,\ Aerogel} = \Sigma\ \theta_{rec} / \text{Nph}$; (event by event)
- $\theta_{exp.} = \cos^{-1} \sqrt{(p^2 + m^2)}/(n*p)$; n = refractive index

n = 1.00076 (Gas)
n = 1.02 (Aerogel)

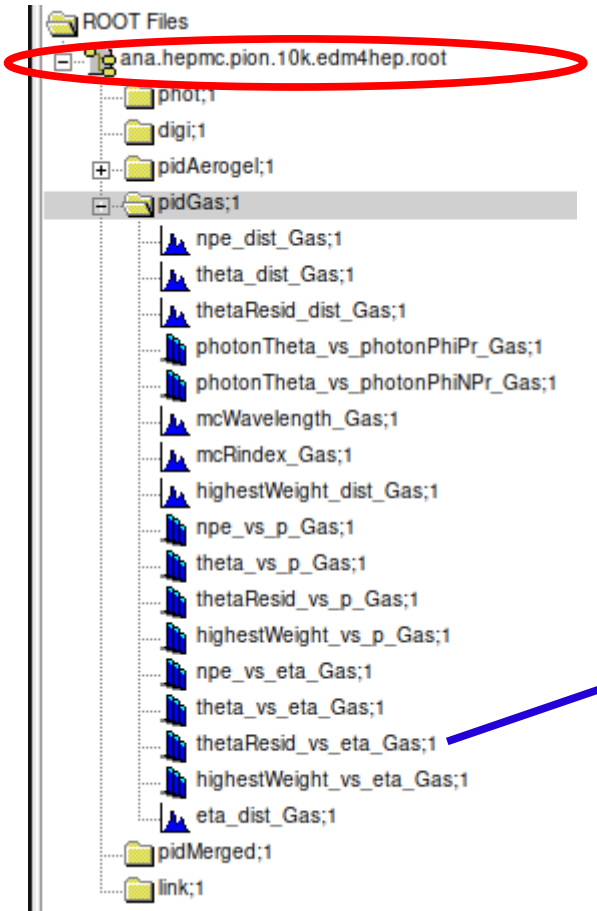
Drich.hepmc file

root -l drich-hepmc-writer.C'("drich.hepmc", 50000)'

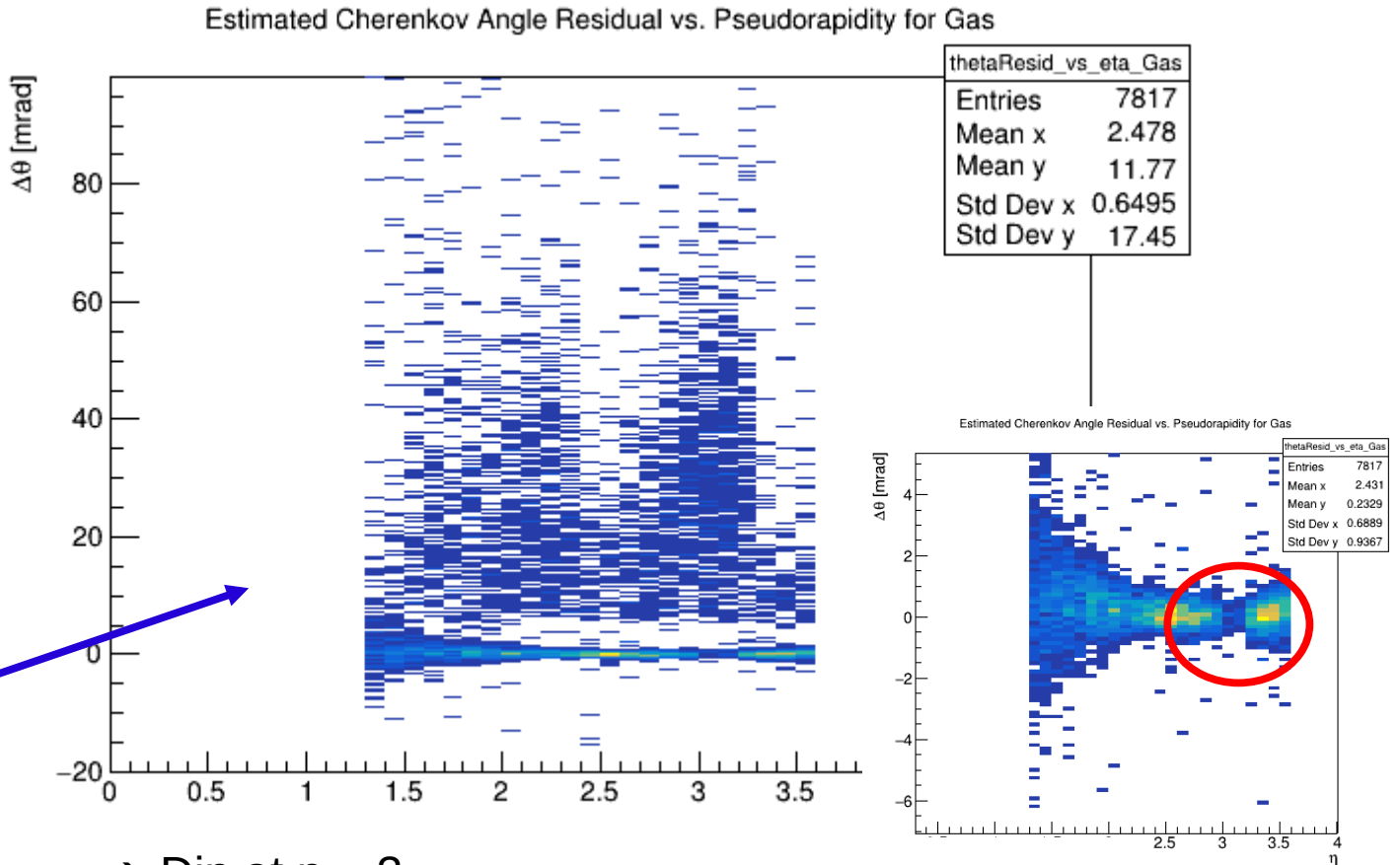


- Simulation simulate.py -i drich.hepmc -n 50000
- Reconstruction
- Analysis

Output root file

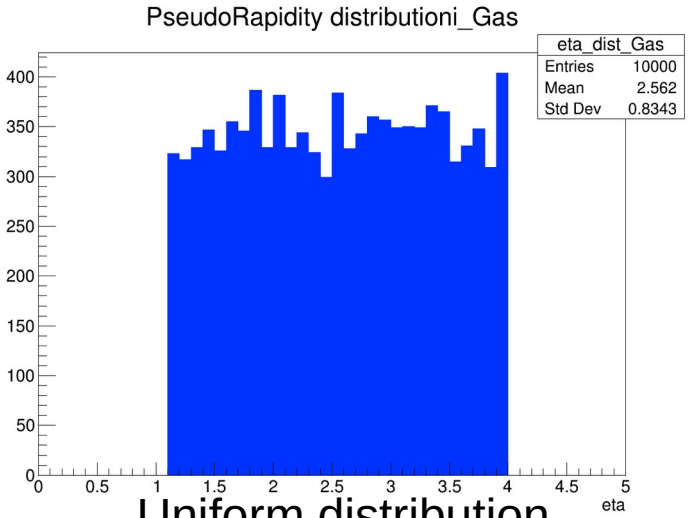


θ_{resid} vs. η, Gas, 10k

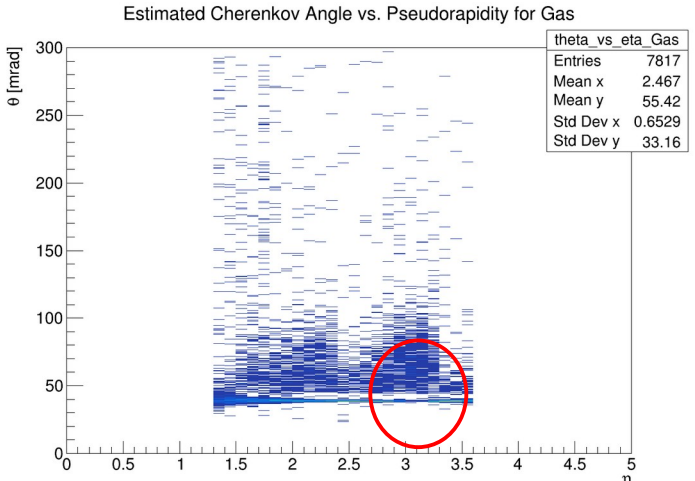


- Dip at η ~ 3
- Events scattered at +Δθ upto 100 mrad

Output root file

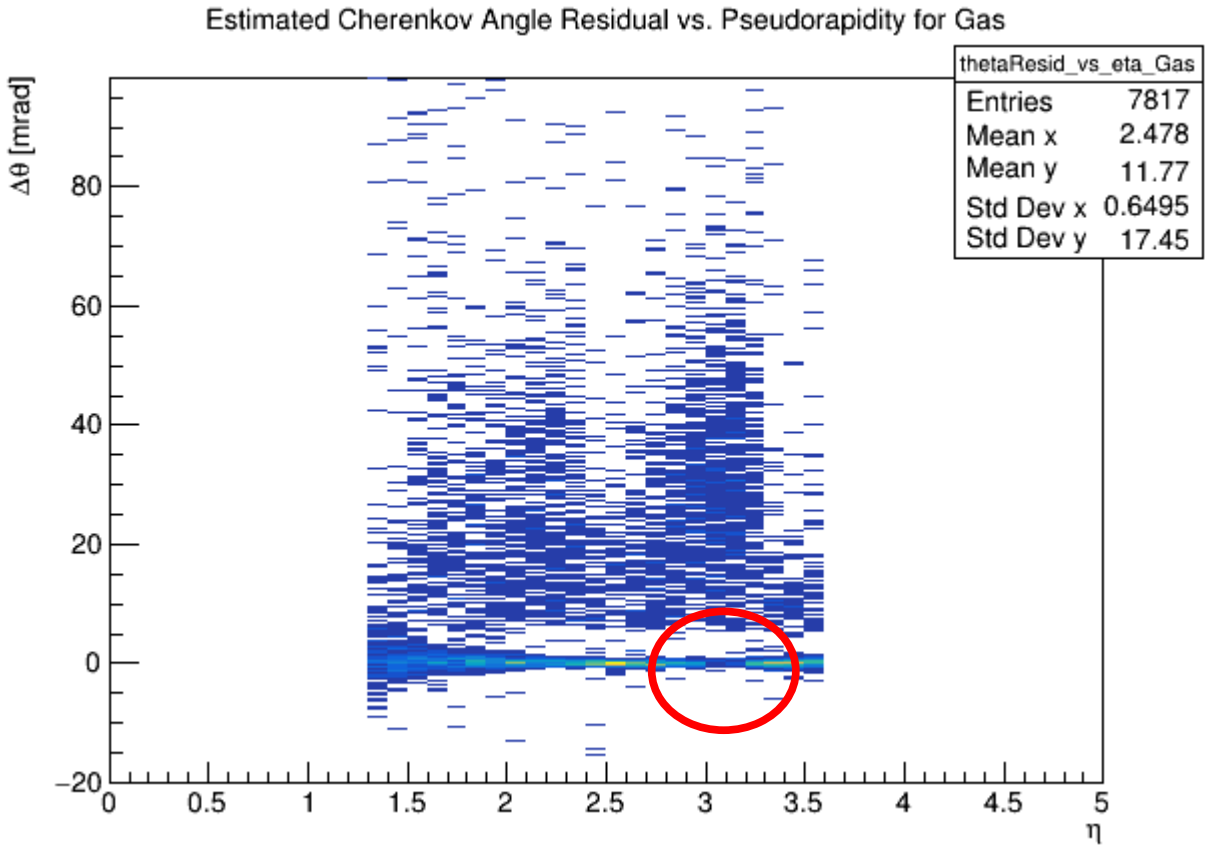


Uniform distribution



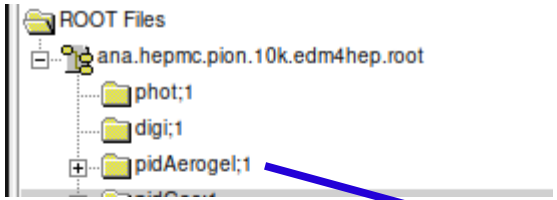
Also present in θ_{Ring} vs. η

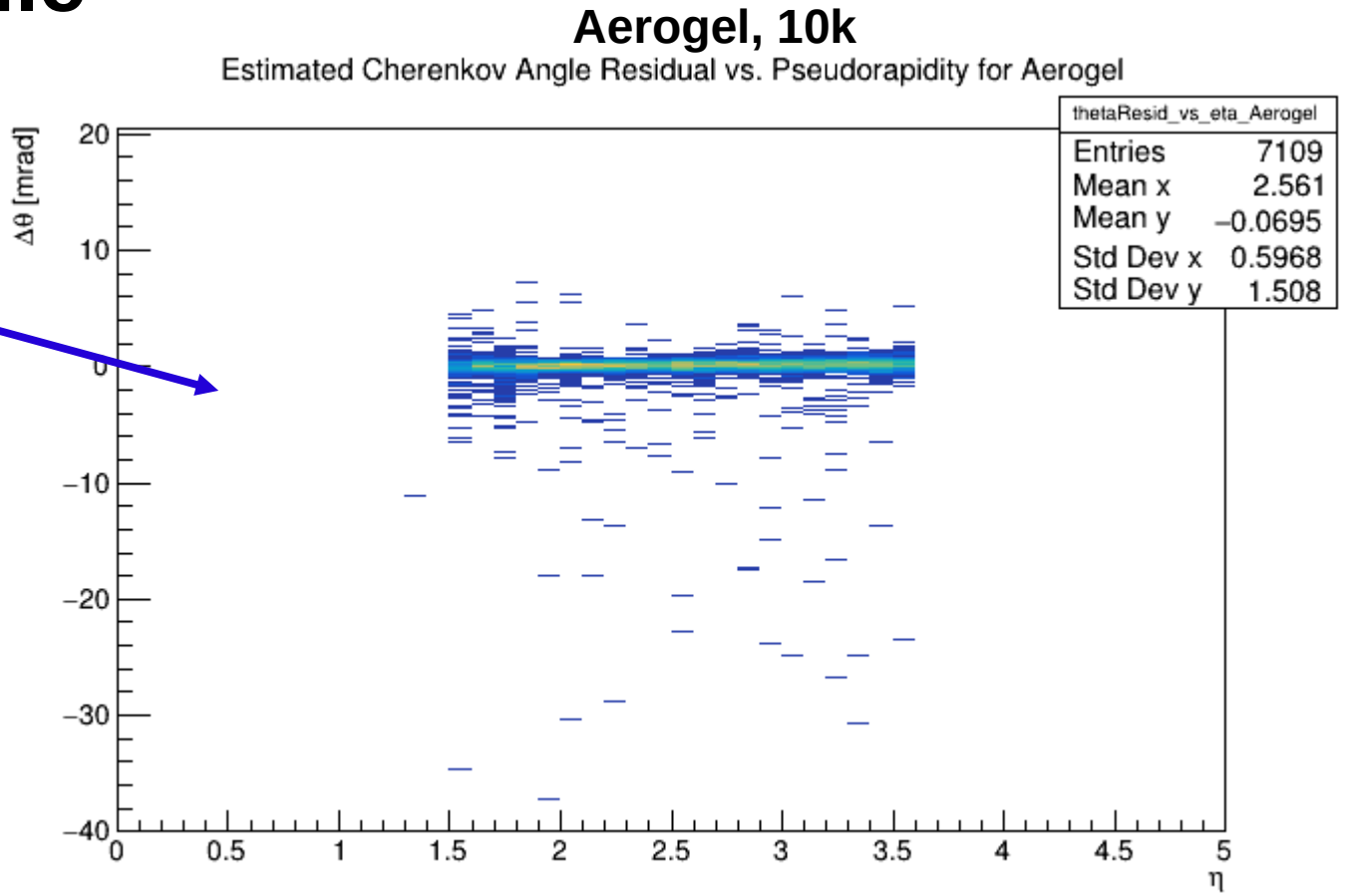
θ_{resid} vs. η, Gas, 10k



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

Output root file





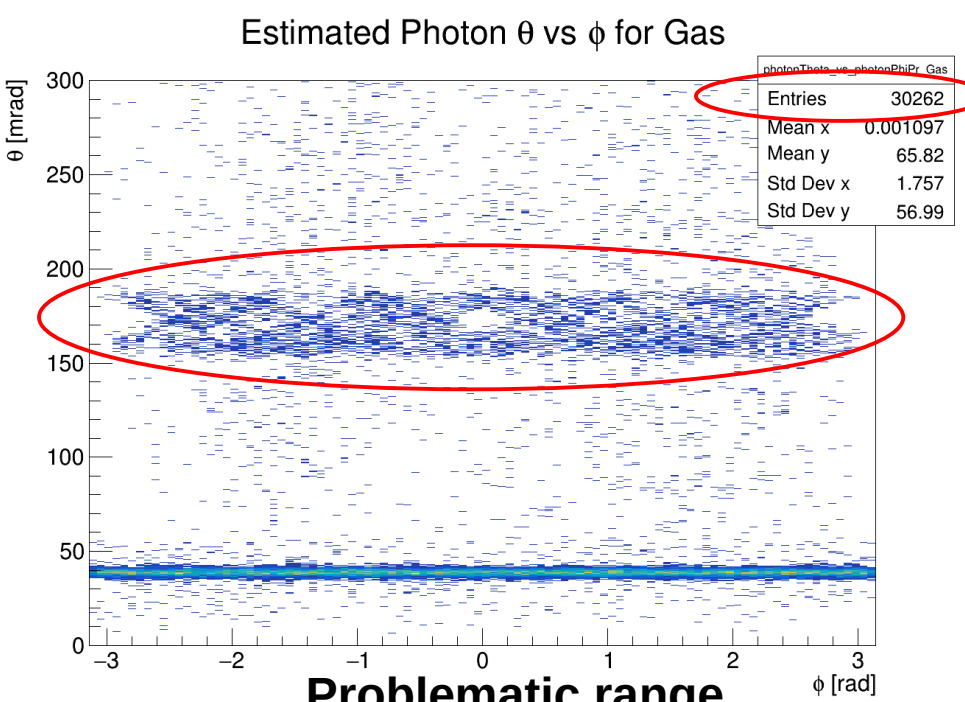
Similar pattern absent for θ in Aerogel

Events mostly limited to -10 mrad < Δθ < +10 mrad

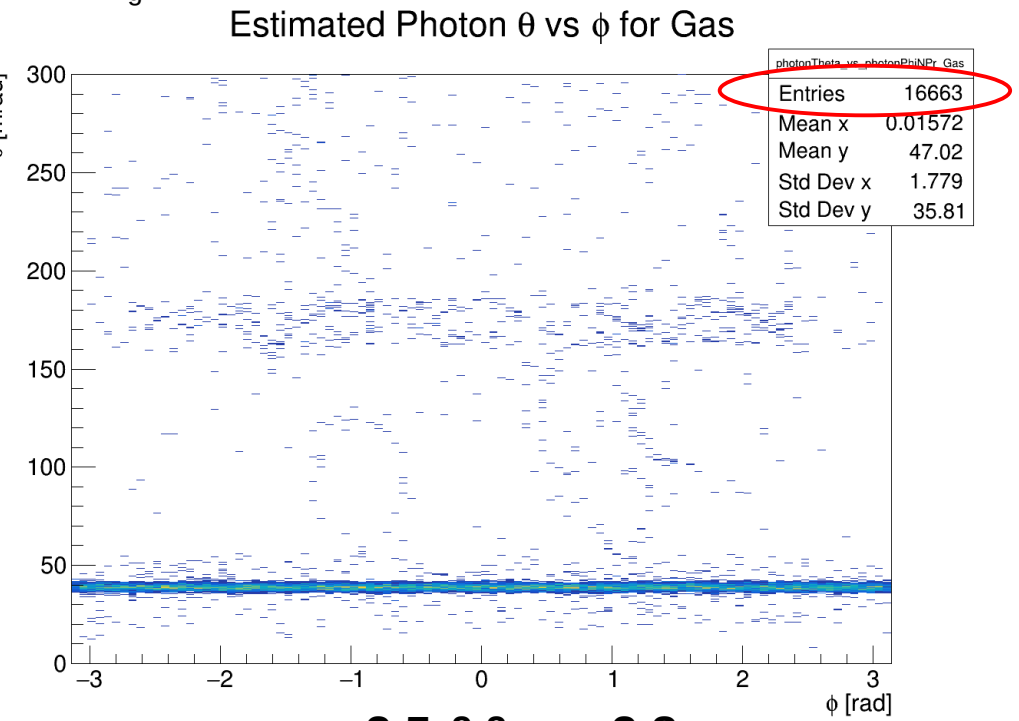
Output root file

$\theta_{rec.}$ vs. azimuthal angle, 10k

$\theta_{rec.}$ not θ_{Ring}



Problematic range
η > 2.8 && η < 3.3



η > 2.5 && η < 2.8

- $\theta_{rec.}$ Cher. photons produced in Aerogel misunderstood as $\theta_{rec.}$ Cher. photons produced in Gas
- Sub-optimization of θ_{Ring} definition

Source code modified

.../eic_simulation/drich-dev/reconstruction_benchmarks/benchmarks/rich/src/
CherenkovPIDAnalysis.cc

Before

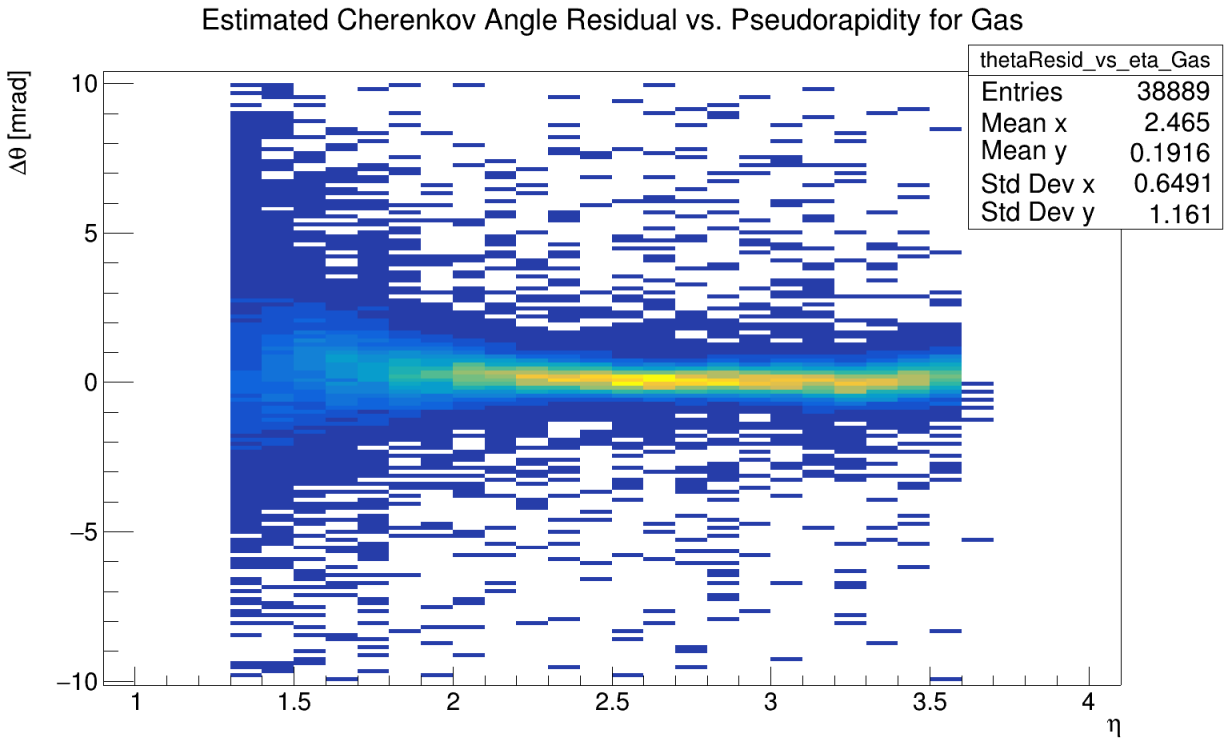
```
for(const auto& [theta,phi] : cherenkov_pid.getThetaPhiPhotons()){//UNCOMMENTING FROM HERE
      theta_rec += theta;
    }
    theta_rec /= cherenkov_pid.getNpe();  ----------> θRing
```

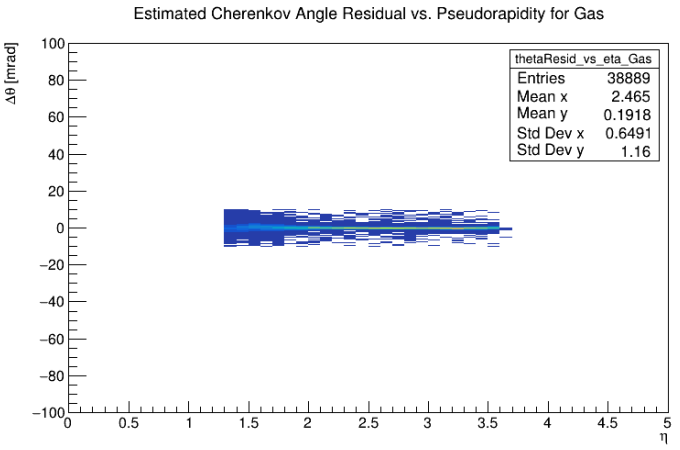
After

```
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
```

Output root file - modified

Gas, 50k

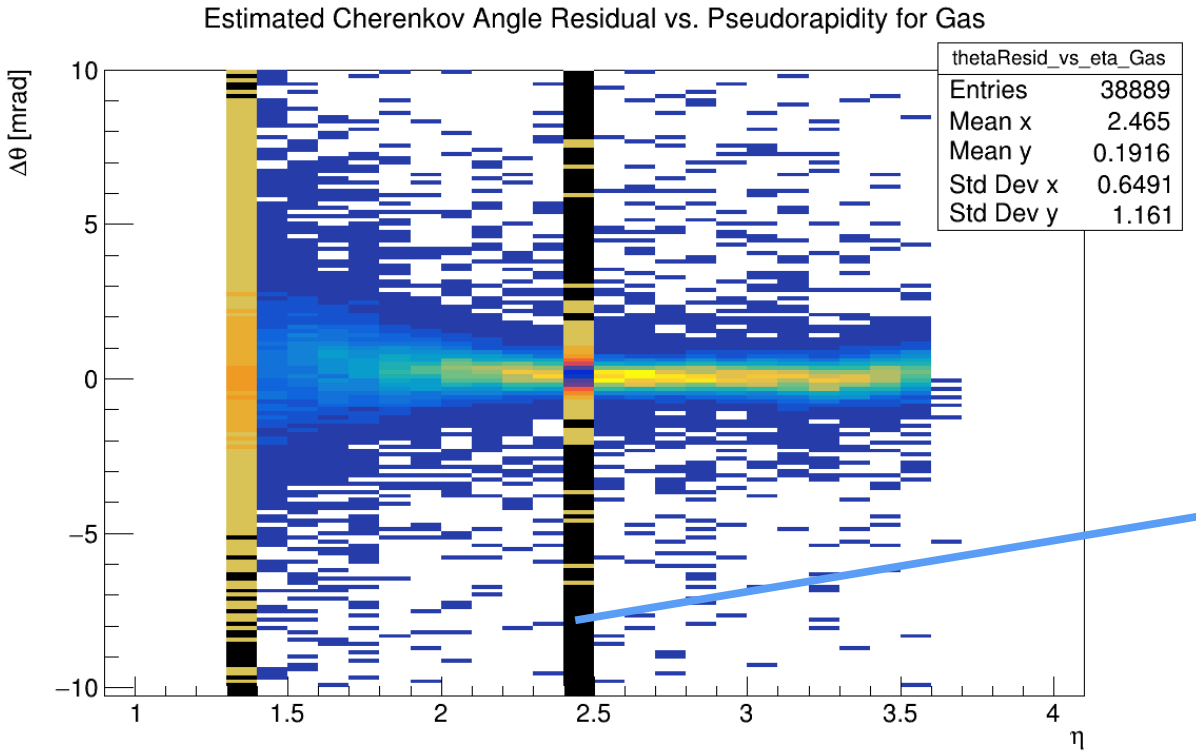


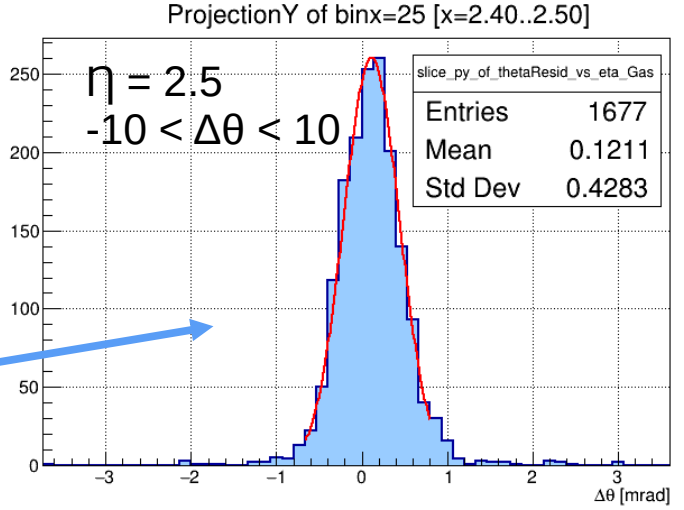


- Scatter plot of Cherenkov angle residual, Δθ and η
- $\Delta\theta = \theta_{resid} = (\theta_{Ring} - \theta_{exp})$
- Δθ broad for $\eta < 1.8$

Resolution θ_{resid} vs. η (Gas)

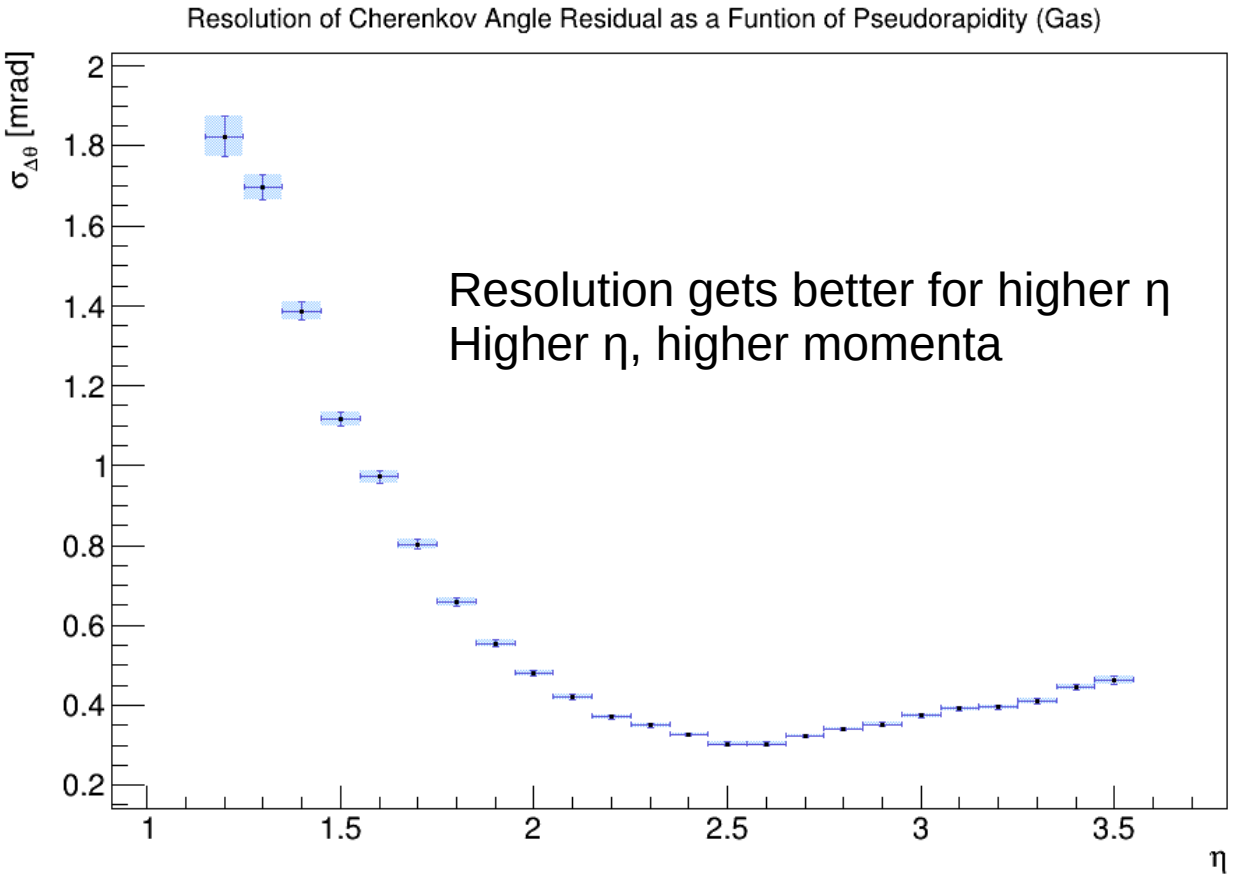
Slice by slice evaluation of σ



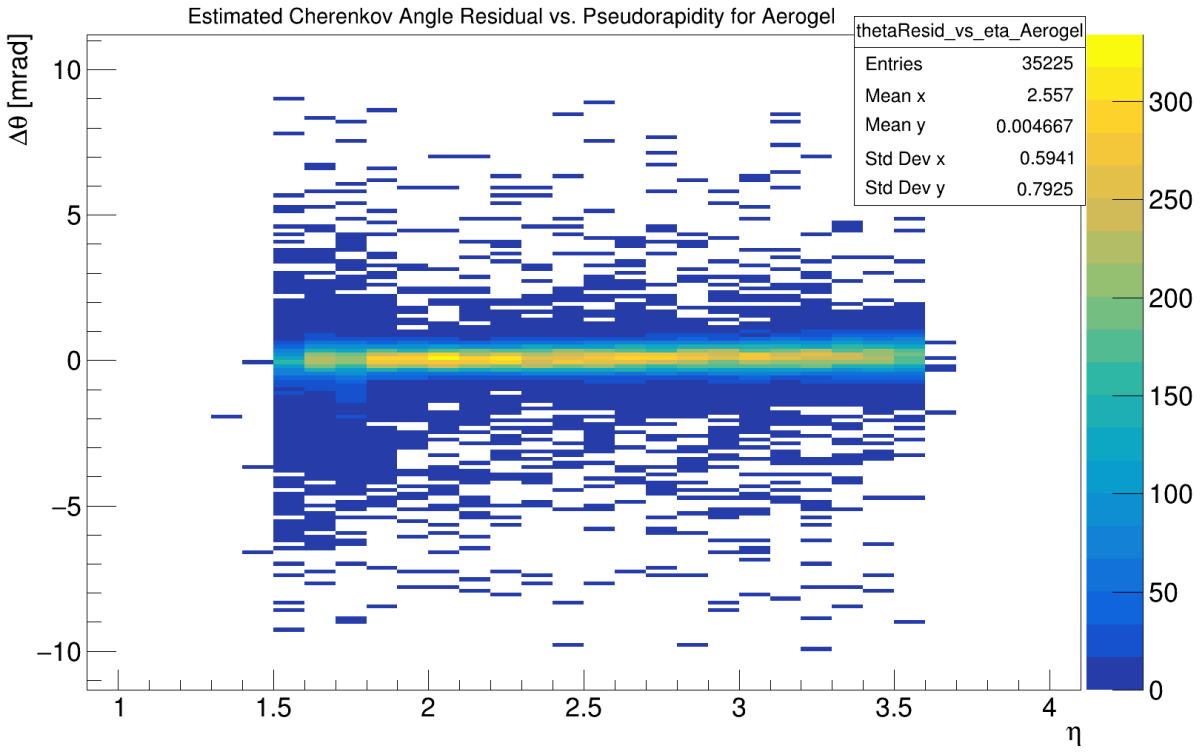


$\sigma_{\Delta\theta,slice}$ extracted from fitting parameter

Resolution θ_{resid} vs. η (Gas)



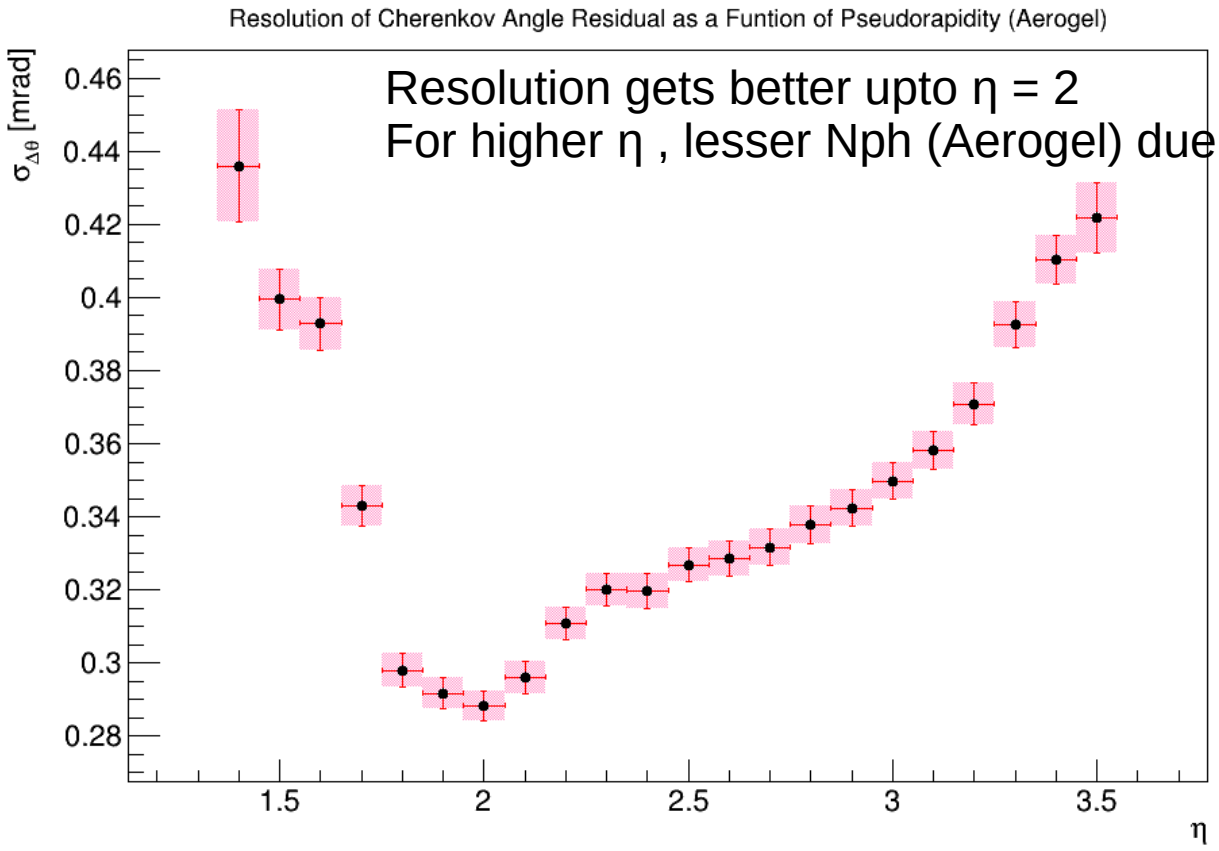
Output root file



Aerogel, 50k

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

Resolution θ_{resid} vs. η (Aerogel)



Thank you!