Update on dRICH Simulation Activities for TDR

dRICH Simulation Meeting

25 September 2024

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for Team CUH & CUK

Aim & Strategy

- **For TDR:**
  - PID performance of dRICH (in terms of N_σ vs p plots) for both radiators)
  - Look Up Tables (LUTs)

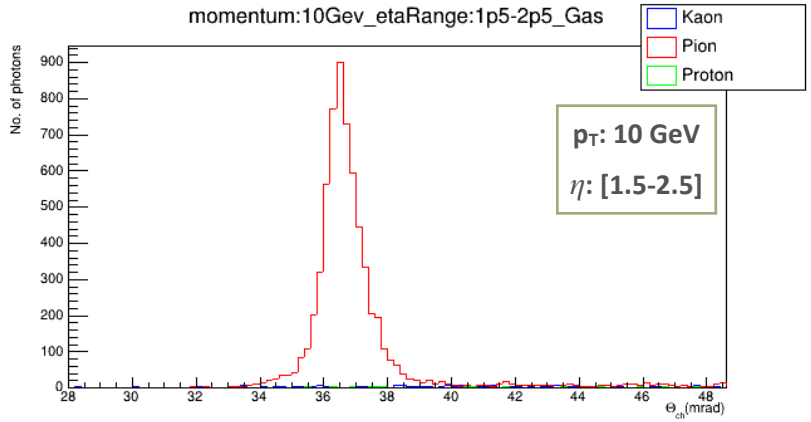
- **Previous presentation (13 September 2024):**
  - PID detector performance of dRICH at ePIC with gas as the radiator
  - Particles considered: π^+, K^+ and protons
  - **Using polar scan** in two different η regions: [1.5 to 2.5] and [2.5 to 3.5]
  - Different p-regions in range 10-60 GeV with step-size of 2.5 GeV
  - Issue 1: data overwriting (?) while simulation using polar scan
  - Issue 2: calculation of N_σ as difference in two mean values (θ_c) only

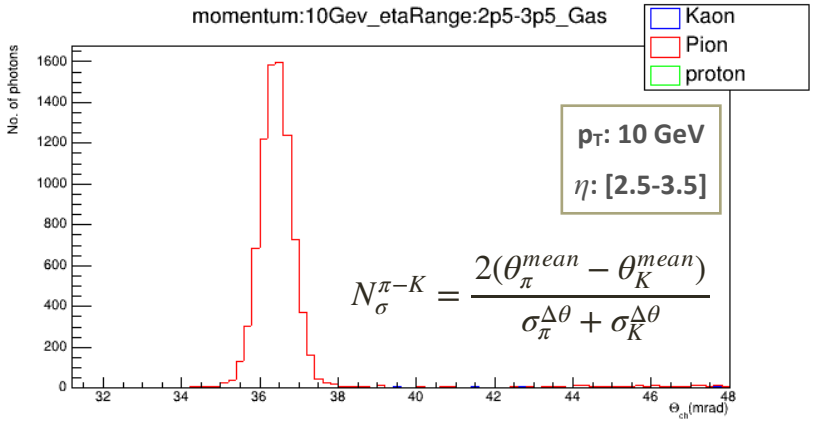
- **Today's presentation (Similar study with resolved issues):**
  1. Simulation one-by-one for each value of p & η and then merging the files according to two η regions: [1.5 to 2.5] and [2.5 to 3.5] for each p-value
  2. Accurate calculation of N_σ $(\pi - K)$ and plotting it as a function of momentum

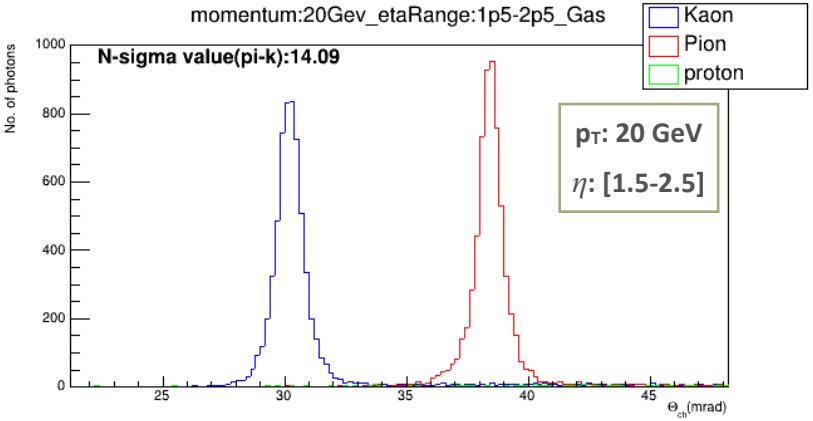
Particle Identification at dRICH

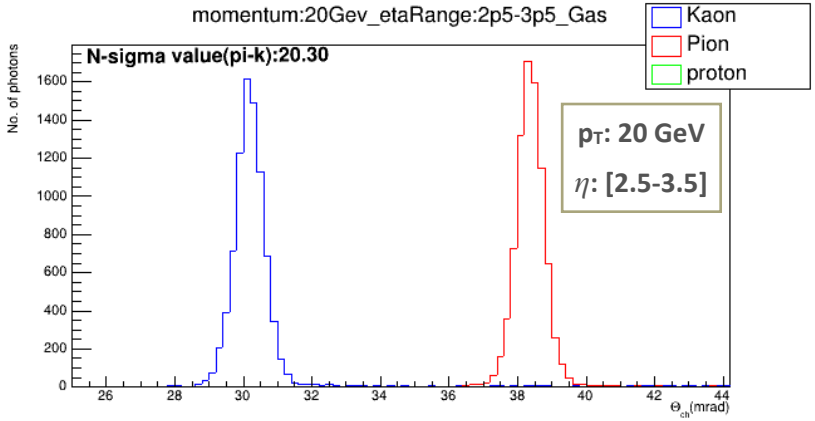
Radiator: Gas

Credits: Rohit, Tanya, Girdish, Taniya







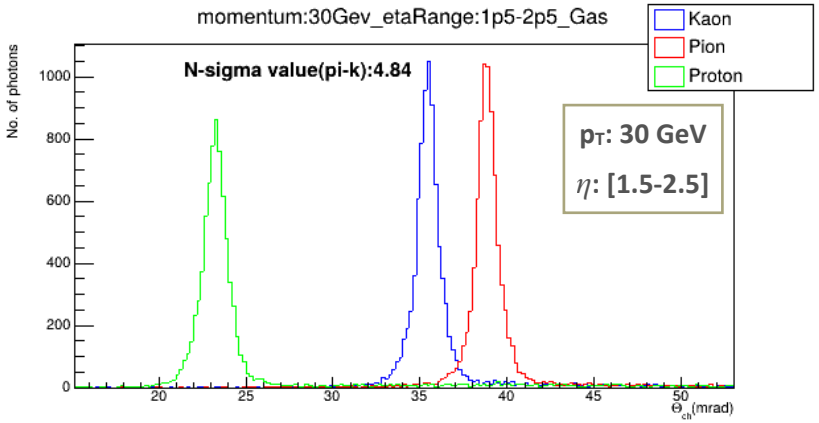


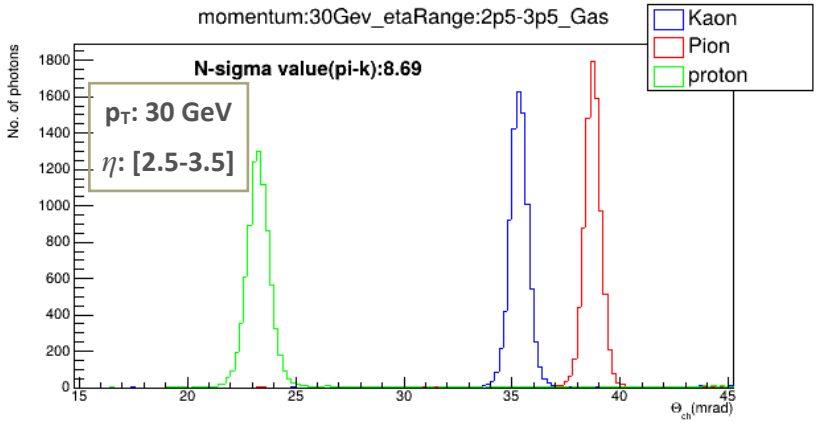
- The kaons with higher (>10 GeV) threshold are not observed at 10 GeV
- The protons with even higher (>20 GeV) threshold are not observed at 10 GeV & 20 GeV

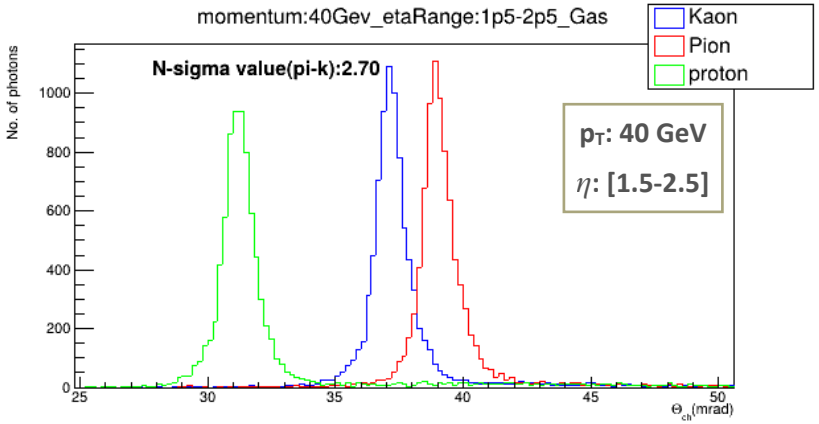
Particle Identification at dRICH

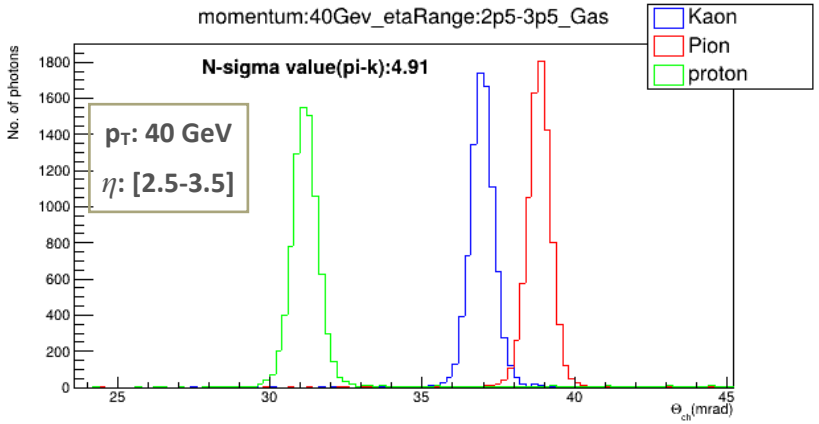
Radiator: Gas

Credits: Rohit, Tanya, Girdish, Taniya









- $N\sigma$ separation decreases as particle momentum increases
- Separation is better in high-η region

$$N_{\sigma}^{\pi-K} = \frac{2(\theta_{\pi}^{mean} - \theta_{K}^{mean})}{\sigma_{\pi}^{\Delta\theta} + \sigma_{K}^{\Delta\theta}}$$

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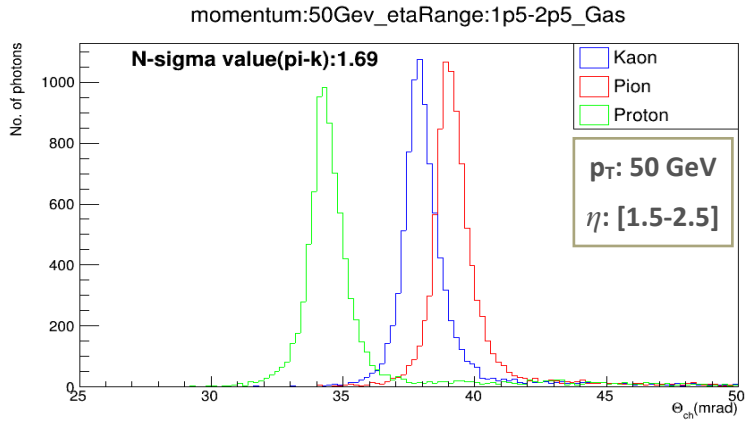

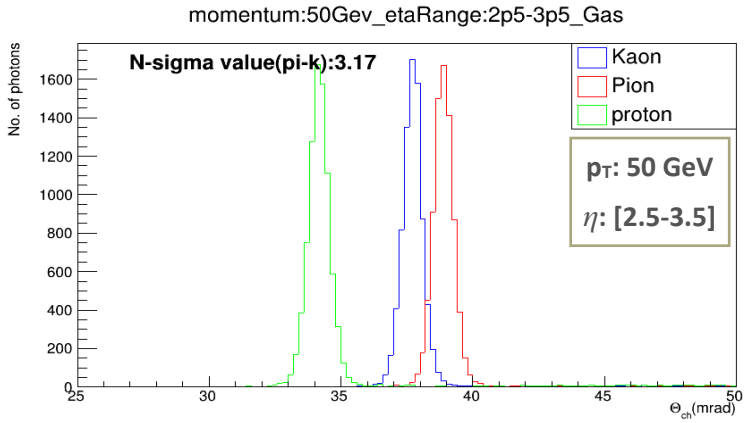

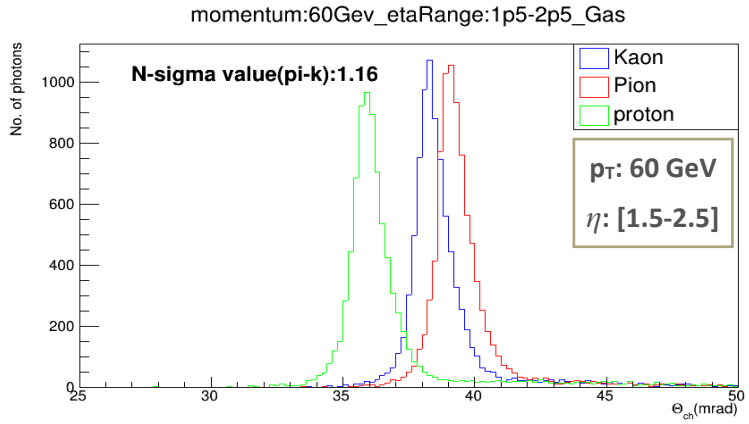

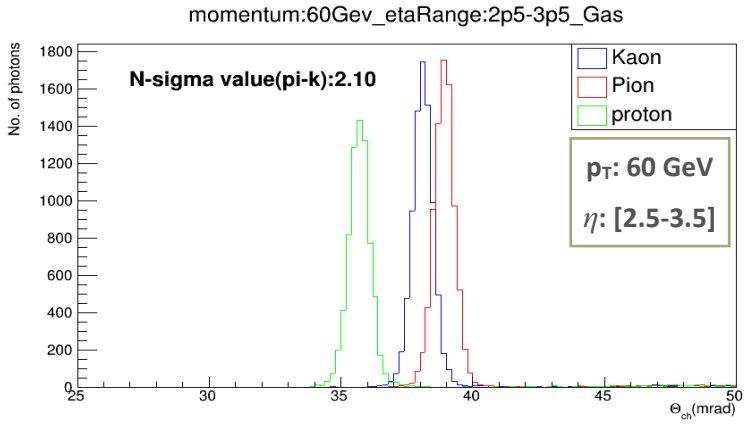

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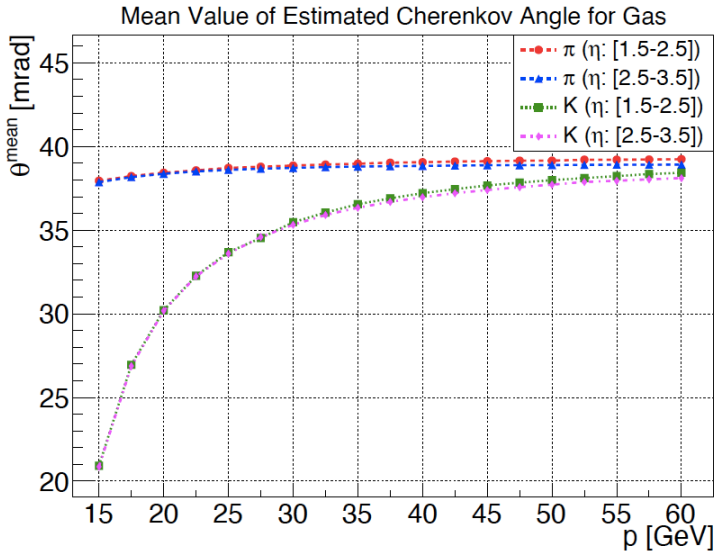
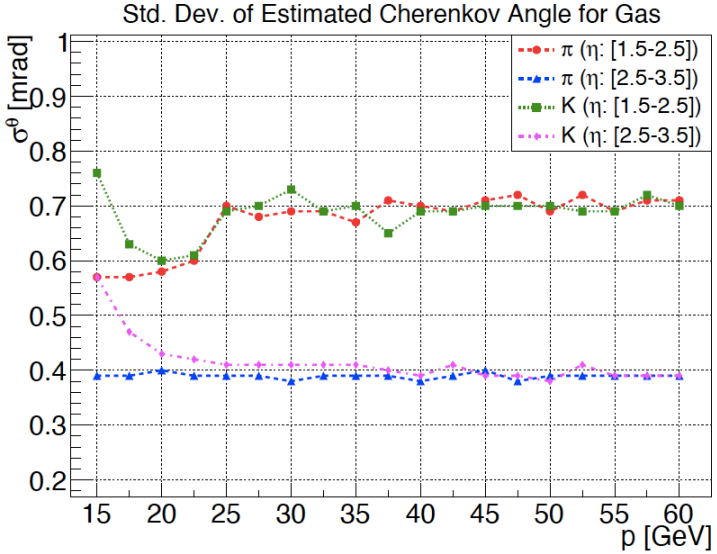
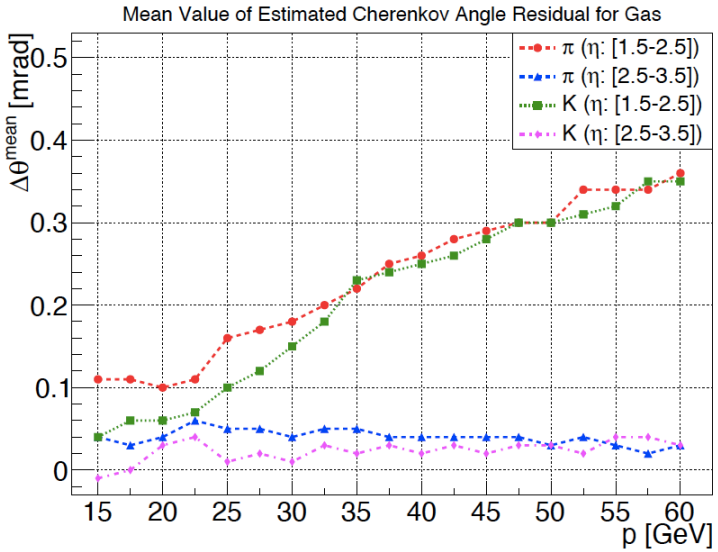
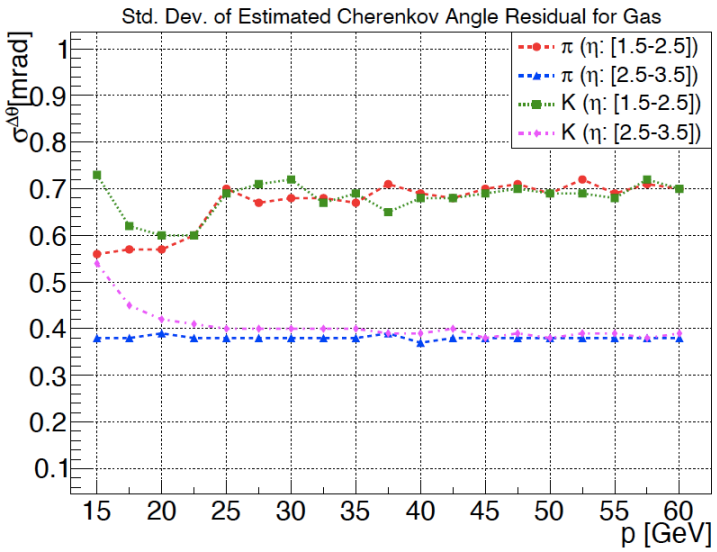
Particle Identification at dRICH

Radiator: Gas

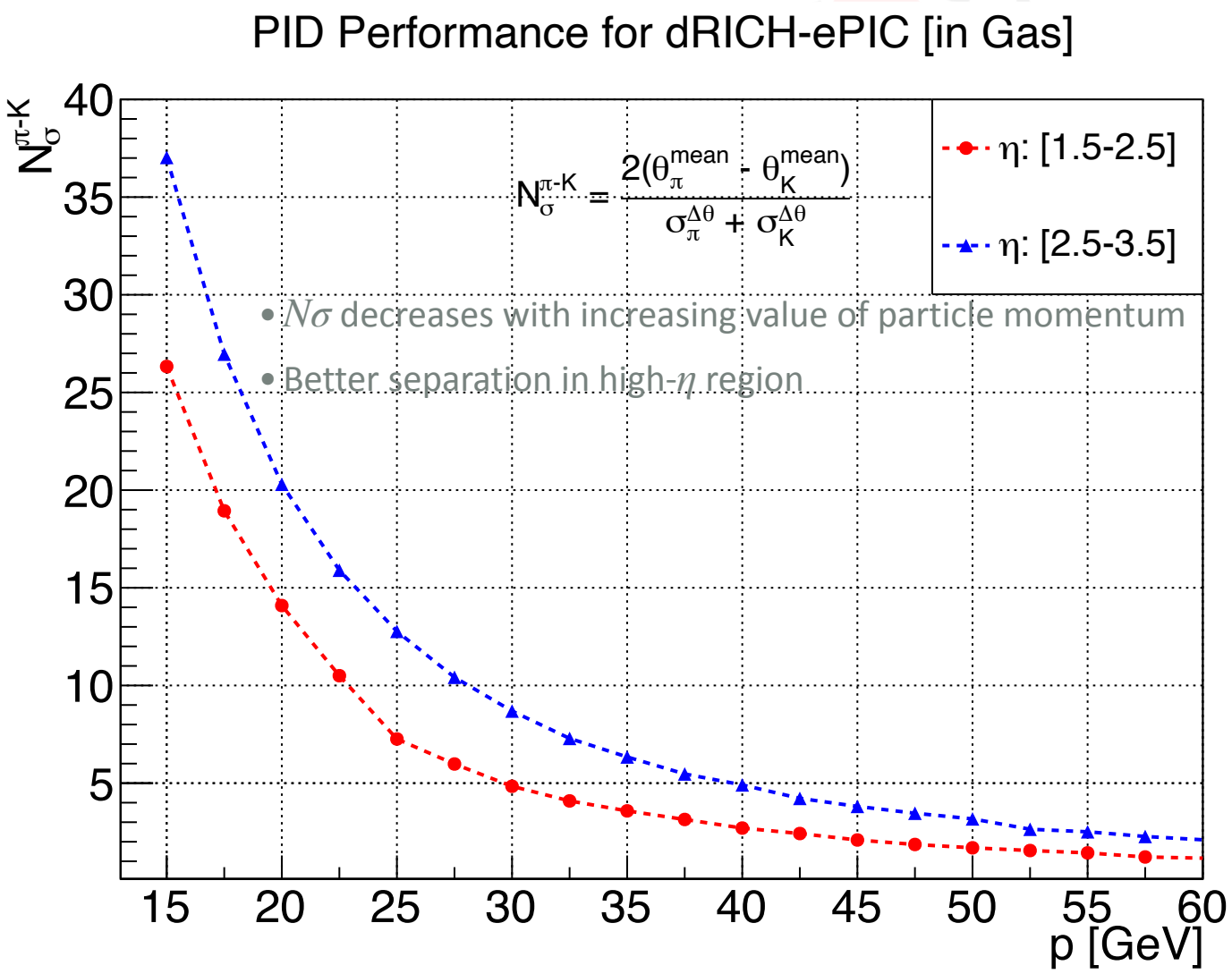








$N\sigma$ vs p ($\pi - K$ separation)



GPU Facility @CUK

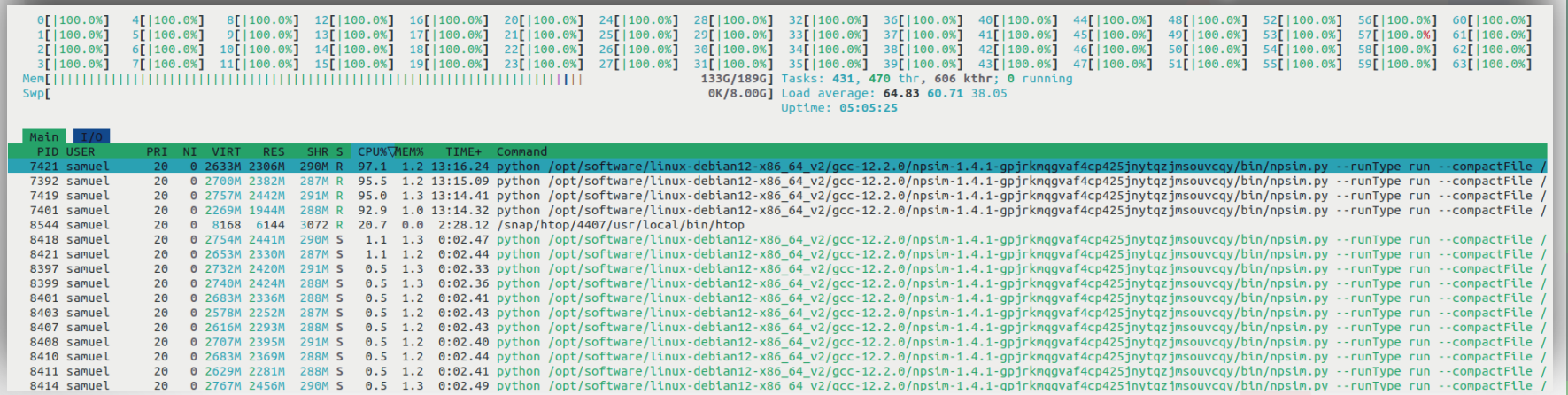
GPU Specifications

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

Availability

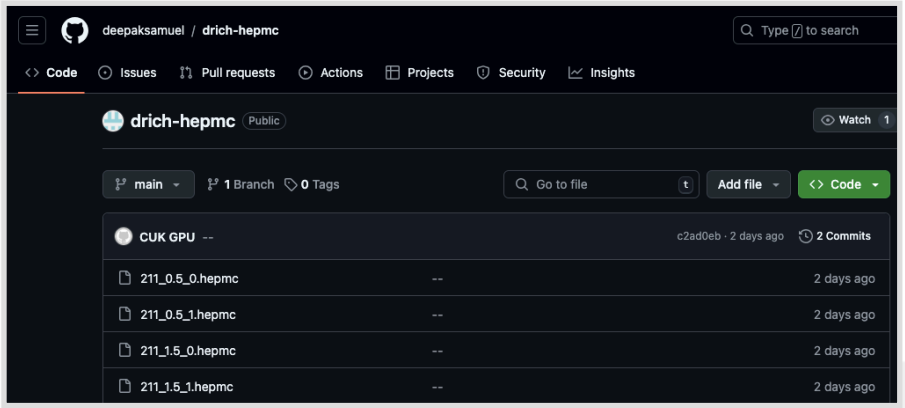
12h per day
for EIC activities

Parallel processing of
DRICH simulations

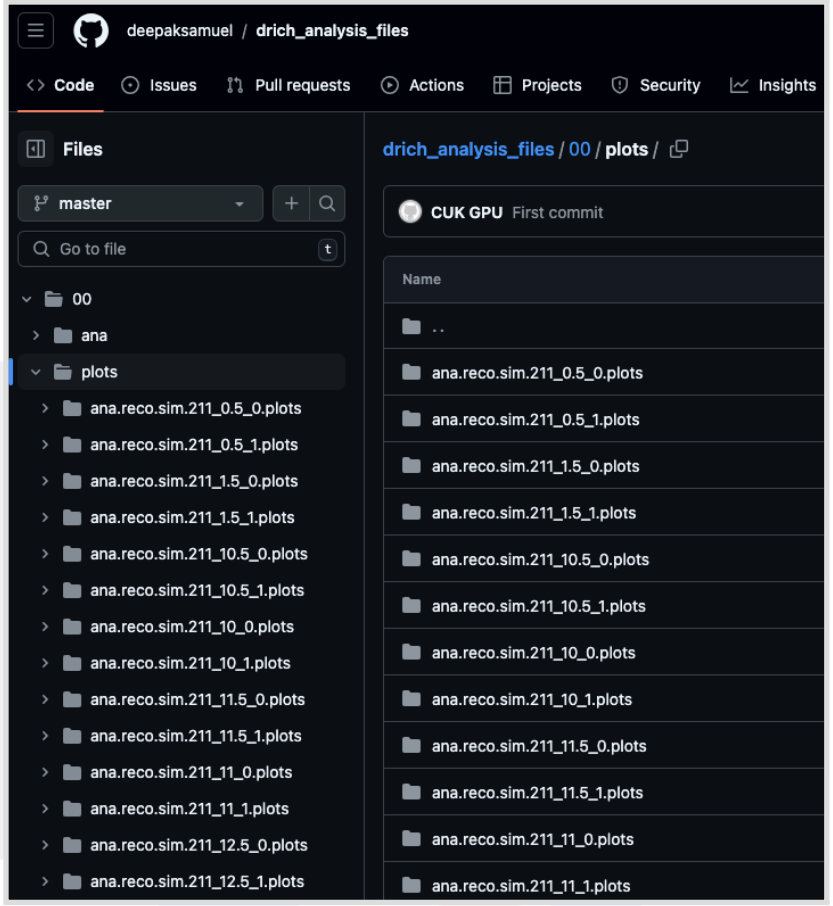


Use of GPU for Simulation

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



https://github.com/deepaksamuel/drich_analysis_files



- Switching to GPU for event simulation
- Production of HEPMC files
- Thanks to basis script from Chandra & significant efforts from Deepak

- *Event generation is being done (for pions, kaons and protons) in two η-regions: [1.5 to 2.5] and [2.5 to 3.5] for different momentum values in the range 10-60 GeV with a step-size of 0.5 GeV [10k events for each p-value]*

[Test Run for 50 events only]

- The HEPMC files are also accessible to other members of the group for their use

Summary

- We aim to perform PID performance studies for dRICH at ePIC (TDR contribution)
  - N_σ vs p plots for both radiators for corresponding to $\pi - K$ and $p - K$ separation
  - Look Up Tables (LUTs)
- Fully working machinery for producing N_σ vs p plots
- Next (final) round of event generation & reconstruction is being done using GPU@CUK and with new aerogel parameters
- We are looking forward to show the N_σ vs p plots for both radiators during the next meeting

Thank you

We look forward to your comments and suggestions…

Our Team

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Student (CUK)

Indranil Samanta
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Hrishikesh
Student

Nebin George
Student

Niranjan
Student