

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**

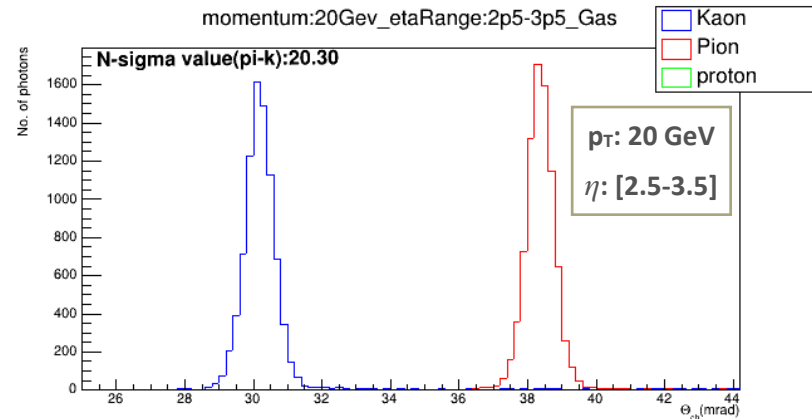
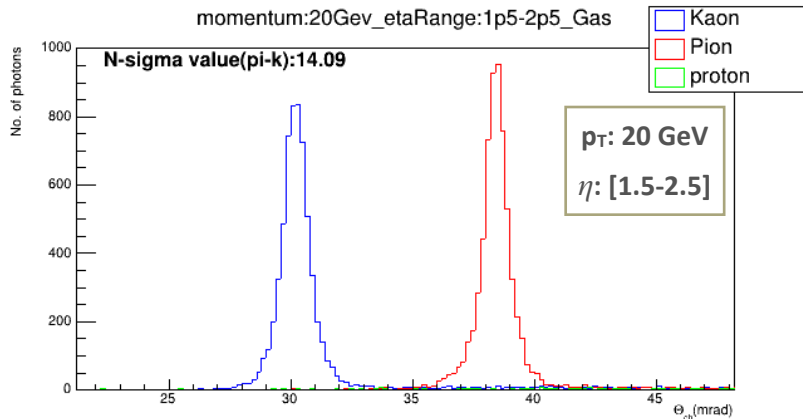
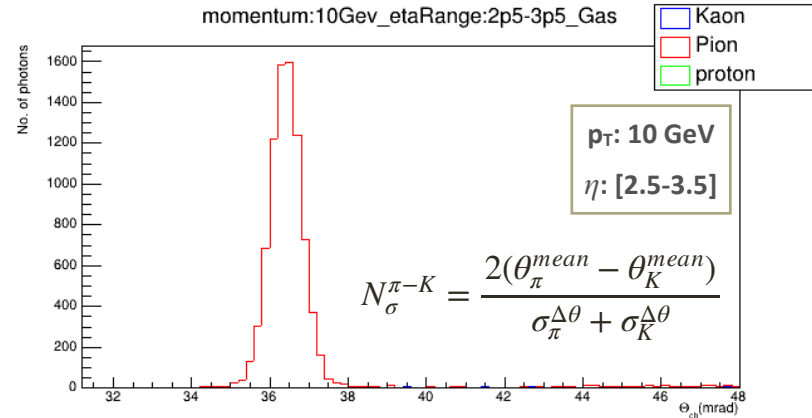
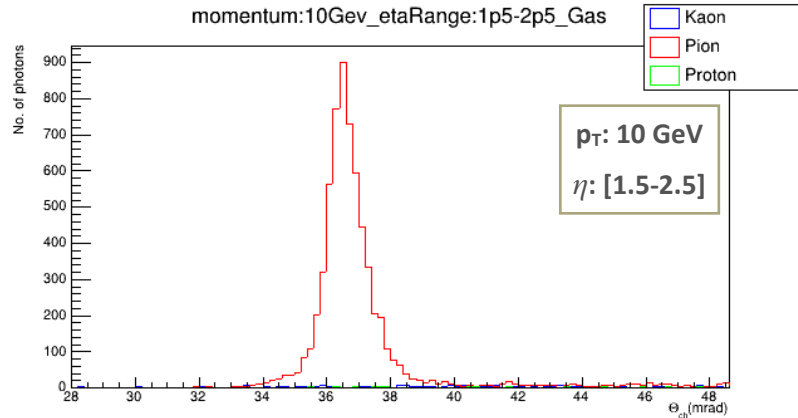
- Today's presentation (Similar study with resolved issues):

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 $N_\sigma(\pi - K)$ and plotting it as a function of momentum

Particle Identification at dRICH

Radiator: Gas

Credits: Rohit, Tanya, Girdish, Taniya

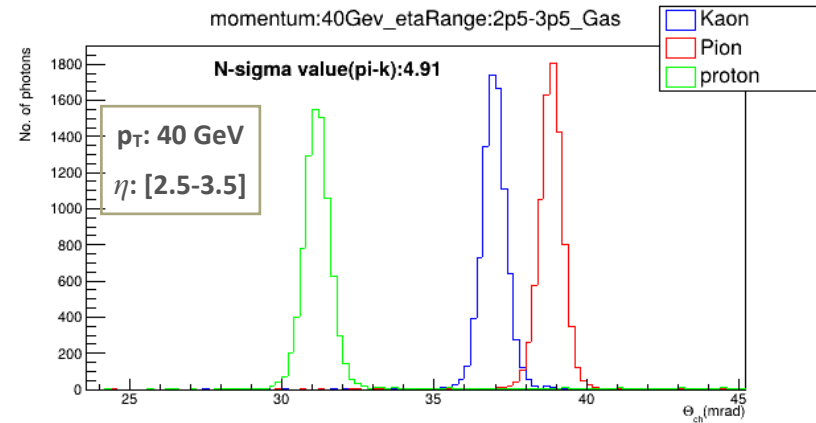
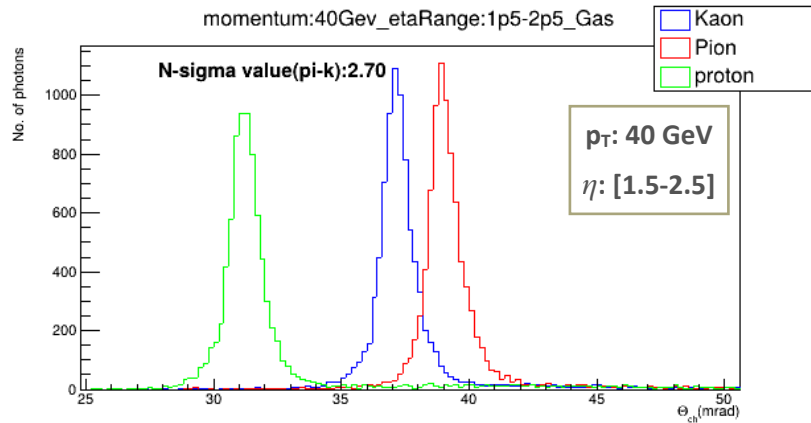
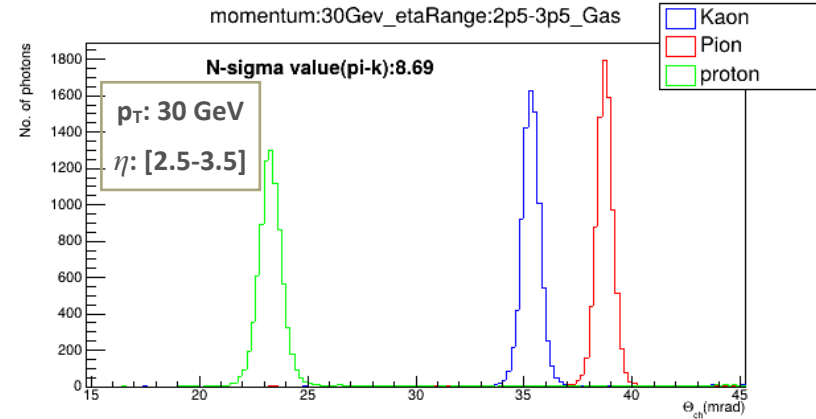
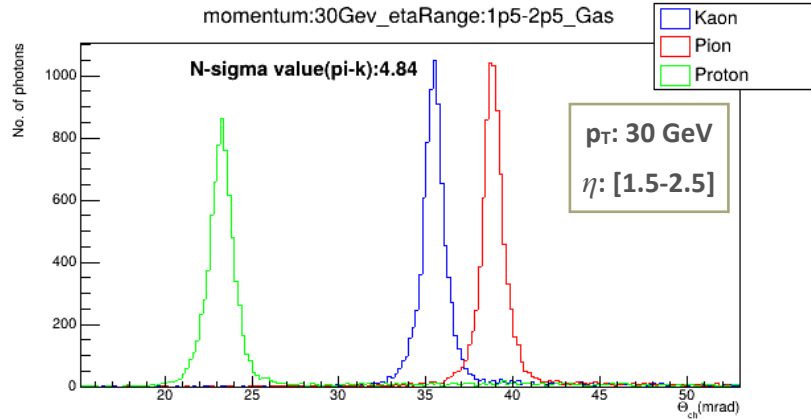


- The kaons with higher (>10 GeV) threshold are not observed at 10 GeV
- The protons with even higher (>20 GeV) threshold are not observed at 10 GeV & 20 GeV

Particle Identification at dRICH

Radiator: Gas

Credits: Rohit, Tanya, Girdish, Taniya



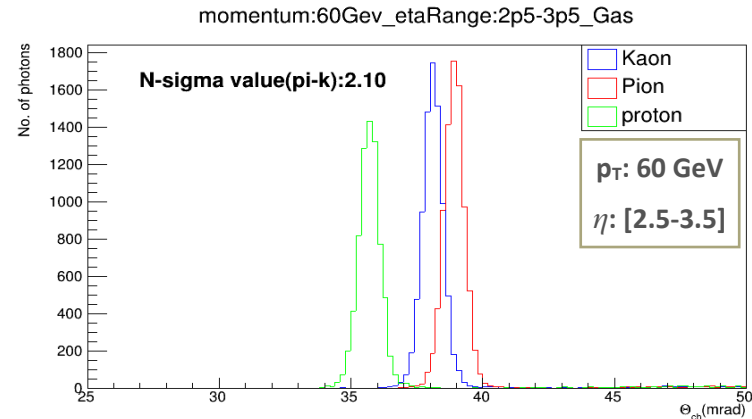
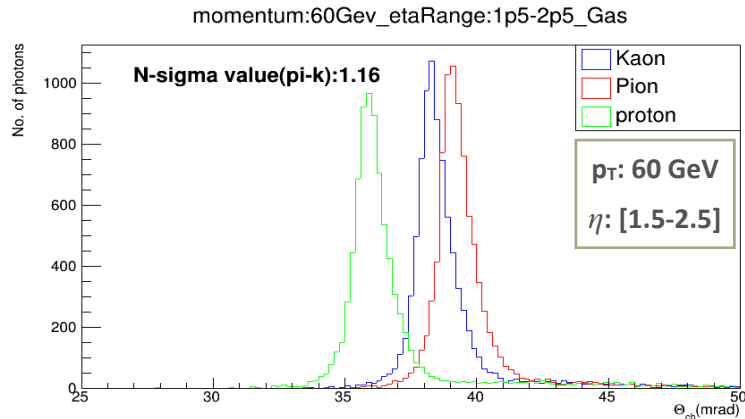
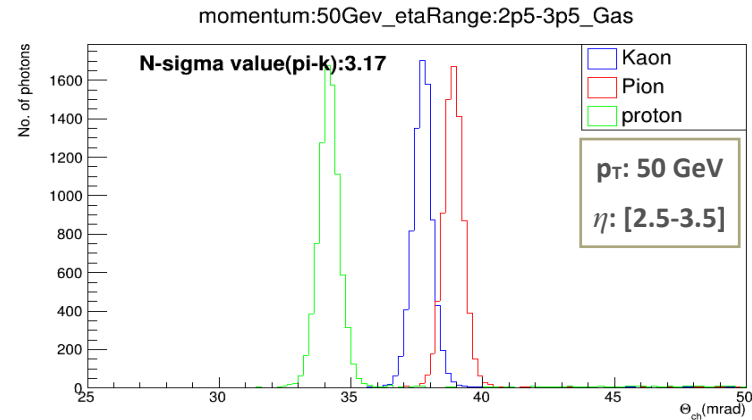
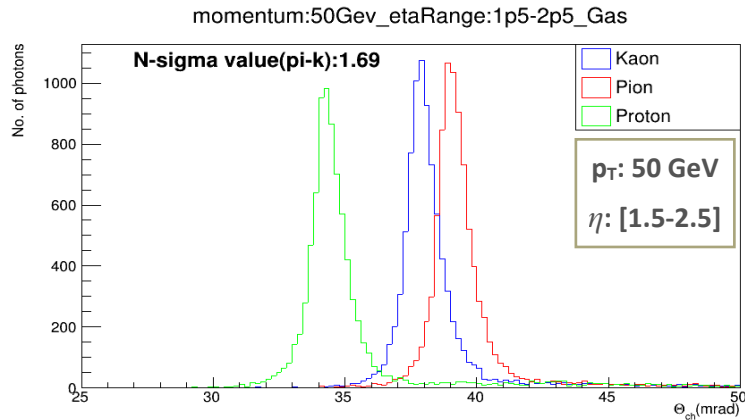
- $N\sigma$ separation decreases as particle momentum increases
- Separation is better in high- η region

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

Particle Identification at dRICH

Radiator: Gas

Credits: Rohit, Tanya, Girdish, Taniya

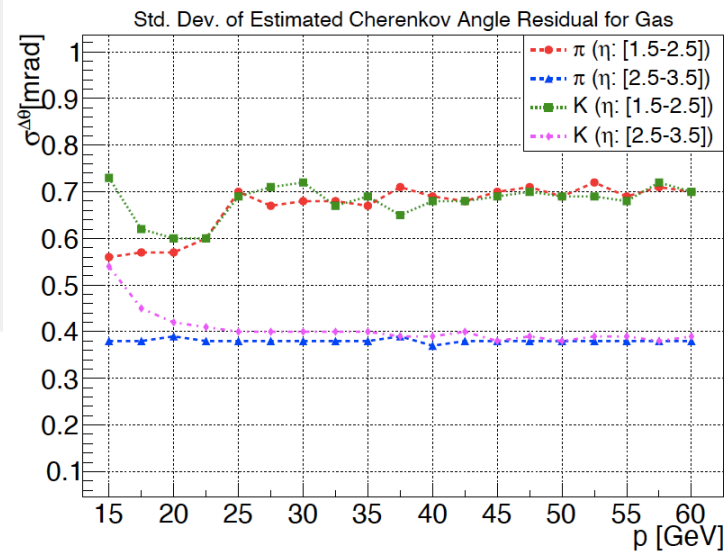
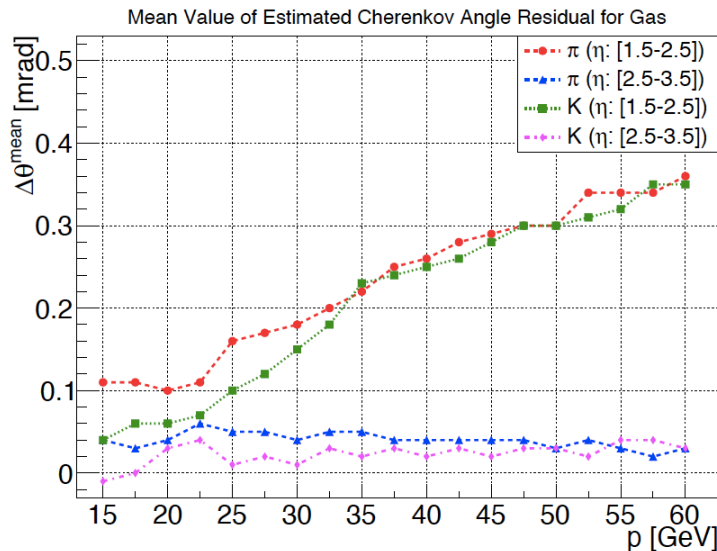
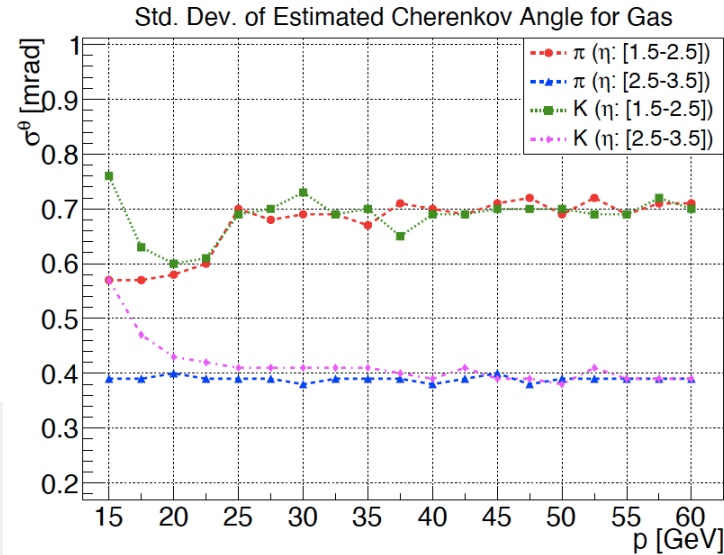
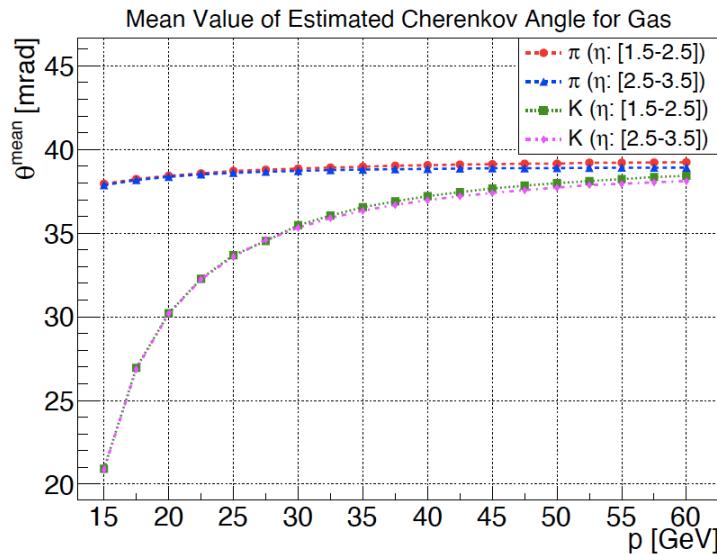


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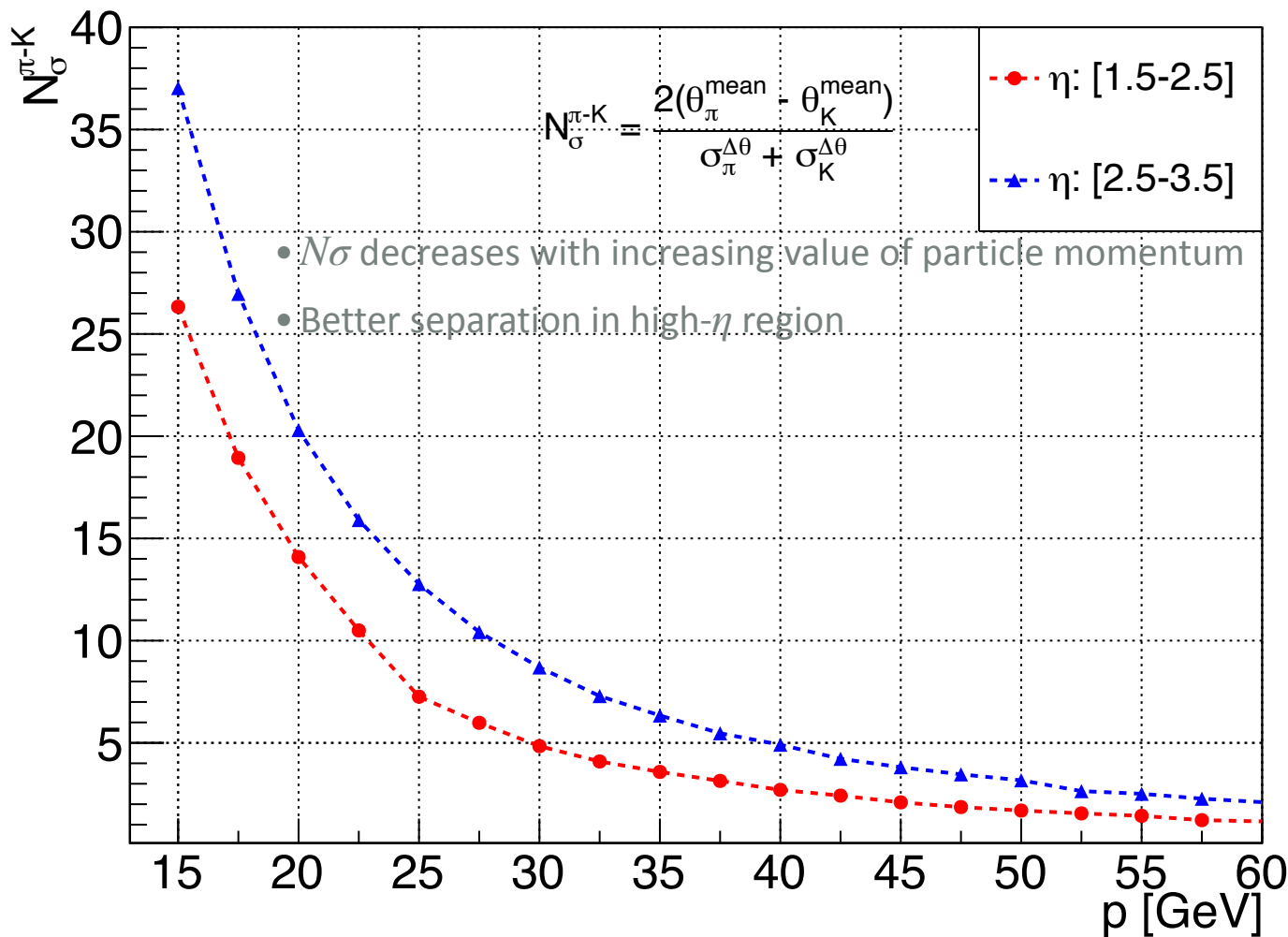
Particle Identification at dRICH

Radiator: Gas



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

PID Performance for dRICH-ePIC [in Gas]



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



```

0[|100.0%] 4[|100.0%] 8[|100.0%] 12[|100.0%] 16[|100.0%] 20[|100.0%] 24[|100.0%] 28[|100.0%] 32[|100.0%] 36[|100.0%] 40[|100.0%] 44[|100.0%] 48[|100.0%] 52[|100.0%] 56[|100.0%] 60[|100.0%]
1[|100.0%] 5[|100.0%] 9[|100.0%] 13[|100.0%] 17[|100.0%] 21[|100.0%] 25[|100.0%] 29[|100.0%] 33[|100.0%] 37[|100.0%] 41[|100.0%] 45[|100.0%] 49[|100.0%] 53[|100.0%] 57[|100.0%] 61[|100.0%]
2[|100.0%] 6[|100.0%] 10[|100.0%] 14[|100.0%] 18[|100.0%] 22[|100.0%] 26[|100.0%] 30[|100.0%] 34[|100.0%] 38[|100.0%] 42[|100.0%] 46[|100.0%] 50[|100.0%] 54[|100.0%] 58[|100.0%] 62[|100.0%]
3[|100.0%] 7[|100.0%] 11[|100.0%] 15[|100.0%] 19[|100.0%] 23[|100.0%] 27[|100.0%] 31[|100.0%] 35[|100.0%] 39[|100.0%] 43[|100.0%] 47[|100.0%] 51[|100.0%] 55[|100.0%] 59[|100.0%] 63[|100.0%]
Mem[|||||] Tasks: 431, 470 thr, 606 kthr; 0 running
Swap[|||||] Load average: 64.83 60.71 38.05
                                Uptime: 05:05:25

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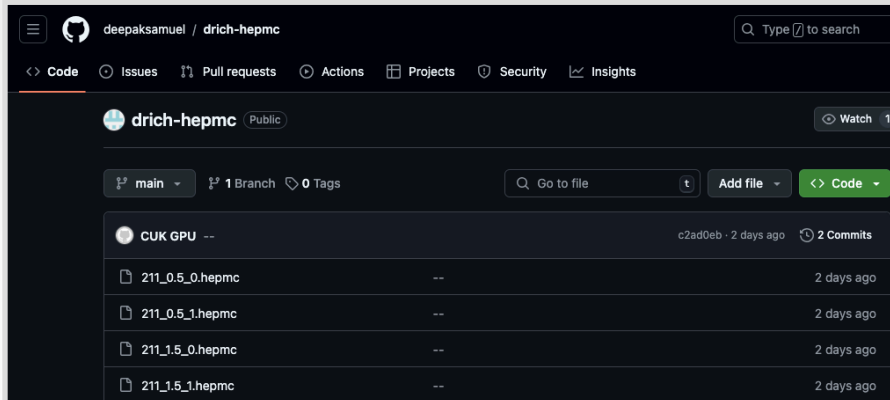
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Main I/O
PID USER PRI NI VIRT RES SHR S CPU%MEM% TIME+ Command
7421 samuel 20 0 2633M 2306M 298M R 97.1 1.2 13:16.24 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
7392 samuel 20 0 2700M 2382M 287M R 95.5 1.2 13:15.09 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
7419 samuel 20 0 2757M 2442M 291M R 95.0 1.3 13:14.41 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
7401 samuel 20 0 2269M 1944M 288M R 92.9 1.0 13:14.32 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
8544 samuel 20 0 8168 6144 3072 R 20.7 0.0 2:28.12 /snap/htop/4407/usr/local/bin/htop
8418 samuel 20 0 2754M 2441M 290M S 1.1 1.3 0:02.47 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
8421 samuel 20 0 2653M 2330M 287M S 1.1 1.2 0:02.44 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
8397 samuel 20 0 2732M 2420M 291M S 0.5 1.3 0:02.33 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
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8403 samuel 20 0 2578M 2252M 287M S 0.5 1.2 0:02.43 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
8407 samuel 20 0 2616M 2293M 288M S 0.5 1.2 0:02.43 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /
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8414 samuel 20 0 2767M 2456M 290M S 0.5 1.3 0:02.49 python /opt/software/linux-debian12-x86_64_v2/gcc-12.2.0/npsim-1.4.1-gpjrknqgvaf4cp425jnytzqjmsouvqy/bin/npsim.py --runType run --compactFile /

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Use of GPU for Simulation

<https://github.com/deepaksamuel/drich-hePMC>

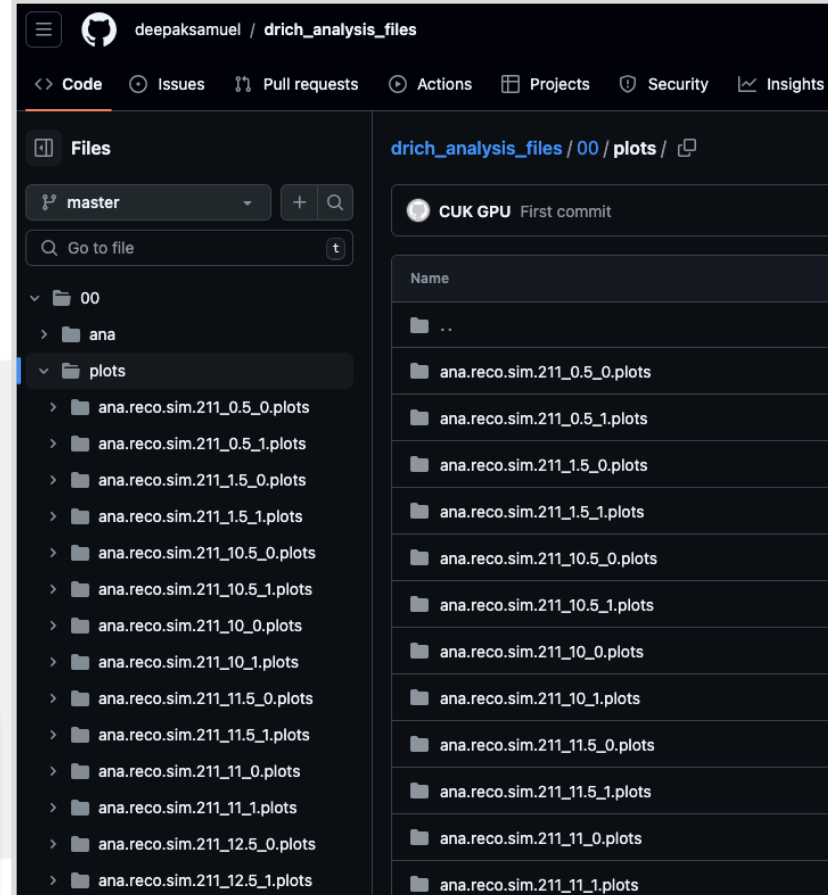


- Switching to GPU for event simulation
- Production of HEPMC files
- Thanks to basis script from Chandra & significant efforts from Deepak

• *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]*

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

https://github.com/deepaksamuel/drich_analysis_files



[Test Run for 50 events only]

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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Girdish Laishram
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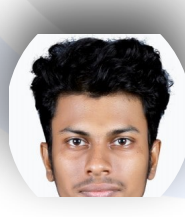
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Adithyan Rajan
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Indranil Samanta
Student



Hrishikesh
Student



Nebin George
Student



Niranjana
Student