Updates from simulation side

Chandradoy Chatterjee
On behalf of the dRICH simulation team

CENTRAL UNIVERSITY OF KARNATAKA

CENTRAL UNIVERSITY OF HARYANA

Duke UNIVERSITY

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

UNIVERSITÀ DELLA CALABRIA

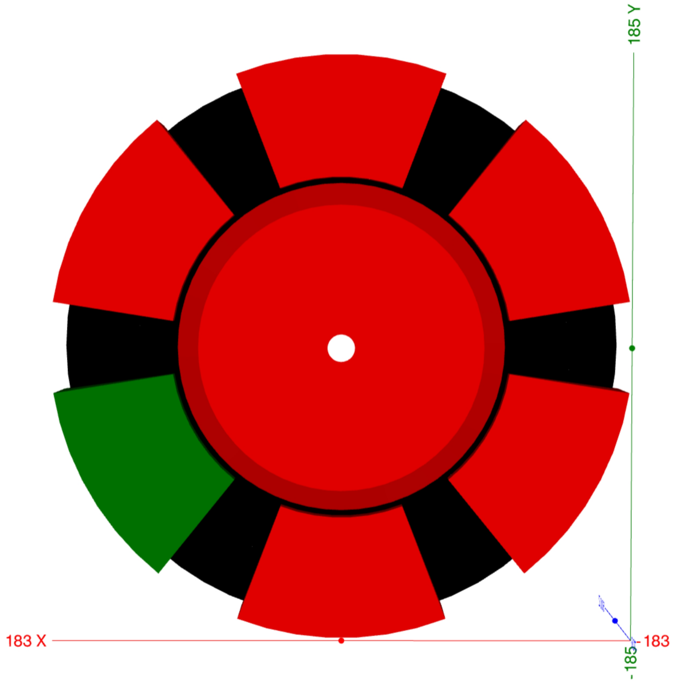
INFN

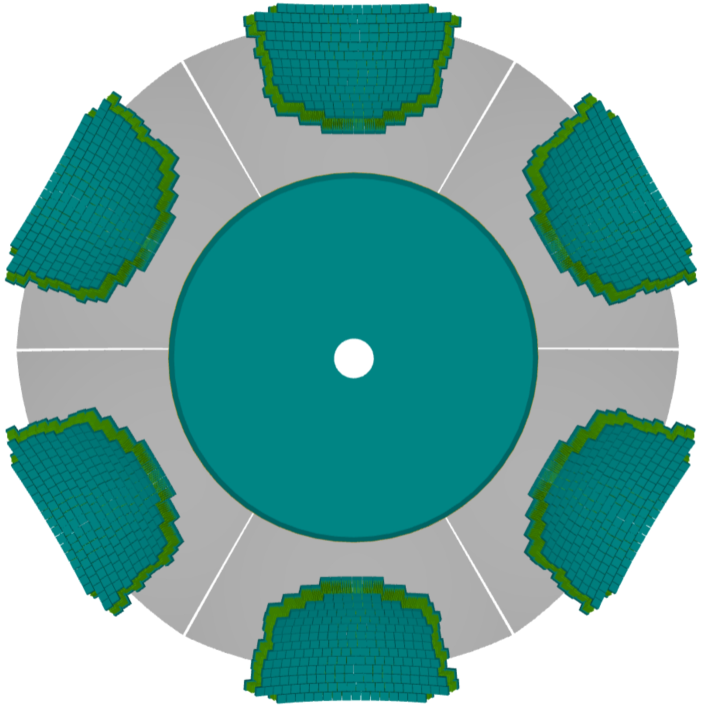
UNIVERSITÀ DEGLI STUDI DI SALERNO

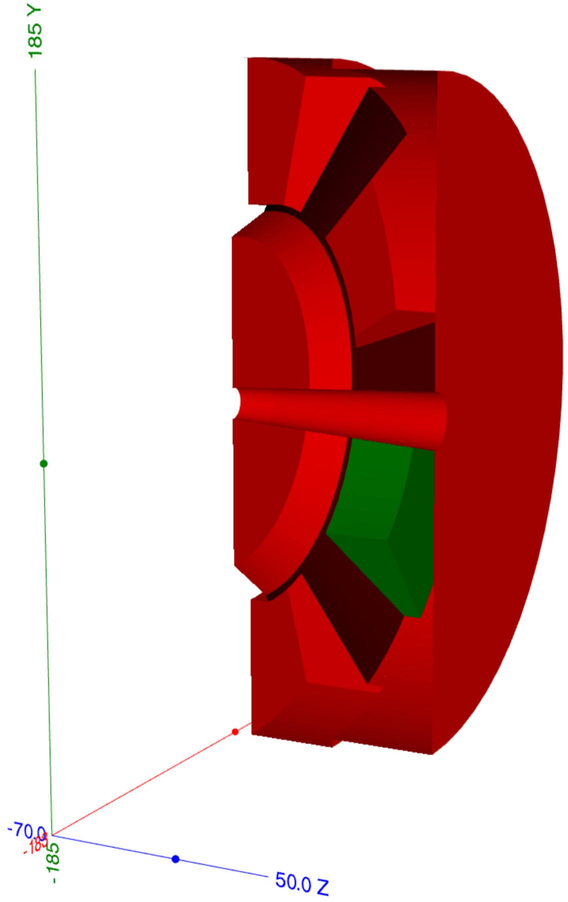
Outline

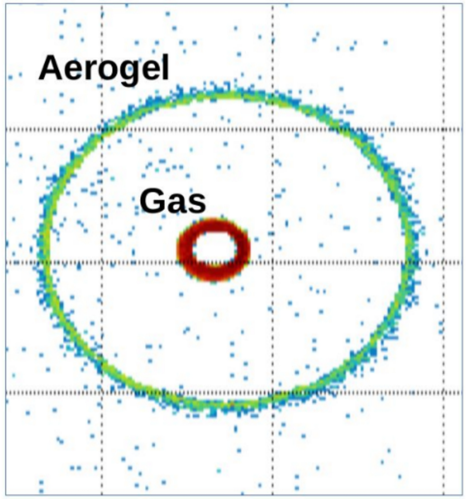
- Quick recapitulations: What do we learn?
- Ongoing activities
- Required tasks for PID review
- Discussions

Let’s Recall (geometry)



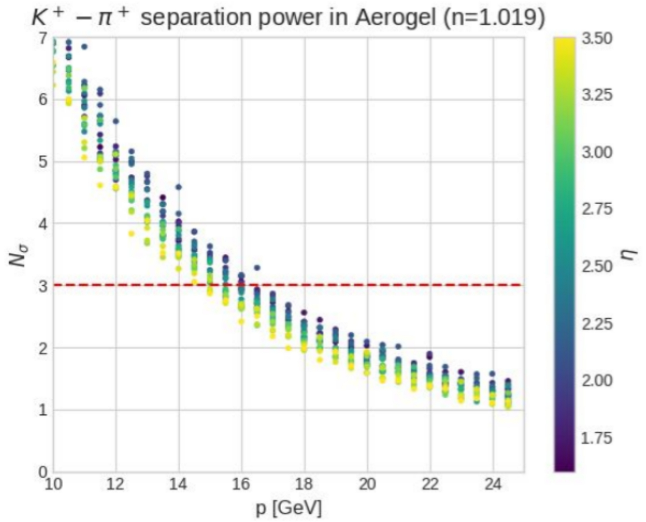


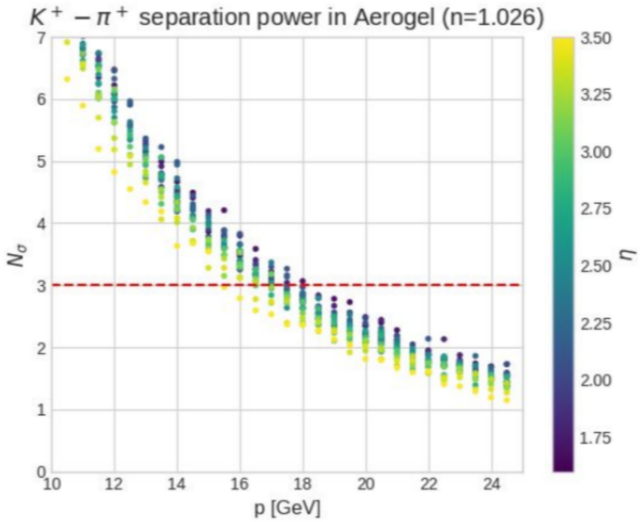




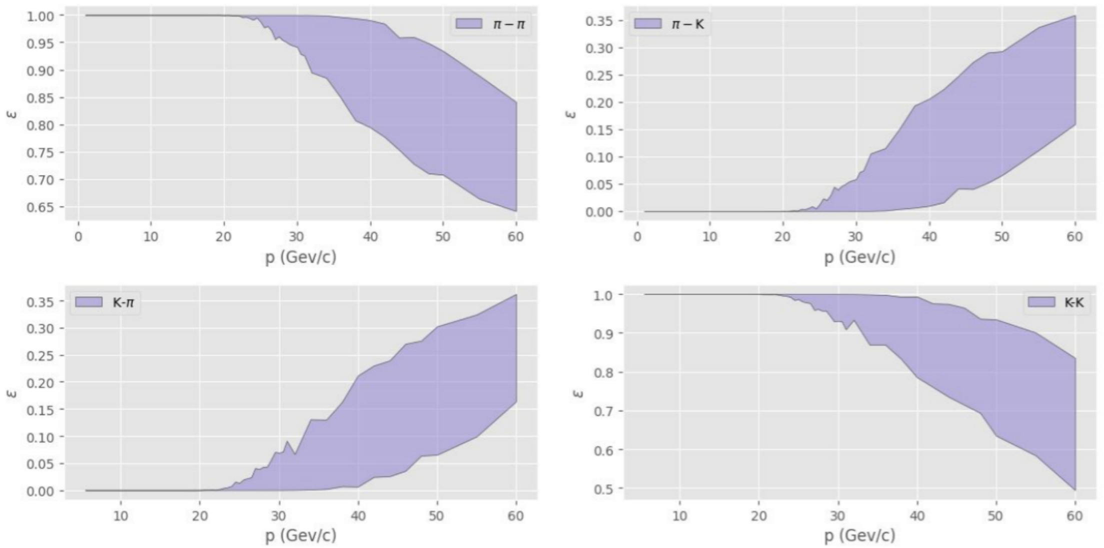
- Length: Along beam ~ 120 cm, Radially~180 cm
- Aerogel (nominal refractive index = 1.019) and C_2F_6 (nominal index = 1.00076) used as radiator.
- Six identical mirror-sensor sectors
- Each sensor sector is composed of 209 Photon Detection Units (PDUs). Each PDU is a matrix of 2X2 SiPM sensors (S13361-3050AE-08). Each sensor is a matrix of 8X8 channels.

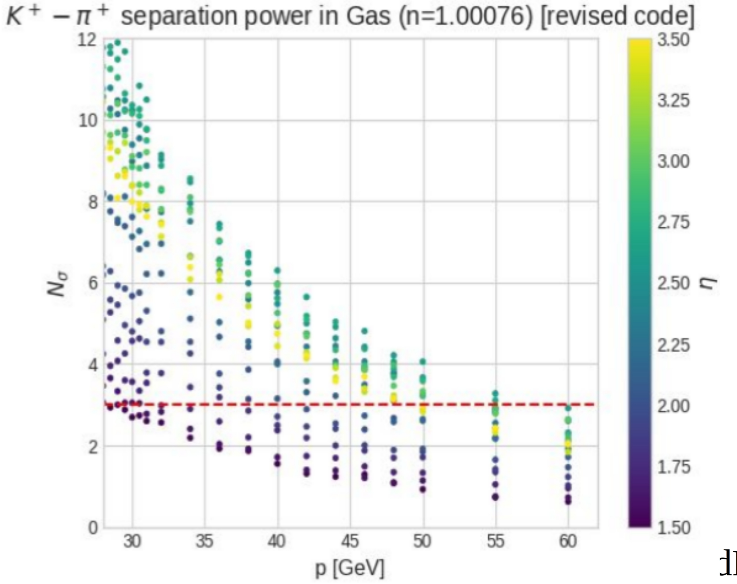
Let’s Recall (Performance)



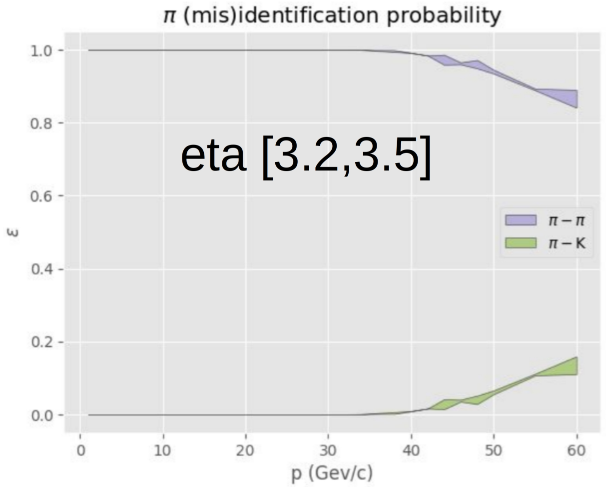


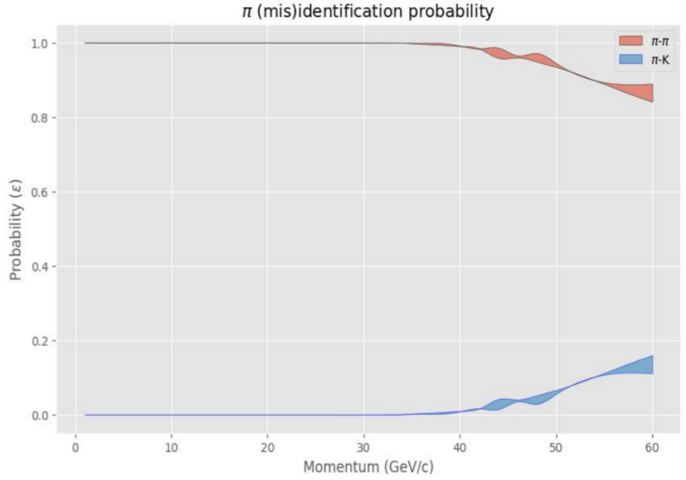
eta: 1.5-3.5 (full range)



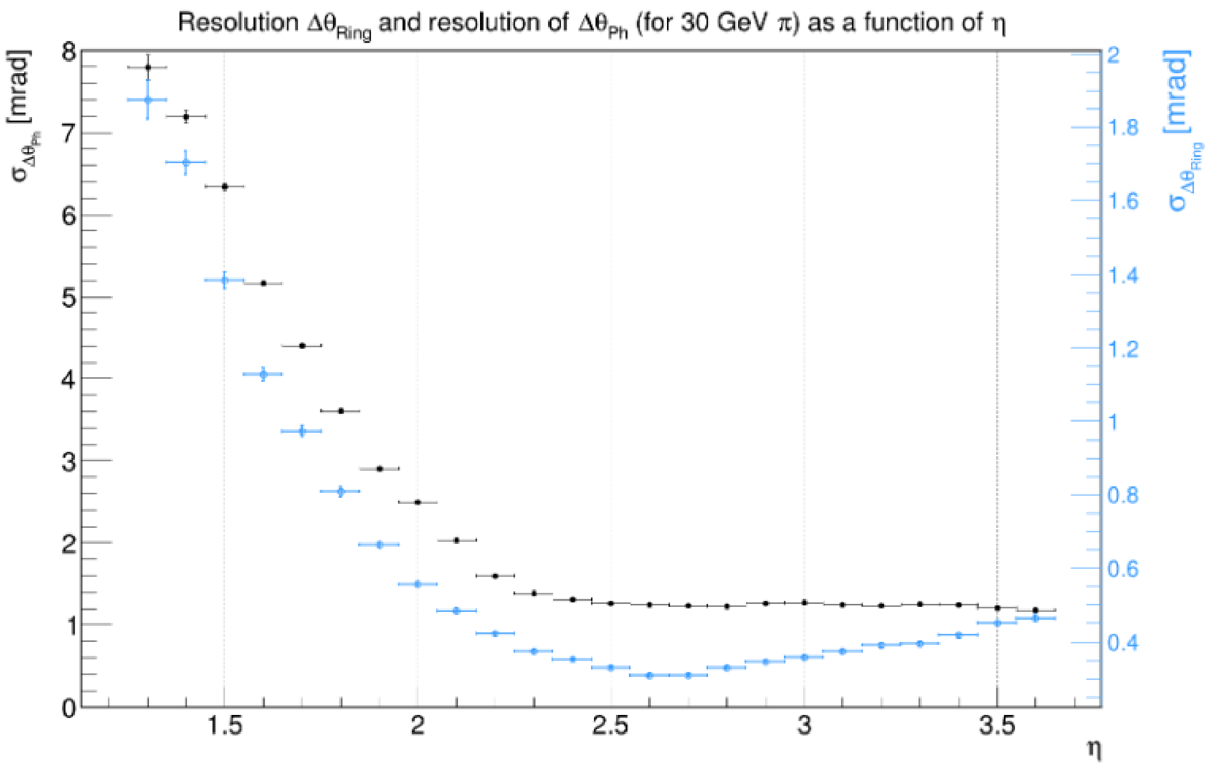


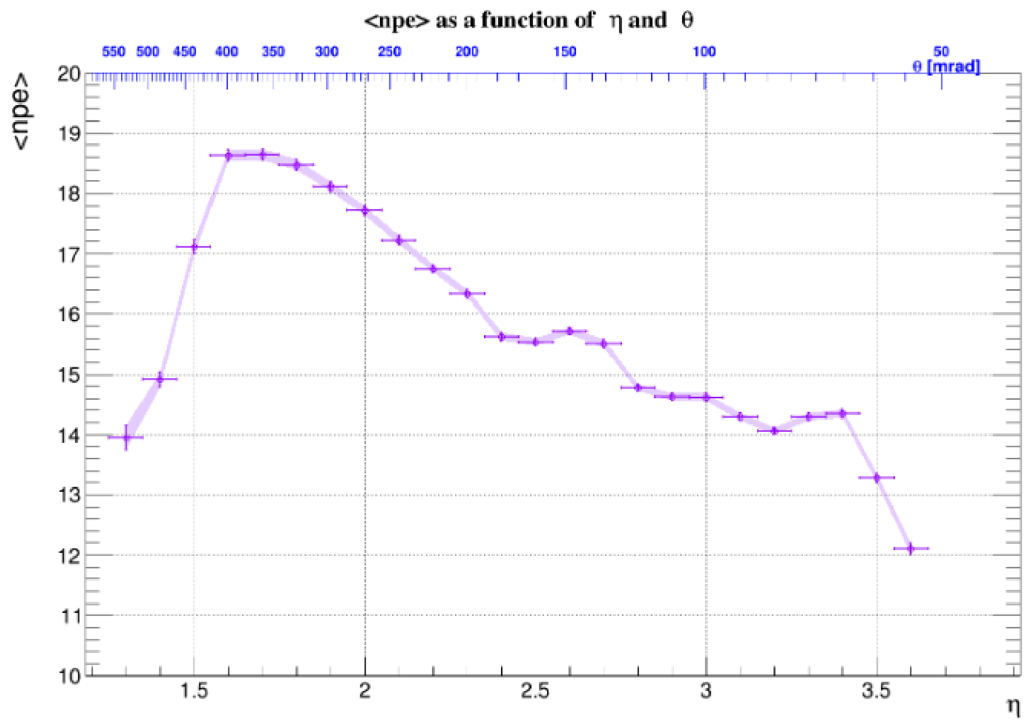
Merged probabilities: Both radiators (Aerogel + Gas)





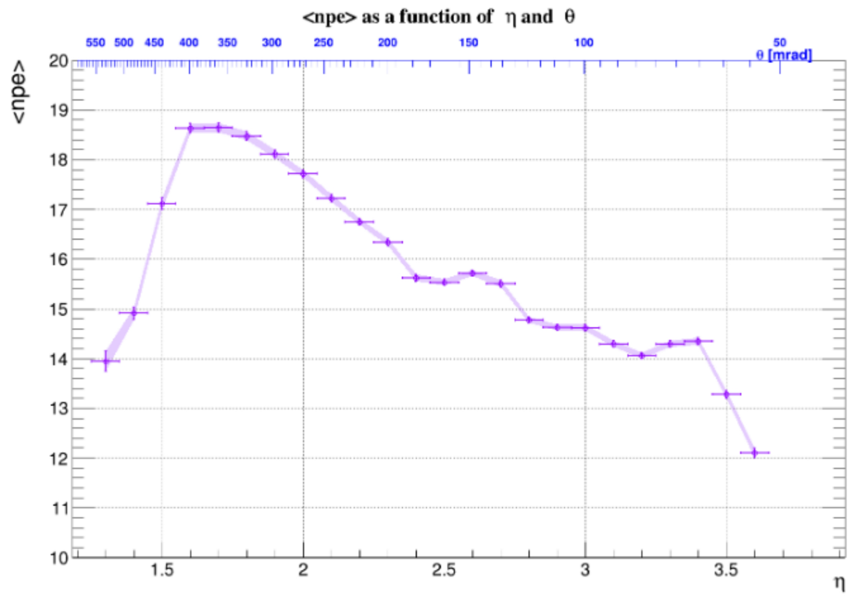
Let’s Recall (Performance)

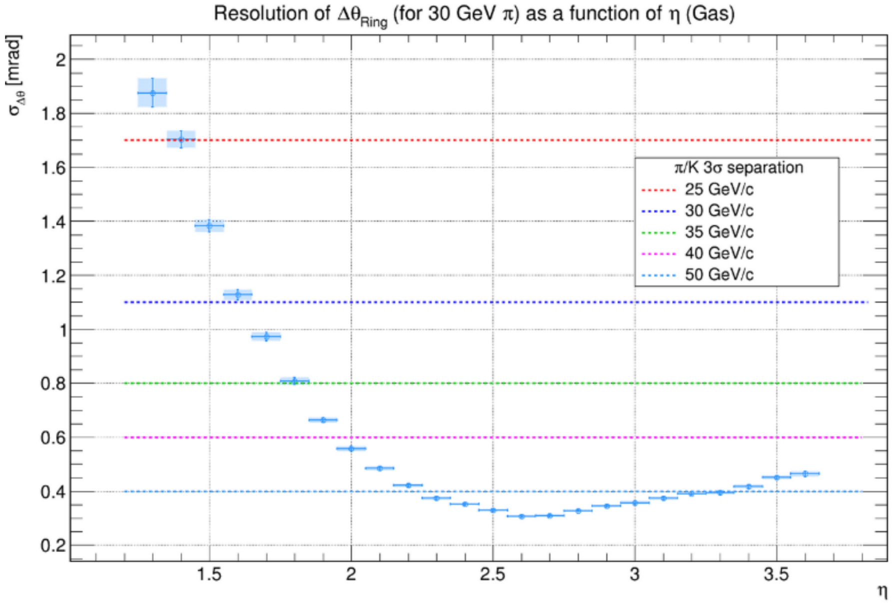




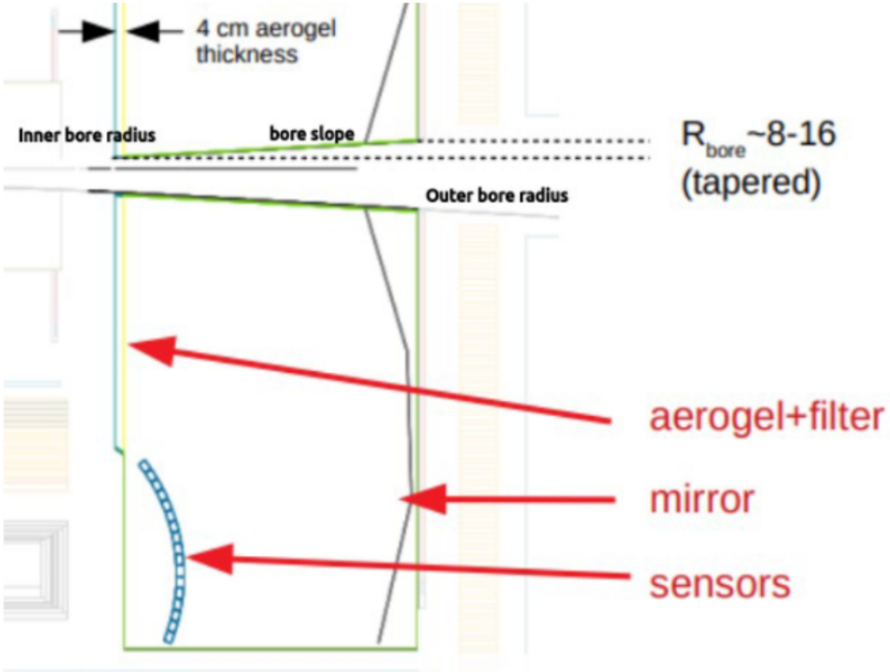
Jinky showed us: We have marginal photons in the highest pseudorapidity.
The optical tuning in current configuration is not the stopping point.
Rule of thumb: We loose 1-2 photons, we go out of 50 GeV/c three -sigma limit!

Ongoing:Effect of the beam-pipe





Structure and dimensions of beam pipe



Beam pipe dimensions

- Inner bore radius = 8.621cm
- Outer bore radius= 15.478cm
- Bore slope =0.057

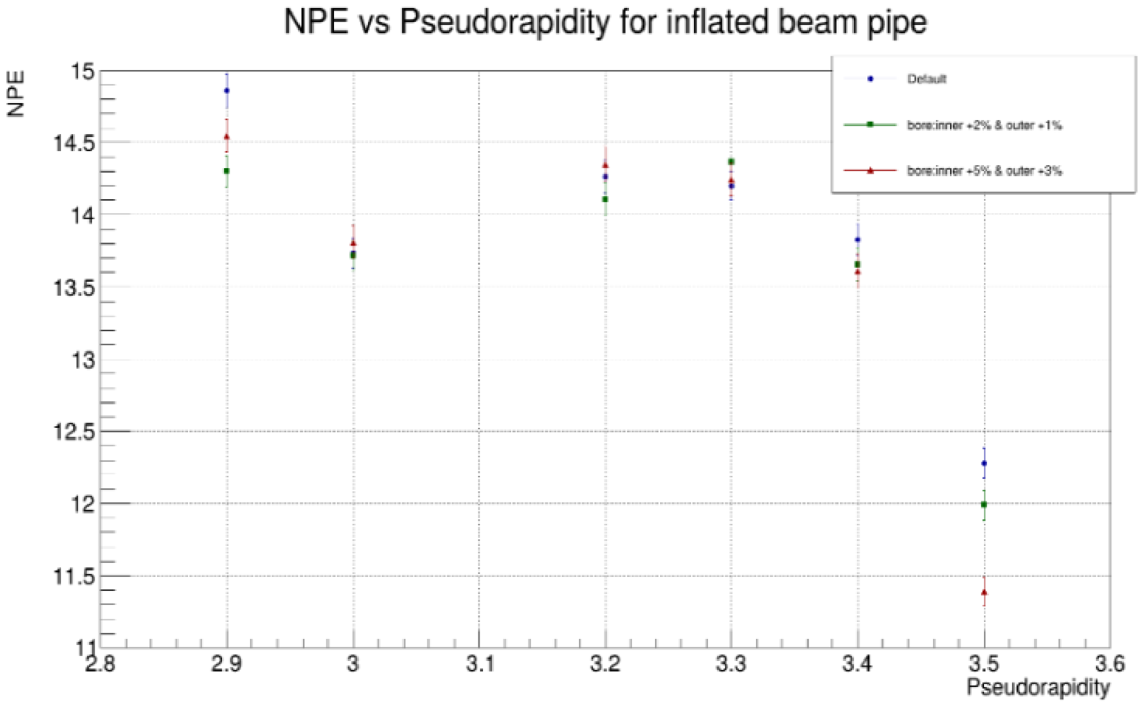
Investigate the effects of beam pipe inflation on detector performance particularly in high pseudorapidity regions.

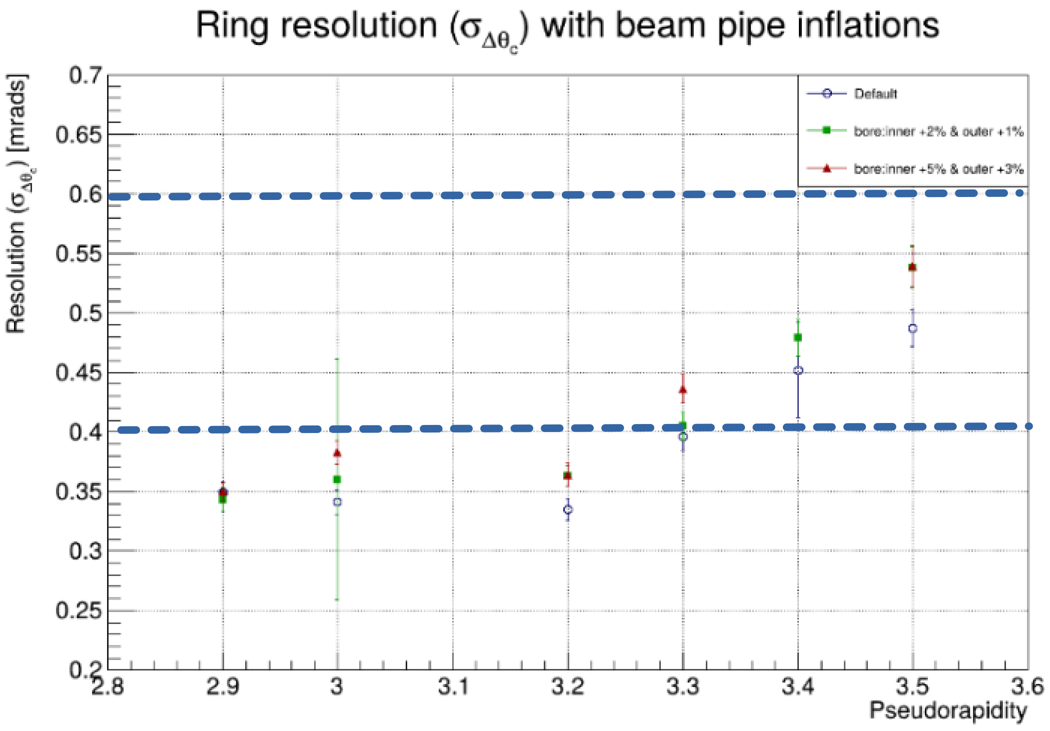
Studies by Rohit Singh

Ongoing:Effect of the beam-pipe

Studies by Rohit Singh

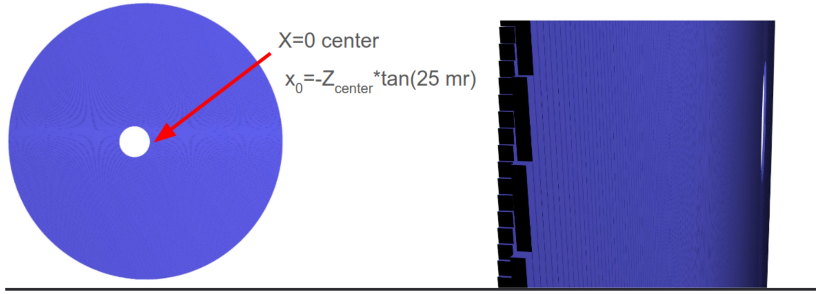
- Default - Inner bore radius = 8.621cm outer bore radius = 15.478 cm
- Inflated inner bore by 2% = 8.793 and outer bore by 1% - 15.633 cm
- Inflated inner bore by 5% = 9.052 and outer bore by 3% - 15.942 cm

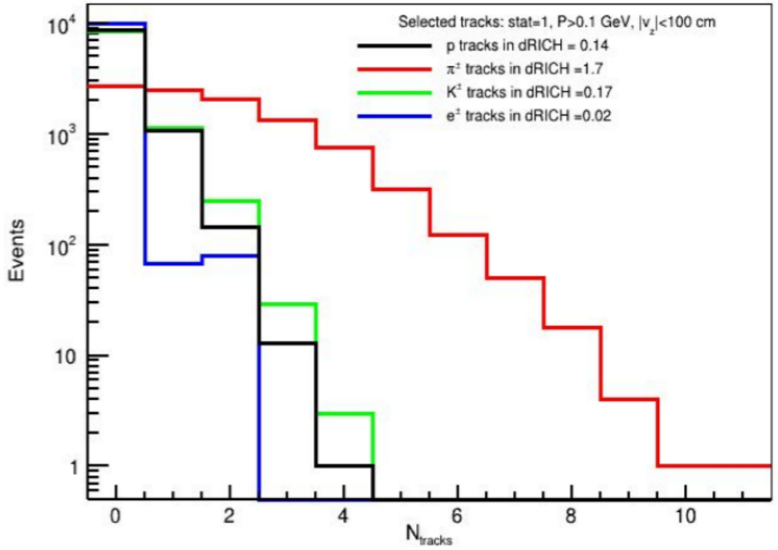


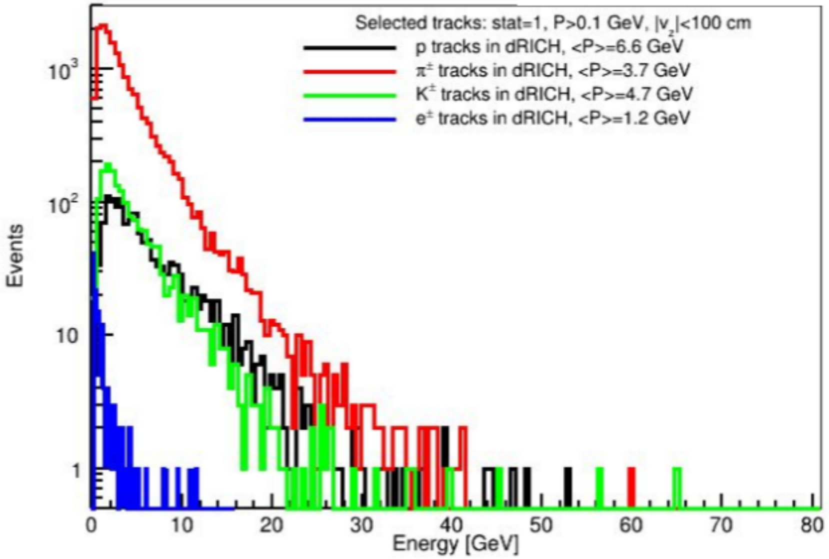


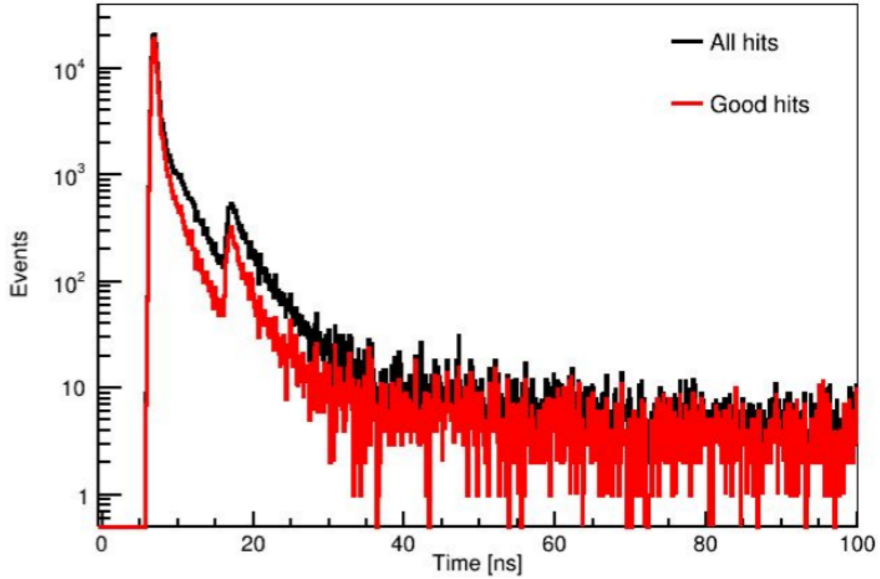
We have tools to play with bore radii and slope.
Effects coming from inner radii and outer radii can be estimated

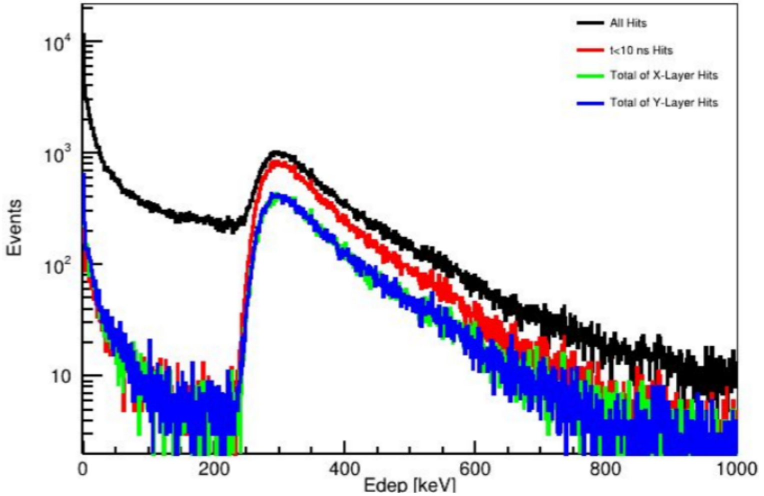
Ongoing activities: dRICH tagger







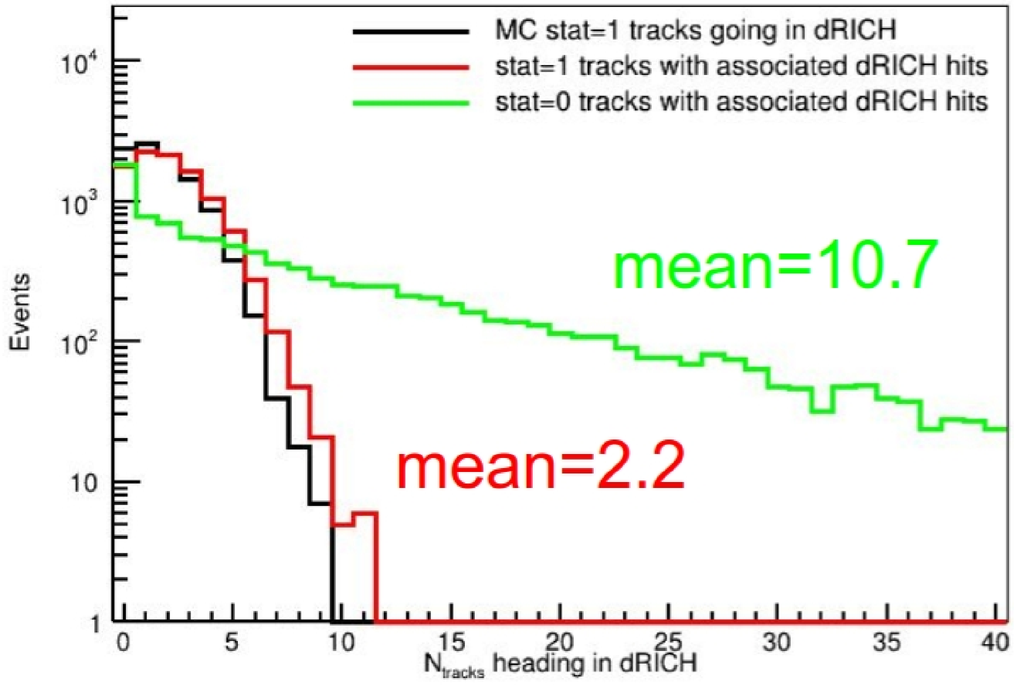


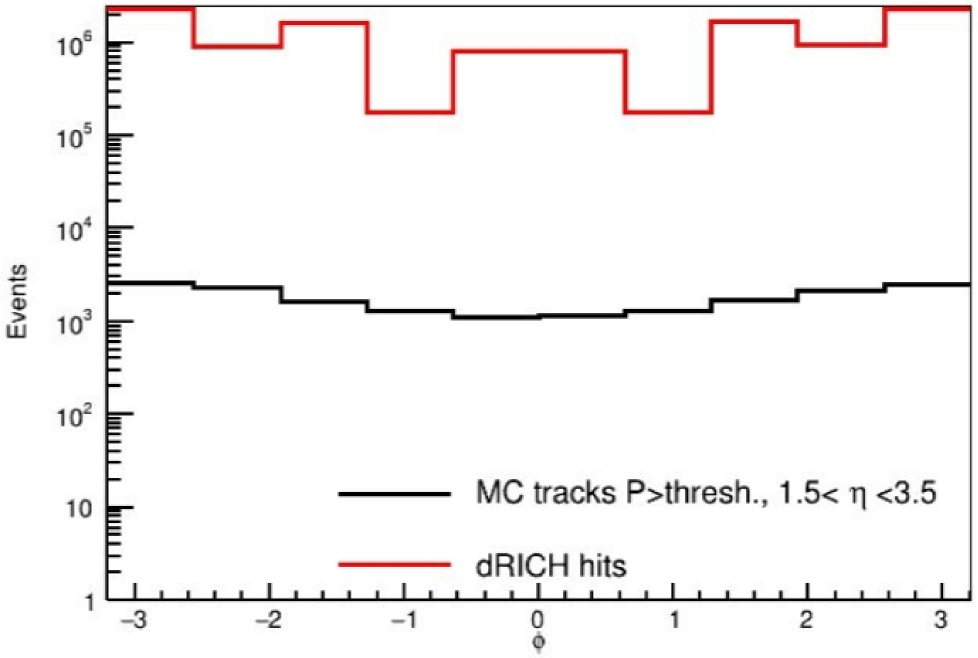


- mean number of dIT (>50 keV, <10 ns) hits =18, or about 9 hits/layer - looks high for 2 tracks? But only 1.4 hits/layer associated with stat=1 tracks!
- most probable deposited energy =300 keV/layer =2400 photons , assuming trapping efficiency of 4.2% (Kuraray) gives 50 photons/SiPM;
- time for 81% of hits within 2 ns , 89% in 10 ns -OK (doesn't include light propagation in fiber);

A dRICH tagger has been implemented and presented by M. Osipenko

Ongoing activities: dRICH tagger



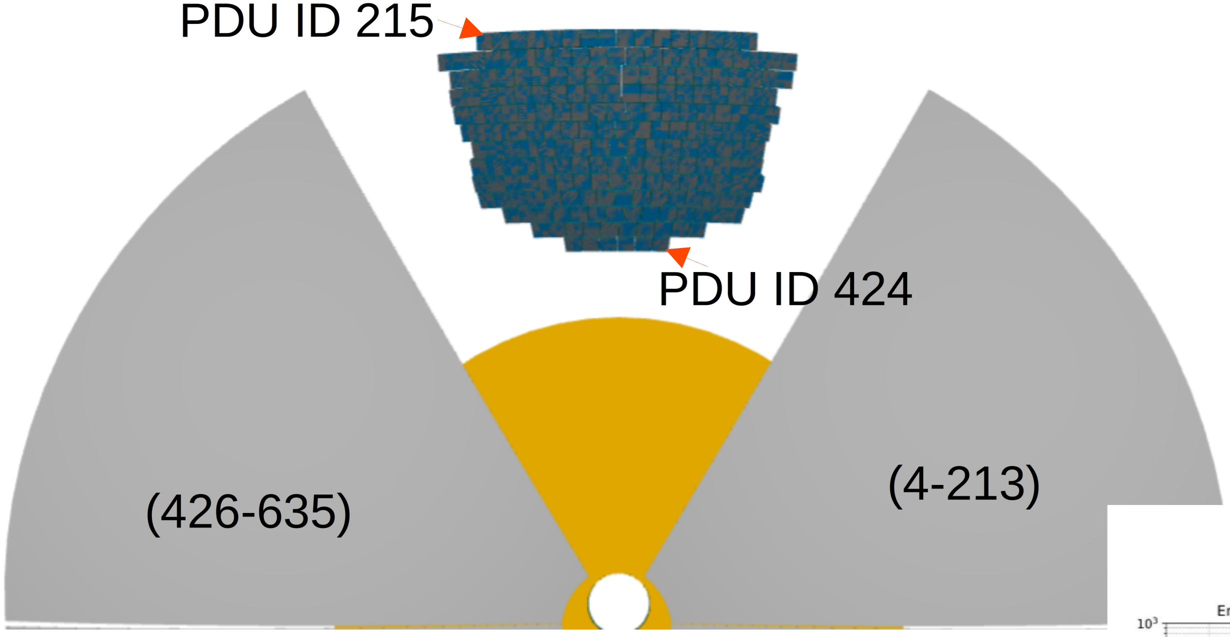


Large (around 5 times) more hits than hits generated by final state stable particles!

A dRICH tagger has been implemented and presented by M. Osipenko

Ongoing activities: PDU occupancy

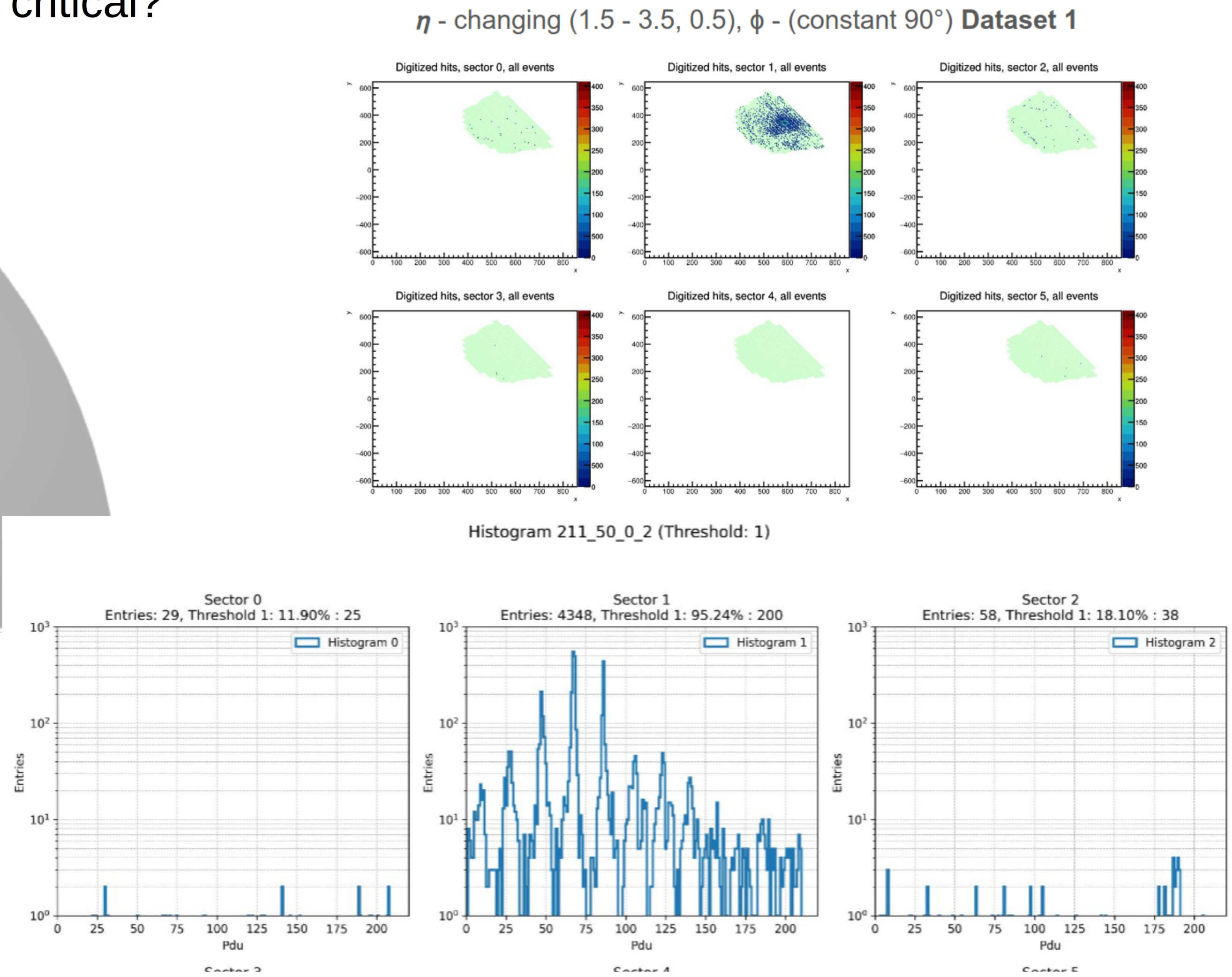
Objective: How many PDUs are critical?



Example of PDU IDs.
Numbering does not start from 0
because of logical placements.
Skips one in next sector.

Studies by Nebin and colleagues

Single particle varying eta, fixed phi. (snapshot)

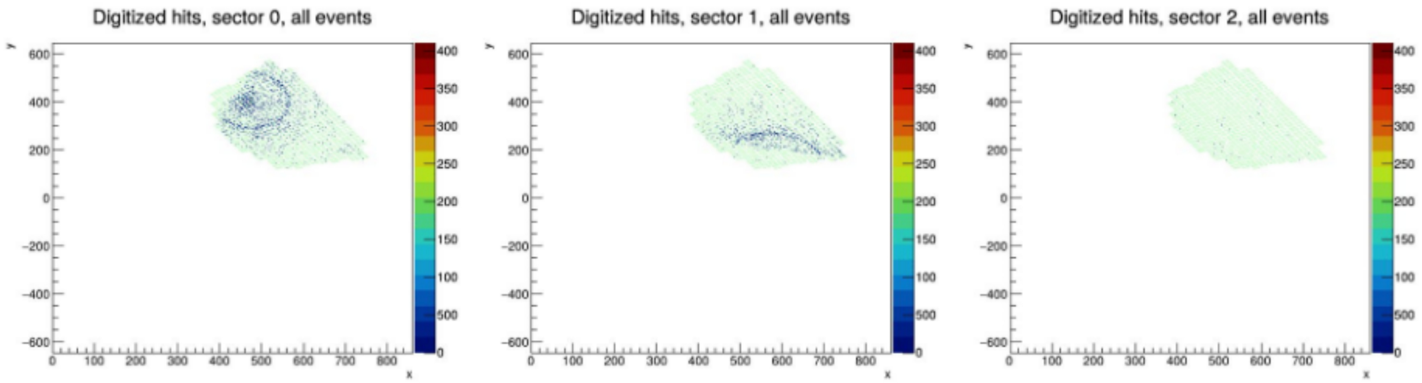


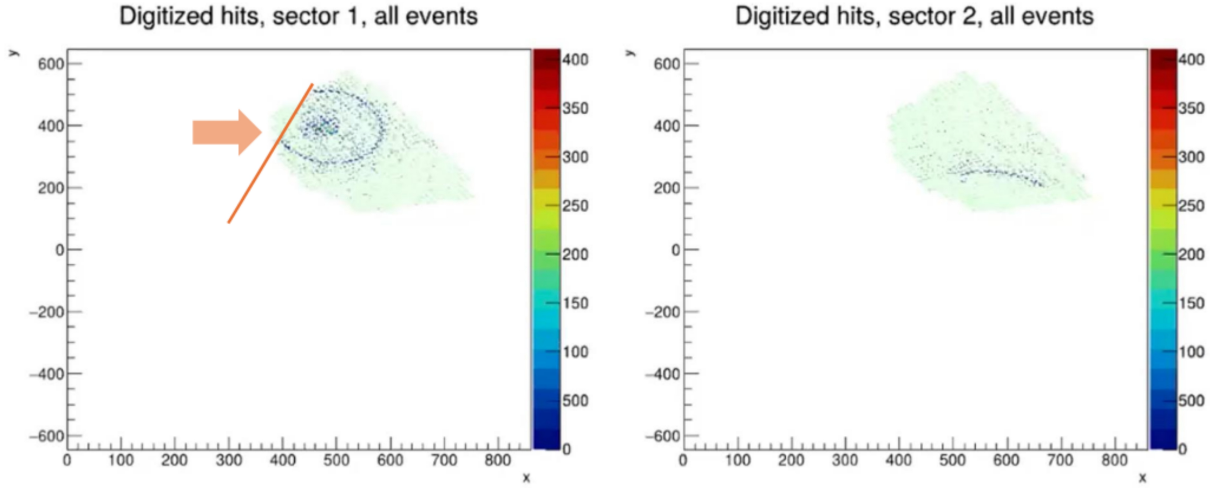
Ongoing activities: PDU occupancy

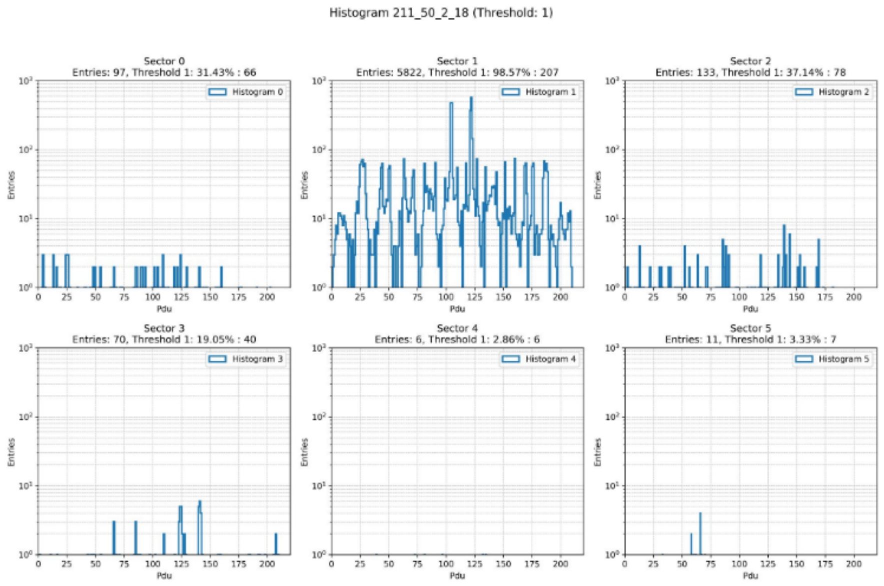
Single particle varying phi, fixed eta. (snapshot)

Studies by Nebin and colleagues

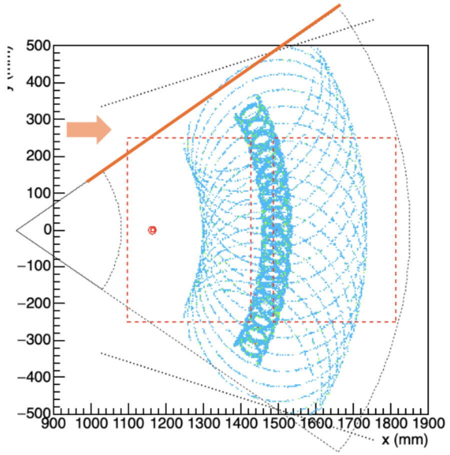
η - constant (1.7), ϕ - (55° - 130°, 5° steps) **Dataset 2**



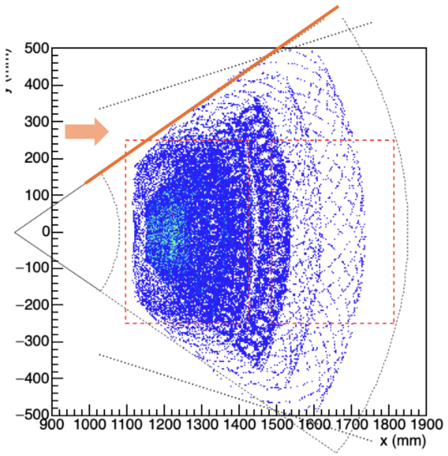




η = 1.7



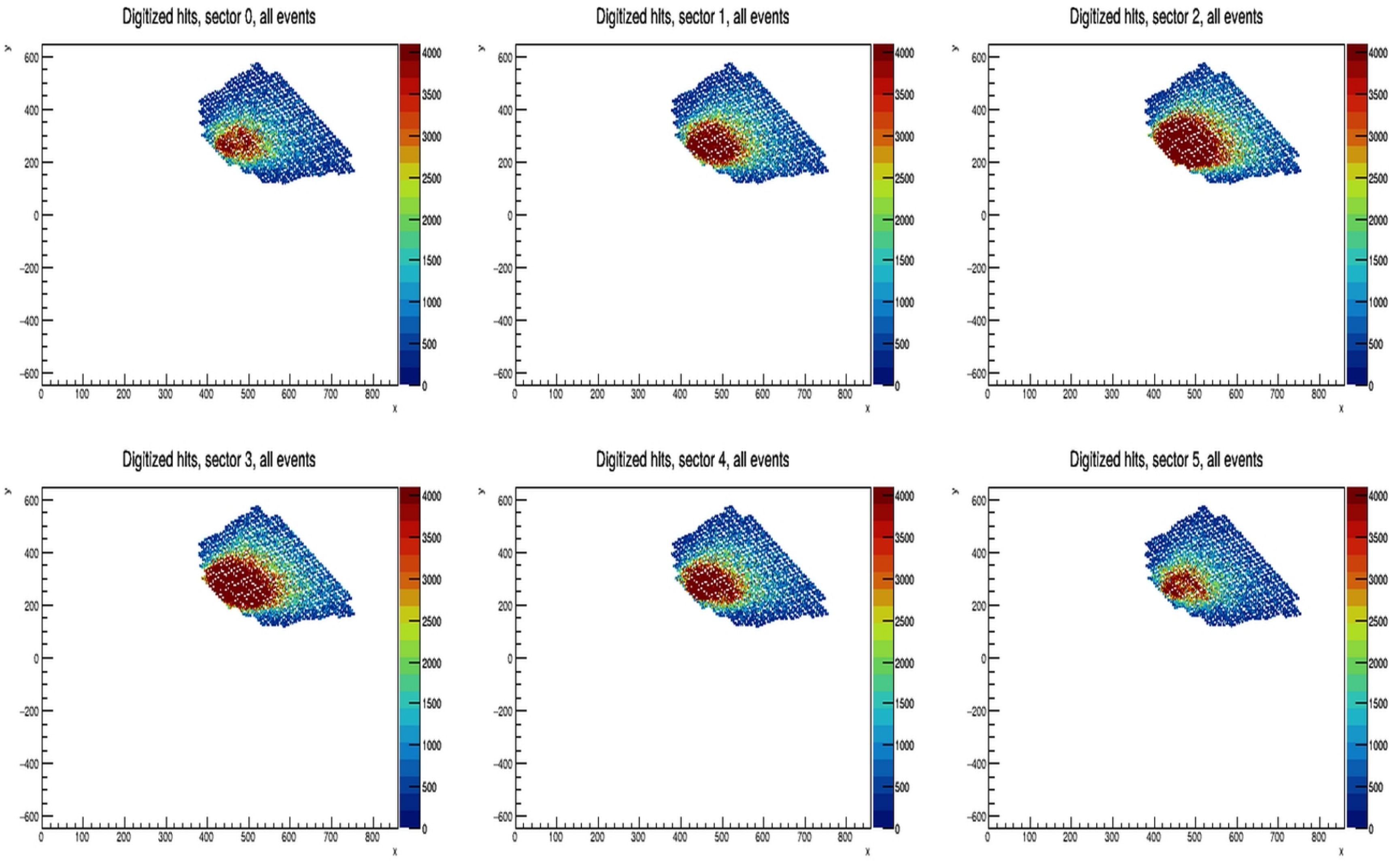
η = 1.5 – 3.5



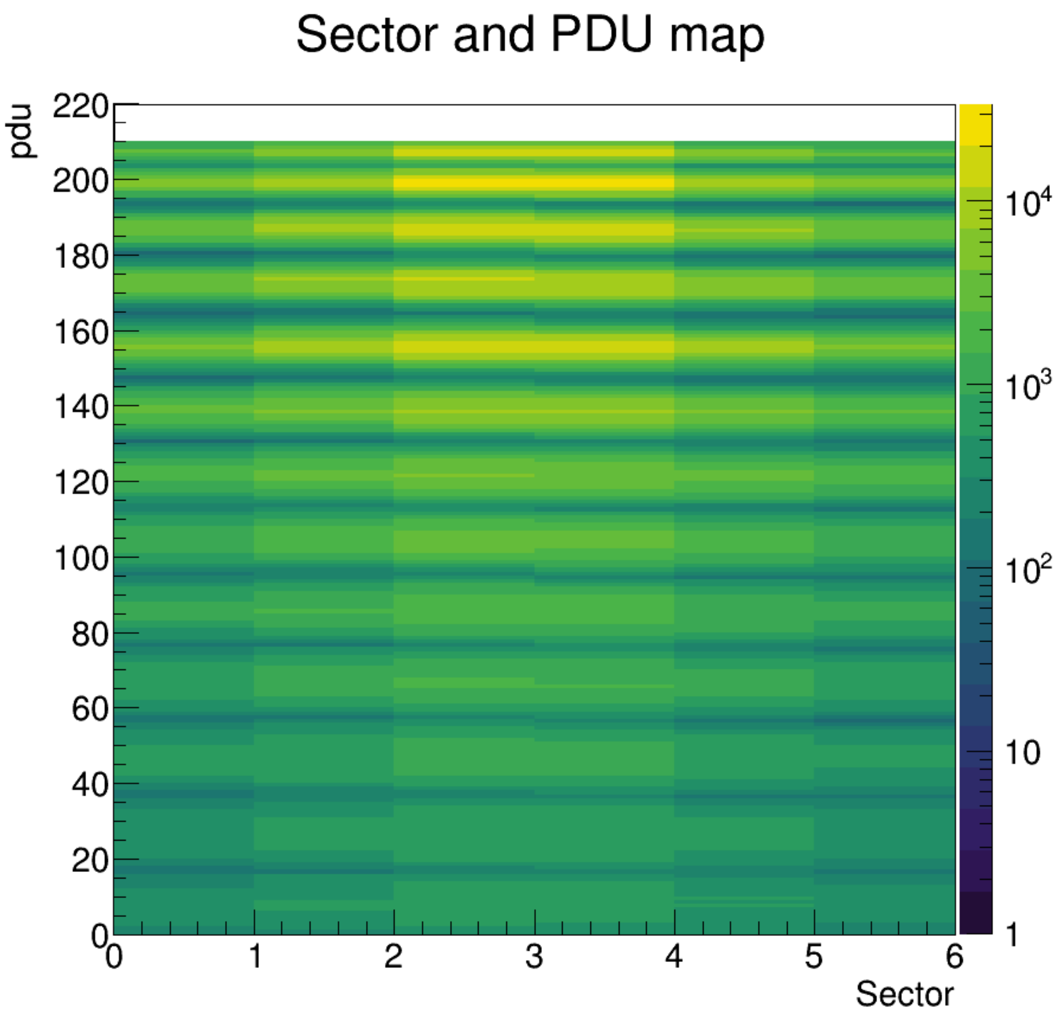
Marco’s toy MC estimates

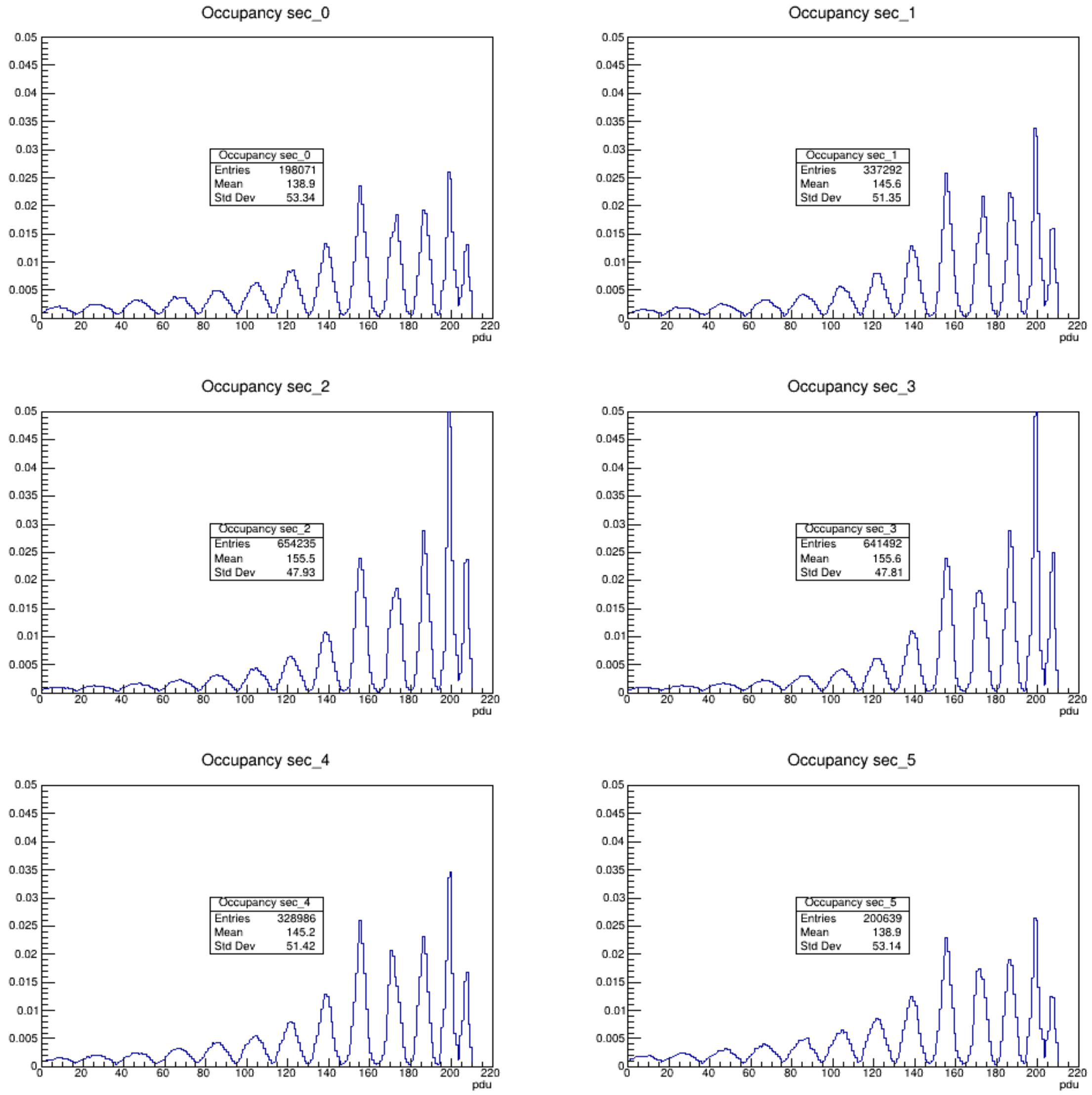
Ongoing activities: PDU occupancy

We took 20 reconstructed DIS files.
A total of ~ 20 K events
Energy: 10X100 configuration (sqrt(s) ~ 60 GeV)
X-ing = 0.0025
Q**2 >1
Registered hits in dRICH: 2360715



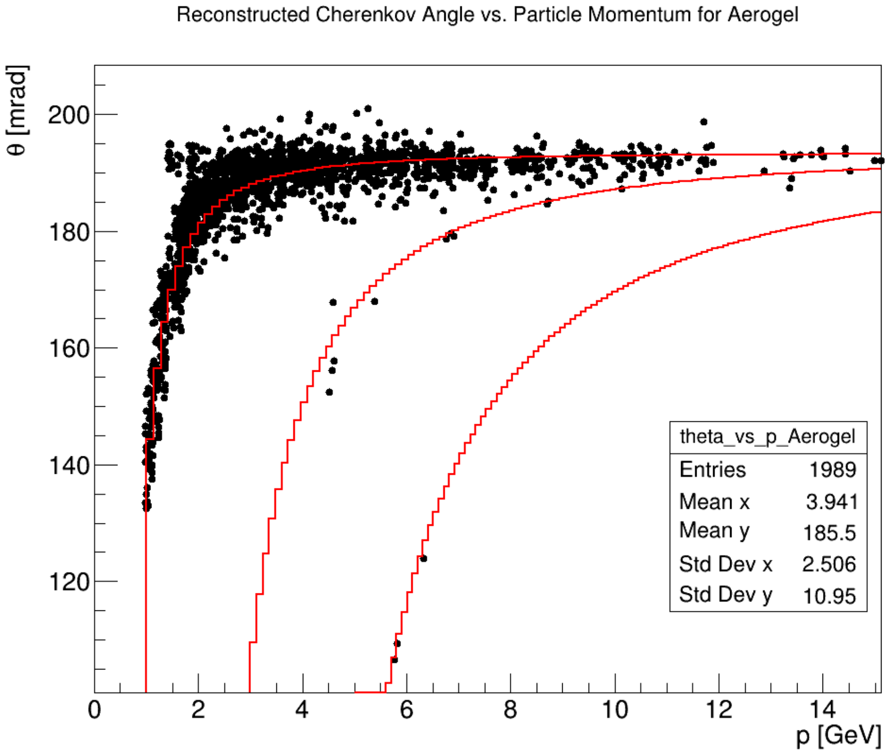
Ongoing activities: PDU occupancy

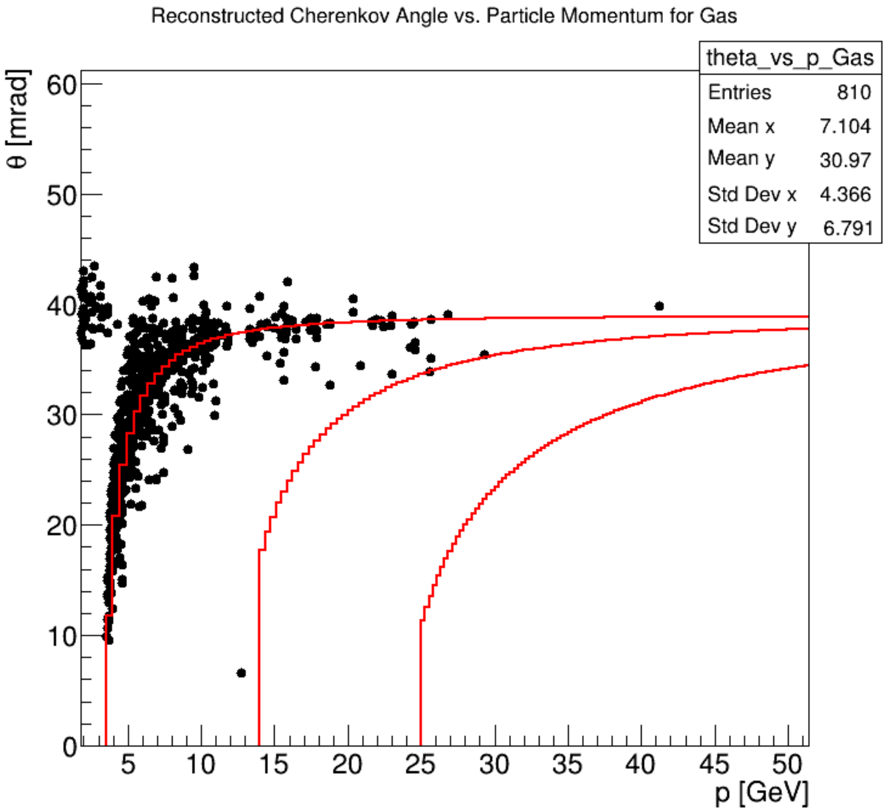




Ongoing activities: First look in performance

How is dRICH performance for these events?



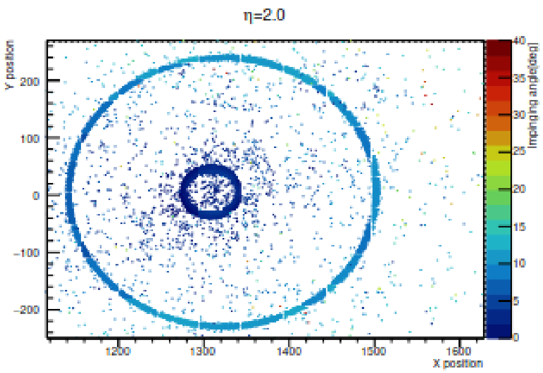


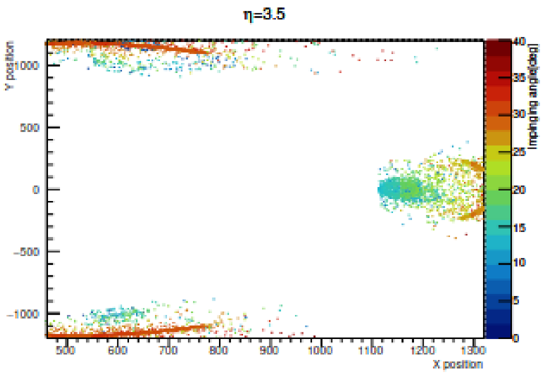
Still Using **IRT-v1**
We see very few "trustable" tracks!
Mostly pions and electrons, very few kaons and almost no protons (in Gas)
Reconstructed angles looks meaningful.
Certain things are under study!

Ongoing activities: IRT-v2

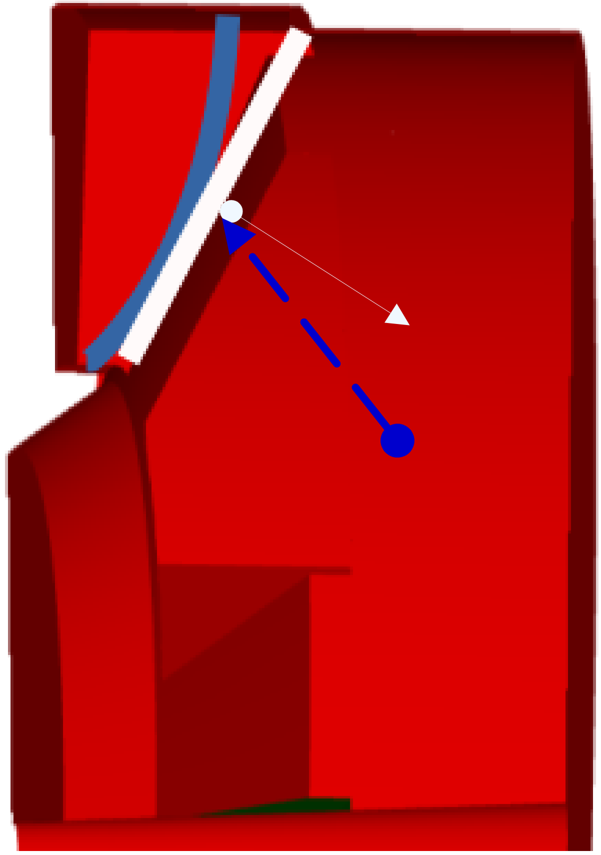
1. Personal conversation with Alexander, he also feels that pfRICH performance in EICRecon will be required for PID review.
2. We are currently working to check what are the limitations with IRT-v1 to reconstruct DIS events.
3. Next week Alexander plans to push the his personal EICRecon to github so that we can give a look to it and start working on it.

Ongoing activities: Impinging angle in quartz window





- Currently we don't have an implemented quartz window between SiPM and gas.
- Concept of impinging angle is similar but technically different.
- Nebin G. from CUK will be taking over this job.
- As a first effort DIRC quartz bar's optical parameters are considered.
- It will be a physical volume and need to somehow find out to measure the impinging angle on the surface. Fortunately, single normal for the whole surface.

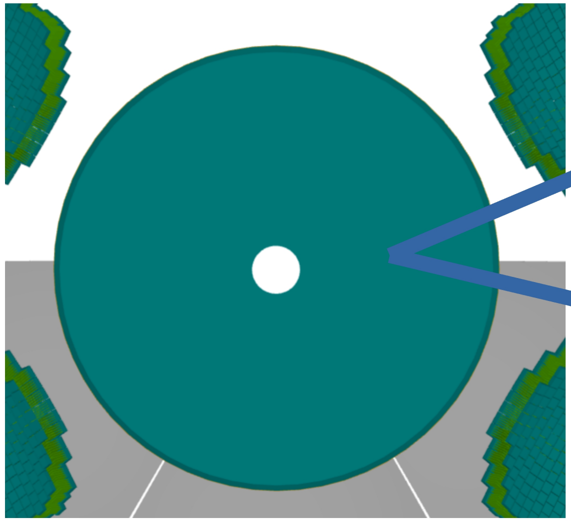


Impinging angle in SiPM: Studies by T. Boasso

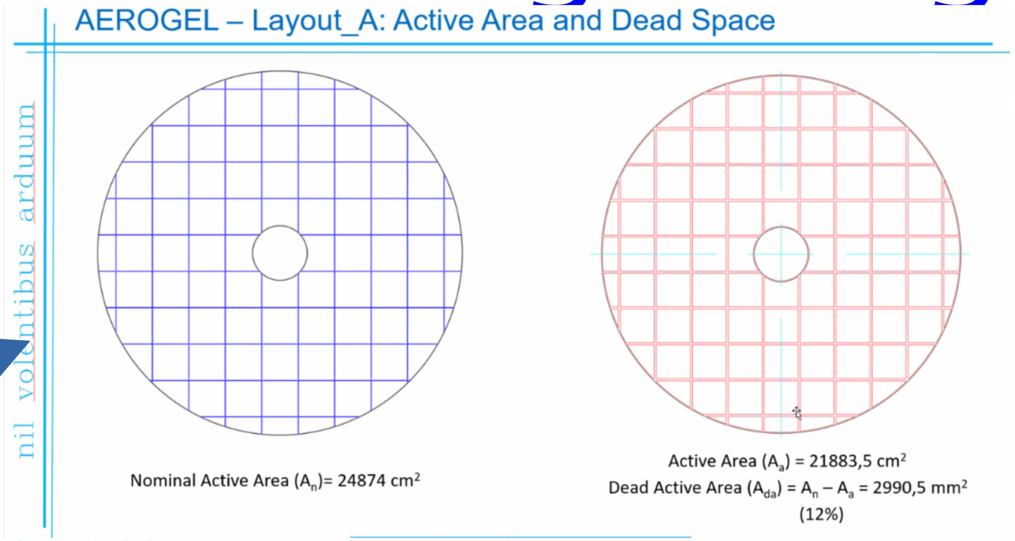
ePIC Ongoing activities: tiling aerogel

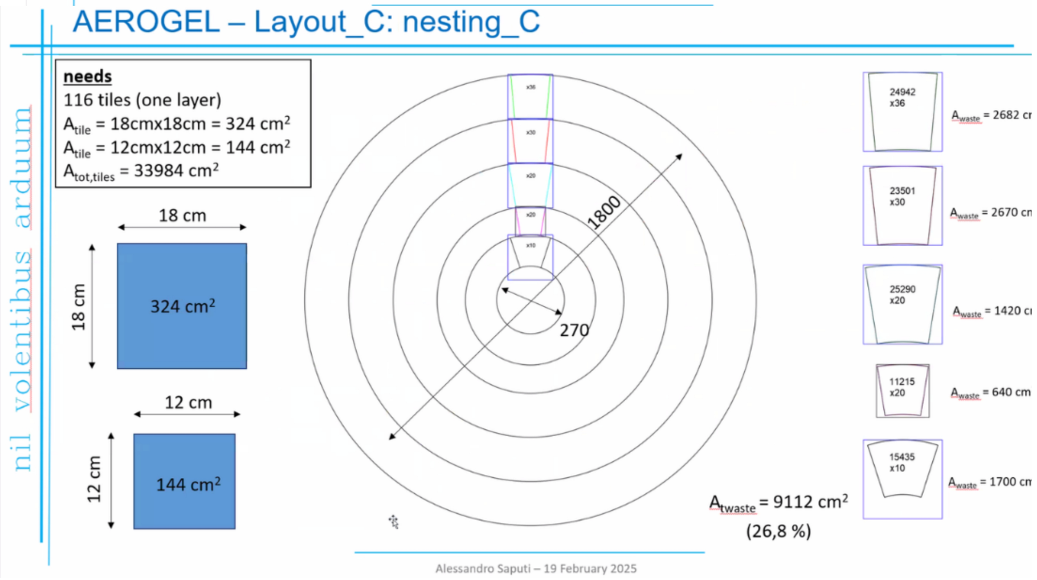
Implementation dea:
- No fixed parametrization.
- User tunable tile parameters.

Rohit Singh and Luisa will be taking part in implementation and validation



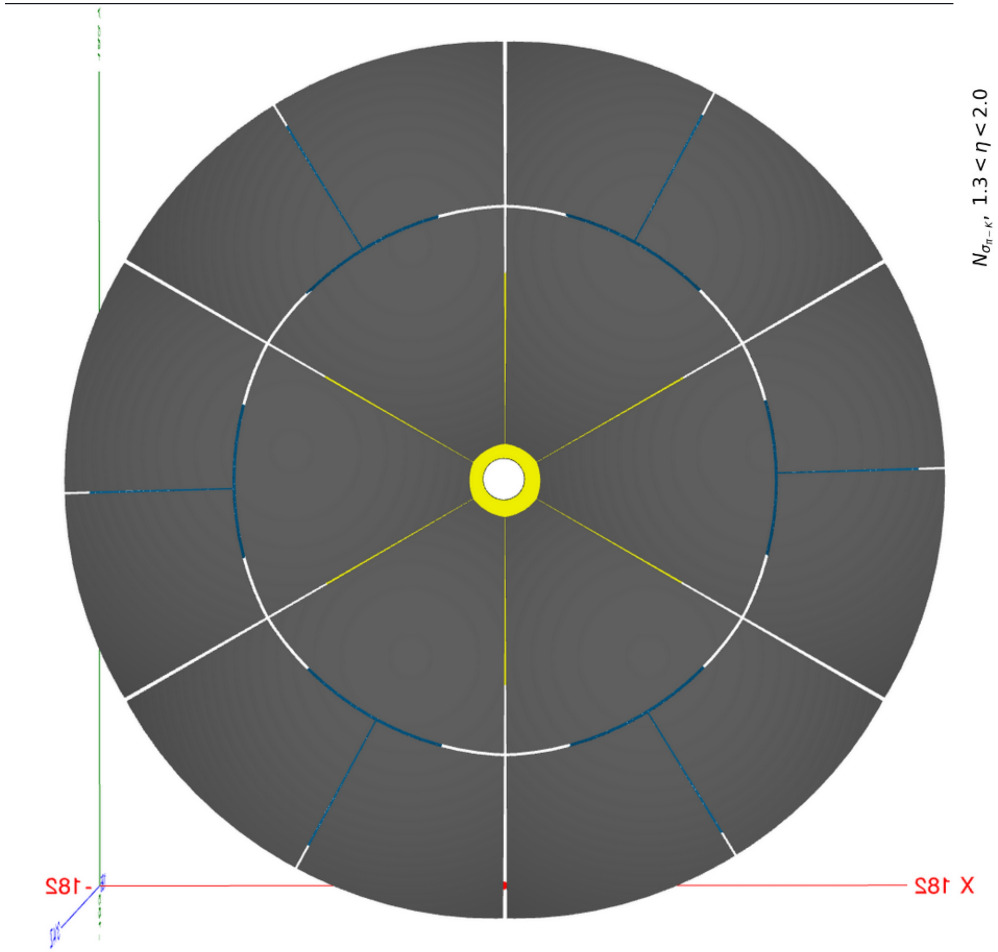
Or

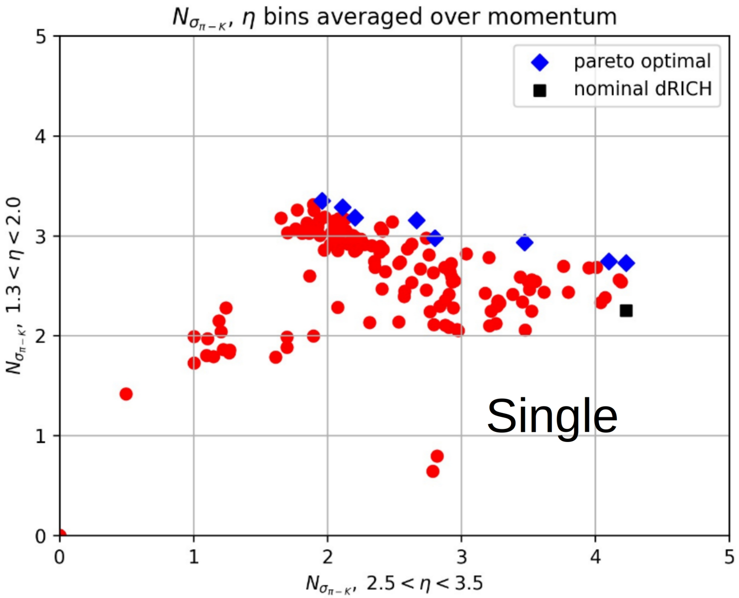


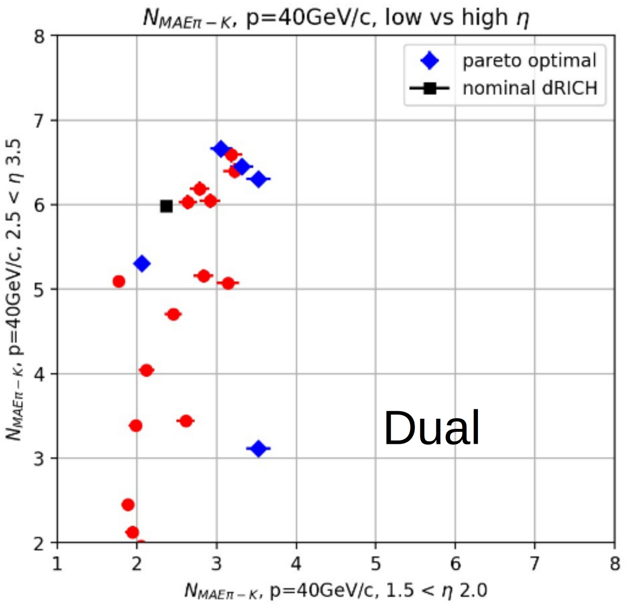


Validation:
- Estimation of dead areas.
- Impact in performance.

Ongoing activities: tiling mirrors







- An existing tiled mirror implementation.
- Connor has played with it, implementing different radii.
- Few tests can be done relatively quickly (border effects).
- User tunable radii (same implementation to allow user to choose single or dual mirror configuration).

Required tasks for PID review

The three pending questions:

- What is the effect of the impinging angles on the quartz window?
- What is the status of robust PID reconstruction with multi-particle?
- Requirement of windows to separate sensors and gas material.

Few other plan that I have:

- Study the performance with different SiPM parameters.
- Checking the performance with DIS events (reasonable statistics) and identify IRT v1 limitations.
- Estimation of the dead-areas.
- Estimation of the “reasonable” beam-pipe effect.

What else?

Discussions, Comments and suggestions