pfRICH : Step by step studies

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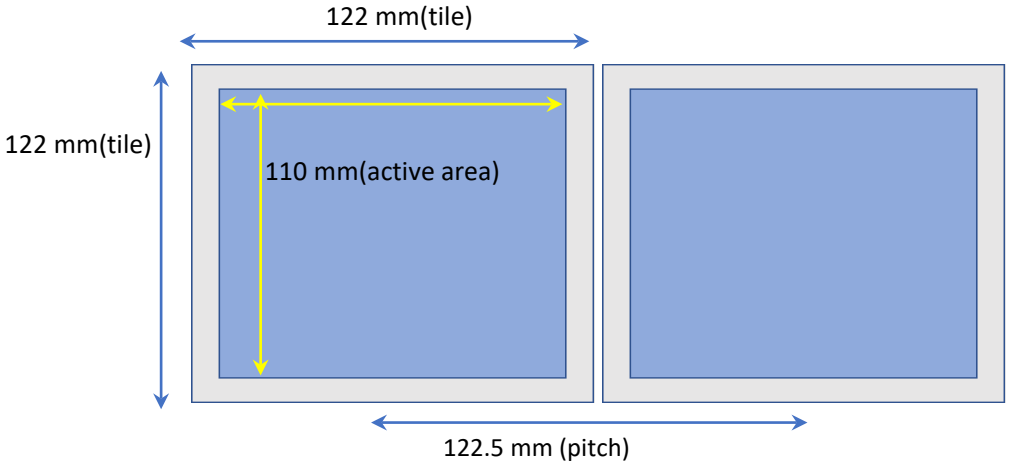
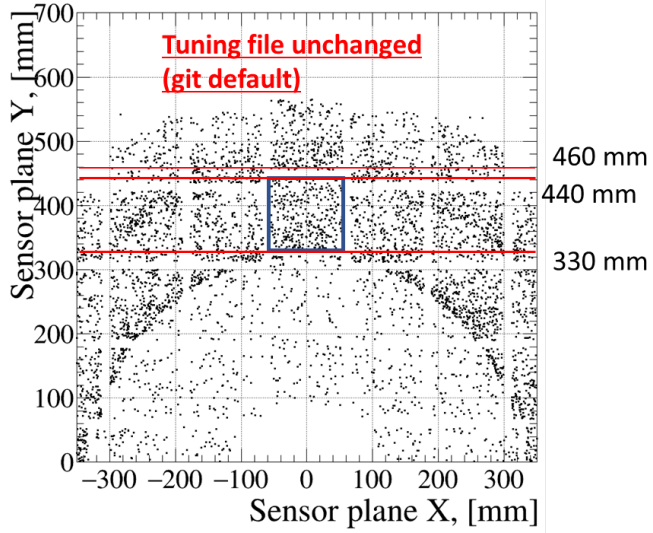
HRPPD

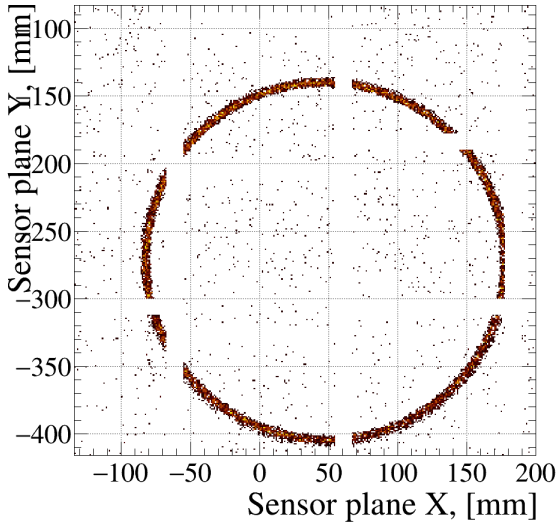


So, if a full tile is accumulated, in the event display, we expect a square of side around 110 X 110 mm. The gap between those squares will be ((122-110))+0.5 mm ~ 15 mm.



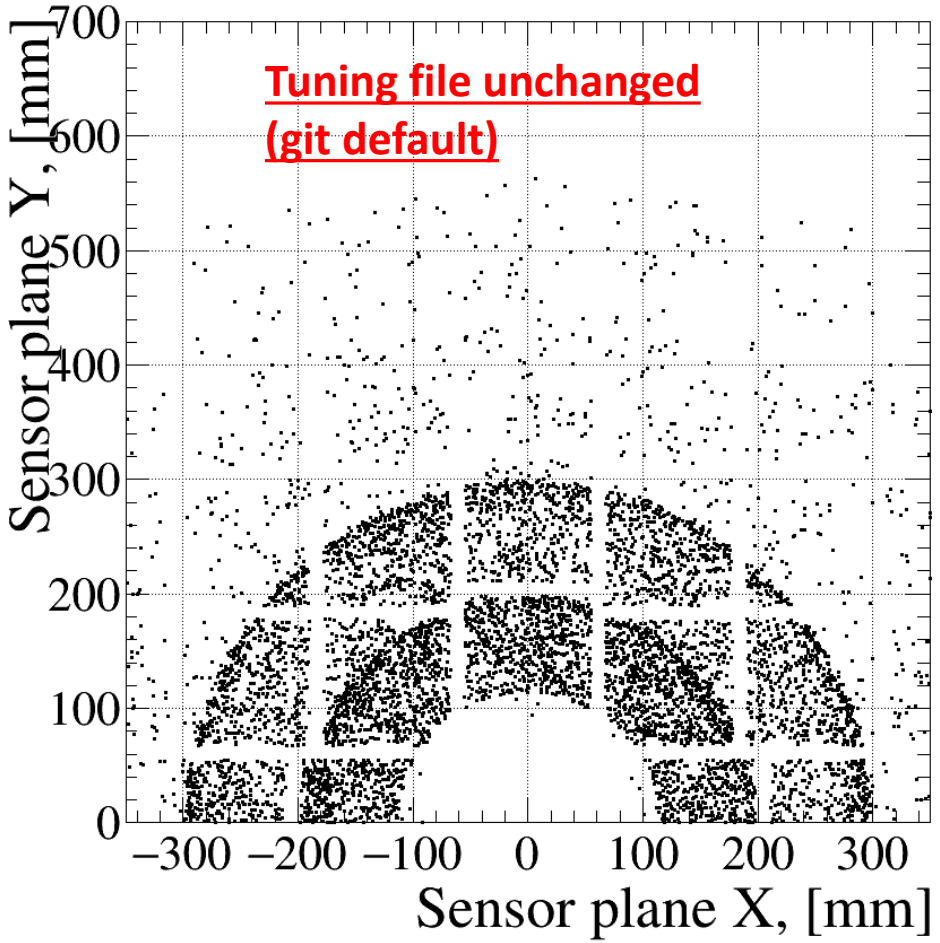
Some back of the envelope numbers!

Assume <n> 1.044
For a saturated particle (beta =1);
cos(theta_Cherenkov) = 1/1.044
theta_Cherenkov ~ 16.7^{O} or ~ 290 mrad.
Total gas volume 54 cm. The Sensor plane is at 12 cm from the rear side. Aerogel of 2 cm (average emission point is at the middle).
Assuming ~ 45 cm of expansion 45*0.290 cm ~ 13 cm

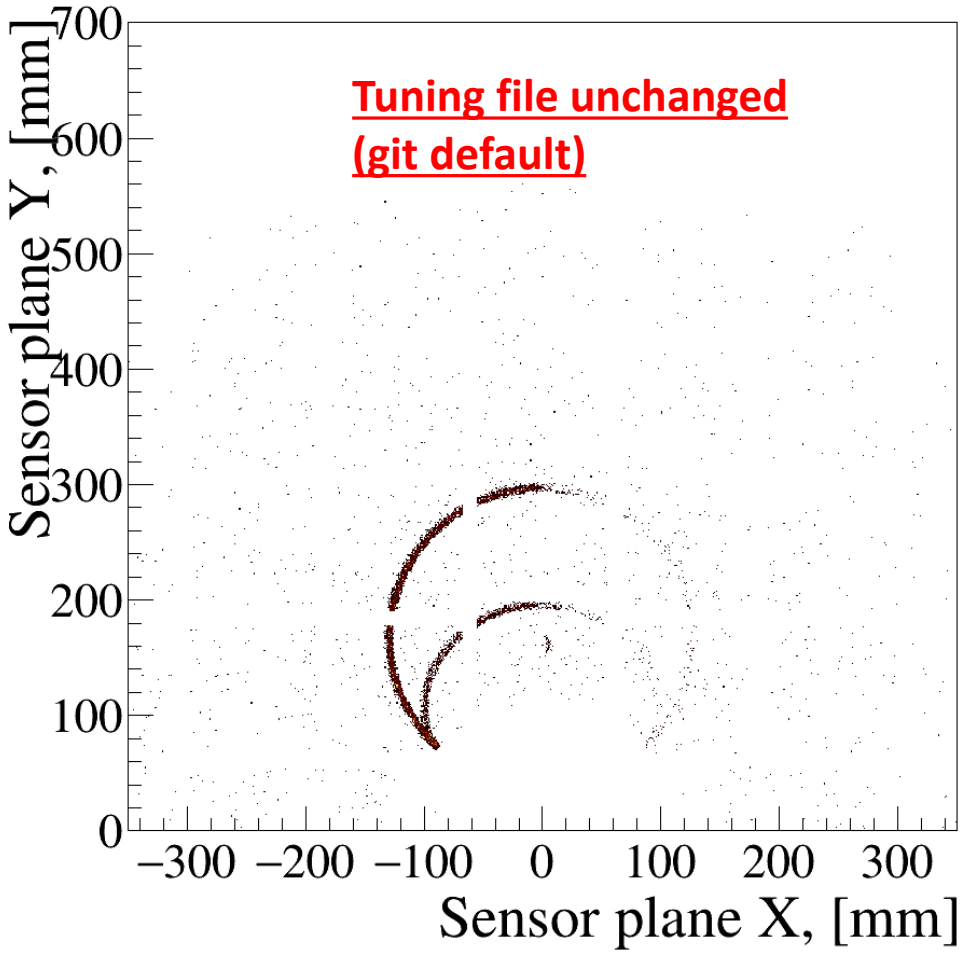


At an intermediate eta (2.5):
ring X axis spans {140,400} mm ~
260 mm ~ 26 cm of diameter ~ 13 cm radius

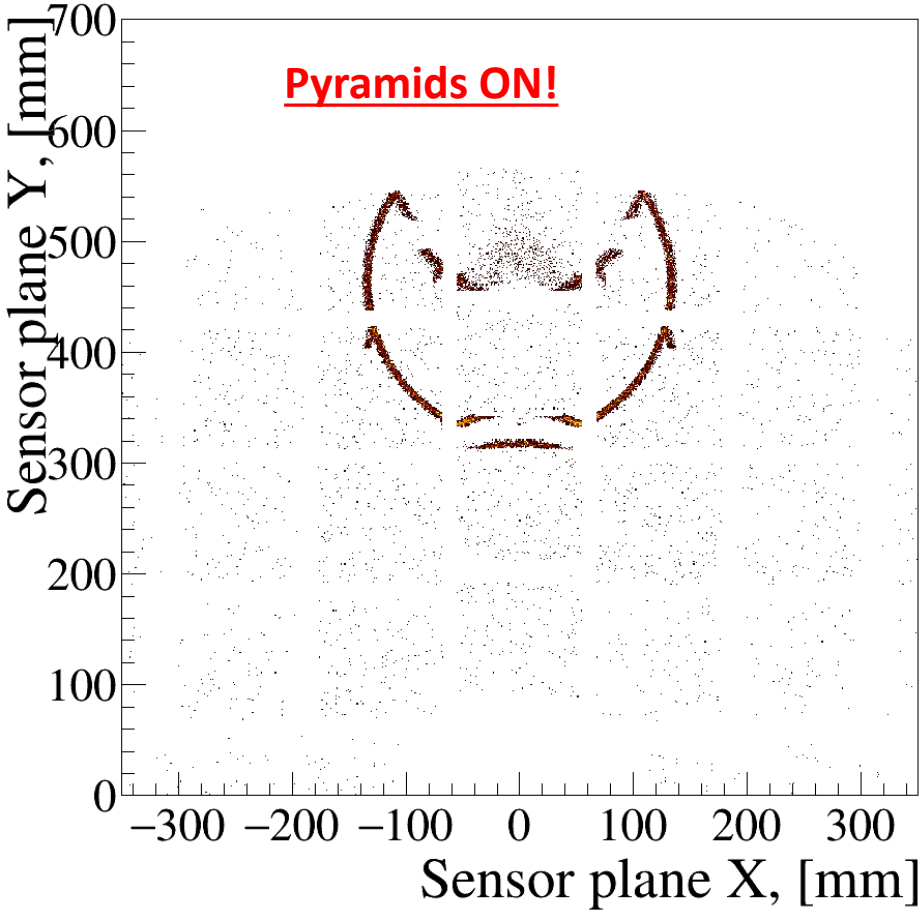
theta = 5.7 degrees (eta 3.0) and uniform phi



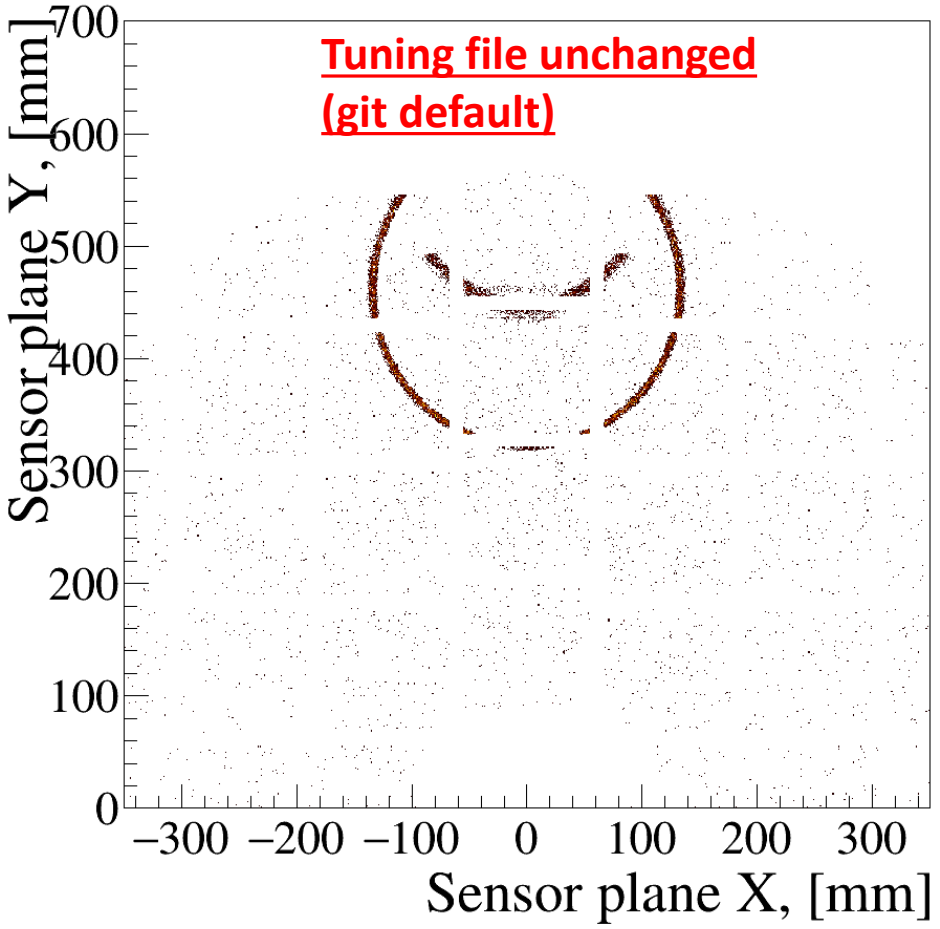
theta = 5.7 degrees (eta 3.0) and phi = 90 degrees



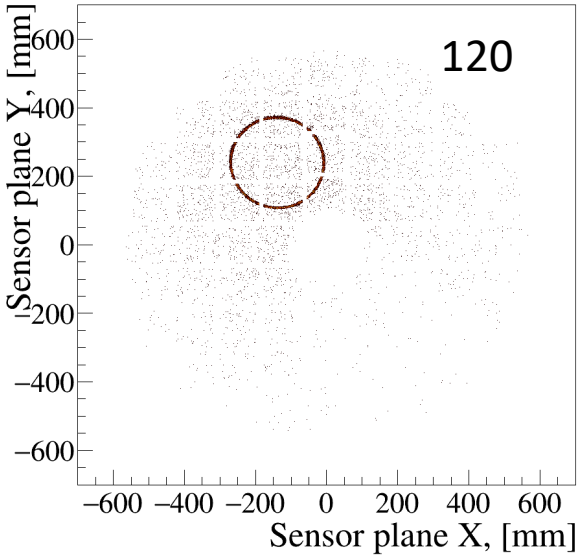
theta = 15.415 degrees (eta 2.0) and phi 90 degrees

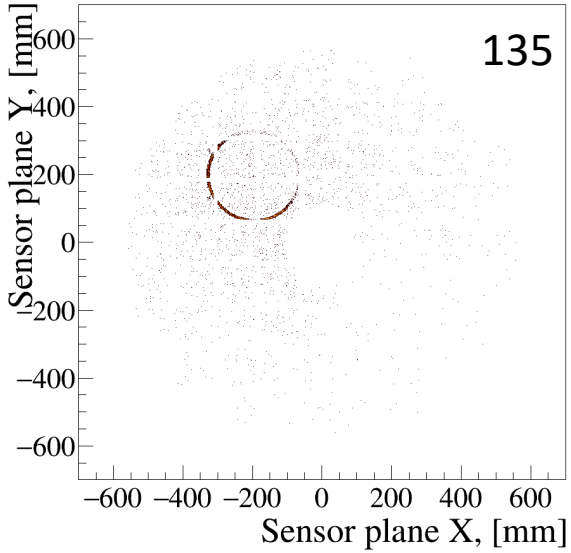


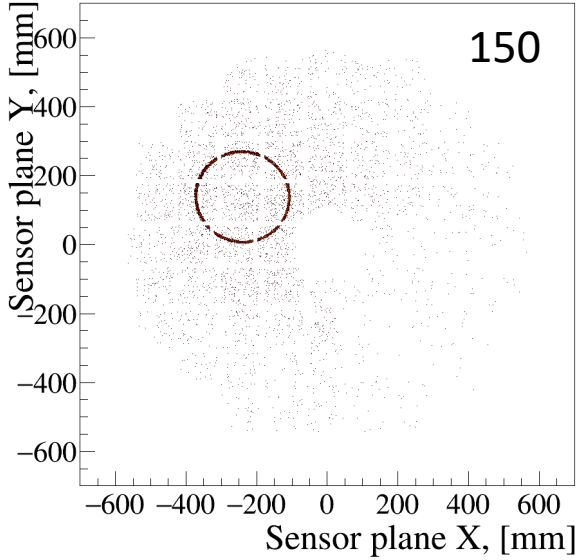
theta = 15.415 degrees (eta 2.0) and phi 90 degrees

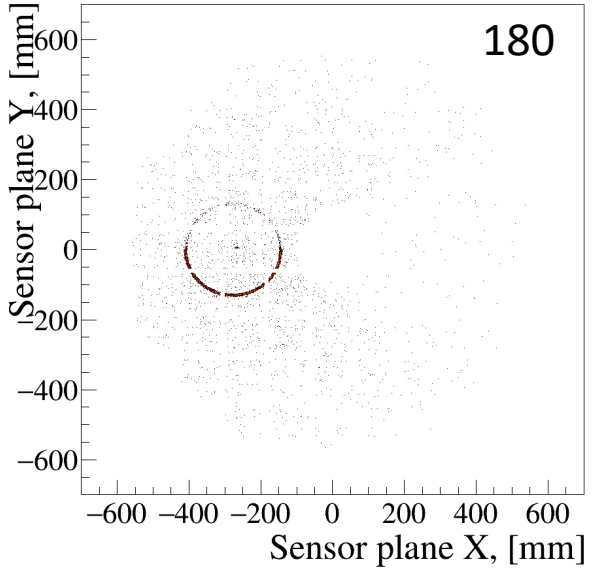


phi angle scan: ring quality (eta 2.5) no pyramidal mirror



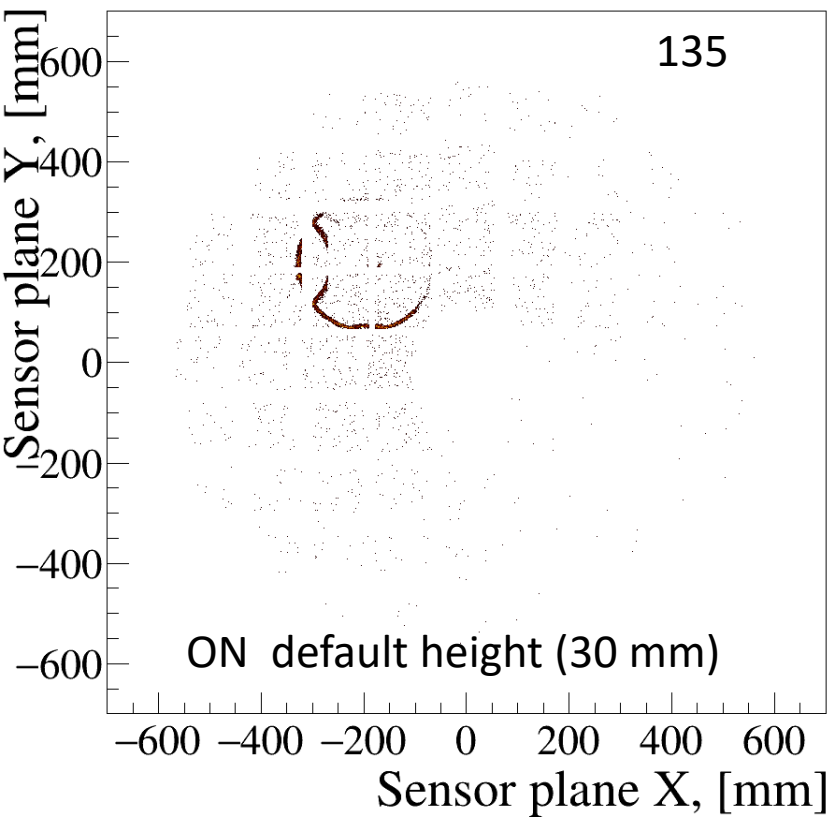


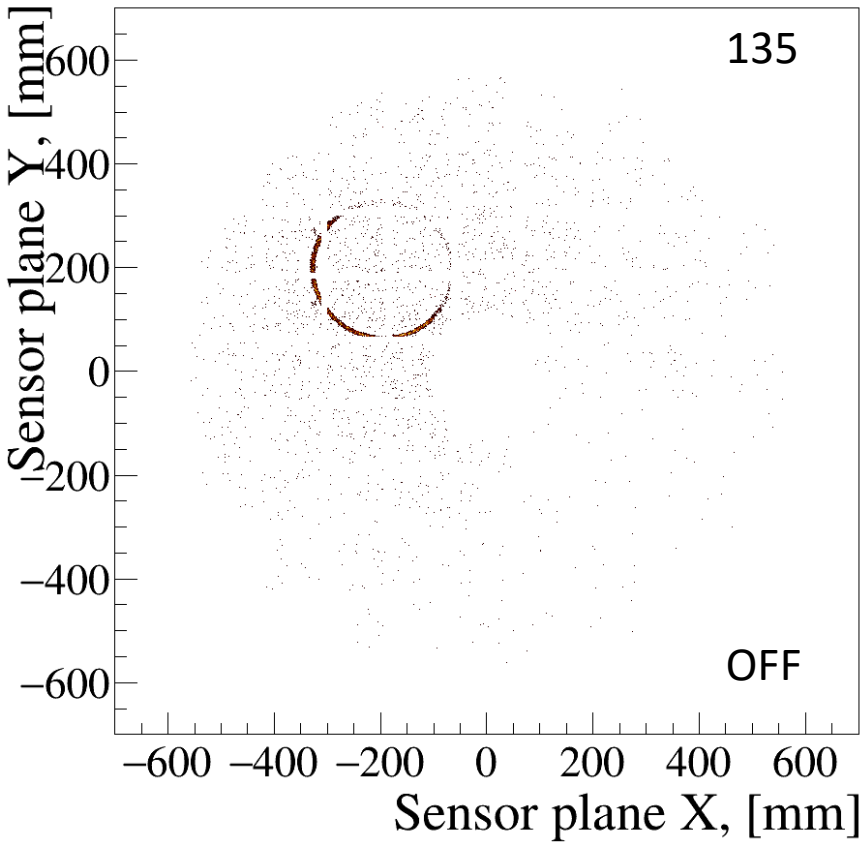




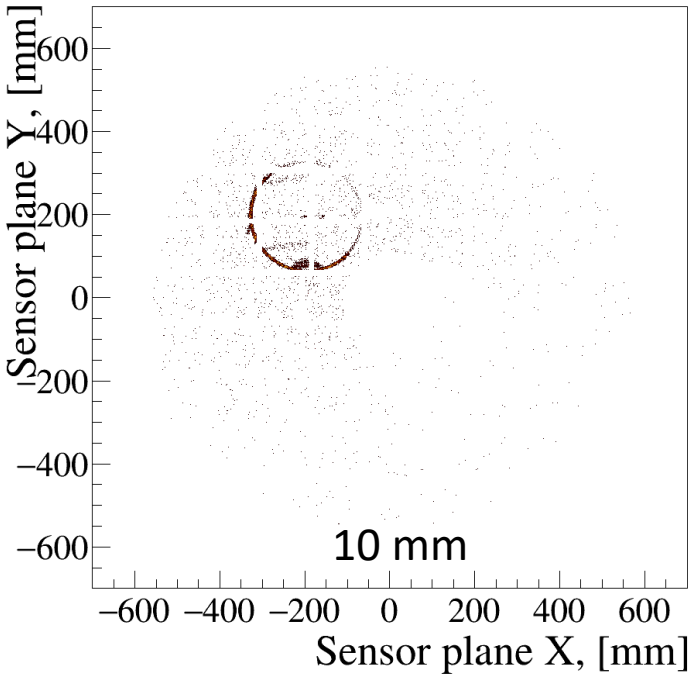
Why is the part of the ring missing for (135 and 180 degrees)?
For 135 degree maybe it is passing close to the dead area and hence it is missing the ring.
But for 180 degree the part of the ring is passing through the active part! The reason of the missing ring is unclear.
For curiosity I turned on the pyramidal mirror and checked how does it look like (135 degree)?

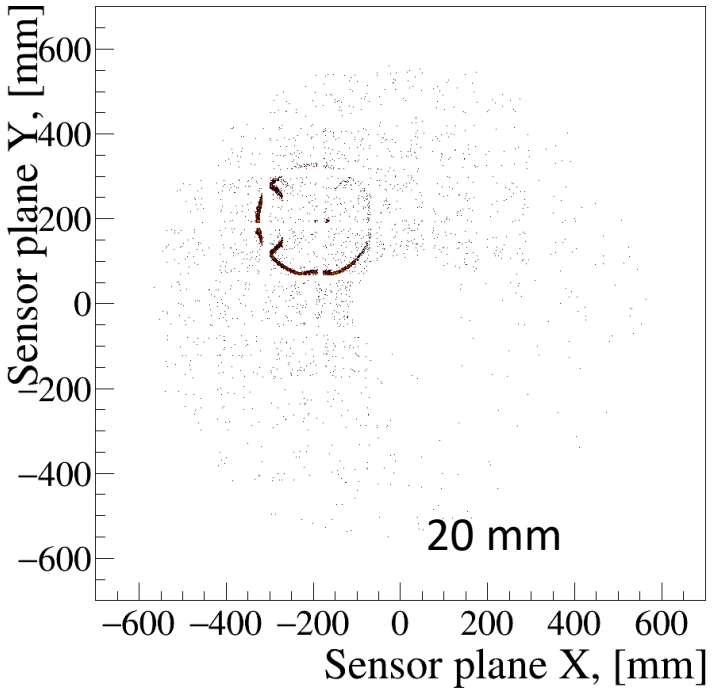
Same eta (2.5) and phi (135 degree) just turned on the pyramidal mirror

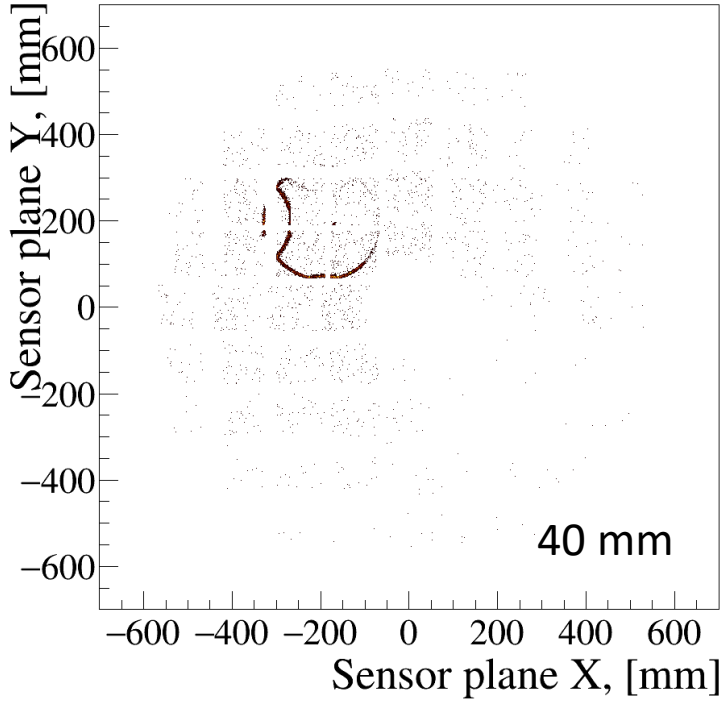


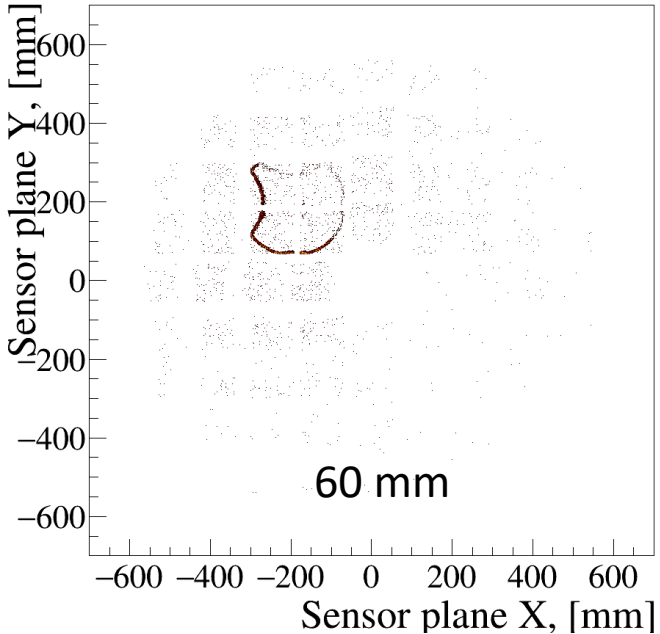


Scanning the effect of the height



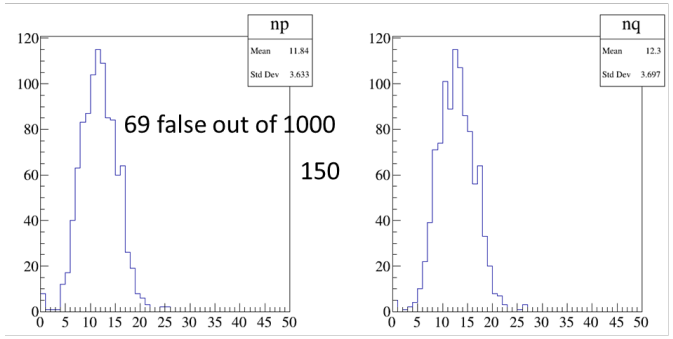


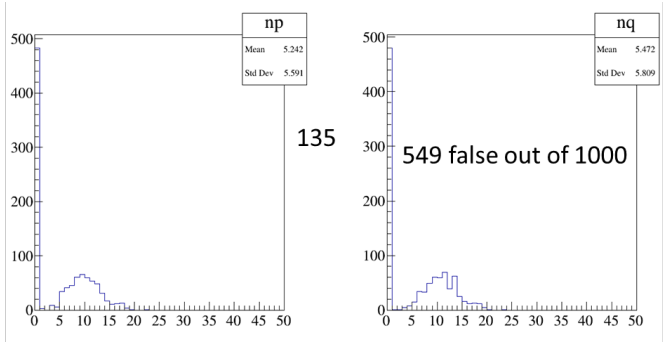


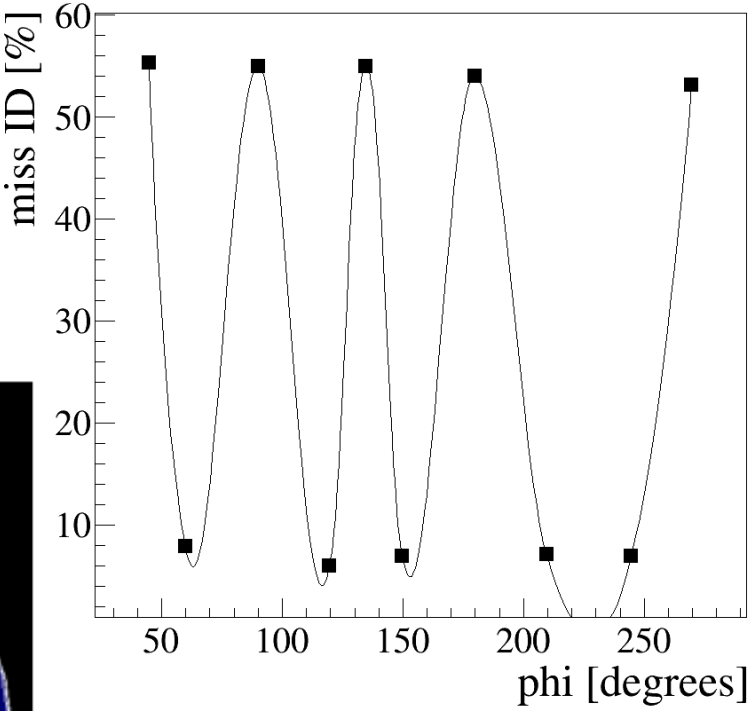


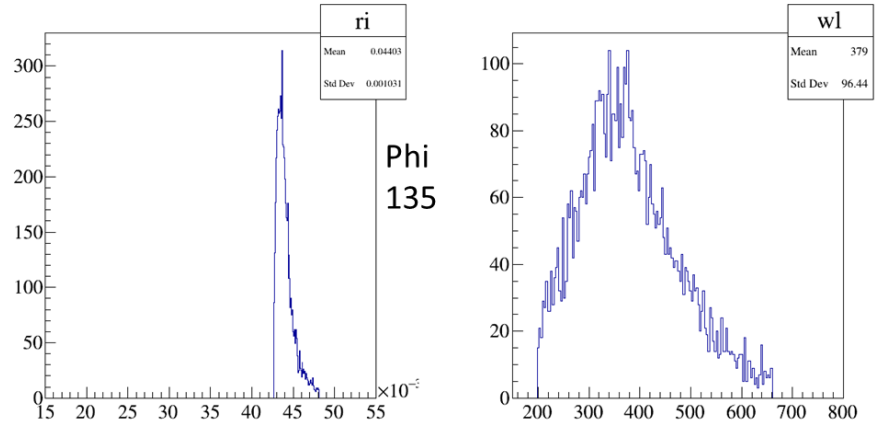
No impact for lost photons! → Aerogel tiling plays the role (understood)

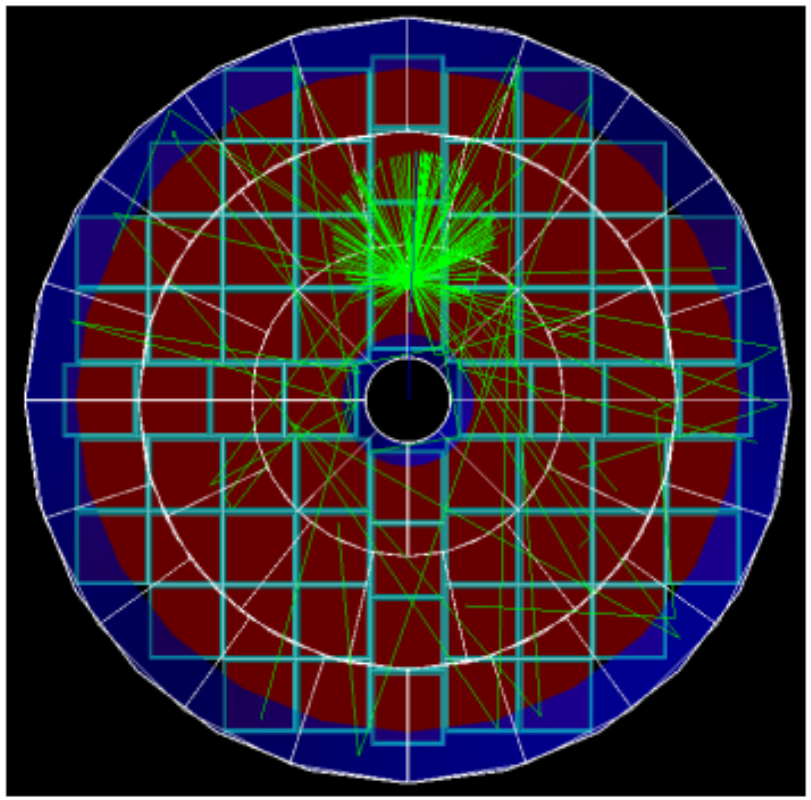
How are the number of photons depending on phi and particularly for 135 degrees for eta 2.5

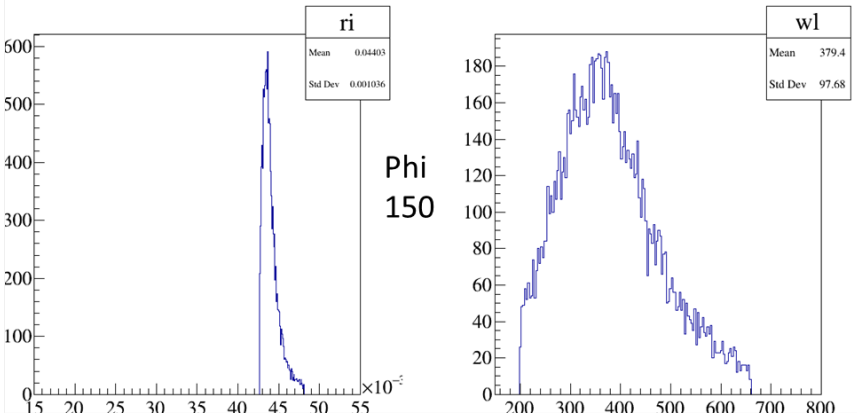






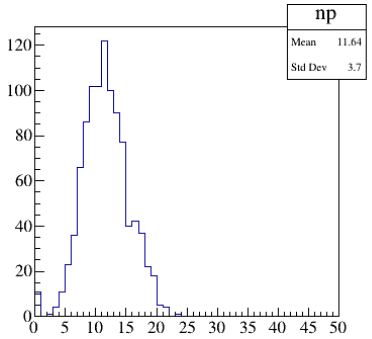


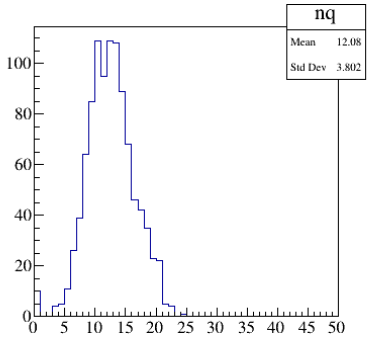


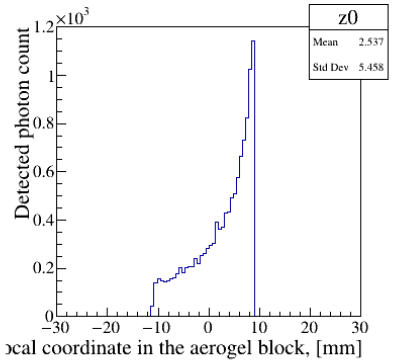


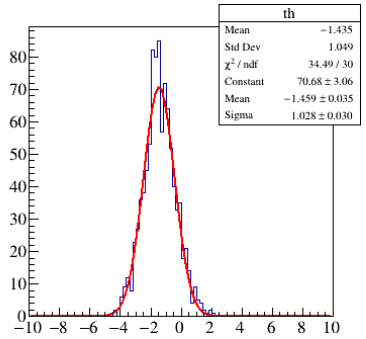
Negligible impact if phis are integrated.

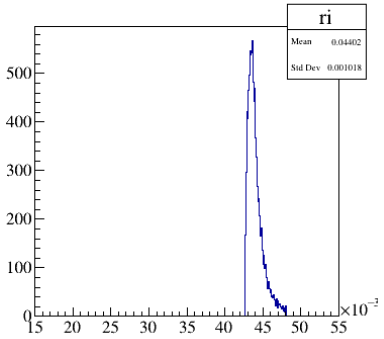
7% miss ID

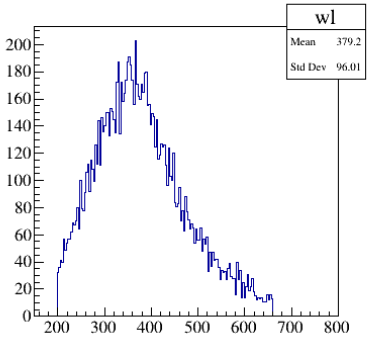


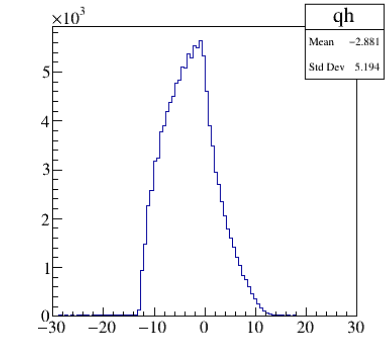


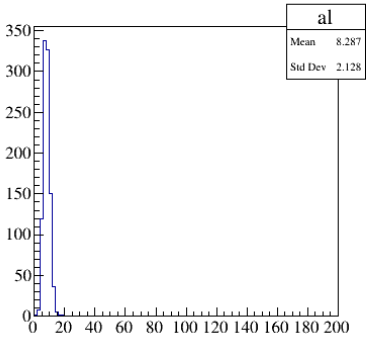






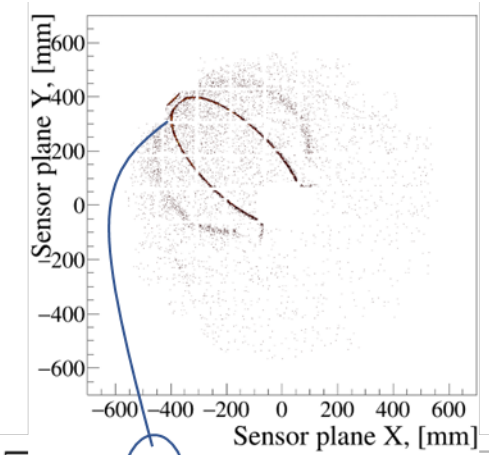




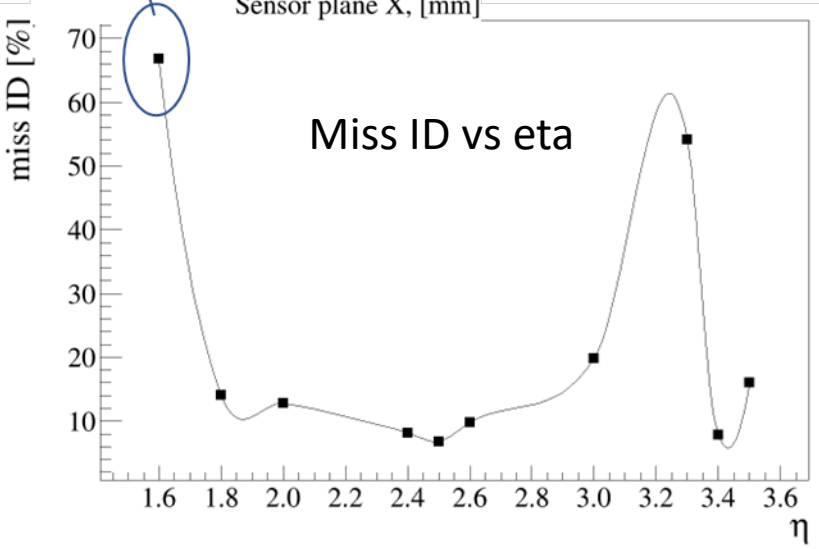


Phi integrated for eta 2.5

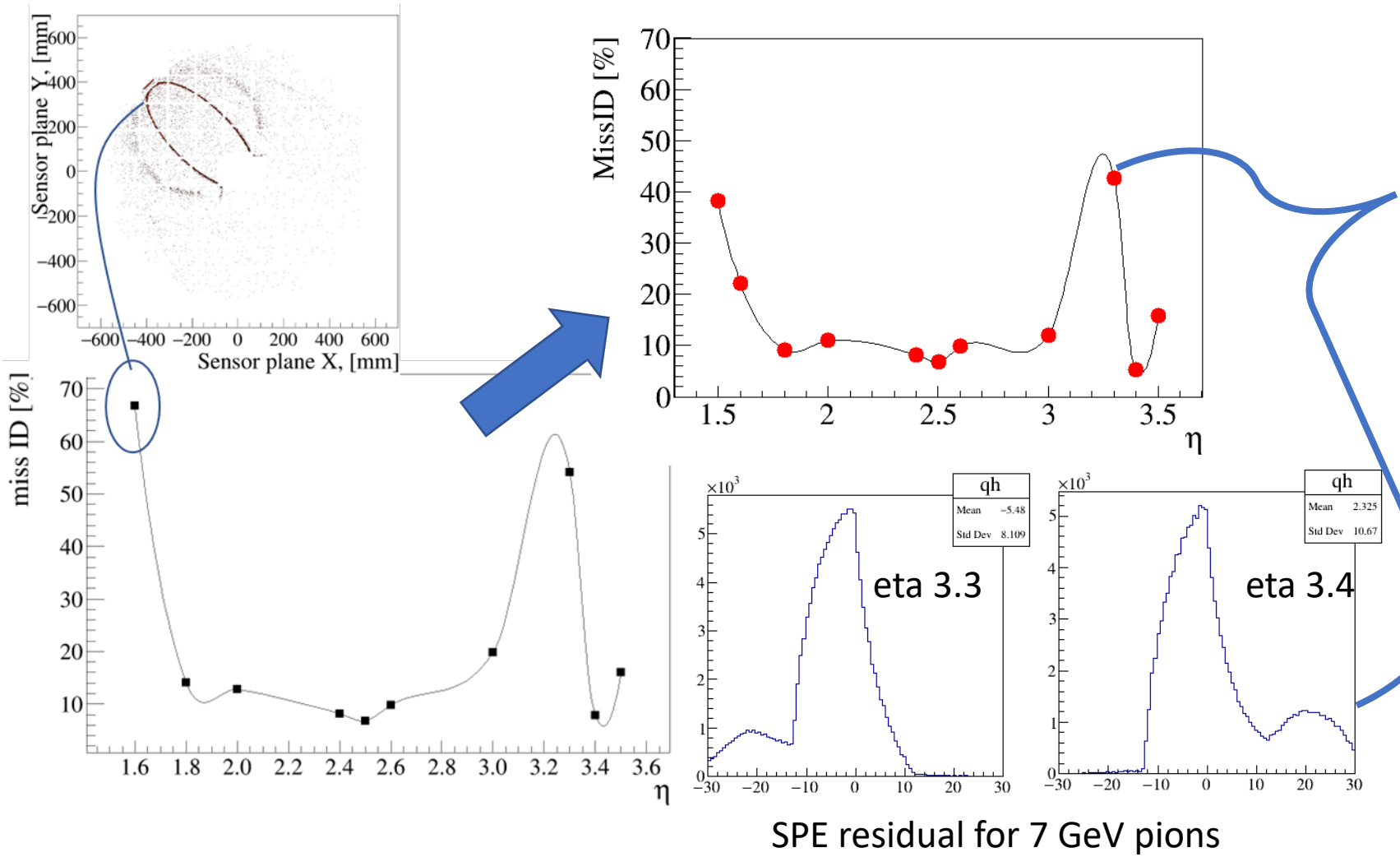
7% miss ID globally → Chance of these specific particle phis are small



No conical geometry activated in IRT



Miss ID with conical mirror option in IRT

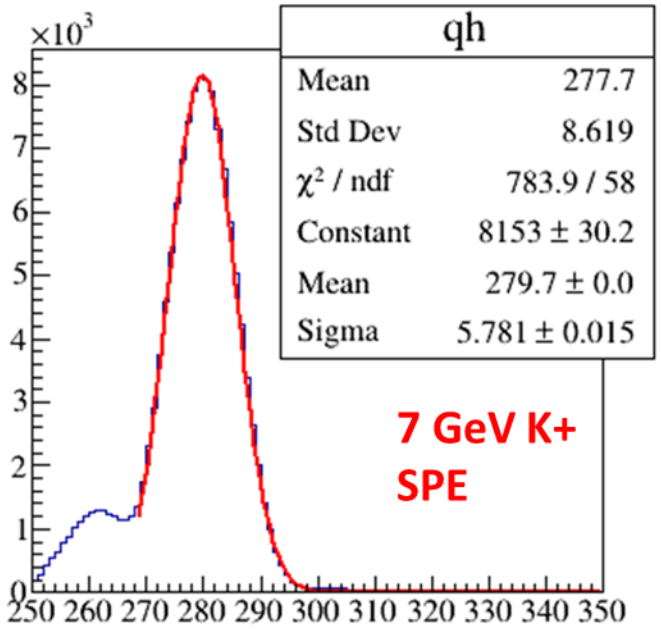


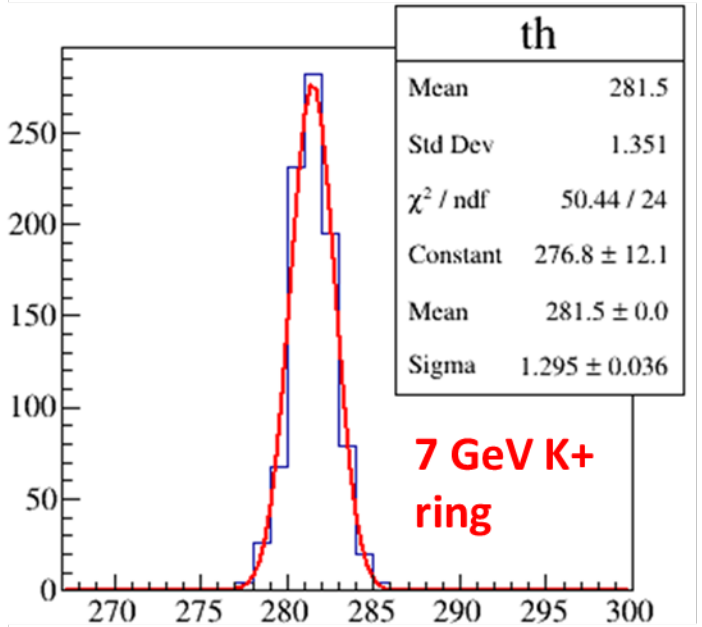
SPE residual for 7 GeV pions

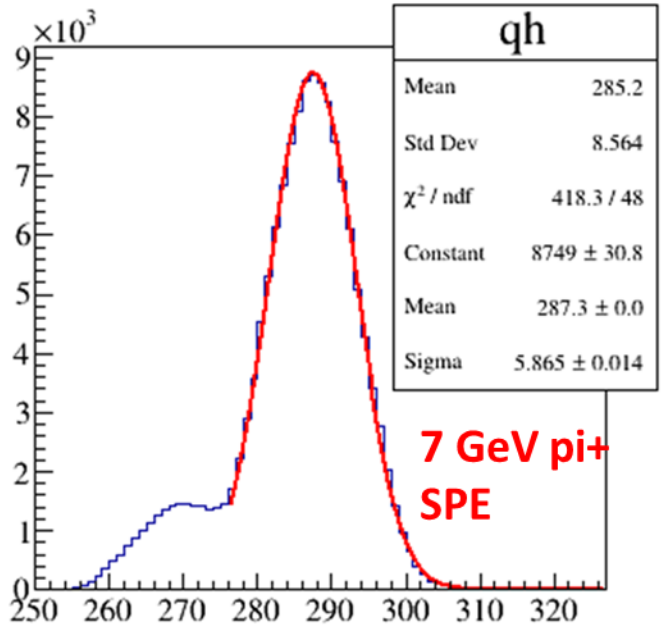
The negative residual at eta 3.3 and positive residual at eta 3.4 can subject to artifact of miss ID calculation.
Miss ID is computed for pair of hypotheses (pi/K) in this case. And based on SPE info a weight is assigned to the two mass hypotheses.
For 3.3 negative residual indicates SPE with smaller angle than pions → favor to kaons→ higher miss ID. Eta 3.4 is free as the higher angles should not favor kaons. If the reconstruction “error” is systematic we expect reverse behavior for kaons.

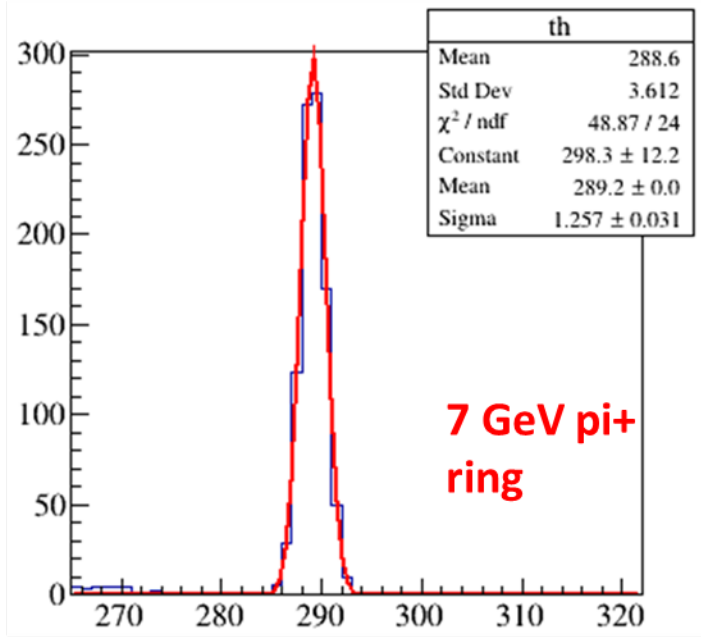
NOT THE CASE!!

At eta 3.3 4% missID and at eta 3.4 5% miss ID.
A sort of pi/K asymmetric behavior.
Is not present in pi/P K/P pairs.









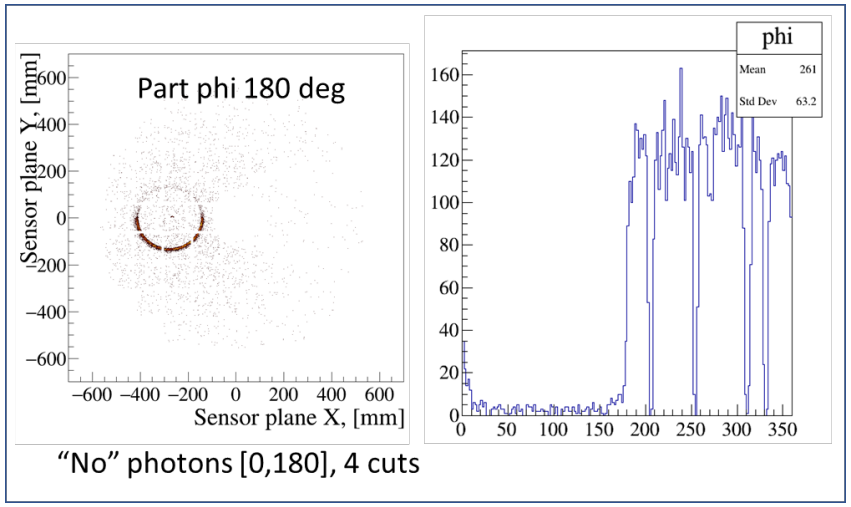
eta 3.3

Theoretically
<n> ~ 1.044
Theta_kaon ~ 282 mrad
Theta_pion ~ 290 mrad

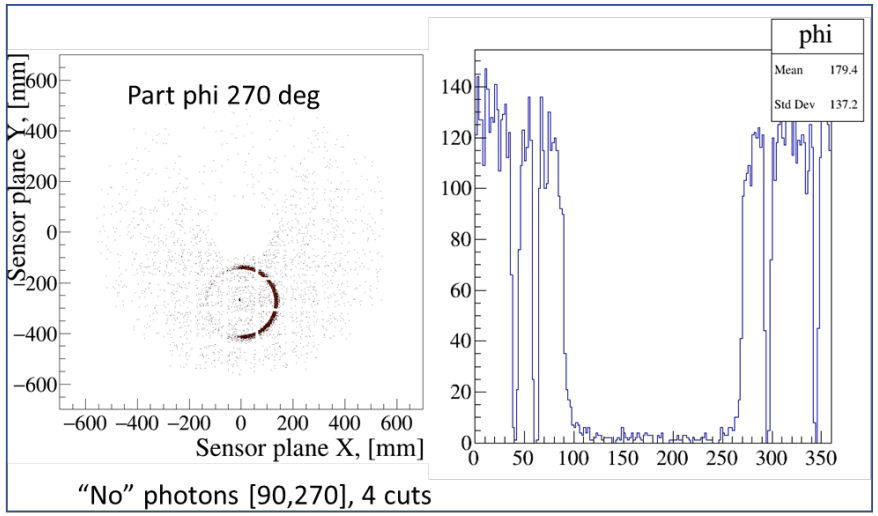
Around 7 sigma apart!

Then why pi/K discrepancy?
→ Studying!

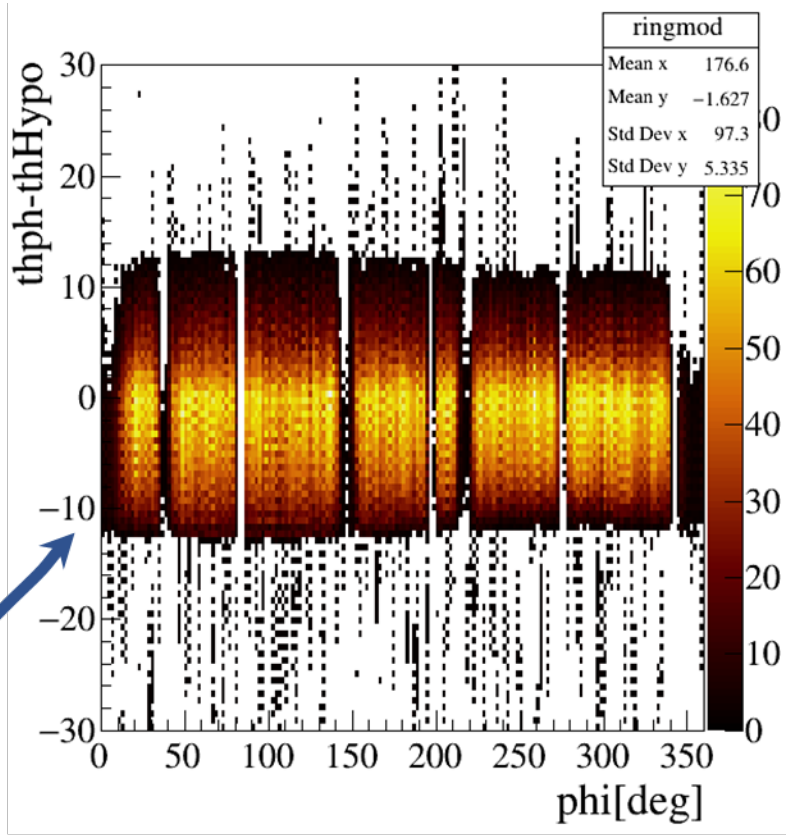
Adding photon azimuth angles

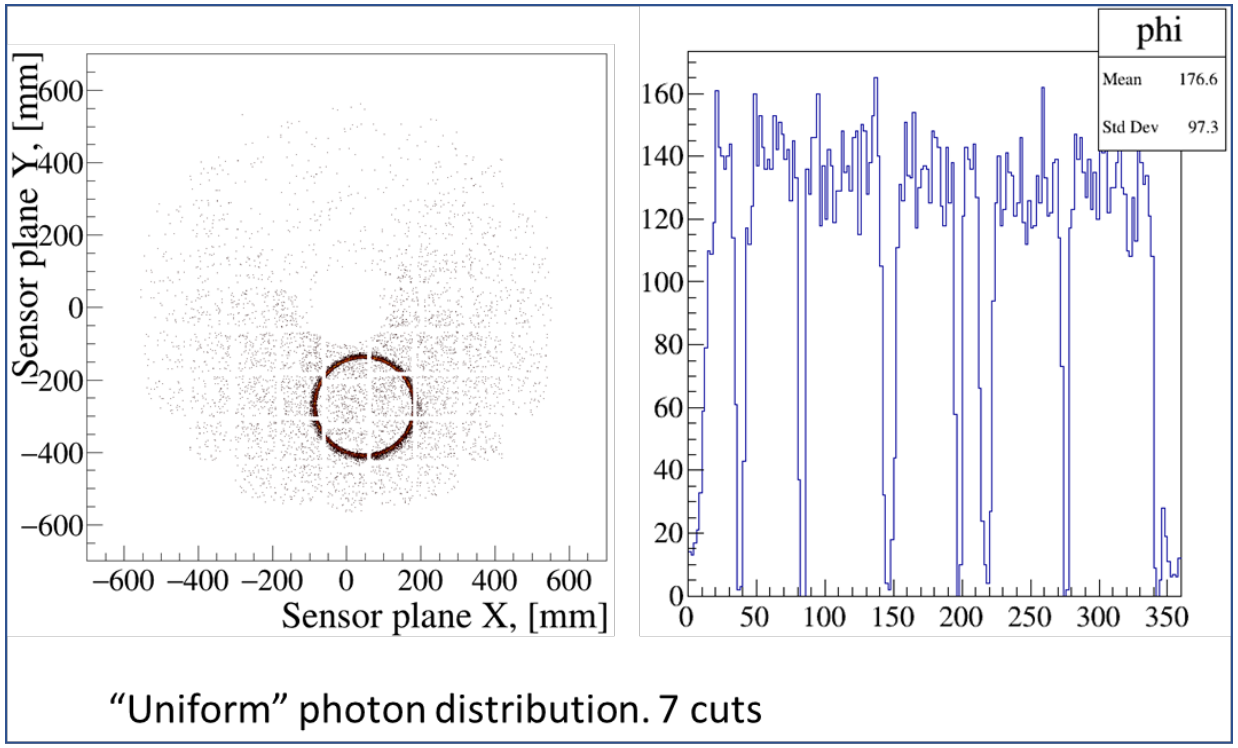


"No" photons [0,180], 4 cuts

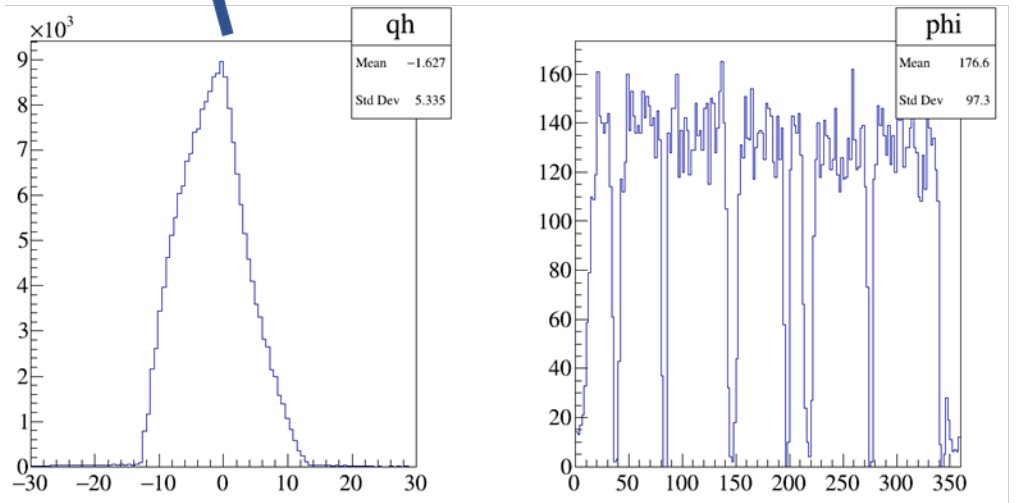


"No" photons [90,270], 4 cuts

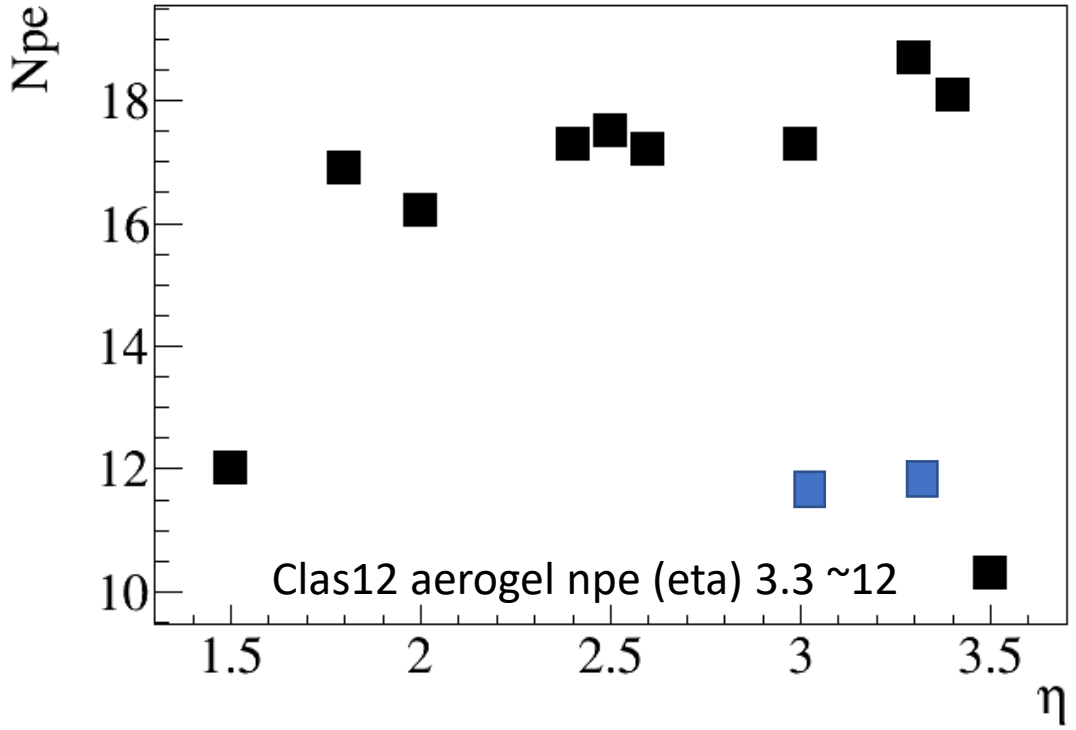


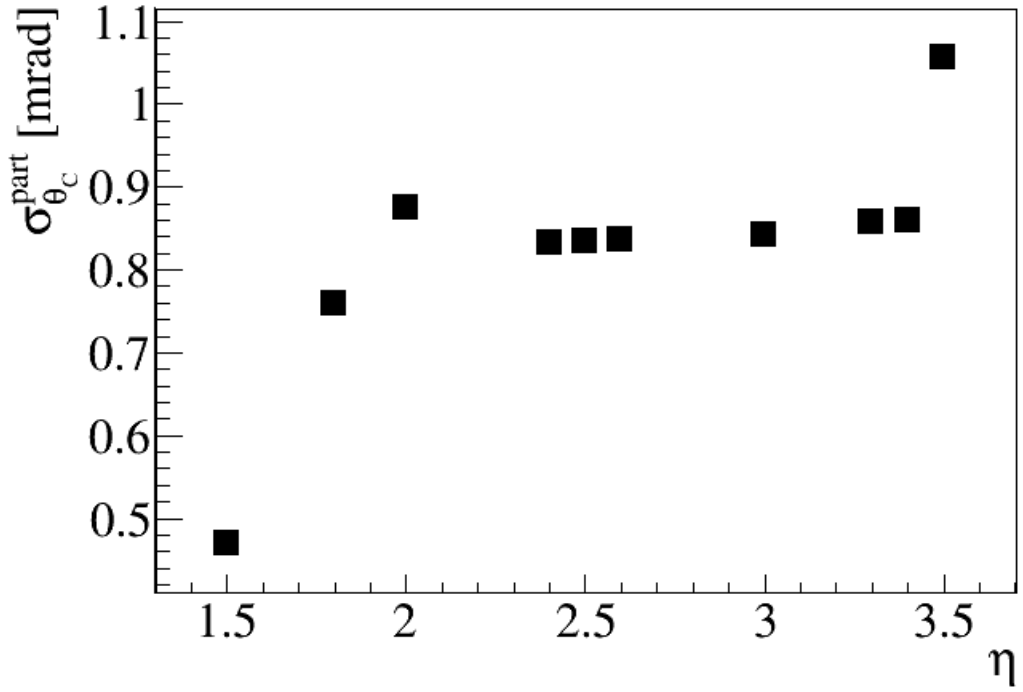


"Uniform" photon distribution. 7 cuts

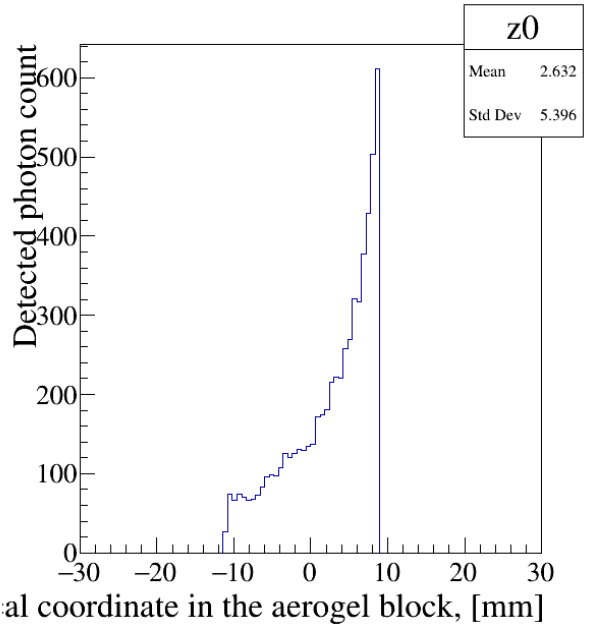


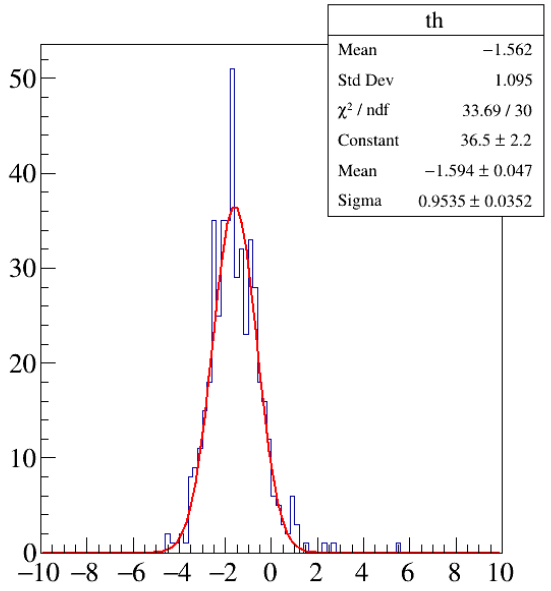
Npe and sigma_CherenkovanglePart vs eta (belle 2 aerogel small r.i.)



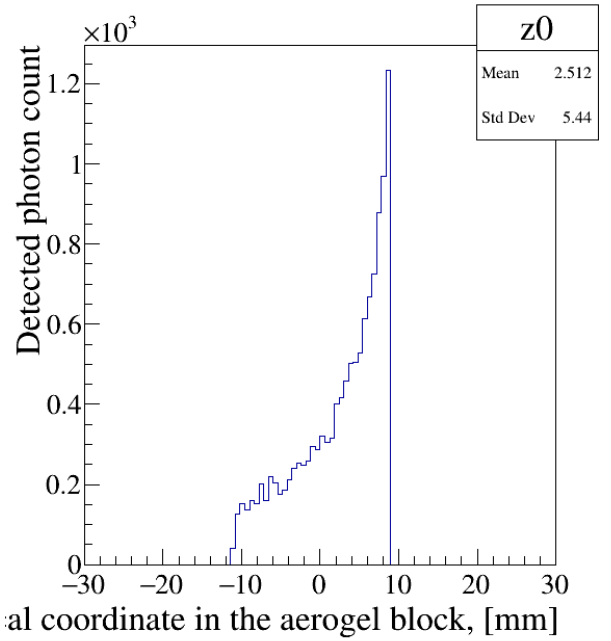


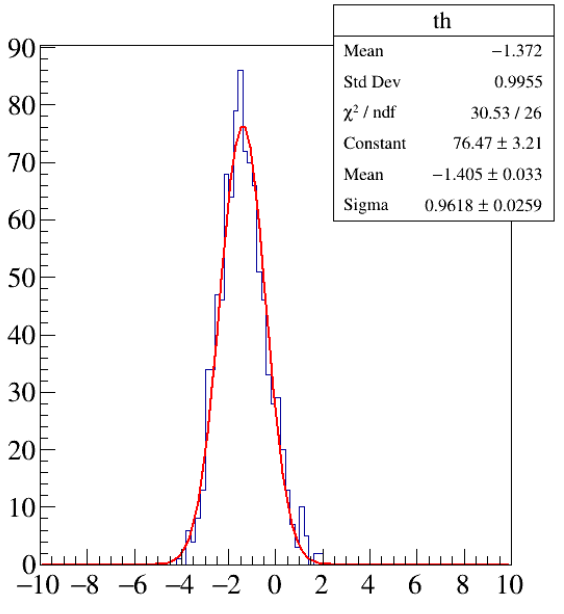
Backups



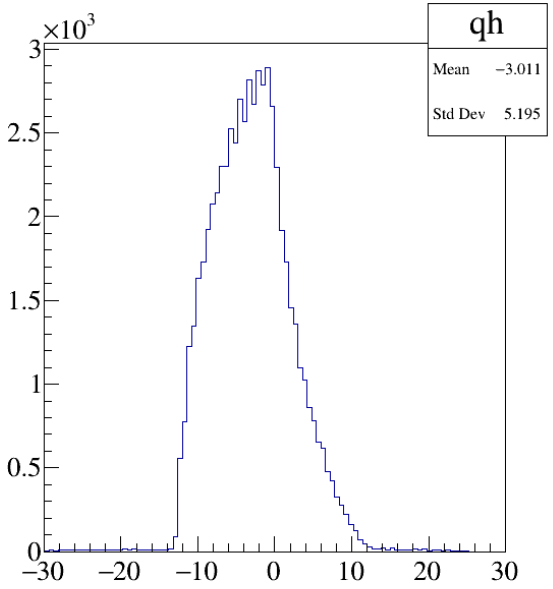


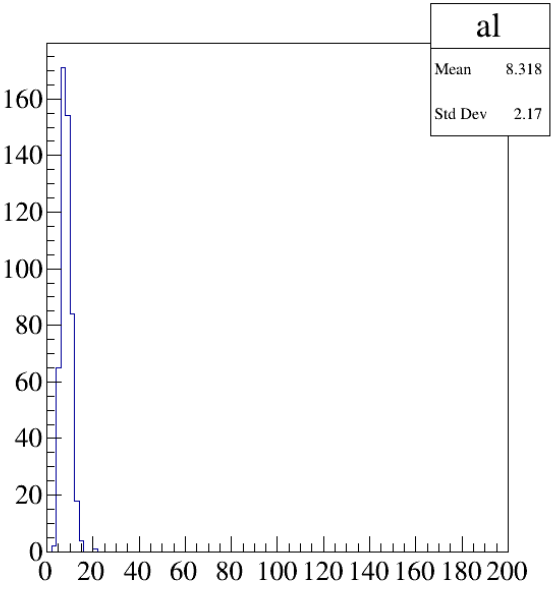
Phi 135

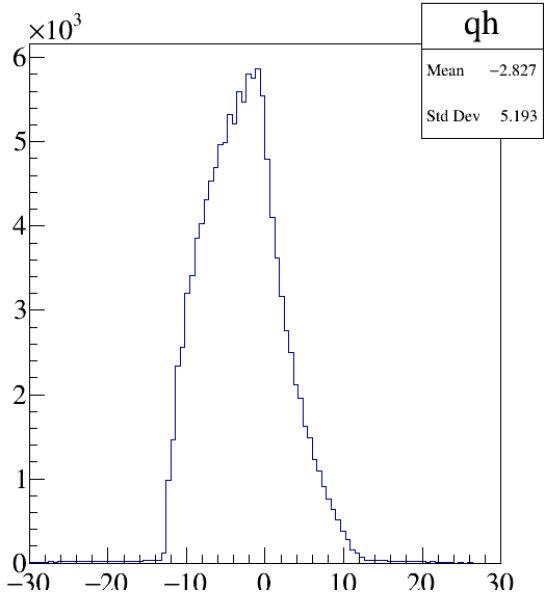


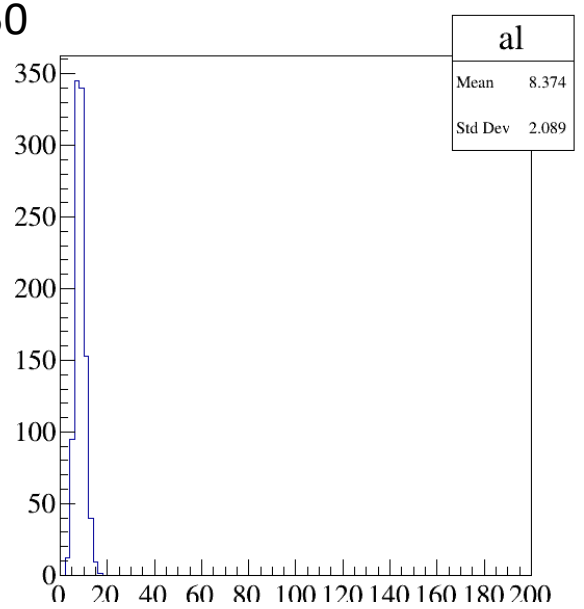


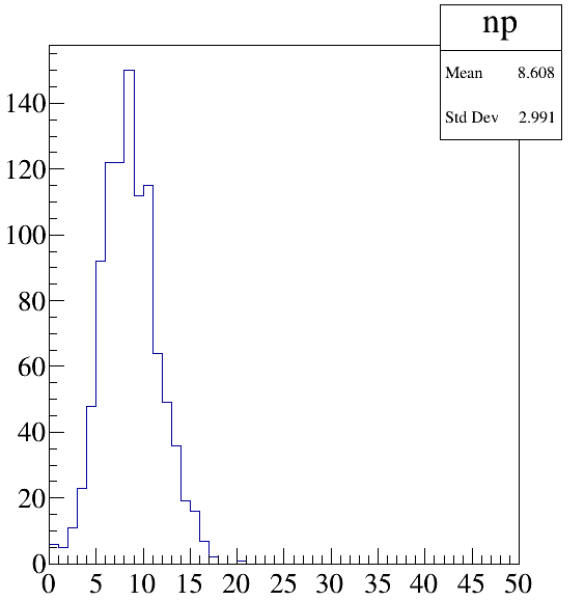
Phi 150

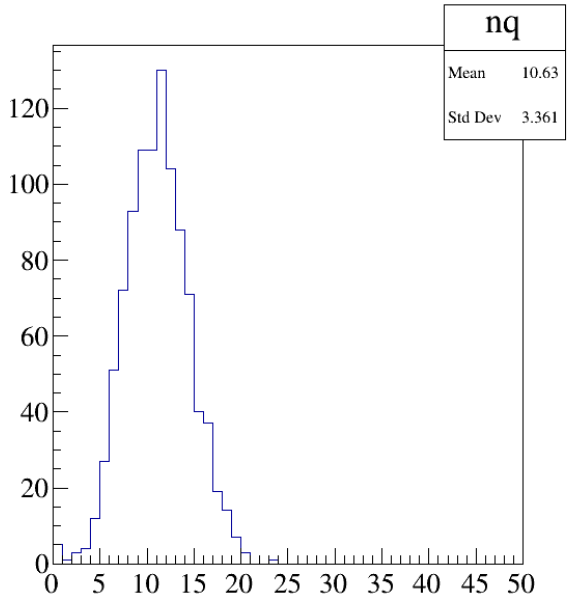


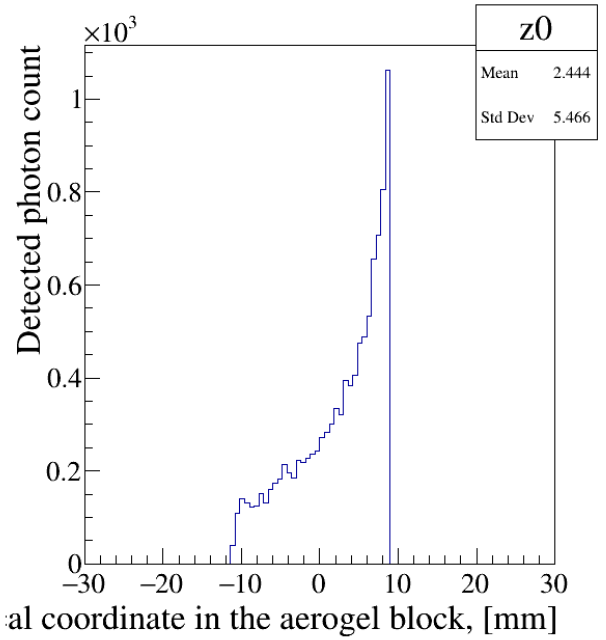


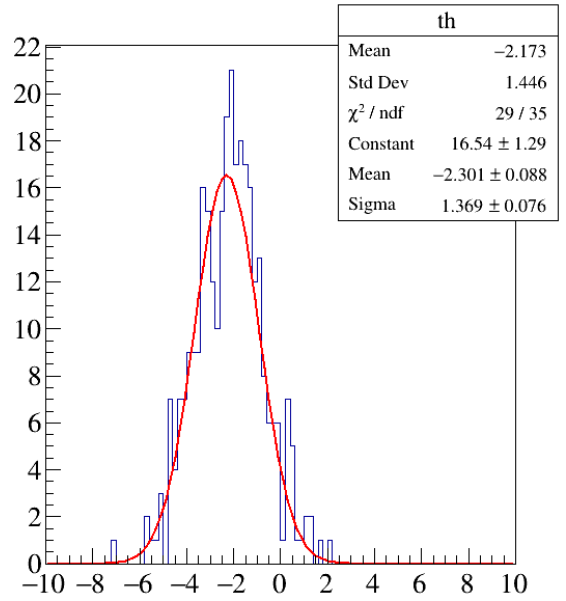




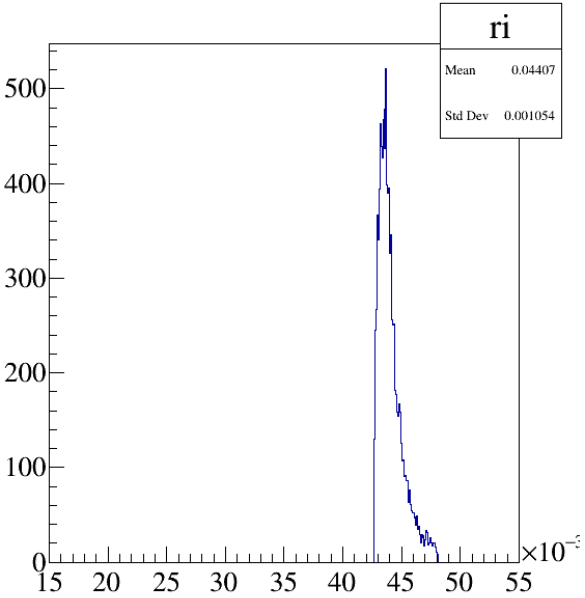

np
Mean 8.608
Std Dev 2.991

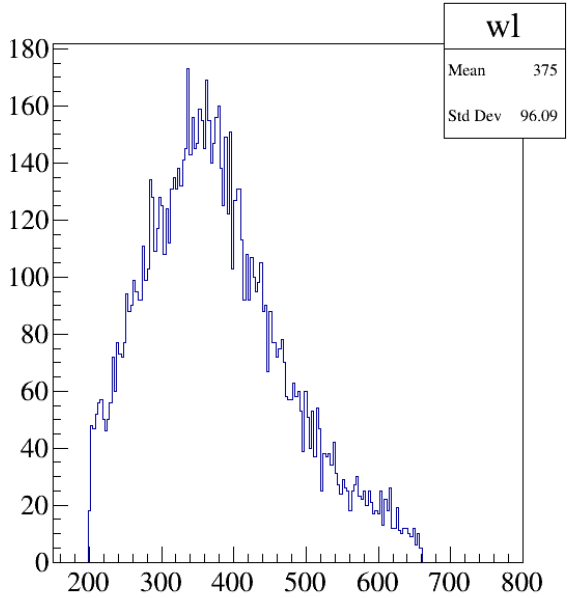

nq
Mean 10.63
Std Dev 3.361

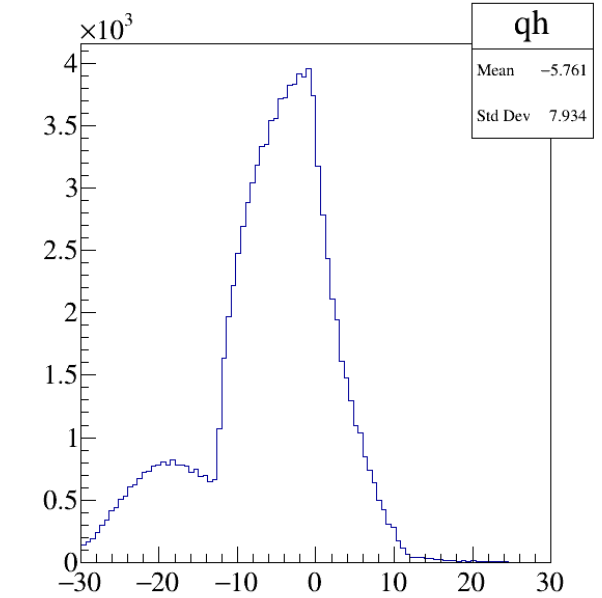

×10^3
Detected photon count
z0
Mean 2.444
Std Dev 5.466
al coordinate in the aerogel block, [mm]

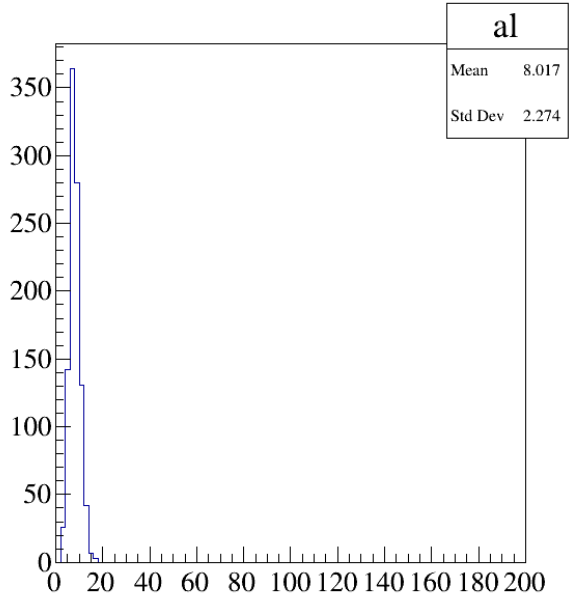

th
Mean −2.173
Std Dev 1.446
χ² / ndf 29 / 35
Constant 16.54 ± 1.29
Mean −2.301 ± 0.088
Sigma 1.369 ± 0.076

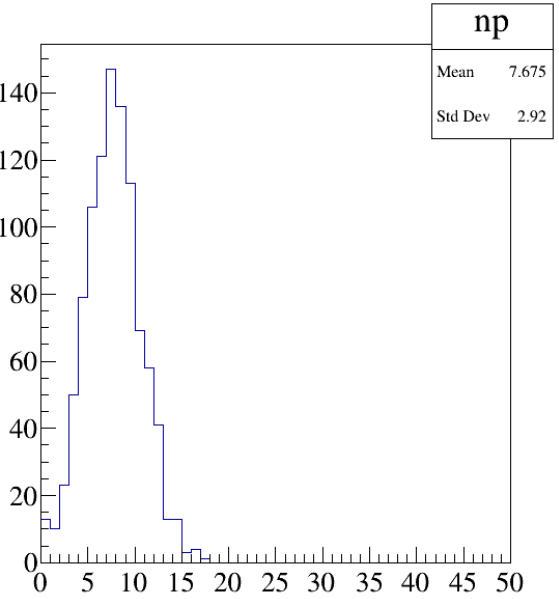
Eta 3.3

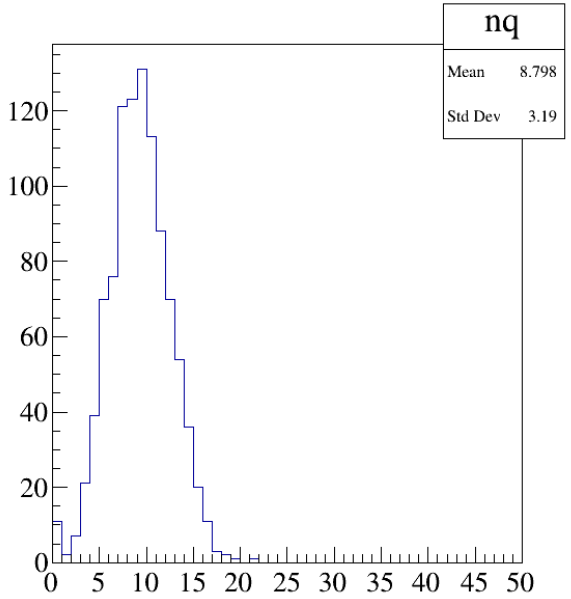

ri
Mean 0.04407
Std Dev 0.001054
×10^-3

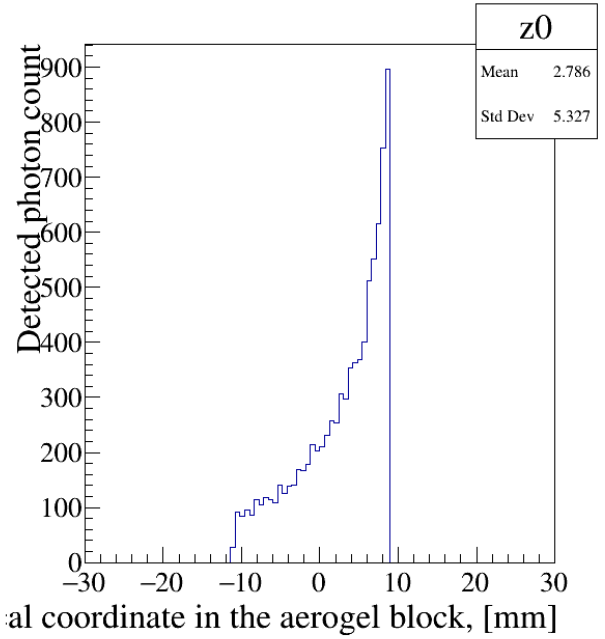

wl
Mean 375
Std Dev 96.09

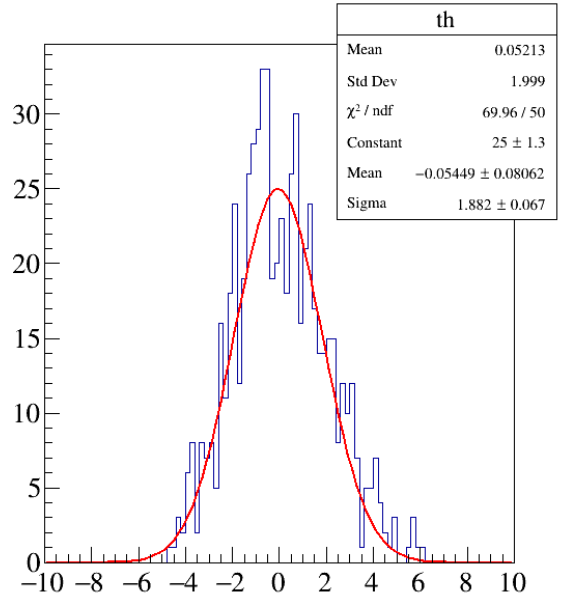

×10^3
qh
Mean −5.761
Std Dev 7.934


al
Mean 8.017
Std Dev 2.274

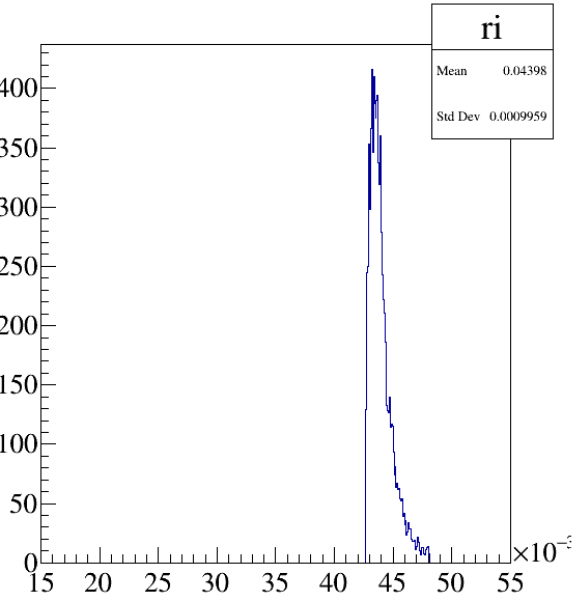

np
Mean 7.675
Std Dev 2.92

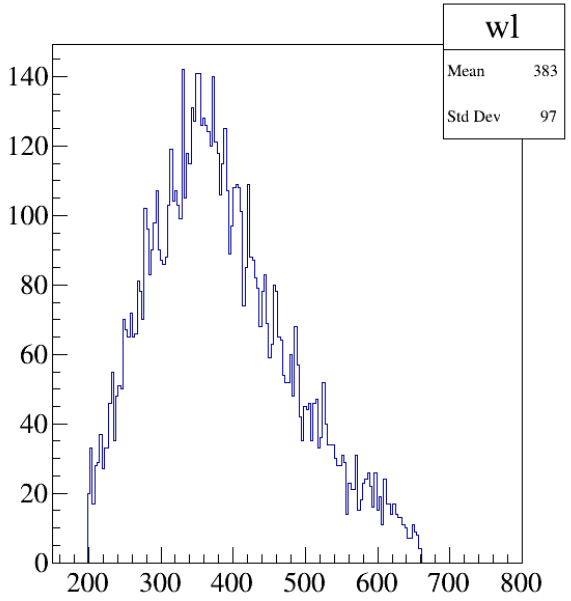

nq
Mean 8.798
Std Dev 3.19

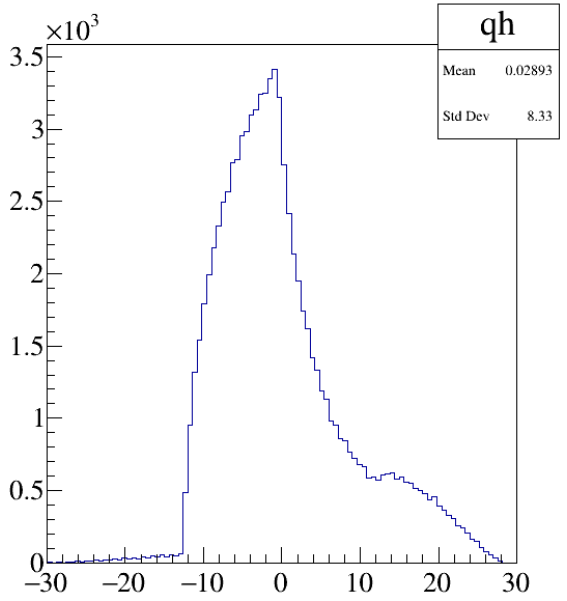

z0
Mean 2.786
Std Dev 5.327
Detected photon count
al coordinate in the aerogel block, [mm]

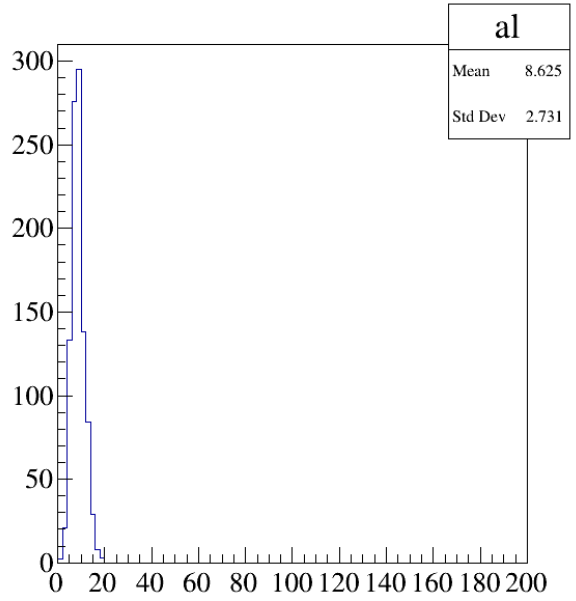

th
Mean 0.05213
Std Dev 1.999
χ² / ndf 69.96 / 50
Constant 25 ± 1.3
Mean −0.05449 ± 0.08062
Sigma 1.882 ± 0.067

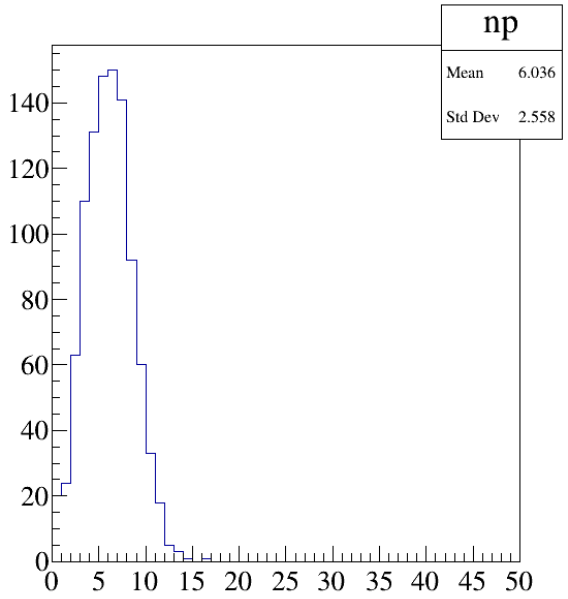
Eta 3.4

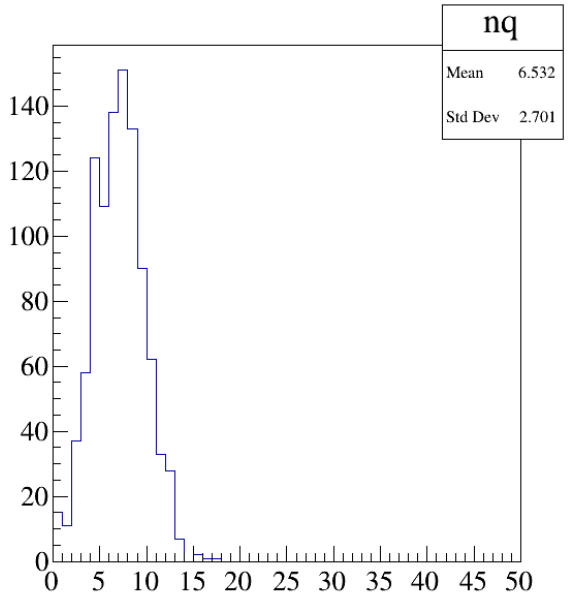

ri
Mean 0.04398
Std Dev 0.0009959

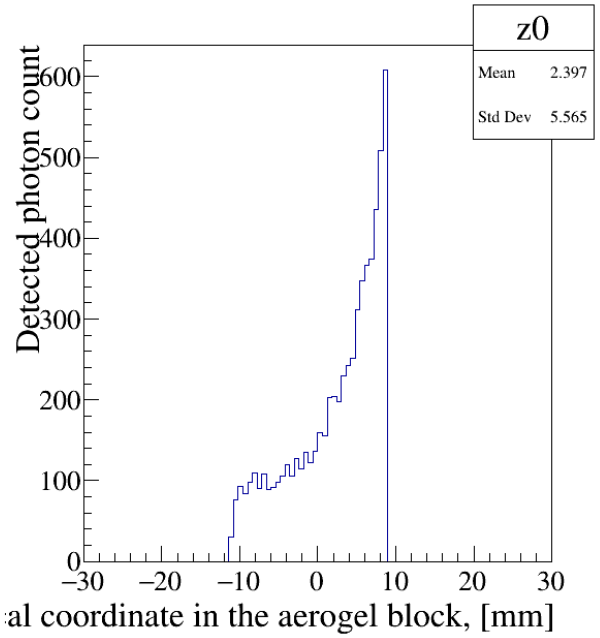

wl
Mean 383
Std Dev 97

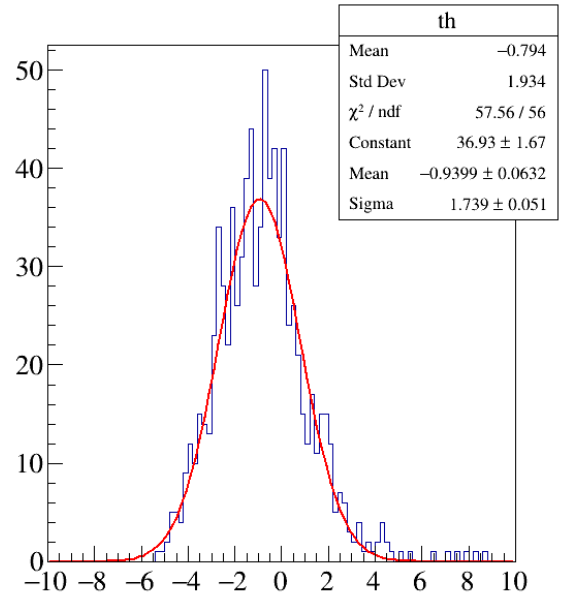

qh
Mean 0.02893
Std Dev 8.33


al
Mean 8.625
Std Dev 2.731

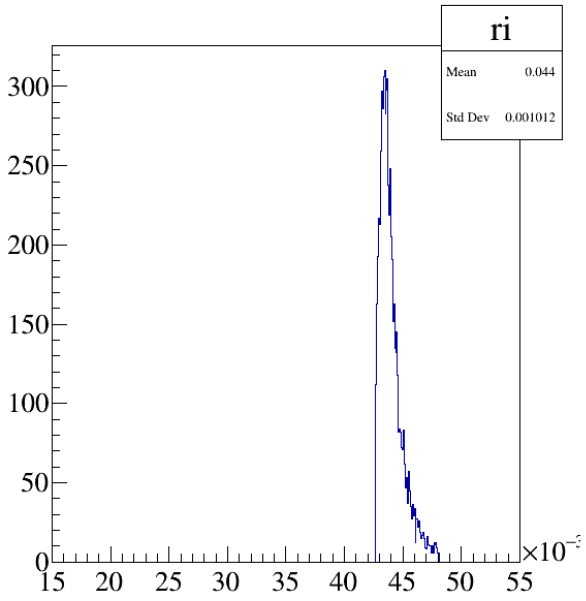

np
Mean 6.036
Std Dev 2.558

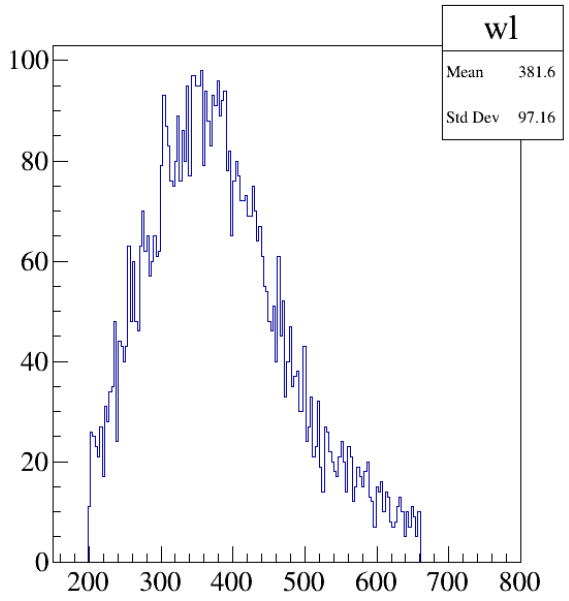

nq
Mean 6.532
Std Dev 2.701

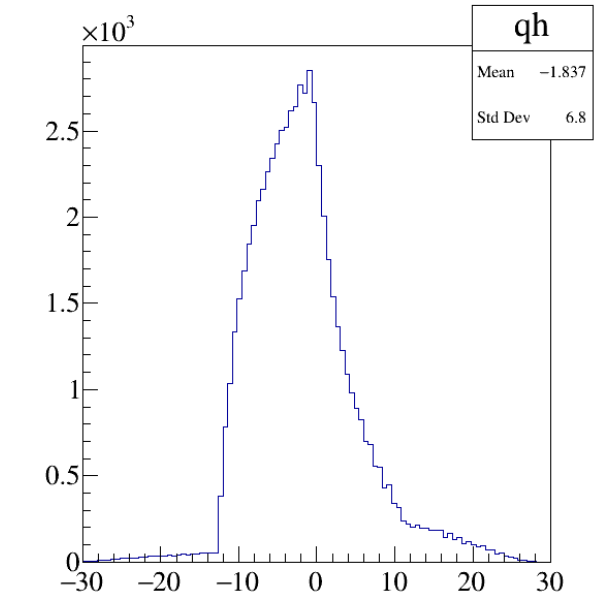

z0
Mean 2.397
Std Dev 5.565
Detected photon count
al coordinate in the aerogel block, [mm]

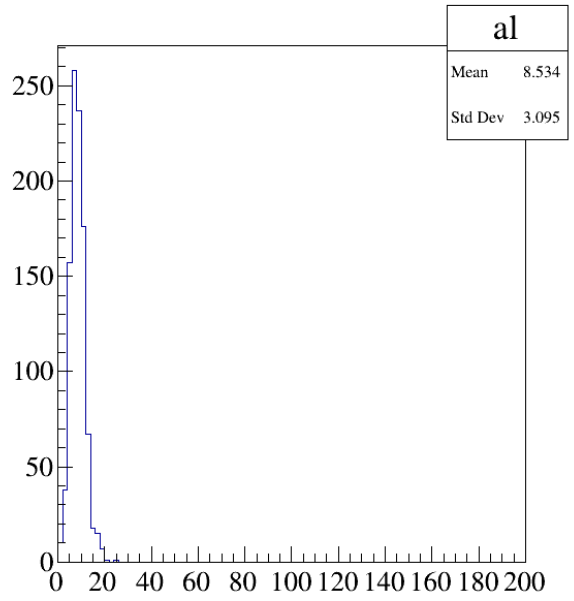

th
Mean −0.794
Std Dev 1.934
χ² / ndf 57.56 / 56
Constant 36.93 ± 1.67
Mean −0.9399 ± 0.0632
Sigma 1.739 ± 0.051

Eta 3.3


ri
Mean 0.044
Std Dev 0.001012


wl
Mean 381.6
Std Dev 97.16


qh
Mean −1.837
Std Dev 6.8


al
Mean 8.534
Std Dev 3.095