Cherenkov angle reconstruction performance study with the standalone pfRICH simulation

pfRICH General Meeting

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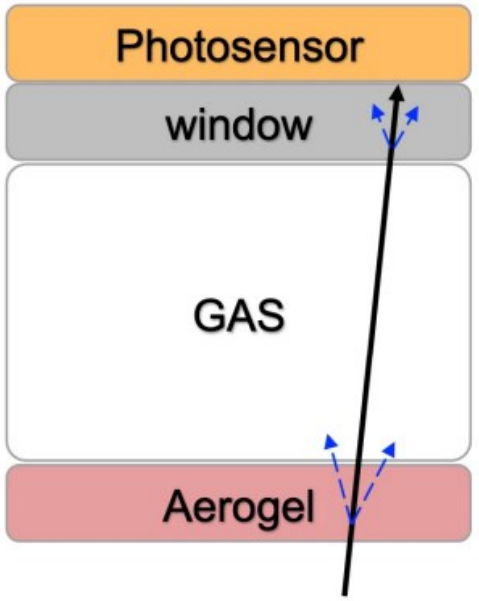
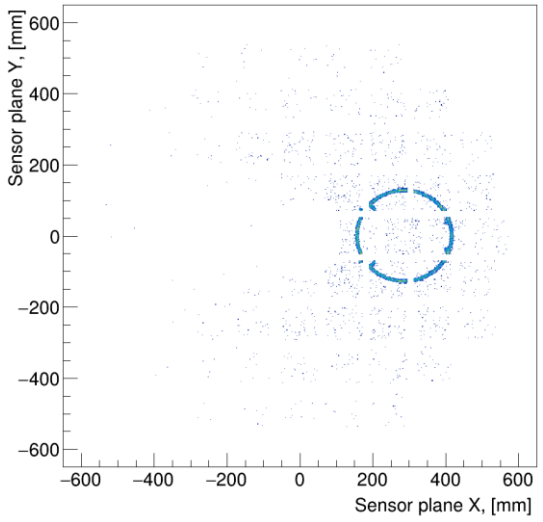
Simulation workflow

- Generate events with epic.default.h
  - Particle type: π^+
  - $p = 1, 4, 10$ GeV
  - $\eta = -1.5, -1.8, -2.5, -3.2$
  - $\phi = 0, 5, 10, \ldots, 355$ degrees

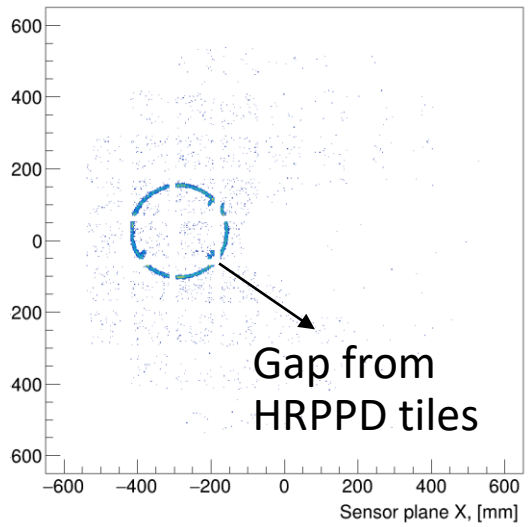
  For each set of (p, η, ϕ), 1000 single-particle events are generated
- Check the photon hits on the sensor plane with hit-map-epic.C
  - E.g, $p = 10$ GeV, $\eta = -2.5$



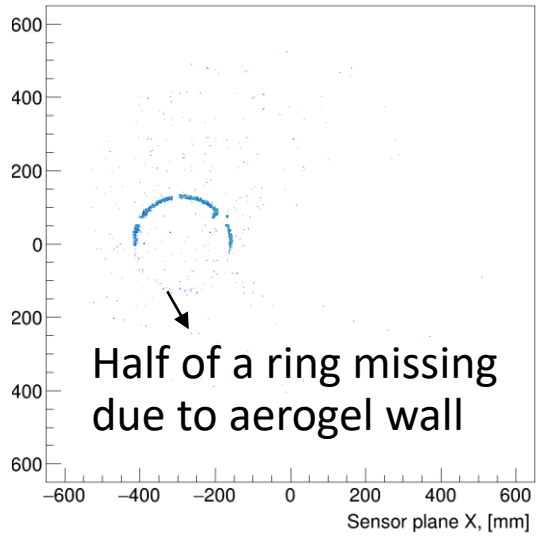
$\phi = 0$



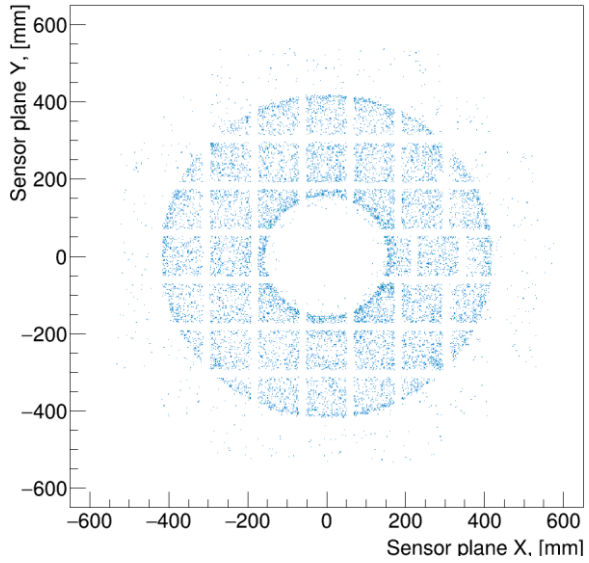
$\phi = 175$



$\phi = 180$



$\phi \in [0,360)$

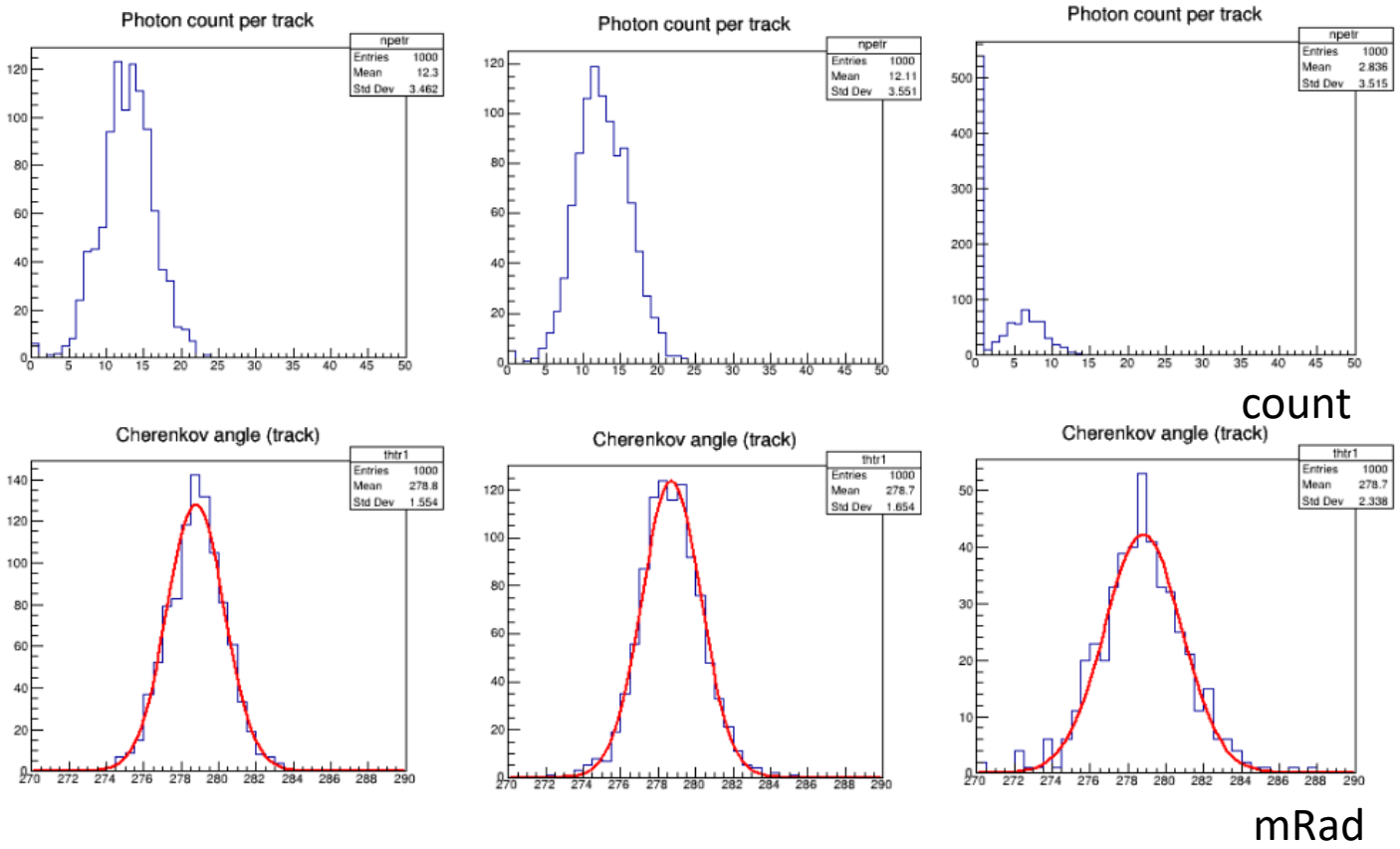


Simulation workflow

- Plot the number of photons and track level Cherenkov angle and with reco-epic.C

$p = 10$ GeV
$\eta = -2.5$

$\phi = 0$ $\phi = 175$ $\phi = 180$



At $\phi = 180$, number of photons is shifted to the left and has a peak at 0, which worsens the angle resolution

- Why is it sometimes 6 photons and many times no photon at all?

Efficiency vs (p, η, ϕ)

- Number of photons is higher for higher momentum, expected from $N_\gamma = \frac{N_c(1-\frac{1}{\beta^2 n^2})}{1-\frac{1}{n^2}}$, where N_c is a constant dependent on detector geometry
- Periodic dips in efficiency could be from the same effect as Fig 4.13 in CDR

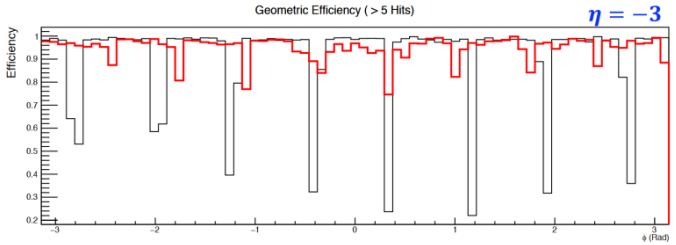
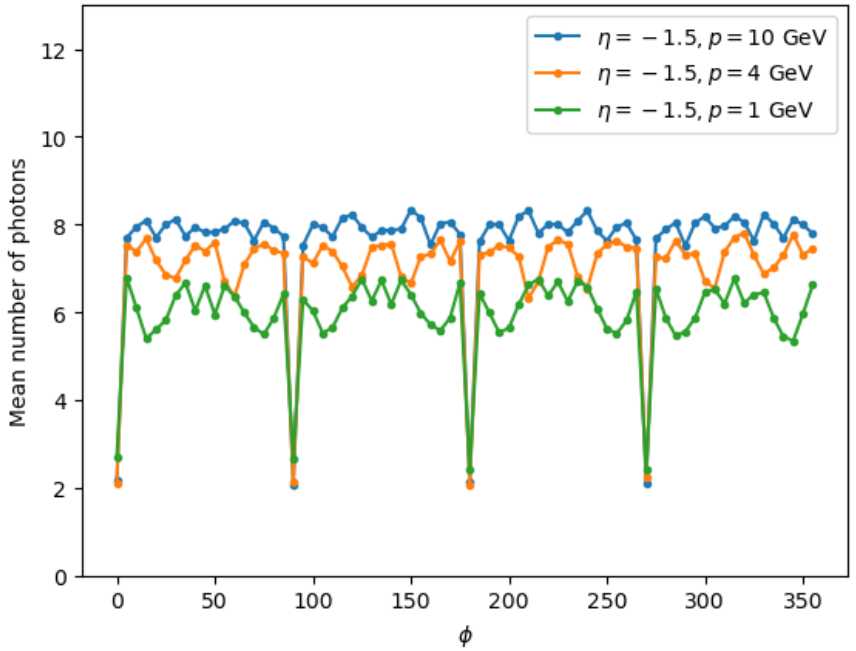
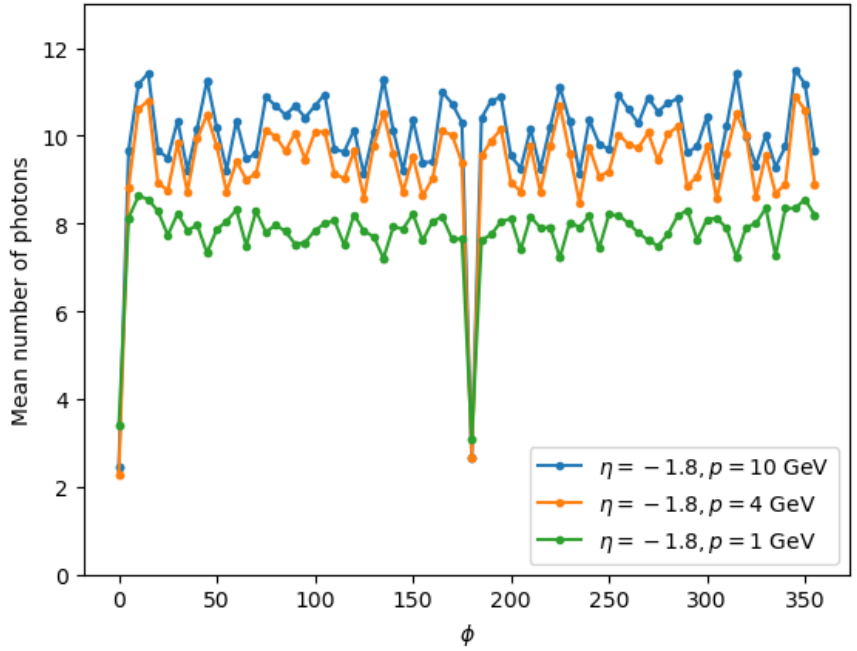
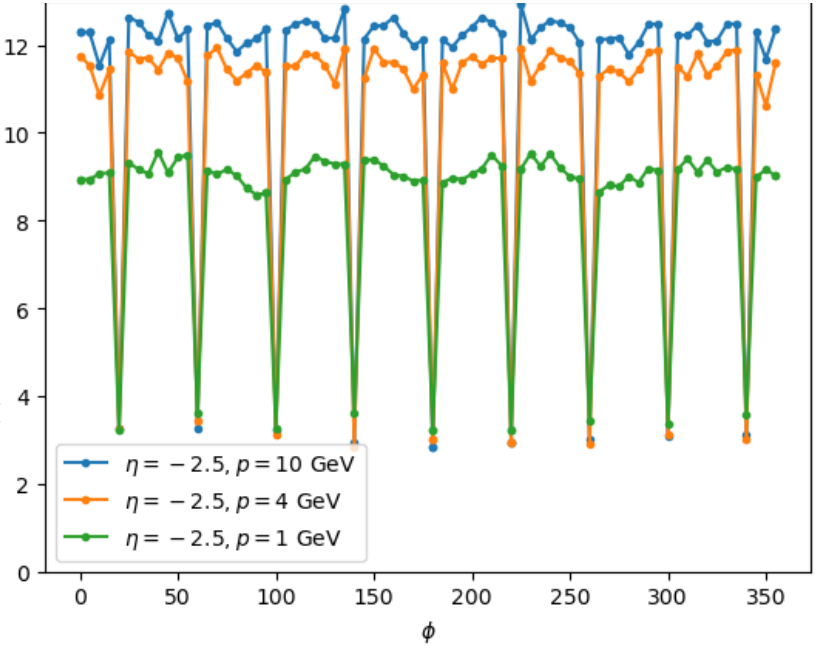
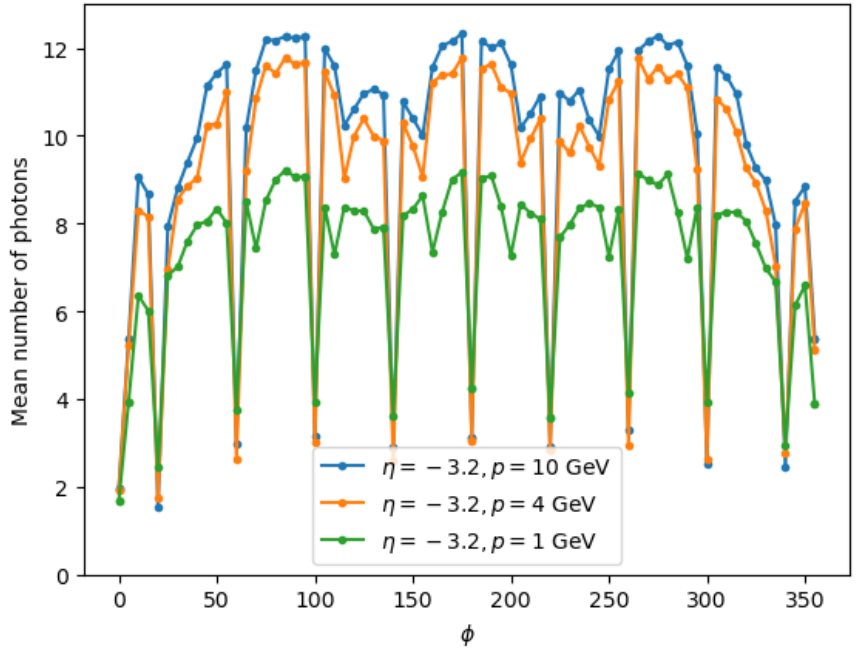


Figure 4.13: Efficiency to receive > 6 hits as a function of primary charged particle azimuthal angle ϕ for only Cherenkov photons originating in the HRPPD window (black) and only photons originating in the aerogel (red).

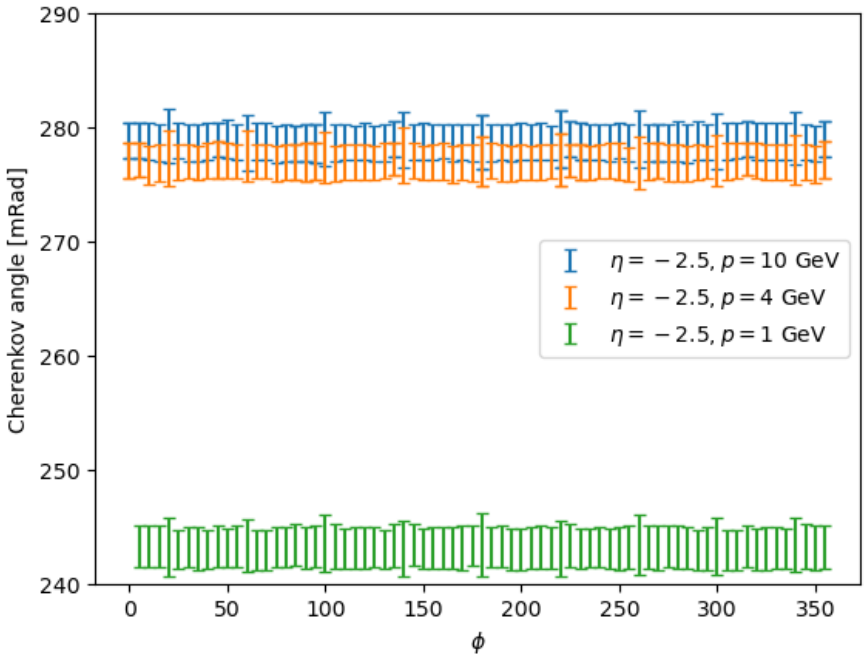


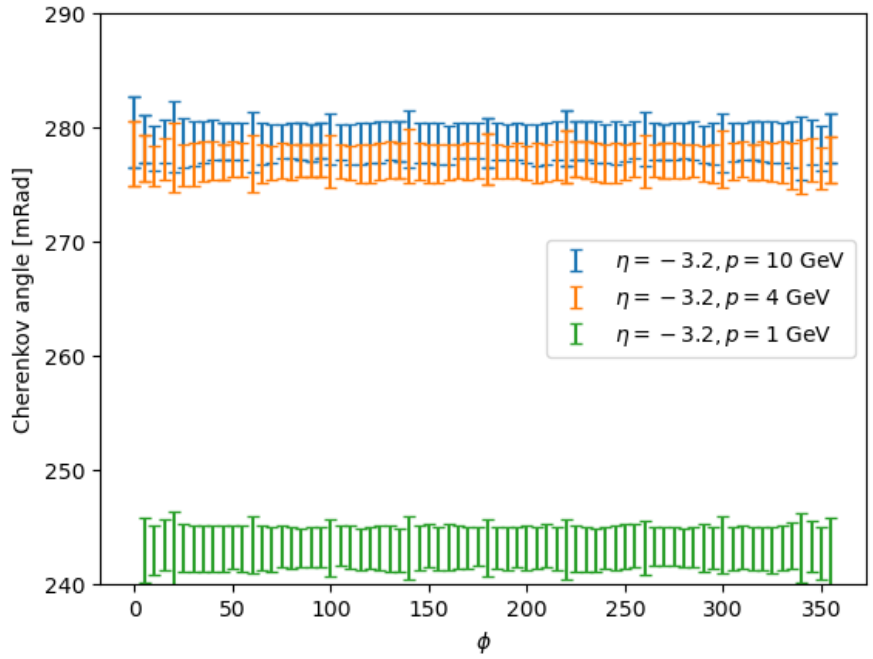






Cherenkov angle vs (p, η, ϕ)



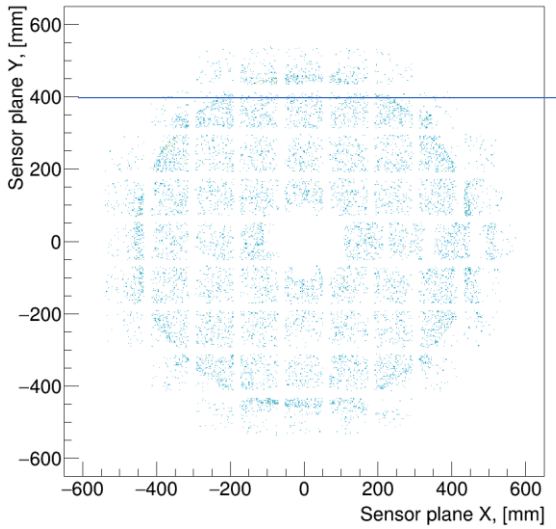


- Resolution is worsened where we have lower number of photons at the ϕ dips
- Errorbars indicate standard deviation of the distributions
- Mean and errors from histograms, not from fit

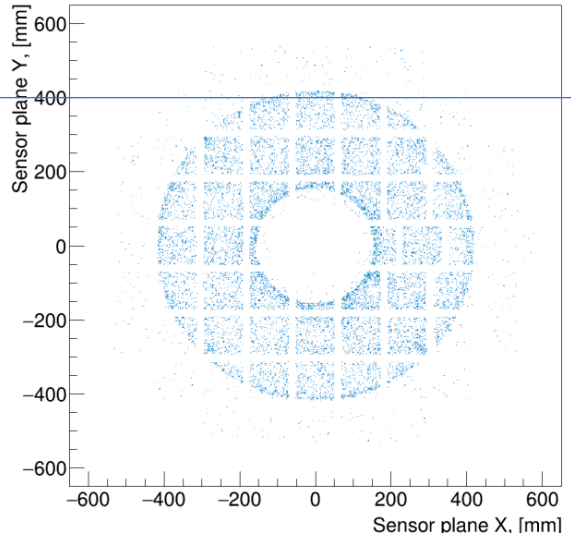
Backup

$p = 10$ GeV, $\phi \in [0,360)$

$\eta = -1.5$



$\eta = -2.5$



$\eta = -3.2$