Aerogel Refractive index study

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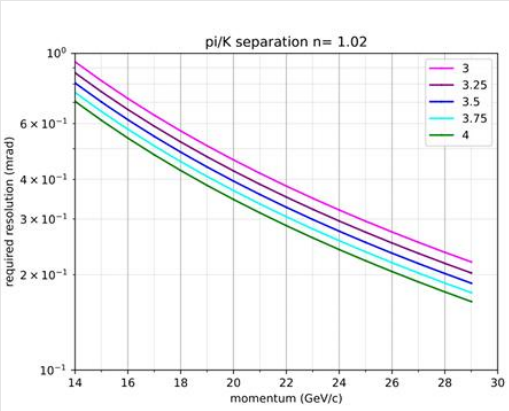
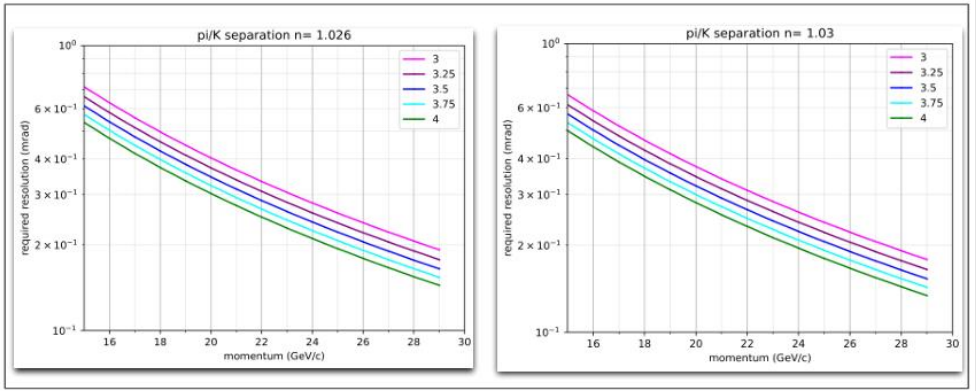
REQUIREMENTS FOR AEROGEL AND FOR THE GAS





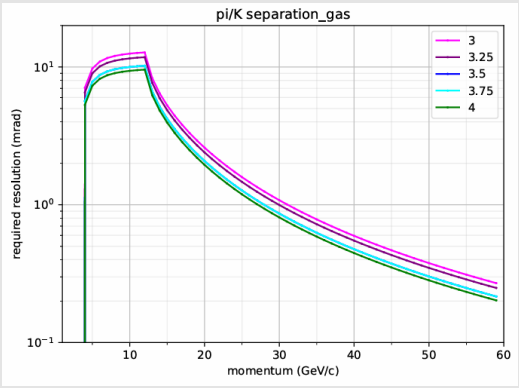
All studies done with nominal aerogel. Now we need to optimize it!

Baseline

Type-1 (n=1.026)

Type-2 (n=1.03)

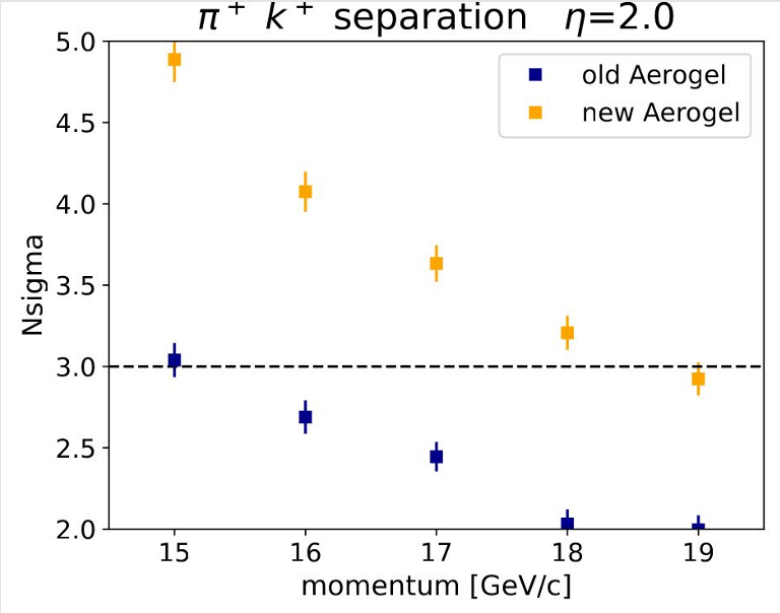
Higher refractive index = higher photon yield

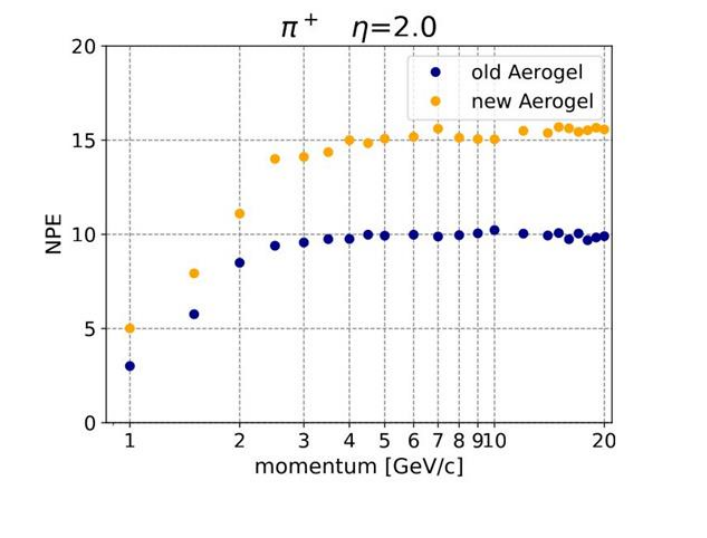


In order to achieve at least a 3σ pion/Kaon separation above 50 GeV/c we need a *ring resolution* ($\frac{\sigma_{PE}}{\sqrt{NPE}}$) around 0.3 mrad.

Performance Comparison of Aerogel Type-1 (n=1.026)

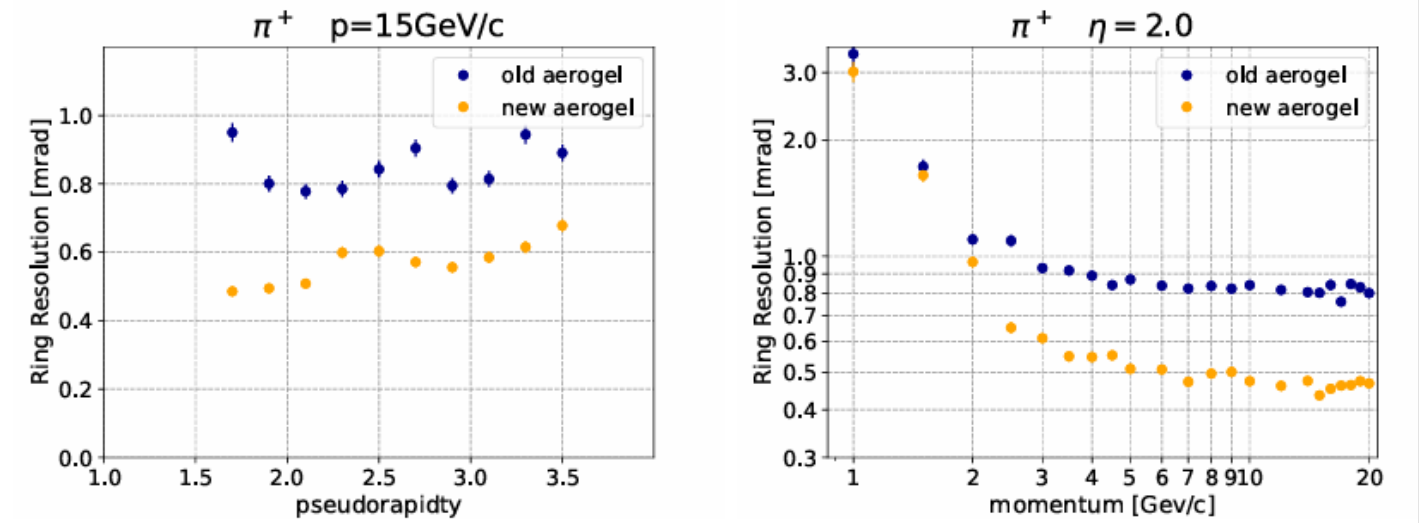
Gain in performance (wrt baseline), 3.5-4 GeV/c more!





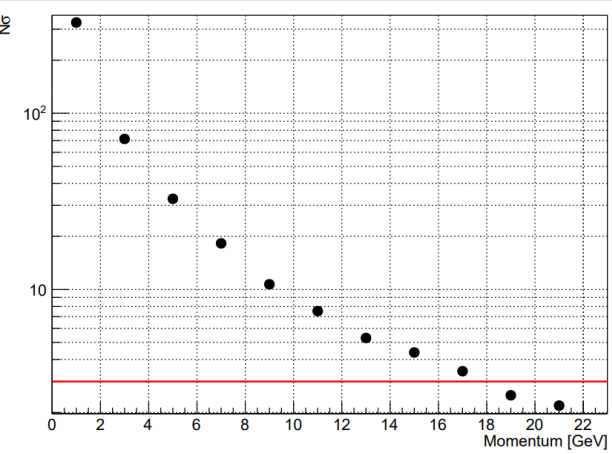
Significantly larger number of photons, ~1.5 times more Nph!

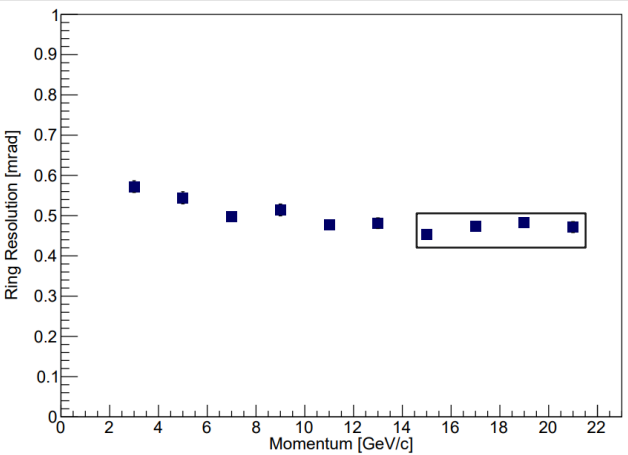
Performance Comparison of new Aerogel Type-1 (n=1.026)

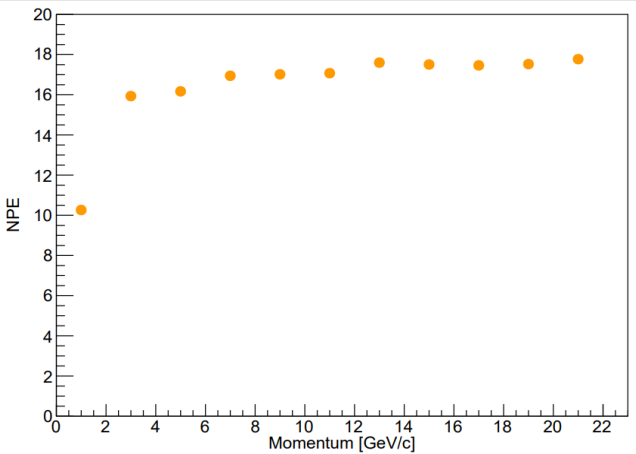


New type-1 Aerogel provides ring resolution capable to perform PID ~ 18-19 GeV (@eta=2.0)

Performance Comparison of Aerogel Type-2 (n=1.03)





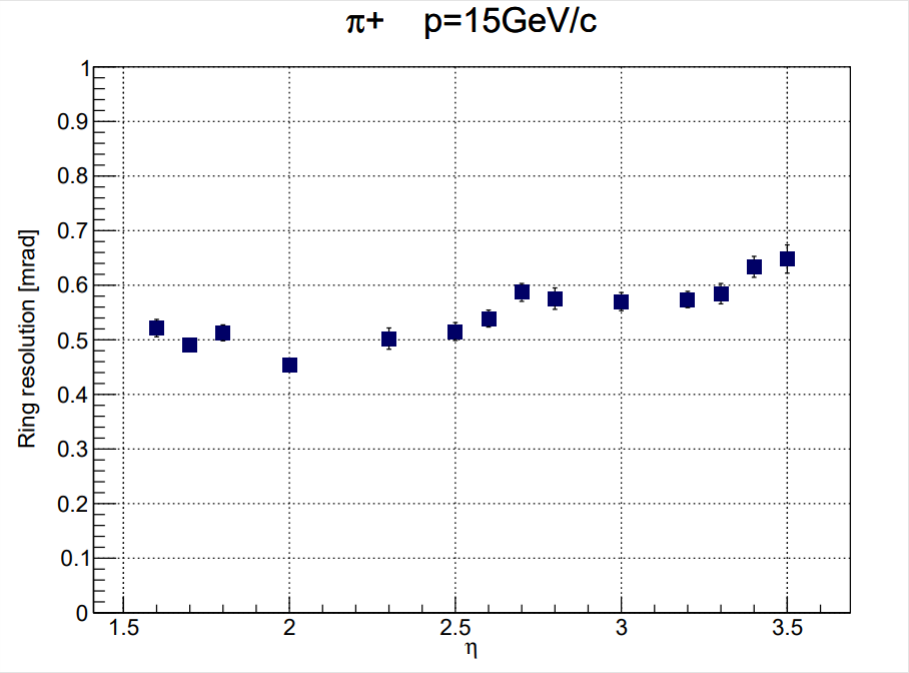


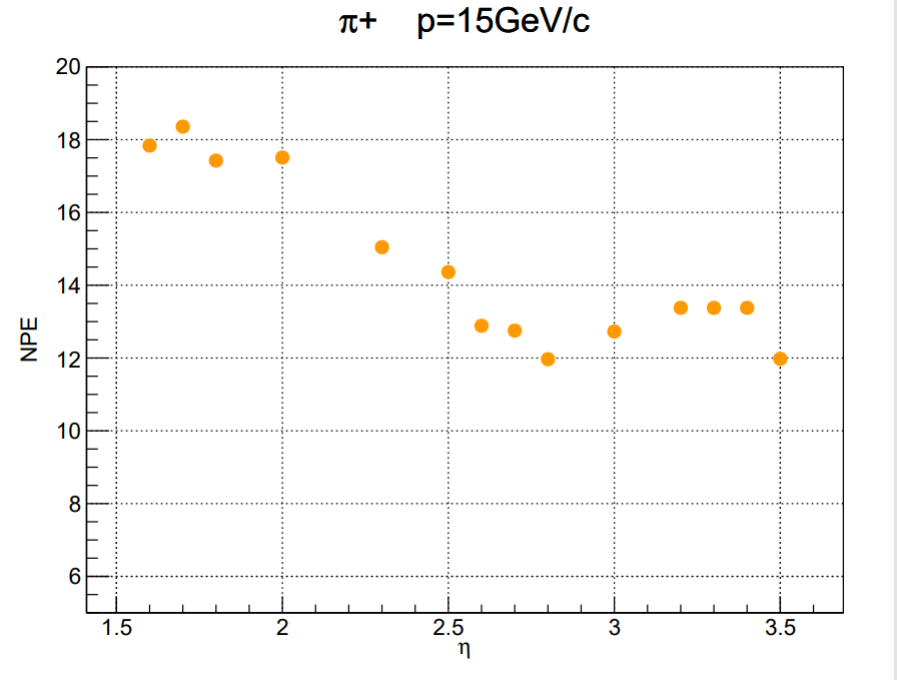
π+, φ=0, **η=2.0**

@ η=2.0 we achieve 3σ with ~ 17 GeV/c of momentum for the aerogel.
We gain 1-2 photons more.

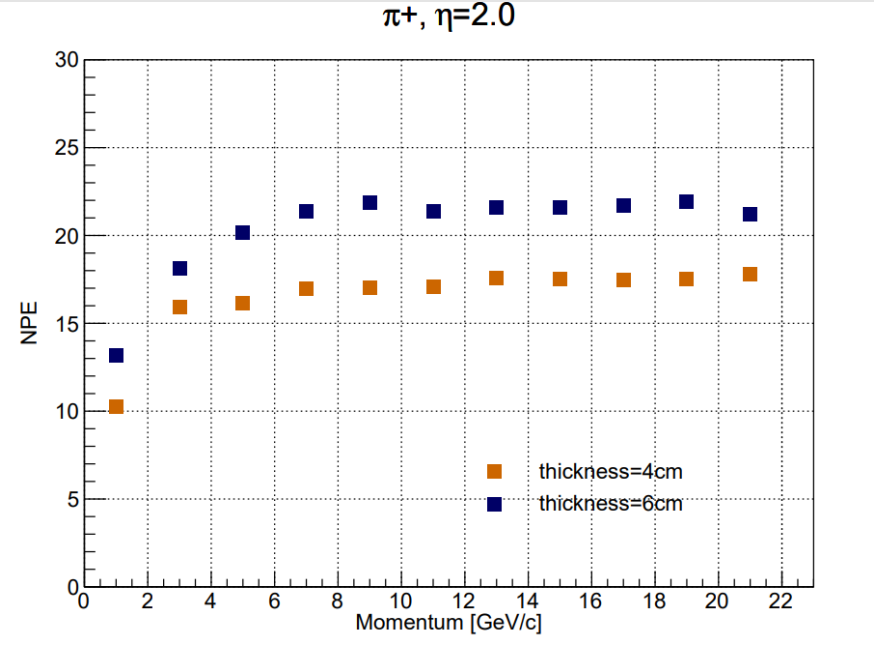
Performance: NPE and Resolution vs η

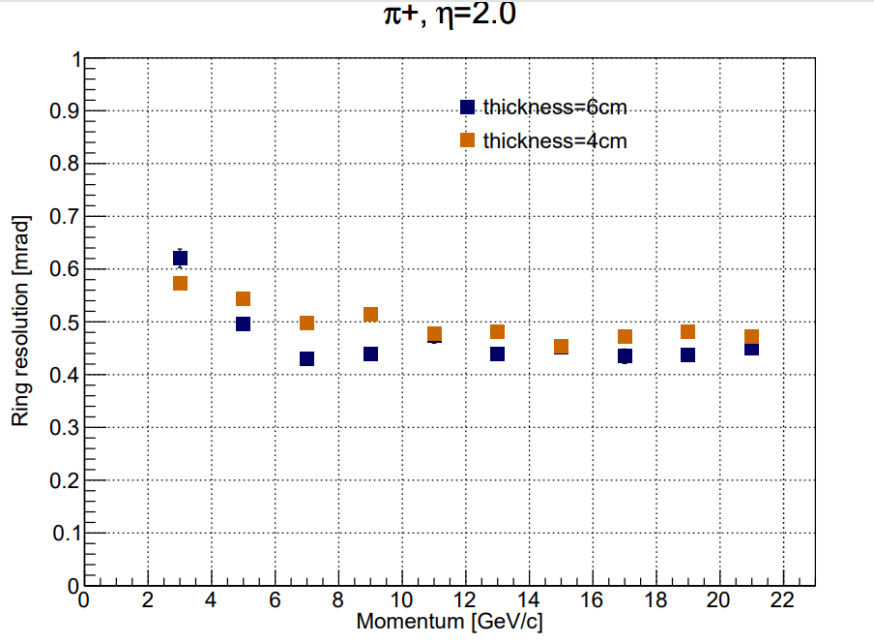
Aerogel Refractive Index = 1.03



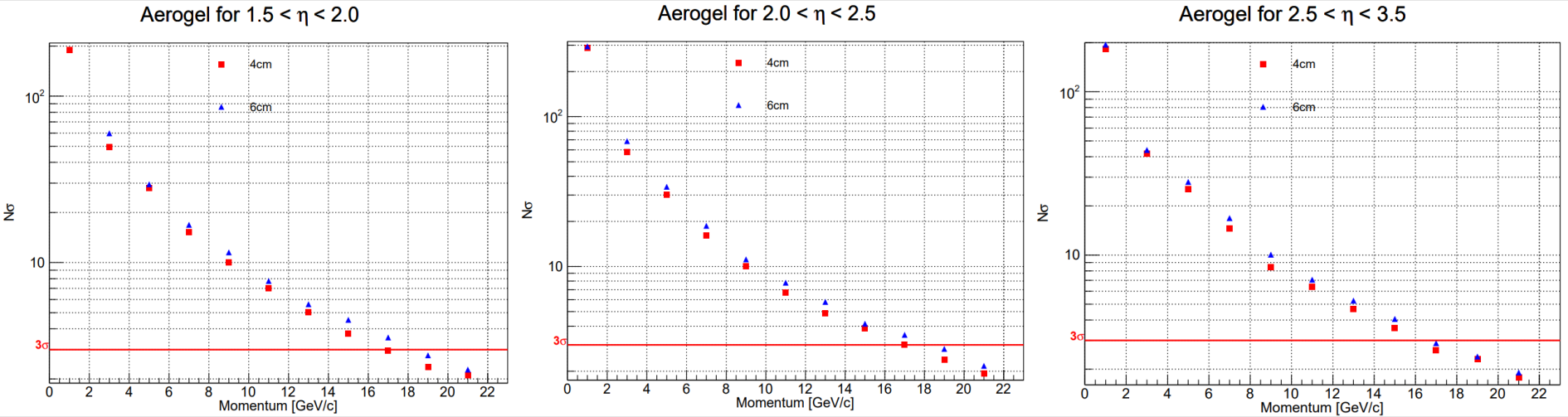


Performance: NPE and Resolution vs η

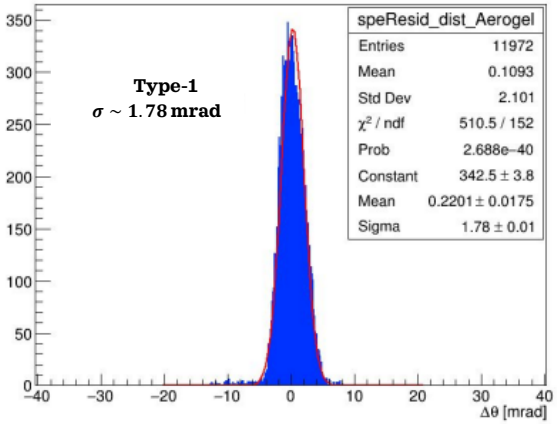


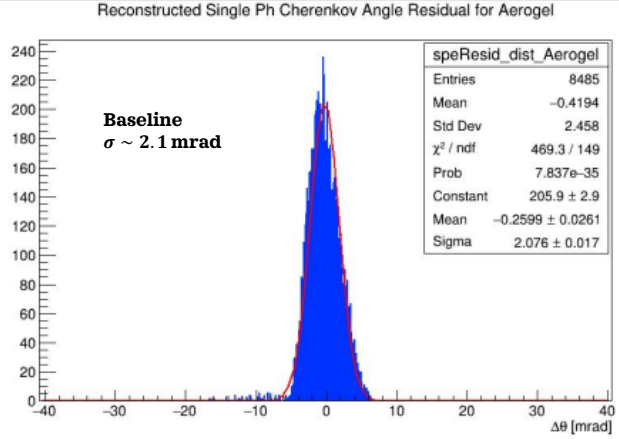


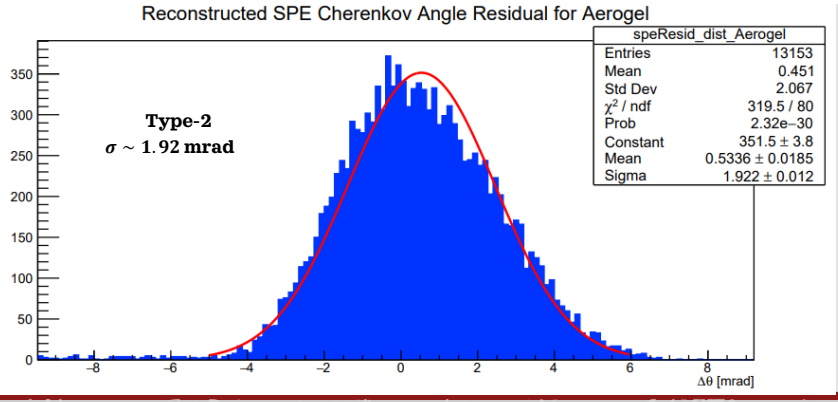
Performance: Nσ Separation



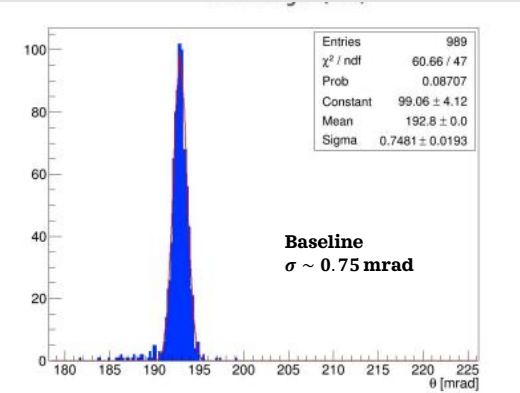
COMPARISON SPE TYPE-1 vs TYPE-2



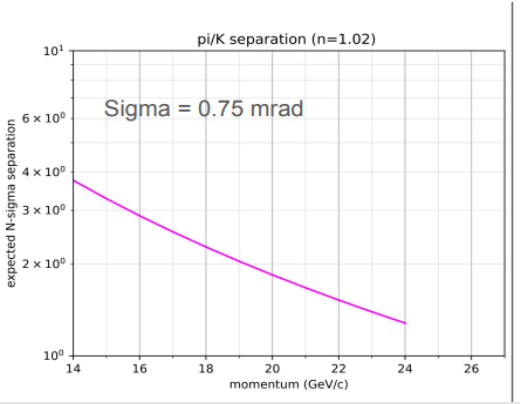




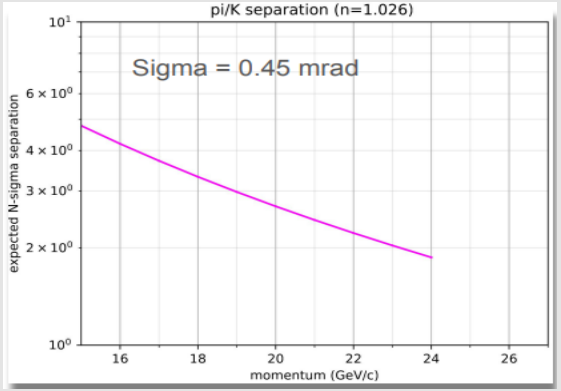
COMPARISON RING TYPE-1 vs TYPE-2

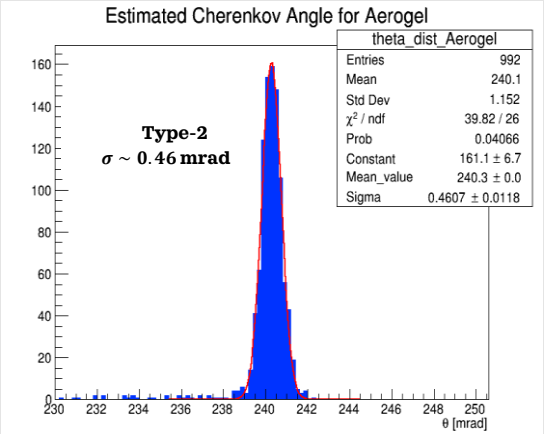


Baseline
$\sigma \sim 0.75$ mrad

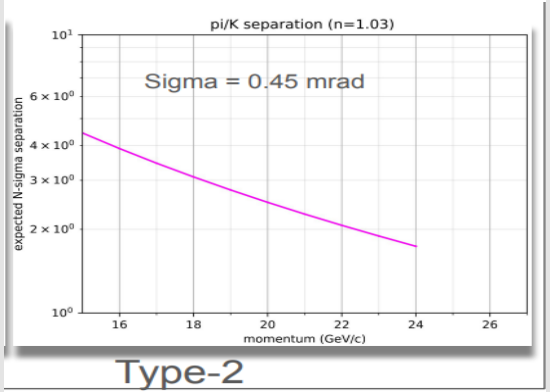


Type-1
$\sigma \sim 0.45$ mrad



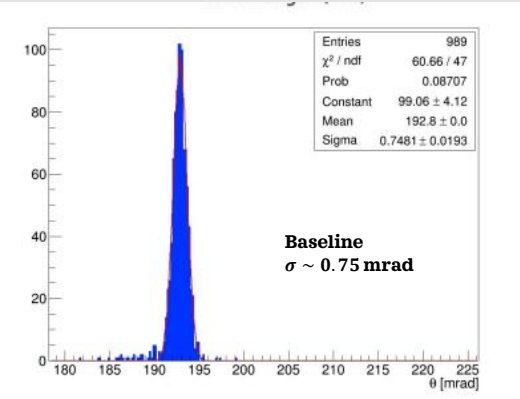


Type-2
$\sigma \sim 0.46$ mrad

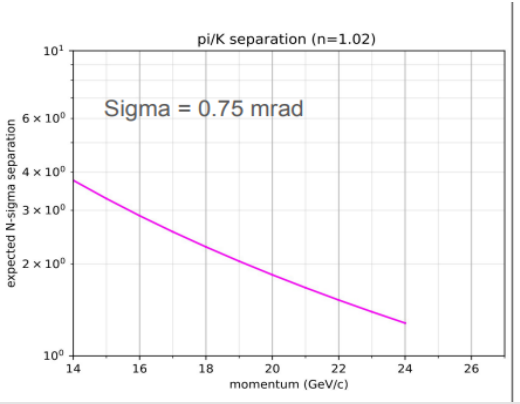


COMPARISON RING TYPE-1 vs TYPE-2

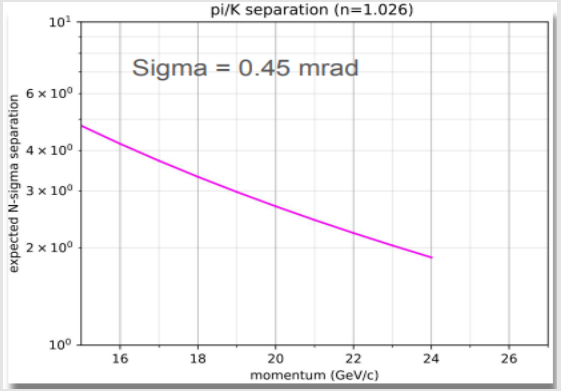
Type-2
6 CM

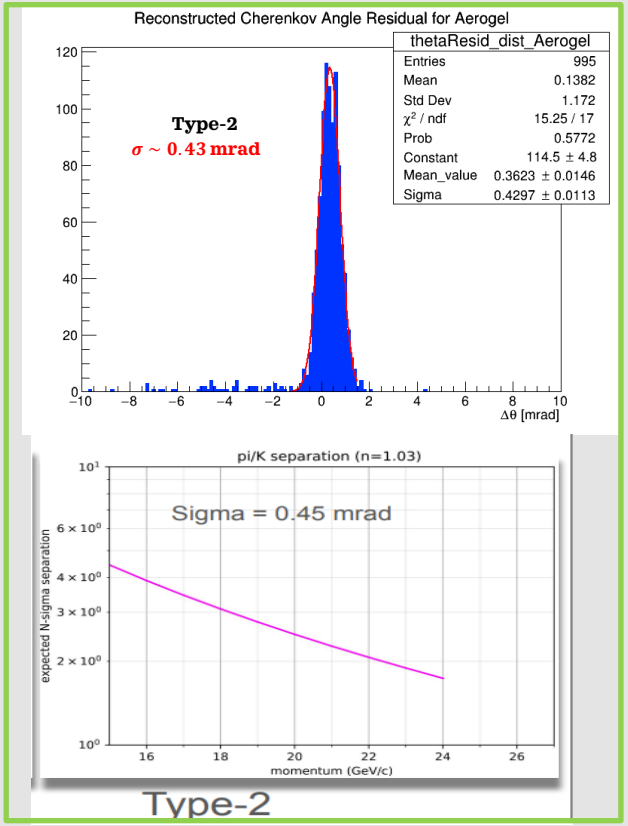


Baseline
$\sigma \sim 0.75$ mrad



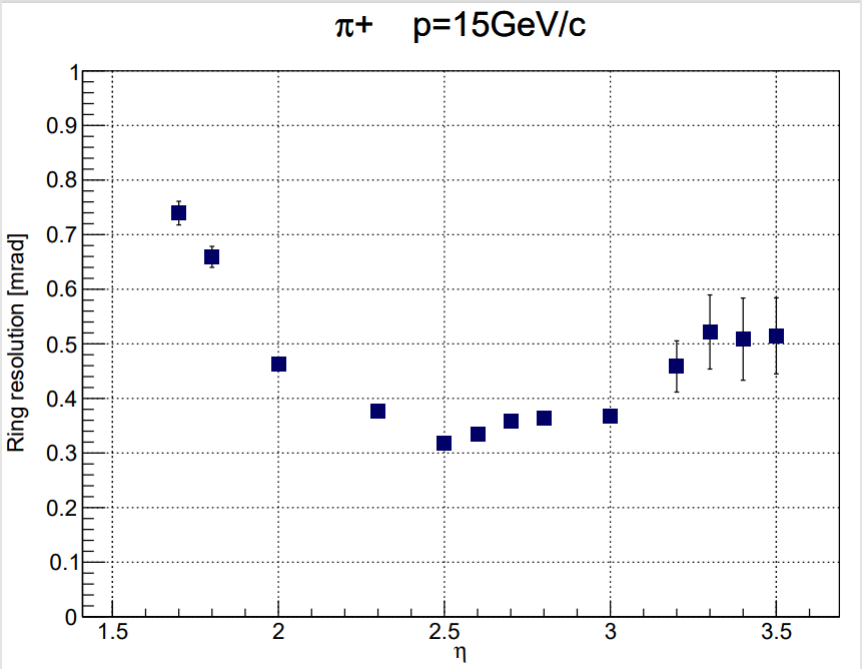
Type-1
$\sigma \sim 0.45$ mrad

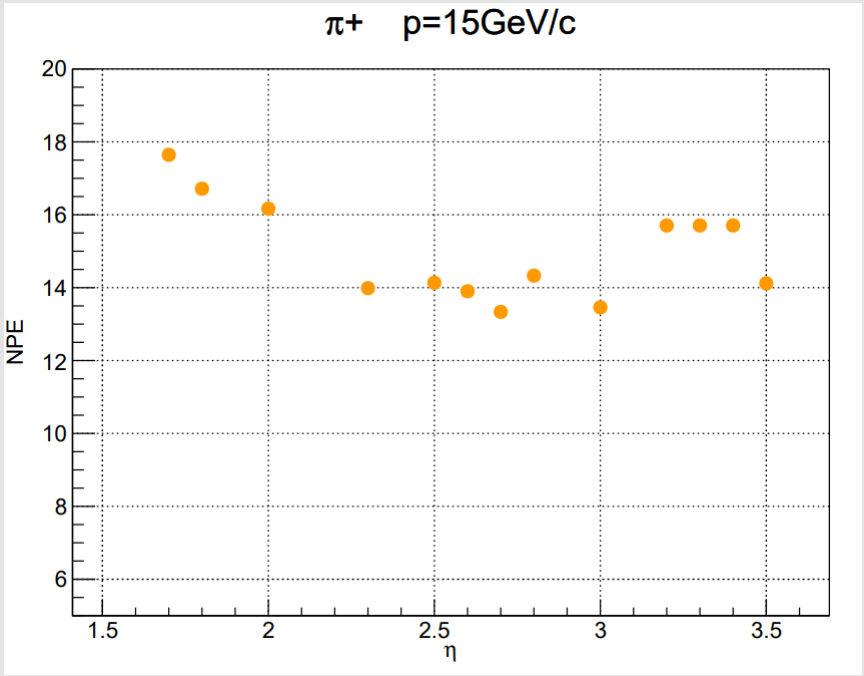




Performance: NPE and Resolution vs η

GAS





SUMMARY

Type-1 (n=1.026)

- Nσ up to ~18 GeV/c
- Npe ~ 15 @$\eta = 2.0$ for thickness=4 cm and NPE ~ 20 for thickness= 6 cm
- Ring resolution as expected $\sim$ 0.45 mrad
- Single photon resolution (SPE) $\sim$ 1.78 mrad

Type-2 (n=1.03)

- Nσ up to ~17 GeV/c
- Npe $\sim 16 - 17$ @$\eta = 2.0$ for thickness=4 cm and NPE $\sim$ $21 - 22$ for thickness= 6 cm
- Ring resolution as expected $\sim$ 0.45 mrad for thickness=4 cm but 0.43 for thickness = 6 cm
- Single photon resolution (SPE) $\sim$ 1.92 mrad

THANKS!

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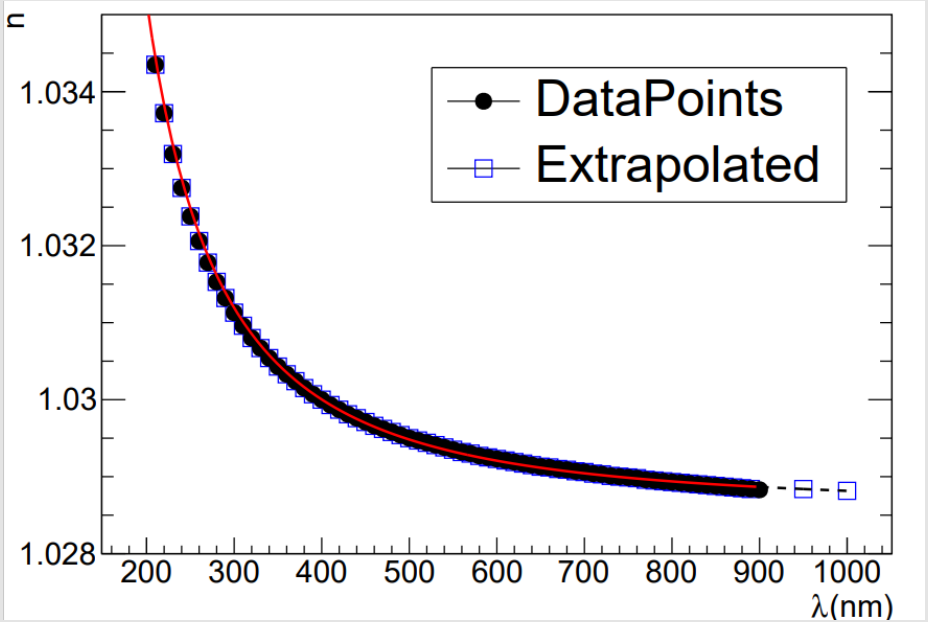
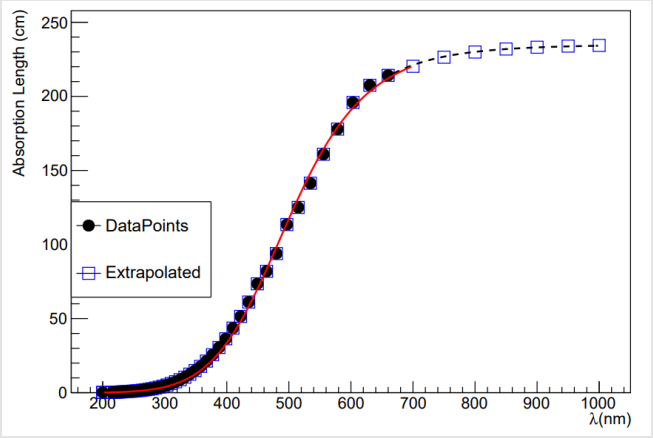
PARAMETRIZATION OF RADIATOR

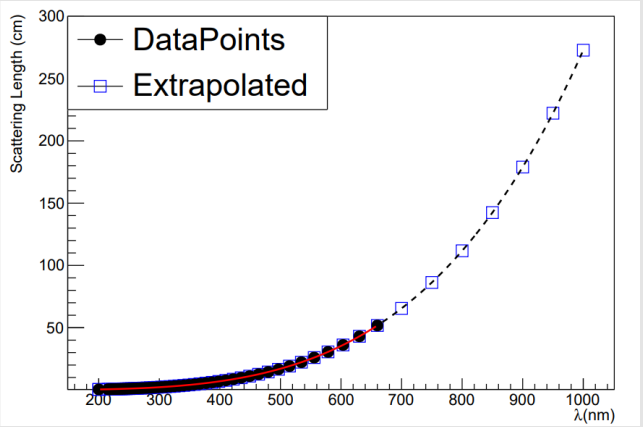
Aerogel refractive index



Aerogel Absorption Length (cm)



Aerogel Rayleigh Length (mm)

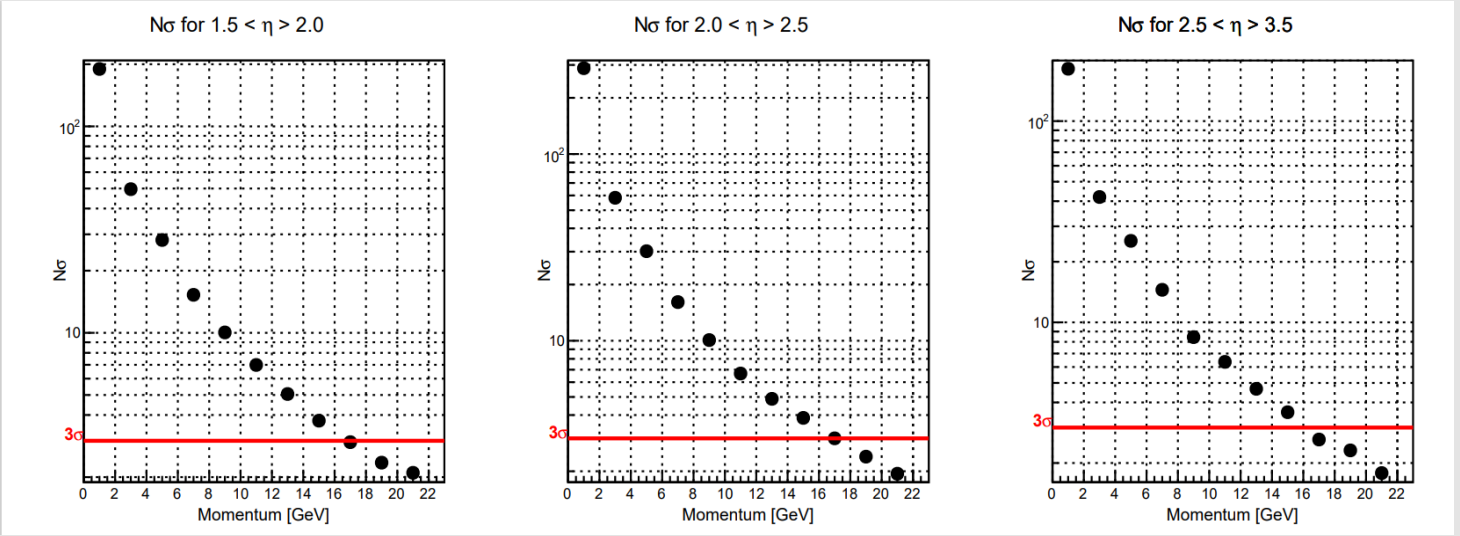


Performance: Nσ Separation of π AND K

Aerogel Refractive Index = 1.03

- ✓ Momentum → **[1.0 , 21.0]** GeV/c in steps of 2 GeV/c.
- ✓ Pseudorapidity $(\eta) \rightarrow$ **[1.5, 2.0] , [2.0, 2.5] , [2.5, 3.5].**
- ✓ Evaluation of the separation between pions and kaons as a function of the particle momentum with:

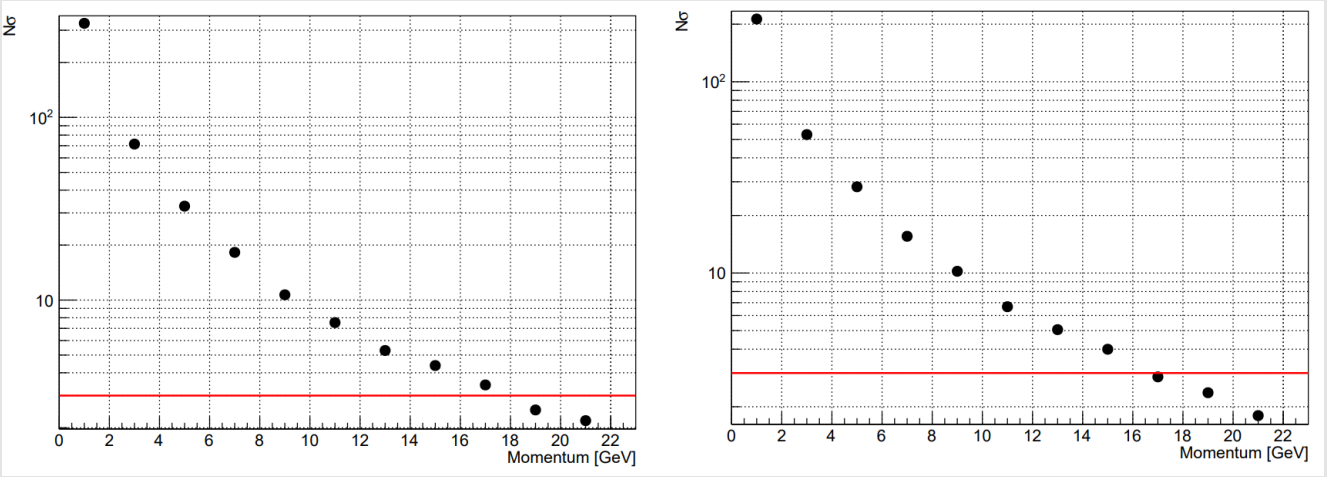
$$N\sigma = \frac{M\pi - M_k}{\sigma_{\pi k}}$$



Performance: Nσ Separation of π AND K

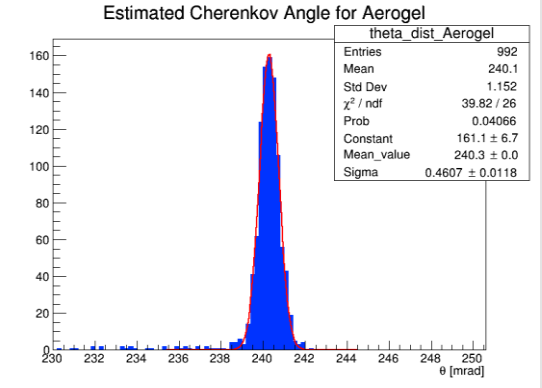
Aerogel Refractive Index = 1.03

φ=0, η=2.0



φ=0, η=2.5

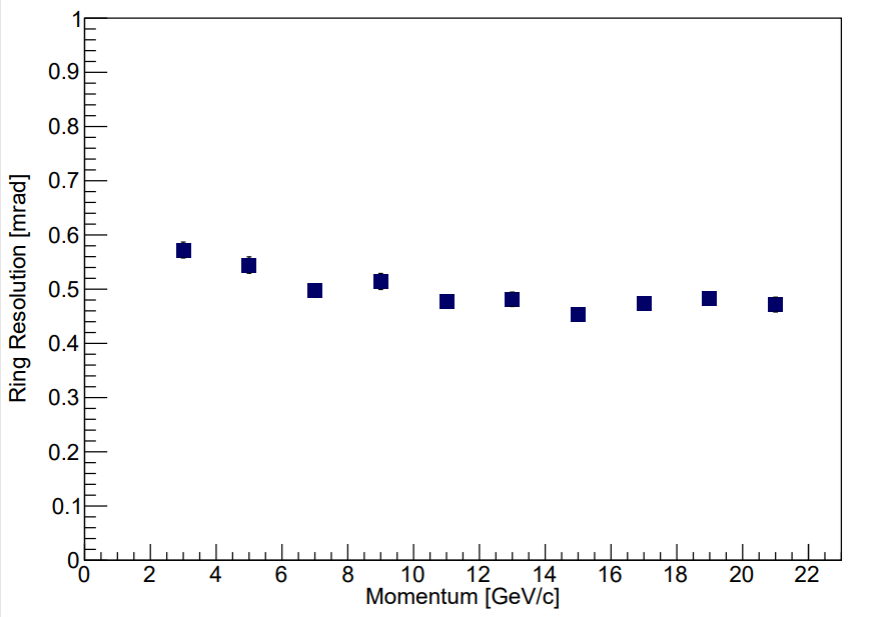
Cerenkov angle $\theta \approx 0.240\, rad \approx 13.7°$ for $\eta = 2.0$ and p=15 GeV



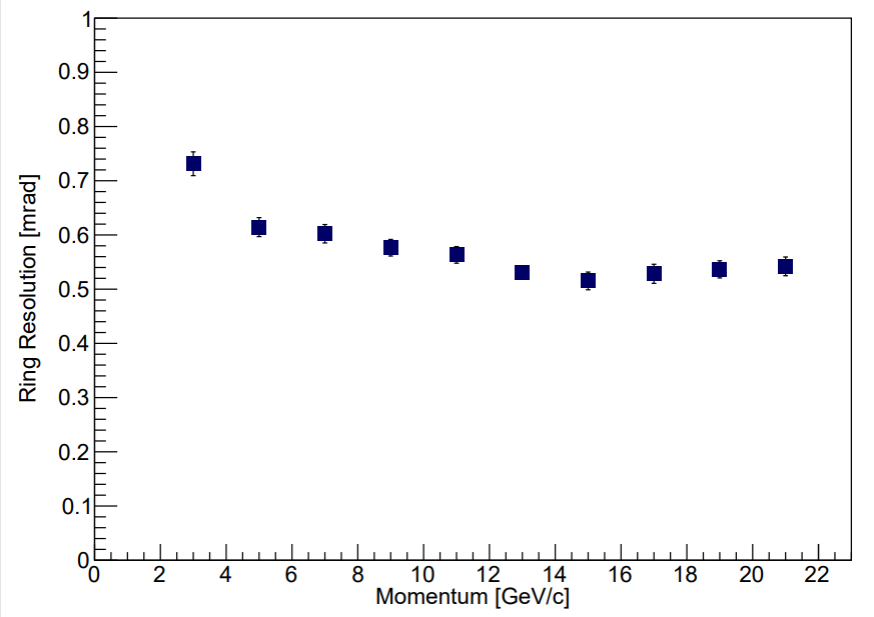
Performance: RESOLUTION

Aerogel Refractive Index = 1.03

π+, φ=0, **η=2.0**



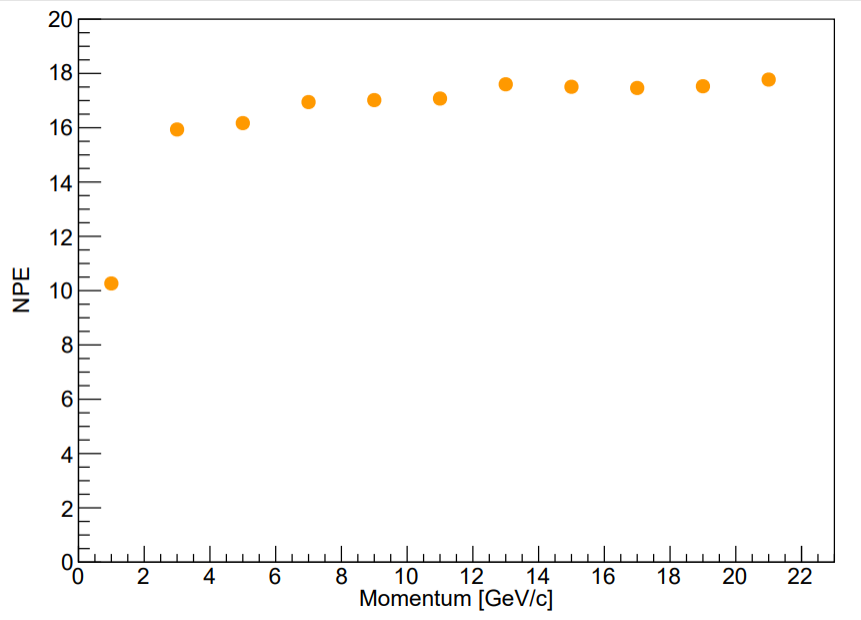
π+, φ=0, **η=2.5**



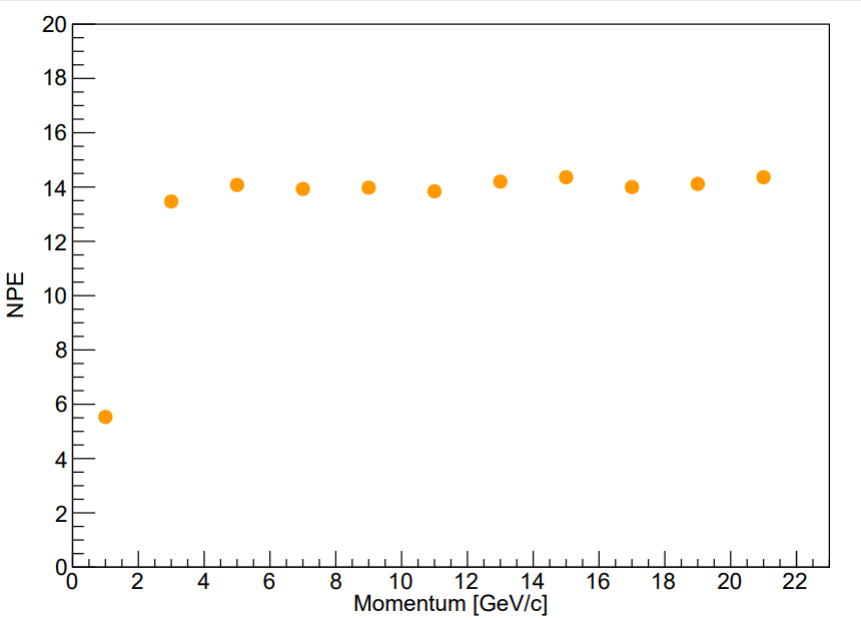
Performance: NPE

Aerogel Refractive Index = 1.03

π+, φ=0, **η=2.0**

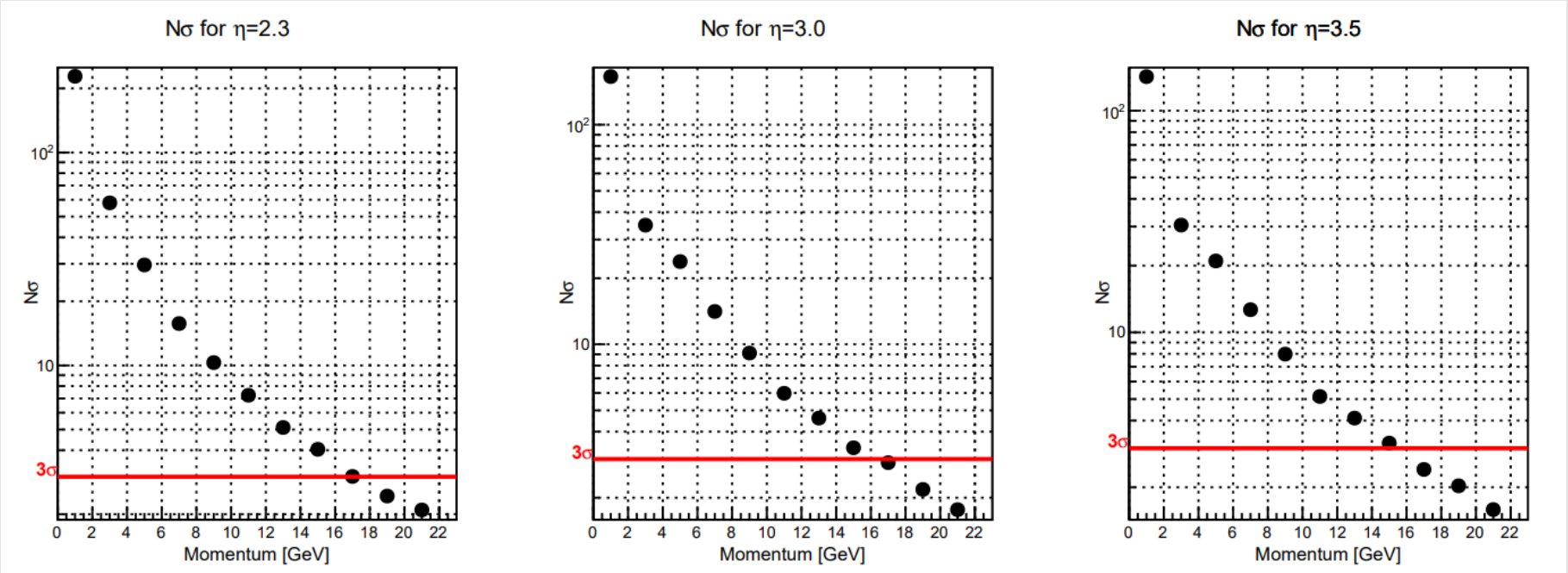


π+, φ=0, **η=2.5**



Performance: Nσ Separation of π AND K

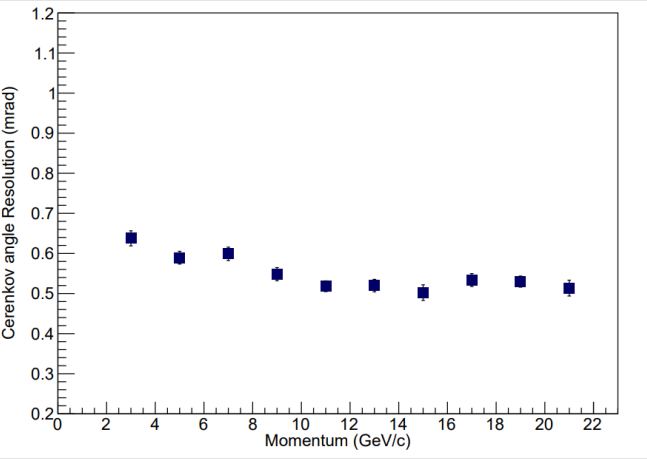
Aerogel Refractive Index = 1.03



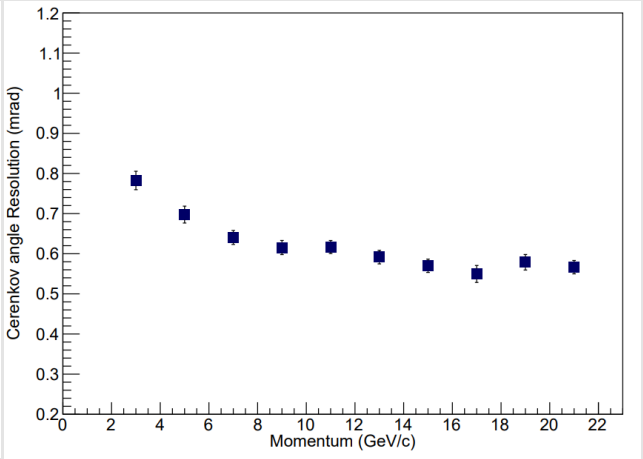
Performance: Resolution

Aerogel Refractive Index = 1.03

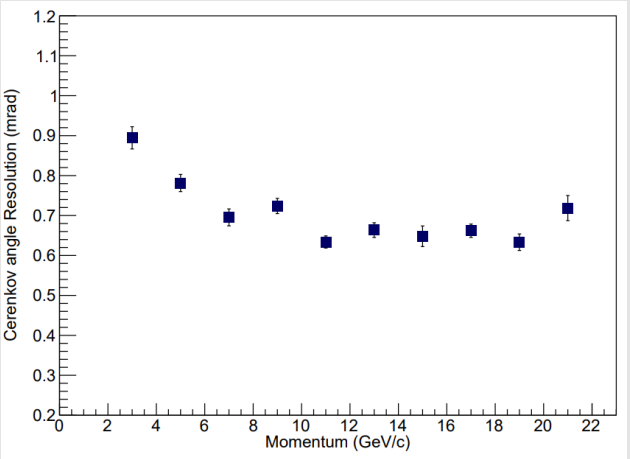
π+, φ=0, **η=2.3**



π+, φ=0, **η=3.0**



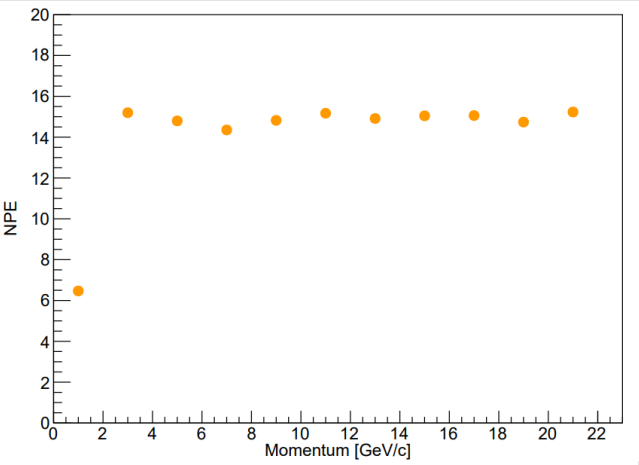
π+, φ=0, **η=3.5**



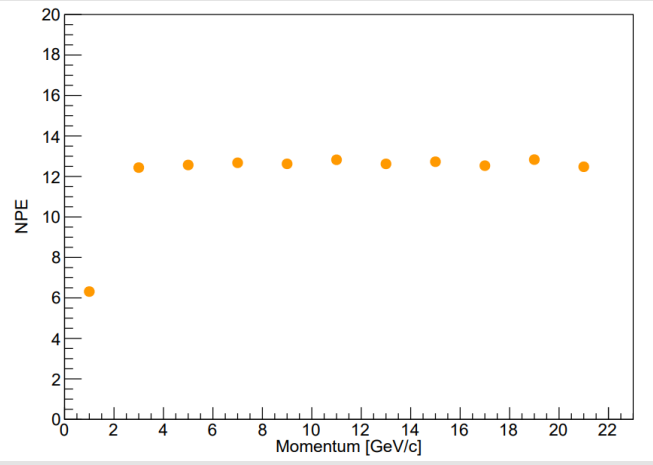
Performance: NPE

Aerogel Refractive Index = 1.03

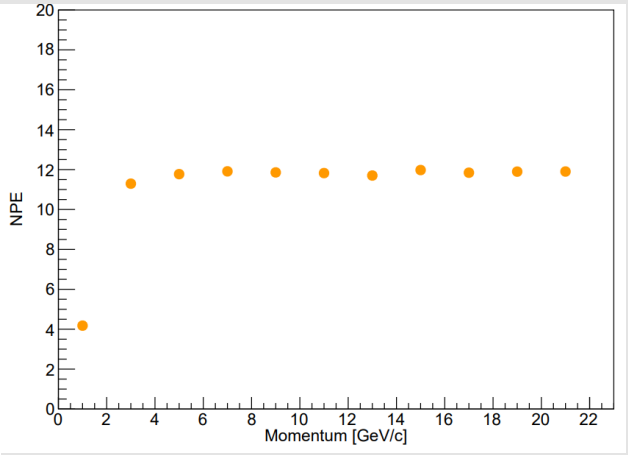
π+, φ=0, **η=2.3**



π+, φ=0, **η=3.0**

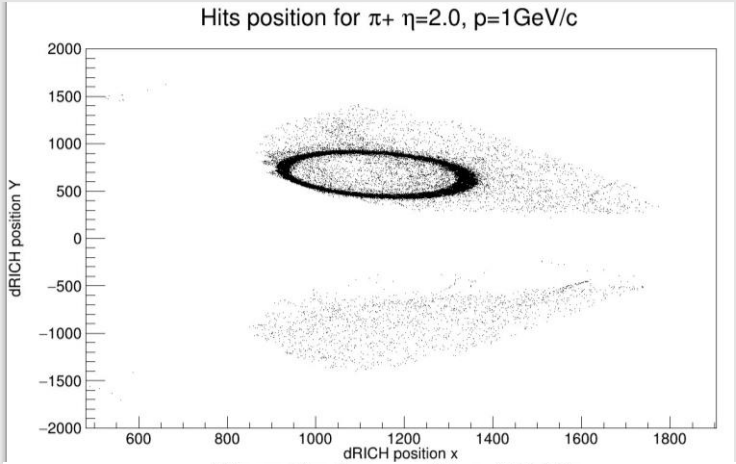


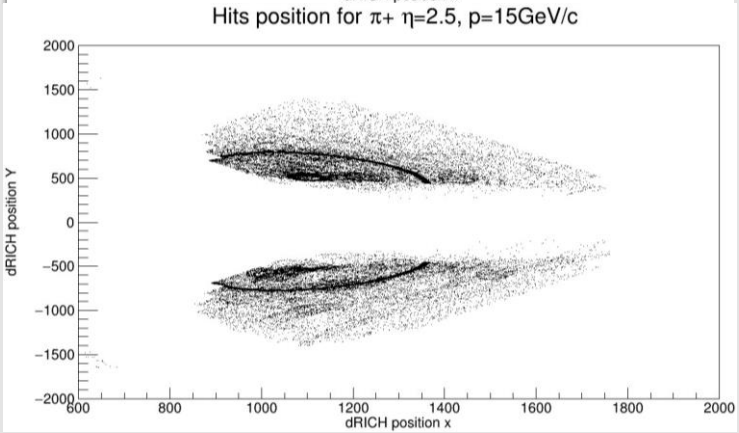
π+, φ=0, **η=3.5**

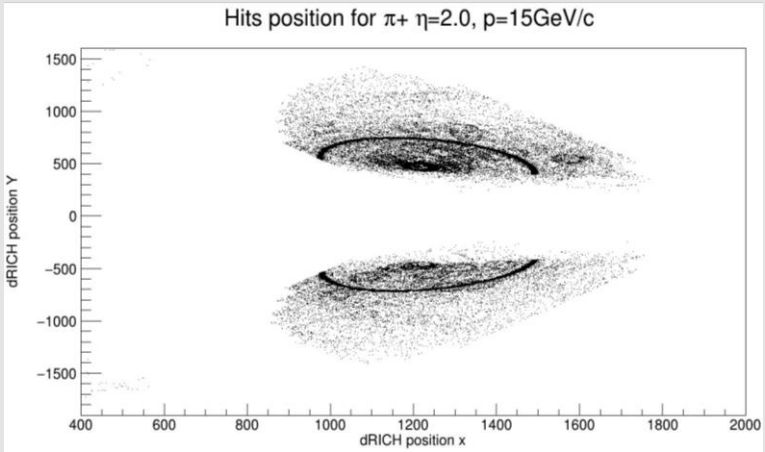


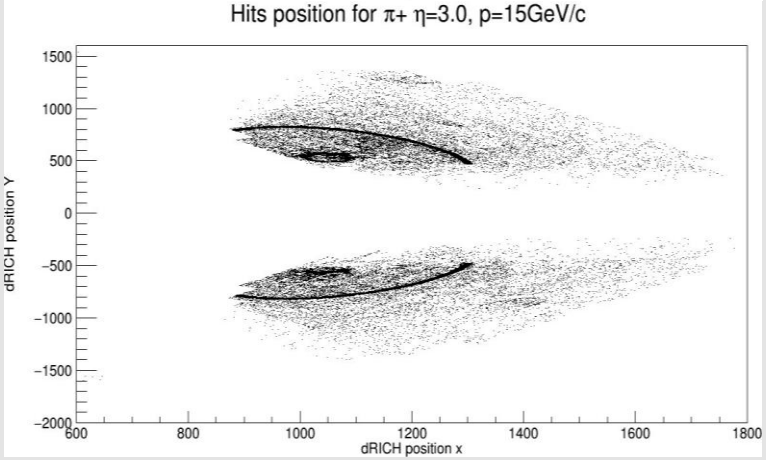
Performance: Hits position

Aerogel Refractive Index = 1.03









Performance: Hits position

Aerogel Refractive Index = 1.03