Update on pfRICH GEANT4 simulations

A. Kiselev (BNL)

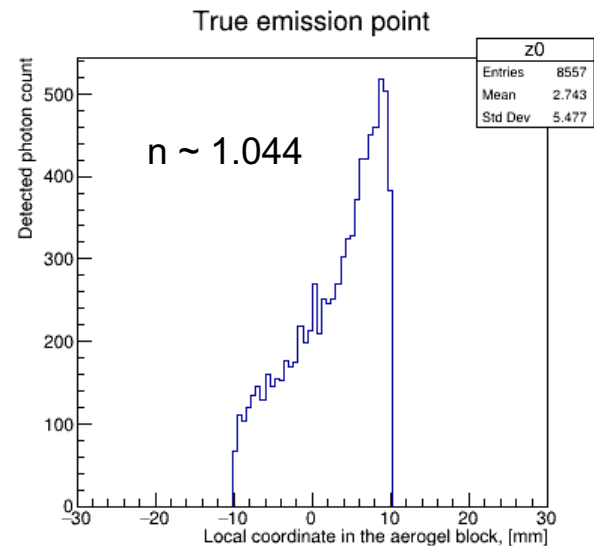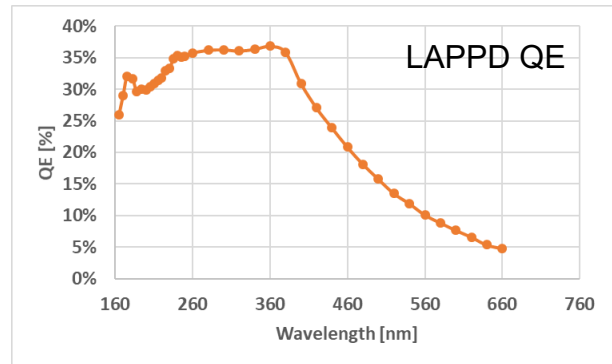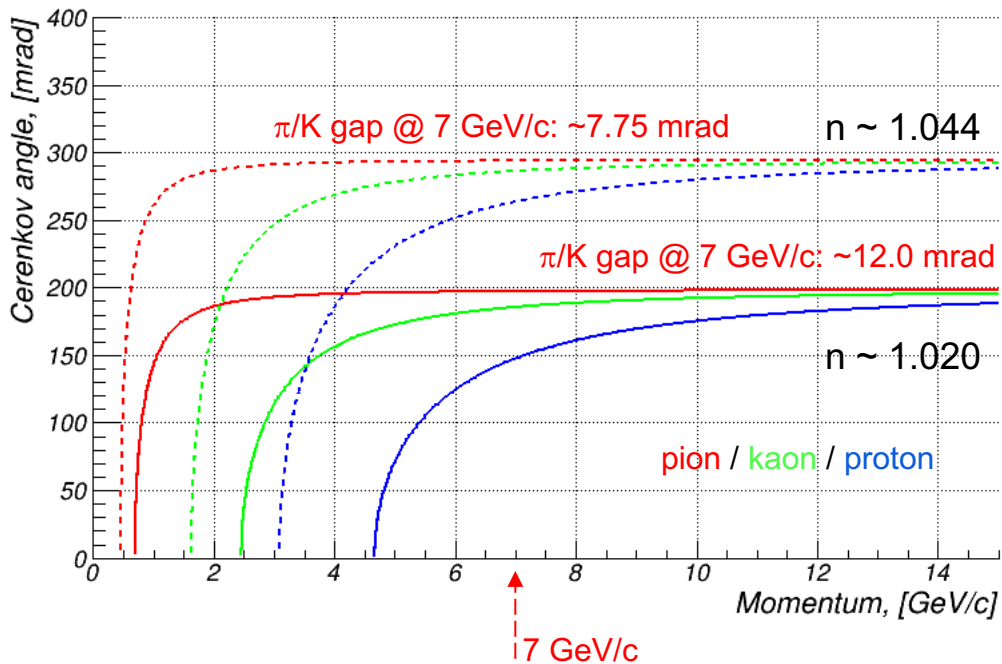**pfRICH meeting, November 16, 2022**

GEANT implementation

- Vessel: full available length (54 cm), starting at Z = -1187mm

- Gas volume (nitrogen): R_{min} = 72 mm, R_{max} =628 mm

- Aerogel: 3cm thick n ~ 1.020 and 2cm thick n ~ 1.045 (no segmentation yet)

- Aerogel RINDEX / ABSLENGTH / RAYLEIGH parameterizations following CLAS12 data

- Acrylic filter with a 300nm wavelength cutoff

- Sensor plane at 12 cm from the rear side of the vessel (hit XY-resolution ~600 μm)

- QE plot as provided by Incom + 70% safety factor

- Tile segmentation matching suggested HRPPD formfactor (~116 mm x 116 mm)

- Active area 80% of the tile footprint, as suggested by Incom for future HRPPD models

- IRT: conical mirrors (and multiple optical paths per sensor) implemented

Aerogel & QE curve

- Two different options considered so far:

  - $n \sim 1.020$ ($\rho \sim 110$ mg/cm^3), 3cm thick, effective attenuation length ~ 31 mm

  - $n \sim 1.044$ ($\rho \sim 225$ mg/cm^3), 2cm thick, effective attenuation length ~ 16 mm

LAPPD QE

π/K gap @ 7 GeV/c: ~7.75 mrad   n ~ 1.044

π/K gap @ 7 GeV/c: ~12.0 mrad

n ~ 1.020

pion / kaon / proton

7 GeV/c

True emission point

n ~ 1.044

Photon count and Cherenkov angle resolution

- π @ 7 GeV/c
  - Hard to get to $<N_{pe}> \sim 10$ in a single-layer configuration
  - Two-layer configuration *would* work, but:
    - Requires refractive index tuning on the level of ~0.001
    - Requires a crystal-clear aerogel
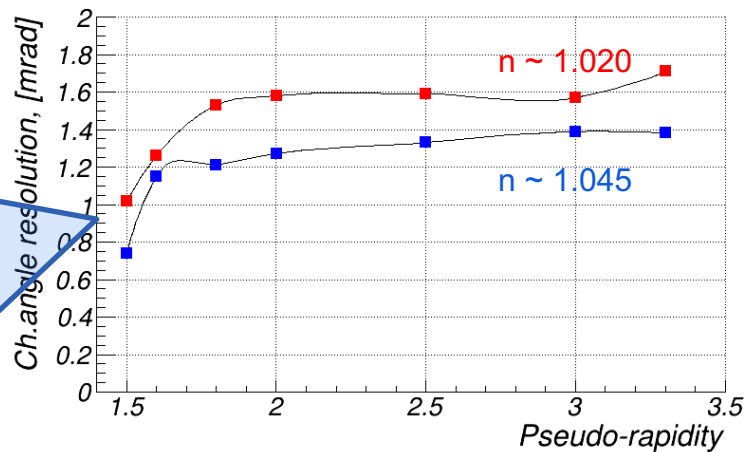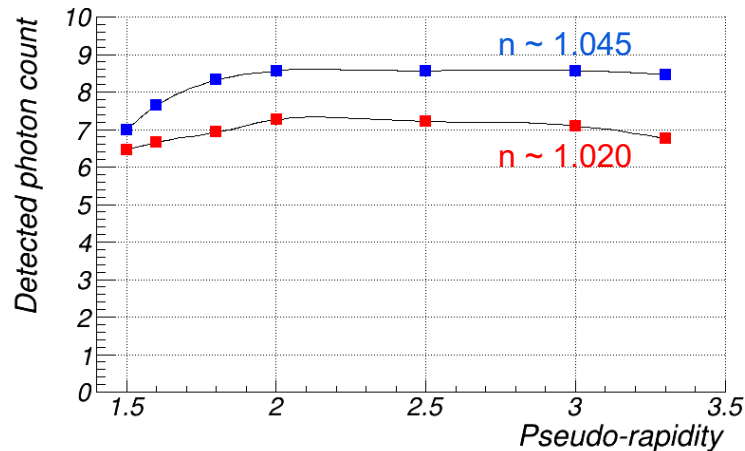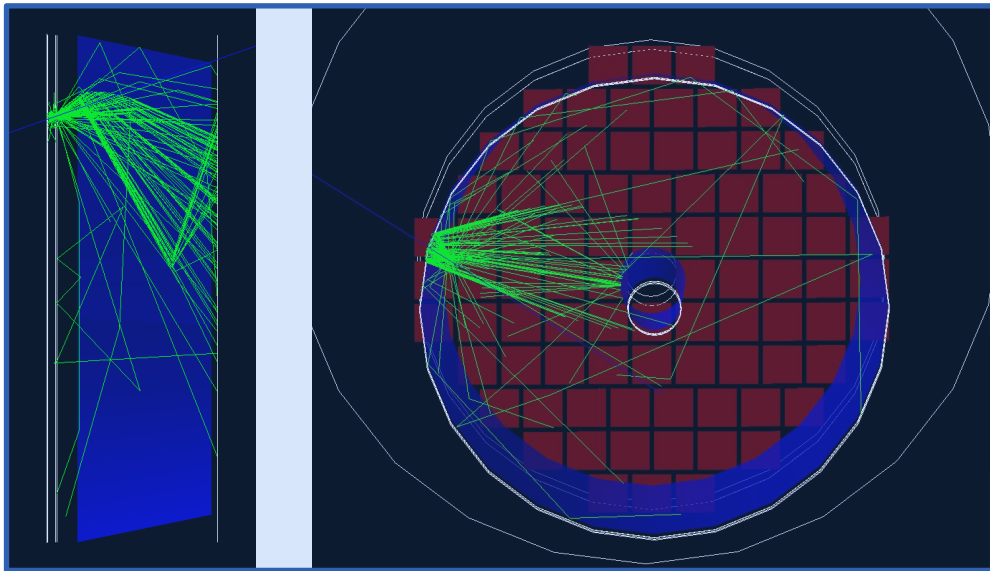
Next steps

- Provide Delphes parameterization "as is"

- Provide material budget parameterization

- Upload codes on GitHub

- Consider beam pipe constraints (will limit the acceptance to $\eta \sim$ 1.5 .. 3.0, at best)
  - Will require a different tiling scheme

- Implement single photon timing (direct / reflected ambiguity resolution)

- Implement aerogel tiling scheme

- Consider a (fake) transparent aerogel & a two-layer setup?

- Consider Fresnel lenses?