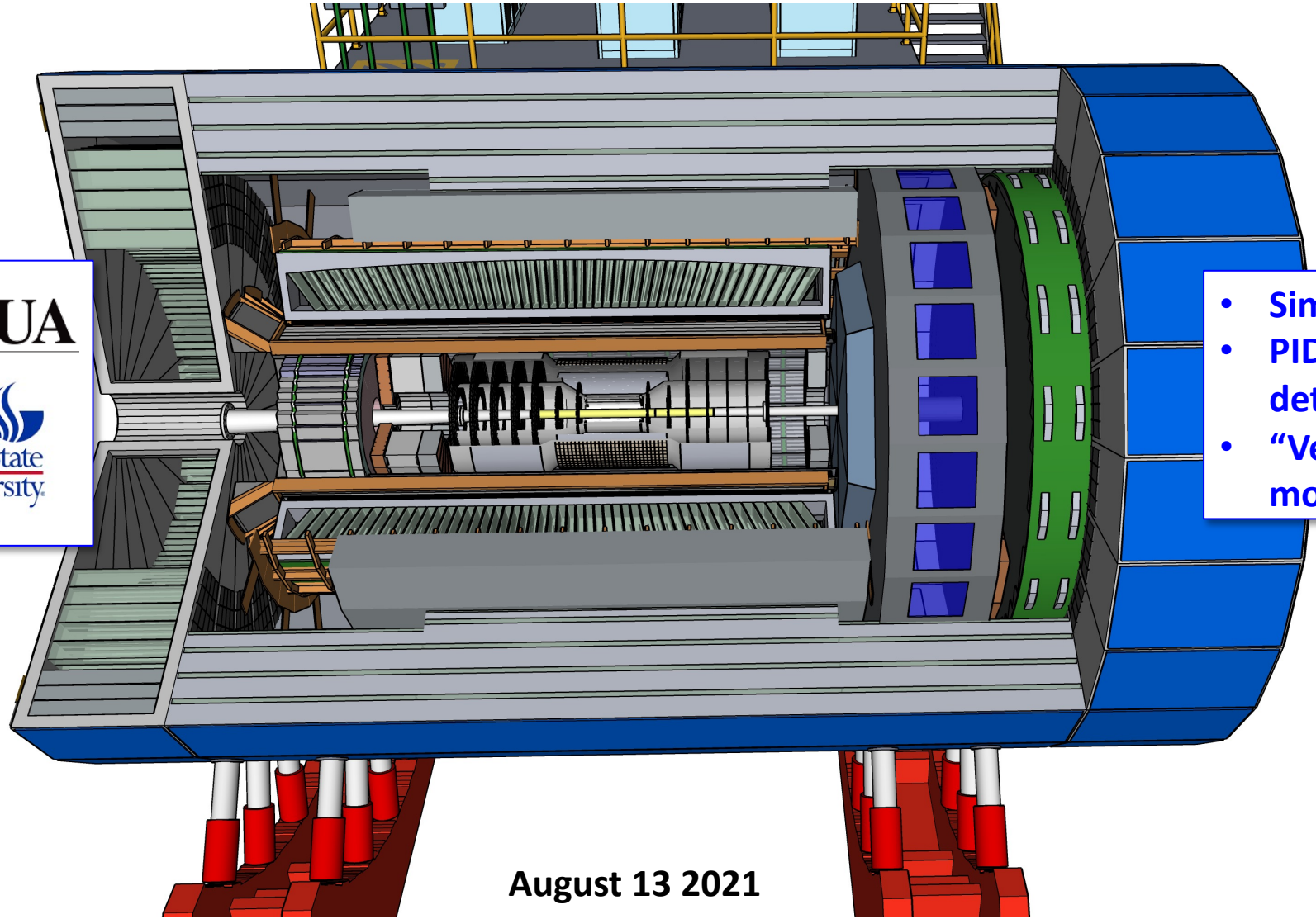
ECCE PID WG Meeting

Greg Kalicy CUA

Xiaochun He Georgia State University

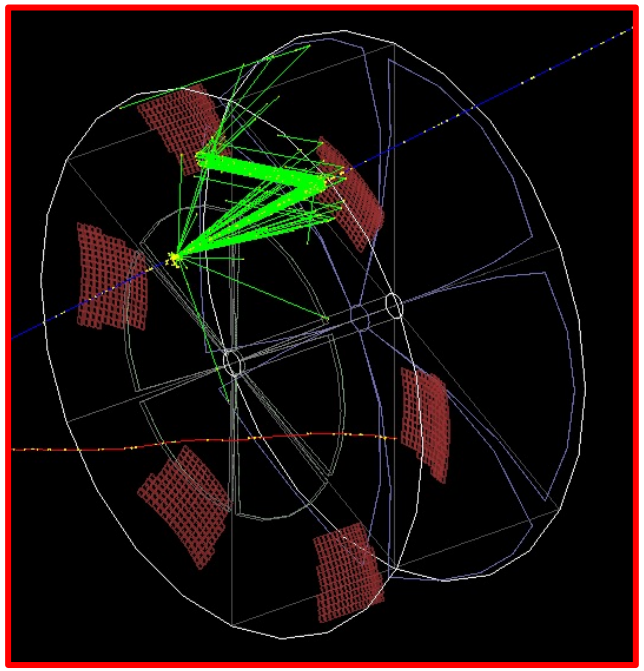


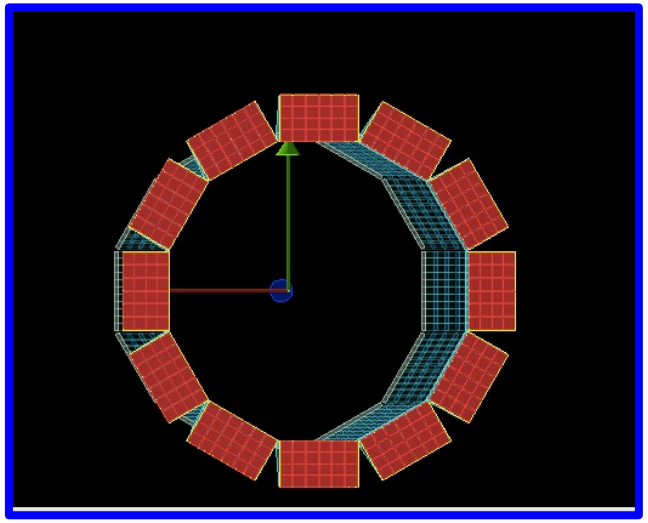
- Simulation Status
- PID coverage of Cherenkov detectors
- “Veto” Mode for lower momentum

August 13 2021

PID@ECCE F4A

- **Sebastian and Cameron** will scale down dRICH for the Simulation run.
- **Nilanga** scaled down hpDIRC to current ECCE geometry. Works on full reconstruction.
- **Cameron** pulled/will pull scaled dRICH and hpDIRC to ECCE F4A.
- **Chris Dilks** is working on improving scaling of dRICH.
- **Evaristo Cisbani** Will help with checking dRICH fast simulation parametrization but doesn't expect big change with our small size change.



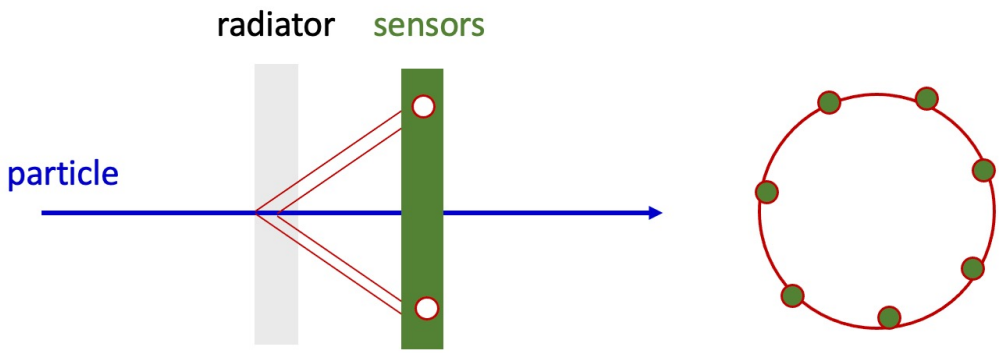


CHERENKOV DETECTORS "VETO" MODE

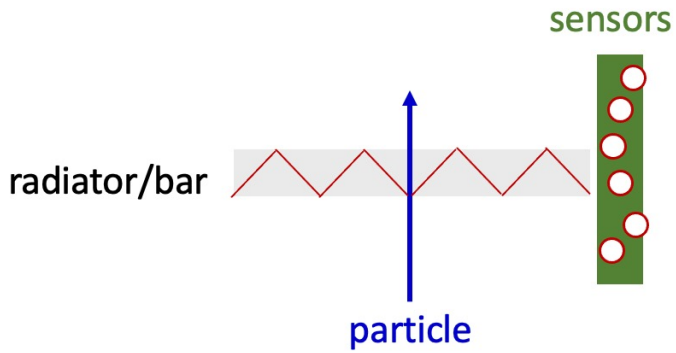
- Cherenkov detectors perform π/K separation below the kaon threshold, in "veto mode":
  - if the track in the radiator is below the kaon threshold, any signals produced must be from low-mass particles such as pions. (ex. COMPASS RICH, LHCb RICH, DELPHI RICH)
- Bedtime story about RICH "veto" mode for DELPHI RICH: https://inis.iaea.org/collection/NCLCollectionStore/_Public/27/073/27073494.pdf
- For a standard RICH, photons are detected as soon as a particle is above threshold and hit the sensor plane
- For the DIRC the photons still need to survive the total internal reflection limit

CHERENKOV DETECTORS "VETO" MODE

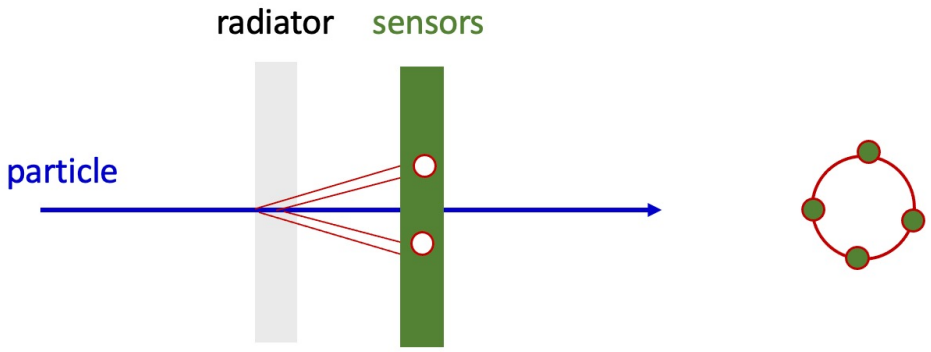
gaseous RICH, $p >> p_{thresh}$



DIRC, $p >> p_{thresh}$



gaseous RICH, $p = p_{thresh} + \Delta p$



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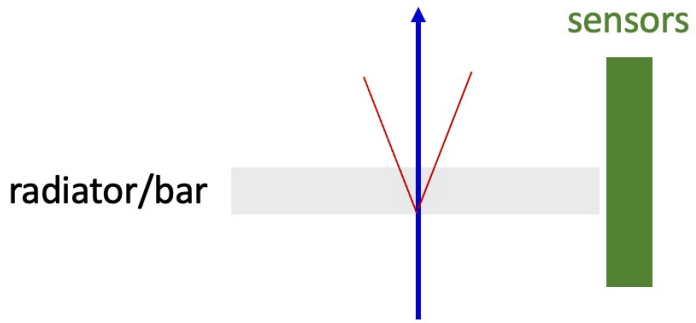
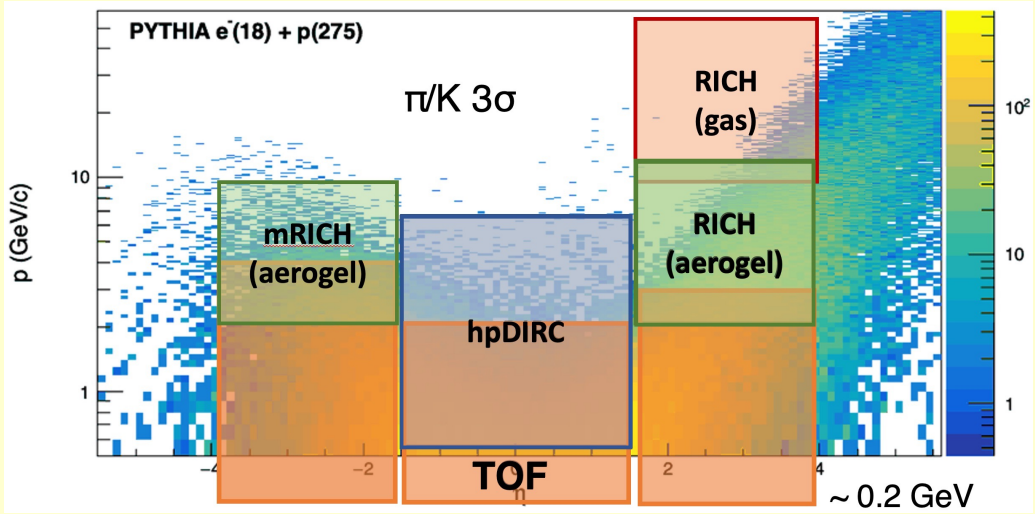


Cherenkov PID Coverage

- **h-endcap: dRICH**
  - **Ring imaging:**
    - **π/K < 50 GeV/c**
    - **e/π <15 GeV/c**
  - **"Veto" mode:**
    - **e/ π above few MeV/c** (up to ~15 GeV/c)
    - **π/K,p above 0.7 GeV/c** (or ~1 GeV/c at "full efficiency")
    - **K/p > 2.5 Gev/c** (or ~3 GeV/c at "full efficiency")
- **e-endcap: mRICH**
  - **Ring imaging:**
    - ***π/K: 2-9 GeV/c***
    - **e/π : 0.6-2./2.5 GeV/c**
  - **"Veto" mode:**
    - **k/π : 0.6-2 GeV/c**
    - **e/π : <0.6 GeV/c**
    - **K/p <3.8 GeV/c**
- **barrel: hpDIRC**
  - **Ring imaging:**
    - **π/K <6-7 GeV/c**
    - **e/π <1.2 GeV/c**
  - **"Veto" mode:**
    - **e,K/π >0.2/0.3GeV/c**
    - **K/p >1 GeV/c**

Only Ring Imaging for Cherenkov Detectors



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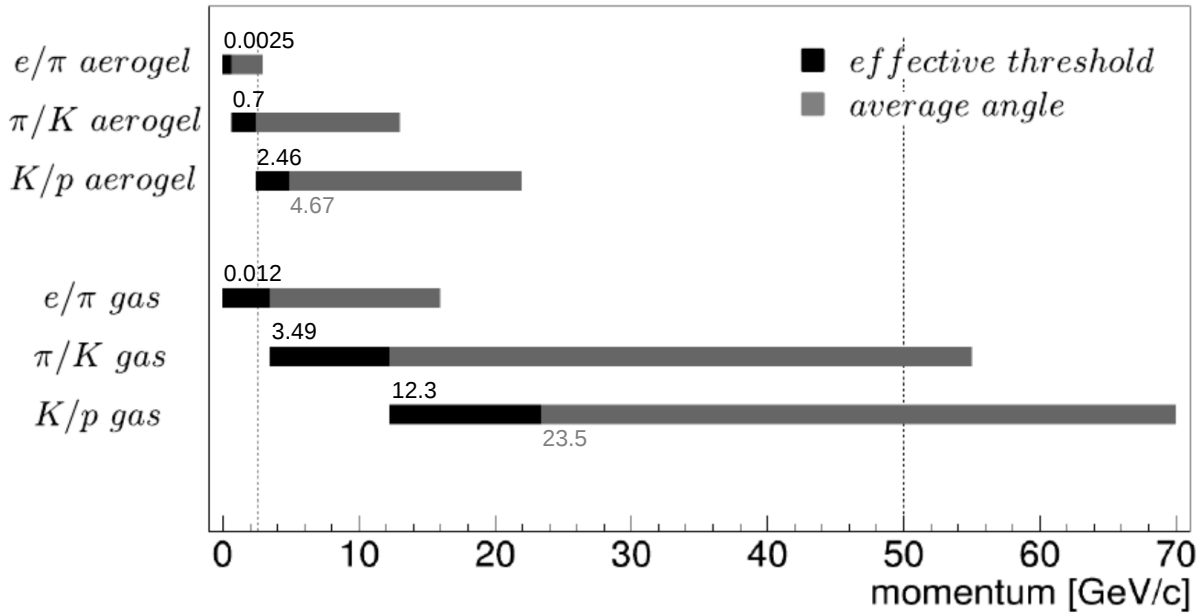
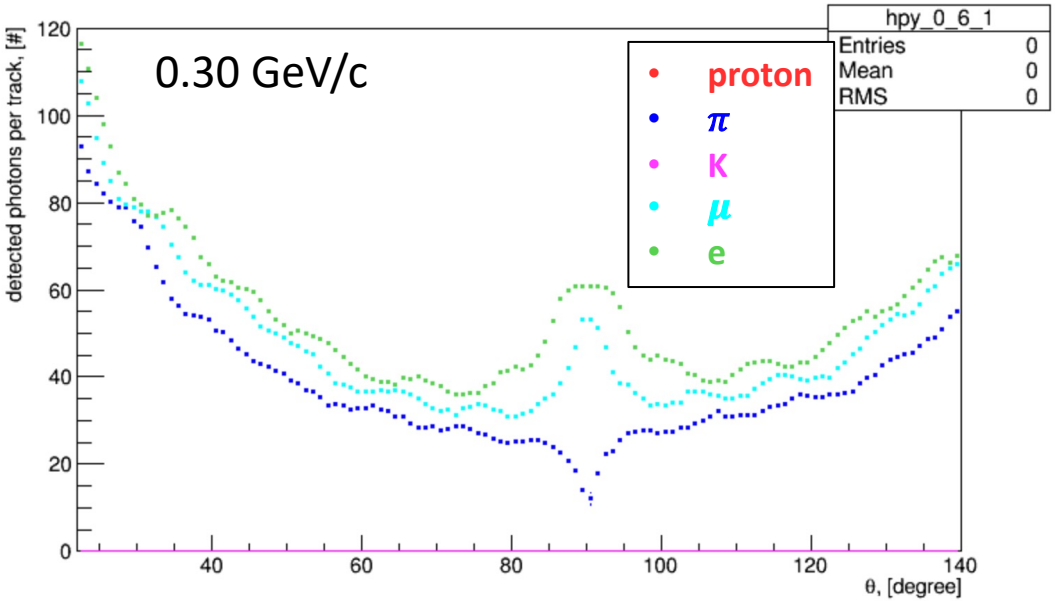
dRICH momentum coverage:

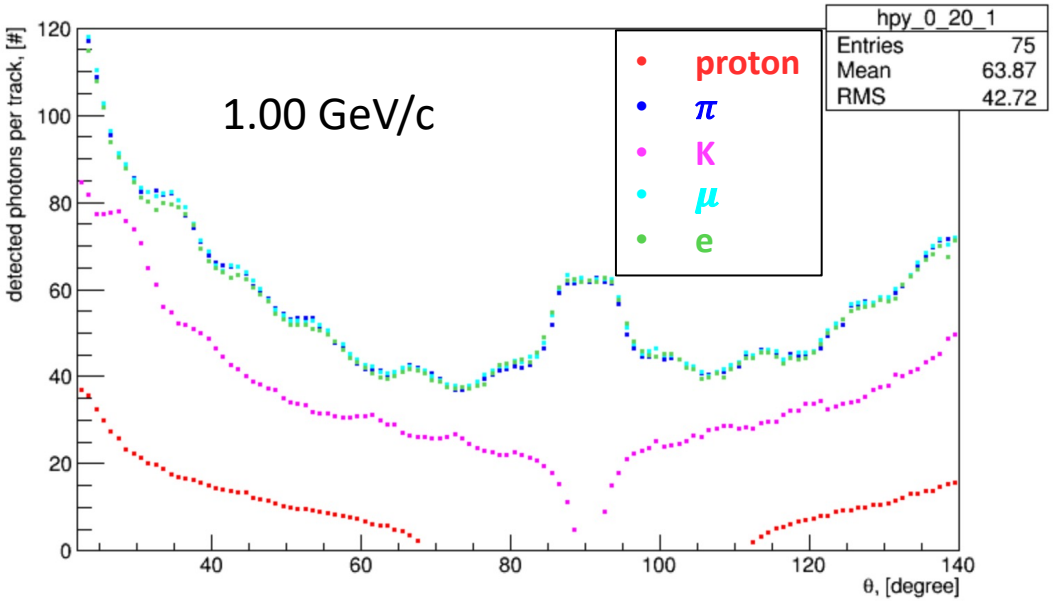


aerogel: n=10.2
gas: n=1.0008

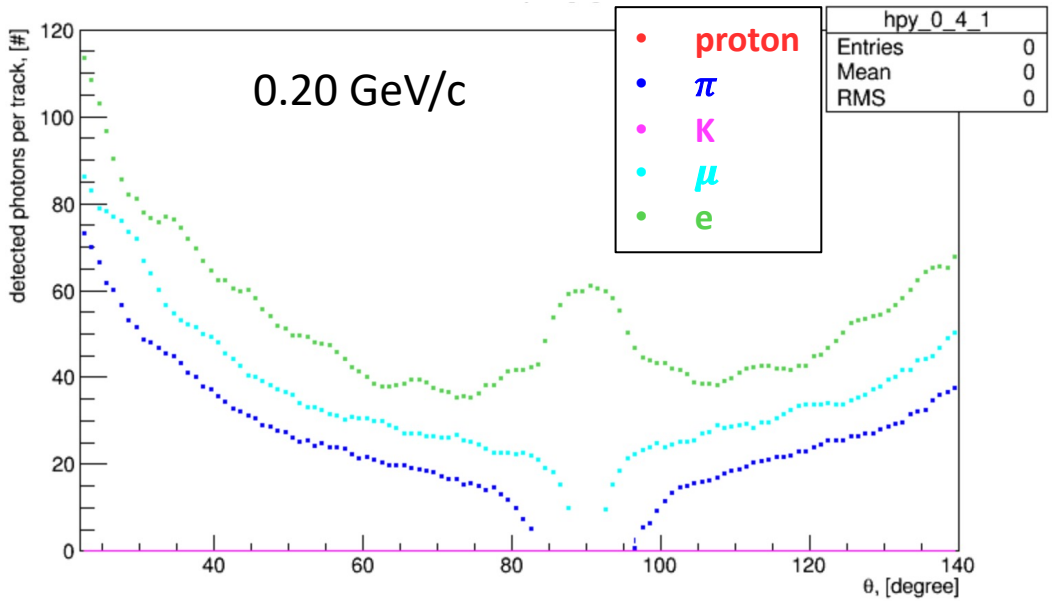
HPDIRC VETO MODE

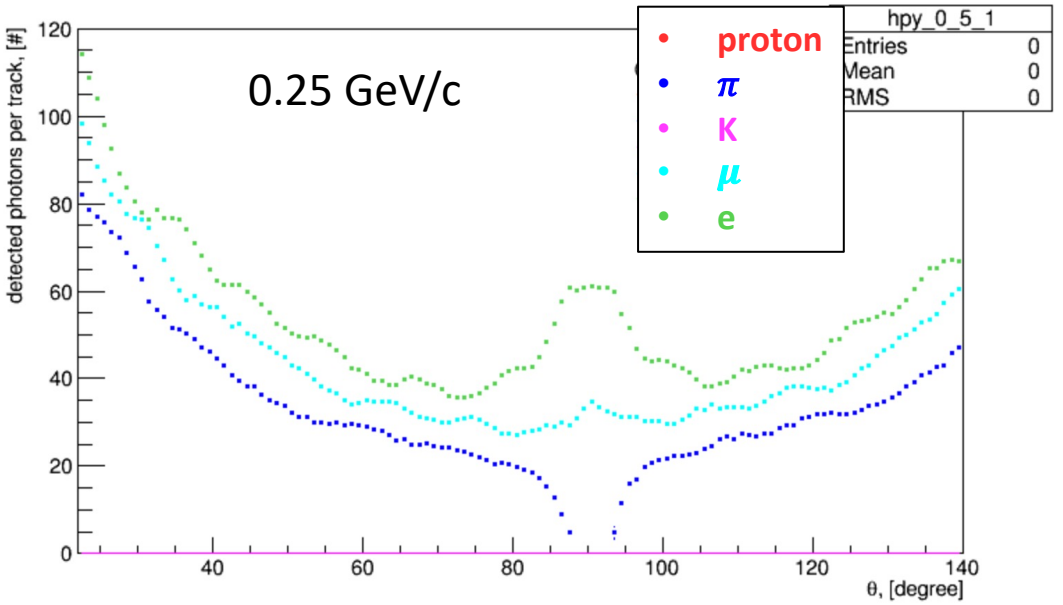
- At 0.3 GeV/c, pions will create a strong Cherenkov signal (more than 10 detected photons) for all polar angles, kaons are still below Cherenkov threshold.
- Even at 0.2 GeV/c, only a small gap in pseudorapidity from -0.15 to +0.15.
- Studies done with full G4 simulation but for PANDA geometry without magnetic field! Will be validated for ECCE.

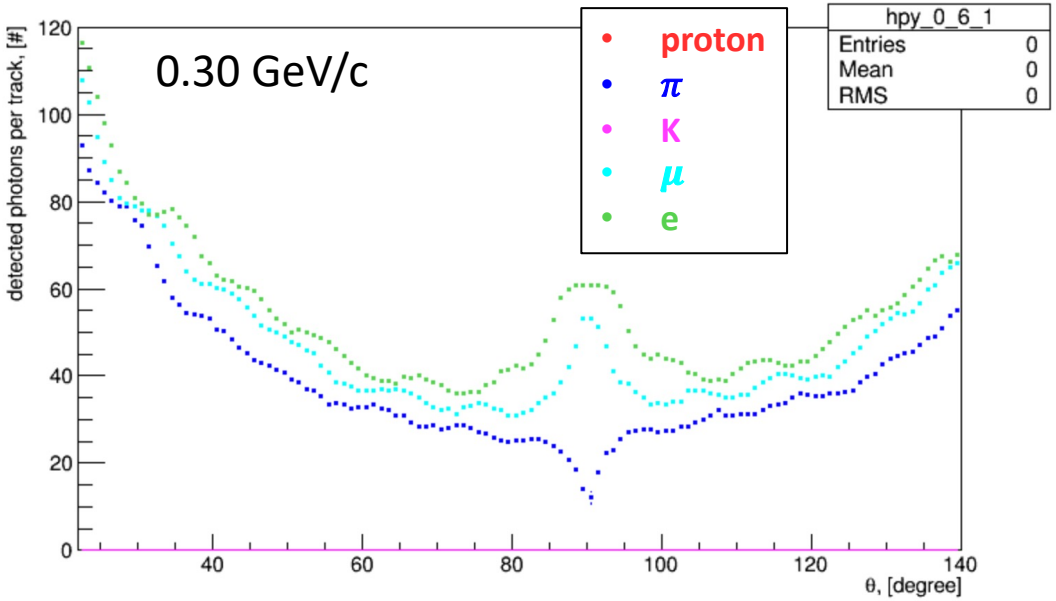


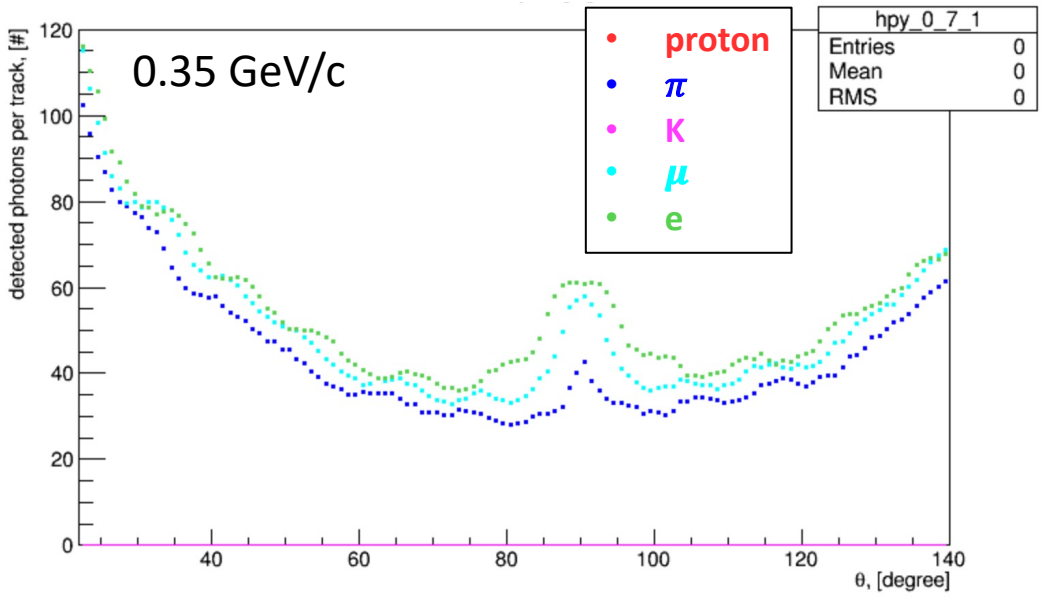


HPDIRC VETO MODE

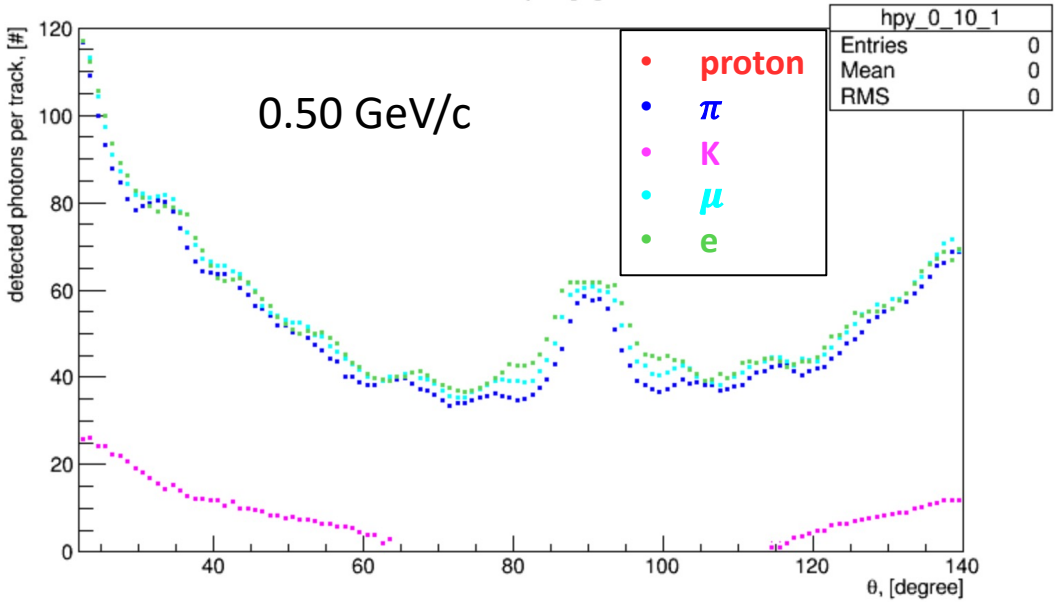


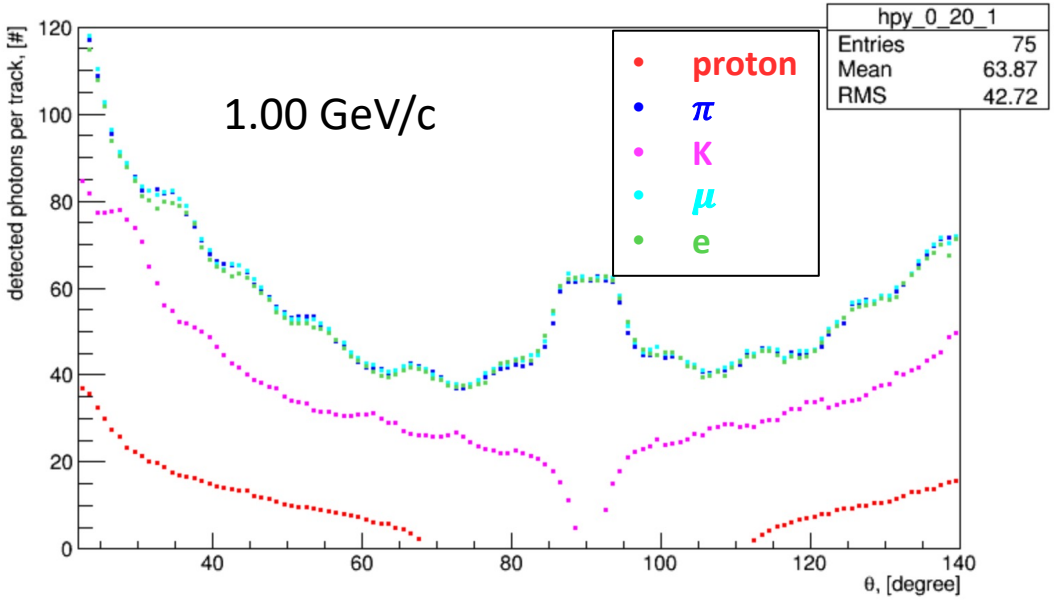


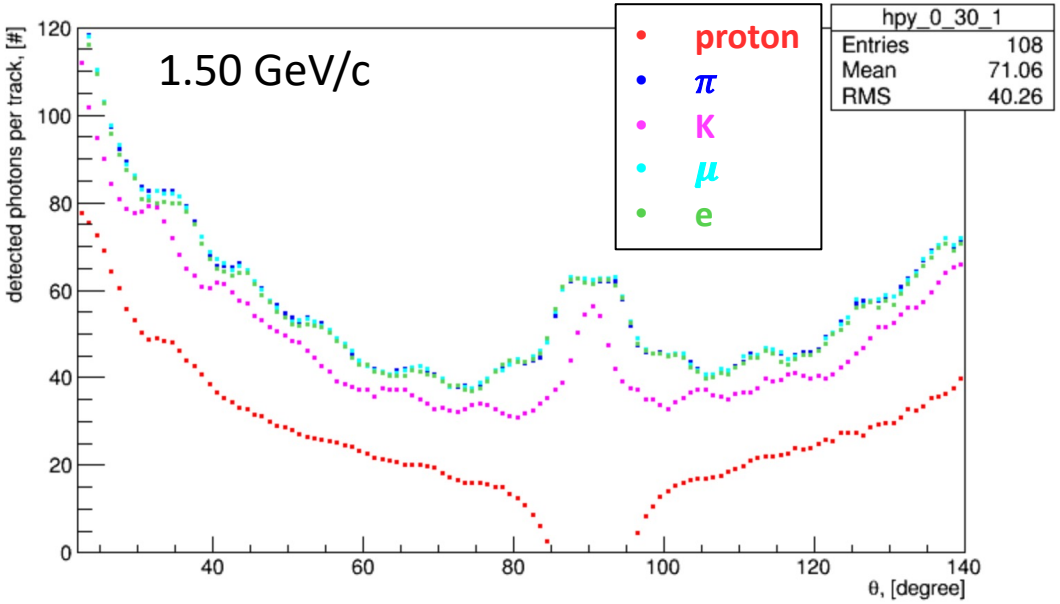


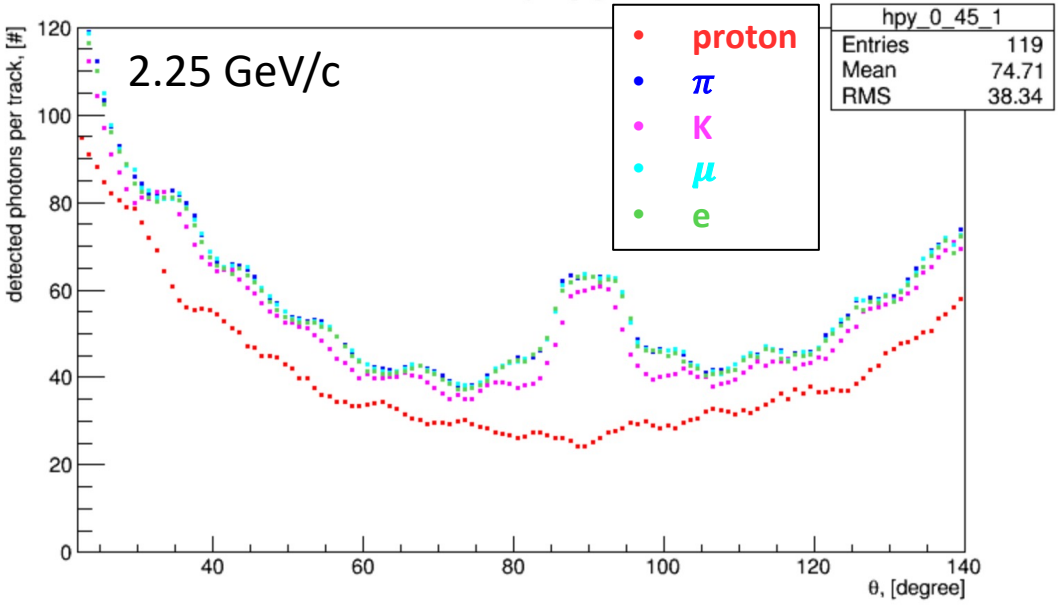


HPDIRC VETO MODE

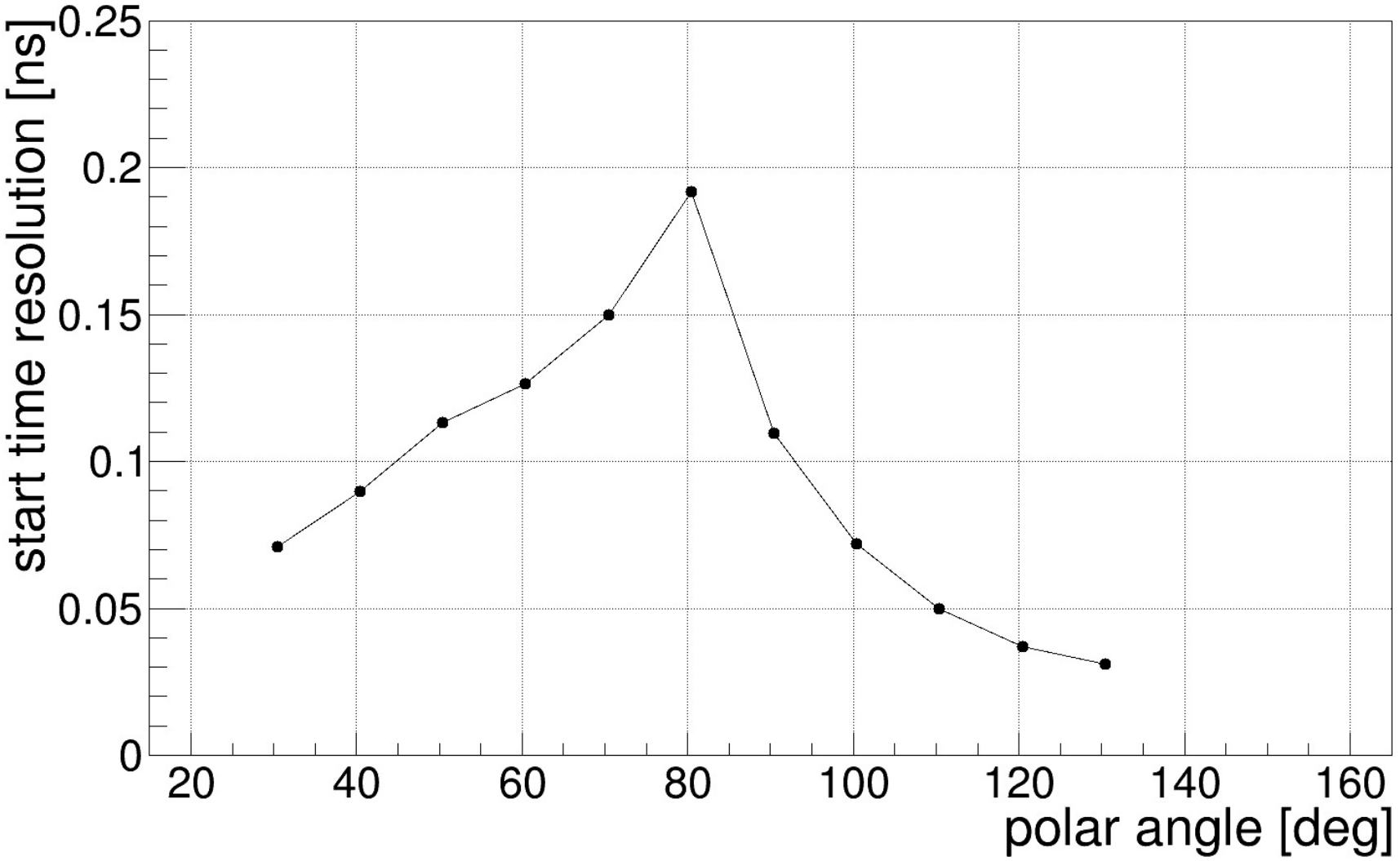








HPDIRC START TIME RESOLUTION



Study done only for a single track in whole DIRC, the performance will improve for events with more particles in the DIRC!

dRICH Radial Size

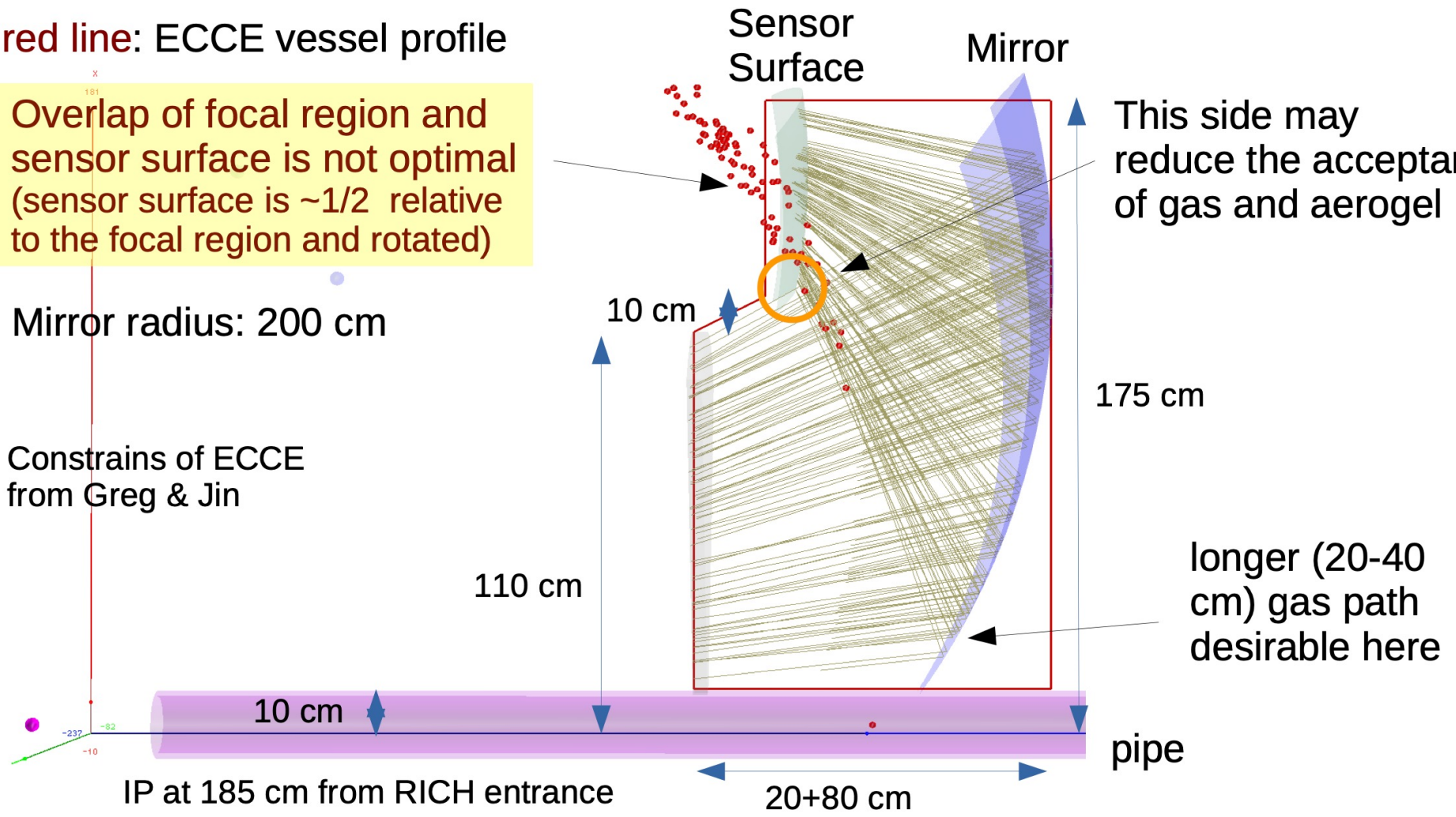
red dots: focal region (approx.)
yellow lines: photons at **gas Cherenkov** angles relative to charger particles direction from IP

red line: ECCE vessel profile

Overlap of focal region and sensor surface is not optimal (sensor surface is ~1/2 relative to the focal region and rotated)

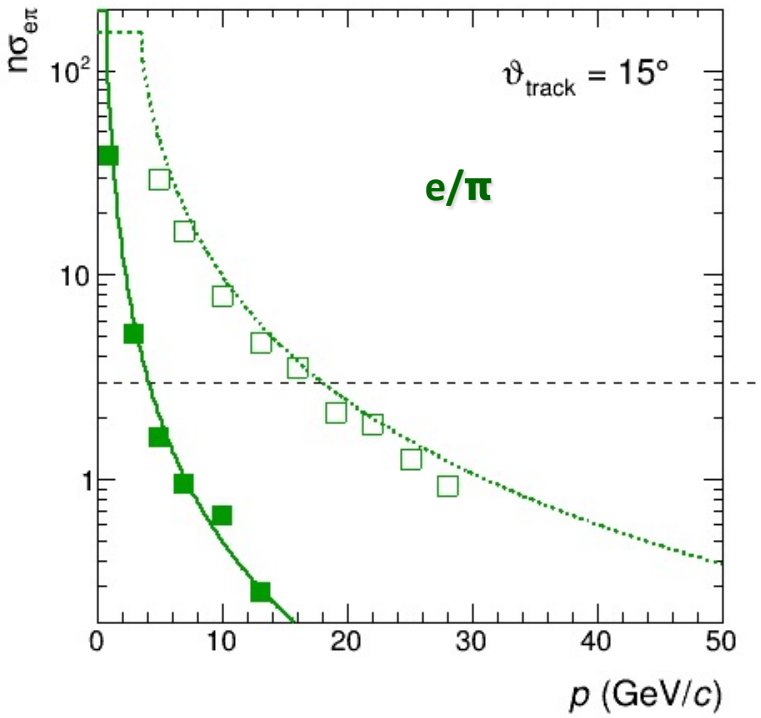
Mirror radius: 200 cm

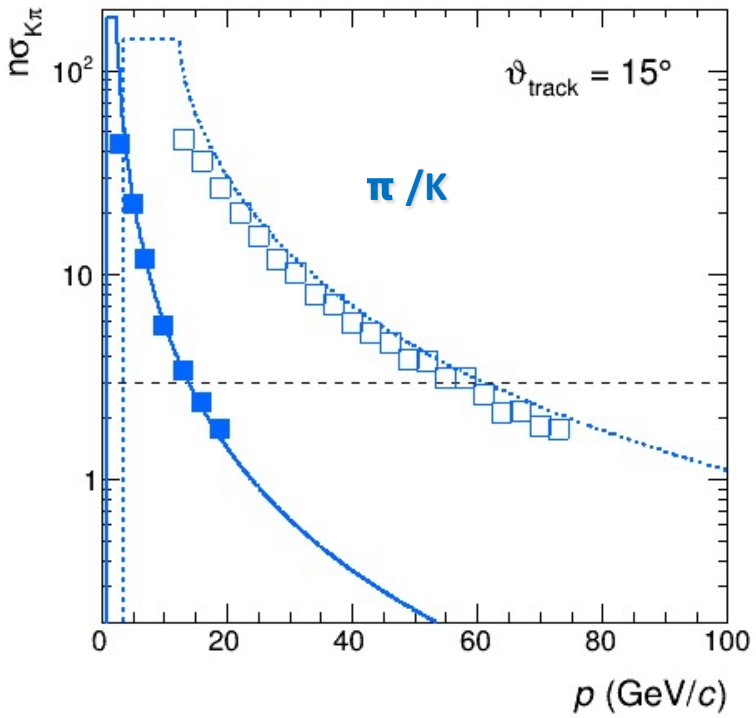
Constrains of ECCE from Greg & Jin

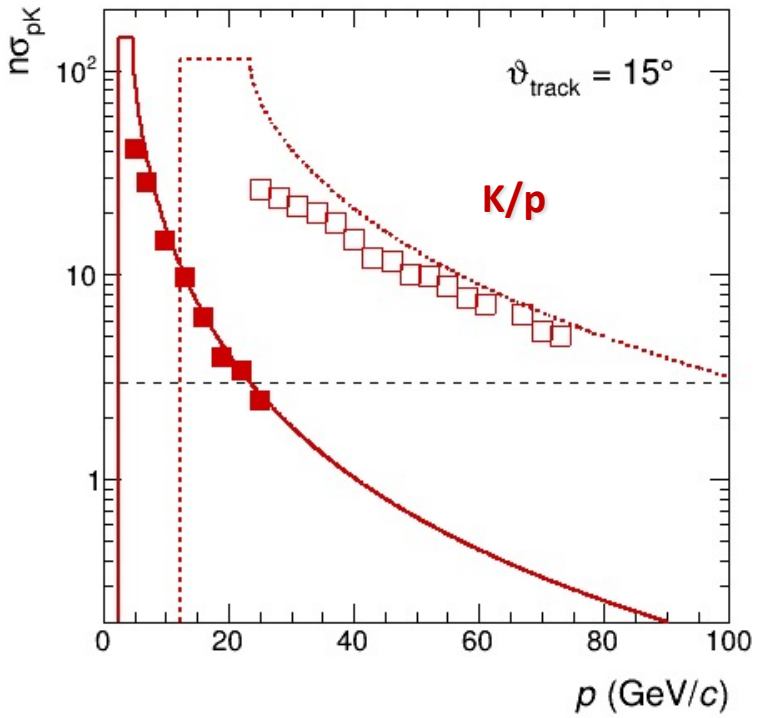


DRICH

Performance of the dRICH developed by the EIC PID consortium (eRD14)







PID@ECCE