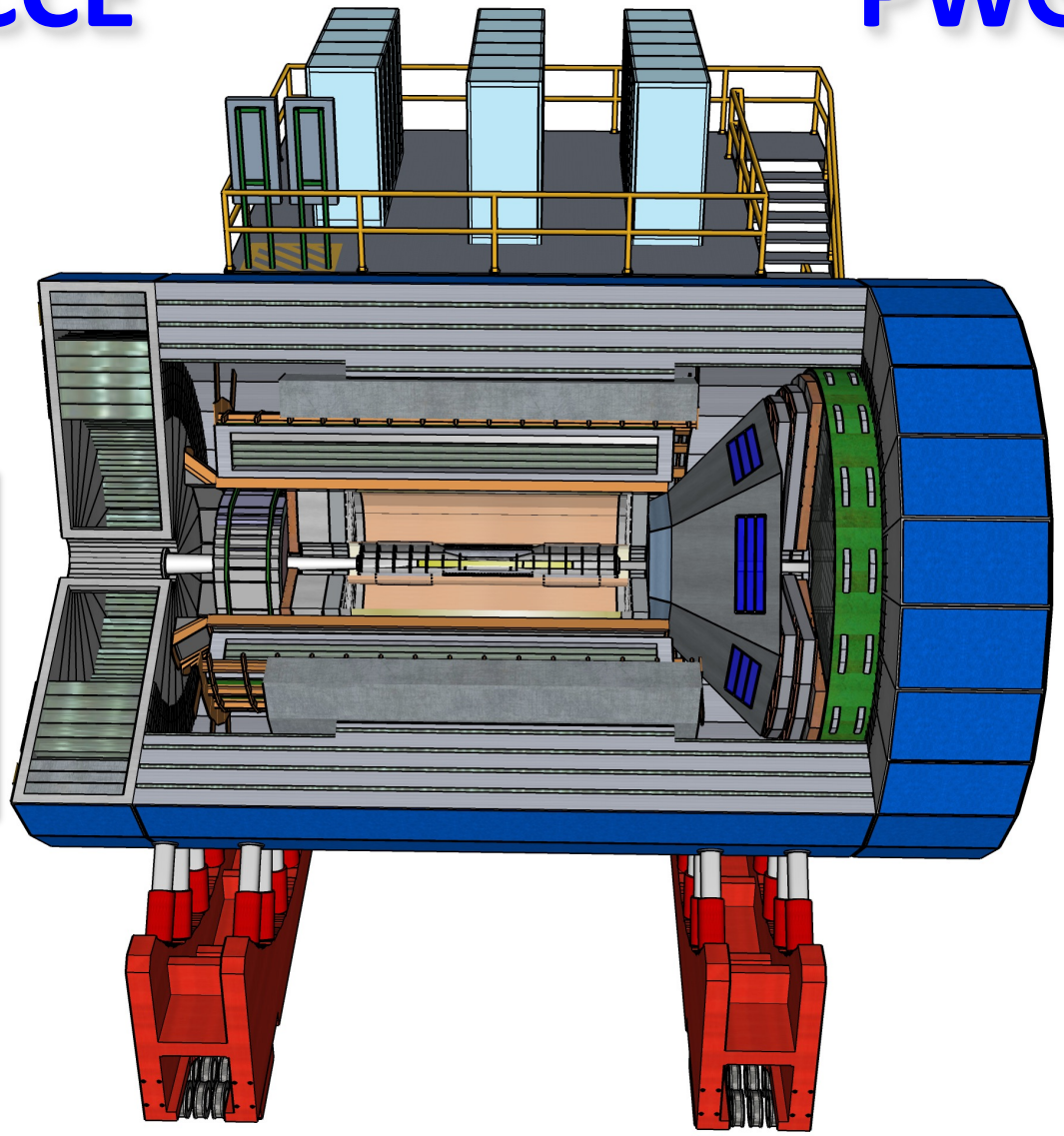
PID@ECCE

PWG Meeting



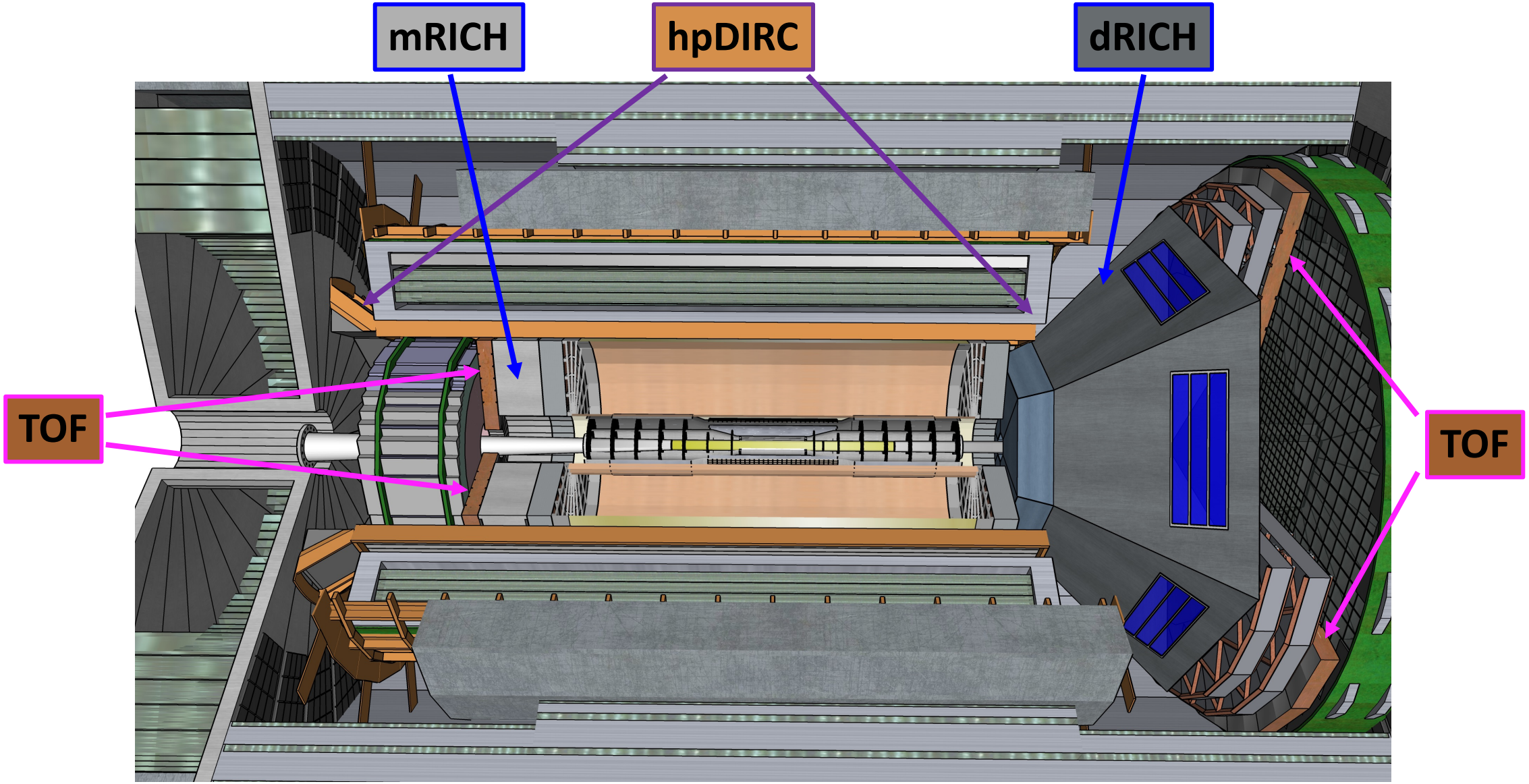
Greg Kalicy — CUA

Xiaochun He — Georgia State University

- Technologies
- Constrains
- Performance

June 14th 2021

ECCE SketchUp Design



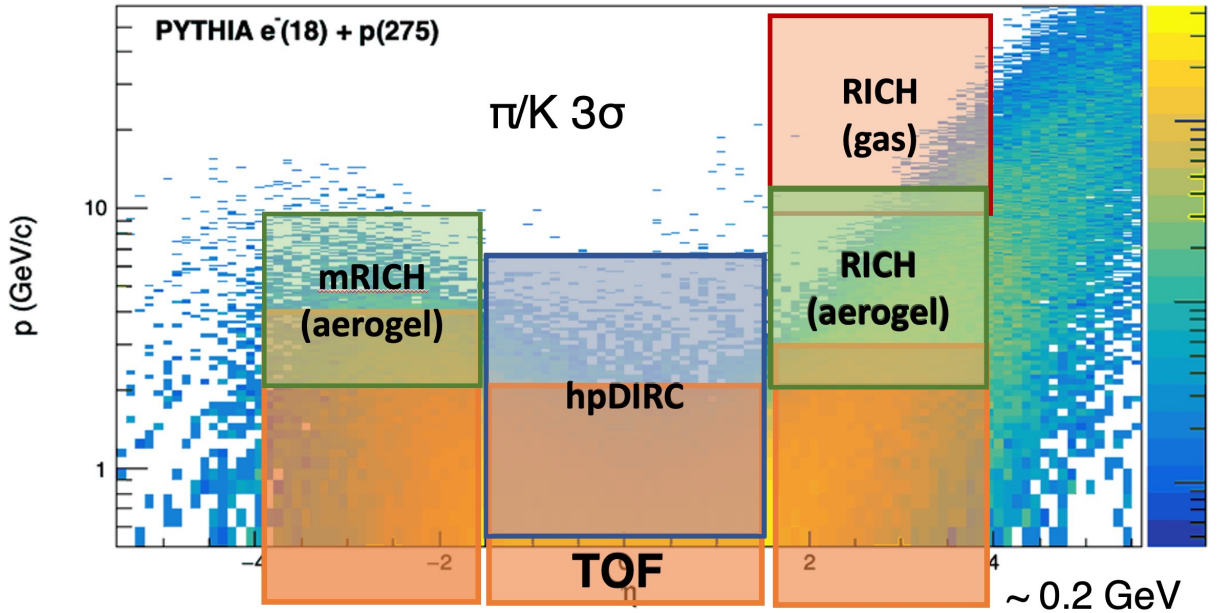
PID@ECCE

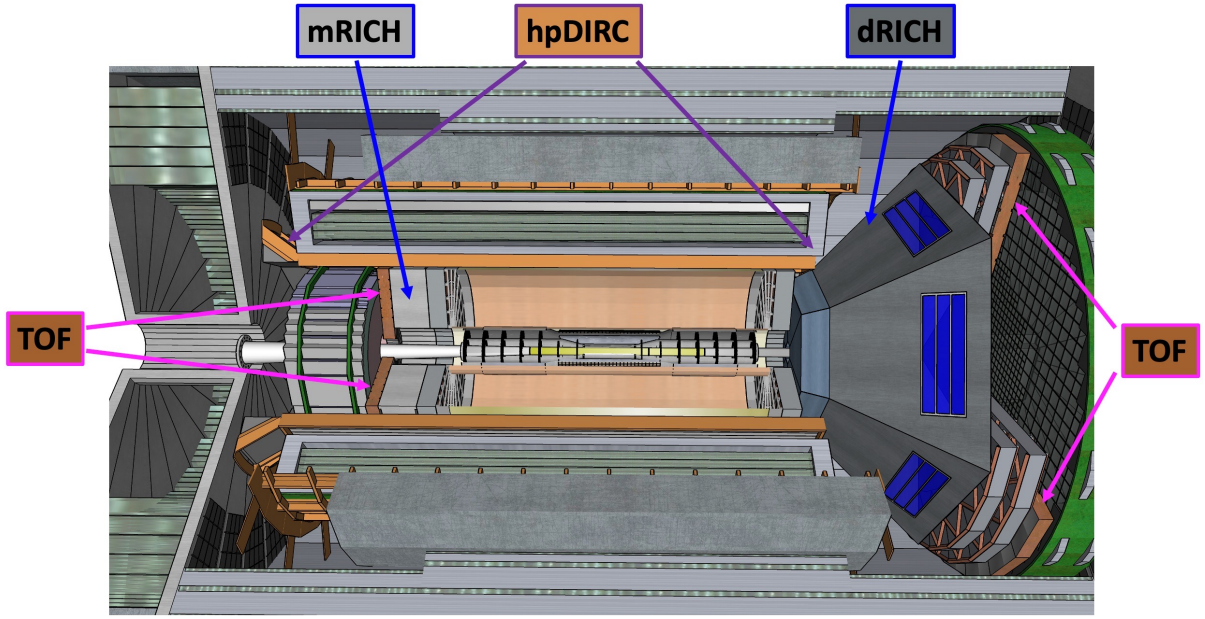
- **h-endcap**: **dRICH with two radiators** (gas + aerogel)
  π/K separation up to ~50 GeV/c
  e/π separation up to ~15 GeV/c

- **e-endcap**: **compact aerogel mRICH**
  π/K separation up to ~10 GeV/c
  e/π separation up to ~2 GeV/c

- **barrel**: **compact high-performance DIRC**
  π/K separation up to ~6-7 GeV/c
  e/π separation up to ~1.2 GeV/c

- **LGAD based TOF**:
  cover lower momenta down to ~0.2 GeV/c

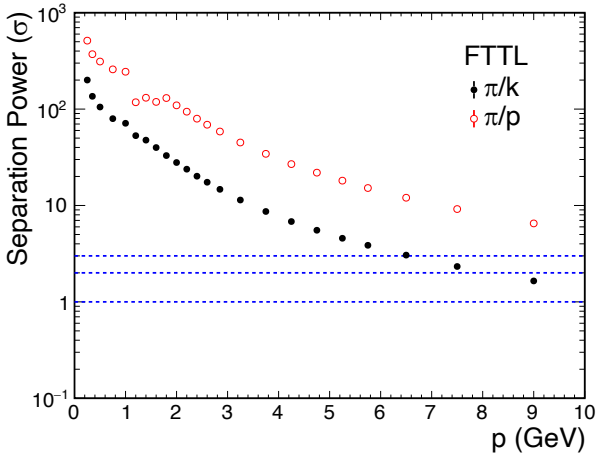


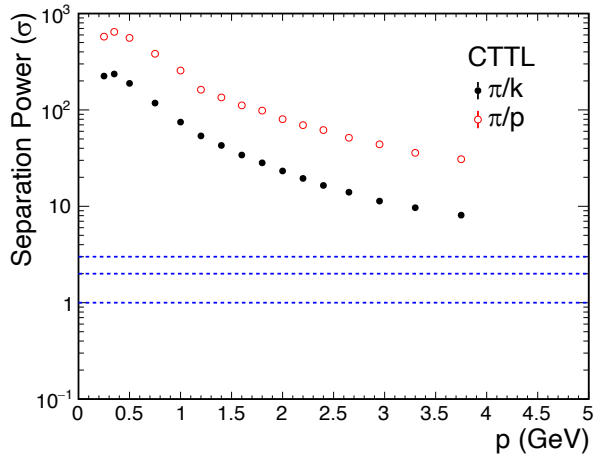


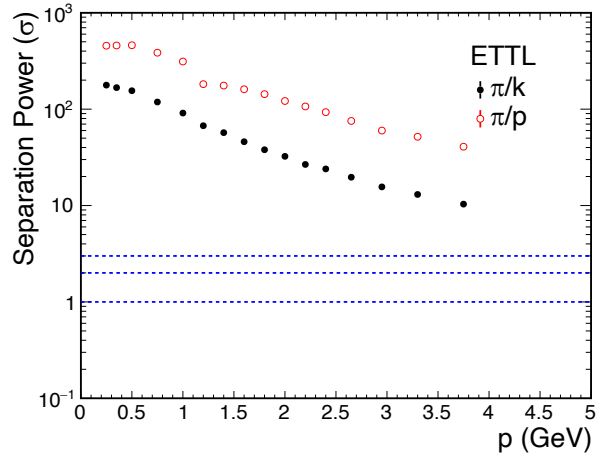
LGAD TOF PID PERFORMANCE

Forward (1<η<3.5): Central (|η|<1): Backward (-3.5<η<-1):

$\sigma_t = 0$ ps

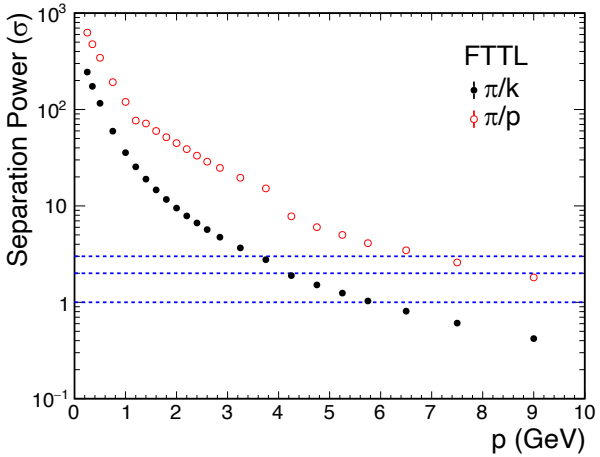


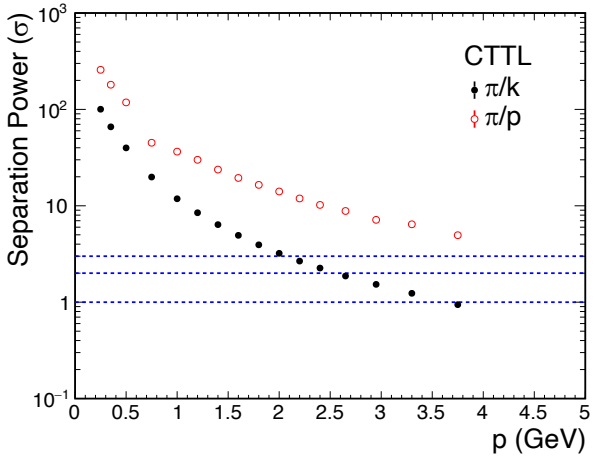


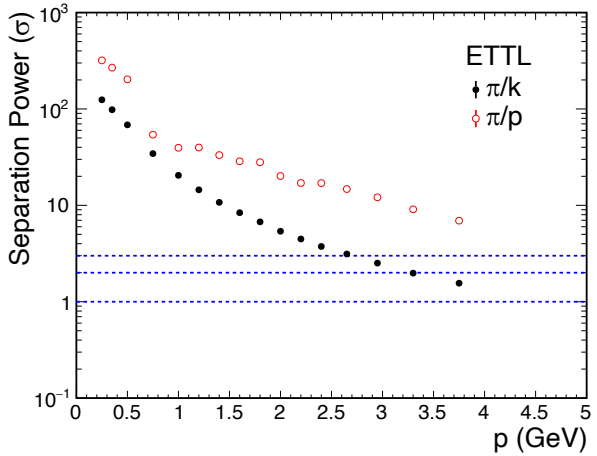


all uncertainties (t_0, t_f, L) included

$\sigma_t = 20$ ps



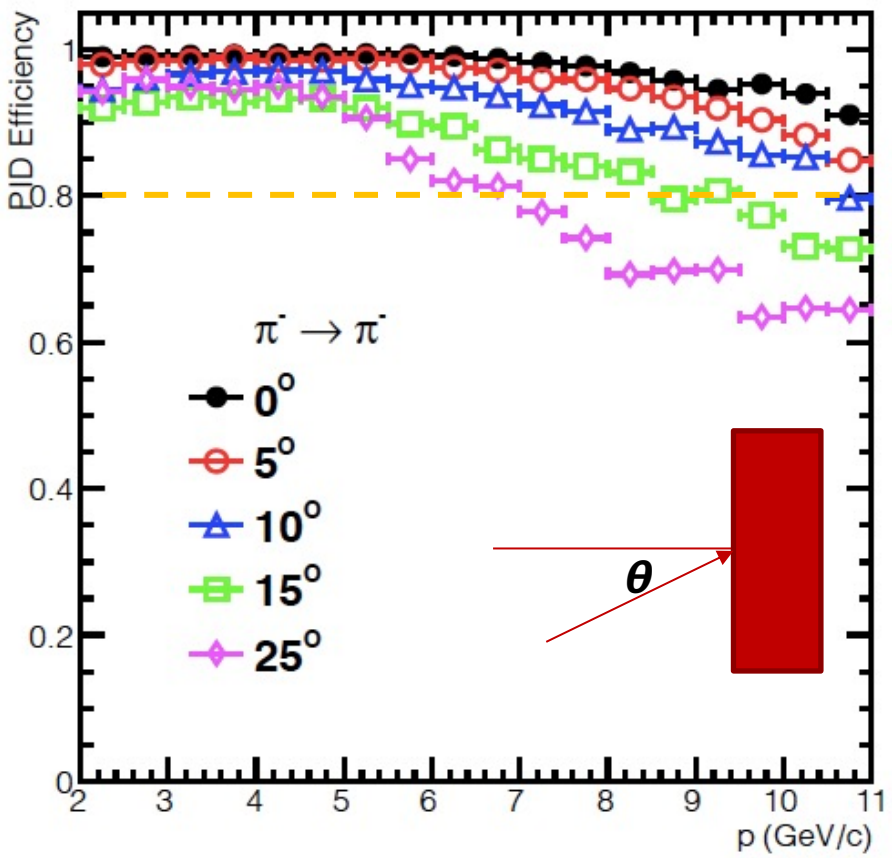


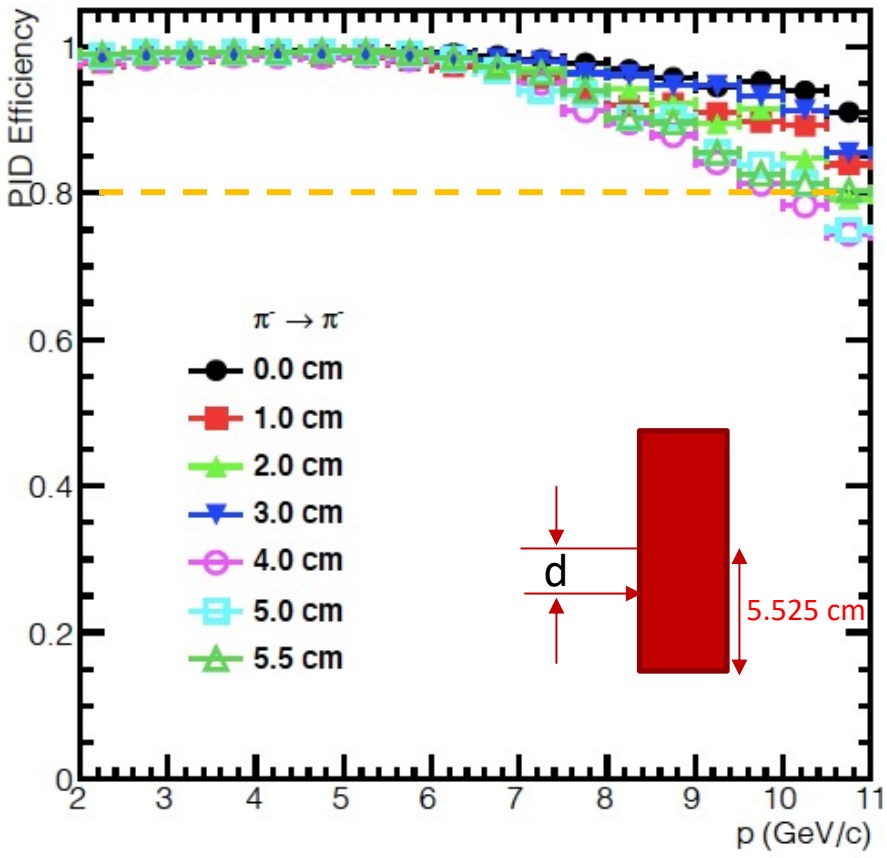


0.2-4 GeV 0.2-2.5 GeV 0.2-3 GeV

Path length uncertainties limit the ultimate PID performance to ~ 6 GeV/c

mRICH PID Performance / Single Module





3 s.d. sepparation

- When incident perpendicular no impact even at the edge of the Aerogel
- Efficiency drops beyond 15°

➡ **Projective setup if preferable!**

Construction code output: $\mathcal{L}_\pi, \mathcal{L}_K, \mathcal{L}_p$

$\pi^- \to \pi^-$: $\mathcal{L}_\pi - \mathcal{L}_K > 0 \&\& \mathcal{L}_\pi - \mathcal{L}_p > 0$

dRICh Simulated Performance

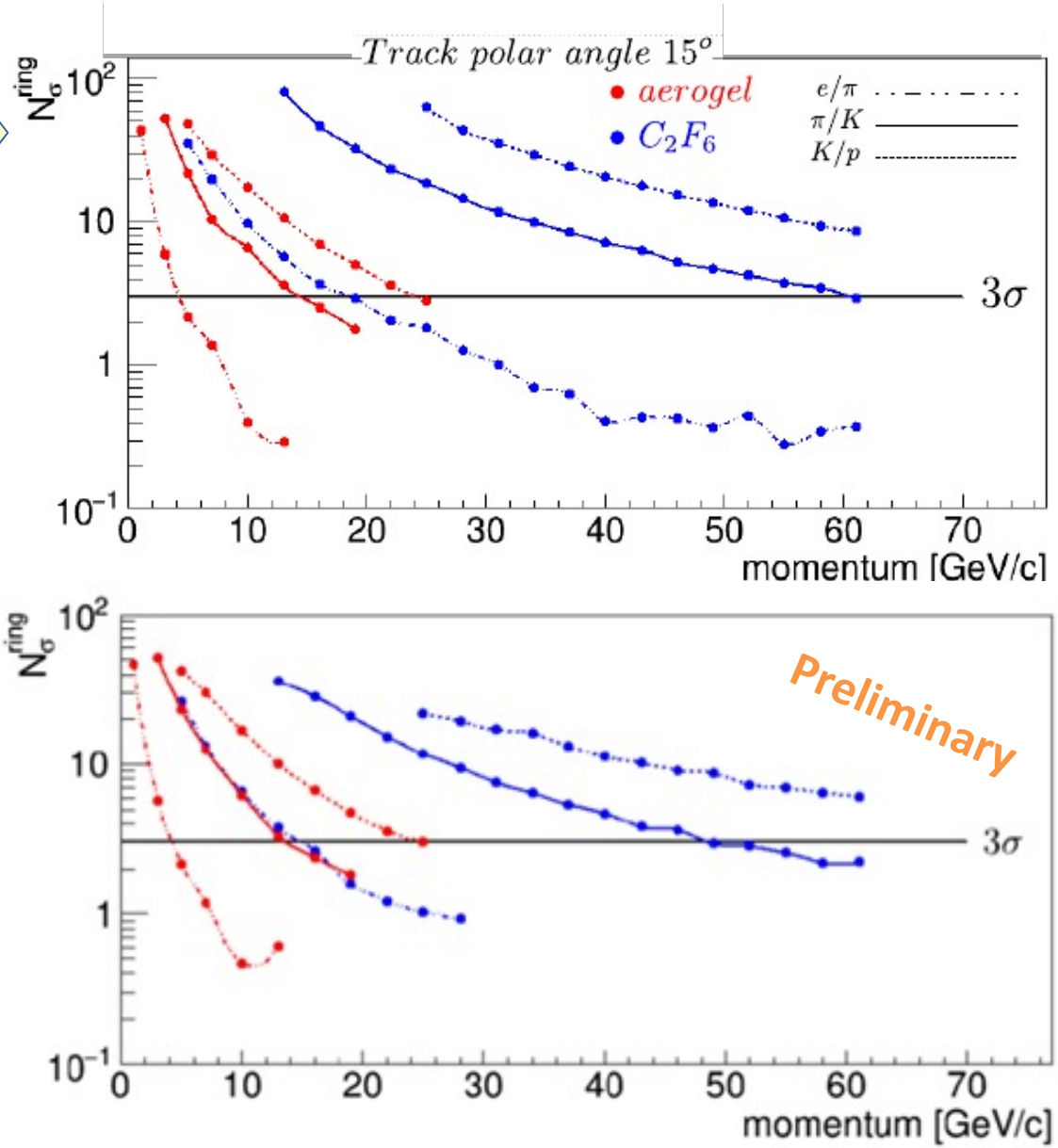
Optics manually optimized for 1.6 m

GEANT4 (GEMC) simulation includes:

- Acrylic Filter (<300nm) after the aerogel to minimize Rayleigh scattering
- Mirror quality from CLAS12
- PMT 3x3 mm pixel, QE from real CLAS12/PMT data (200-500 nm)
- **Tracking accuracy 0.5 mrad**
- **3T central magnetic field**

Cherenkov Angle reconstruction based on Inverse Ray Tracing

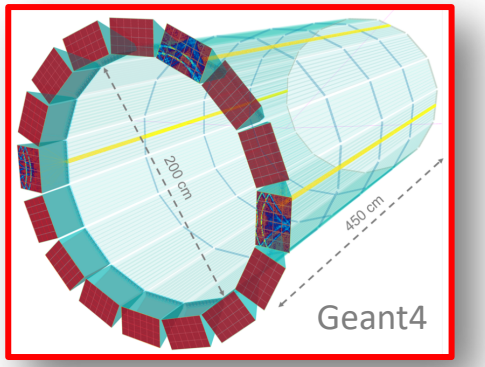
Optics barely adapted to ~1.0 m



HPDIRC

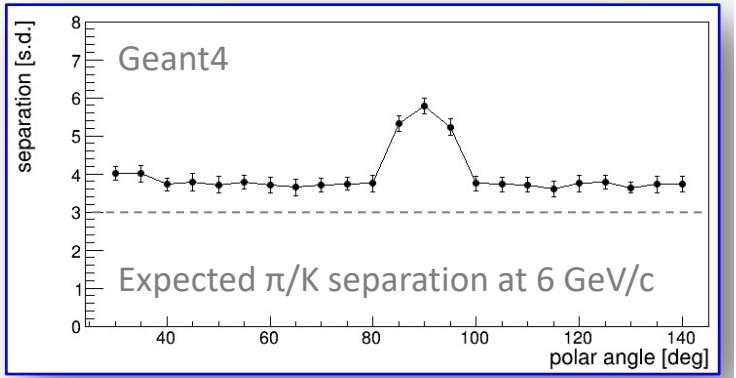
Concept:

- Fast focusing DIRC, utilizing high-resolution 3D (x,y,t) reconstruction
- Innovative 3-layer spherical lenses, compact fused silica expansion volumes
- Fast photon detection using small-pixel MCP-PMTs *(eRD14)* and high-density readout electronics *(eRD14)*



Excellent performance over wide angular range:

- ≥ 3 s.d. π/K up to 6 GeV/c, ≥ 3 s.d. e/π up to ~1.2 GeV/c
- Low momentum π/K identification in "veto mode" down to 0.2-0.3 GeV/c



Key Features:

- **Radially compact** (8-10 cm; impact on cost of post-DIRC systems)
- **Flexible design** (to deal with sensor in B-field and detector integration)
- **Low demand on detector infrastructure** (no cryogenic cooling, no flammable gases)
- **R&D at advanced stage** (PID performance estimate based on test beam results, excellent agreement between detailed simulation and prototype data, fast simulation available)