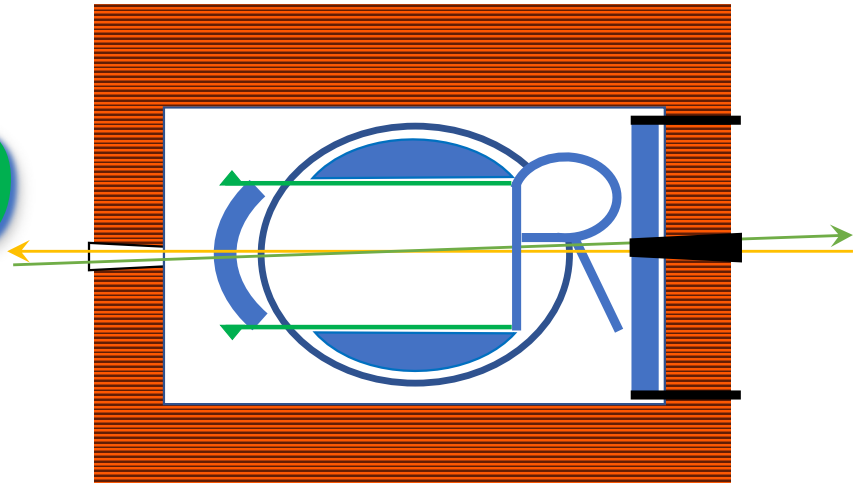
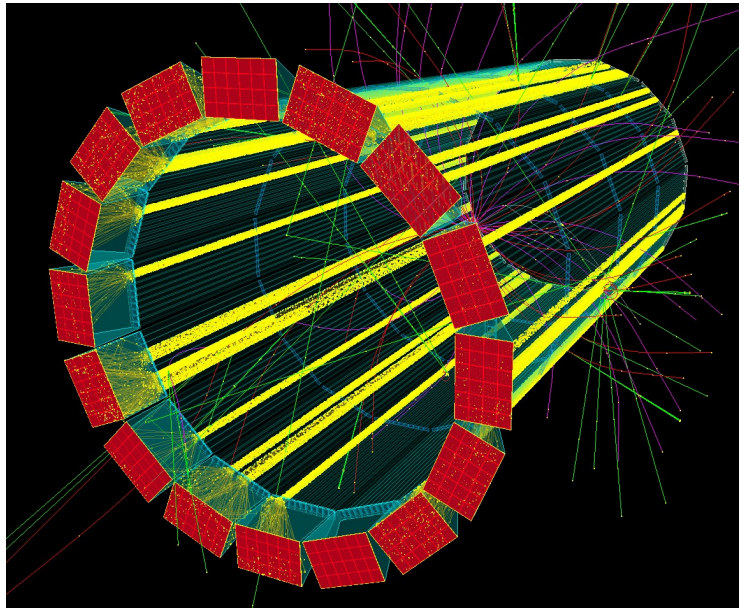
PID@



Greg Kalicy

CUA



- **Low-Mass Light hpDIRC**

August 26th 2021

CORE PID

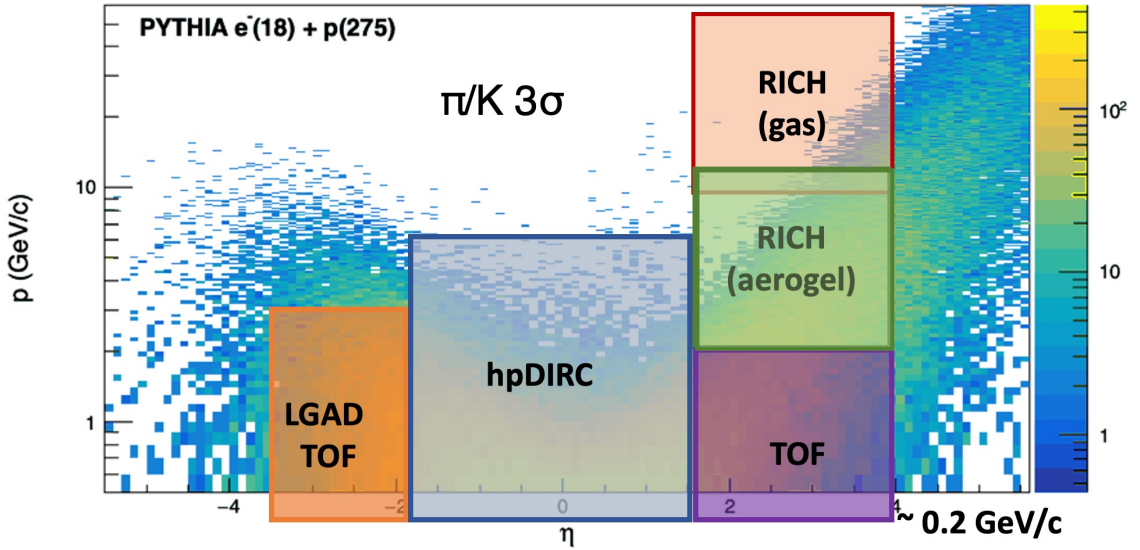
CORE PID concept:

- **Charged kaons ($K^{+/-}$) are identified by the three PID systems:**
  - **h-endcap: dRICH with two radiators** (gas + aerogel)

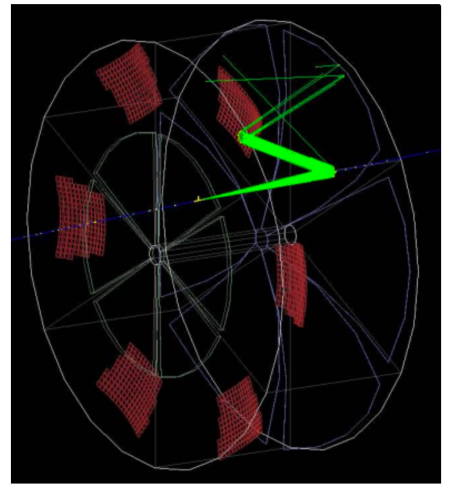
  π/K separation up to ~50 GeV/c
  - **e-endcap: LGAD-based TOF**

  π/K separation up to ~3 GeV/c
  - **barrel: compact low-mass high-performance DIRC**

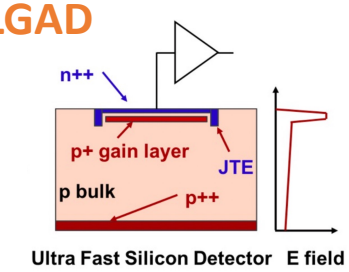
  π/K separation up to ~6 GeV/c



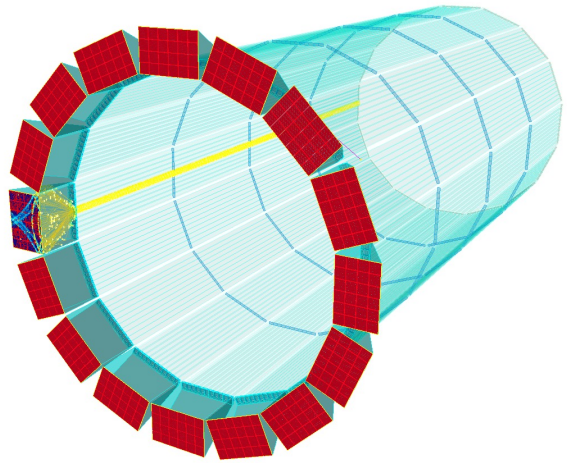
dRICH



LGAD



hpDIRC



Low-Mass Thin hpDIRC

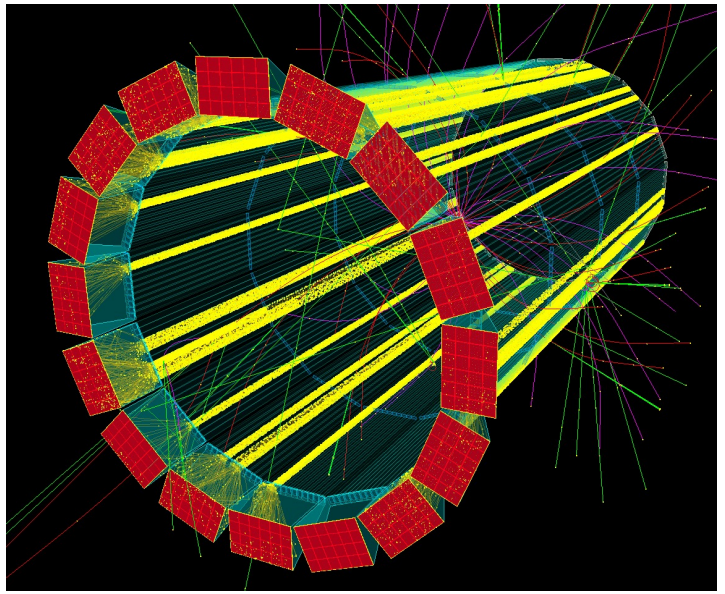
- **CORE barrel hpDIRC geometry:**
  - **47cm radius**
  - **290cm barbox length**
  - **16 barboxes**, 5 long radiator bars side-by-side in a barbox
  - **Radiator bar**: 10 x 35 x 2900 mm^3 (T x W x L) (2-3 shorter bars glued together)
- **Focusing optics:**

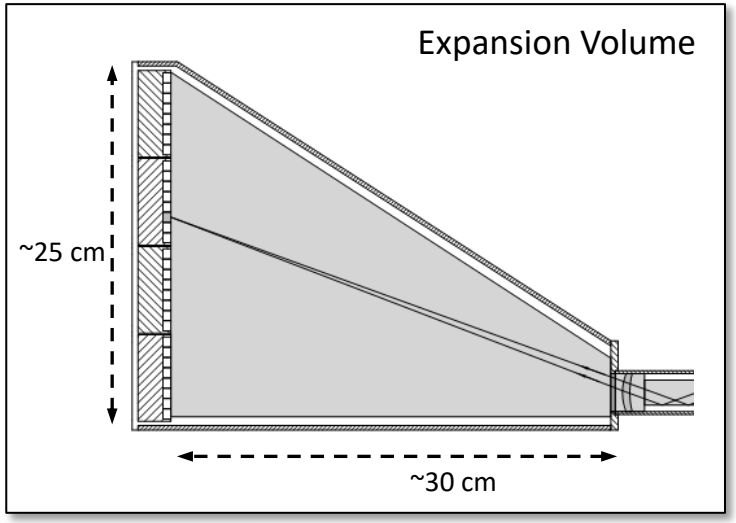
  Radiation-hard **3-layer spherical lens**
- **Expansion volume:**

  Solid fused silica prism: 24 x 18 x 30 cm^3 (H x W x L)

  Additional longitudinal space for MCP-PMTs, readout cards, cables: ~13cm
- **Readout:**

  12 commercial MCP-PMTs per prism, total 49k channels readout by hpDIRC
- **Number of sectors, barrel radius and bar length** can be still optimized for integration, PID performance largely independent of barrel radius and bar length
- **Expansion volume shape** can be optimized for MCP-PMT magnetic field performance (tilted backplane)



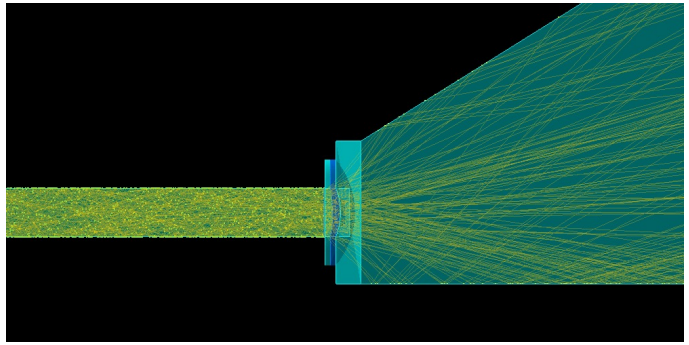


Low-Mass Thin hpDIRC

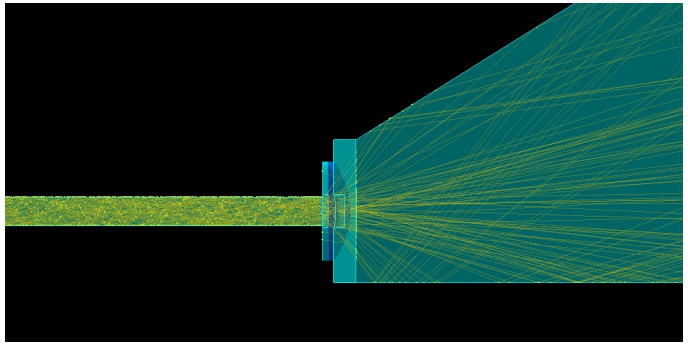
Key features of low-mass thin hpDIRC:

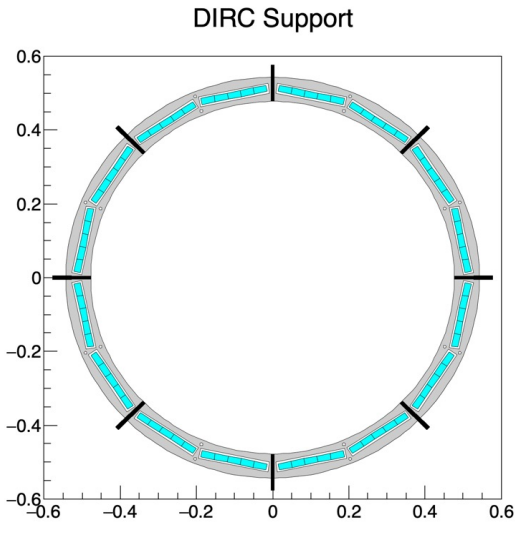
- 41% reduction in mass benefits the Emcal
- The lower weight allows for simpler support structure
- A smaller radius makes new bars more affordable
- Performance can be further optimized
- Prototype of large 10mm thick fused silica radiator were produced by Nikon for TORCH DIRC
- **Significant e/π ID improvement around 1 GeV/c, without significantly affecting π/K ID above 4 GeV/c!**
- **In threshold mode π/K separation down to 0.2-0.3 GeV/c**
- Detailed G4 and F4A simulation studies of performance are in progress

Bar thicknes = 17mm



Bar thicknes = 10mm





1250 x 660 x 10 mm³ plate produced for TORCH DIRC by Nikon

Jochen Schwiening, Roman Dzhygadlo, Greg Kalicy, Nilanga Wickramaarachchi

Low-Mass Thin hpDIRC

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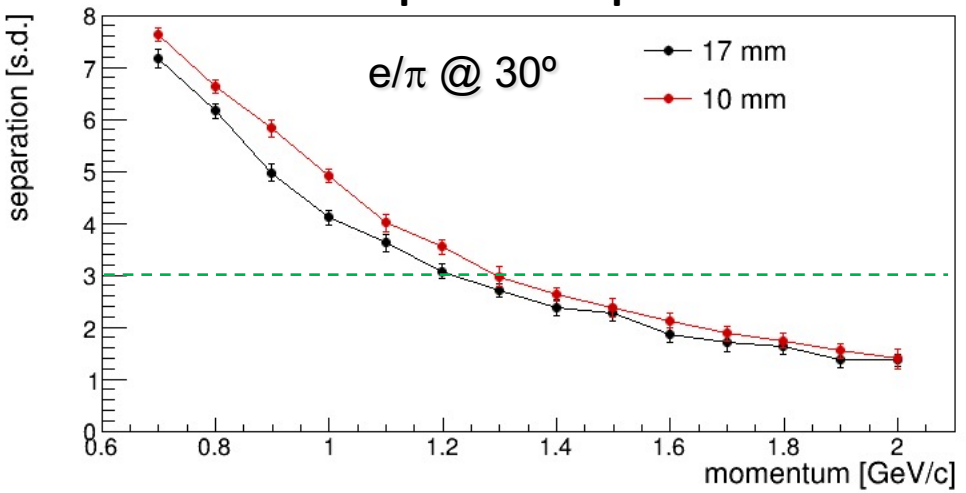
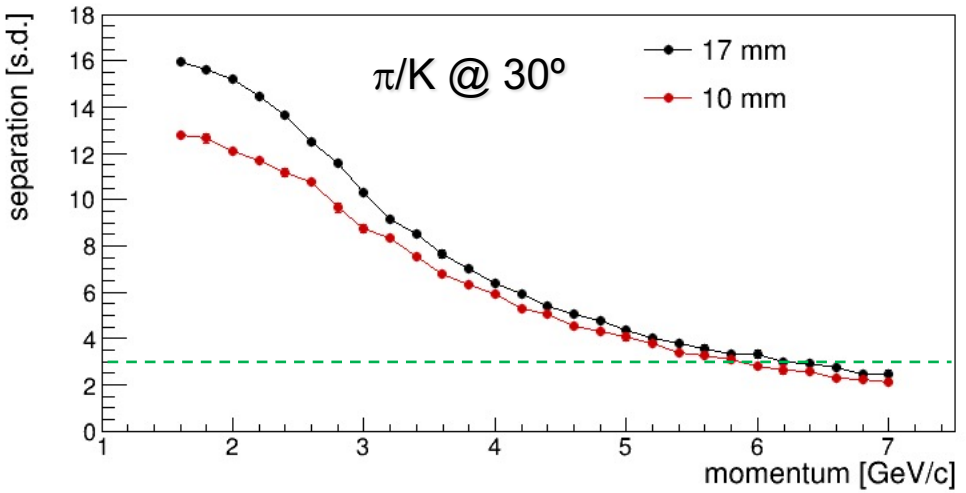
- Detailed G4 and F4A simulation studies for full phase space of performance are in progress

G4 simulation performance of 10mm and 17mm options of hp DIRC



conservative estimates shown

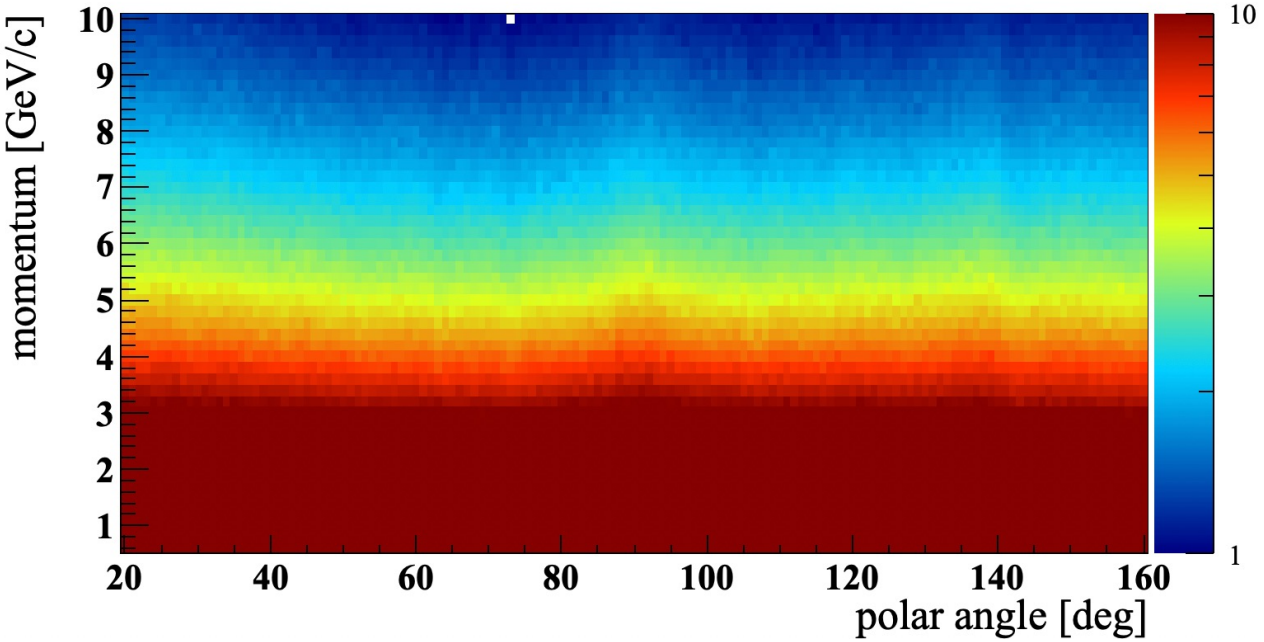


Jochen Schwiening, Roman Dzhygadlo, Greg Kalicy, Nilanga Wickramaarachchi

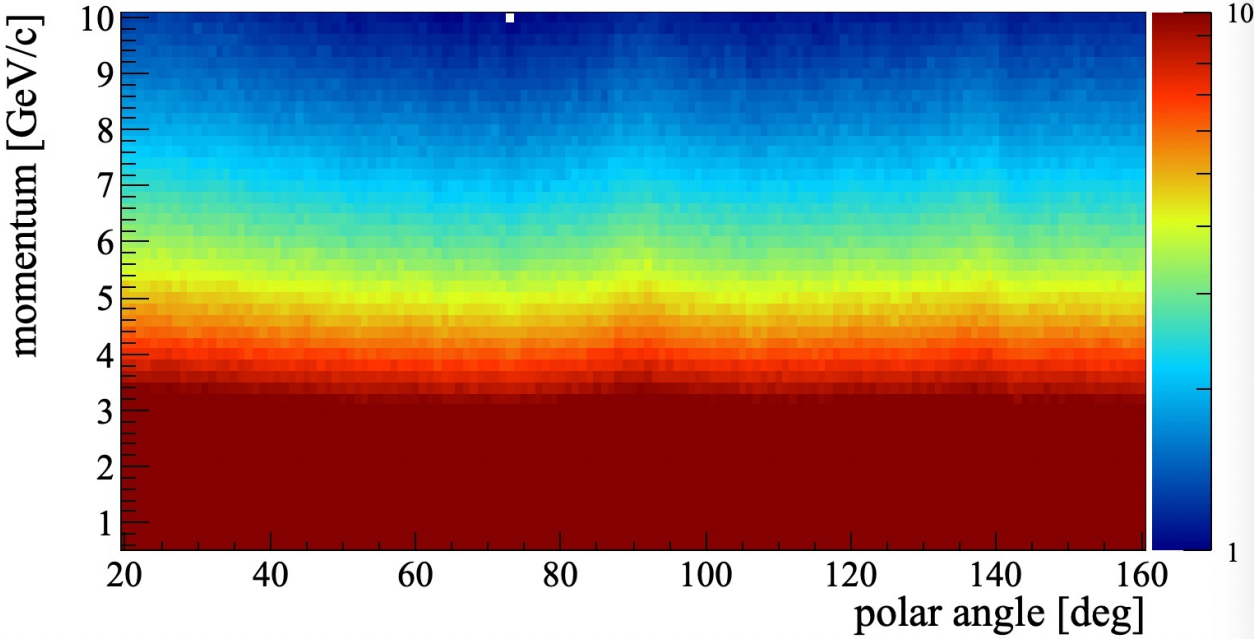
Low-Mass Thin hpDIRC

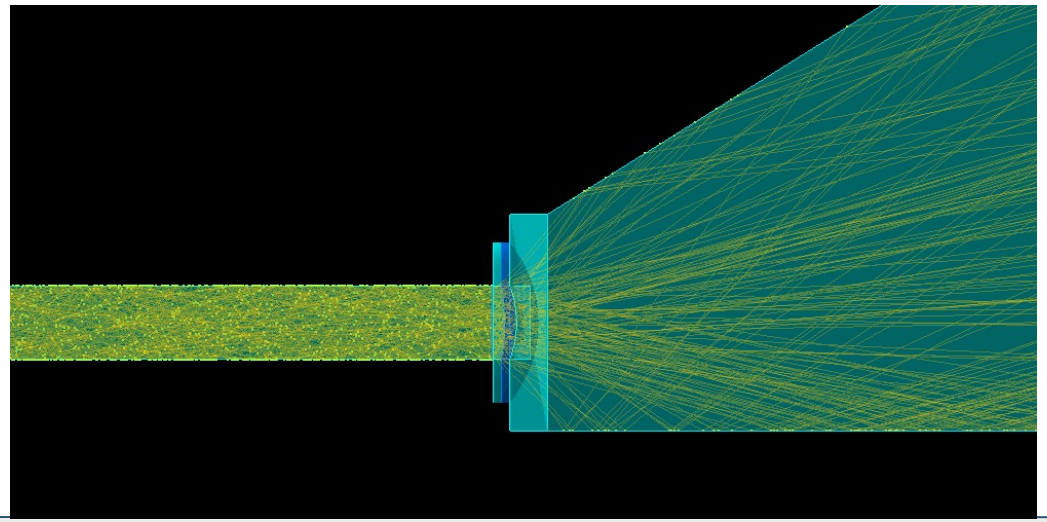
π/K separation power [s.d.]

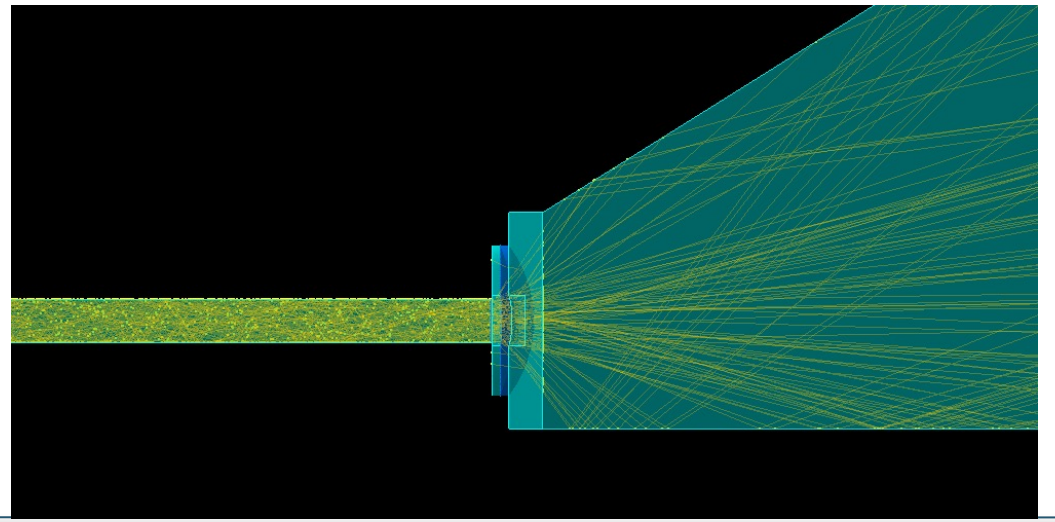
Bar thickness = 17mm



Bar thickness = 10mm

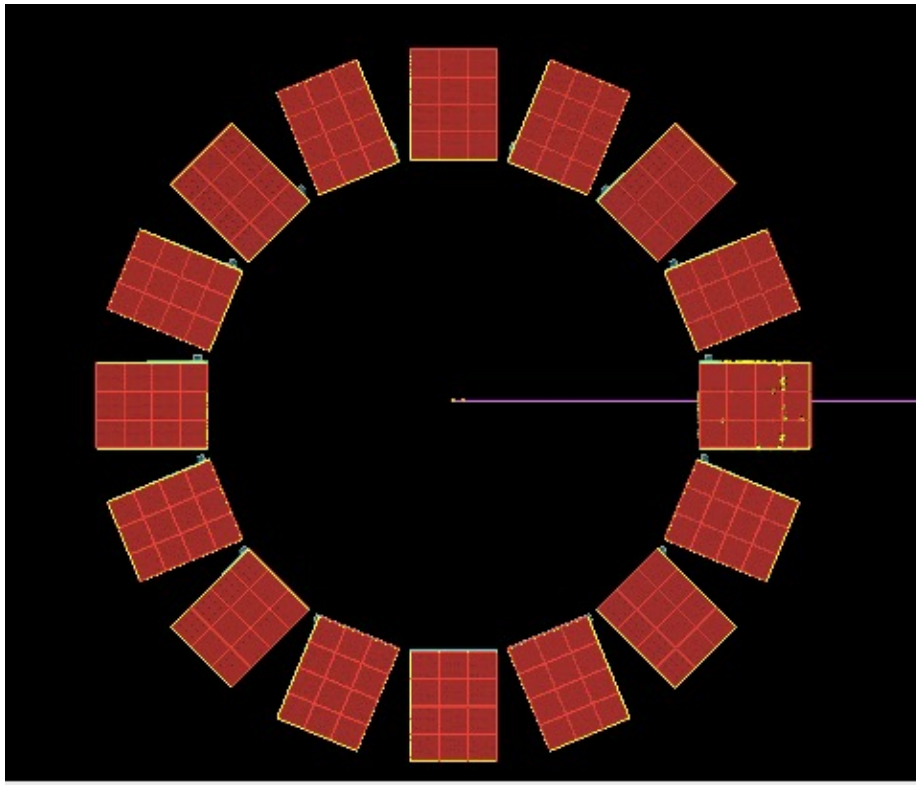


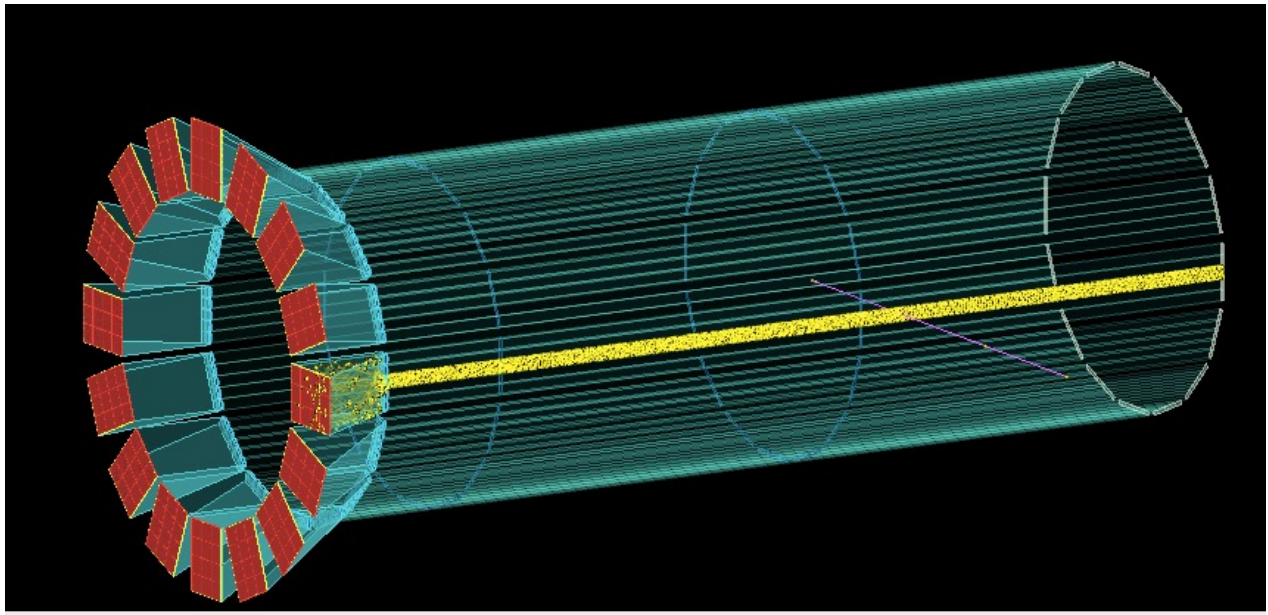


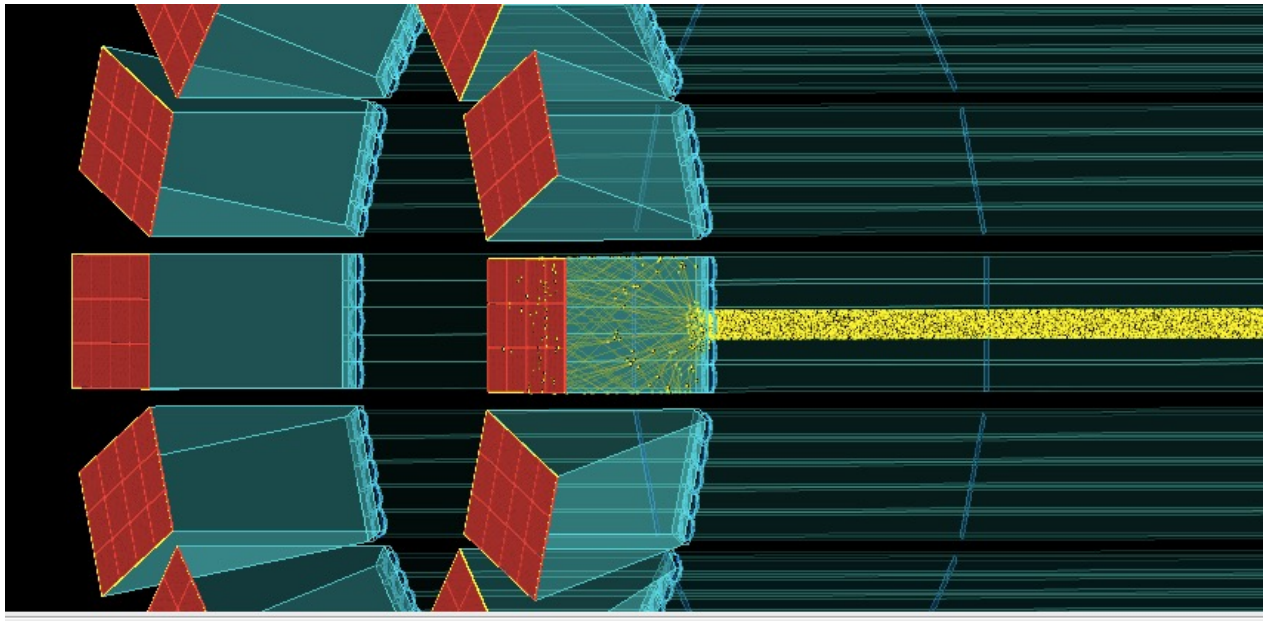


LOW-MASS THIN HPDIRC

Fun4All Simulation





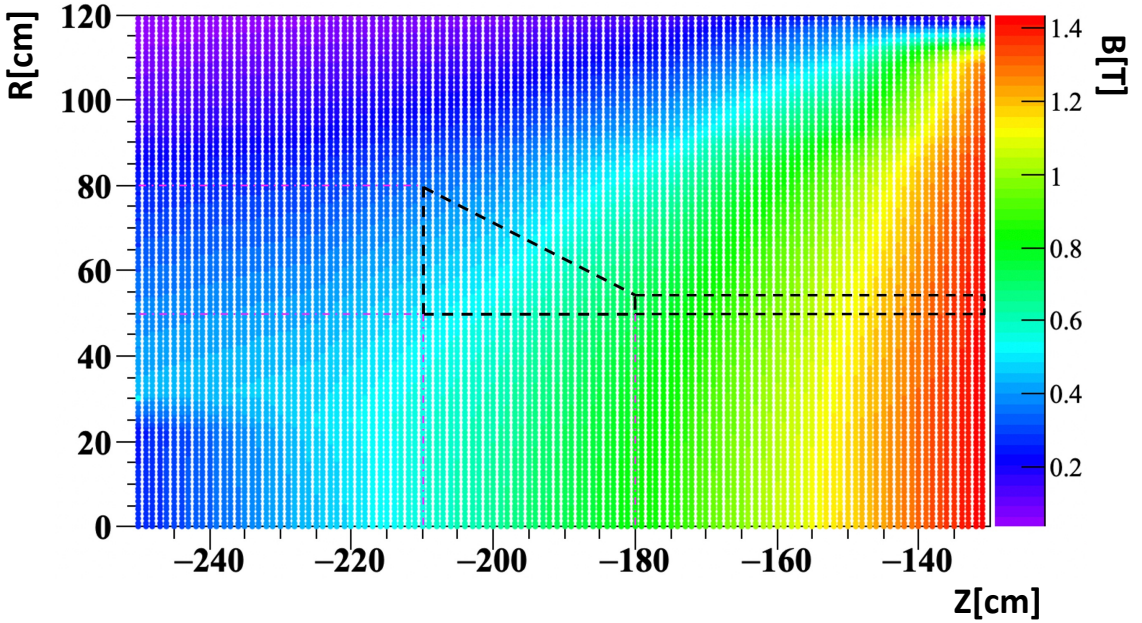


Jochen Schwiening, Roman Dzhygadlo, Greg Kalicy, Nilanga Wickramaarachchi

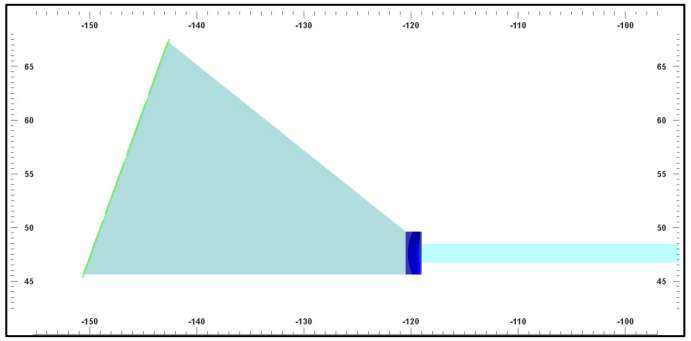
HPDIRC IN MAGNETIC FIELD

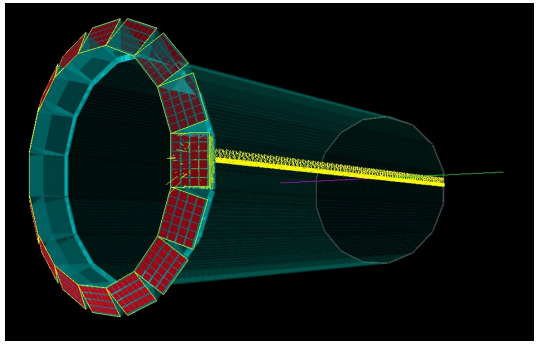
- **Field on hpDIRC photosensors < 0.5 T!**
- **Easily manageable field for commercially available options for MCP-PMTs**
- Validation tests of two MCP-PMT options being performed in JLab High B Facility as we speak!
- Studies of hpDIRC performance with magnetic field in Geant4 stand alone simulation are in progress
- Expansion volume shape can be optimized for MCP-PMT magnetic field performance (tilted backplane)

hpDIRC with CORE Magnetic Field Map

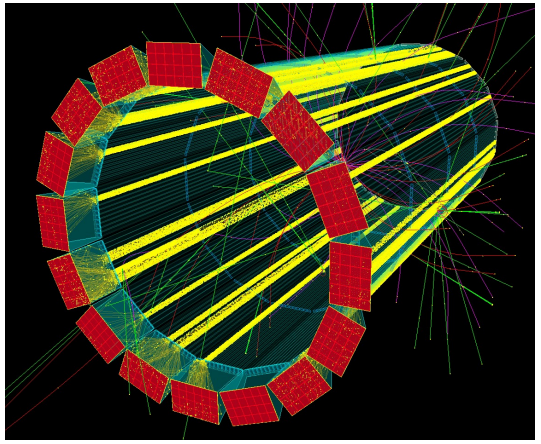


hpDIRC with Tilted Detector Plane



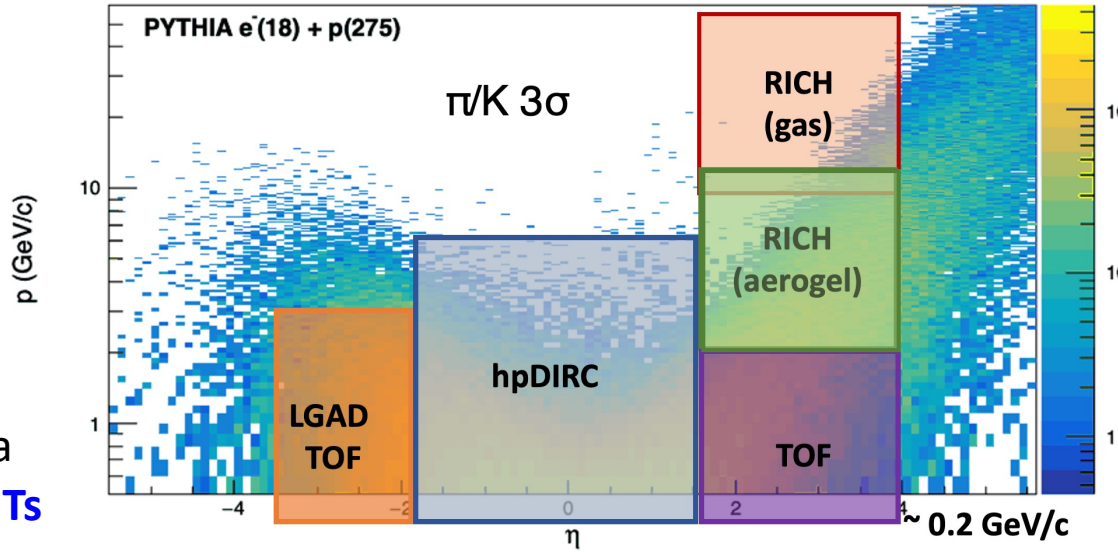


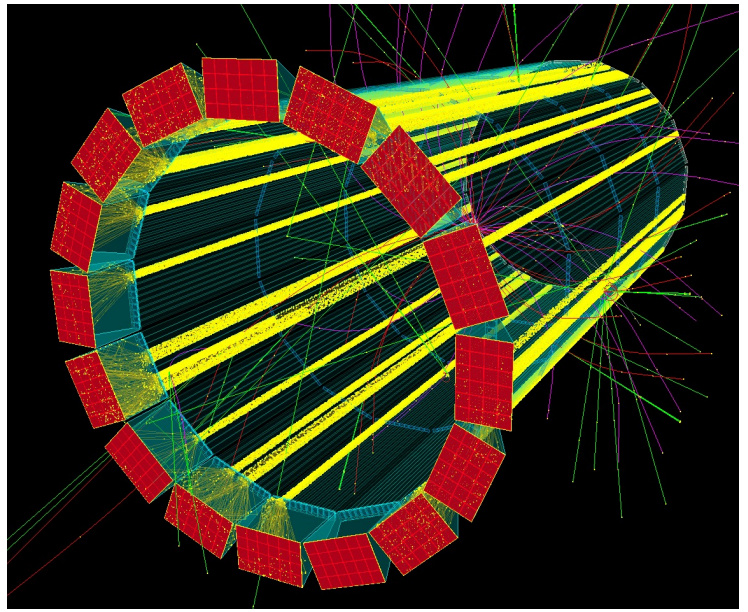
hpDIRC with Magnetic Field in Geant4 Simulation



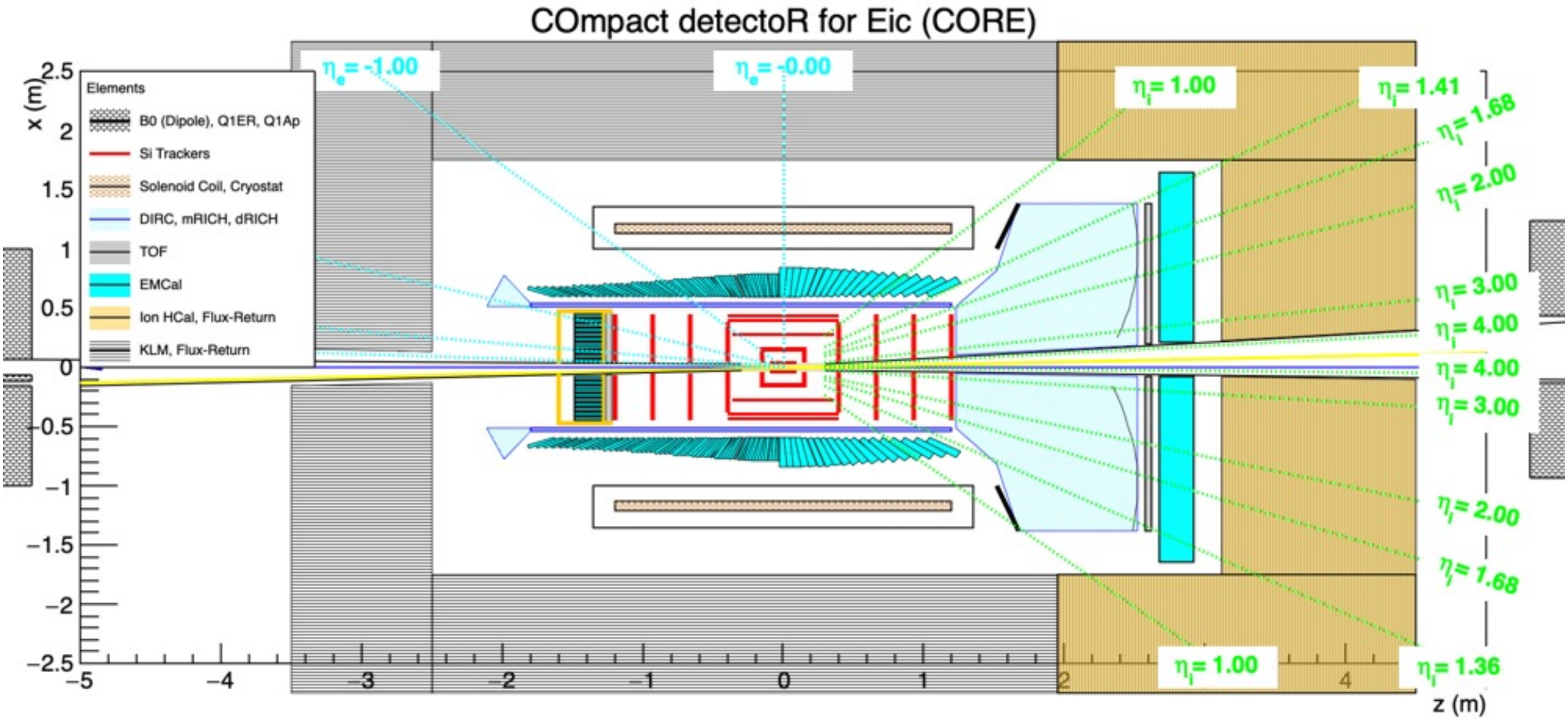
SUMMARY

- **Charged kaons ($K^{+/-}$) are identified by the three PID systems:**
  - **dRICH** (π/K separation up to ~50 GeV/c)
  - **LGAD-based TOF** (π/K separation up to ~3 GeV/c)
  - **hpDIRC** (π/K separation up to ~6 GeV/c)
- **Threshold mode of dRICH and hpDIRC** allows to cover lower momenta.
- The 2.5 m long CORE solenoid allowing for a quick transition from a high field in the tracker to a **very low field on the hpDIRC MCP-PMTs and excellent projectivity in the dRICH!**
- **Low-Mass Thin hpDIRC:**
  - 10mm thick radiator bars are great option for 2nd EIC detector
  - Reduction in mass beneficial the Emcal
  - Smaller radius makes new bars option more afordable
  - **Significant e/π ID improvement at lower momenta, without significantly affecting π/K ID above 4 GeV/c!**
  - **Porting to CORE F4A in progress!**





CORE PID


COmpact detectoR for Eic (CORE)
Elements
B0 (Dipole), Q1ER, Q1Ap
Si Trackers
Solenoid Coil, Cryostat
DIRC, mRICH, dRICH
TOF
EMCal
Ion HCal, Flux-Return
KLM, Flux-Return
x (m)
z (m)
η_e = -1.00
η_e = -0.00
η_i = 1.00
η_i = 1.41
η_i = 1.68
η_i = 2.00
η_i = 3.00
η_i = 4.00
η_i = 4.00
η_i = 3.00
η_i = 2.00
η_i = 1.68
η_i = 1.00
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