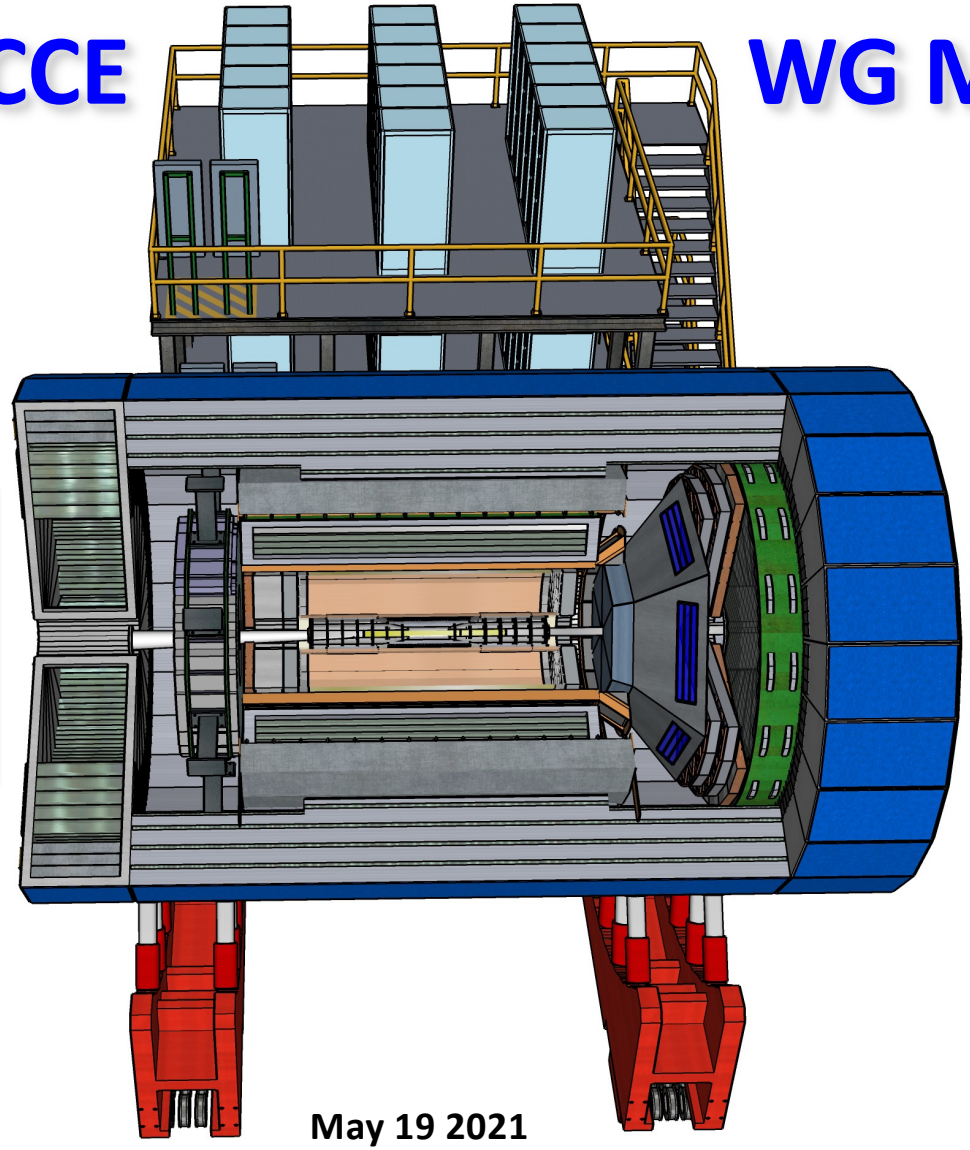
PID@ECCE WG Meeting

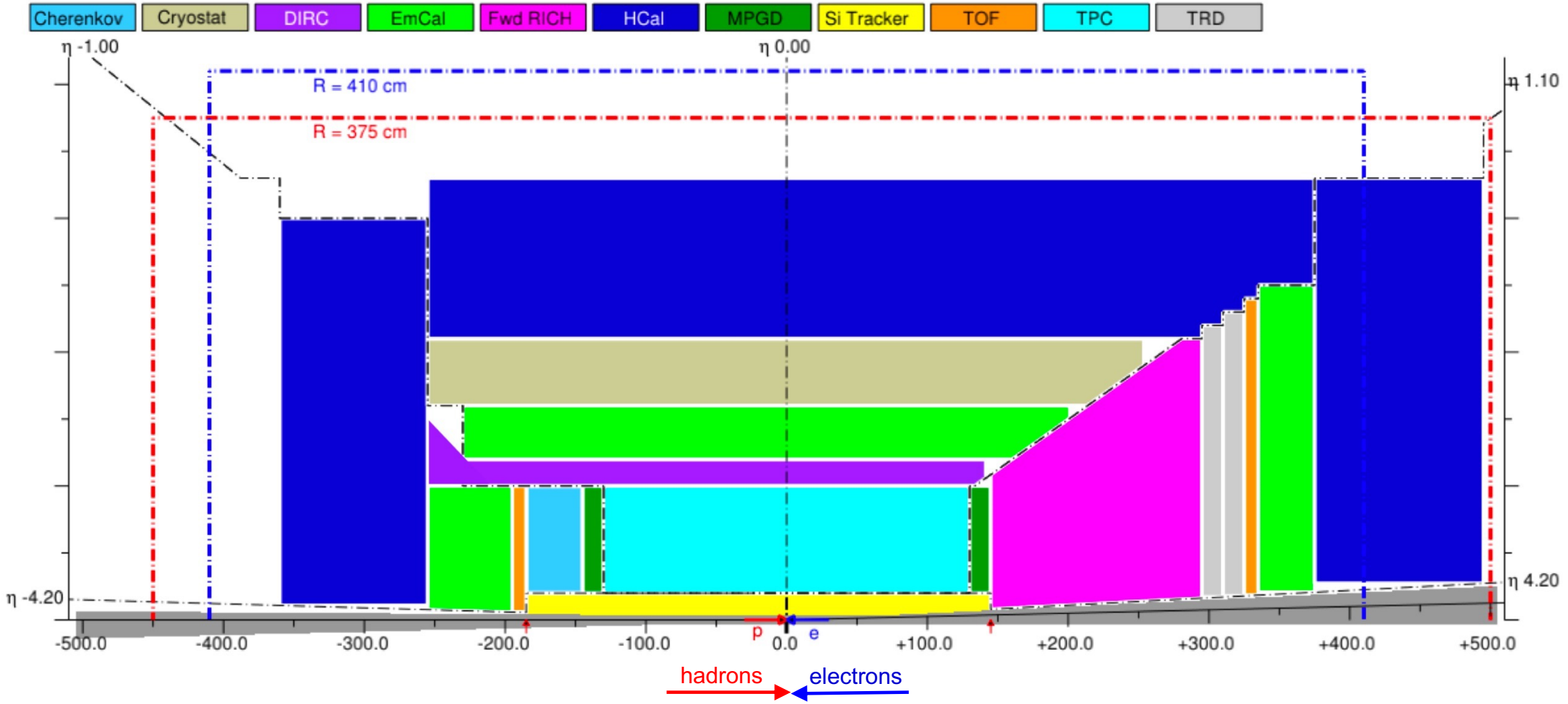
Greg Kalicy
CUA
Xiaochun He
Georgia State University



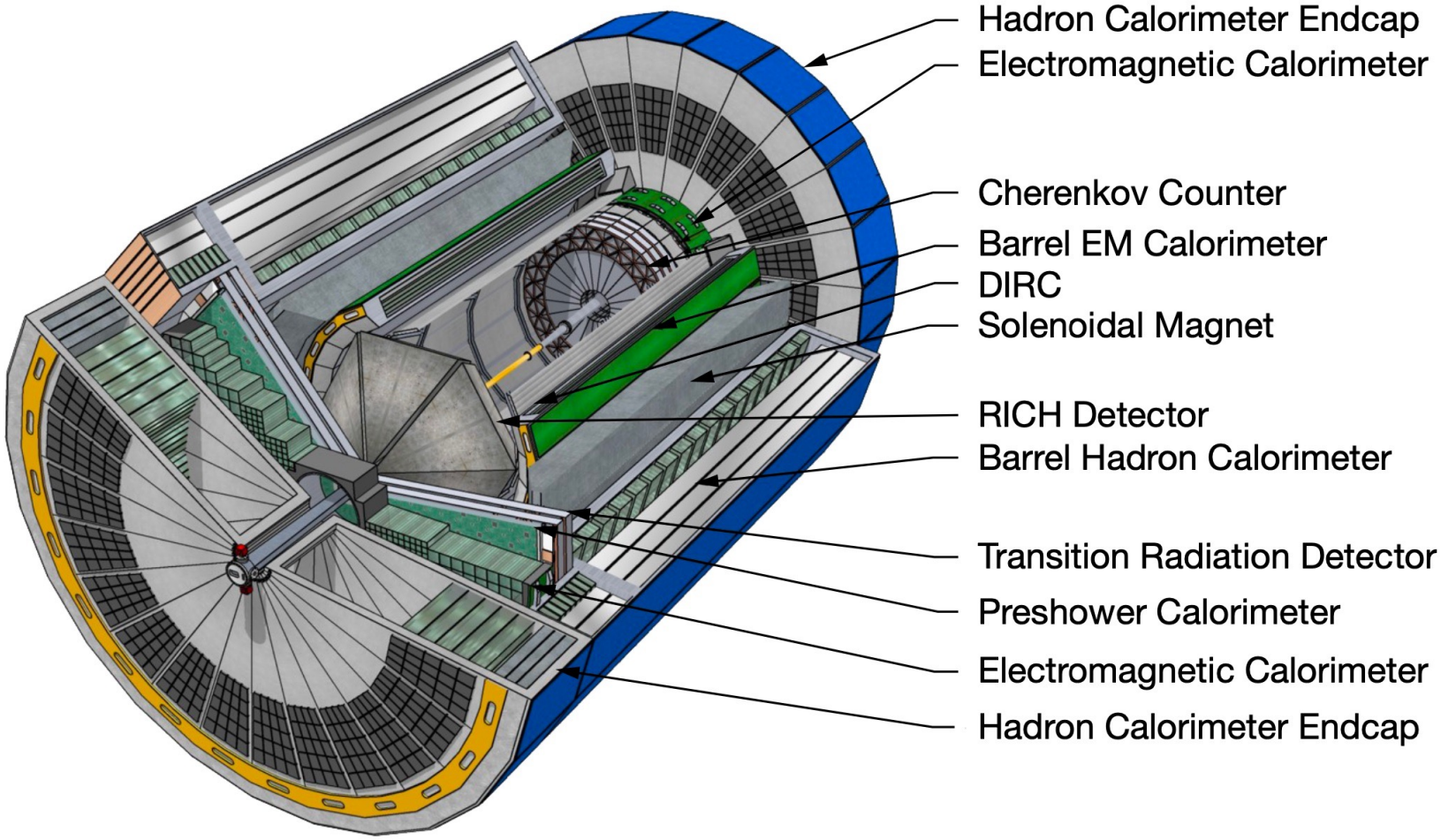
- PID options in Yellow Report
- PID at ECCE
- Fun4All Simulation
- Lots of work, not much time!
- Meetings

May 19 2021

YR Reference Detector



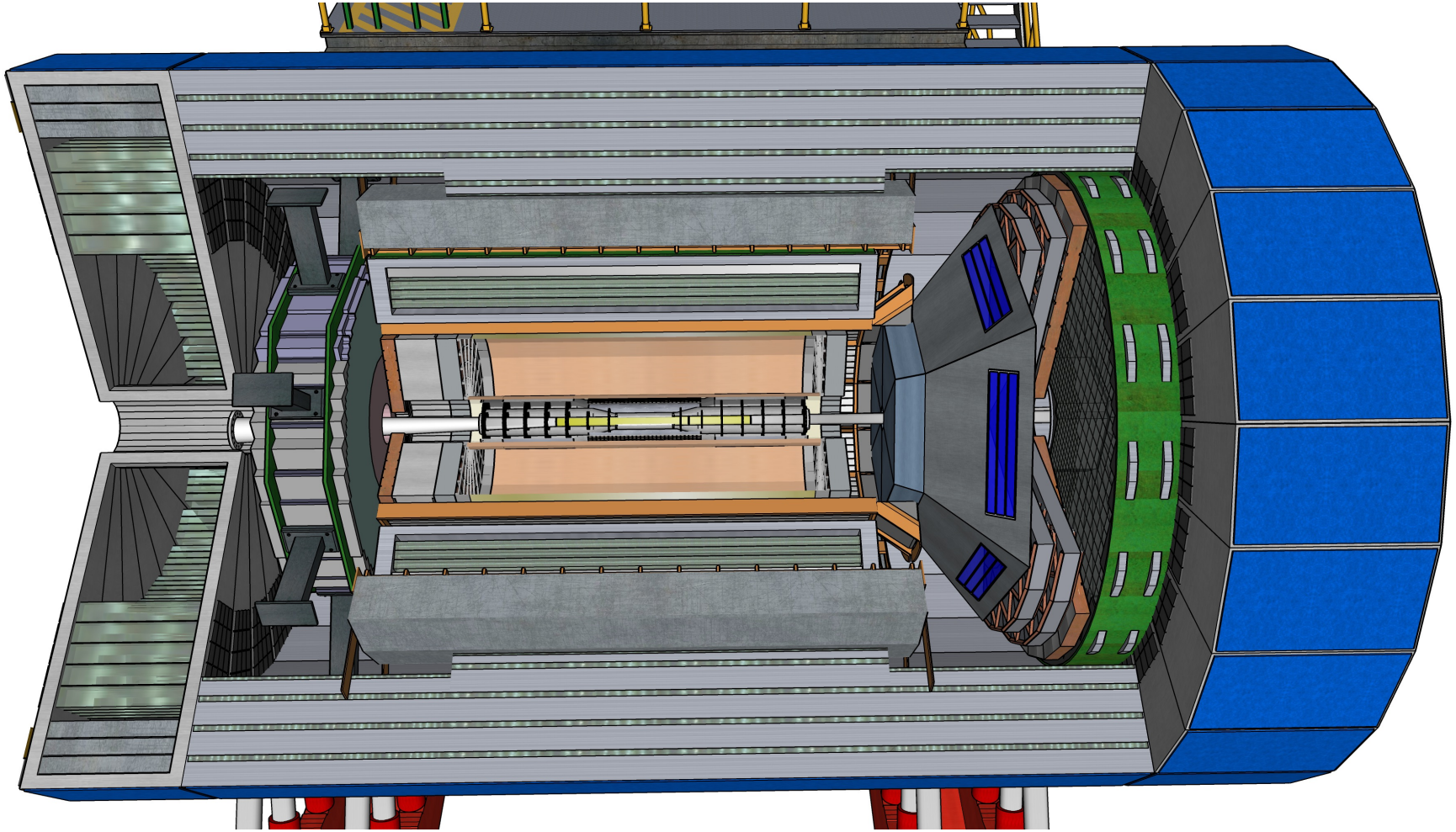
YR Reference Detector



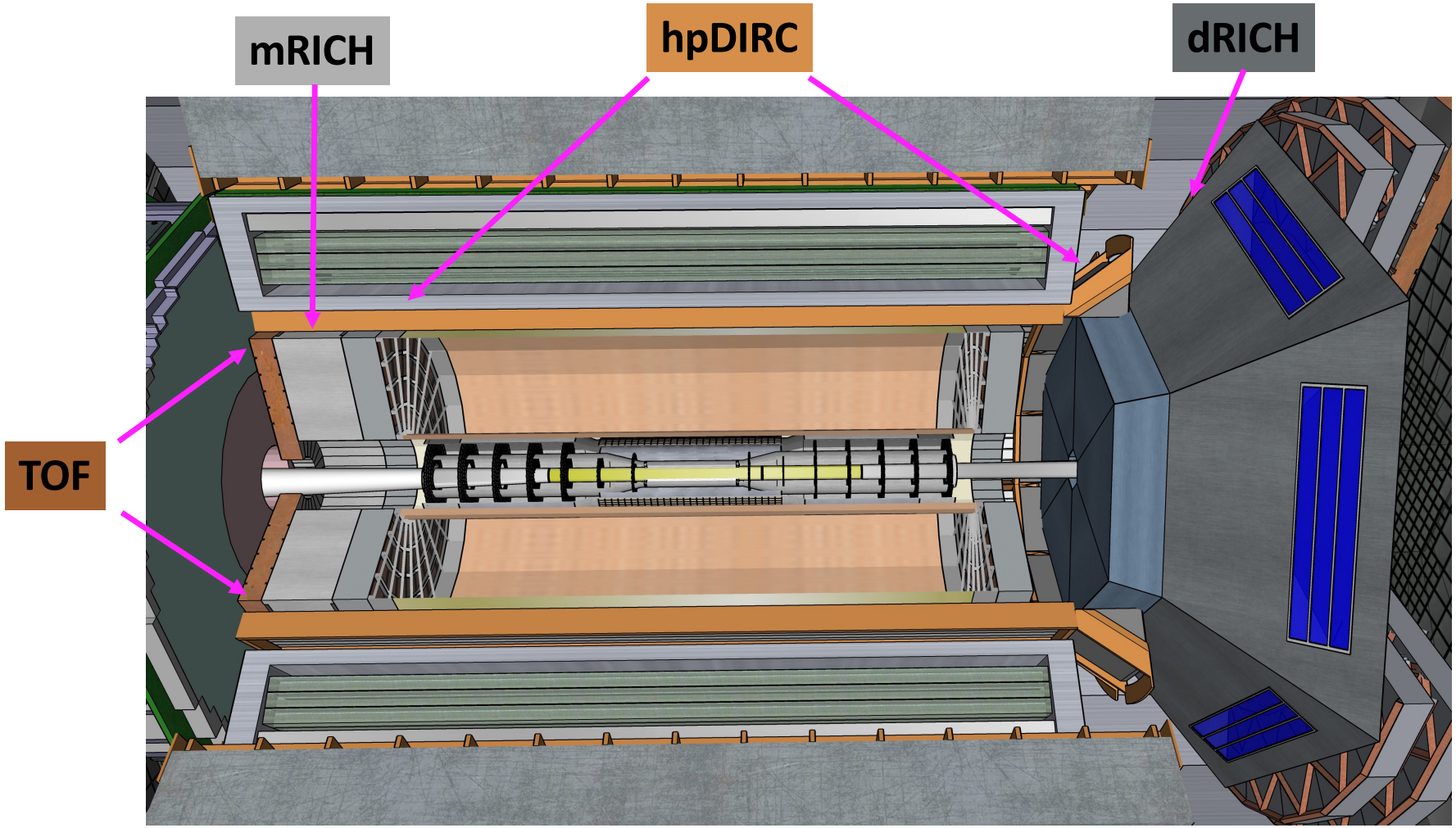
PID IN YELLOW REPORT

system	system components	reference detectors	detectors, alternative options considered by the community		
tracking	vertex	MAPS, 20 um pitch	MAPS, 10 um pitch		
	barrel	TPC	TPC[a]	MAPS, 20 um pitch	MICROMEGAS[b]
	forward & backward	MAPS, 20 um pitch & sTGCs[c]	GEMs	GEMs with Cr electrodes	
	very far-forward & far-backward	MAPS, 20 um pitch & AC-LGAD[d]	TimePix (very far-backward)		
ECal	barrel	W powder/ScFi or Pb/Sc Shashlyk	SciGlass	W/Sc Shashlyk	
	forward	W powder/ScFi	SciGlass	PbGl	Pb/Sc Shashlyk or W/Sc Shashlyk
	backward, inner	$PbWO_4$	SciGlass		
	backward, outer	SciGlass	$PbWO_4$	PbGl	W powder/ScFi or W/Sc Shashlyk[e]
	very far-forward	Si/W	W powder/ScFi	crystals[f]	SciGlass
h-PID	barrel	High performance DIRC & dE/dx (TPC)	reuse of BABAR DIRC bars	fine resolution TOF	
	forward, high p	double radiator RICH (fluorocarbon gas, aerogel)	fluorocarbon gaseous RICH	high pressure Ar RICH	
	forward, medium p		aerogel		
	forward, low p	TOF	dE/dx		
	backward	modular RICH (aerogel)	proximity focusing aerogel		
e/h separation at low p	barrel	hpDIRC & dE/dx (TPC)	very fine resolution TOF		
	forward	TOF & areogel			
	backward	modular RICH	adding TRD	Hadron Blind Detector	
HCal	barrel	Fe/Sc	RPC/DHCAL	Pb/Sc	
	forward	Fe/Sc	RPC/DHCAL	Pb/Sc	
	backward	Fe/Sc	RPC/DHCAL	Pb/Sc	
	very far-forward	quartz fibers/ scintillators			

1.5T Magnet Detector in SketchUp



1.5T Magnet Detector in SketchUp



PID@ECCE

Porting PID systems to ECCE fun4all:

- **mRICH** - already implemented, perfect as example!
- **dRICH** – in progress, active help from Evaristo!
- **hpDIRC –** in progress, active help from Chris Pinkenburg!

- **Sources:**
  - **Wiki with basic info, meeting slides, and links:** **https://wiki.bnl.gov/eicug/index.php/ECCE_Detector#ECCE_Particle_ID**
  - **Todays meeting: https://indico.bnl.gov/event/11911/**
  - **mRICH code:** https://github.com/msar15/mRICH_G4.git

Moving Forward

PID@ECCE WG meetings

- **We will try to keep bi-weekly**
- **As short as possible**
- **Additional short, targeted meetings – as needed.**

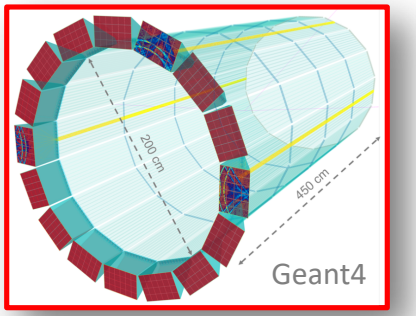
- **Deadlines:**

1. **June 1st - Technologies and configurations recognition**
2. **June 15th - Preliminary evaluation (stand alone simulation, advancement of R&D)**
3. **June 29th - ECCE Fun4All implementation**
4. **July 27th - Fine-tuning of geometries and locations**
5. **August 31st -Physics capability with PID validation**
6. **September 28th - Final Evaluation**
7. **October 26th - Proposal writing**

HPDIRC FEATURES

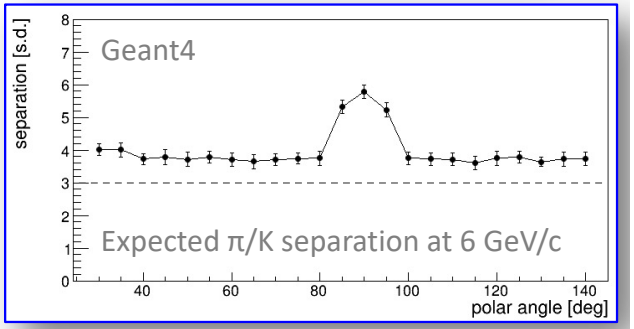
Concept:

- 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)*



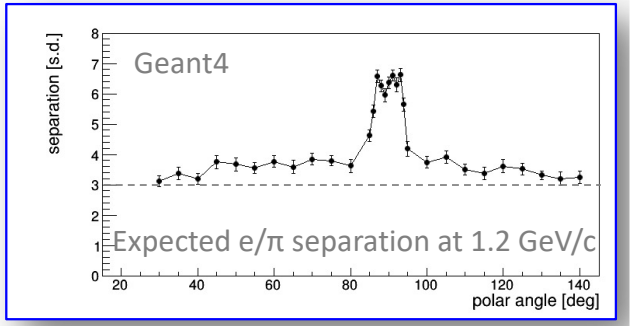
Excellent performance over wide angular range:

- ≥ 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



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)



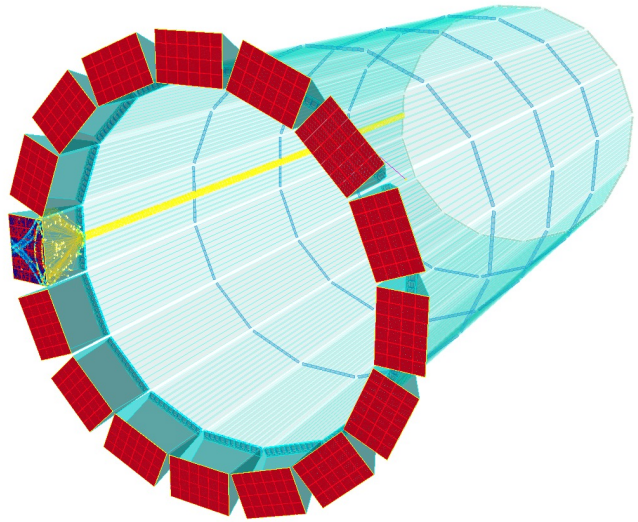
HPDIRC GROUP CONTRIBUTION

Institutions from EOI:

- CUA, GSI, BNL, W&M, USC, SBU, UH, JLab, ODU

Potential contribution to proposal:

- Experience and knowledge from very advanced PANDA Barrel DIRC R&D and recent GlueX DIRC construction, calibration, and operation.
- Supporting integration of hpDIRC to the full detector simulation
- Support for validation of hpDIRC simulation studies
- Work on proposal text



Further R&D:

- hpDIRC EOI team well-positioned to address remaining R&D issues and to work with all interested EIC groups on the hpDIRC simulation, design, construction, and operation
- eRD14 DIRC team plans to continue working on hpDIRC R&D as part of the EIC PID consortium, will submit proposals for continued funding via directed/project R&D and generic R&D funds

HPDIRC QUESTIONS

1. **What is local magnetic field strength at hpDIRC sensors location?**
   - Small-pore MCP-PMTs shown to be OK for fields up to 2 Tesla
     (see recent result from A. Lehmann et al. for 6μm-pore 2'' Photek AuraTek MCP-PMT)
   - If expected fields are much higher: investigate SiPM as alternative
     (dark noise, radiation damage, cooling, annealing, integration issues)
   - Ongoing effort within eRD14, study of LAPPD/commercial MCP-PMTs in high B-fields
   - Have EOI members with SiPM expertise and interest to study SiPM use in hpDIRC
2. **What are the final geometrical and space constrains? (to finalize hpDIRC design)**
   - Barrel length and radius will be optimized for detector integration without impact on hpDIRC PID performance
   - Prism shape can be optimized for magnetic field lines and space needs
3. **What is the need for barrel PID at high momentum, is an additional system planned?**
   - Improved hpDIRC high-momentum PID could be further investigated with some R&D
4. **Investigating option of reusing BaBar DIRC bars:**
   - Effort has to start soon due to expected phasing out of expertise at SLAC