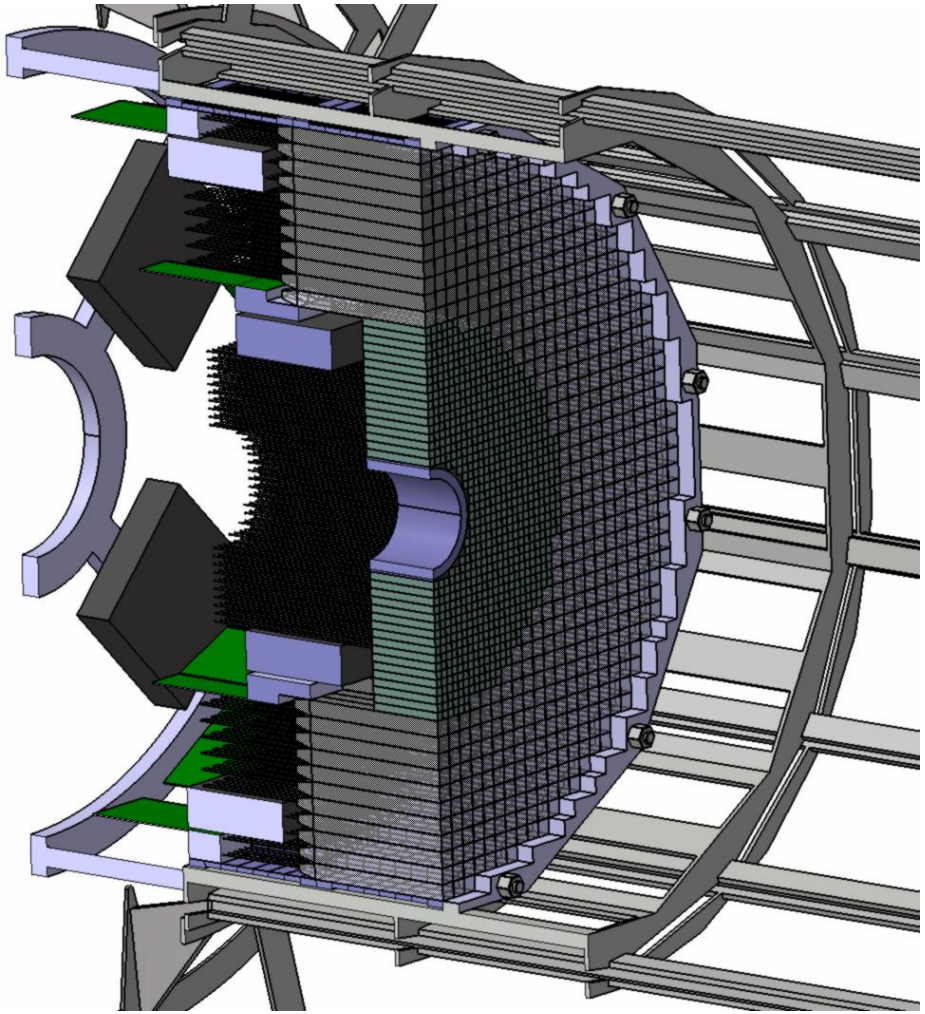


Backward ECAL

Carlos Muñoz Camacho

IJCLab-Orsay, CNRS/IN2P3 (France)

for the EEEMCal consortium:

JAMES MADISON UNIVERSITY

A. ALIKHANYAN National Laboratory

THE CATHOLIC UNIVERSITY OF AMERICA

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

LEHIGH UNIVERSITY

MIT

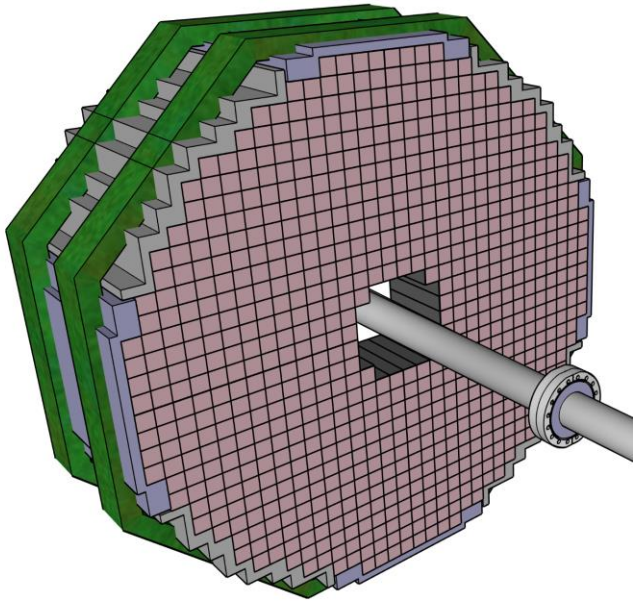
LNS

UK

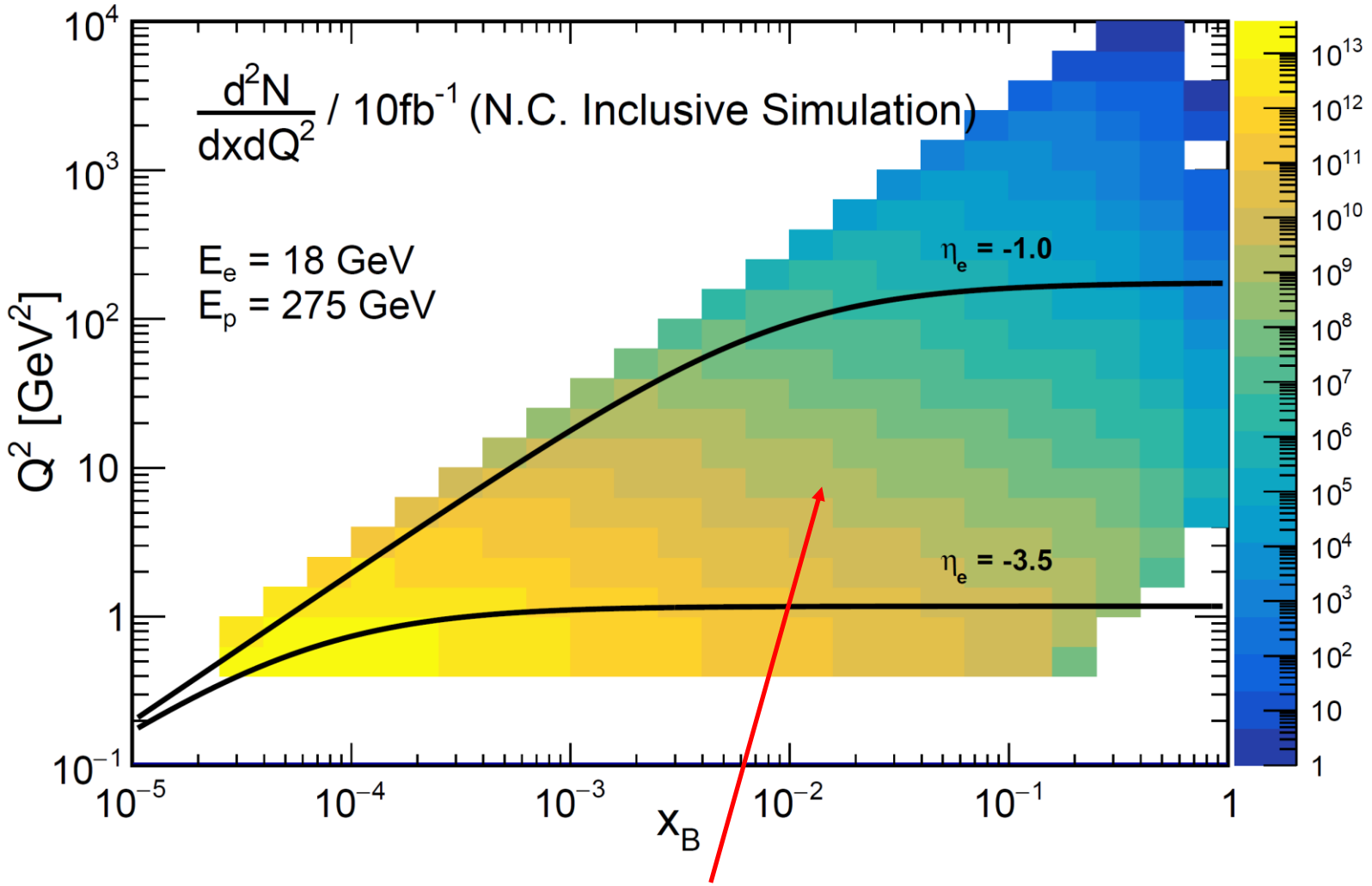
CHARLES UNIVERSITY

FIU FLORIDA INTERNATIONAL UNIVERSITY

Introduction



Anticipated readout with SiPM



Region of physics enabled by the EEEMCal

The EEEMCal consortium

US

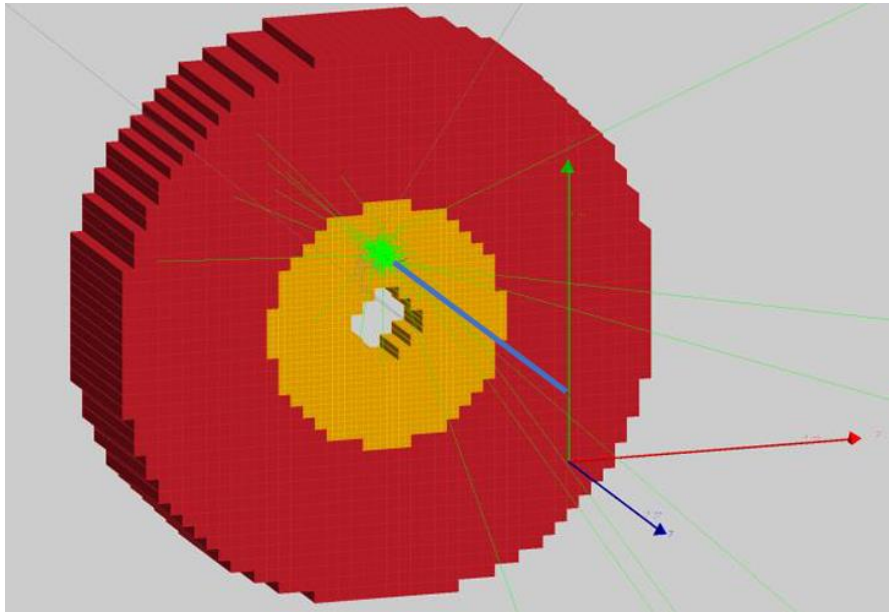
- The Catholic University of America (contact: Tanja Horn, hornt@cua.edu)
- Lehigh University (contact: Rosi Reed, rosijreed@lehigh.edu)
- University of Kentucky (contact: Renee Fatemi, renee.fatemi@uky.edu)
- MIT and MIT-Bates Research and Engineering Center (contact: Richard Milner, milner@mit.edu)
- Florida International University (contact: Lei Guo, leguo@fiu.edu)
- James Madison U. (contact: Gabriel Niculescu, gabriel@jlab.org)

International

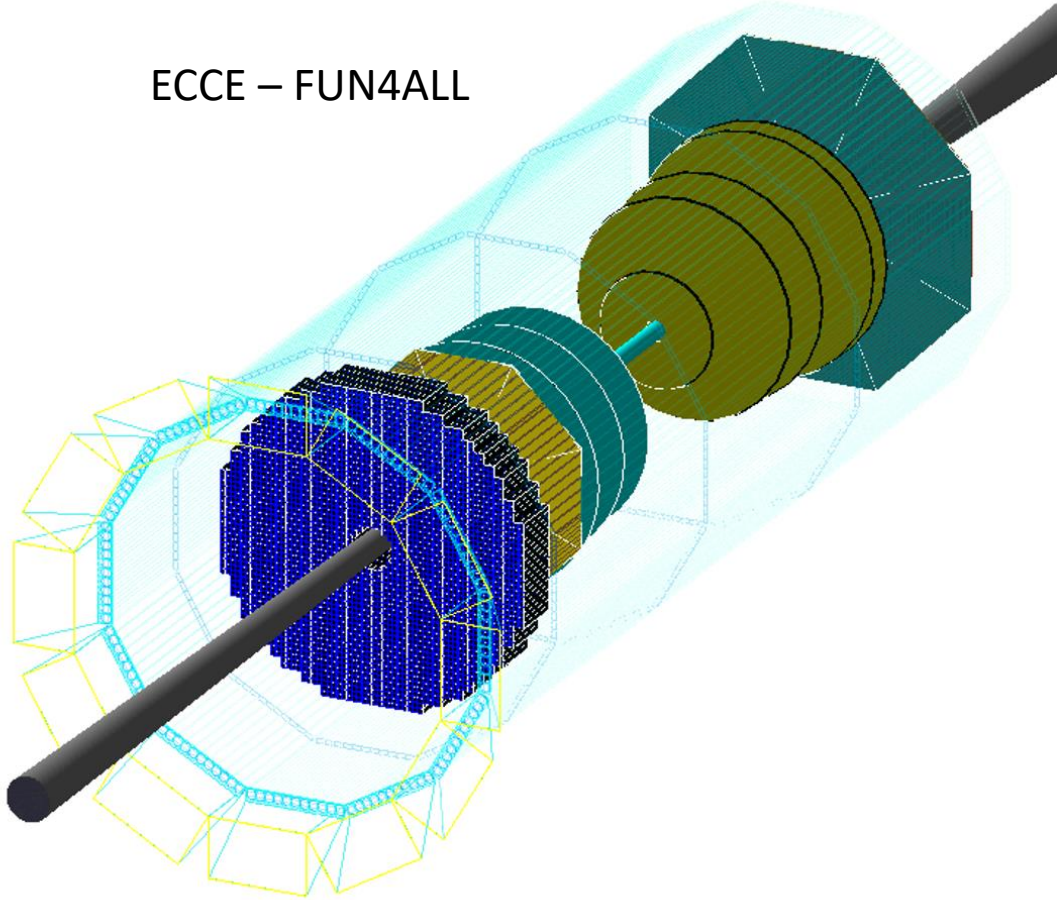
- AANL, Armenia (contact: Ani Aprahamian, aapraham@nd.edu)
- Charles University Prague, Czech Republic (contact: Miroslav Finger, Miroslav.finger@cern.ch)
- IJCLab-Orsay, France (contact: Carlos Munoz-Camacho, munoz@jlab.org)

EEMCal in simulations

ATHENA – DD4HEP



ECCE – FUN4ALL



Physics performance studied in detailed during proposal process and within different software frameworks

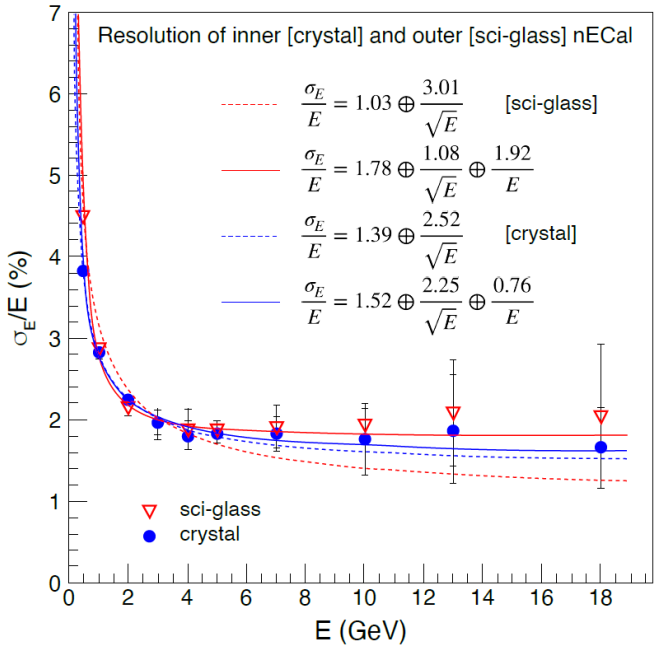
Physics performance

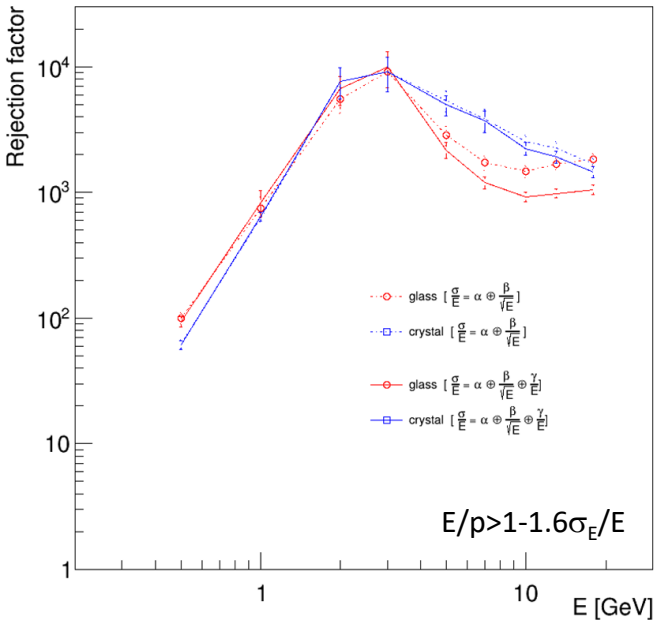
Energy resolution:

Performances well within YR requirements

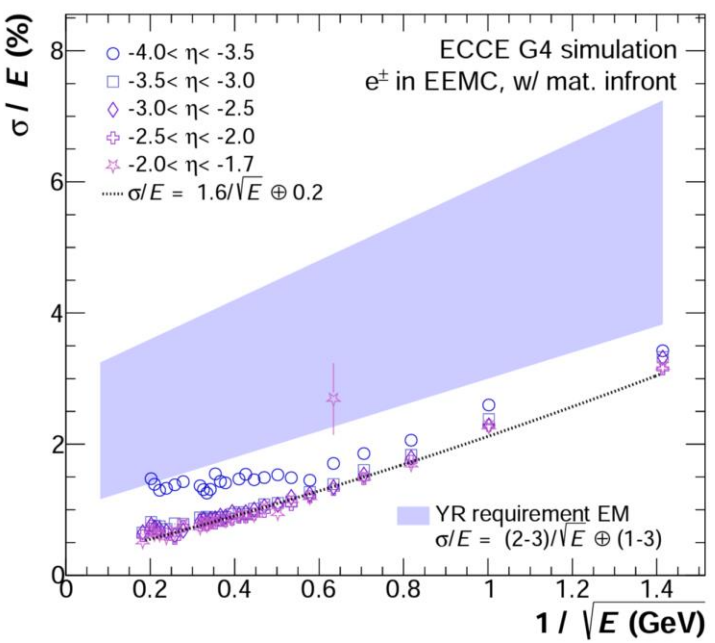
Pion rejection:

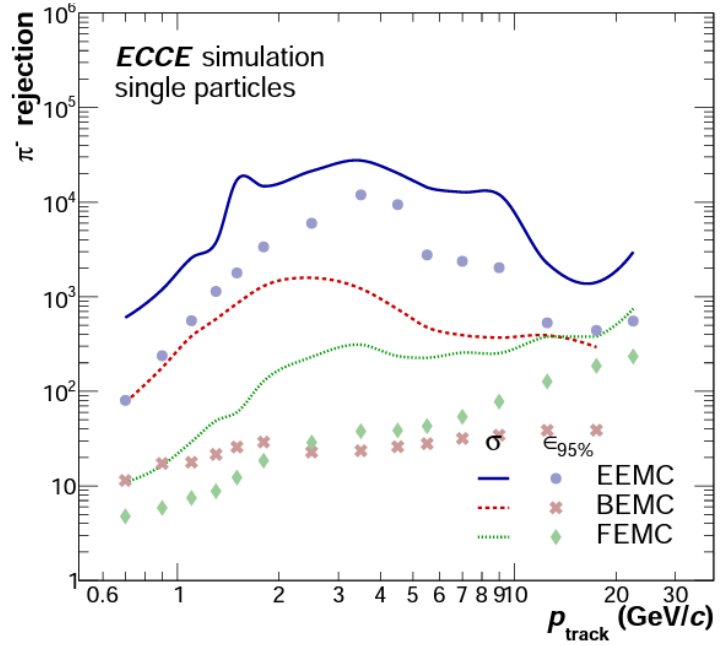
ATHENA



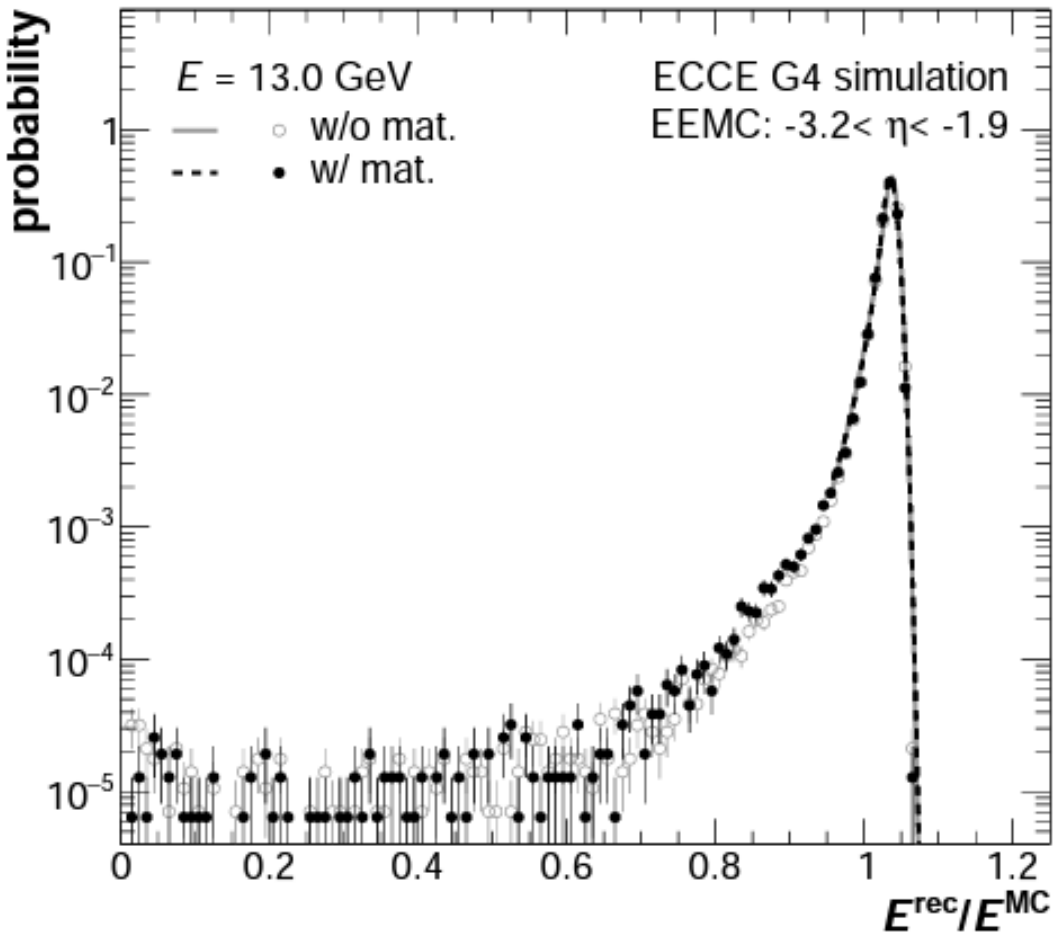


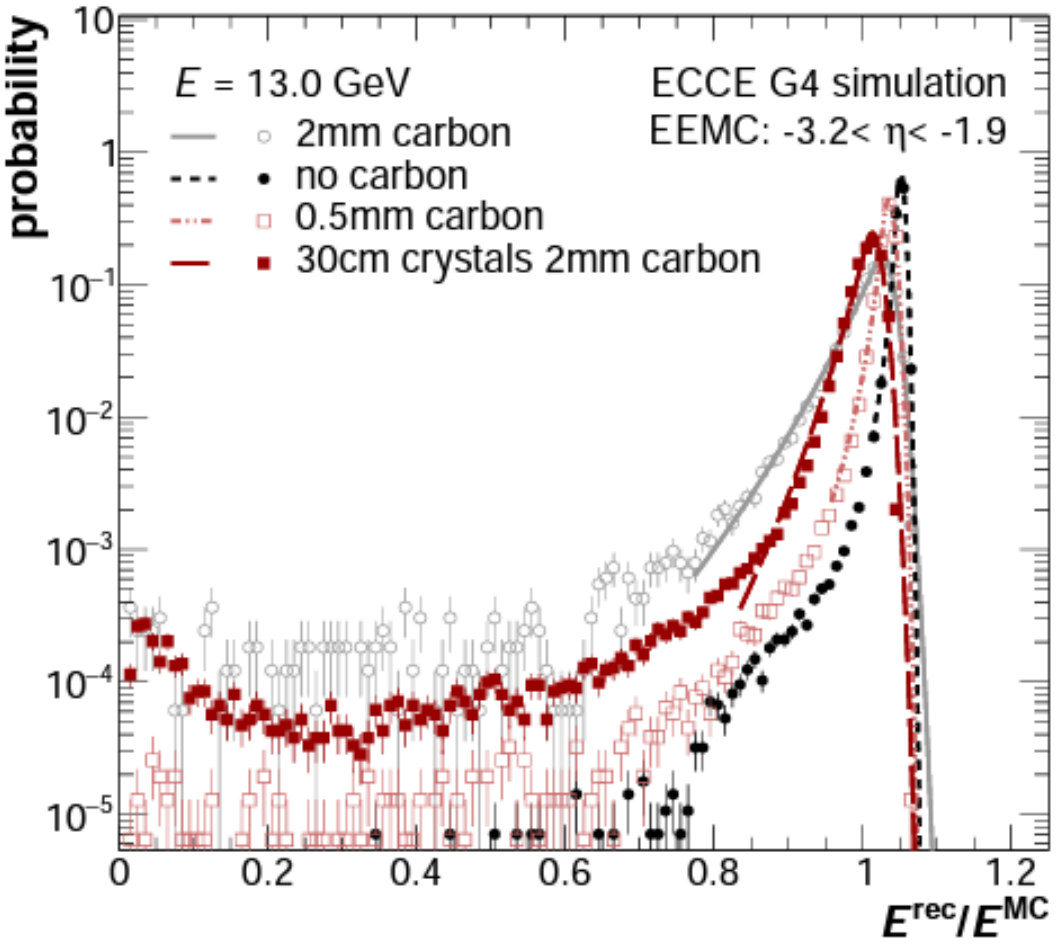
ECCE



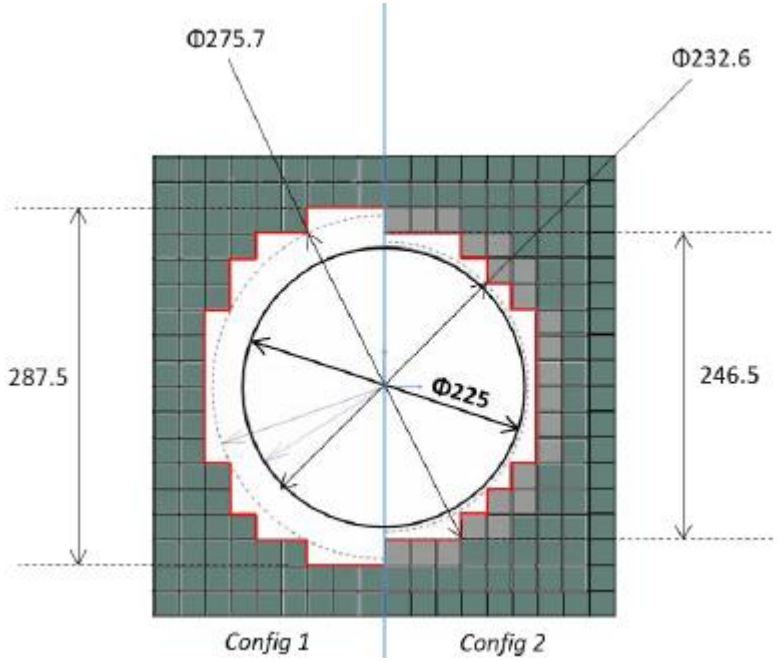


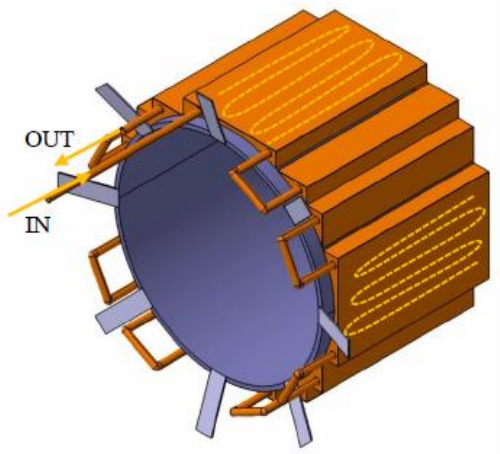
Physics performance: tails…



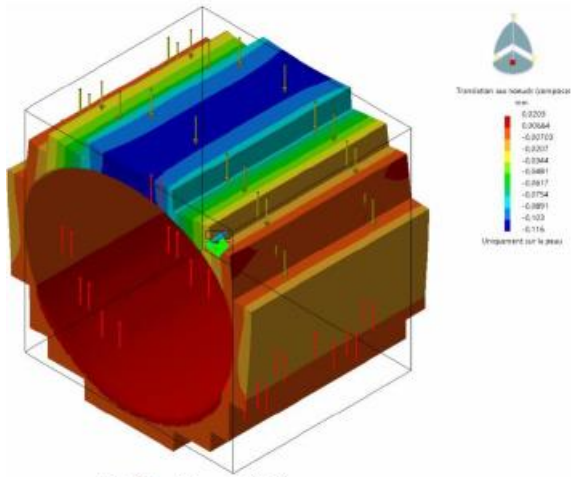


Towards a preliminary technical design

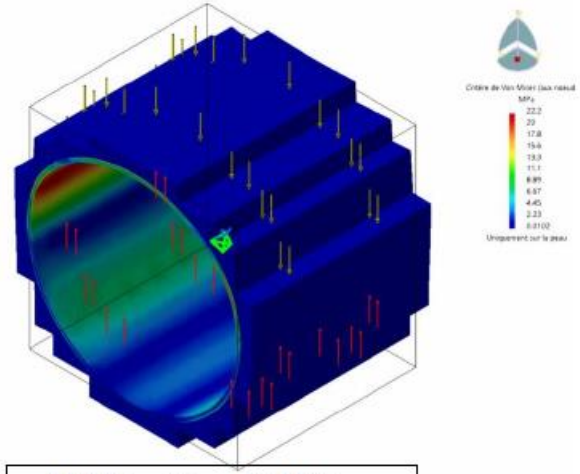




Cooling



Deflection < 0.1 mm

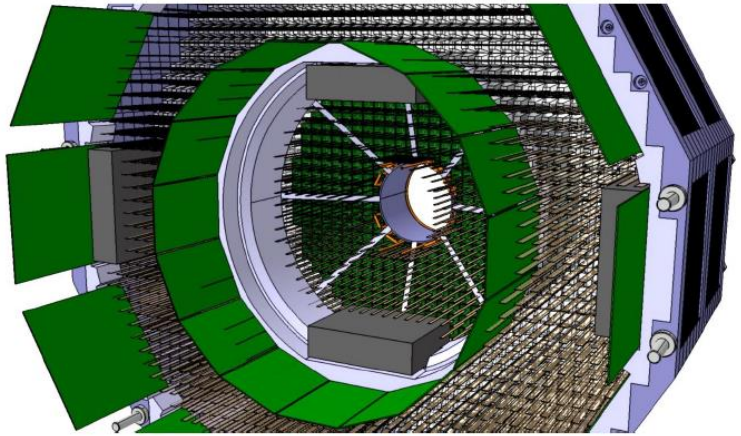


22.2 Mpa < Inox Yield Stress

EEEMCal

(Electron Ion Collider - EIC)

Mechanical design & Integration

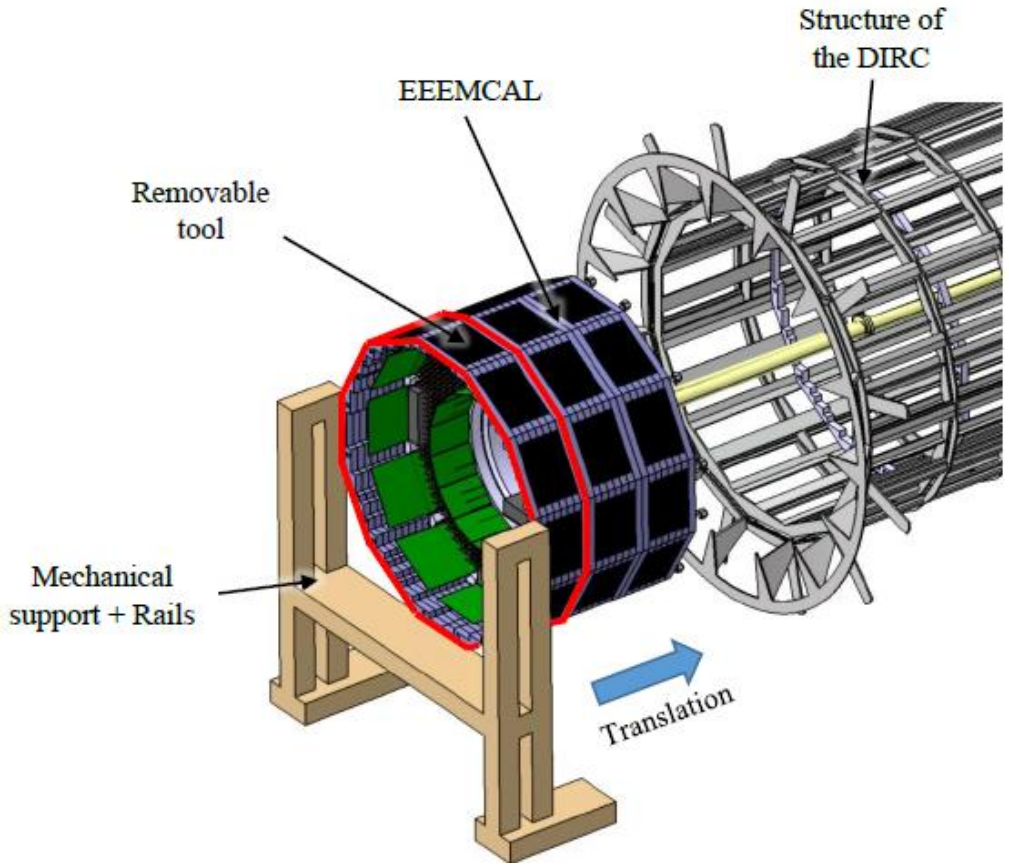


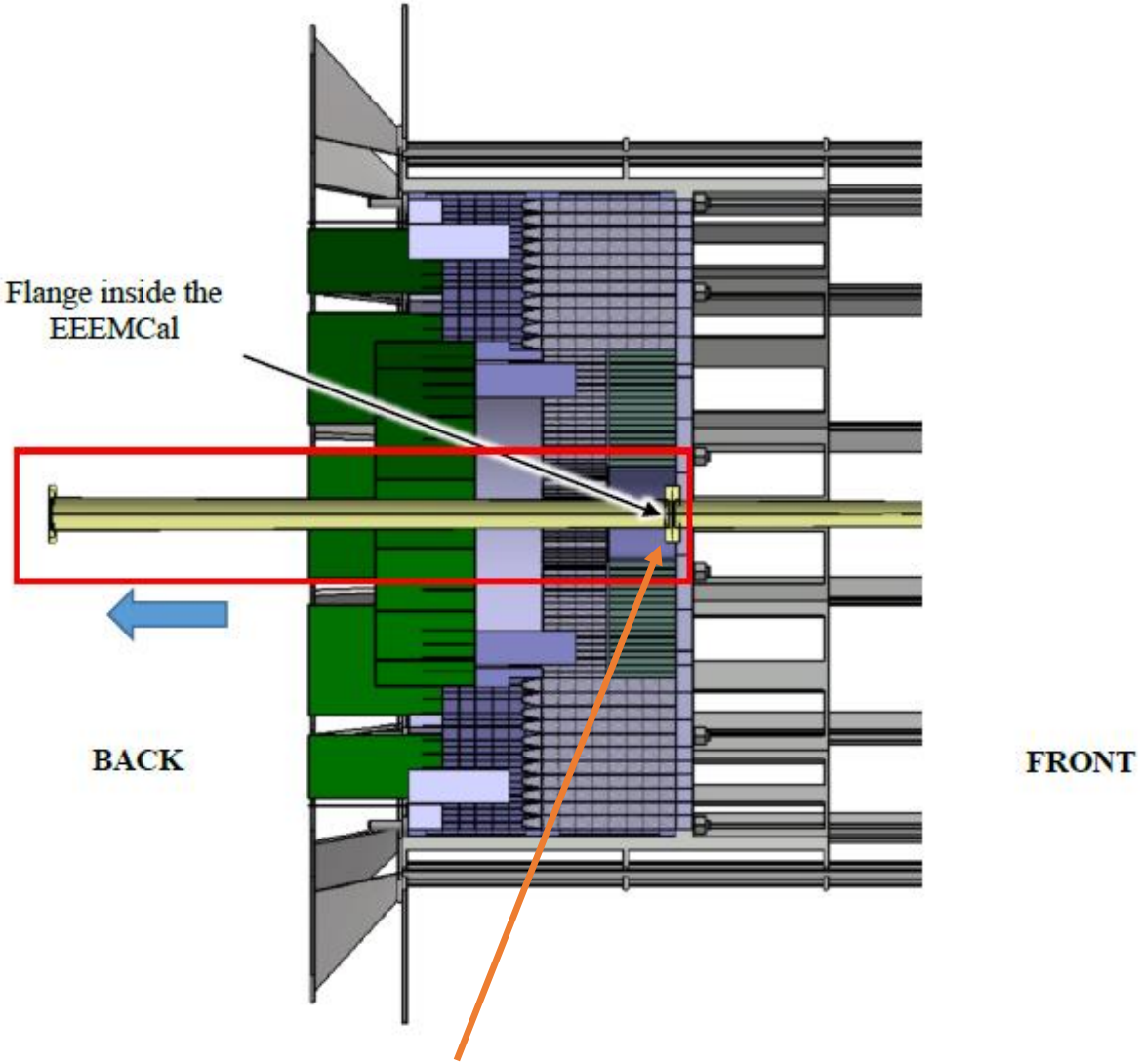
Date: 14/10/2021

Julien BETTANE
(IJCLab/Mechanical department)

Version: 1.2

EEMCal assembly

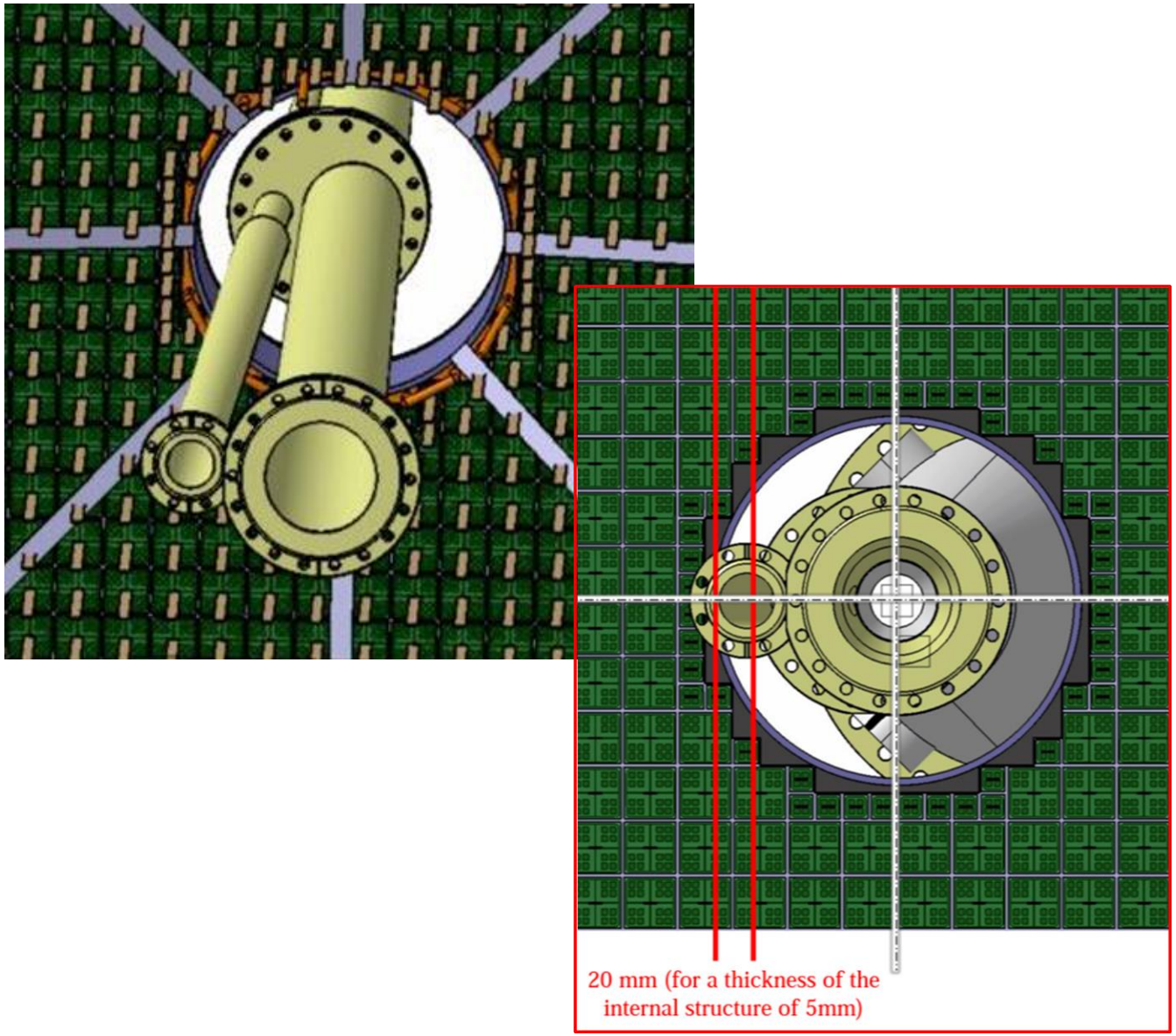


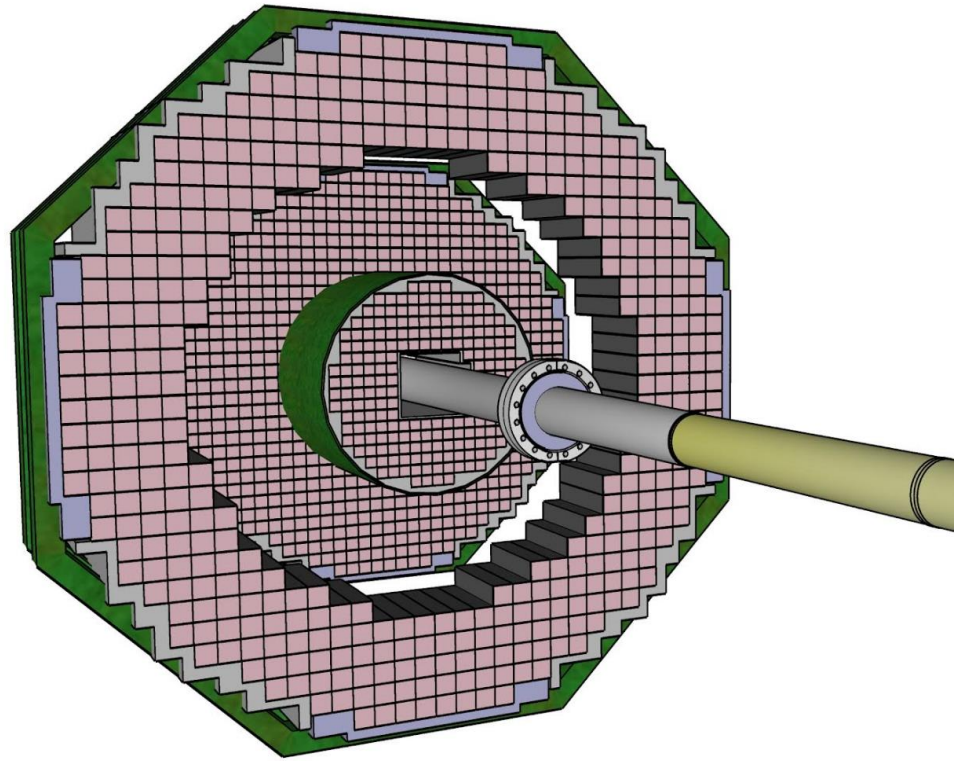


Limitation in pseudorapidity coverage

Ongoing efforts advancing the design
(flange optimization, inner calorimeter, etc)

EEMCal: enhancing pseudorapidity coverage





Other option being explored:
addition of an inner calorimeter attached to the beampipe

EEMCal – R&D plans

Year	Deliverable/Goal	Responsible Team
2021	Determine impact of calorimeter support structure on physics performance, e.g., energy resolution; define	AANL, CUA, IJCLab
2022	Concept design; Force calculations; thermal aspects; prototype tests	IJCLab, MIT
2023	100% design drawings, start of procurement, fabrication	IJCLab, MIT
2024	Procurement, fabrication	IJCLab, MIT
2025	Procurement, fabrication	IJCLab, MIT
2026	Assembly, installation, test	IJCLab, MIT
2027	Assembly, installation, test	IJCLab, MIT

Table 1: Mechanical

Year	Deliverable/Goal	Responsible Team
2021	Final formulation optimization and scale up SciGlass; characterize scintillator material; develop simulations and algorithms to optimize shared coverage; construction and initial commissioning of prototypes for beam test program	AANL, Charles U., CUA, FIU, MIT
2022	Prototype and beam tests; process design verification to scale up	AANL, Charles U., CUA, IJCLab, FIU, Lehigh U., MIT, UKY
2023	Production of scintillator material; Q&A; labeling and selection	AANL, Charles U., CUA, FIU
2024	Production of scintillator material; Q&A; labeling and selection	AANL, Charles U., CUA, FIU
2025	Production of scintillator material; Q&A; labeling and selection	AANL, Charles U., CUA, FIU
2026	Assembly, installation, test	AANL, Charles U., CUA, FIU
2027	Assembly, installation, test	AANL, Charles U., CUA, FIU

Table 2: Scintillator

Year	Deliverable/Goal	Responsible Team
2021	Identify constraints; photodetector and microelectronics development; construct prototypes and initial commissioning	Charles U., IJCLab, MIT, Lehigh U., UKY
2022	Prototype and beam tests	AANL, Charles U., CUA, IJCLab, FIU, Lehigh U., MIT, UKY
2023	Production of photodetector and FEE; Q&A; labeling and selection	IJCLab, Lehigh U., UKY
2024	Production of photodetector and FEE; Q&A; labeling and selection	IJCLab, Lehigh U., UKY
2025	Production of photodetector and FEE; Q&A; labeling and selection	IJCLab, Lehigh U., UKY
2026	Assembly, installation, test	IJCLab, Lehigh U., UKY
2027	Assembly, installation, test	IJCLab, Lehigh U., UKY

Table 3: Readout

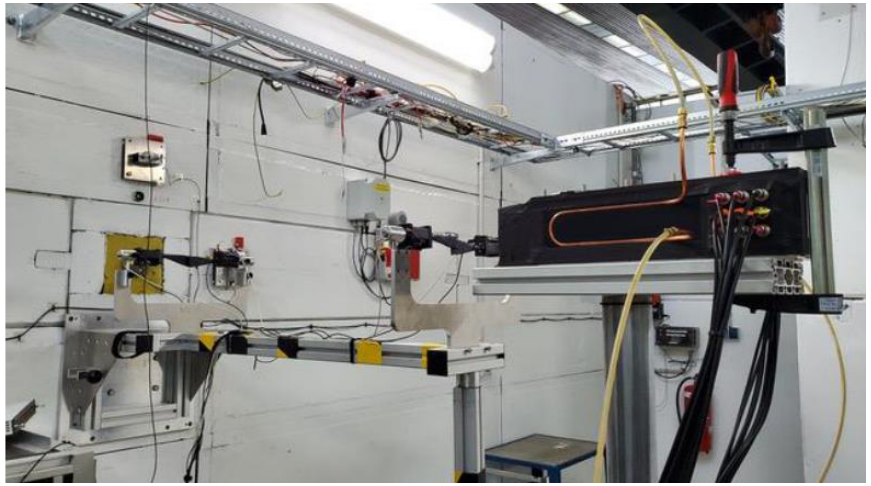
Year	Deliverable/Goal	Responsible Team
2021	Development of simulations, reconstruction and analysis algorithms, artificial intelligence framework for optimization	AANL, FIU, MIT, Lehigh U., UKY
2022	Initial commissioning of simulations and algorithms	AANL, FIU, MIT, Lehigh U., UKY
2023	Testing and optimization of simulations and algorithms; concept	AANL, FIU, MIT, Lehigh U., UKY
2024	Testing and optimization of simulations and algorithms; concept	AANL, FIU, MIT, Lehigh U., UKY
2025	Testing and optimization of simulations and algorithms; concept	AANL, FIU, MIT, Lehigh U., UKY
2026	Installation, test	AANL, FIU, MIT, Lehigh U., UKY
2027	Installation, test	AANL, FIU, MIT, Lehigh U., UKY

Table 4: Software

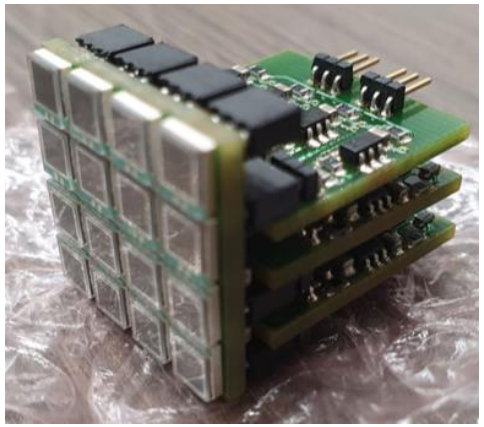
EEMCal – ongoing tests

Goal:

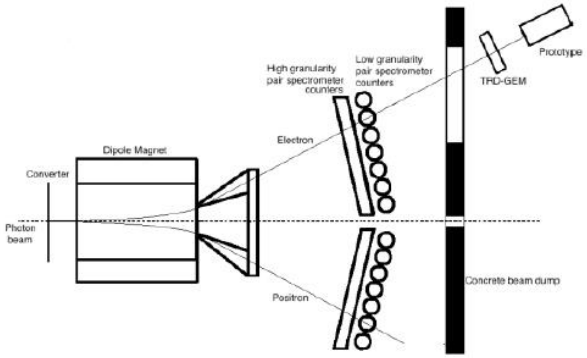
Tests of photosensor readout (SiPM) & triggerless DAQ

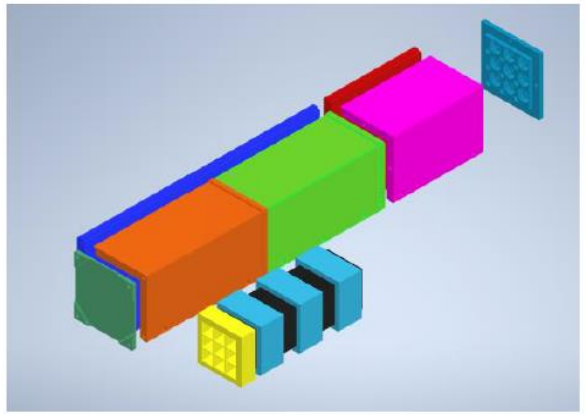


Prototype beam tests at DESY

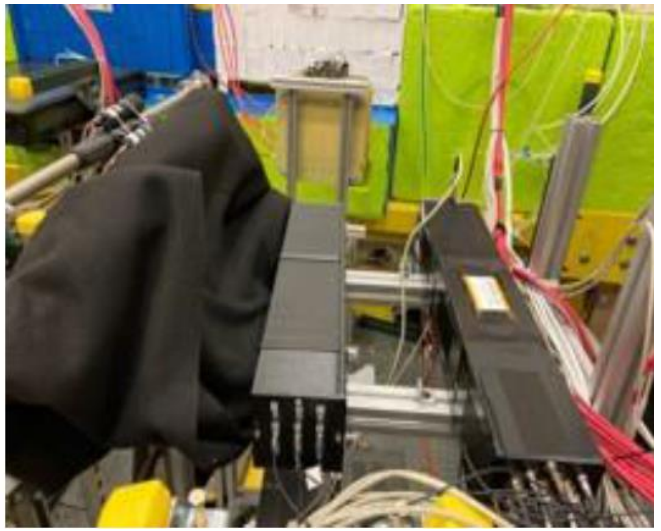


Readout module for 1 crystal with 16 SiPM





Prototype beam tests in Hall D at JLab



Conclusion

- Backward calorimetry is crucial for reconstructing the DIS scattered electron
- Requirements include excellent energy resolution and high pion suppression
- Design choice based on PWO crystals
- The EEEMCal consortium is leading the development, is actively working on advancing the design, and is eager to engage in the next steps towards a TDR and future construction

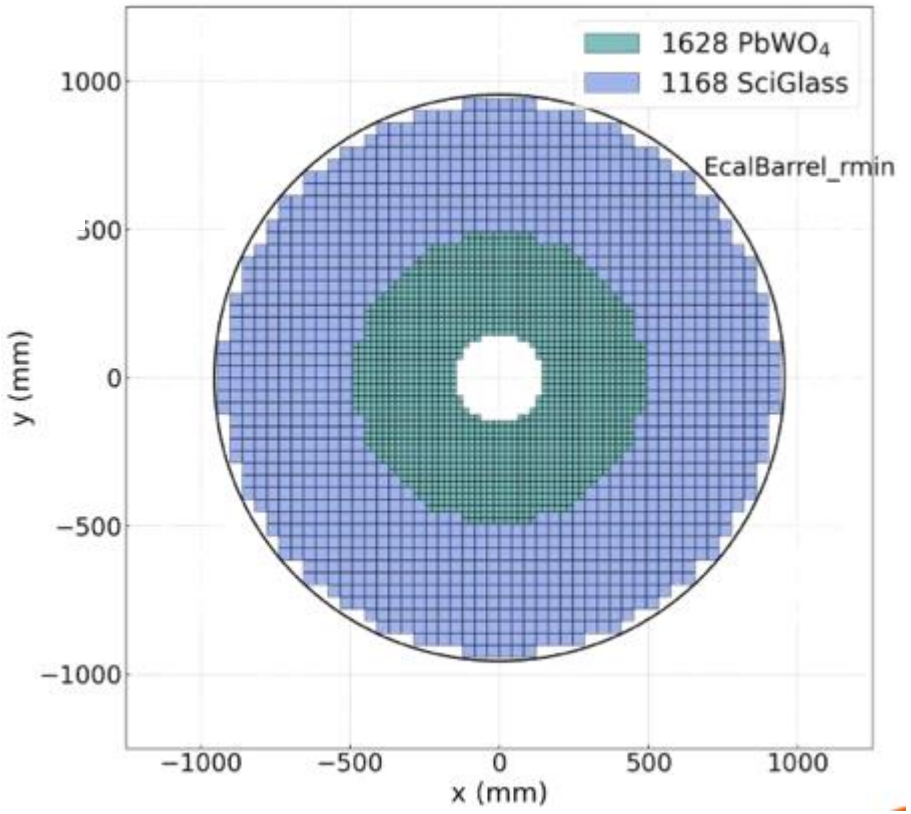
Backup

Introduction

- Design already common between ATHENA and ECCE (based on PWO)

- Only 2 differences:
  - ATHENA, due to its larger size, include a ring of SciGlass at large angle

    Not needed with the size of the BaBar magnet → all PWO



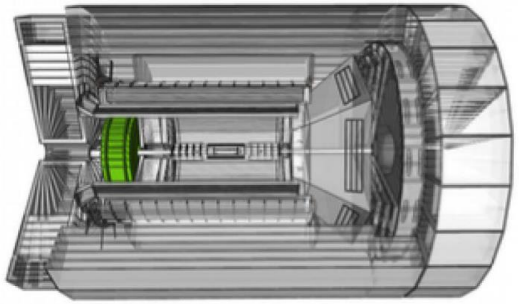
  - HCAL in ATHENA and no HCAL in ECCE (*this will be the focus of a future meeting*)

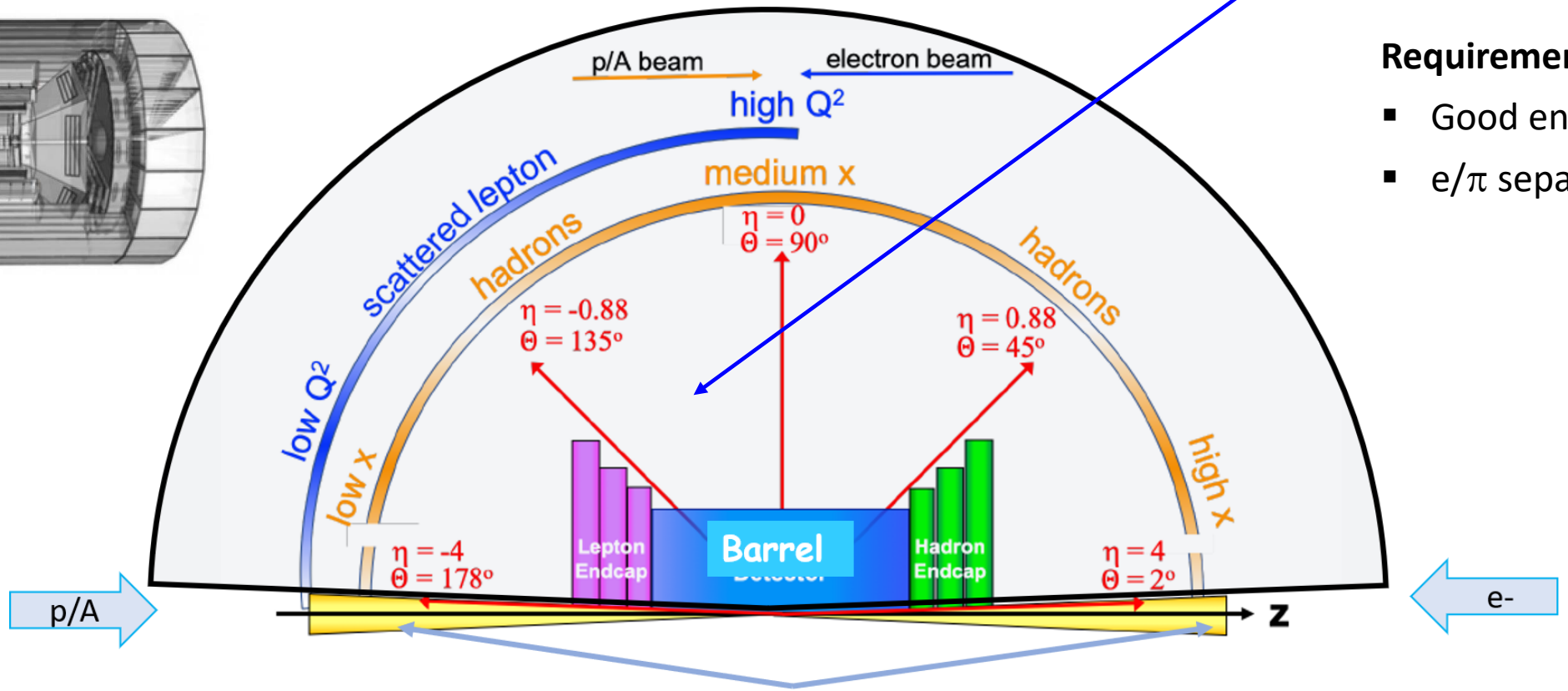
Scattered electrons – special detection requirements

Scattered electrons have to be detected in the Lepton Endcap (-3.5 < η < -1.0)

High resolution important in region -3.5 < η < -2

- Determines electron kinematics
- Physics requires (1-2%)/√E
- Particle E: ~0.02 – 18 GeV





Requirements:

- Good energy resolution
- e/π separation up to 10^{-4}