

1<sup>st</sup> Annual Conference on Electron-Ion Collider Physics in China

# Electromagnetic Calorimeter Research and Development on EicC and H-NS

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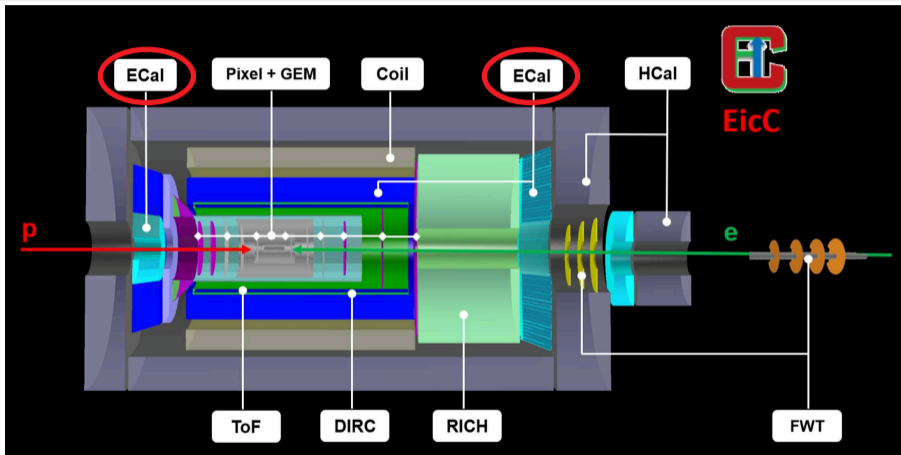
Shandong University (Qingdao)

Apr. 19 - Apr. 22, 2026

# Outline

- 1 Electromagnetic Calorimeter on EicC
- 2 Progress of Hardware Research and Development
- 3 Summary and Outlook

## Spectrometer of EicC



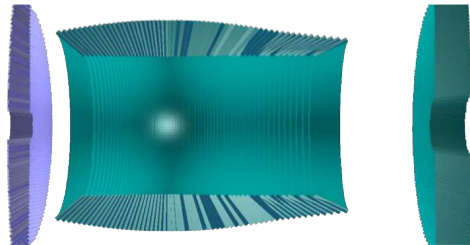
- Baseline design of EicC: **3.5 GeV electron beam** and **20 GeV proton beam**,
- Main parts of the spectrometer: Vertex, Tracking, PID, **ECal**, FWT, ...,

# Electromagnetic Calorimeter at EicC

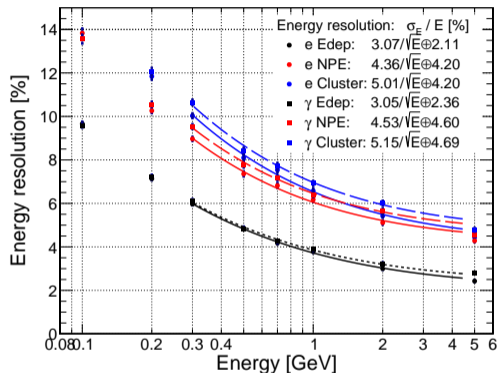
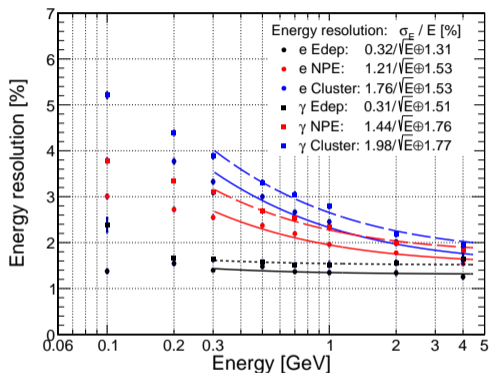
| ECal       | type     | $z/r$ [m] | L [cm]                | coverage [cm]        | pseudorapidity ( $\eta$ )               | tower size [cm $\times$ cm] |
|------------|----------|-----------|-----------------------|----------------------|---|-----------------------------|
| e-Endcap   | CsI      | $z=-1.8$  | 30.0<br>(16.1 $X_0$ ) | $18.0 < r < 153.0$   | (-3.0, -1.0)<br><b>(174.3°, 139.6°)</b> | 4.0 $\times$ 4.0<br>(front) |
| barrel     | Shashlik | $r=0.9$   | 48.0<br>(16 $X_0$ )   | $-105.8 < z < 187.5$ | (-1.0, 1.5)                             | 4.0 $\times$ 4.0<br>(front) |
| ion-Endcap |          | $z=3.0$   |                       | $30.0 < r < 145.0$   | (1.5, 3.0)                              |                             |

- Shashlik and crystal (CsI) designs for different parts,
- Three parts: electron-endcap, central barrel and ion-endcap,
- Angular coverage:  $-3.0 < \eta < 3.0$ .

Design and Performance Simulation of ECal: arXiv:2512.04432

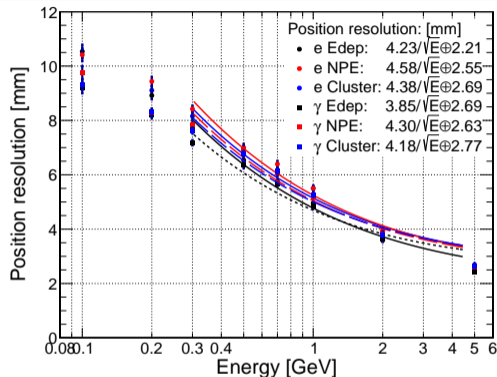
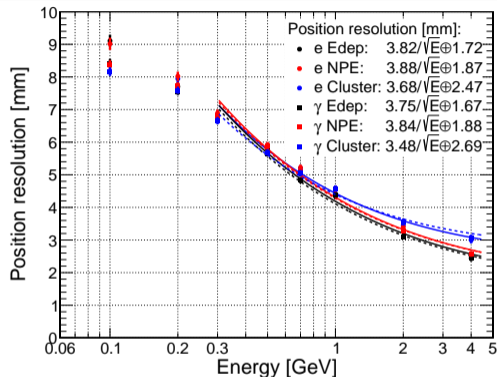


# Energy Resolution from Geant4 Simulations



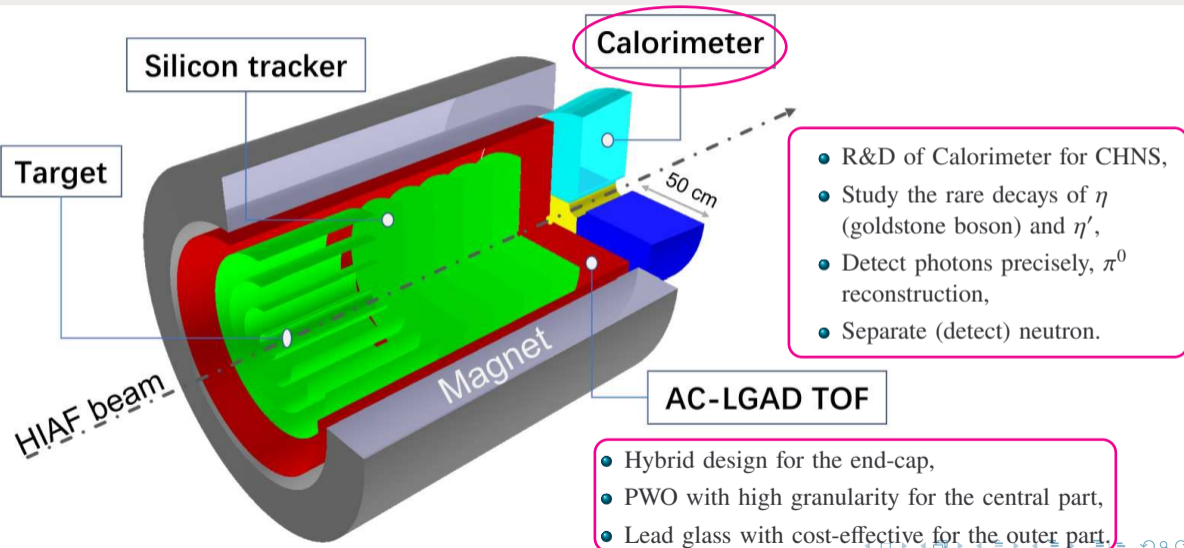
- Energy resolution:  $\sim 2.0\%$  (**pCsI**) and  $\sim 6.0\%$  (**Shashlik**) @ 1.0 GeV,
- Parameterization in the simulations, including photon collection, quantum efficiency, etc.
- Only intrinsic and constant parts considered yet.

# Position Resolution from Geant4 Simulations

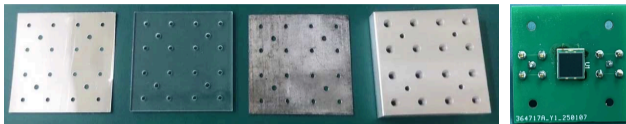


- Position resolution:  $\sim 5$  mm @1.0 GeV for both pCsI and Shashlik,
- Parameterization in the simulations, including photon collection, quantum efficiency, etc.
- Only intrinsic and constant parts considered yet.

# Calorimeter for China Hyper-Nuclear Spectrometer



# Shashlik Module Assembling



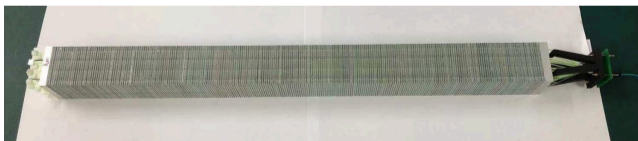
**ESR Scintillator Lead Aluminum SiPM**



**Assembling**



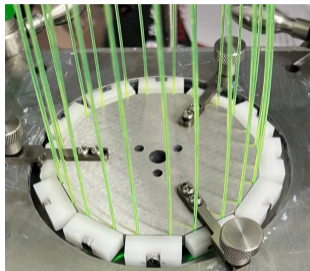
**Add Pressure**



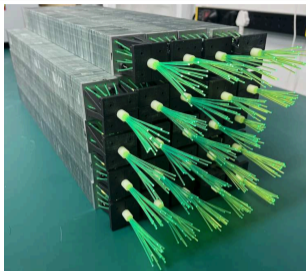
**Shashlik Module**

- The Shashlik module is assembled in the lab,
- 25 Shashlik modules assembled for the prototype.

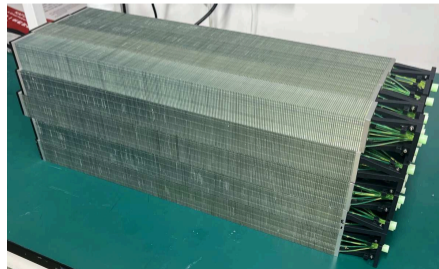
# Shashlik Prototype Assembling



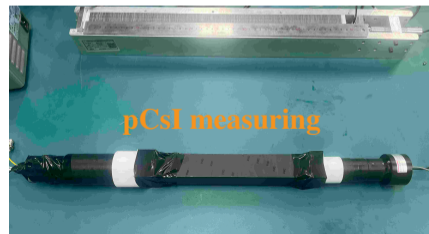
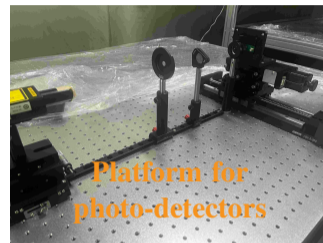
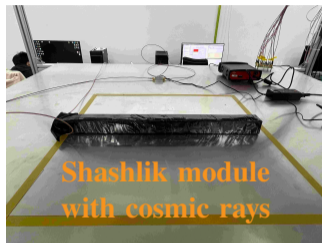
Fibers Polishing



Bundling Fibers

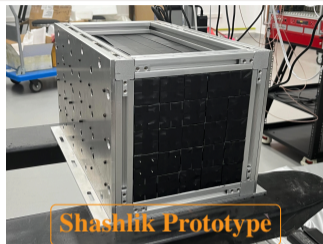


# Laboratory for Detector R&D

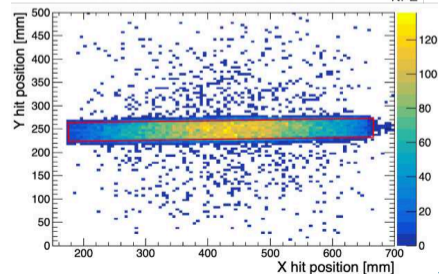
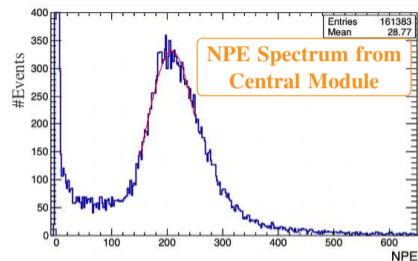
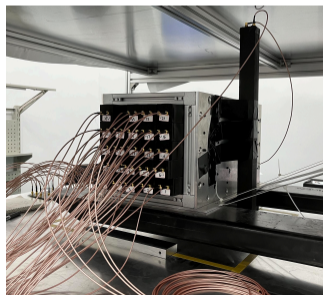


# Test the Prototype with Cosmic Rays

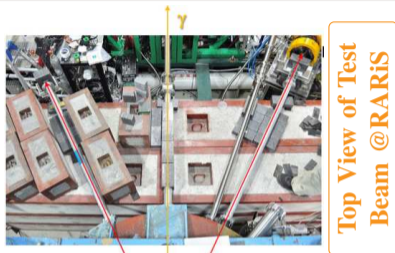
Cosmic Ray Platform



Shashlik Prototype



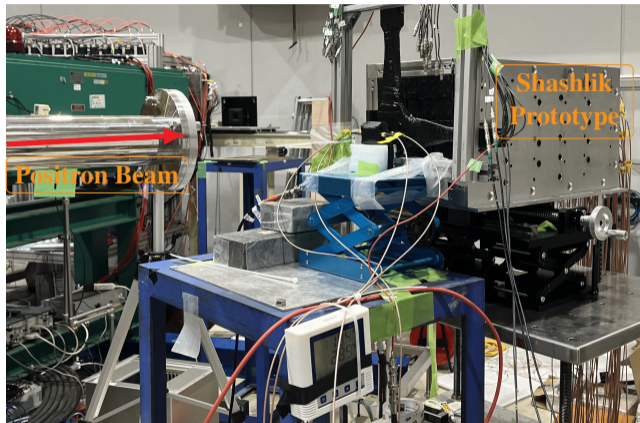
# Test the Prototype with Positron Test Beam at RARiS



Top View of Test Beam @RARiS



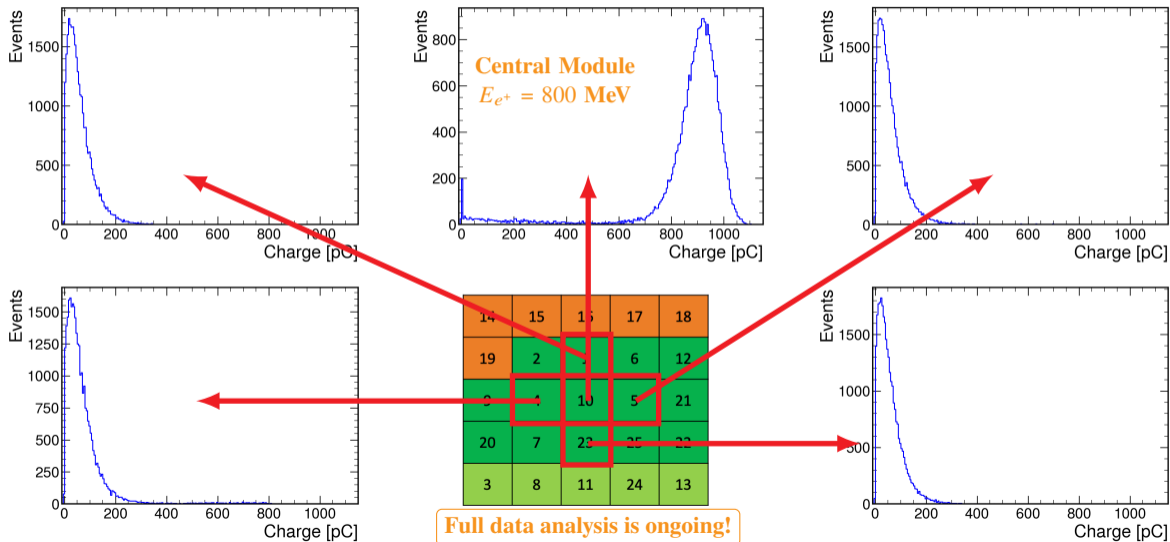
Dipole Magnet



Beam Test at RARiS

Positron Beam: 50 - 822 MeV

# Preliminary Results from Beam Test – Charge Collected by SiPM



## Summary and Outlook

- Two types of electromagnetic calorimeter are designed for the EicC experiment,
- Sampling EMC with **Shashlik** design for the **central barrel** and **ion-endcap**,
- Homogeneous EMC with **pCsI crystal** for the **electron-endcap**,
- Hybrid EMC design including **PWO crystal** for H-NS is considered,
- **Shashlik 5×5 array prototype** is assembled and its performance is tested with **positron beam**: energy and position scan,
- The results will be reported soon with full data analysis,
- A **prototype of pCsI crystal** is ongoing.

*Thanks!*

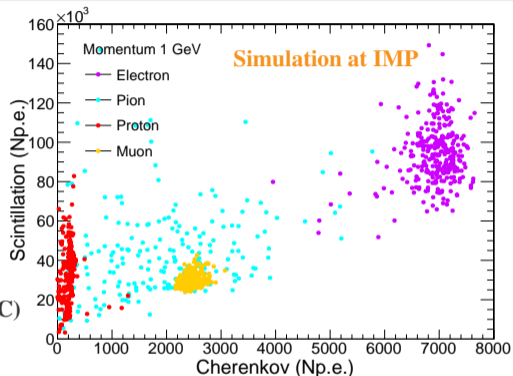
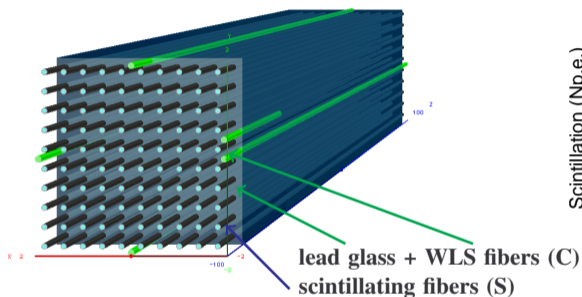
Welcome to join:  
[dxlin@impcas.ac.cn](mailto:dxlin@impcas.ac.cn)



# Backup

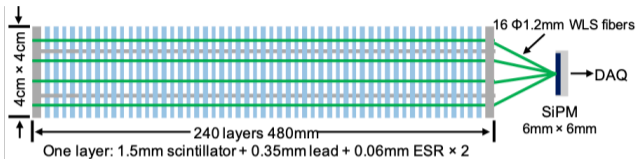
# ADRIANO Calorimeter

Instruments 8(4) (2024) 49.



- A Dual Readout Integrally Active Non-segmented Option (ADRIANO), a semi-homogeneous integrally active calorimeter,
- Two components of optical output, Scintillation and Cherenkov, for energy measurement and PID,
- As an Electromagnetic and Hadronic calorimeter at the same time, flexible configuration.

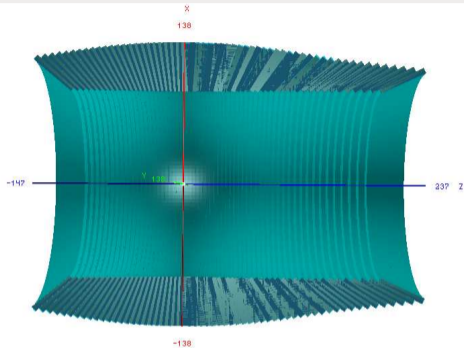
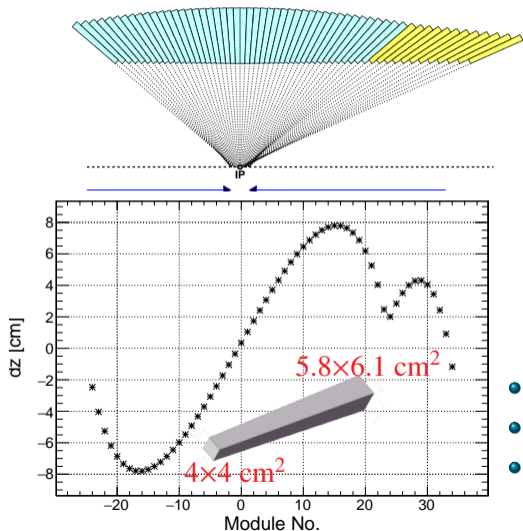
# Modules of Shashlik and CsI Crystal



- Shashlik module for the central barrel and hadron-forward endcap,
- Each layer contains: 0.35 mm lead, 1.50 mm scintillator and 0.06 $\times$ 2 ESR,
- Wavelength shift fibers (16) to collect scintillation light,
- 240 layers (480 mm) corresponding with 16 $X_0$  radiation length.

- Pure Cesium Iodide (CsI) module for the electron-forward endcap,
- Homogeneous material is sensitive material as well as absorber,
- Scintillation light collected with UV-sensitive APD at one end,
- Length 30 cm is equivalent to 16 $X_0$  radiation length.

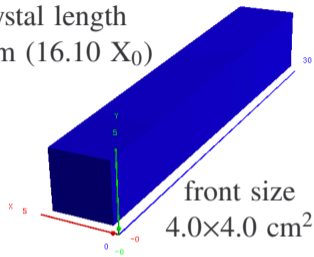
# Design of the Barrel



- Trapezoid module roughly towards the interaction point (IP),
- Two groups of modules with different shape along z-axis,
- Around 8178 modules for the barrel ( $58 \times 141$ ).

## Configuration of the Endcap

crystal length  
30 cm ( $16.10 X_0$ )



rear size  
 $4.67 \times 4.67 \text{ cm}^2$

front size  
 $4.0 \times 4.0 \text{ cm}^2$

- Coverage of pseudo-rapidity:  $-3.0 < \eta < -1.0$ ,
- Distance from the front plane to IP: **1.8 m**,
- total crystals:  $\sim 3900$  modules,
- Crystal is wrapped with Tyvek,
- Similar for the ion-endcap with Shashlik modules.

