4-year overview

Huan Zhong Huang
For UCLA Experimental Group

January 10, 2025

Groups members: current and past

Graduate students

current: **Thomas Marshall, Xiatong Wu, Yunshan Cheng, Aditya Dash & Maria Sergeeva**

previous (& current location): **Zhiwan Xu (LANL)**

Postdocs

current:

previous (& current location): **Zhongling Ji (Syracuse/Jlab)**

Undergrads

current: **Nihal Gozlukluoglu Karakus, Lyra Yi**

previous (& current location):

Staff: **Oleg Tsai, Gang Wang and Huan Zhong Huang**

List main accomplishments in past 4 years

- Spearhead design of fEMcal for ePIC. From conceptual to final design review scheduled in spring 2025.
- Coordinated efforts in developing TDR, with Version 1 released to ePIC collaboration in December 2024.
- Carry out the eRD106 to finalize the design of fEMCal, eRD106 will be completed in Feb 2025.
- Coordinated successful final design reviews for SiPMs and scintillation fibers (CD3A, CD3B).
- Coordinated efforts in developing calorimetry concepts for ATHENA detector.
- Developed the GEANT description of the fEMCal detector

Detector construction plans at campus/lab

- **UCLA group will coordinate overall efforts to build fEMCal.**
- **UCLA is a construction site to receive and certify all scintillation fibers for fEMCal.**
- **UCLA electronics shop will produce all SiPM boards.**
- **UCLA students/staff will test/calibrate all SiPM boards.**
- **UCLA staff will oversee installation/integration and commissioning of fEMCal in ePIC**

Key roles in ePIC

- **Huan Z. Huang and Oleg Tsai are serving as DSLs for fEMCal.**
- **O.Tsai is serving as technical coordinator for fEMCal.**
- **O.Tsai is serving as co-convener for ePIC calorimetry WG.**

Previously

- **O.Tsai served as co-convener of joint ECCE and ATHENA calorimetry WG.**
- **O.Tsai served as co-convener of ATHENA calorimetry WG.**

Key non-EIC accomplishments

Worked on sPHENIX EMC construction

Participate in the sPHENIX EMC calibration effort

STAR

- CME upper limit from isobar collisions
- CME related charge separation from BES II data
- EM field effect on directed flow of charged particles
- CMW searches and background studies
- Hyperon directed flow and hyperon-K correlations

sPHENIX

- Heavy flavor physics program

3-4 EIC highlights with pictures (multiple slides)

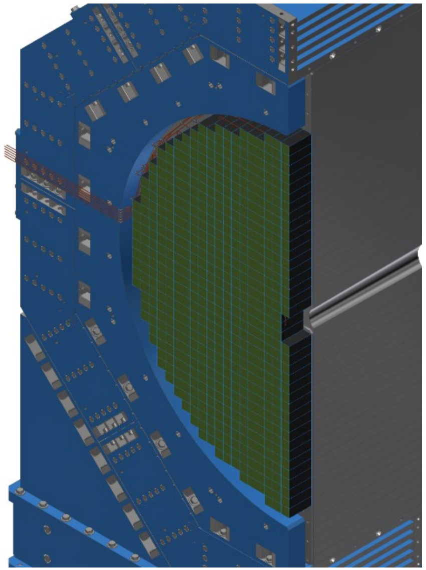
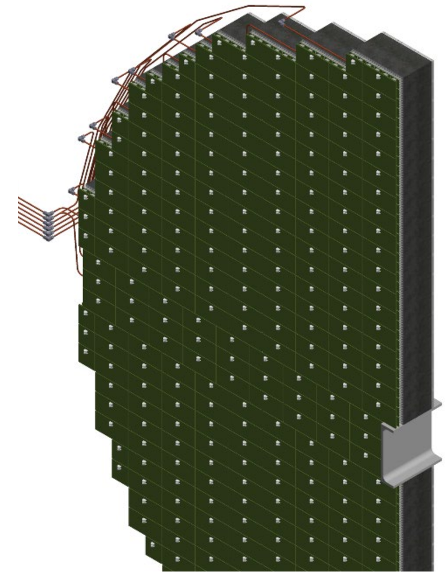


Table 8.44: Some requirements on performance of fEMCal and its parameters

Parameter	Requirements	Comments
Geometrical Acceptance	$1.4 \lesssim \eta \lesssim 3.9$	$R_{out} \sim 190$ cm, $Z_{frontface} \sim 341$ cm Hole for the beam pipe $30 \times 30\ cm^2$
Integration envelope	R_{max}=205 cm, Depth = 27 cm	
E_{min} in a single tower	15 MeV	Minimal shower energy 50 MeV
E_{max} in a single tower	100 GeV	18×275 GeV, ep
Maximum rate in a single tower	10 kHz	E_{thr}=15 MeV, 10×275 GeV ep 500 kHz collision rate
Radiation doses	15 kRad	Integrated over 10 years
Neutron fluxes	4×10^{11} n/cm^2	1 MeV eq, integrated over 10 years
Energy resolution	$\lesssim 12\%/\sqrt{E} \oplus (2)\%$	Verified in the test beams
γ/π^0 separation	up to 50 GeV	$\sim$ 5% mis-identification at 50 GeV
Depth	23 X_0	Minimize leakages
Detector parameters	**Units**	**Comments**
X_0, R_m	7 mm, 19 mm	Rad. length, Moliere radius
f_{samp}	2%	e/h $\simeq$1 above 10 GeV
Scintillating Fibers	⌀ 0.47 mm	Single clad sc. fibers
Light yield	$\sim$ 1600 pixels/GeV	Test beam results.
Transverse size of tower	2.5 cm $\times$ 2.5 cm	Matches R_m
Transverse size of installation block	10 cm $\times$ 10 cm	Block of 16 towers
Total number of towers	18320	
Photodetector	S14160-6015PS	Four 6×6 mm^2 SiPMs per tower 15 um pixels size
Monitoring system	Blue LED	LED integrated on SiPM board. One LED per four towers



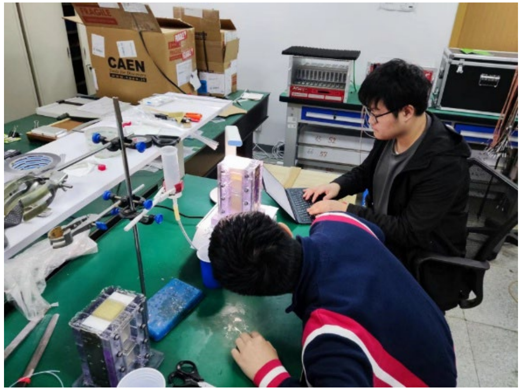
In preparation for Final Design Review, detailed detector engineering modeling. Table with detector parameters from TDR.

Forward EMCal progress 2023-2024

- Mounting scheme on fHCal designed.
- Structural Tests completed

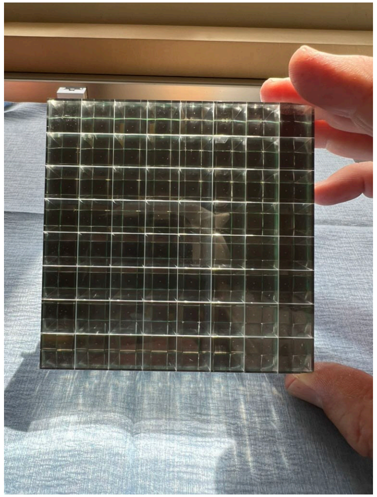
- Installation tooling designed
- Installation procedures verified

- Prototyping of readout integration is in progress

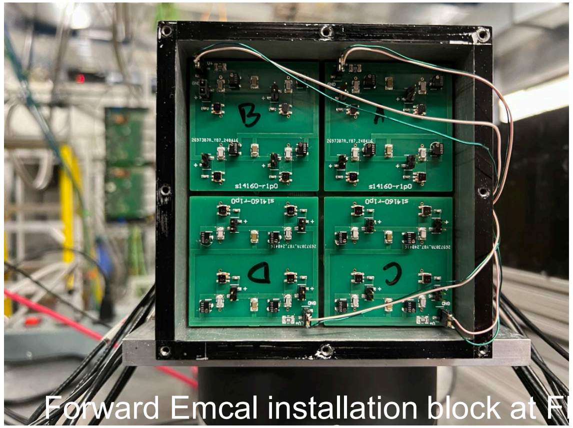


- Refining of production methods is in progress

Major forward EMCal progress in 2024



- New highly efficient and compact light guide designed.
- Production method established.

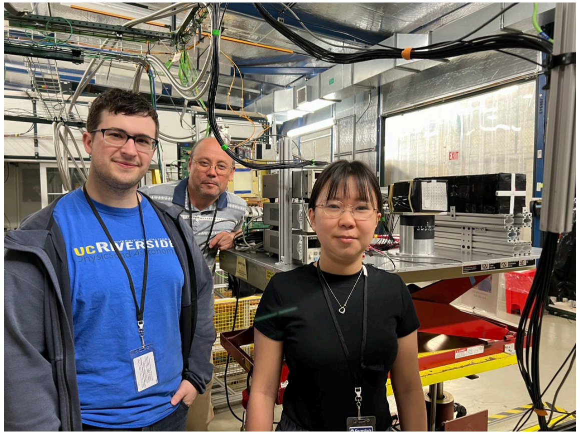


Test Run at FNAL completed (06/13/2024)
Goals to measure:
- Absolute Light Yield
- Uniformities of response

Data analysis is in progress.

Readout:

- SiPM board designed and ~ready to produce prototypes
- FEB layout in progress, ~20% complete
- FEB - RDO interface scheme defined.
- Power cable group definitions & rack space requirements in progress.
- Initial round of COTS DC/DC and SIPM radiation testing completed (UC Davis 64 MeV protons, May 2024)



UC EIC Students at FNAL.

Leveraged funding (grants due to MRPI project)

eRD106 ~ $77k

DOE support of 50% post-doc for three years ~ $135k

EIC support of UCLA staff ~ $100k

Publications in past 4 years

- **Science Requirements and Detector Concepts for the Electron-Ion Collider: EIC Yellow Report. Nucl. Phys. A 1026 (2022) 122447**

- **ATHENA Detector Proposal -- A Totally Hermetic Electron Nucleus Apparatus proposed for IP6 at the Electron-Ion Collider. JINST 17 (2022) 10, P10019**

Future plans in the EIC program

- Finalize design of the fEMCal, produce TDR.
- Lead the fEMCal team through series of reviews toward construction phase.
- Complete the construction/installation/commissioning of the detector.

Work on simulations of physics measurements using the forward EMCal+Hcal+Tracking

Topics: forward jets/heavy flavor physics

3D image of the nucleon and nuclei

Backup