

EEEMCAL R&D Outline – DRAFT

The Electron-Endcap Electromagnetic Calorimeter (EEEmCal) will enable unique detector capabilities for scattered electron and final-state photon detection crucial at the EIC. For CY 2021/22 there is a near term need for research in the following four areas:

- **Support structure and resolution:** the impact of the mechanical structure and module geometry on the detector performance has to be defined. This will form the basis for concept/design for the EMCal frame including temperature/motion control and light monitoring/curing systems.
- **Scintillator material performance:** scintillator material has to be characterized and its performance as EMCal detector verified. These efforts will form the basis for active materials for the EMCal and process design verification to scale up.
- **Photodetector and electronics:** the constraints and requirements for the readout of the EMCal have to be documented and photodetector and microelectronics solutions have to be developed.
- **Software:** Simulations, algorithms, and an artificial intelligence framework for design optimization have to be developed. These efforts will provide the framework for detector design.

The EEEMCal team will address this need taking advantage of unique capabilities at our member institutions and leveraging local resources (i.e., the machine shops at MIT/MIT Research and Engineering Center, the crystal and glass fabrication facilities at Crytur and the Vitreous State Lab/CUA, ASIC development at IJCLab, etc.). The deliverables and goals for each year are listed in Tables 1-4. The tables also include the major activities anticipated in the following years for successful detector construction, assembly, installation, and testing, consistent with the EIC Project timescale. The EEEMCal team expects to collaborate closely with the EIC Project Management and technical departments at both BNL and Jefferson Lab.

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