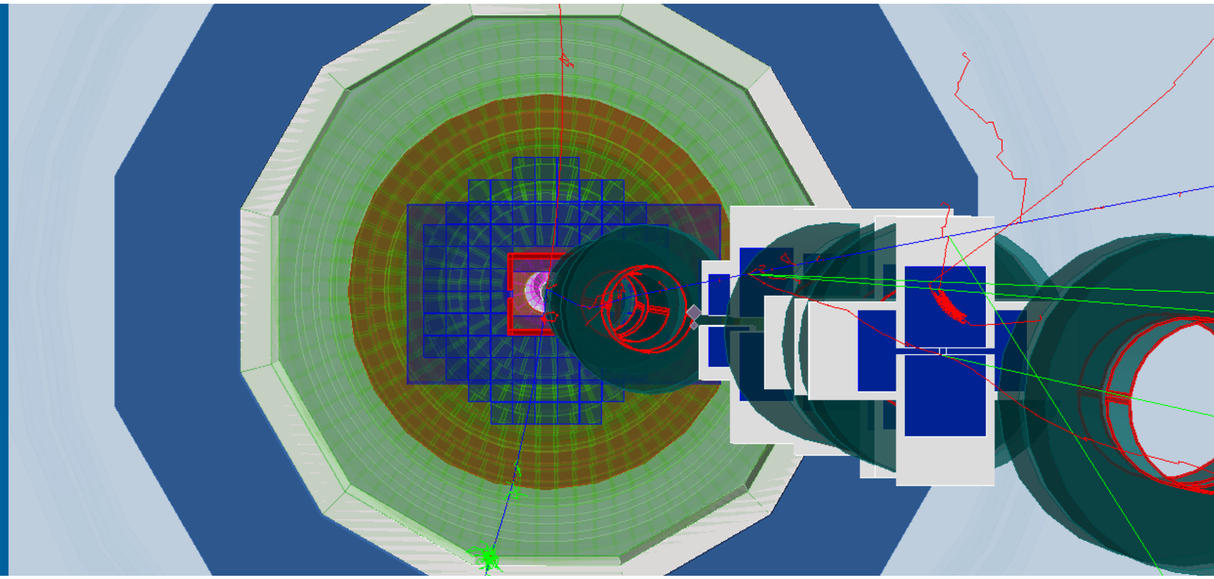
Argonne NATIONAL LABORATORY

EARLY IDEAS FOR EOI FROM ARGONNE NATIONAL LABORATORY



COREY ADAMS (CELS/PHY)
WHITNEY ARMSTRONG (PHY)
JOHN ARRINGTON (PHY)
MANOJ BHANUDAS (PHY/HEP)
IAN CLOET (PHY)
ADAM FREESE (PHY)
KAWTAR HAFIDI (PSE)
SYLVESTER JOOSTEN (PHY)
JIHEE KIM (PHY)
KIMINAD MAMO (PHY)
JOSE MARTINEZ-MARIN (PHY)
JESSICA METCALFE (HEP)
ZEIN-EDDINE MEZIANI (PHY)
BRAHIM MUSTAPHA (PHY)
VAL NOVOSAD (MSD)
CHAO PENG (PHY)
TOM POLAKOVIC (PHY/MSD)
PAUL REIMER (PHY)
JUNQI XIE (PHY)
…AND MANY OTHERS

U.S. DEPARTMENT OF ENERGY
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EICUG Meeting, July 2020

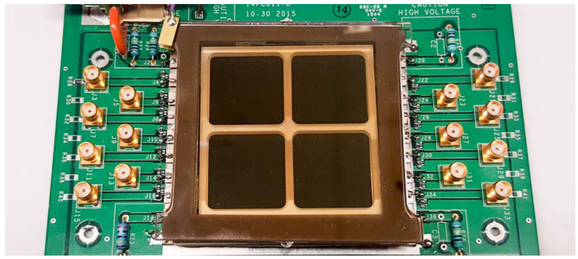
ARGONNE NATIONAL LABORATORY

About us

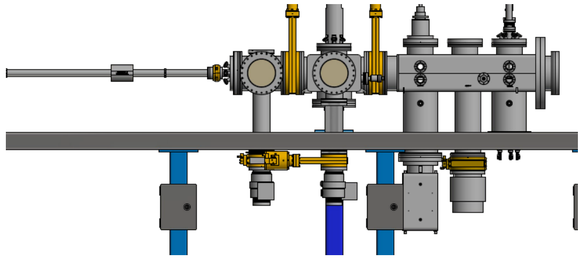
- Large multi-purpose laboratory in the Chicago area
- Actively investing in EIC research through an LDRD project (collaboration between the medium-energy, theory and accelerator groups of the Physics Division), as well as through Program Development funds.
- Strong interest in EIC beyond the scope of these efforts.
- Drawing on experience and resources across many divisions at Argonne (Computer Science, Material Science, HEP, ALCF, …)

PIXELATED MCP-PMT TECHNOLOGY

Fast light sensors to enable RICH/DIRC in areas with high magnetic fields.



- High-resolution (spacial+timing) sensors that can work in strong magnetic fields important for all RICH/DIRC designs.

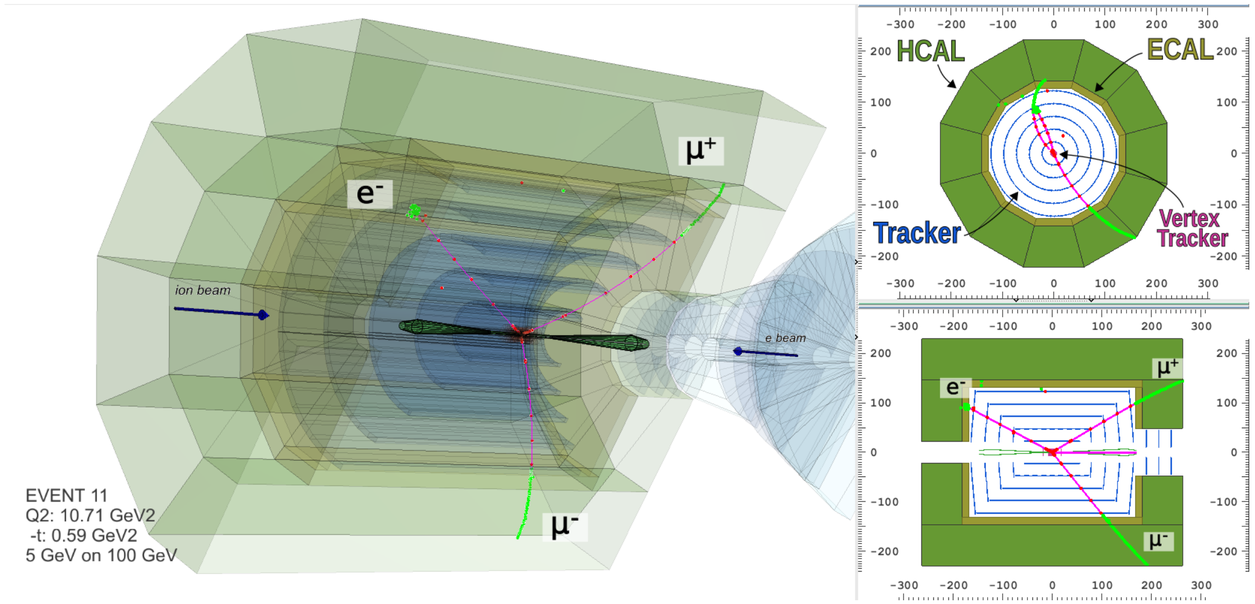


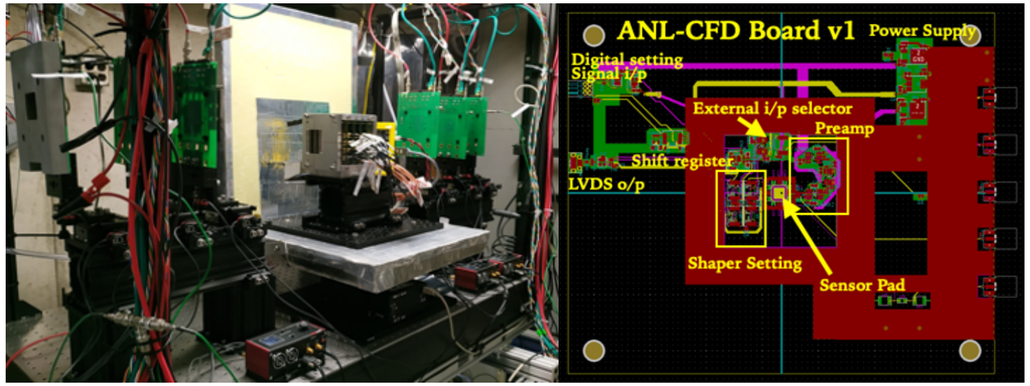
- In-house program to develop and construct pixelated 10x10cm MCP-PMTs, currently building new R&D fabrication facility.

- Strong relation through SBIR with Incom for (affordable!) commercialization of our technology, and with Nalu Scientific to develop dedicated readout ASIC.

EIC DETECTOR DEVELOPMENT

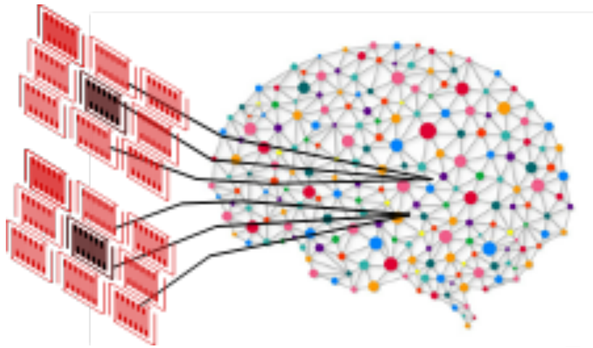
The TOPSiDE detector and beyond





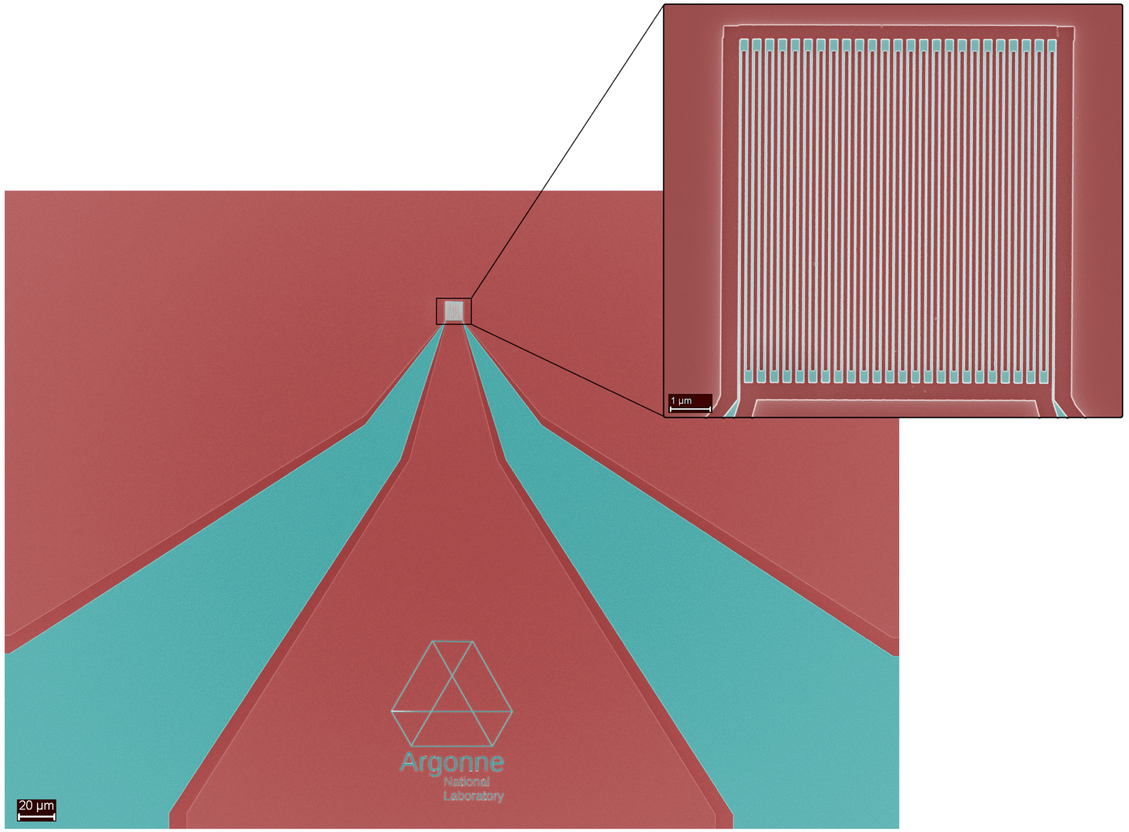
- Leverage ultrafast silicon technology (UFSD) to simplify barrel.
  - R&D on LGAD sensors, collaboration with HEP.
- Development of a gas RICH for the forward endcap.
  - Experienced with Cherenkov and RICH design and construction, ties in perfectly with our MCP-PMT program.

- Next-generation detectors and readout can be tightly integrated with AI-accelerated edge-computing, ideally from the ground up.
- Can draw on world-class expertise in AI at Argonne to develop AI-accelerated micro-electronics.



SUPER-CONDUCTING NANOWIRE DETECTORS

Efficient, fast sensors for a high-radiation, high-field environment



- Strong program in superconducting nanowire sensors (Physics and Material Science Divisions).
- Sensors can operate in fields up to (at least) 7T, can operate inside of magnets.
- Novel concept for high-resolution rad-hard detector based around superconducting nanowires (early R&D stage), good potential for near-beamline detector for tagging in the far-forward region.
- Capability to fabricate nanowire sensors on-site.
- Developing readout electronics for cold environments, together with HEP electronics group and Nalu Scientific.

NEXT-GENERATION COMPUTING AT EIC

Leveraging a long history with high-performance computing.


Jean F. Hall, 1953

- Enable and support EIC Computing
  - Leverage exa-scale computing at Argonne for data processing and simulations
  - High-performance distributed data storage and sharing, already deployed Petrel (ALCF service) allocation for EICUG as pilot
- Software development for EIC
  - State-of-the-art simulation-reconstruction tools leveraging DD4hep and ACTS, aimed for future heterogeneous computing environment.
  - Develop optimized AI techniques to deal with globally sparse/locally dense data unique to particle physics. Existing multi-disciplinary collaboration between Argonne and SLAC.

SUMMARY

Argonne is highly invested in the EIC

- Highlighted ongoing endeavors related to the EOI:
  - Development and fabrication of high-resolution MCP-PMTs with readout electronics for RICH/DIRC
  - TOPSiDE detector concept and UFSD
  - Gas-RICH for the forward region
  - AI-accelerated edge-computing
  - Novel superconducting detector technology
  - Exa-scale HPC resources to support the EIC community
  - Simulation and reconstruction software development for future heterogeneous computing environments