A Totally Hermetic Electron-Nucleus Apparatus (ATHENA)

- Brookhaven National Laboratory will host a new collider, the Electron-Ion Collider (EIC), capable of colliding polarized electrons with polarized protons and nuclei.
- This unique environment places stringent requirements on the tracking system needed for the measurement of the scattered electron and charged particles in the collisions. A low material budget to reduce multiple scattering, large tracking lever arm, and high magnetic field are critical for excellent momentum resolution.
- A Totally Hermetic Electron-Nucleus Apparatus (ATHENA) was designed around a 3 T solenoid magnet and was proposed as a potential EIC detector.

ATHENA Tracker and MPGDs

- Module size: inner radius ~ 45 cm, outer radius ~ 77 cm
- Material budget ~ 0.4% X/X₀ per module
- Provide additional hits for track reconstruction
- Covers ~ 1.1 < |η| < 2.0
- Simulated resolution 50 μm(rφ)×250 μm(r)

Micromegas Barrel

- Module size ~ 50×70 cm²
- Material budget ~ 0.4% X/X₀ per module
- 2 inner layers (r ~ 50 cm) and 2 outer layers (r ~ 70 cm)
- Covers |η| < ~ 1.1
- Extends lever arm in barrel region for track reconstruction.
- Simulated resolution 150 μm

μRWELL

- Located behind dRICH to aid PID
- Needs to cover large area with a radius of ~ 196 cm and pseudorapidity ~ 1.5 < η < 3.75.
- Material budget can be more relaxed (~ 1% X/X₀)
- Simulated resolution 50 μm(rφ)×250 μm(r)

Main EIC MPGD R&D Areas

- EIC MPGD R&D supported by DOE is being carried out by eRD-108 and addresses several areas of R&D:
  - Further reduction of material budget
  - Development of large area μRWELL detectors
  - Reducing readout channel count without sacrificing spatial resolution via 2D zigzag and capacitive charge sharing readouts
  - 3 coordinate readout structures

Coverage and Performance

- Tracking Material Surfaces R (mm)
  - Silicon Vertex
  - Silicon Barrel
  - Micromegas
  - GEM Rings
  - μRWELL

Momentum Resolution Performance

- 2D Zigzag Concept
- Capacitive Sharing – 2D Strip Concept

Pitch: 800 μm