eRD108 (MPGDs)
FY24 Progress Report

ePIC / EIC Project
Detector R&D Day March 25th 2024

A. Francisco on behalf of CEA Saclay

eRD108 Consortium

The eRD108 Consortium

Project ID: eRD108

Project Name: Development of EIC ePIC MPGD Trackers.

Brookhaven National Laboratory (BNL): Craig Woody
CEA Saclay: Francesco Bossù, Maxence Vandenbroucke
Florida Institute of Technology (FIT): Marcus Hohlmann
Istituto Nazionale di Fisica Nucleare (INFN Roma Tor Vergata): Annalisa D'Angelo
University of Virginia (UVa): Huong Nguyen, Nilanga Liyanage
Temple University (TU): Matt Posik, Bernd Surrow
Thomas Jefferson National Accelerator Facility (JLab): Kondo Gnanvo
Vanderbilt University (VU): Sourav Tarafdar

Project Members:

BNL: B. Azmoun, A. Kiselev, M. Purschke, C. Woody
CEA Saclay: F. Bossù, A. Francisco, M. Vandenbroucke
FIT: M. Hohlmann, P. Iapozzuto
INFN: A. D'Angelo, A. Fantini, B. Benkel
JLab: K. Gnanvo
TU: M. Posik, B. Surrow
UVa: H. Nguyen, N. Liyanage
VU: S. Tarafdar, V. Greene, J. Velkovska

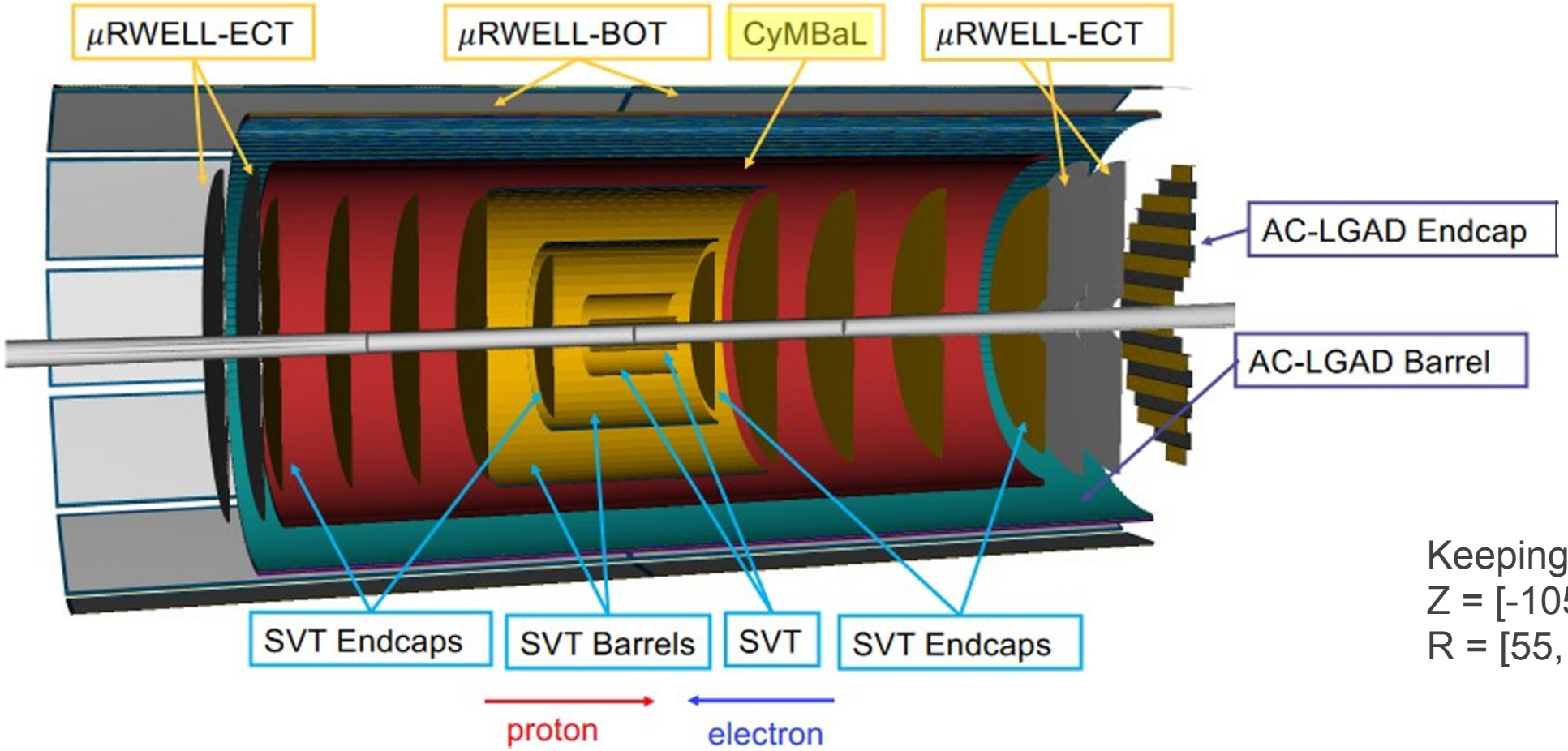
Contact Person: Kondo Gnanvo; kagnanvo@jlab.org

This presentation focuses on Micromegas R&D - only project funded for FY24

CyMBaL sub-system

Cylindrical Micromegas Barrel Layer

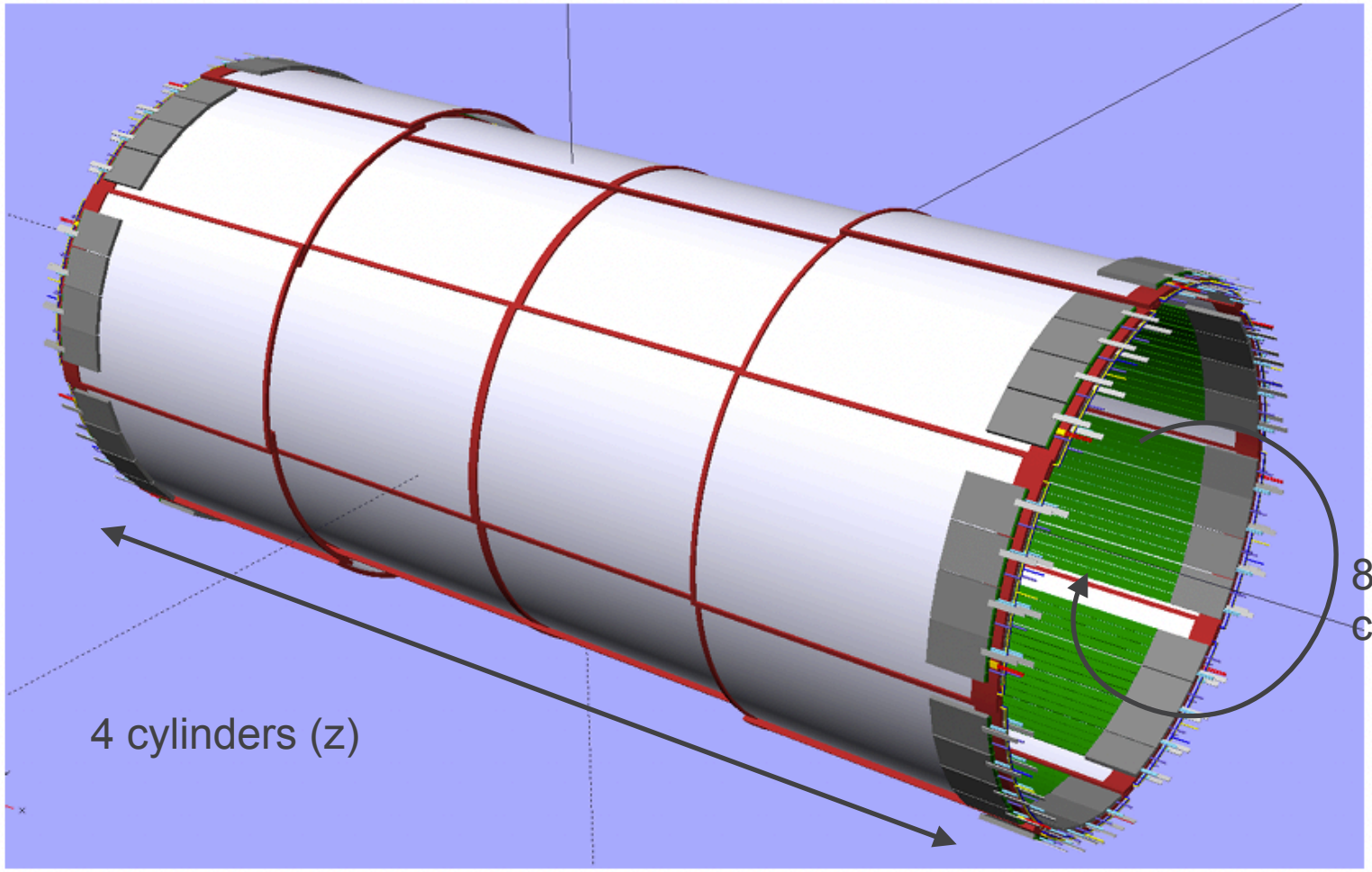
- Around the SVT
- Additional hit points for pattern recognition



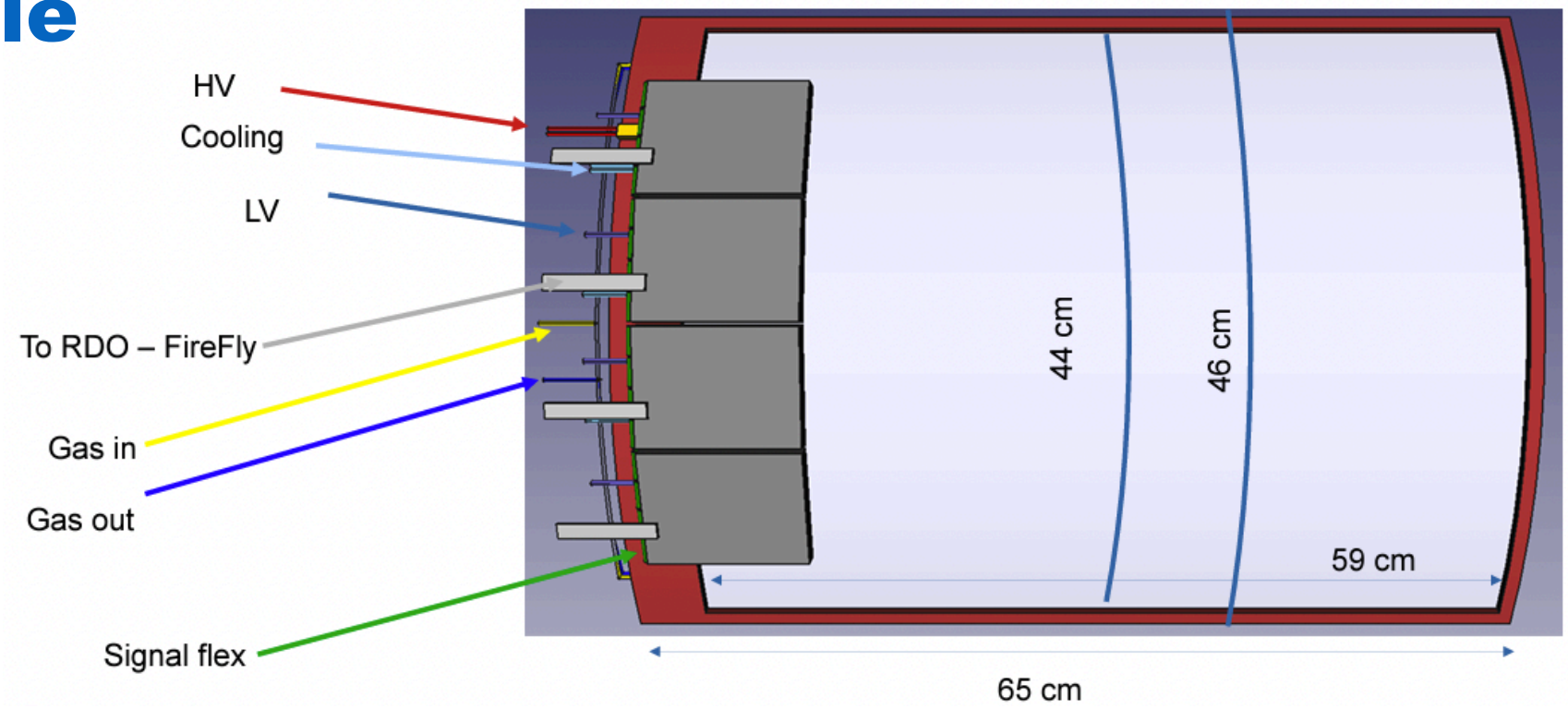
Keeping zones
Z = [-105, 140] cm
R = [55, 60] cm

CyMBaL - layout

- Barrel layout of **4 cylinders of 8 identical tiles with 2D-readout**
- Curvature radii: 55cm/57.5cm for inner/outer cylinders
- Hermeticity through ϕ and z overlaps (except in the middle)



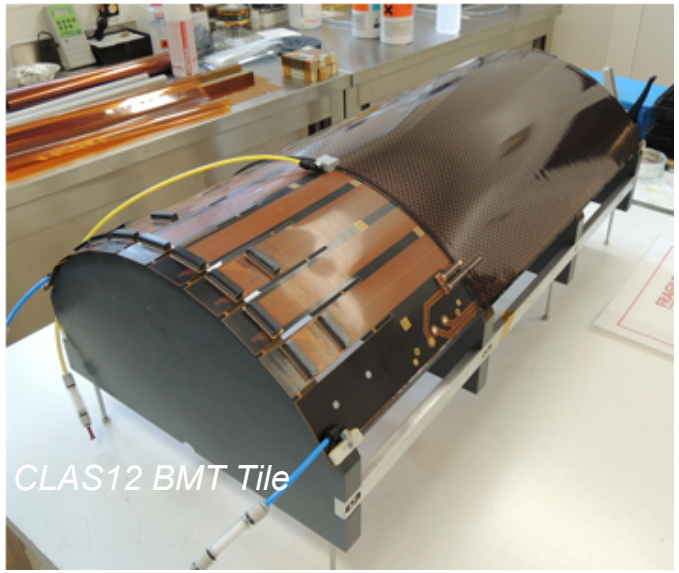
CyMBaL - tile



- Dimensions close to CLAS12 Micromegas module (BMT) - baseline for the design
- Readout strips per module: 1024 and 32 channels per connector → 32 connectors
- Front end boards (based on SALSA ASIC) on system edges

CyMBaL tiles à la CLAS12

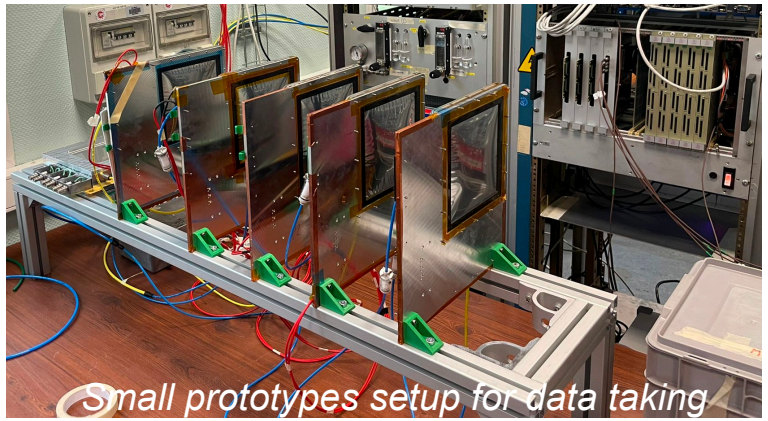
- Design of the tile **very similar to CLAS12 BMT detector** (project lead by CEA and taking data since 2017)
  - B=5T solenoid, total active area ~4m2
  - Light cylindrical tiles (~0.4% X0 per layer)
- **Build on past experience** by upgrading CLAS12 design for ePIC needs
  - **Bending** of the tile (larger radius)
  - Upgrade from **1D to 2D** readout

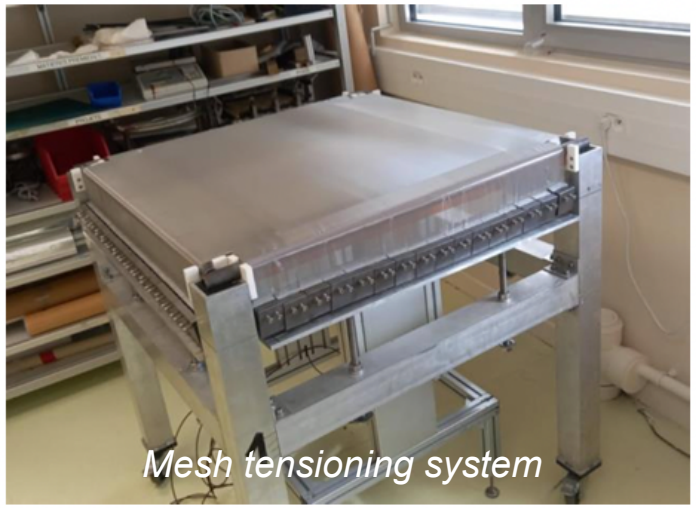

CLAS12 BMT Tile


CLAS12 MVT open for maintenance

Previous report - achievements from FY23

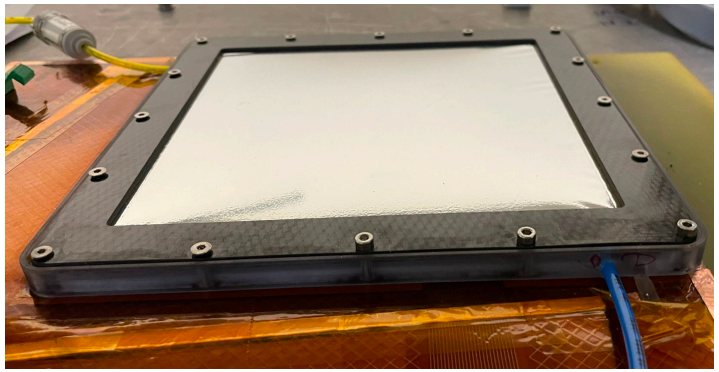
- Planned cylindrical MicroMegas R&D to upgrade the CLAS12 Micromegas technology to be 2D readout
- **2D readout optimization:**
  - Design and build several small prototypes with different 2D-readout motives and different resistivity
  - Test beam at MAMI (Mainz)
  - Executed as planned
- **For full scale prototype**
  - Early design for a longer detector
  - Set-up of mesh tensioning system for low tension


Small prototypes setup for data taking


Mesh tensioning system

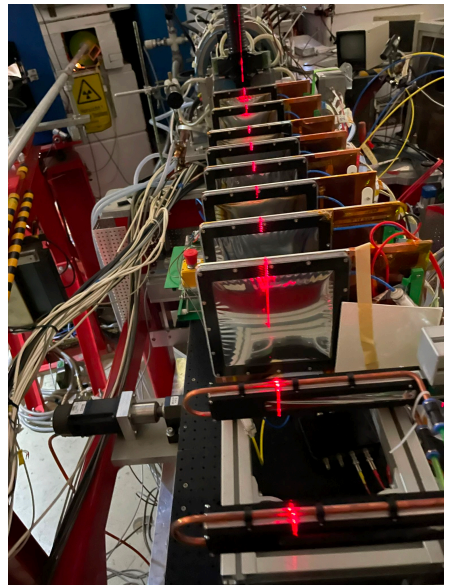
Low-X_0 2D micromegas R&D

- **R&D for very-low material budget** (0.2% X_0) 2D Micromegas
- Replacing FR4 (PCB) with **light kapton foil** stretched over carbon frame
- **Investigating optimal 2D readout and resistive patterns** + combinations
  - Varying resistivity, shape, pitch, etc..
- Less support = stronger constraints for production
- Testing **small flat prototypes** (12x12 cm^2)

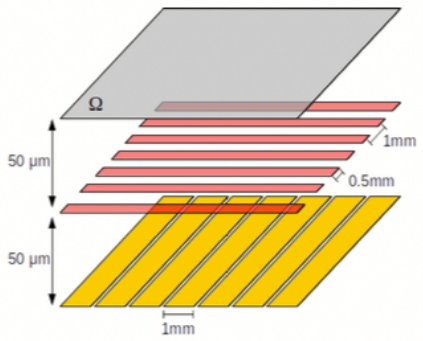


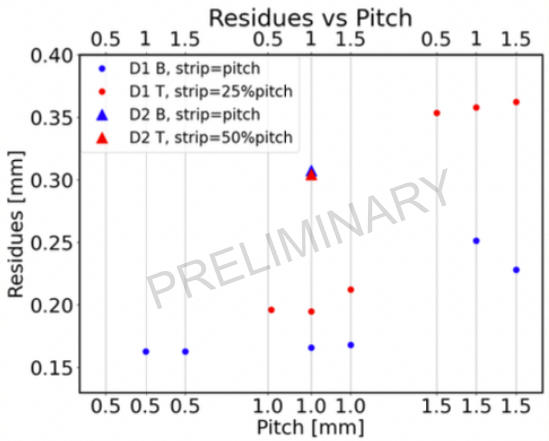
Testing of low-X_0 micromegas

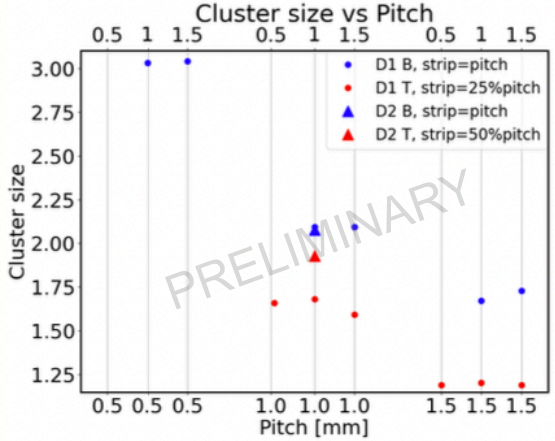
- Tested several small Micromegas and µRWELL prototypes
- Looking for optimal performances (cluster size, uniformity of charge sharing, resolution)
- Beam test of about one week in June ‘23 in Mainz at MAMI
- Results from TB dominated by multiple scattering but 1mm strips design shows interesting performances
- Testing of updates for the serigraphy/bulk processes

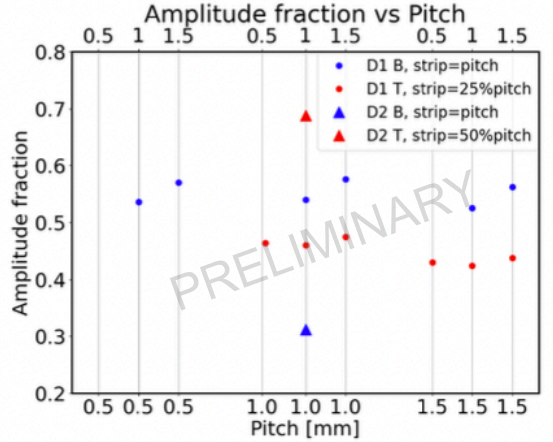


Ex. for straight strips readout



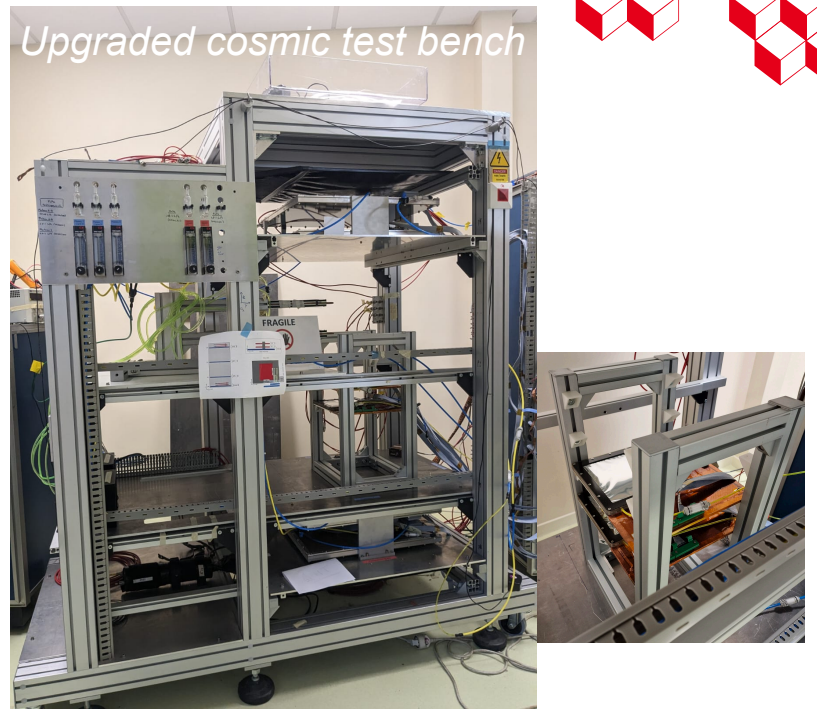






FY24

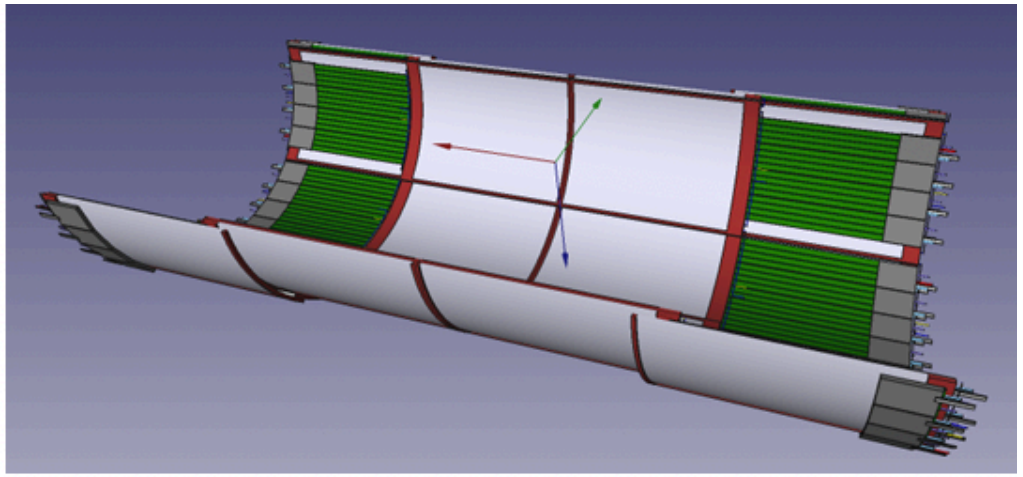
- **Finalize design for 2D-readout and resistive patterns (from small prototypes results)**
  - Set-up of upgraded cosmic test bench + potential 2nd test beam
- **Completion and tests of the large-scale prototype**
  - Starting from the mechanical design and structure of a CLAS12 tile to save resources and time
  - Upgrade to 2D readout
- **Design and building of the mechanical mock up for the ePIC tiles**
  - Structure and tooling
- **Mitigation for resolution degradation at large angles**
  - Gas mixture optimisation with smaller conversion gap (1-mm gap prototype) - in collaboration with Yale U.
  - Thin support material for cylindrical Micromegas

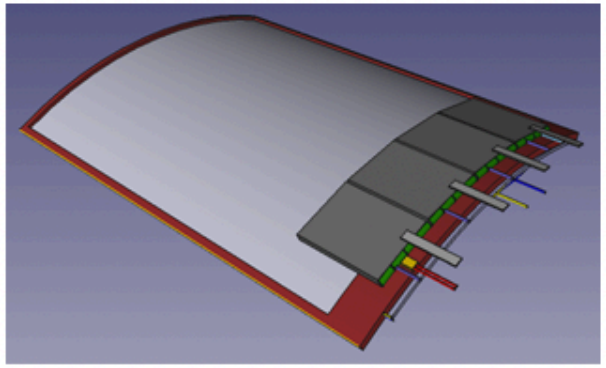


Back-up

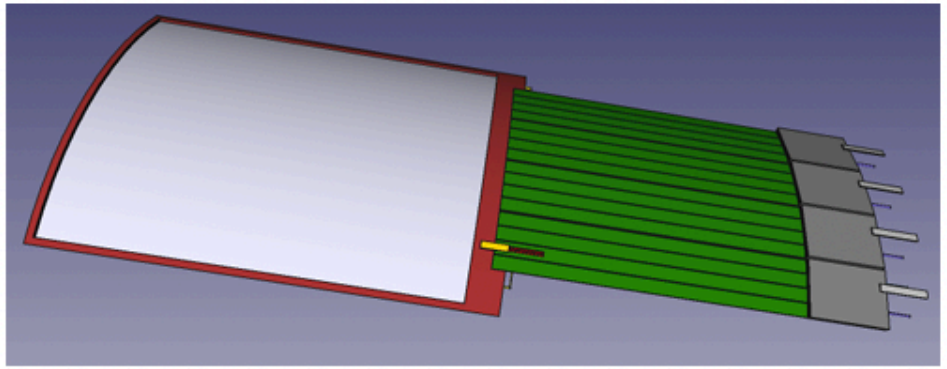
FEB layout

- Front end boards will be placed at the edges of the system
- Inner modules will be connected to the FEBs through ~50 cm of micro-coaxial cables





Outer module



Inner module