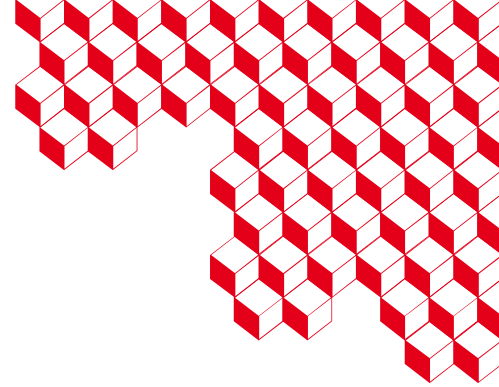




irfu



# CyMBaL – Overview and status

Francesco Bossù – CEA Saclay

ePIC Collaboration Meeting – MPGD DSC Workfest – July 25<sup>th</sup> 2024

# Requirements

## Requirements:

- Provide redundancy and pattern recognition for tracking
- Spatial resolution:  $\sim 150\mu\text{m}$
- Timing resolution  $\sim 10\text{ns}$
- Peaking times:  $\sim 100\text{ns}$
- Light detector:  $\sim 0.5\%X0$  in active areas
- Hermetic

## Solutions:

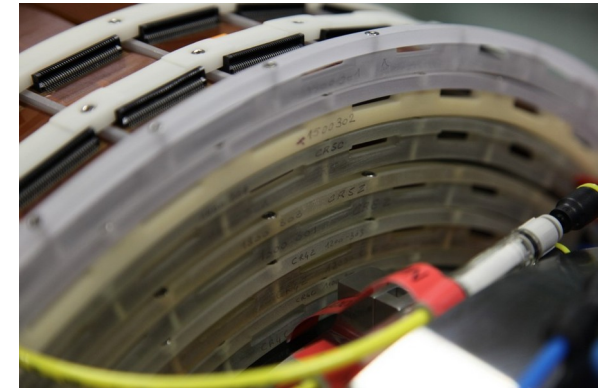
- Cylindrical resistive Micromegas technology developed for CLAS12 BMT:
  - Material budget  $\sim 0.4\%$
  - Working in high radiation environment and in  $B=5\text{T}$
- Modular design
  - Possibly, just a single module design to pave the whole surface

## Ongoing R&D:

- 2D readout with small number of channels

## External constraints:

- Tight space: about 5cm radial keeping zone
- Magnetic field  $\sim 2\text{T}$
- Wrap around the SVT in the entire length



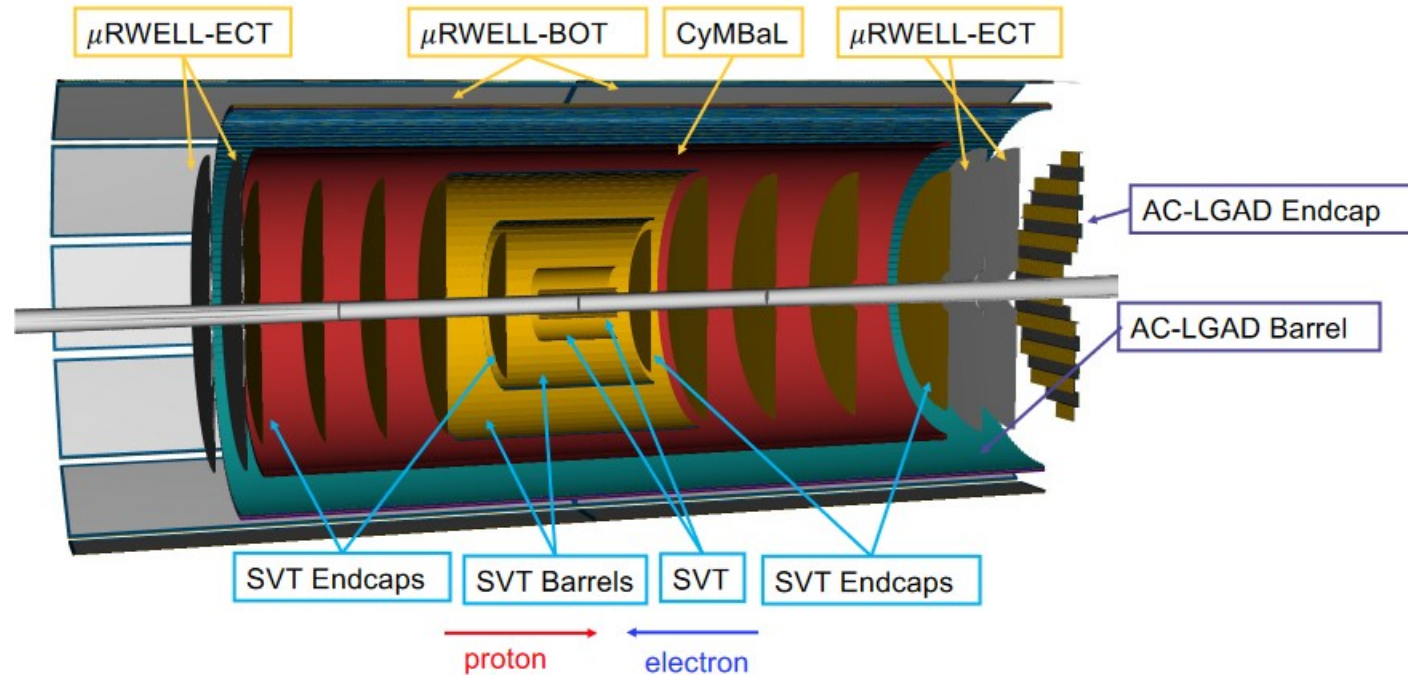
*Close up of the BMT: fits in a tight space*

# CyMBaL

- CyMBaL: Cylindrical Micromegas Barrel Layer
- Wraps around the SVT
- Keeping zones:

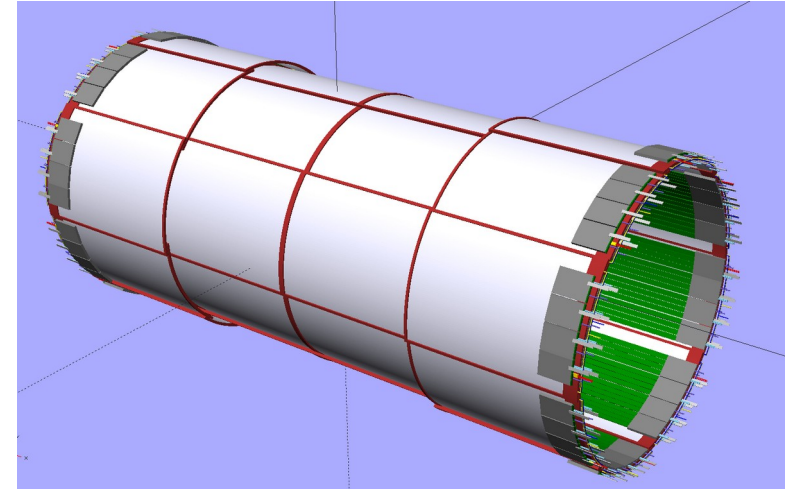
$Z = [-105, 143] \text{ cm}$

$R = [55, 60] \text{ cm}$



# CyMBaL – Design principles

- A single (or few) module PCB readout design, with two curvature radii (55cm and 57.5cm)
  - Simplify production, reduce costs
  - Industrial PCB production (Elvia, ...)
  - Micromegas bulking possible at several sites, example Saclay, Elvia, CERN, ...
- Overlaps in phi and z allow for hermeticity
- Front end boards (FEBs) on system edges to reduce material budget



## *Some numbers:*

- 32 module: 8 modules in  $\phi$  times 4 modules in z
- 1024 readout channels/module
- 32K readout channels

# CyMBaL – Module

## Module dimensions

Z = 67 cm

R\*phi = 48 cm

## Active zone dimensions

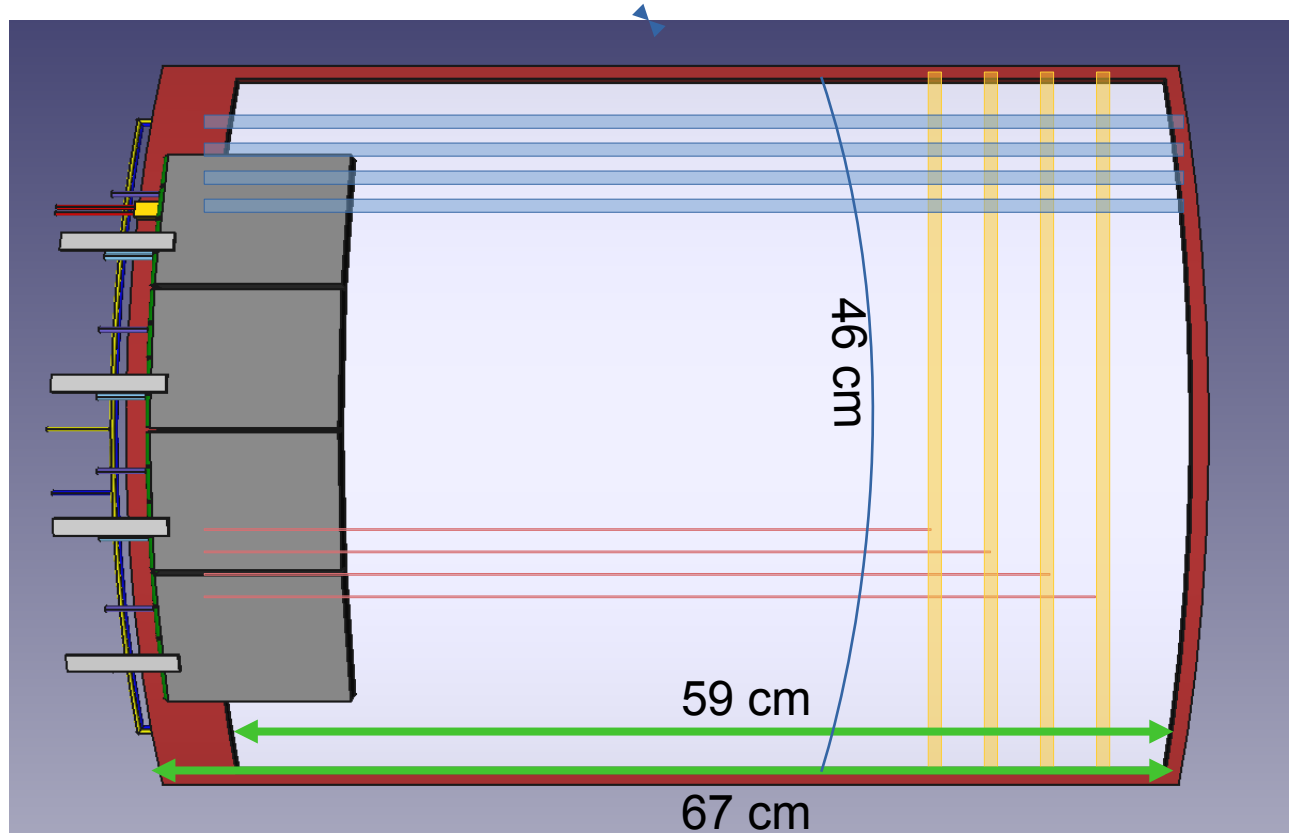
Z = 59 cm

R\*phi = 46 cm

 Z; (r phi)

 C; (z)

 return trail for C strips



# CyMBaL – Module

## Module dimensions


Z = 67 cm

R\*phi = 48 cm

## Active zone dimensions

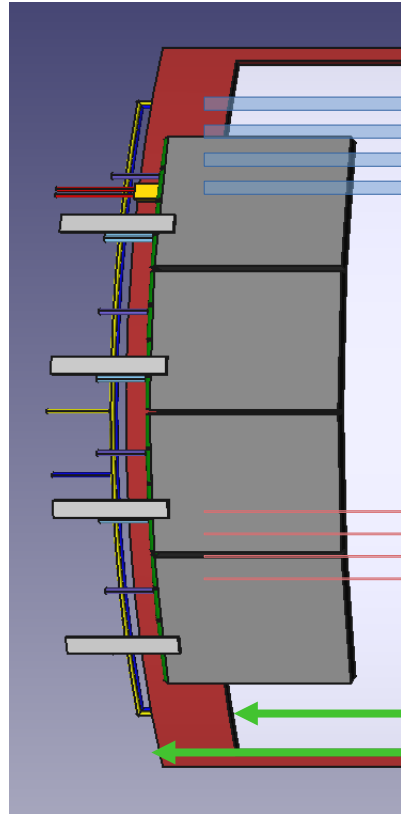
Z = 59 cm

R\*phi = 46 cm

 Z; (r phi)

 C; (z)

 return trail for C strips



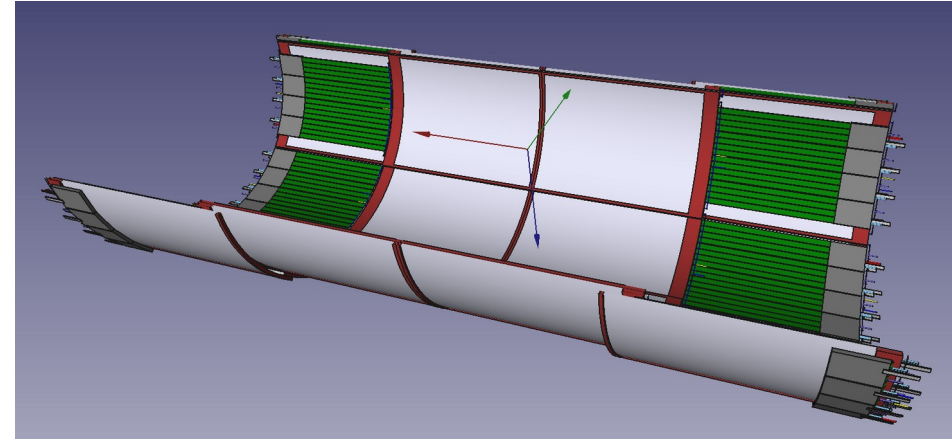
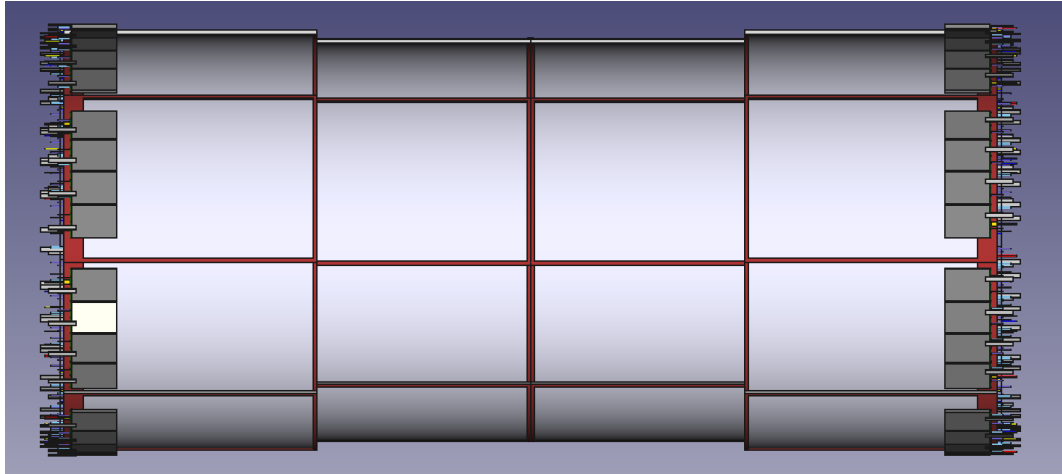
## Dimensions:

- Size: 65 x 46 cm<sup>2</sup>
- Active area: 59x44 cm<sup>2</sup>
- r/o strips: ~1 mm pitch in both directions
- Readout strips per module: 1024
- 32 channels per connector → 32 connectors

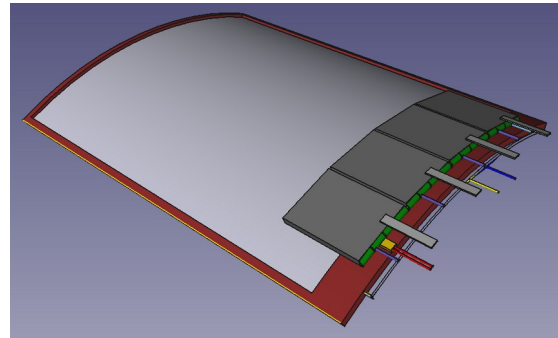
## Services:

- HV: 2 channels (drift and resistive layer)
- Gas: 2 tubes (in and out)
  - ▾ Two tiles can be in series
- 4 FEBs per module
- 4 ASICs per FEB:
  - ▾ 1 4-lines bidirectional optical fiber FireFly to RDO
  - ▾ 2 short flex cables per ASIC (SALSA)
  - ▾ Low voltage
  - ▾ Cooling in and out, possibly in series

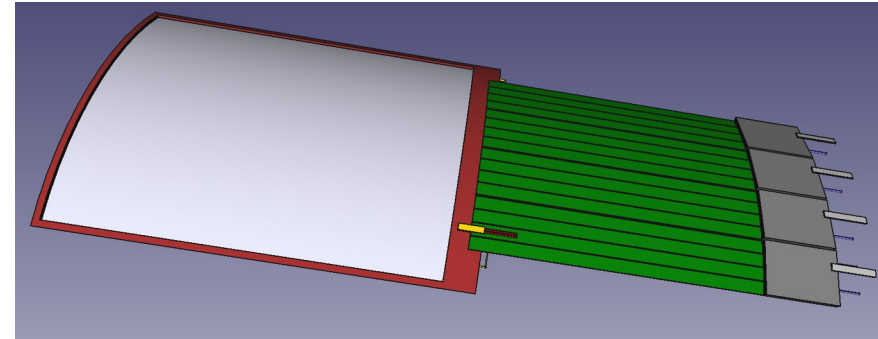
# CyMBaL – Layout



- Four modules in length
- Eight modules in phi
- Overlap in phi and z
- FEB to the periphery
- Inner modules connected to FEB with flex cables



Outer module

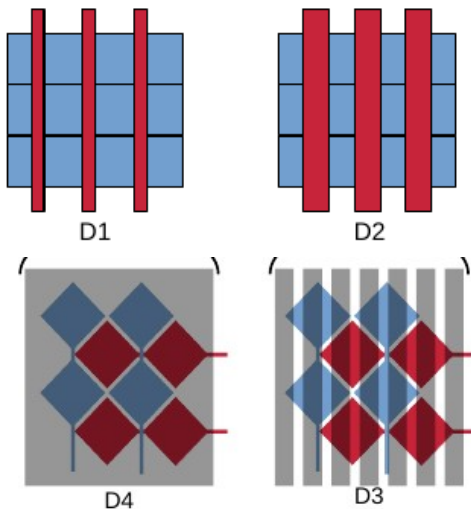


Inner module

# CyMBaL – R&D 2D

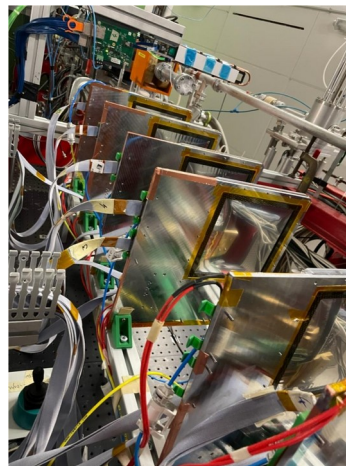
- Upgrade CLAS12 Micromegas technology from 1D → 2D readout
- Small number of readout channels
- Tests of different patterns with different resistive layers

## Designs

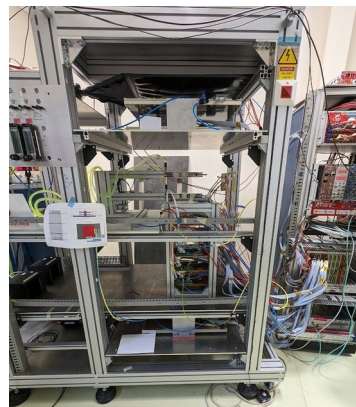


- Pitch and interstrip variation
- ASACUSA like motifs
- Variation of resistive layer (full, strips, grid)

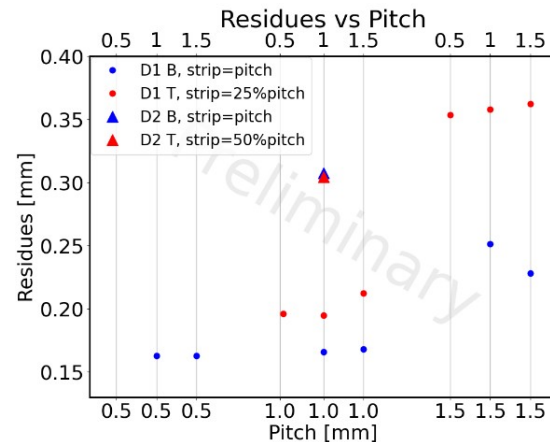
## Tests



Test beam in MAMI



Cosmics in Saclay



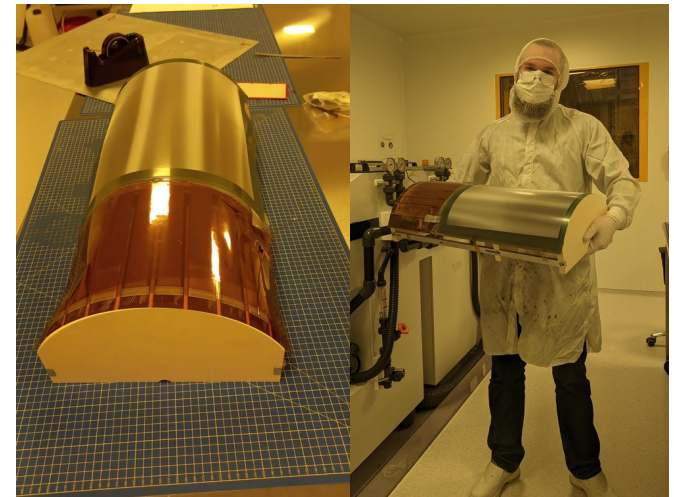
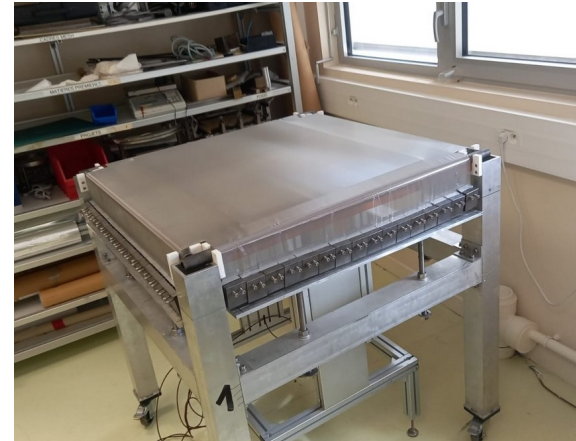
- Test in MAMI affected by large multiple scattering.
- Upgraded cosmics test bench
- Preparing a new test beam

*Tests and analysis lead by Samy Polcher Rafael and Dylan Neff*



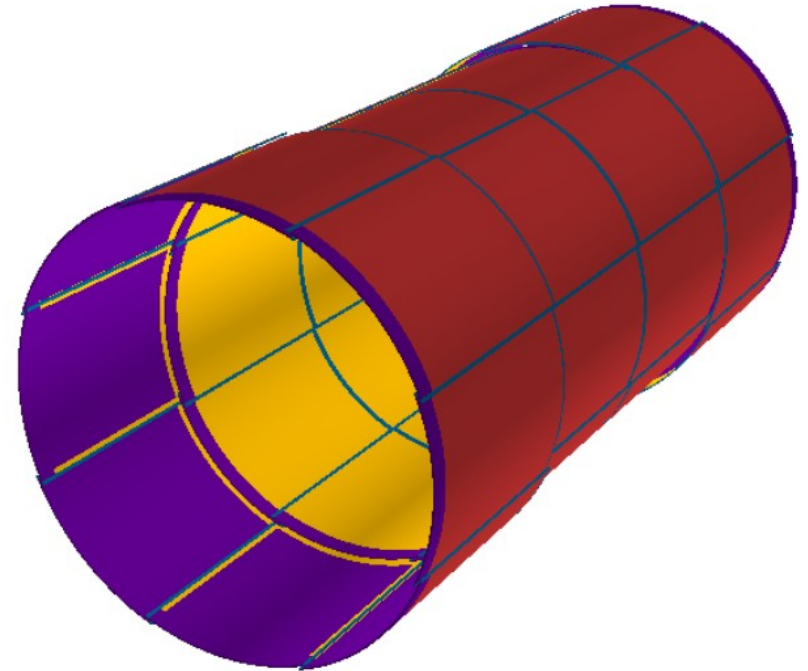
# CyMBaL – Cylindrical prototype

- Refurbishing and re-learning the production of resistive cylindrical Micromegas
  - Refurbishing of the tensioning system
  - Change of photoresistive material for the bulk process
  - Bulking and bending tests using CLAS12 PCBs
- Design of the PCB is waiting for the choice of the 2D pattern
- Choice of the connector :
  - Identified a small form factor KEL connector with lightweight micro-coaxial cables
  - Tests will start in Fall



# CyMBaL – Simulation

- Yann Bedefer took over from what Niv started.
- Moving closer and closer to a realistic implementation of CyMBaL in simulation.
  - Micromegas tiles with correct material for active area and structures
  - Overlaps in phi and z as for CAD design
- Digitization :
  - Currently XYZ voxel digitisation
  - Moving to Cylindrical grid phi-z
  - Final goal: orthogonal strips



# Outlook

- The R&D on 2D readout is progressing
  - Tests in MAMI affected by large multiple scattering
  - Ongoing tests with cosmics
  - Preparation of new prototypes with not-yet-tested combinations of resistive layer and 2D r/o
- Re-learning the cylindrical detector techniques ongoing and choice of the connector are preliminary steps towards the scale 1:1 prototype
- Saclay internal:
  - Internal review in November
  - A new and more formal structure of the CyMBaL + SALSA project
  - New people joining