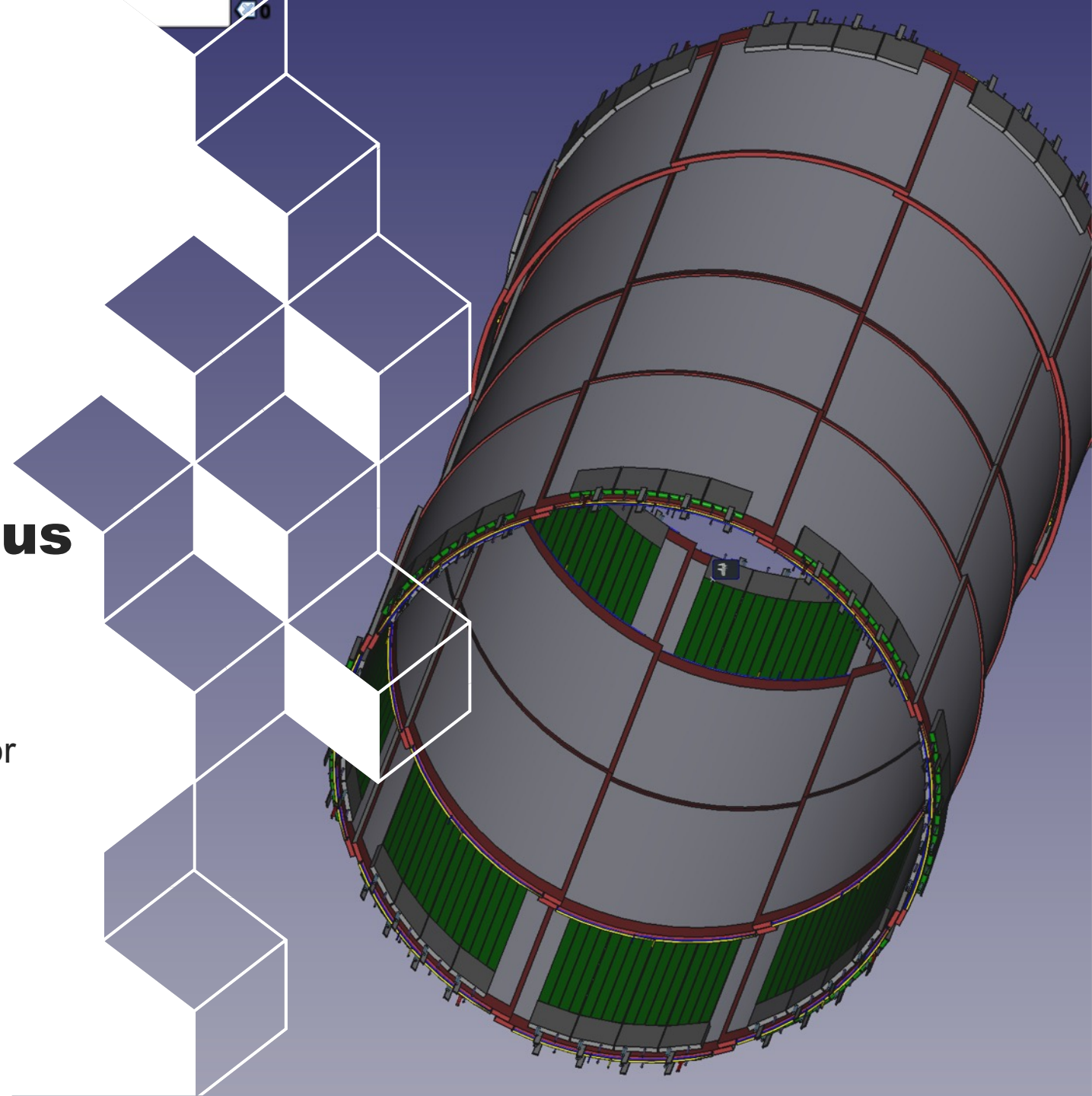
Inner MPGD CyMBaL Status

Alain Delbart, for the CEA/Saclay IRFU team

- From 8 to 12 sectors MPGD inner layer detector
- Development plan revision



EIC/EPIC 3I meeting, 02 june 2025

CyMBaL re-design in 12 sectors

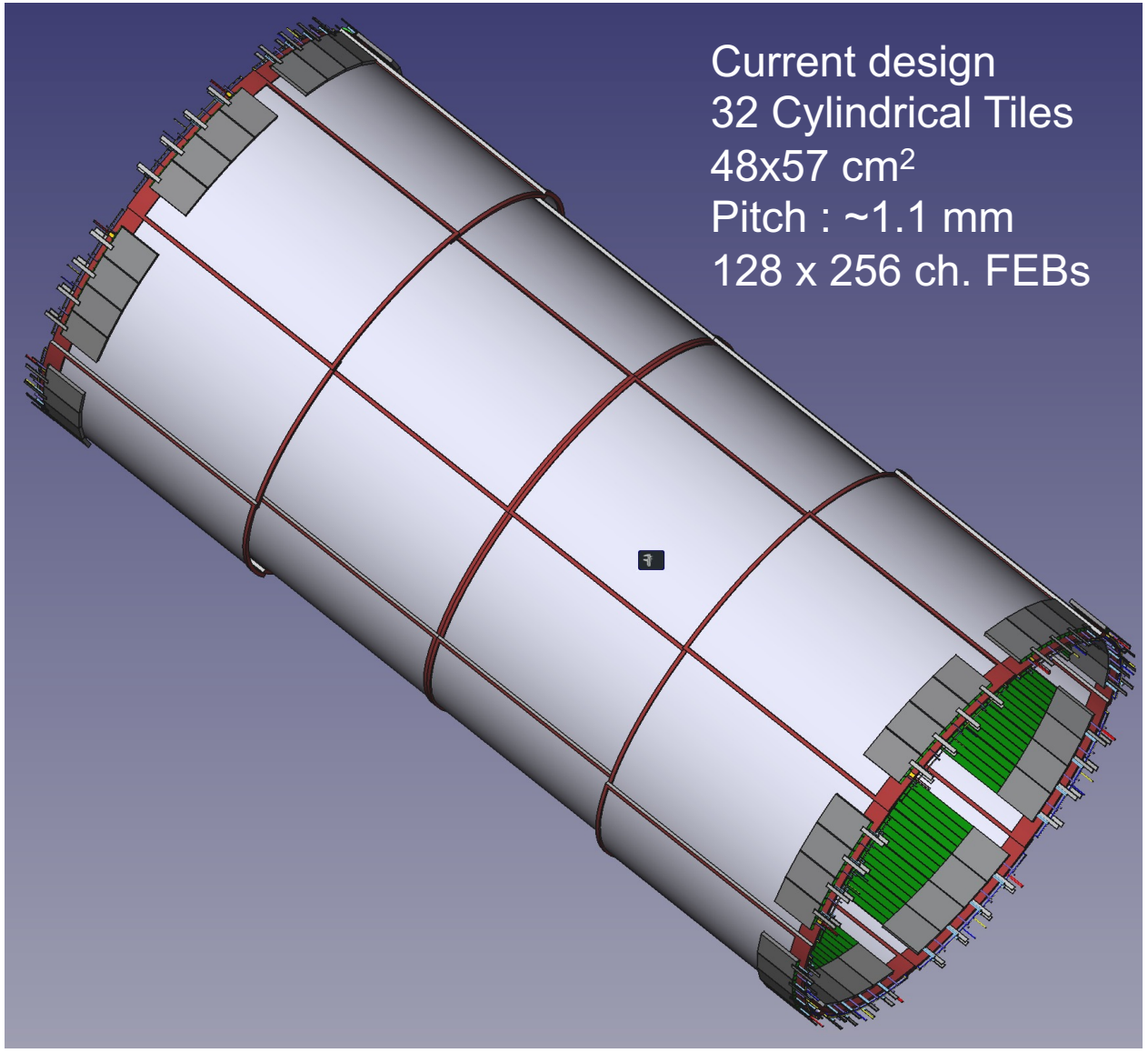
Because of constraints on the EPIC detector installation and maintenance, CyMBaL is now suggested to move from a configuration of 8 to **12 independent sectors**, supported on the external **GST support**, in order to make it more serviceable.

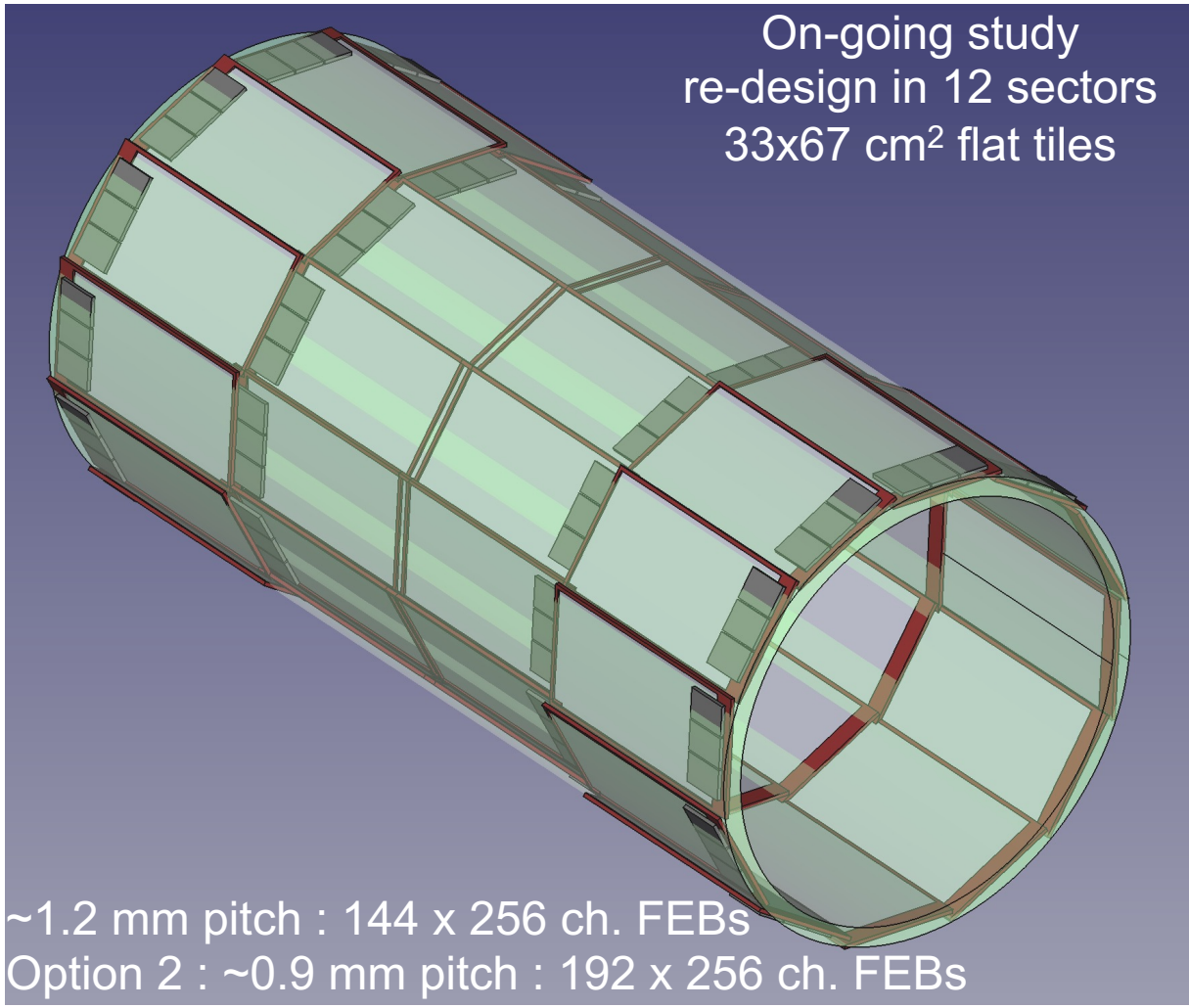
→ **Global re-design** which needs to be validated in terms of **physics performances**, **readout electronics configuration and development plan**.

- From 32 to 48 modules of ~33 cm width: production plan changes (toolings, schedule, cost)
  - Cylindrical Vs flat tiles : estimated 0.5% to 1% X/X0 radiation length increase if flat
- Change in width leads to a complete re-design of the detector readout with an increase of the number of electronics channels : 2D readout anode Vs independent x/y readouts ?, strip pitch Vs track reconstruction, increase of electronics channels & FEBs Vs global ePIC DAQ readout (move back to RDO, more DAM cards ?)
  - Keep same 1024 ch/tile : ~0.9 mm pitch with 192 x 256ch FEBs (50% increase)
  - Or move to a larger ~1.2 mm pitch (144 FEBs) with downgraded track reconstruction performances
- Maintain hermeticity with active area overlaps, or if not possible, check global performances

Major change which requires inputs from requirements and performance from simulation and reconstruction and from the global 3D CAD model (GST+TOF+rails)

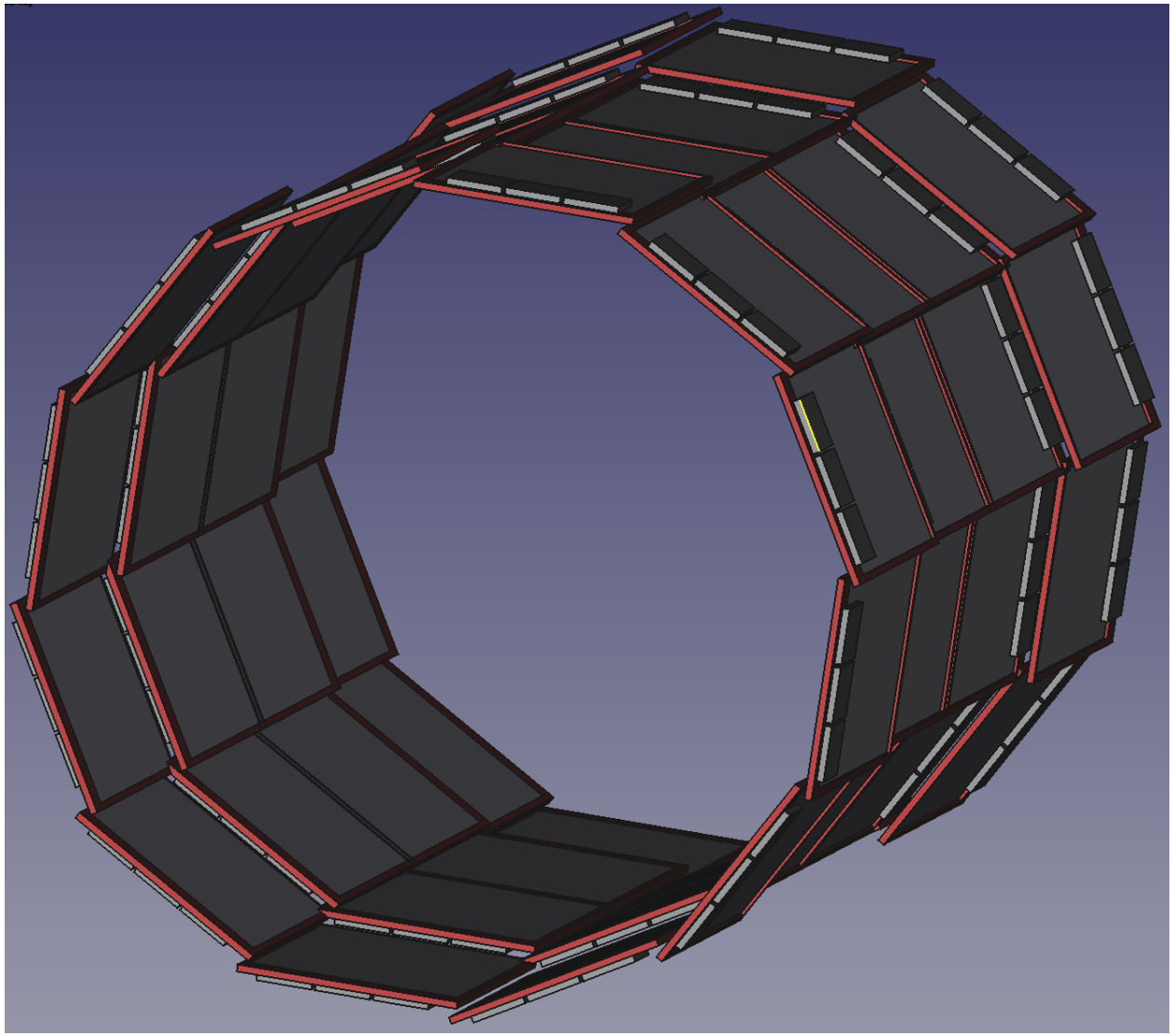
From 8 to 12 inner MPGD sectors …

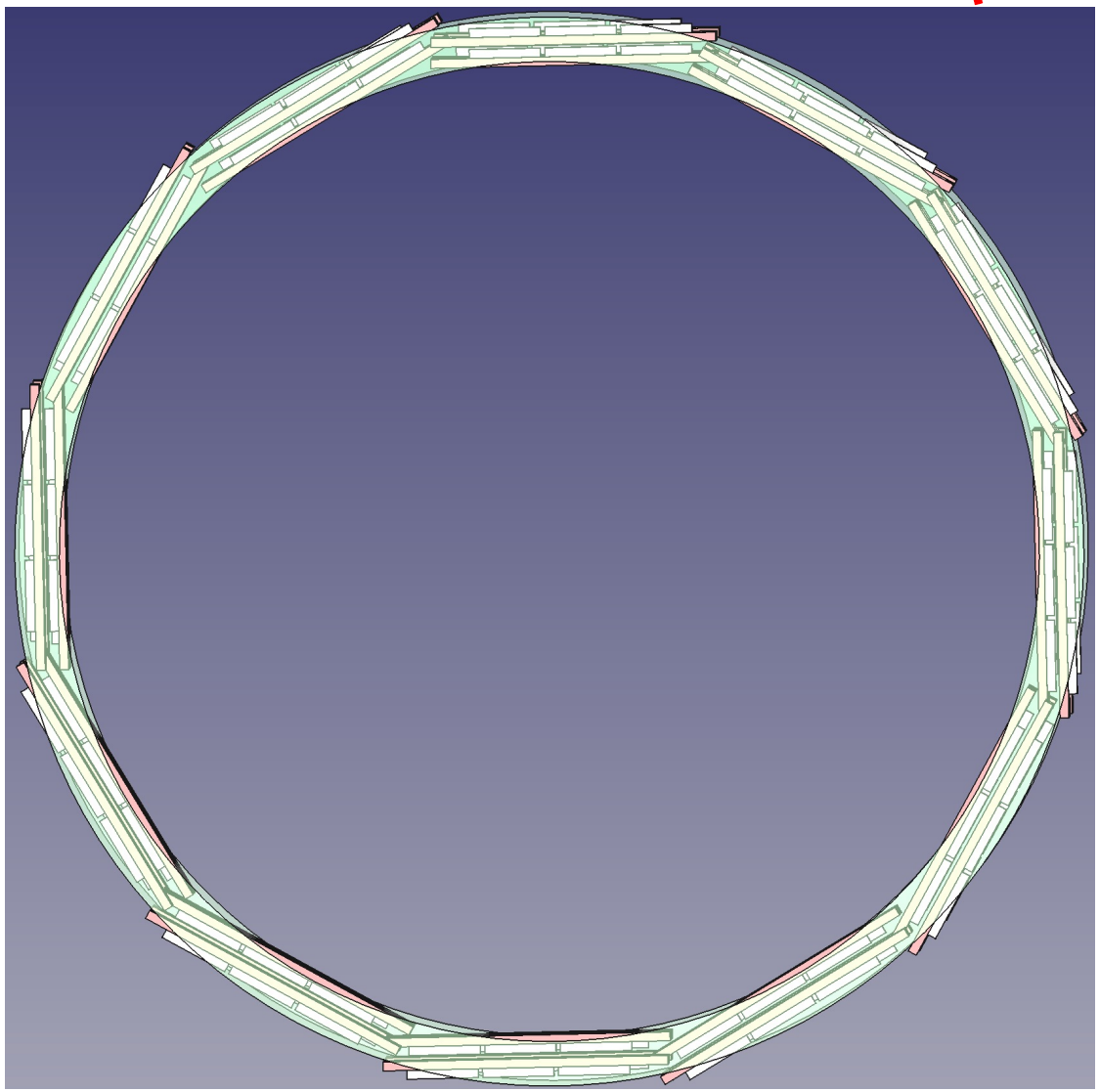




On-going re-design

Difficult to maintain full hermeticity within the current Inner MPGD envelop …





CyMBaL development timeline (under revision)

2025 2026 2027 2028 2030

R&D and design (RDx)

- Finalization of the 2D readout R&D
- Choice of the r/o (**test beam**)
- Design of scale 1 prototype

Scale 1 proto GEICO

- Production and tests of the proto scale 1
- Validation of the tile design

Pre-production

- Production and tests
- Tests & Validation with SALSA2 FEB

Production

- Production of **32 (→48) tiles**
- Validation with cosmics and Fe55
- Tests and production of SALSA3 FEB
- Validation of the FEB→DAQ chain with detectors
- Shipments to BNL

Installation

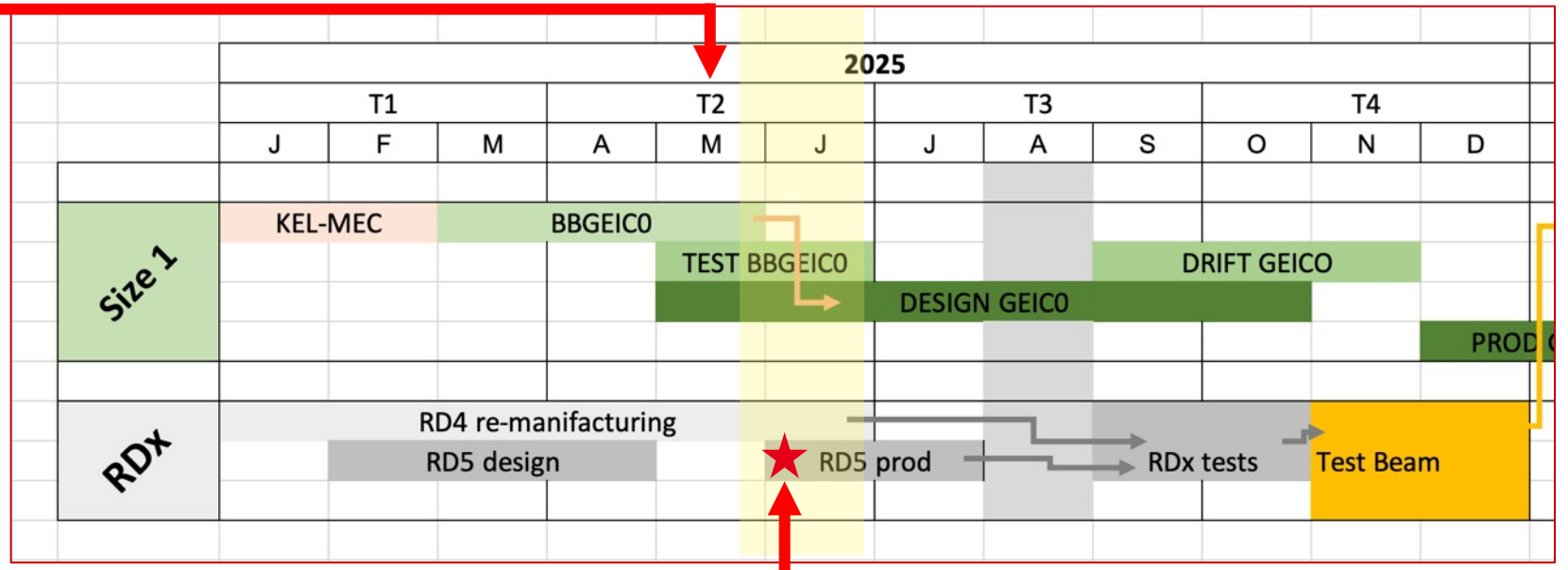
- Commissioning at BNL

+ MPGD base material change to Dynamask

New 12 sectors CyMBaL Design

- Active area coverage
- Planar Vs Cylindrical
- Ch. Count Vs readout pitch
- New FEB design & ch. Numbers Vs ePIC DAQ ?

FEB cooling simulations expected in **sept 2025**



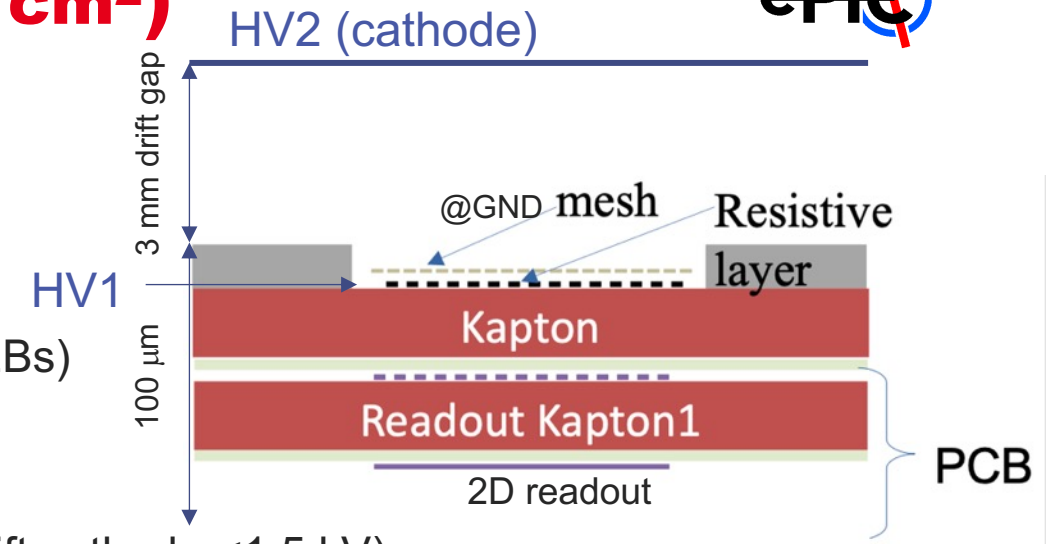
RD5 production paused

Backup

The CyMBaL « resistive micromegas » module design for 32 tiles (1024 ch. 48x67 cm²)

Components

- Copper etched strips on Kapton (&/or FR4) (thick 250-300 μm)
- 316L ~30 microns thick Mesh electrode
- Kapton + Cu drift cathode
- 2-3 Aluminum or Carbon Fiber hoops and 2 longerons
- Connectors : HV, flat micro-coax cables to the Front-End Boards (FEBs)



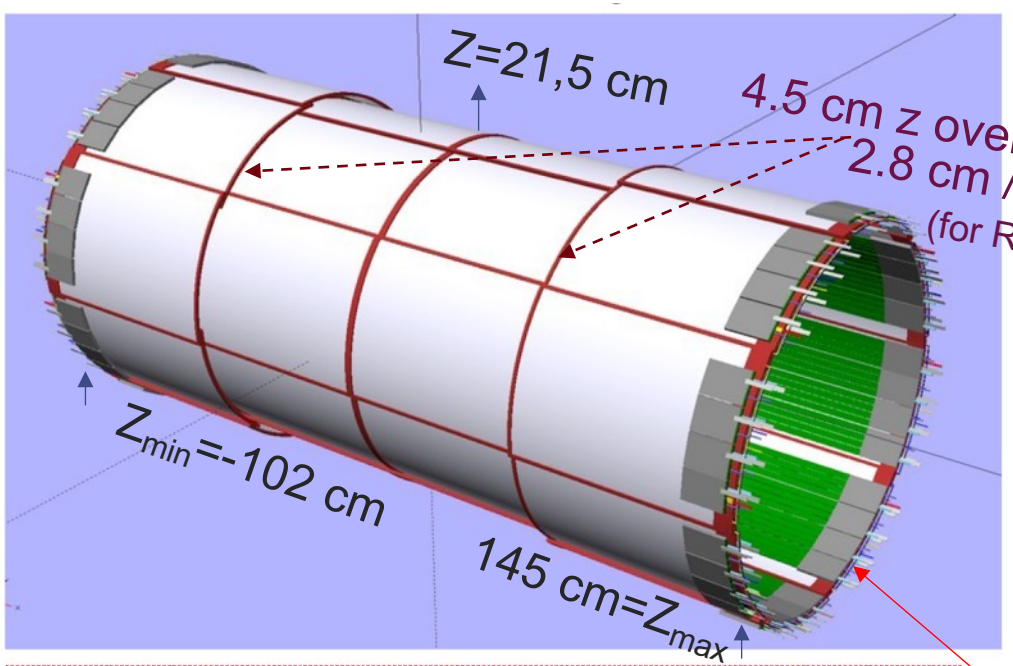
Services (readout electronics not included)

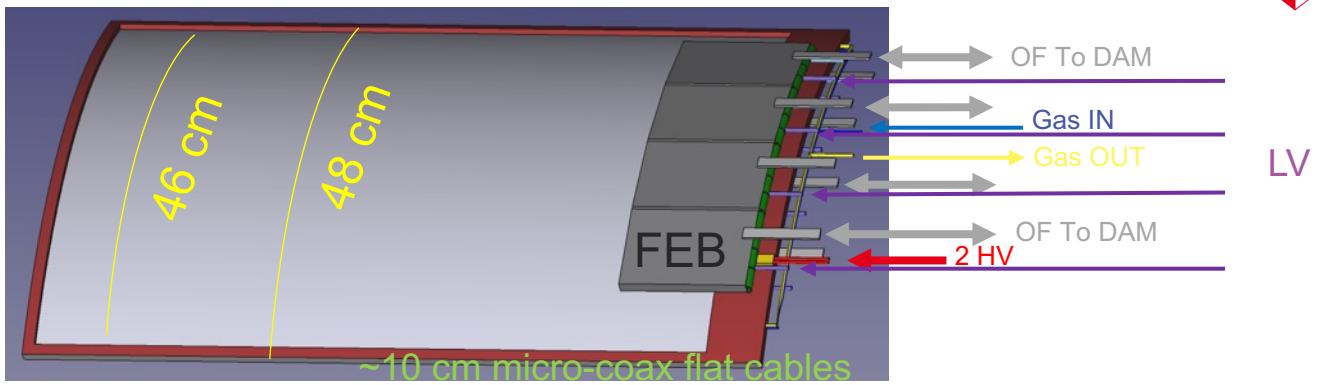
- 2xHV lines : 1 for the resistive anode (<500V), the other for the e- drift cathode <1.5 kV)
- Gas IN/OUT (through inlets in “external” hoop, barrel tiles probably in series)
- No heat dissipation (nA currents)
- Tile PCB and FEB Grounds connected together and to global grounding

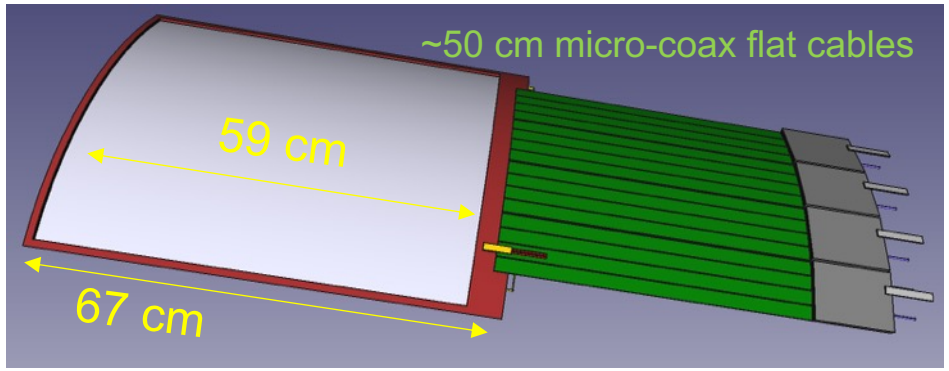
Current status & mid-term plans

- **Flat, small size prototypes to fix the detector 2D readout structure**
  Test beam foreseen week 47-48 @ CERN
- Design & test on dedicated prototypes of the mechanicals (hoops, longerons) needed for 55-60 cm cylindrical shape
- Desing of a scale 1 tile PCB (just started)

The 8 sectors baseline design of the CyMBaL barrel

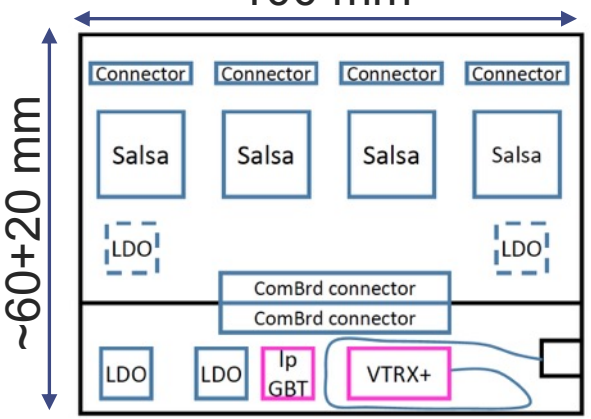






- 32 module: 8 modules in ϕ times 4 modules in z
- Overlaps in ϕ and in z for hermeticity
- 1024 readout channels/module
- 32K readout channels
- 128 FEBs (2x32 on each side - 4/tile)

FEB+cooling plate (15 mm thick ?)



weight estimates

- Raw tile	~1 kg
- FEB PCB	~0.3 kg
- Cooling plate+fluid tube	~0.3 kg

(*rough estimate for 3 mm Al cooling plate + copper tubes, thermal simulations to be done*)

On each side of the barrel	**~40 kg**
Cymbal	**~110 kg**