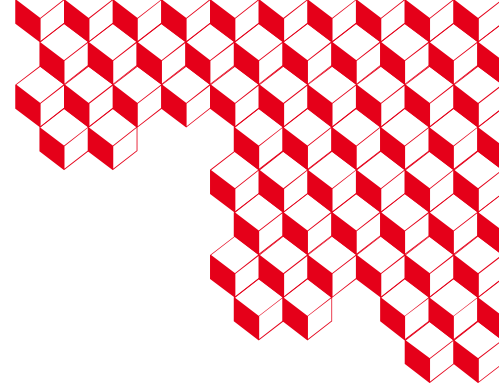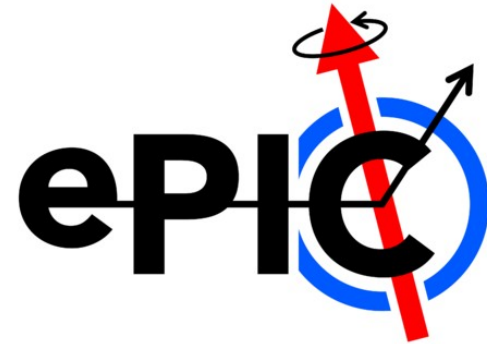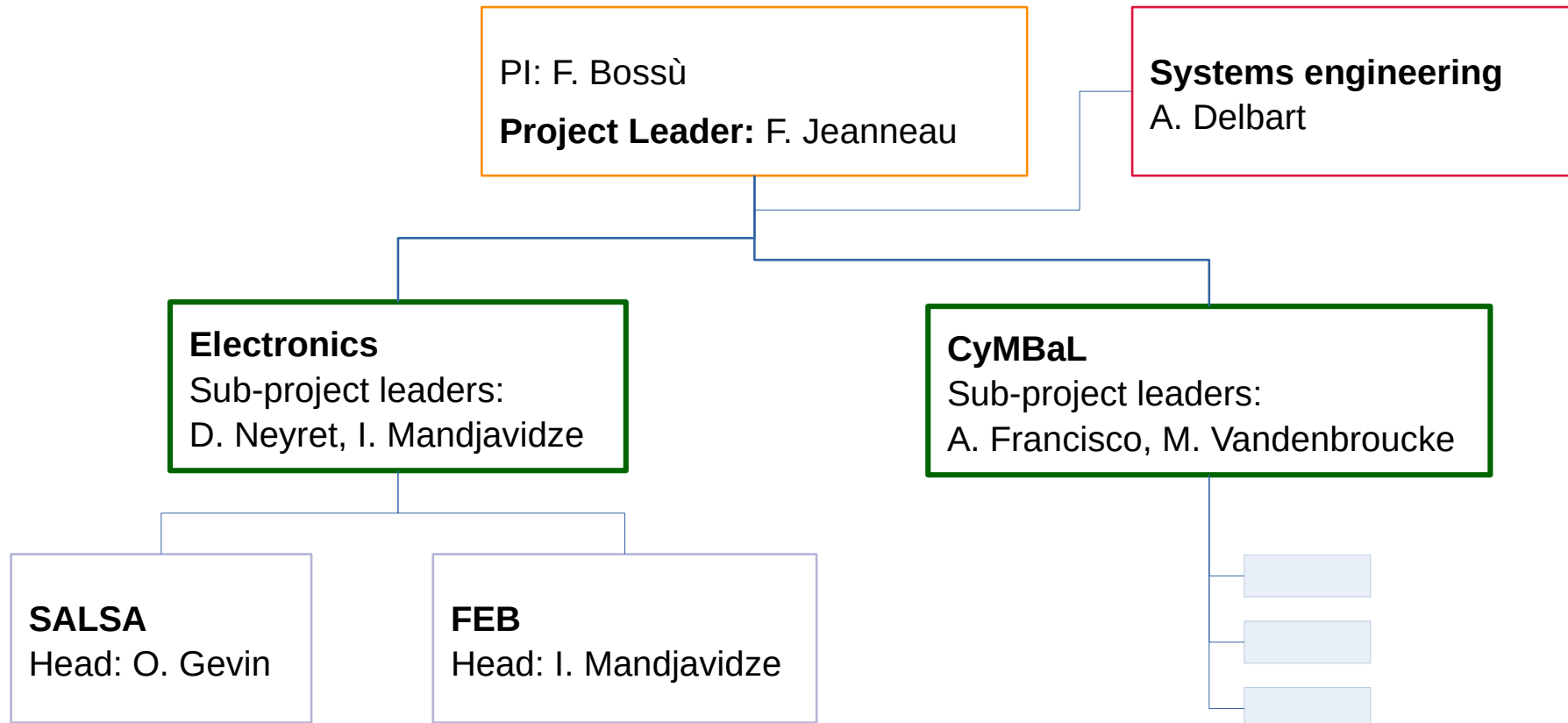# CyMBaL

F.Bossù for the CEA Saclay team

EPIC collaboration meeting
Jan 2025 – Villa Mondragone
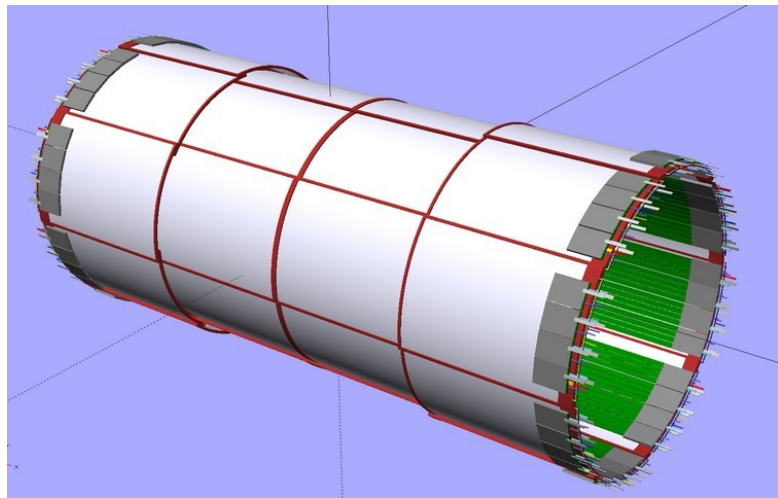
# The team is growing

- In November 2024, CyMBaL and SALSA have been part of an internal review at Irfu.

- Irfu has formalized the start of the project

- The team now has got a better and more formal structure

- New members joined the EIC effort

# New structure

PI: F. Bossù

**Project Leader:** F. Jeanneau

**Systems engineering**
A. Delbart

**Electronics**
Sub-project leaders:
D. Neyret, I. Mandjavidze

**CyMBaL**
Sub-project leaders:
A. Francisco, M. Vandenbroucke

**SALSA**
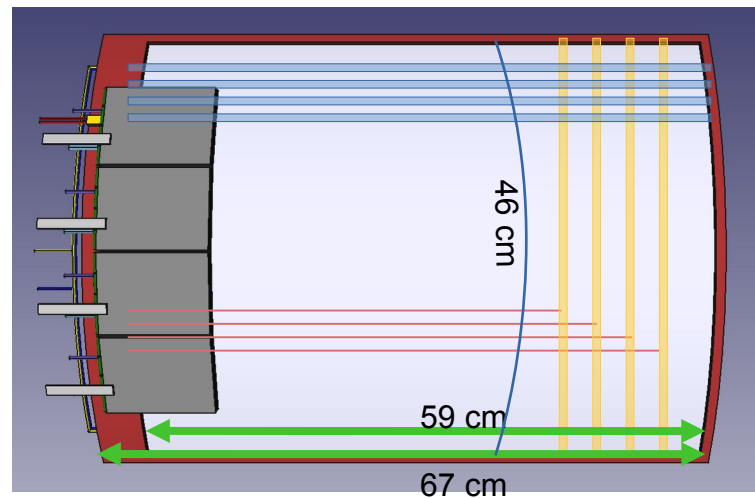Head: O. Gevin

**FEB**
Head: I. Mandjavidze

# CyMBaL

## CyMBaL: Cylindrical Micromegas Barrel Layer



- 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

## Design of a module



46 cm

59 cm

67 cm

**Module dimensions**
Z = 67 cm
R*phi = 48 cm
**Active zone dimensions**
Z = 59 cm
R*phi = 46 cm

# Requirements, rethinking them

**"old" Requirements:**
- Spatial resolution ~150μm
- Time resolution 10-20ns
- Light, less than 1% X0
- Efficiency > 95%
- Hermetic

**Constraints:**
- Hermetic
- Envelope:
  - 55 < R < 60 cm
  - -105 < z < 145 cm
- Size of the tile
- Number of channels: 1kCh
- Magnetic Field: <= 2 T
- Limited space for services

**Assessments**
- Current status simulations, spatial resolution not critical for momentum reconstruction
- No input yet on spatial resolution requirements for pattern recognition
- Barrel TOF:
  - r*phi resolution ~30μm
  - Z resolution ~millimeters

Review the requirements
⊛
Reasonably achievable goals

# Spatial resolution

- Little to no impact of CyMBaL hits on momentum reconstruction resolution
- No inputs yet (AFAIK) on spatial resolution requirements from pattern recognition
  - Physics signal rate is low, i.e. ambiguities will be limited.
  - 1 charged particle per unit of rapidity per event
- Barrel TOF resolutions: very good in r*phi, quite large in z
- CyMBaL can focus on the z resolution
  - The phi resolution is anyway degraded (wrt normal tracks) by the Lorentz Angle effect
  - In Z, we need to counteract the angles of the tracks
- Constraints: 1024 channels per tile (we can have finer pitches in the two directions)

Updated proposed goals:
  r * phi resolution: ~500 µm
  z resolution ~300 µm (150µm for normal tracks)

# Time resolution

- The bunch crossing period is ~10 ns
- Reaching 10 ns with gaseous and resistive detectors is challenging
- Given the small rate per channel, ambiguities will be small, coincidence with TOF
- With a rough analysis of the test beam data: O(30ns)
- Possible optimizations (gas, hit selections, … ) are under considerations

Updated proposed goal:
- Time resolution: 20 ns

# Summary requirements table

| | | |
|---|---|---|
| Envelopes | Defined: 5 cm radial space<br>Module dimension set | |
| Space resolution | R*phi $\leq$ 500 μm<br>Z $\leq$ 300 μm | - Constraint: 1k ch/module<br>- Optimisation of pitch for the z coordinate.<br>- Select hits in time |
| Time resolution | ~ 20 ns | Optimize drift field, gas, hit selection,... |
| Efficiency | $\geq$98% | For MIPs |
| Material budget | ~0.5% X0 | Similar to CLAS12 technology |

Further requirements: gas flammability, gas leaks ($\leq$0.05l/h/module), …

# Summary

Since November 2024, CyMBaL + SALSA have a more formal status at Irfu
A new structure, with more people in the group

We updated the requirement list based on the convolution of the current knowledge of the ePIC performance and the reasonably achievable values

Requirements will/should be tested in simulation for validation

Test in beam in Fall 2025 will help us finalize the choice of the readout pattern and resistive layer to meet the requirements

This updated list will drive the design and construction of the scale 1 prototype