

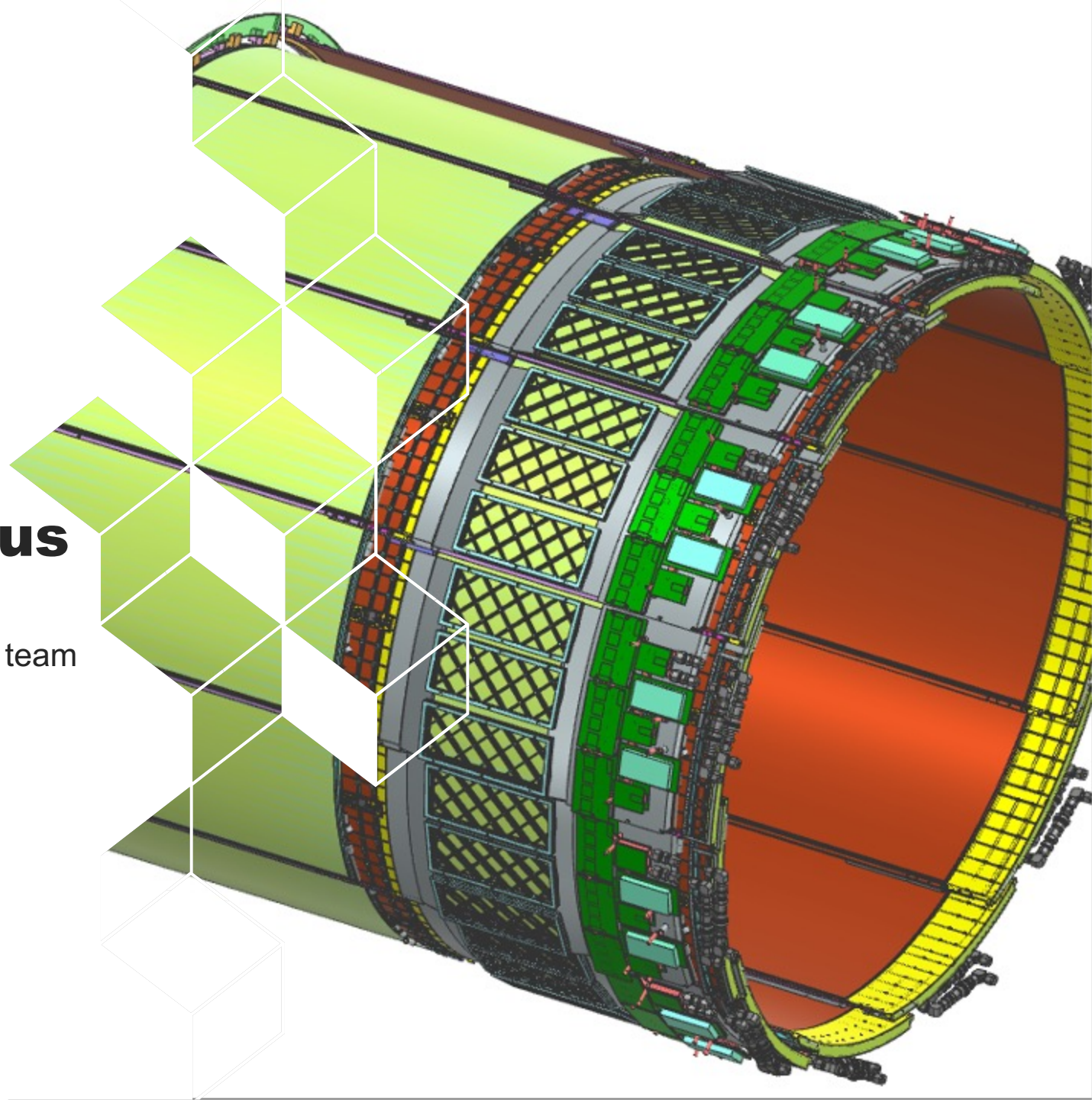


irfu

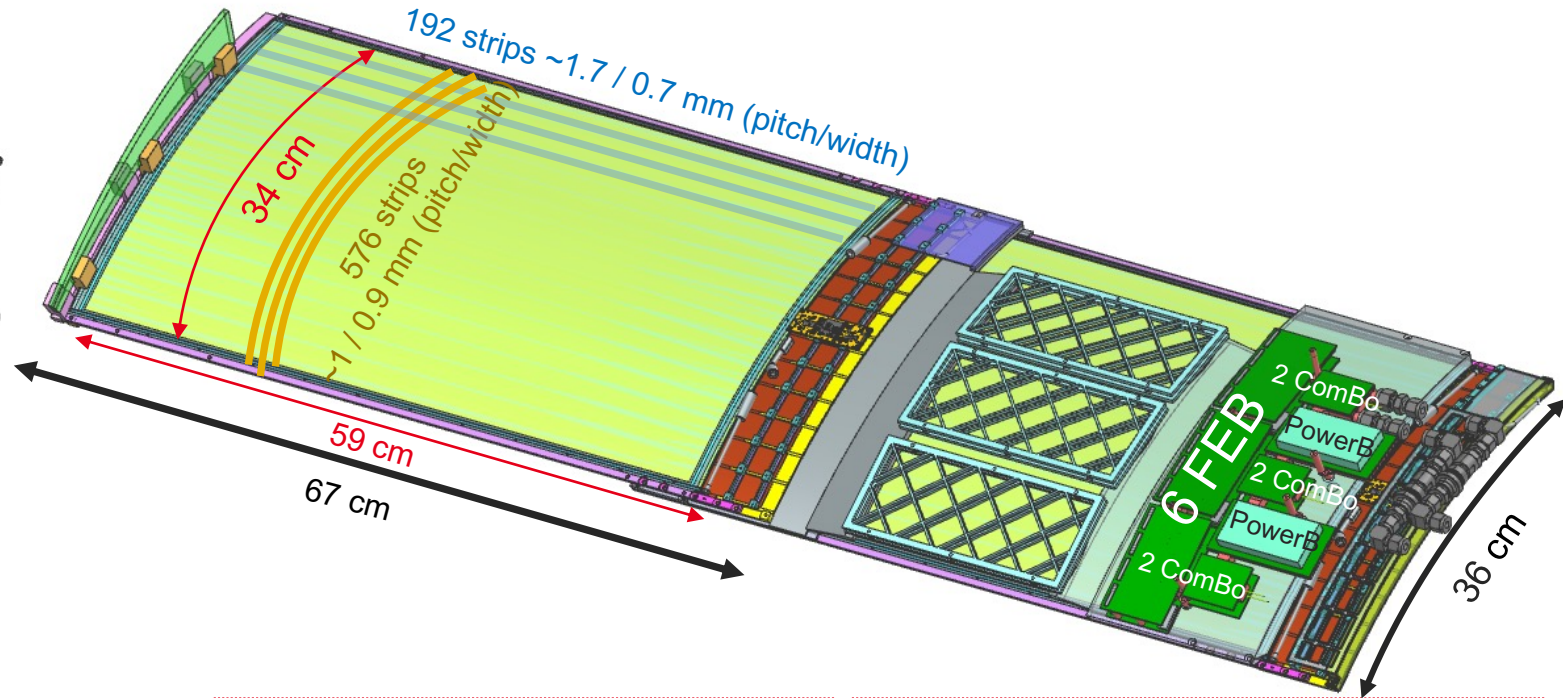
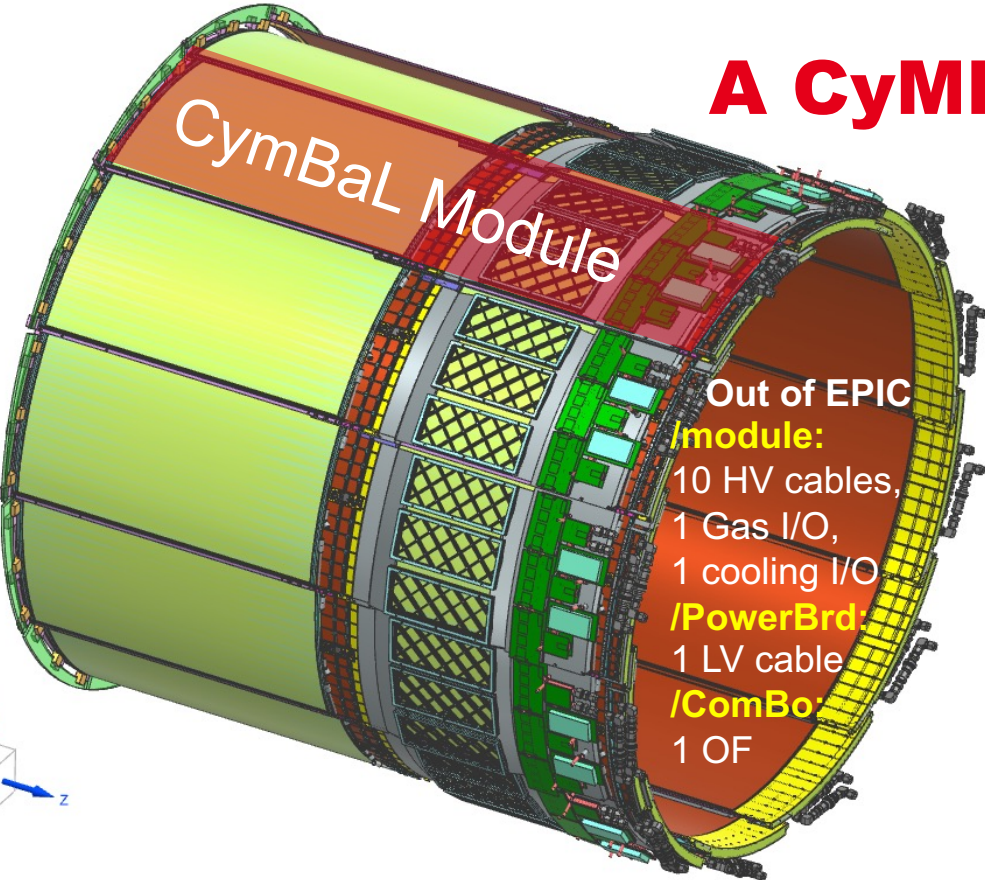


Inner MPGD CyMBaL Status

Alain Delbart, Seraphin Vetter, for the CEA/Saclay IRFU team



A CyMBaL Module (a tray of 2 tiles)



48 tiles: 12 in ϕ $\times$ 4 in z (integration in GST in “fish scale”)

- ❖ $R_{\min} = 55.5$ cm; $R_{\max} = 61.5$ cm (6 cm thick envelop)
- ❖ Overlaps in ϕ and in z for hermeticity (~ 2 -4 cm)
- ❖ 768 readout channels/module
- ❖ **36K readout channels in 3 FEBs/tile (144 FEB with spares)**
- ❖ 18-20°C water cooling : ~ 19 W/FEB, 58W/tile, 2.8 kW total

Module dimensions

$Z = 67.3$ cm / $R^*\phi = 36.6$ cm

Active zone dimensions

$Z = 59$ cm / $R^*\phi = 34$ cm

Weigh estimates

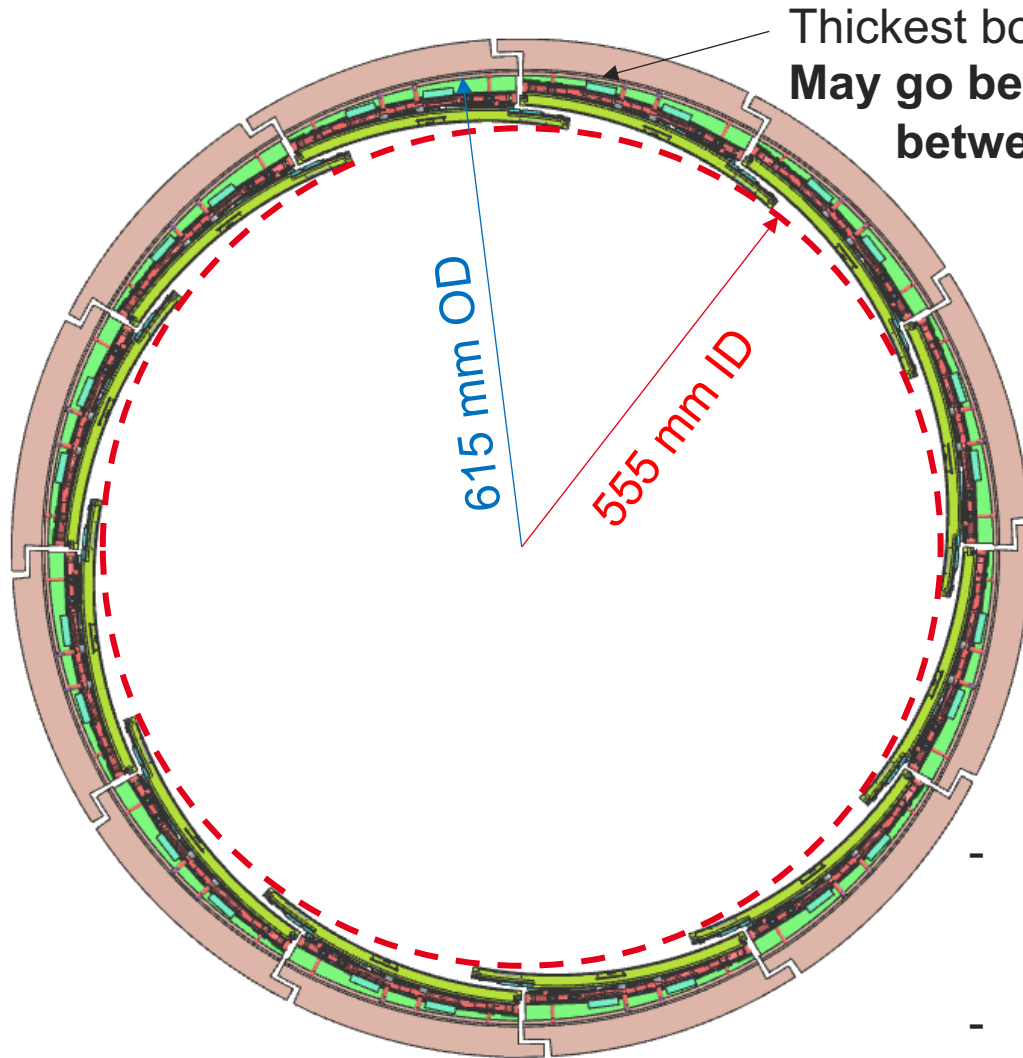
~ 1 kg/tile + ~ 1 kg (Al)-
2kg(Cu)/6FEB.

2 tiles tray: 5kg / 120 kg total

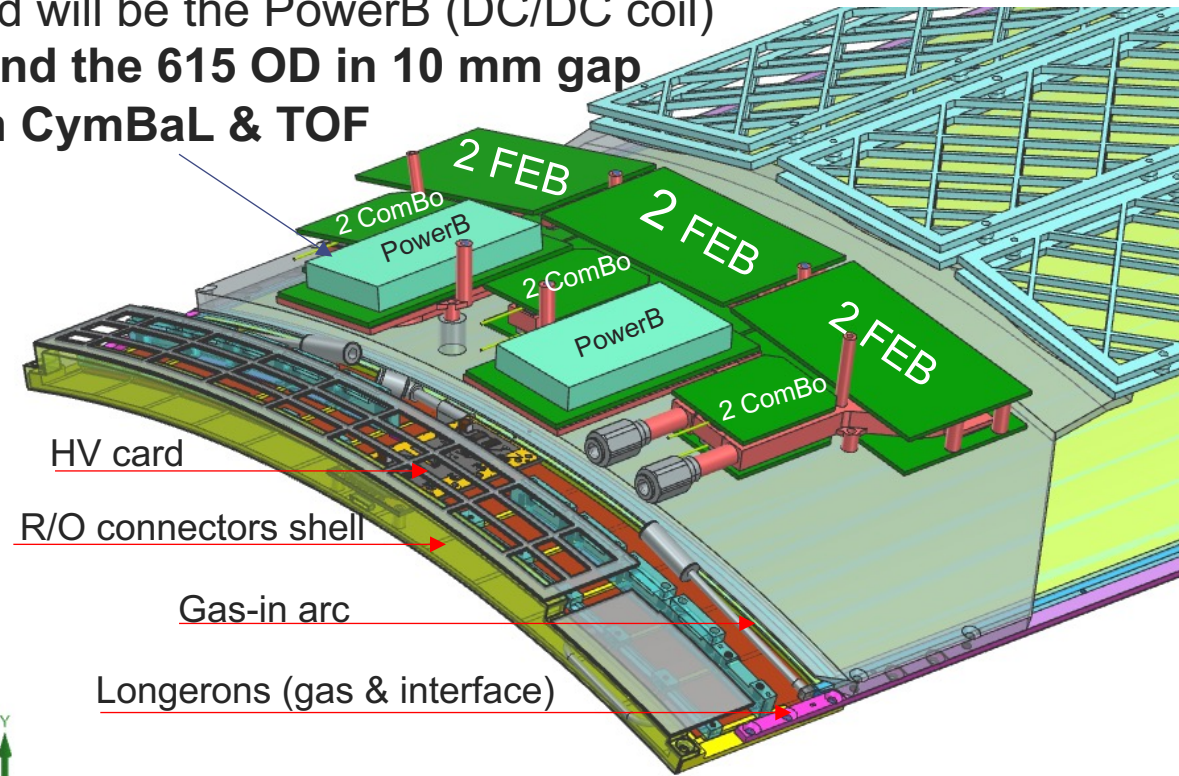
Expected performances

- ❖ Spatial resolution: < 300 (500) μm in Z ($r^*\phi$)
- ❖ ~ 1 mm (z) / ~ 1.7 mm (ϕ) pitch
- ❖ Time resolution ~ 20 ns
- ❖ Efficiency $\geq 98\%$
- ❖ Material budget $\sim 0.5\%$ X0

Front-End Electronics

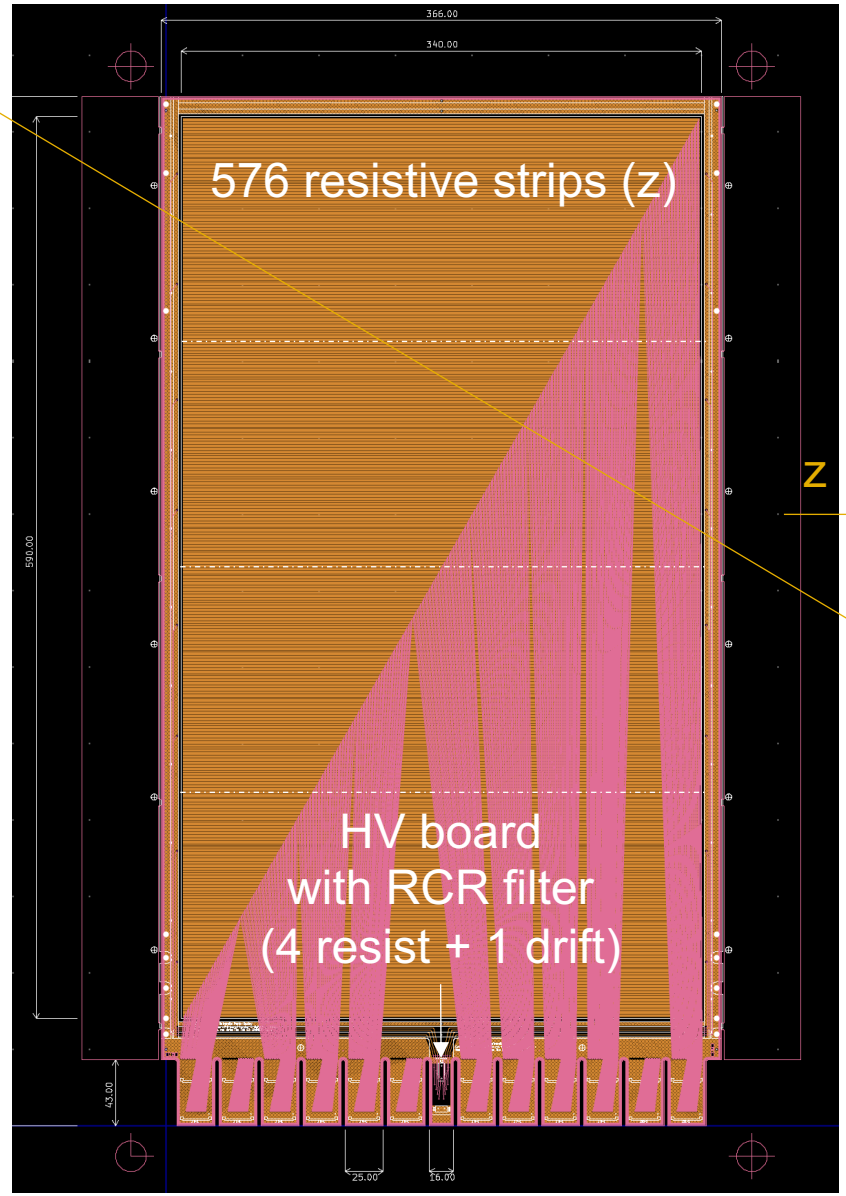
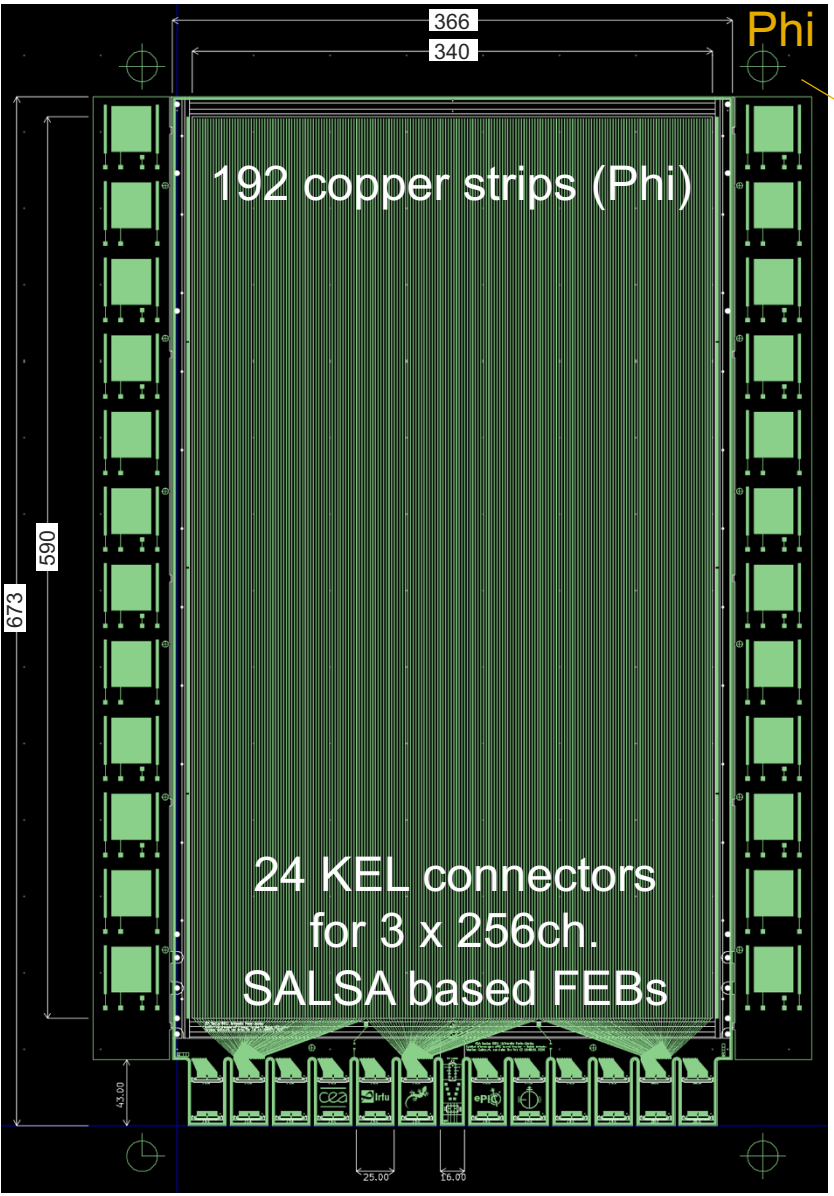


Thickest board will be the PowerB (DC/DC coil)
May go beyond the 615 OD in 10 mm gap
between CymBaL & TOF



- The design of the 3 Front-End Boards is on-going : **David Baudin** (FEB), **Nicolas Robbe** (PowerB, ComB).
- Module design to be updated for **integration in a « TOF-CyMBaL super-tray »** as soon as a CAD model of a TOF tray is available to work with.

CyMBaL « GEICO_V0 » : Micromegas PCB (Version 0.8)



→ 10 produced

Drift cathode @ 3mm above MM mesh @ ~500 V

Coverlay	25 µm
copper plating	0 µm
Copper	12 µm
FR4	100 µm
Copper	12 µm
copper plating	0 µm

MM mesh @ GND

Dynamask pillars

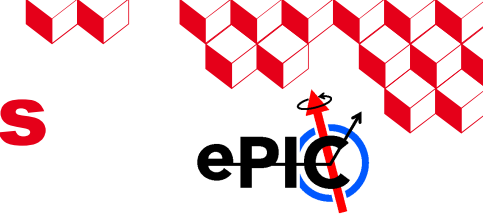
Coverlay	25 µm
Adhesive	25 µm
copper plating	0 µm
Copper	12µm
Polyimide	25 µm
Adhesive	25 µm
Copper	12 µm
Polyimide	50 µm
Copper	12 µm
Adhesive	25 µm
Polyimide	25 µm
Copper	12 µm
copper plating	0 µm
Adhesive	25 µm
FR4	100 µm
Adhesive	25 µm
Coverlay	25 µm

~300 µm total PCB thickness

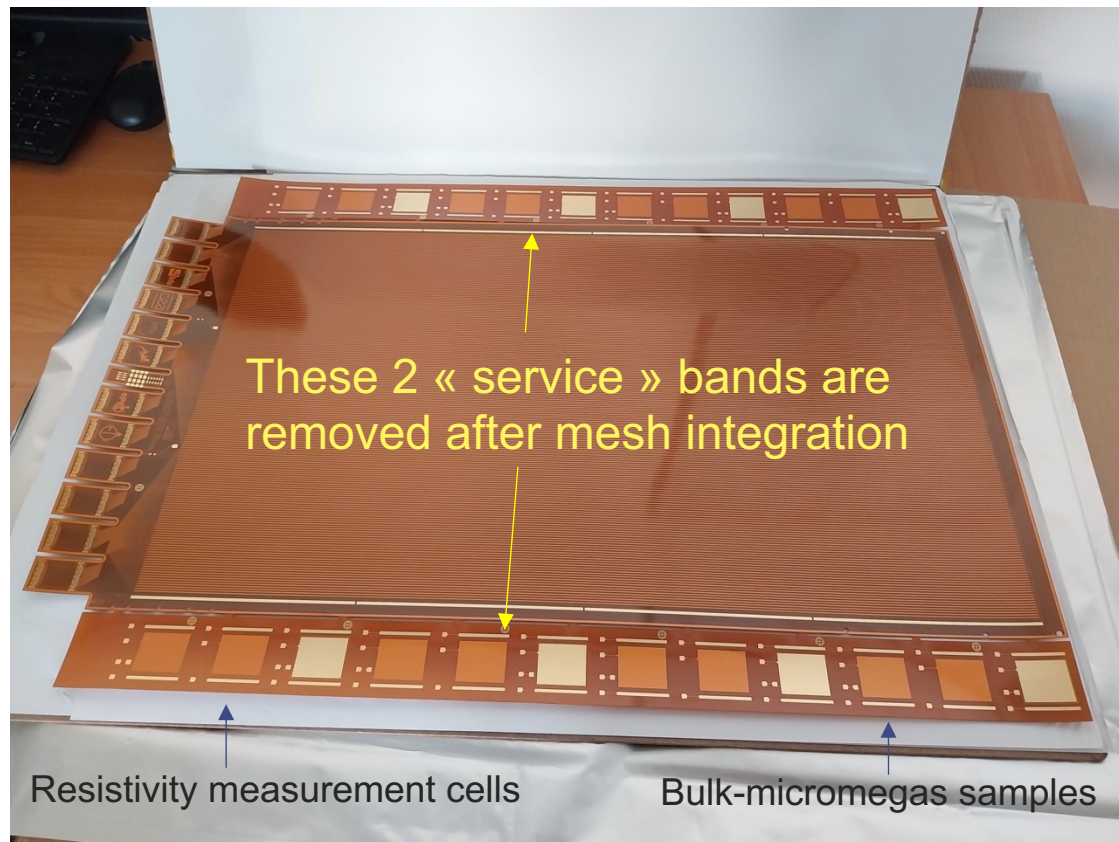


→ 10 produced

GEICO_V0 Readout PCB & Drift electrodes



R/O anode PCB (Wurth provider)



R/O PCB (nCAB provider)



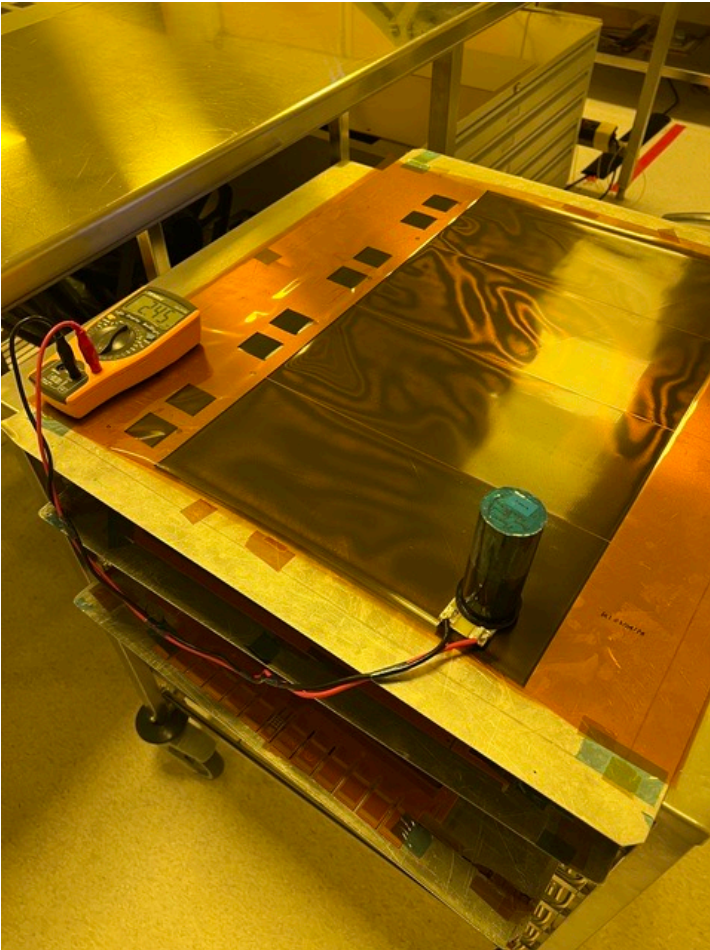
Drift cathode



First GEICO_V0 resistive bulk-micromegas



Resistive strips screen printing
(resistivity Q/C)



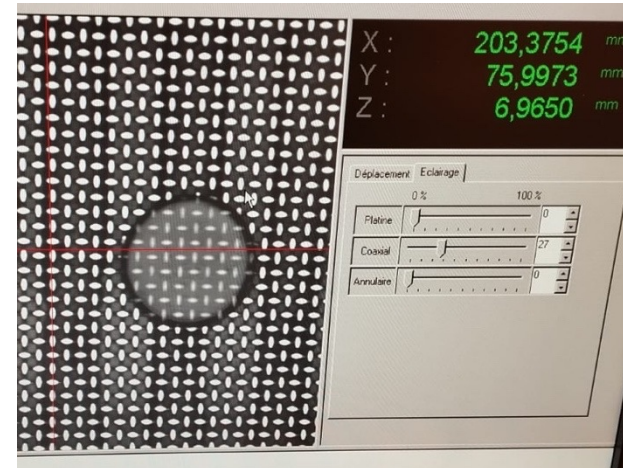
Bulk-micromegas mesh
(before final cutout)



Bulk-micromegas mesh
(HV Q/C)



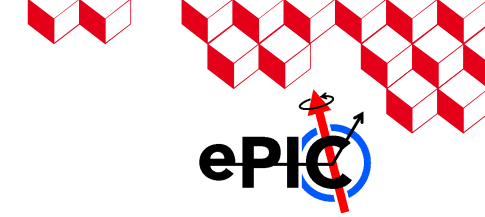
Pillars Q/C



HV Q/C failed : resistive strips continuity was lost after mesh integration process ...

... but ok to be used for a « mechanical » mockup tile assembly

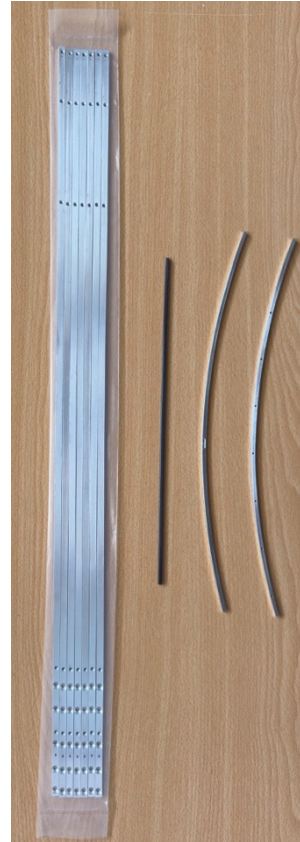
GEICO_V0 mechanical assembly



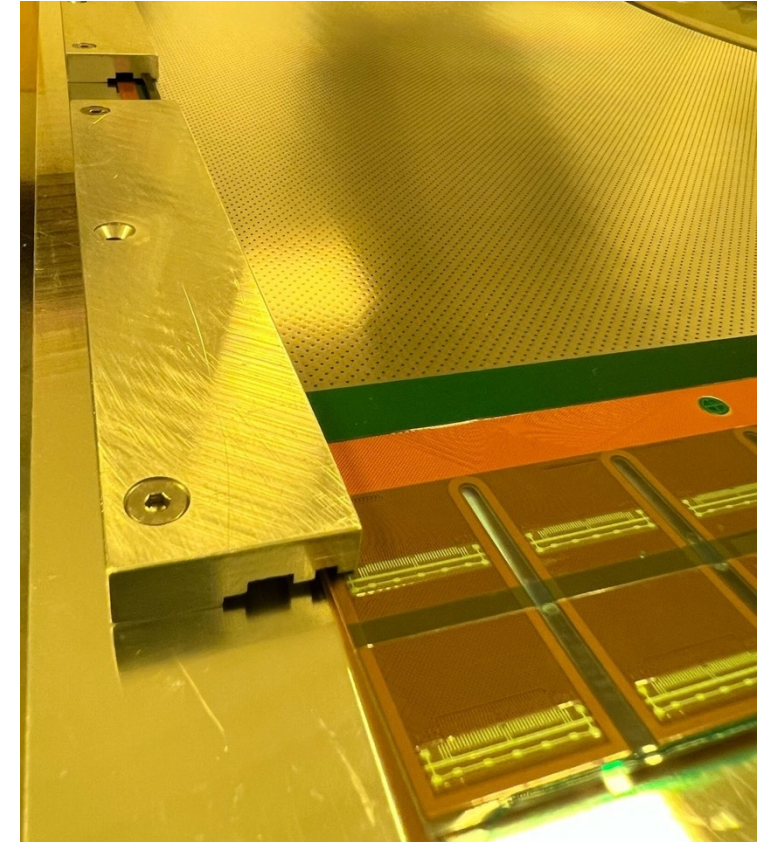
R/O connector shell
(on cylindrical shaping tool)



Longerons & arcs

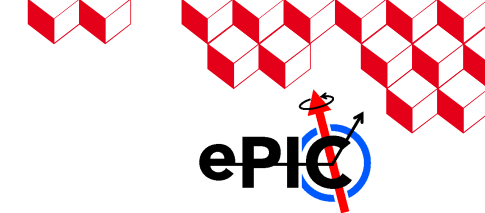


Longeron gluing on flat bed



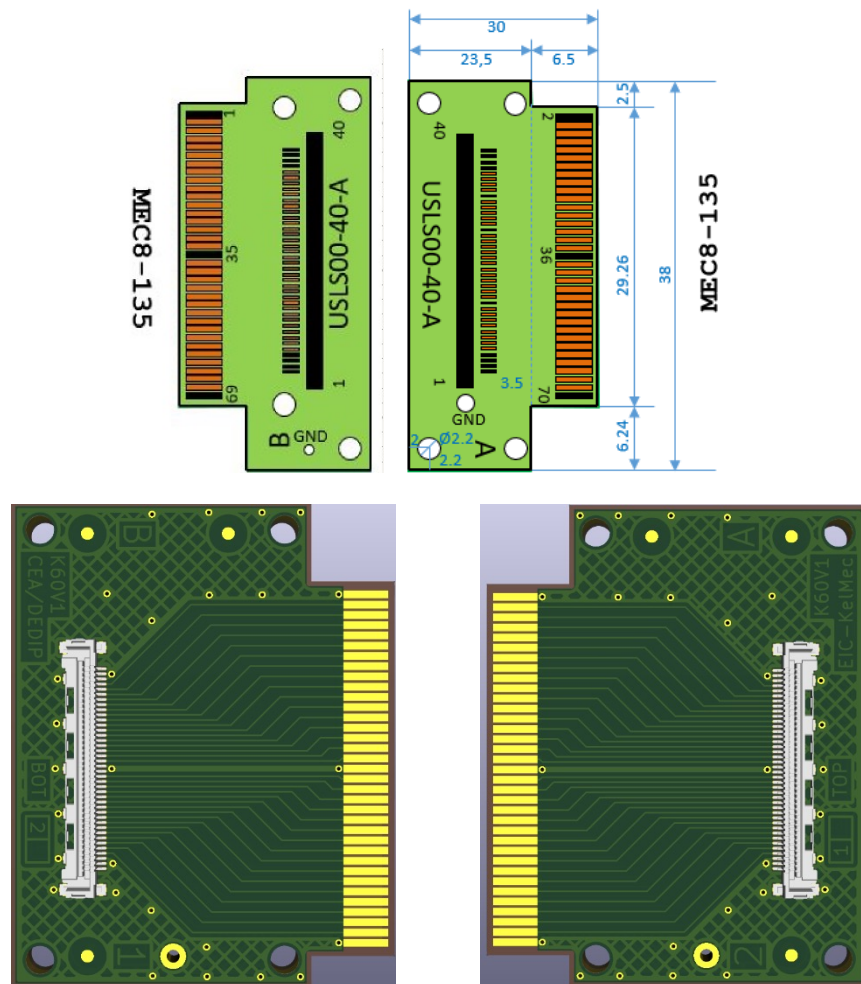
Gas arcs and some tooling pieces are out of specifications → corrections are on-going

HV card & « KEL to Mec8 » adapter card



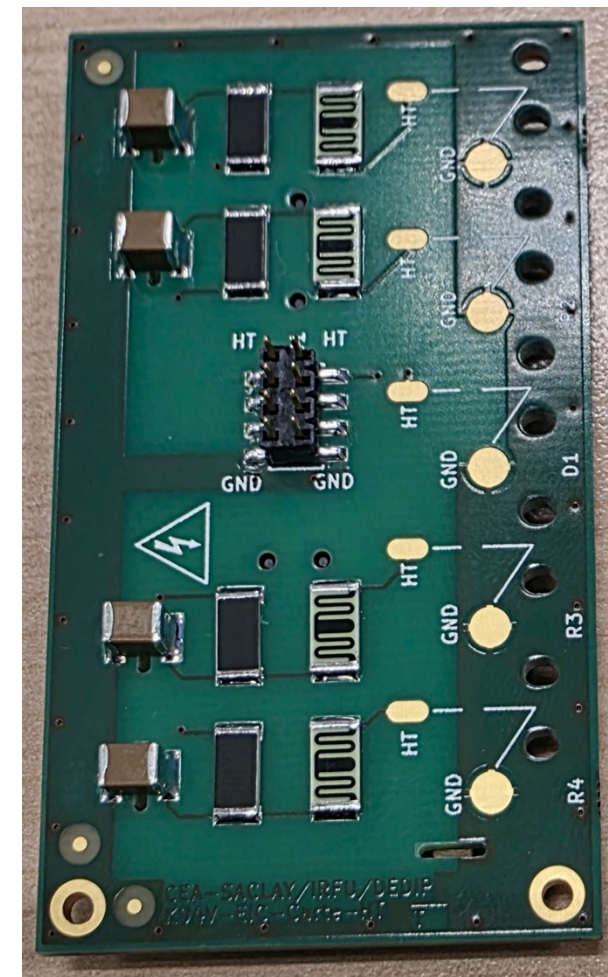
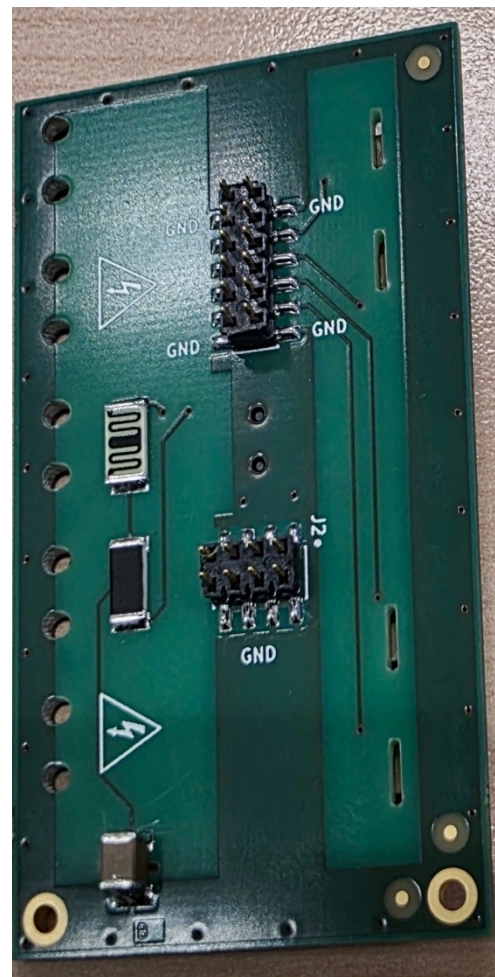
KEL to Mec8 adapter card

(to connect DREAM electronics with KEL limandes)

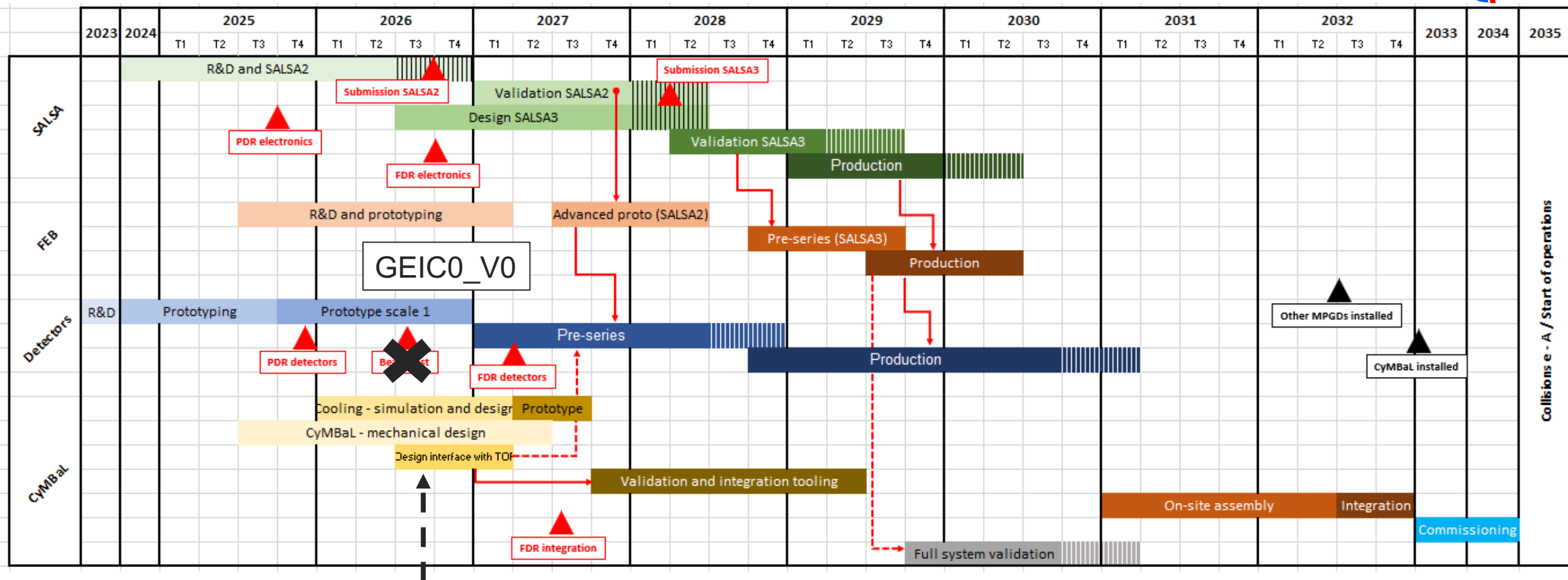


HV card

(1 drift, 4 groups of resistive strips with RCR filter)

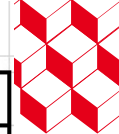


CyMBaL development+production Timeline



- The first resistive Micromegas 2D R/O will be used for the assembly of a GEICO_V0 « mechanical » prototype
- Production of other R/O planes (Resistive strips + mesh) are on the way at our workshop and at the ELVIA company.

A CyMBaL Module = 2 CyMBaL tiles = 6 (FEB/SALSA Carrier + ComBo) + 2 Power Boards = 2 * 768 ch. (2026/07/06 update)



Cooling Scope of Work			
			Unit
Cooling media		Water	
Inlet Temperature		22	°C
Ambient Temperature		23	°C
Cooling Block equivalent Inner Diameter		4	mm
Cooling Block Material		Copper	
Operating Temperatures of components			
	SALSA	25	°C
	DC/DC	?	°C
	LDO	?	°C
	IpGBT	?	°C
	VTRX	?	°C
Maximum Temperature of components			
	SALSA	35	°C
	DC/DC	?	°C
	LDO	?	°C
	IpGBT	?	°C
	VTRX	?	°C
Temperature Rise		0.5	°C
Temperature Stability (+/-)		2	°C
Flow Rate of a single Module		3	l/min
Pressure drop of a single Module		0.04	bar
Heat Dissipation to ambient		3	W
Total Heat Dissipation to ambient		72	W
Cooling loops		24	
Insulation requirement		NO	
Neighboring detectors		SVT, TOF	

Detailed Power Estimates (1 Module)				
		Power (W)	Qty	Total Power (W)
Power Board				26,4
	DCDC (1,5V/8,5A) 70%	4,4	6	26,4
FEB (SALSA Carrier)				72
	SALSA (1.2V/2A)	2,4	24	57,6
	LDO (1.5V/2A)	0,6	24	14,4
Communication Board				13,40
	LDO IpGBT (1.2V/0.5A)	0,6	6	3,6
	LDO VTRX+ (2,5V/0.07A)	0,175	6	1,05
	LDO VTRX+ (1.5V/0,44A)	0,66	6	3,96
	IpGBT (1.2V/0.5A)	0,6	6	3,6
	VTRX+ (2.5V/0.07A & 1,2V/0,02A)	0,199	6	1,194
Total (1 Module)				111,80
Total (24 Modules)				2683,30

1 tile R/O (for illustration only : just to show component types)

