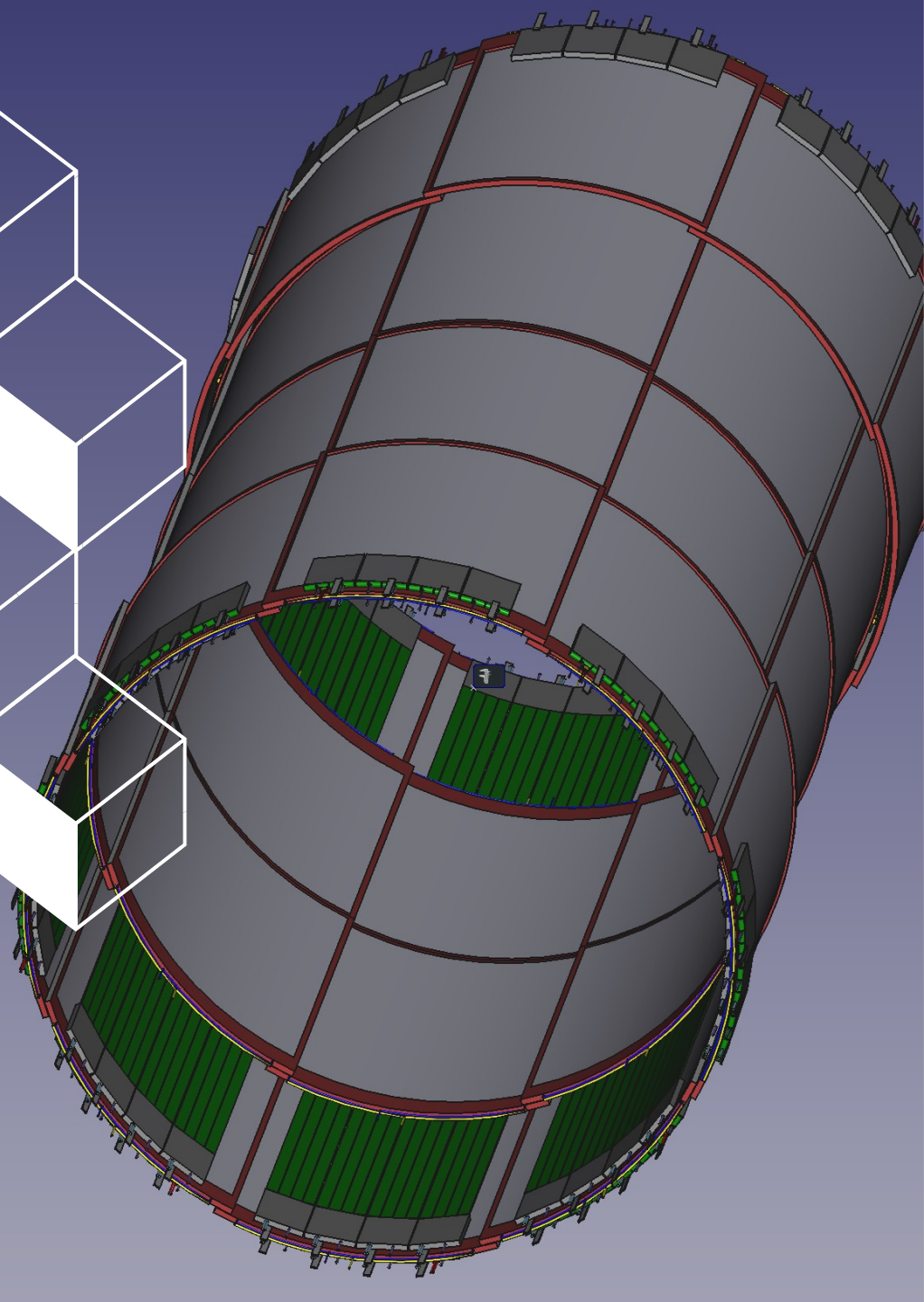
Inner MPGD CyMBaL status

Alain Delbart, for the CEA/Saclay IRFU team

- What is a CyMBaL « resistive micromegas » tile ?
- The current baseline design of the CyMBaL barrel
- Services / cabling
- How to fit & fix it in EPIC - GST (towards PDR) ?

EIC/EPIC 3I meeting, 3 march 2025

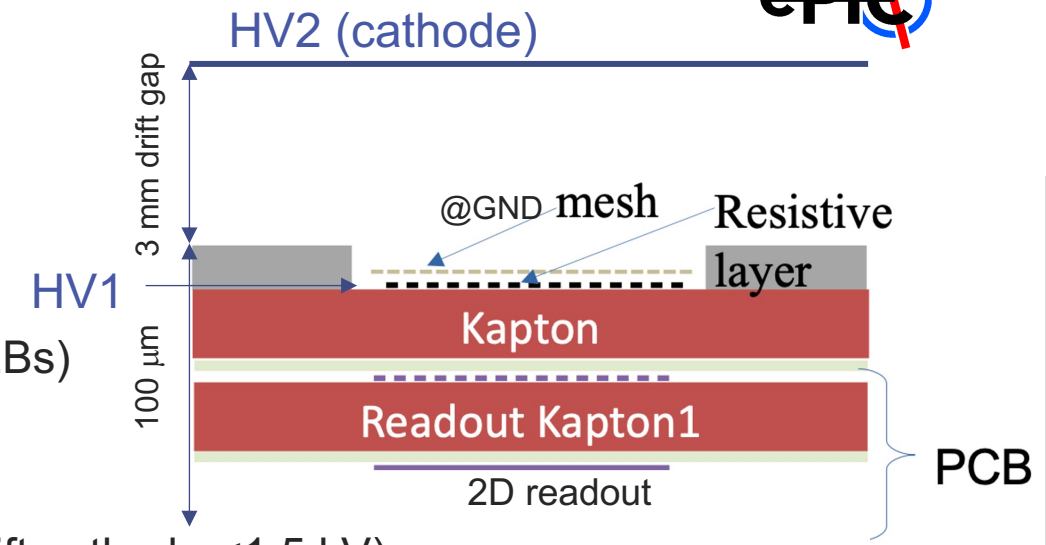


The CyMBaL « resistive micromegas » module

Contact: Audrey Francesco & Maxence Vandenbroucke

Components

- Copper etched strips on Kapton (&/or FR4) (thick 100-150 μm)
- 316L ~30 microns thick Mesh electrode
- Mylar+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)

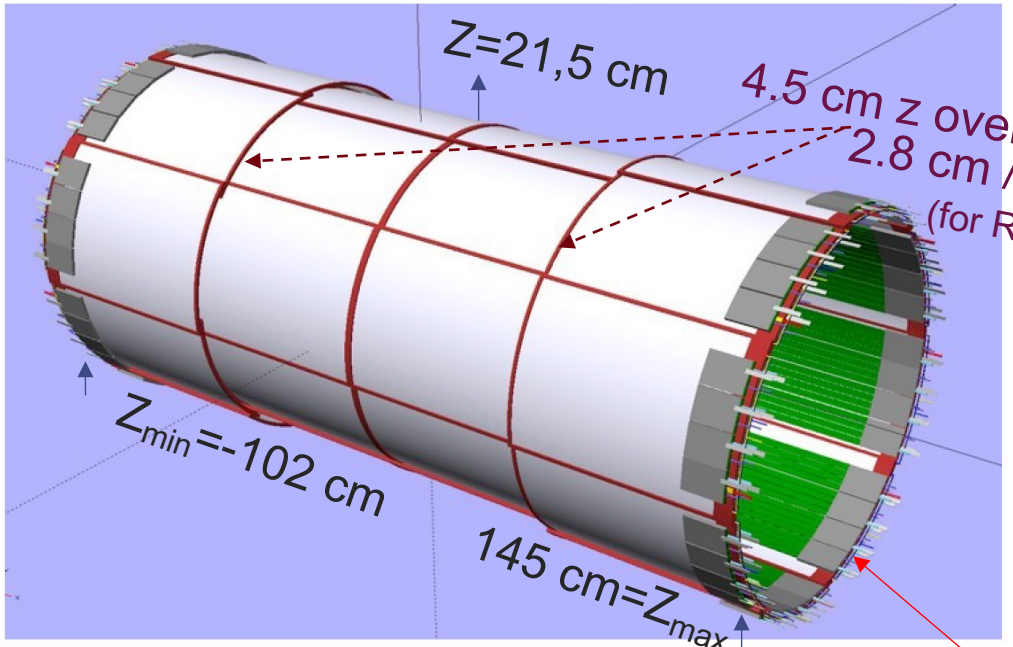
- 2xHV lines : 1 for the resistive anode (<500V), the other for the e- drift cathode <1.5 kV)
- Gas IN/OUT (through inlets in “external” hoop, barrel tiles probably in series)
- No heat dissipation (nA currents)
- Tile PCB and FEB Grounds connected together and to global grounding

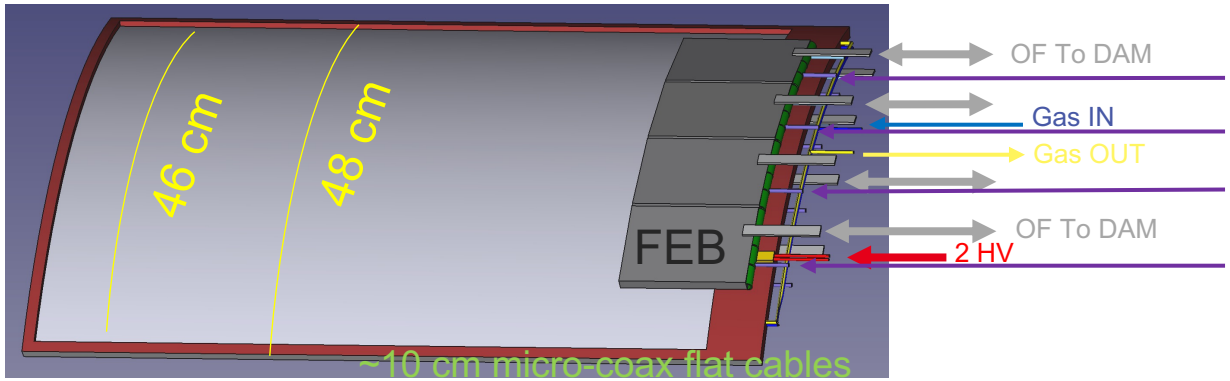
Current status & mid-term plans

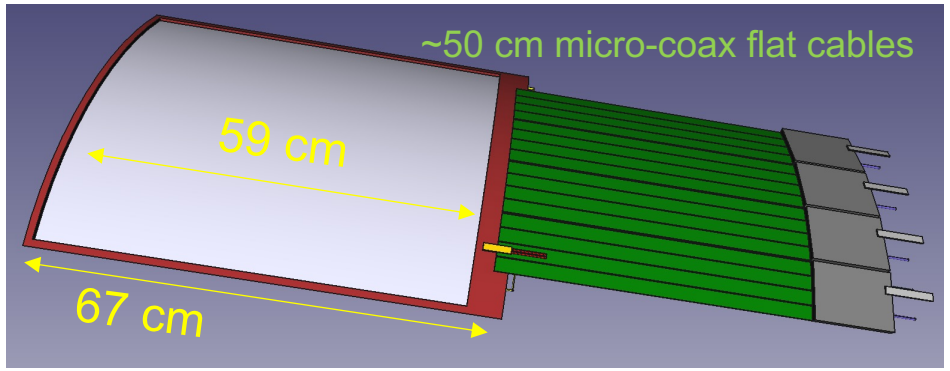
- **Flat, small size prototypes to fix the detector 2D readout structure**
  Test beam foreseen week 47-48 @ CERN
- Design & test on dedicated prototypes of the mechanicals (hoops, longerons) needed for 55-60 cm cylindrical shape
- Desing of a scale 1 tile PCB (just started)

The current baseline design of the CyMBaL barrel

Contact: future mechanical engineer & Alain Delbart

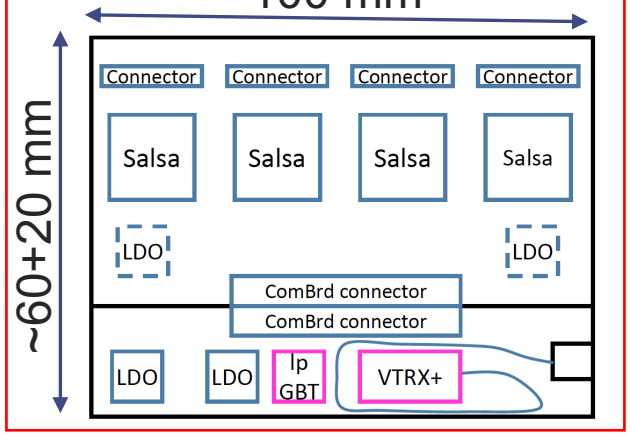






- 32 module: 8 modules in ϕ times 4 modules in z
- Overlaps in ϕ and in z for hermeticity
- 1024 readout channels/module
- 32K readout channels
- 128 FEBs (2x32 on each side - 4/tile)

FEB (~10 mm thick)



weight estimates

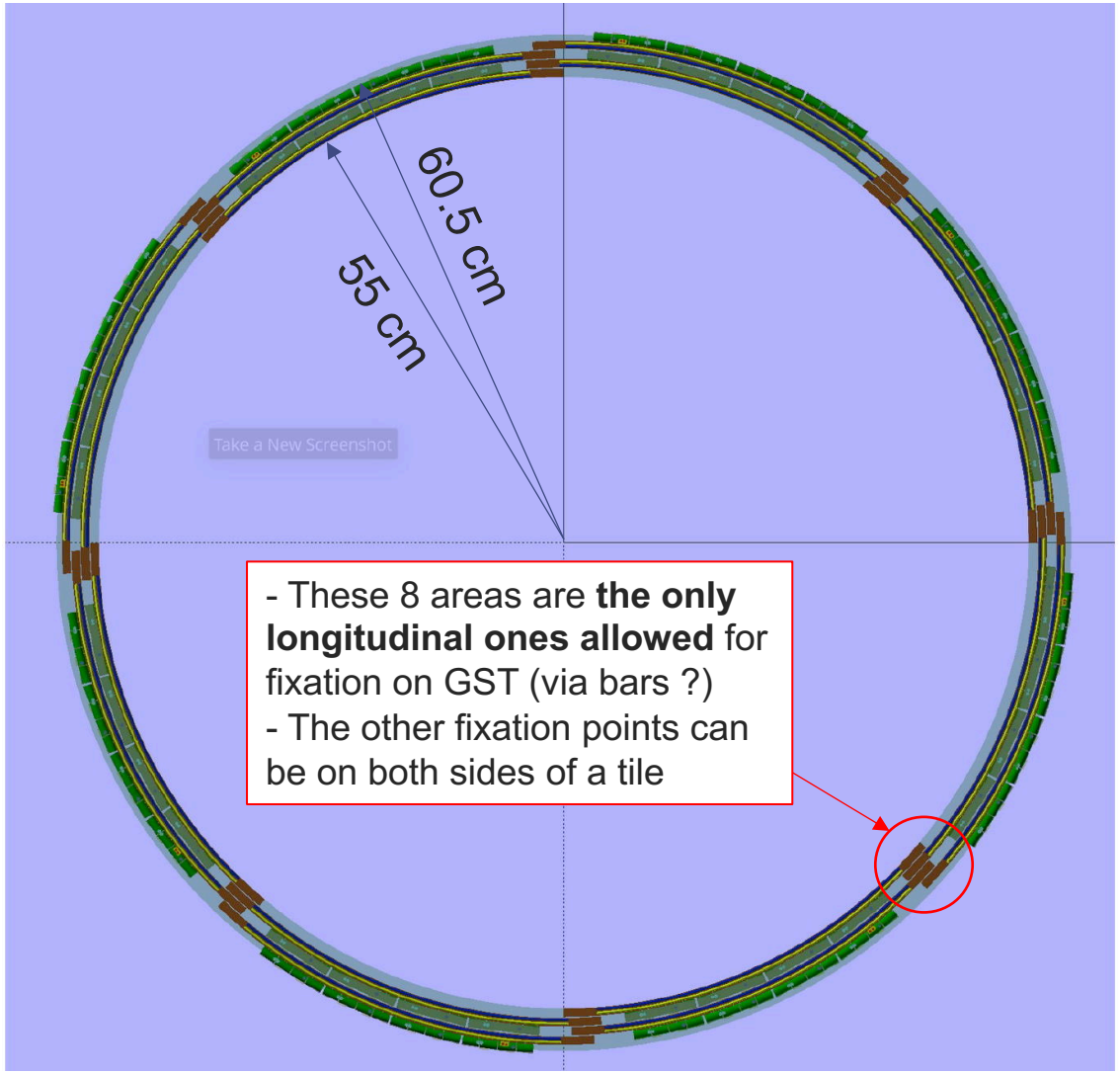
- Raw tile	~1 kg
- FEB PCB	~0.3 kg
- Cooling plate+fluid tube	~0.3 kg

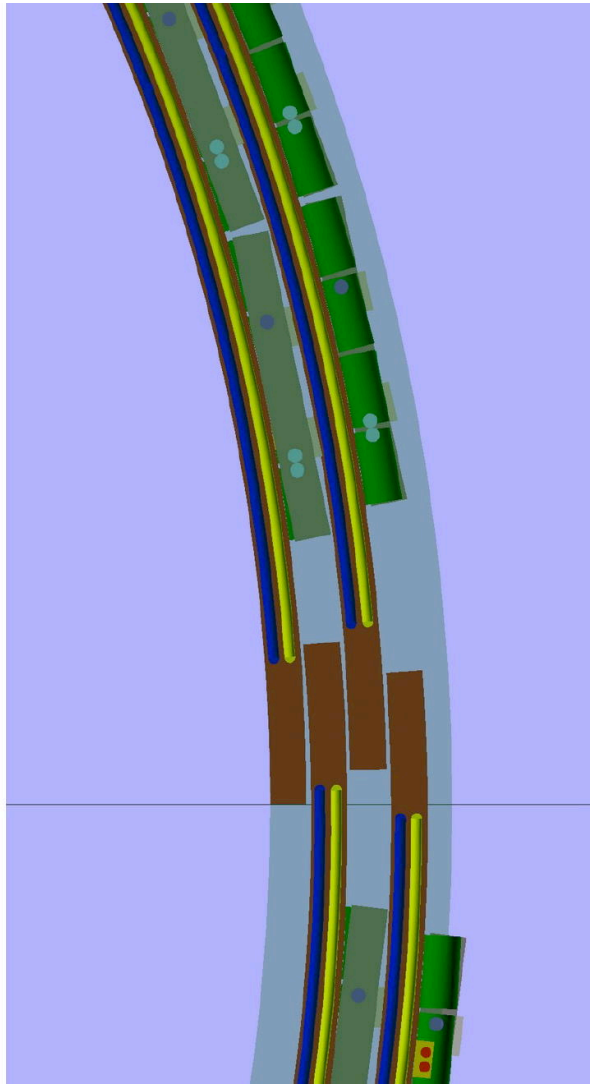
(*rough estimate for 3 mm Al cooling plate + copper tubes, thermal simulations to be done*)

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

The current baseline design of the CyMBaL barrel

Contact: future mechanical engineer & Alain Delbart

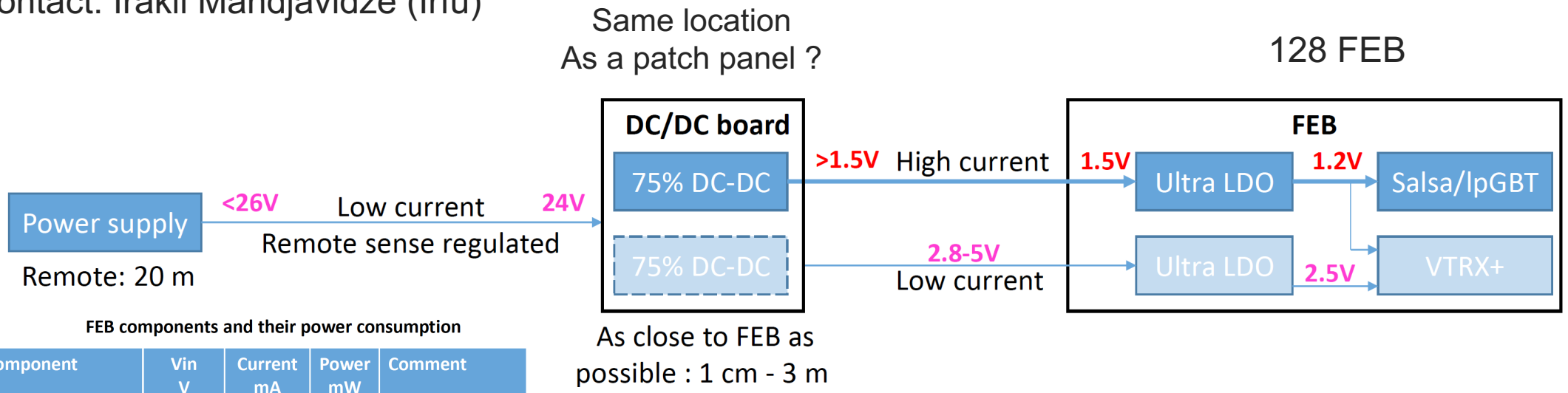




- Detailed engineering design Siemens NX & SolidEdge) will start as soon as a mechanical engineer is available at IRFU …
- … in close contact with the tile PCB design team …
- … and close contact with GST team (Andy/Sushrut)
- To produce a first scale 1 prototype (not yet a Module0)

Powering the Front-End readout electronics

Contact: Irakli Mandjavidze (Irfu)



FEB components and their power consumption

Component	Vin V	Current mA	Power mW	Comment
Salsa 1	1.2	1 000	1 200	15 mW/ch
Salsa 2				
Salsa 3				
Salsa 4				
lpGBT	1.2	420	500	Overestimated
VTRX+	1.2	20	25	
	2.5	70	175	
LDO Salsa 1-2	1.5	2 000	600	LDO / Salsa to avoid hotspots ?
LDO Salsa 3-4				
LDO lpGBT/VTRX+	1.5	440	130	
LDO VTRX+	2.8	70	20	

Total ~6.8 W (8.5 W with 25% safety margin)

→ CyMBaL Barrel total power of **~1.1 kW** (+ extra from DC/DC)

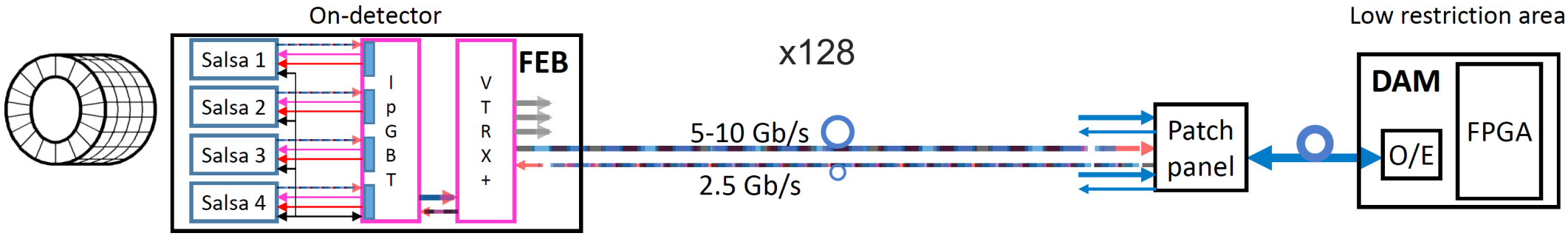
Tim Camarda & Gerard Visser

50-70% Power efficiency of DC/DC converters

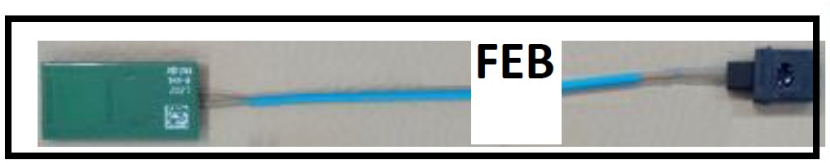
Circuit	V_{IN}	I_{IN}	Reg	V_{OUT}	I_{OUT}	P_{OUT}	P_{LOSS}	P_{EFF}
SALSA ASIC	3.0	2A	LT3033 (1)	1.2V	2A	2.4W	3.6W	50%
SALSA ASIC	3.0	2A	LT3033 (2)	1.2V	2A	2.4W	3.6W	50%
LpGBT	3.0	700mA	LT3033 (3)	1.2V	700mA	850mW	1.3W	53%
VTRX	3.0	50mA	LT3033 (3)	1.2V	50mA	60mW	90mW	50%
VTRX	3.0	105mA	LT3042 (4)	2.5V	105mA	275mW	60mW	78%
Input Reg	24V	870mA	bPOL48V	3.0V	4.86A	14.6W	4.38W	70%

The detector readout electronics

Contact: Irakli Mandjavidze



MT MPO low profile adapter from Senko : 7P5 SM 1
→ **8.6 mm height**



Short pigtail / on board

Fibers of adapted length between patch panels

Short pigtail / on board

The High-voltage cabling (one possible option)

On Cymbal tile

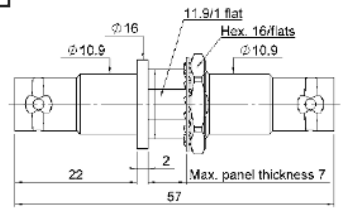
x64

Patch panel

x64

HV PS

HTC-50-1-1 (CEH50) coax cable (CERN)



SHV connector
(ex: radiall R317.072.000)

Services / cabling (new update – no more RDO)

https://brookhavenlab.sharepoint.com/:x:/s/EICPublicSharingDocs/EdH38QZE9HpJrl039jn2-q4BbPvrMv7dTFiLV8--atclKw?rtime=du5DNOZX3Ug

Barrel Inner MPGDs Services

Person to contact F. Jeanneau / F. Bossu

Cables, Fibers, etc.

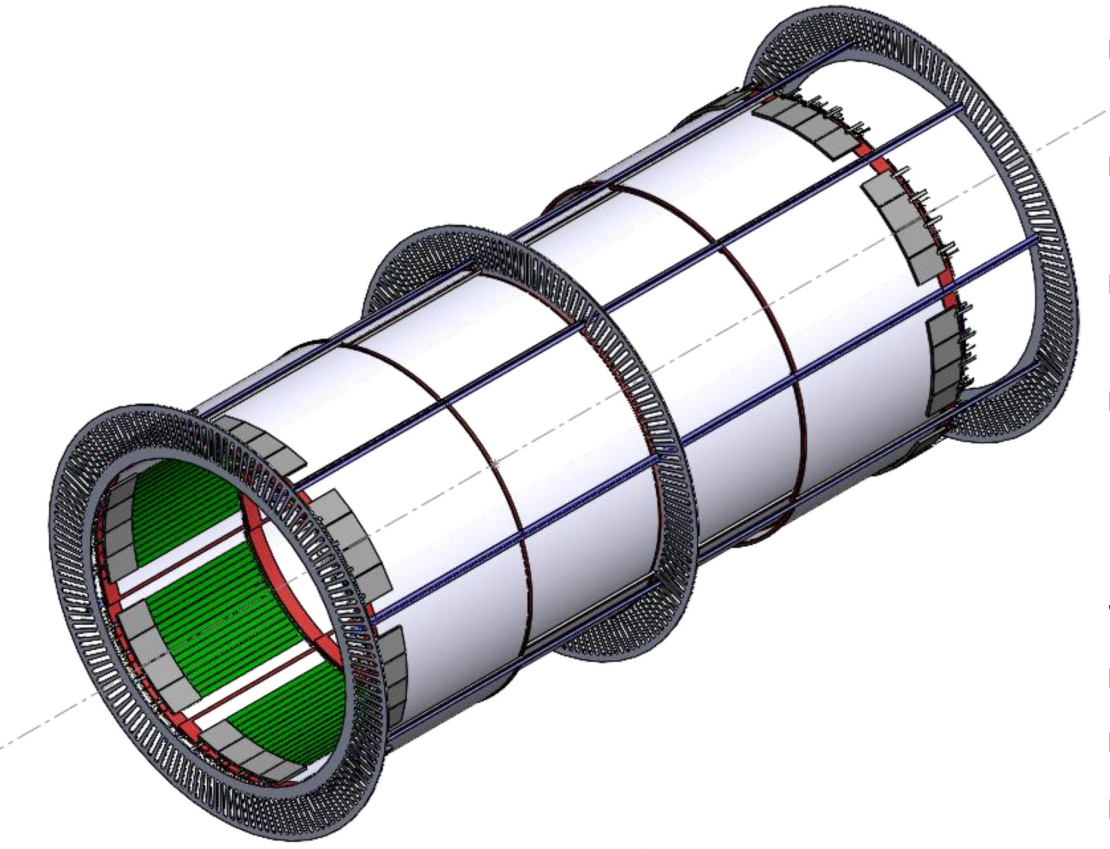
Item	Description	Quantity	Diameter	Estimated Length	Notes	Assumptions
FEE data	VTRX+ MPO parallel optical fiber	128	connector 10mm	To DAM	https://suddendocs.samtec.com/catalog_english/ecue.pdf	
~~RDO data~~	~~FEE optical fibers~~	~~64~~	~~3.2mm~~	~~TBD~~	~~hypothesis: 2 FEB for 1 RDO; **TBD;** MTP® 12 (Male) to MTP® 12 (Female) OM4 Multimode Elite Trunk Cable, 12 Fibers, Type B, Plenum (OFNP), Magenta~~	
HV cables	HV cables to patch panel	96	3.2mm	to patch panel	HTC-50-1-1, 0.5Lz/1.5, CEH50 Dakra; to patch panel	
HV cables	HV cables from patch panel to Rack	1 drift + 2 resistive TBD (example. ten 9-channel HV cables)	TBD	TBD	possibly high density cables if compactness is needed	
LV cables	**From DC/DC** to FEB	128	0 / 4 to 5.5 mm	0/ 0.3 to 1 m	Alpha Wire 3464C (<0,3m), 6328 (0,3-0,5m), 2414C (upt to 1m)	
LV cables	From LV PS **to DC/DC**	128	6 mm	TBD	Alpha Wire 2424C	
Gas tubing	inlet and outlet each 2 modules in serie	16 IN / 16 out	4mm	TBD	https://www.mcmaster.com/5384K524/	2 tiles in series
Flat cables	flat cables from modules to FEEs	512+512	1mmx20mm	10cm / 50 cm	within the CYMBAL envelop	

Cooling, etc.

Item	Description	Quantity	Diameter	Estimated Length	Notes	Assumptions
Cooling tubing	Cooling tubes to FEEs, N FEE in series TBD	32x(2 per FEB)/N	6.25mm ?	TBD	https://www.mcmaster.com/5648K74/	To be confirmed by simulations

How to fit & fix CyMBaL in GST ? (towards PDR)

Obviously, the mechanical designs of the CyMBaL tile and of its integration in GST (mechanical and services) must be done together, with baseline solutions to start with in order to locate and size the fixation / supporting interfaces. Coordination with Andy/Sushrut to organize.



CyMBaL interfaces with GST

- Integration sequence in GST ? In 2 halves via the longitudinal beams ?
- How to use the GST longitudinal beams (up to 8 ?) and the 3 engagement rings to fix the 2 halves ?
- Fixation of the 2 halves on the ~5 mm thick central engagement ring ?
- How to support / fix the ~0.6 kg FEB cards ? Can not be done on the CyMBaL barrel → Via the engagement rings ?

Scale 1 CyMBaL tile design and prototyping

- Mechanical assembly between tiles before assembly in halves ?
- Hoops and longerons (also used for gas spreading in chamber)
- Thermal power dissipation and cooling simulations for design of the FEB cooling (current assumption : 18°C water)

The CyMBaL envelops (01/30/2025)