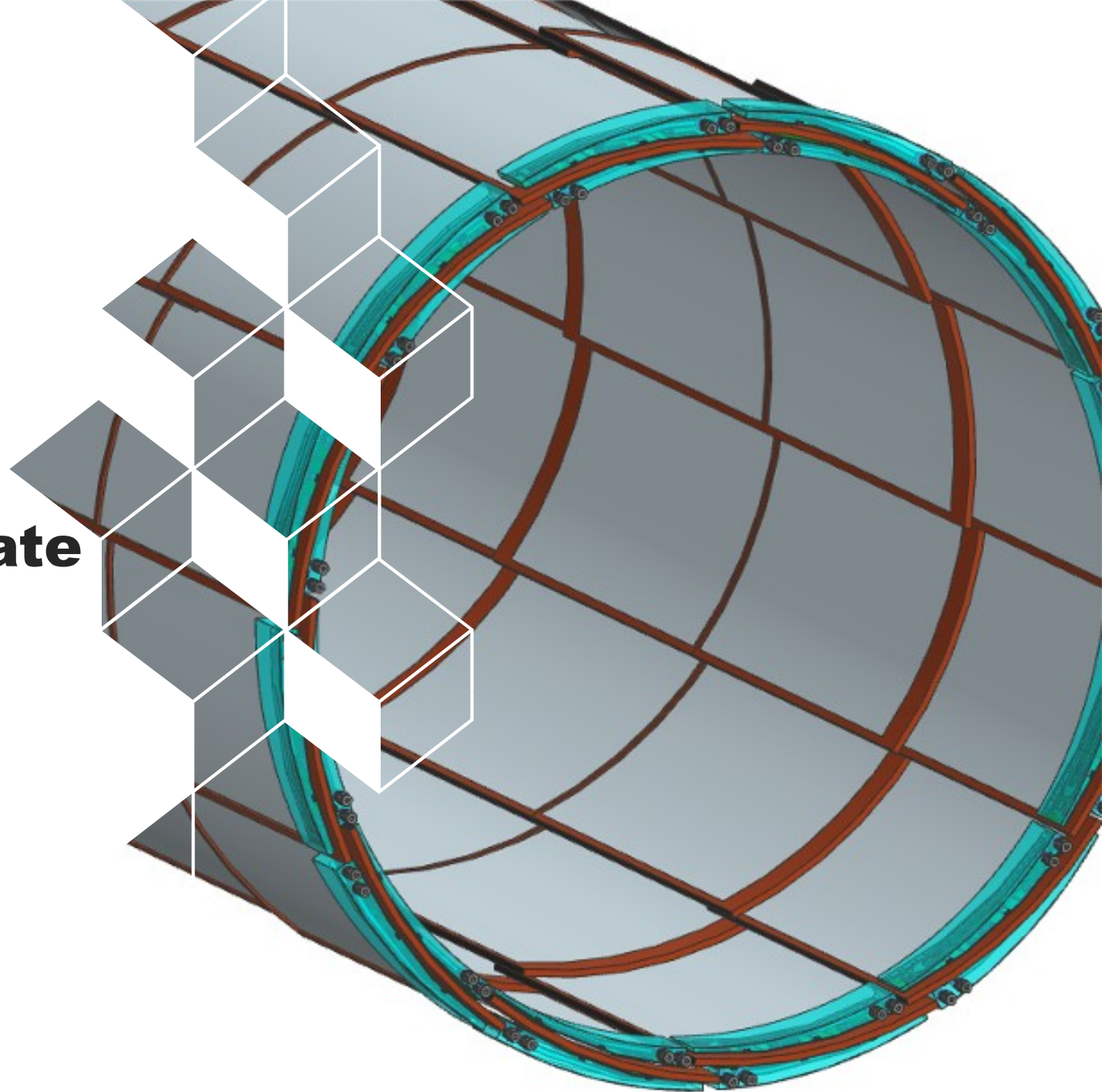




irfu



## Inner MPGD CyMBaL update



EIC/EPIC « meeting DSC », 3 october 2025

# CyMBaL – tile design changes



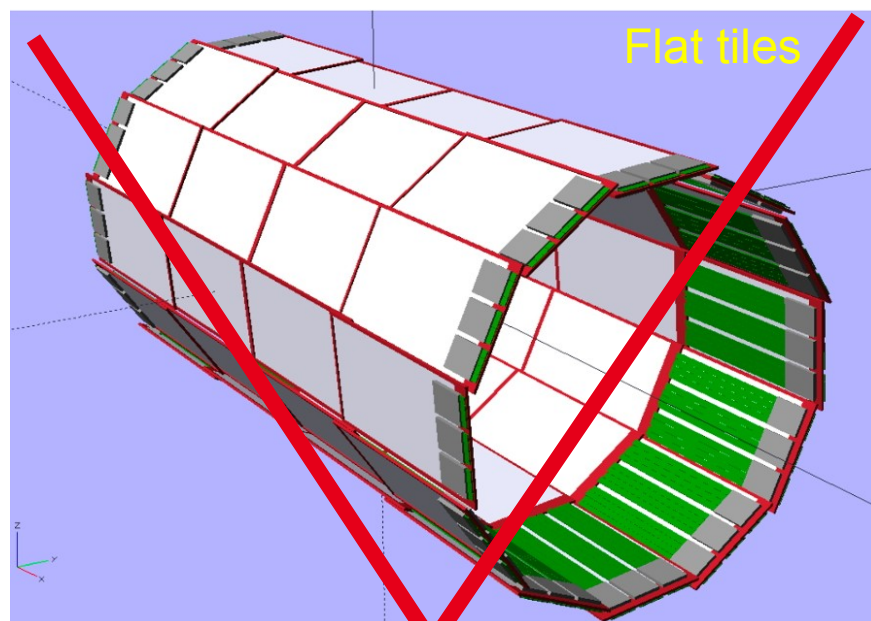
Old design	Z	Phi
External dimensions (cm)	67	48
Active area (cm)	59	46
# strip / pitch (mm)	<b>576 / 1.02</b>	<b>448 / 1.02</b>
SALSA	9	7
FEB	4	

Pitch choice to be finalized with inputs from simulations, but **the total number of channels is fixed to 768**: the constrain is the number of FEB per module

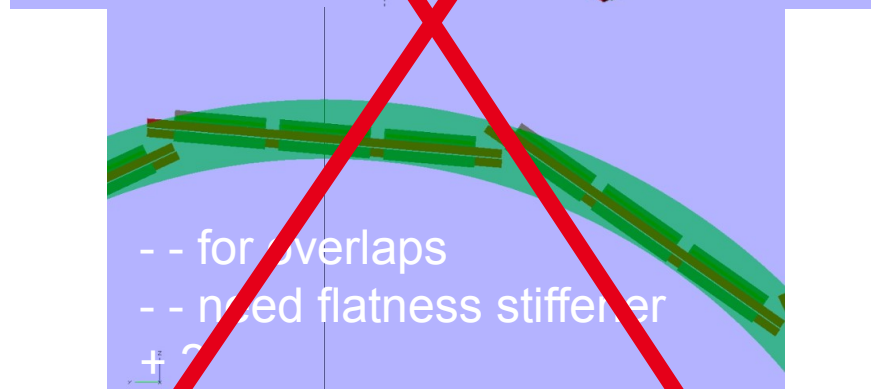
New, option 1, same pitch	Z	Phi
External dimensions (cm)	67	34
Active area (cm)	59	32
# strip / pitch (mm)	<b>512 / 1.15</b>	<b>256 / 1.2</b>
SALSA	8	4
FEB	<b>3</b>	

New, option 2, focus z	Z	Phi
External dimensions (cm)	67	34
Active area (cm)	59	32
# strip / pitch (mm)	<b>576 / 1.02</b>	<b>192 / 1.6</b>
SALSA	8	4
FEB	<b>3</b>	

# CyMBaL configuration : 3 possible options

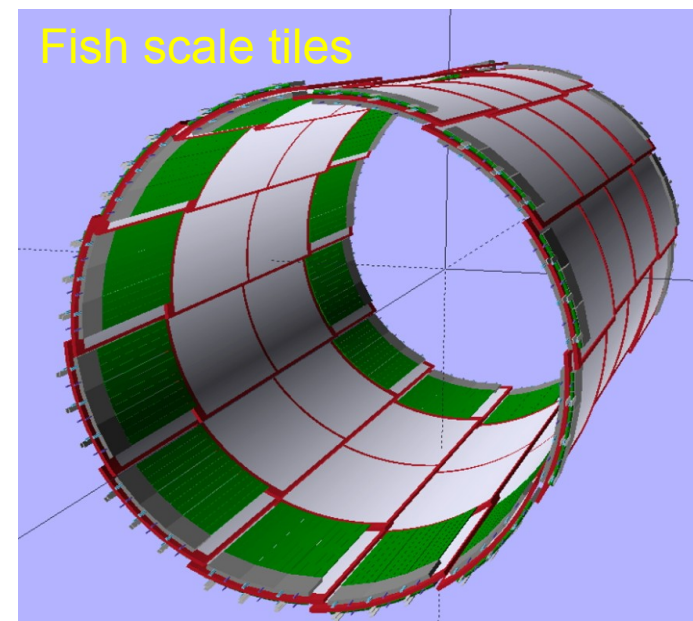


Flat tiles

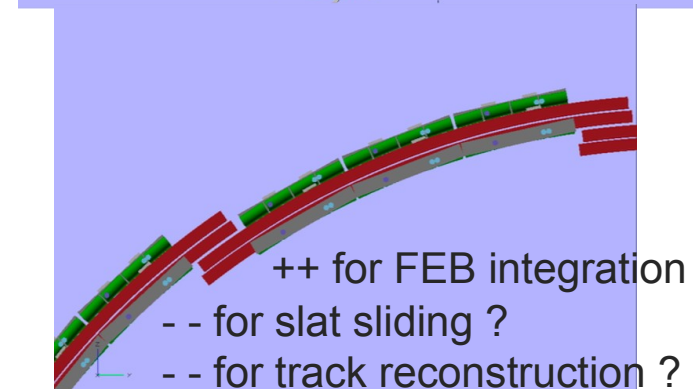


- - for overlaps
- - need flatness stifferer
- + 2

**Keeping zone: [560,615] mm**  
**Flat modules (slats)**  
Slat thickness: 8 mm  
Delta radius in-out modules: 9 mm  
Tiles tilt angle = 5 degrees  
Tile dimensions= 330x670 mm<sup>2</sup>

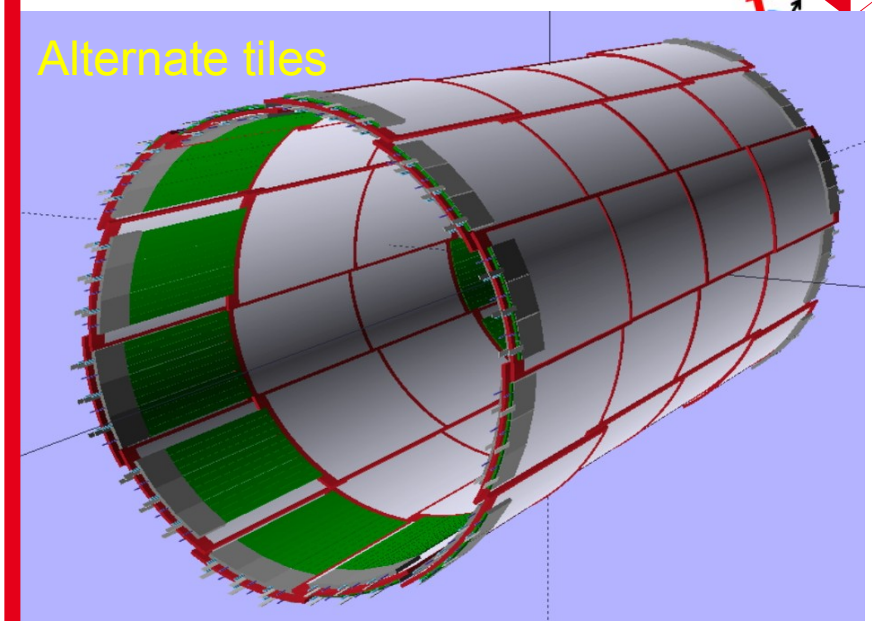


Fish scale tiles

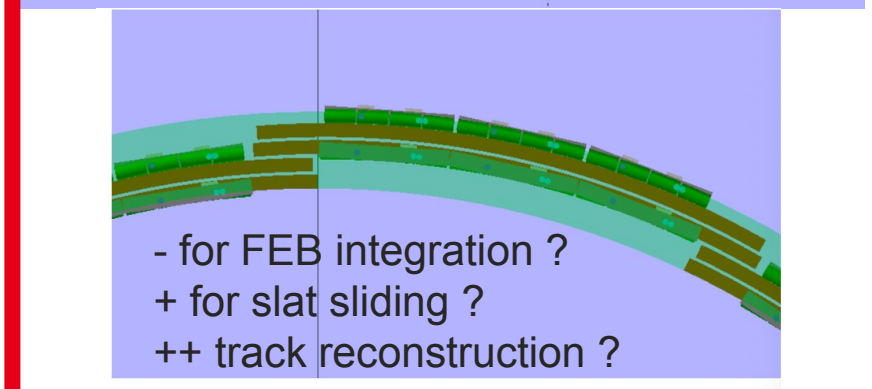


- ++ for FEB integration
- - for slat sliding ?
- - for track reconstruction ?

**Keeping zone: [560,615] mm**  
**Tile curvature radius: 572 mm**  
Tile thickness: 9 mm  
Delta radius in-out modules: 10 mm  
Tiles tilt angle = 4 degrees  
Tile dimensions= 340x670 mm<sup>2</sup>



Alternate tiles



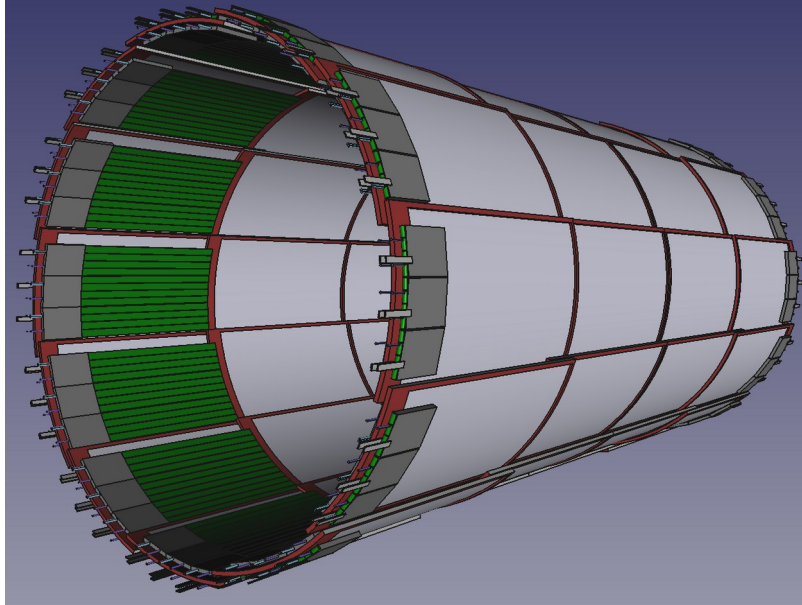
- for FEB integration ?
- + for slat sliding ?
- ++ track reconstruction ?

**Keeping zone: [560,610] mm**  
**Cylindrical modules (tiles)**  
Tile thickness: 9 mm  
Delta radius in-out modules: 11 mm  
Sectors delta radius 23 mm  
Tile dimensions= 340x670 mm<sup>2</sup>

# The current baseline design of the CyMBaL barrel



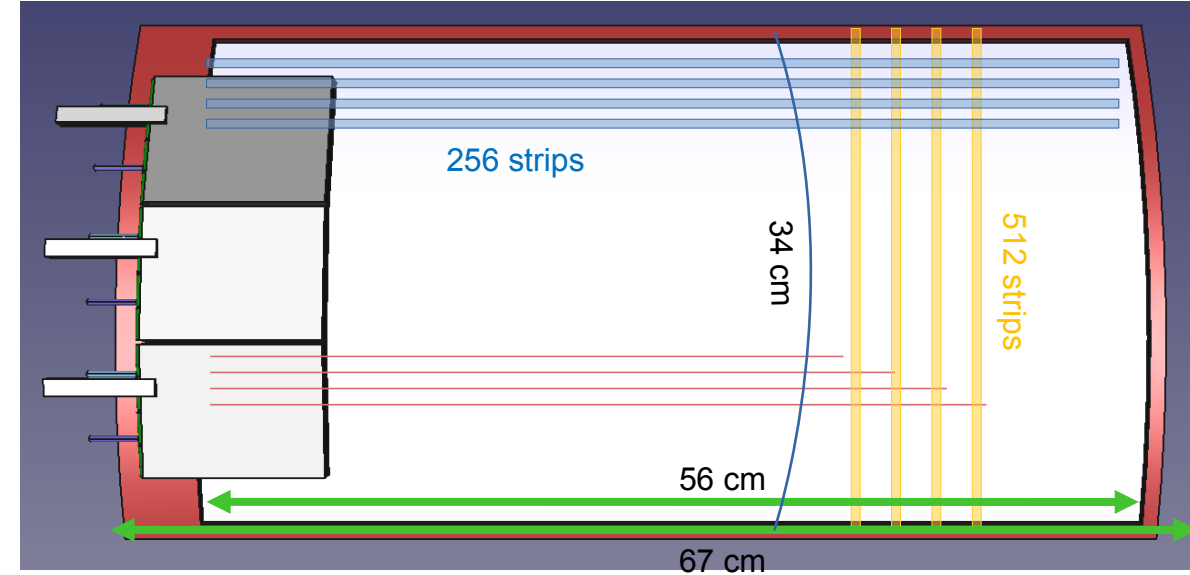
## CyMBaL: Current design (fish scale)



### Services (via patch panels)

- ❖ 3 optical fibers (to DAM)
- ❖ 9 HV cables (TbC)
- ❖ 3 LV cables. (to DC/DC)
- ❖ Gas I/O
- ❖ FEB cooling I/O

## Design of a tile (Cylindrical)



### 48 tiles: 12 in $\phi \times 4$ in z with 3 options for integration in GST

- ❖ Active area overlaps : 4.25 cm (z) / 2.7 cm ( $\phi$ )
- ❖  $R_{\min} = 56$  cm;  $R_{\max} = 61.5$  cm (**To be Confirmed & validated**)
- ❖ Overlaps in  $\phi$  and in z for hermeticity
- ❖ 768 readout channels/module
- ❖ **36K readout channels in 3 FEBs/tile (increase from 32K)**

### Module dimensions

Z = 67 cm

$R^*\phi = 34$  cm

### Active zone dimensions

Z = 59 cm

$R^*\phi = 32$  cm

### Weigh estimates

~1 kg / tile + ~0,6 kg / FEB  
(~135 kg total weight)

### Expected performances

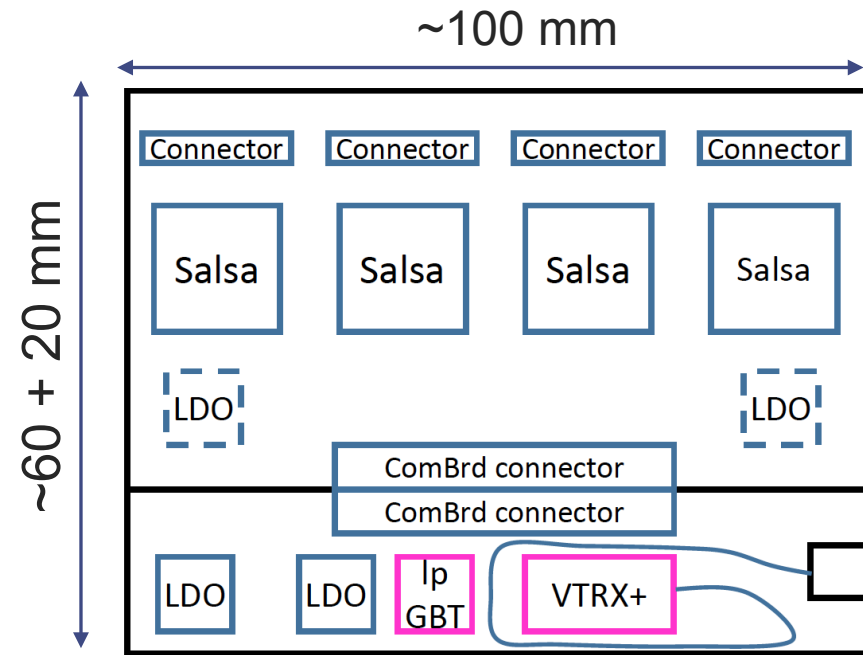
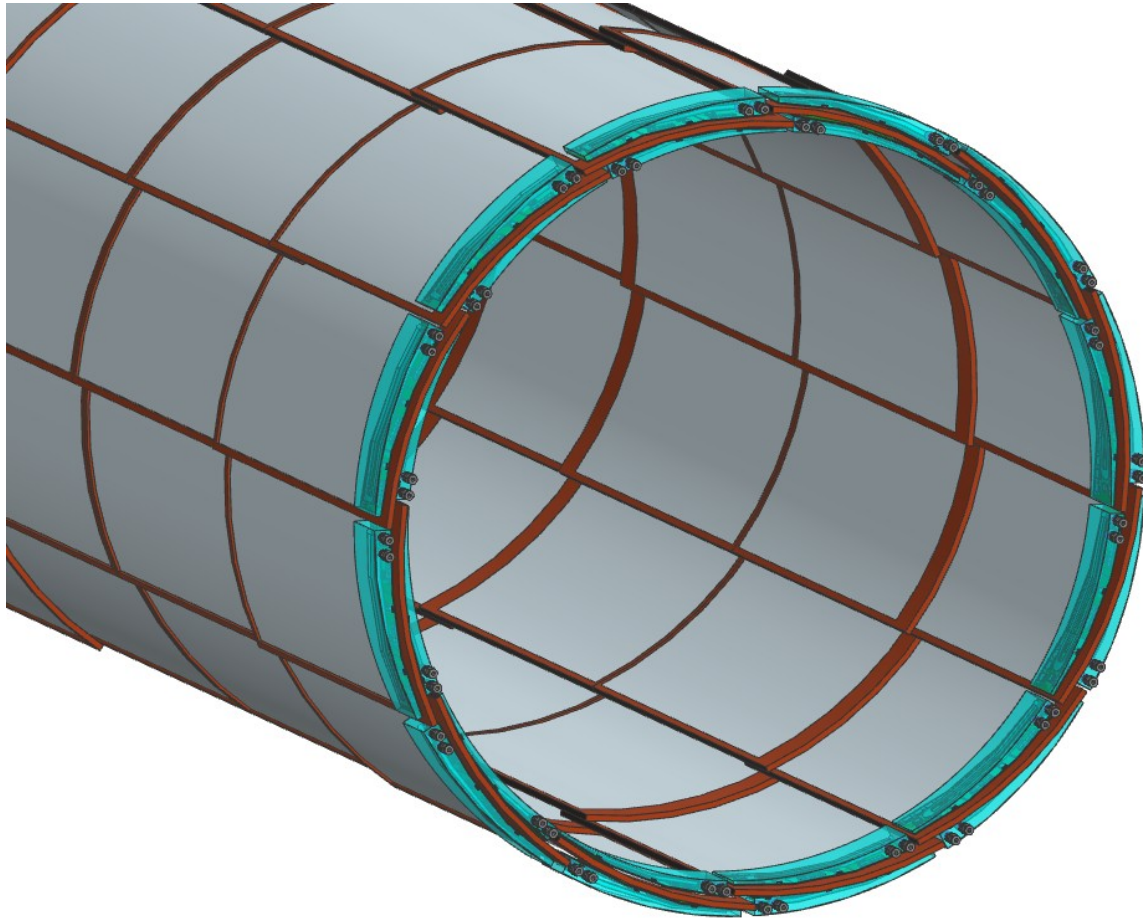
#### To be validated @ CERN test beam

- ❖ Spatial resolution:  
< 300 (500)  $\mu\text{m}$  in Z ( $r^*\phi$ )  
with strip pitch ~ 0.12 mm
- ❖ Time resolution ~20ns
- ❖ Efficiency  $\geq 98\%$
- ❖ Material budget ~0.5% X0

# FEB mechanical integration

Very stringent space to fit the 144 x 256 ch. FEBs (every mm counts !)

- in  $\Phi$  : with  $56 \text{ cm} < R < 61.5 \text{ cm}$  (hence the choice of the « fish scale » configuration)
- in  $z$  : for In/out services connections, and to avoid FEB overlap with CyMBaL active area)
- FEB powering  $\rightarrow$  **room for DC/DC converter cards to find**

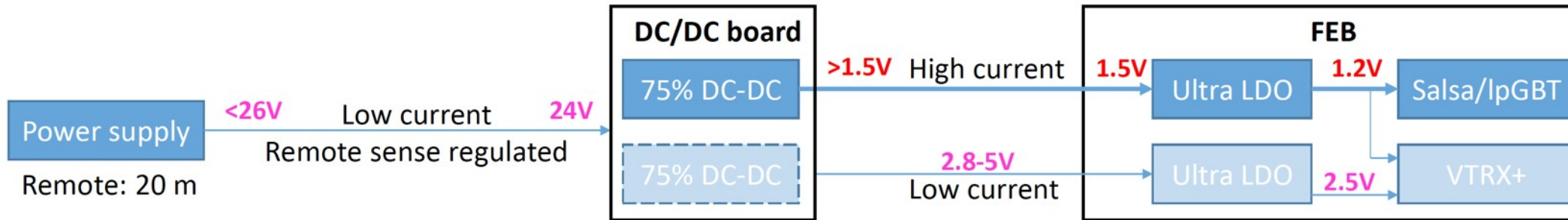


FEB could be divided in 2 cards

+ DC/DC in a separate card

# LV powering of the Front-End readout electronics

144 FEB



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 ~1.2 kW ( + extra from DC/DC)

As close to FEB as possible : 1 cm - 3 m

## Where can we locate the DC/DC converter cards ?

- Can be bulky  
For EMC shielding, connectors, coil thickness, non-magnetic...
- Needs to be cooled

→ No room yet identified within the current CyMBaL envelop

# FEBs cooling : first design & simulations



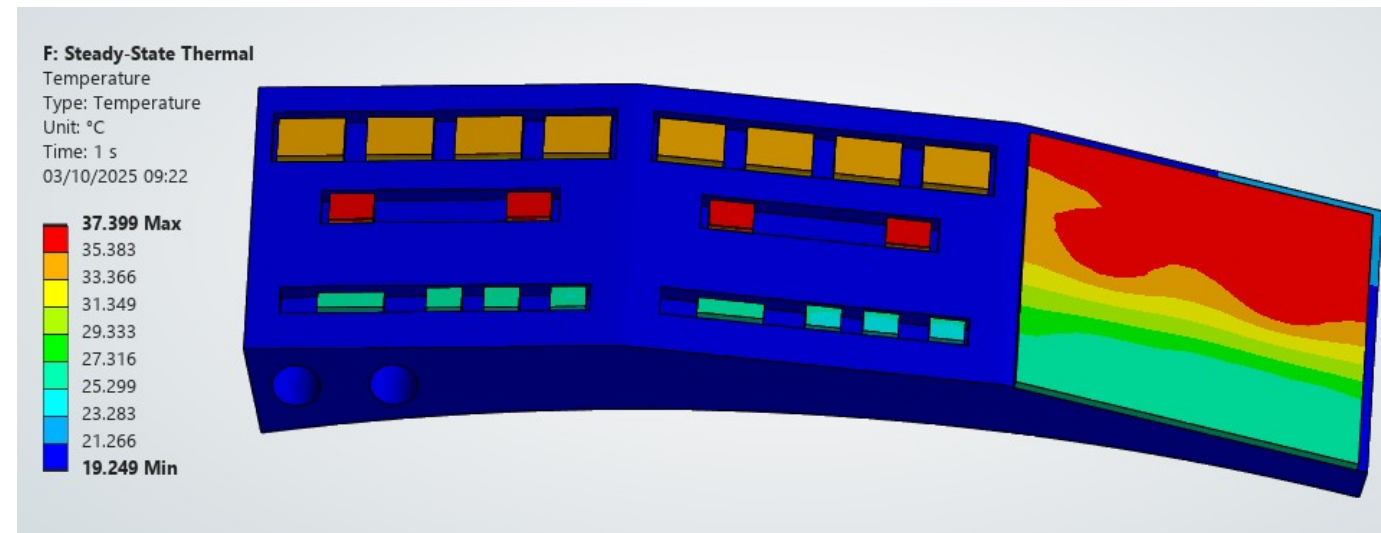
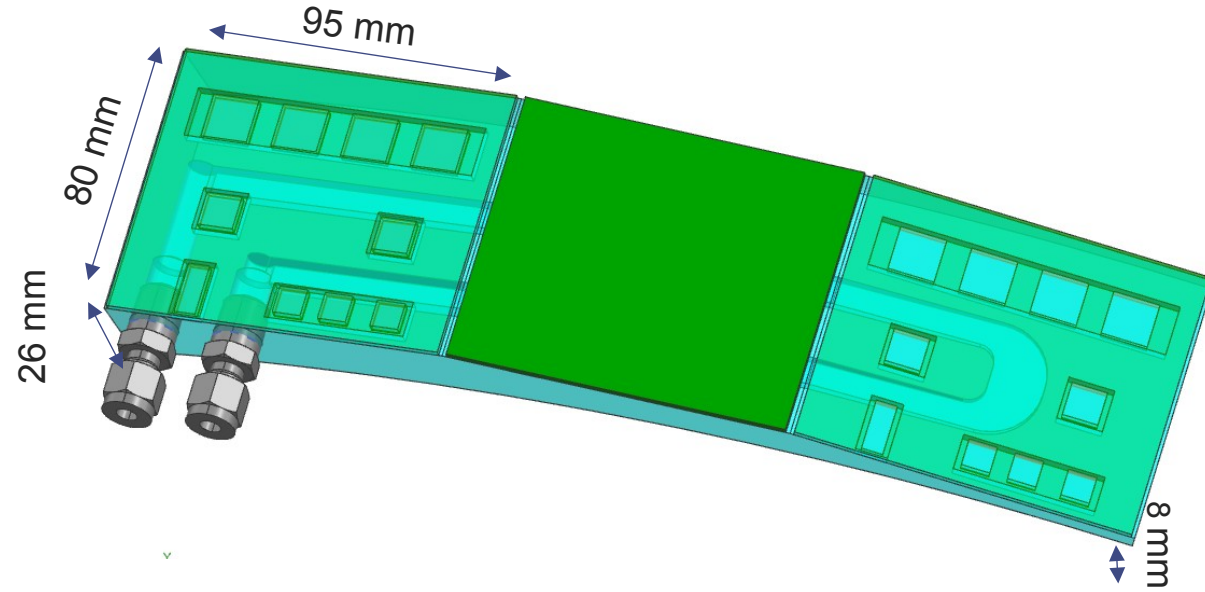
## Simulations inputs:

- 3l/min,  $T_{in}=19$  degC,
- 4 mm ID/6 mm OD water tubes
- non-magnetic grade Aluminum heatsink

## Output :

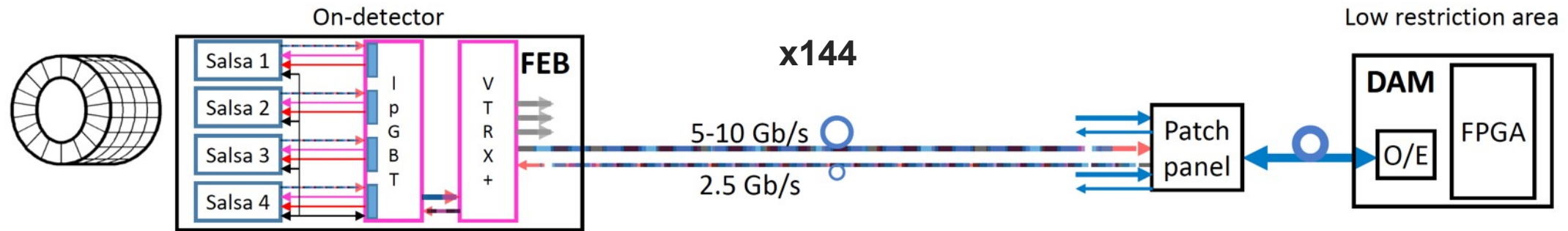
- $T_{out}=19.4$  degC
- Pressure Drop = 0.044 bar
- $T_{max} \sim 37$  degC

Water cooling with these rough parameters works



# 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

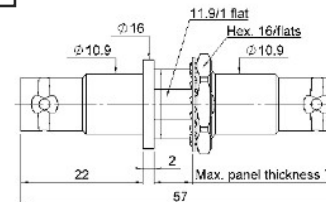
x144

Patch panel

x144

HV PS

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



SHV connector  
(ex: radiall R317.072.000)

# Services / cabling

<https://brookhavenlab.sharepoint.com/:x:/s/EICPublicSharingDocs/EdH38QZE9HpJrI039jn2-q4BbPvrMv7dTFiLV8--atclKw?rttime=du5DNOZX3Ug>  
[https://brookhavenlab.sharepoint.com/:x:/s/EICPublicSharingDocs/EbyvmR-fBZ5Eo2V6NI7eMcgBqtR1I7isGlvRyRK-nE-uJQ?rttime=Le\\_8RP9p3Ug](https://brookhavenlab.sharepoint.com/:x:/s/EICPublicSharingDocs/EbyvmR-fBZ5Eo2V6NI7eMcgBqtR1I7isGlvRyRK-nE-uJQ?rttime=Le_8RP9p3Ug)

8/8/2025 update



Item	Description	Quantity	Diameter	Estimated Length	Notes	Assumptions
FEE data	VTRX+ MPO parallel optical fiber	144	connector 10mm	To DAM	<a href="https://suddendocs.samtec.com/catalog_english/ecue.pdf">https://suddendocs.samtec.com/catalog_english/ecue.pdf</a>	
HV cables	HV cables to patch panel 1 drift + 2 resistive	144	3.2mm	to patch panel	HTC-50-1-1, 0.5Lz/1.5, CEH50 Dakra; to patch panel Max volume occupancy: 3 x OD 3.2mm cables per tile	Max volume occupancy
HV cables	HV cables from patch panel to Rack	TBD (example. ten 9-channel HV cables)	TBD	TBD	possibly high density cables.	
LV cables	From DC/DC to FEB	144	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	144	6 mm	TBD	Alpha Wire 2424C	Alpha Wire 2424C
DCDC	step down DC voltages at patch panel?	TBD	TBD	TBD	DCDC are need to step down voltages efficiently. At the patch panel?	
Gas tubing	inlet and outlet for 2 tiles in serie	24 IN / 24 out	4mm	TBD	<a href="https://www.mcmaster.com/5384K524/">https://www.mcmaster.com/5384K524/</a>	2 tiles in series
Flat cables	flat cables from modules to FEEs	1152	1mmx20mm	10cm / 50 cm	within the CYMBAL envelop	

Cooling, etc.						
Item	Description	Quantity	Diameter	Estimated Length	Notes	Assumptions
Cooling tubing	Cooling tube to FEEs, N FEE in series	TBD	24 IN / 24 out (if 6 FEBs in series)	6.25mm	TBD	<a href="https://www.mcmaster.com/5648K74/">https://www.mcmaster.com/5648K74/</a>

# Open questions to discuss



- What is the **updated envelop** for **CyMBaL** ?
- Is there any **additional space** that could be used for **DC/DC converter cards** ?
- How is the **cable tray** space managed ? Space shared by CyMBaL & TOF ?
- For installation/maintenance, what is the foreseen strategy for cabling : one reserved location for **patch panels** and/or does each sub-detector need to manage his patch panels within its own envelop ?
- **What is the status of the TOF design ?** The **current 3D model of the (GST + rails + TOF + cable-tray + CyMBaL)** is needed to identify and study how/where to attach the CyMBaL tiles, how to design the cables routing, ...