Update on SVT Mechanics

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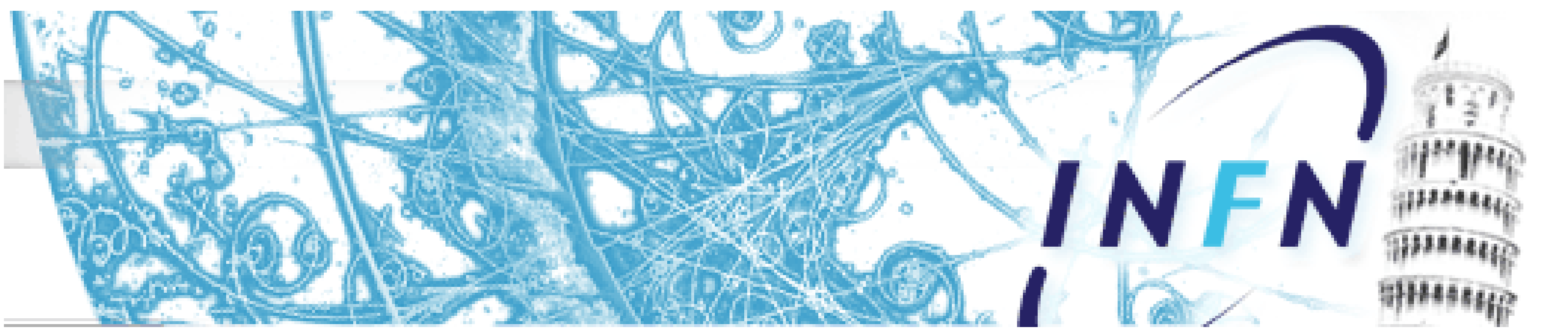
INFN-Pisa

on behalf of the SuperB SVT Group



Outline

- SVT design on layer 1-5
- L0 Striplets version
- L0 supports (MAPS version)
- I.R. general layout
- Conclusion

SVT L1-5 Layout design

Update on the L1-L5 design by London workshop :

1) defined L1-L5 modules dimensions

2) defined modules positions

3) defined gimbal ring positions

4) defined cooling ring position

- this components definition has been usefull to QMUL to proceed on the design of C.F. supporting cones and Space-Frame

5) Moved L1-2 in outer z position respect BaBar position

SVT module master tablet

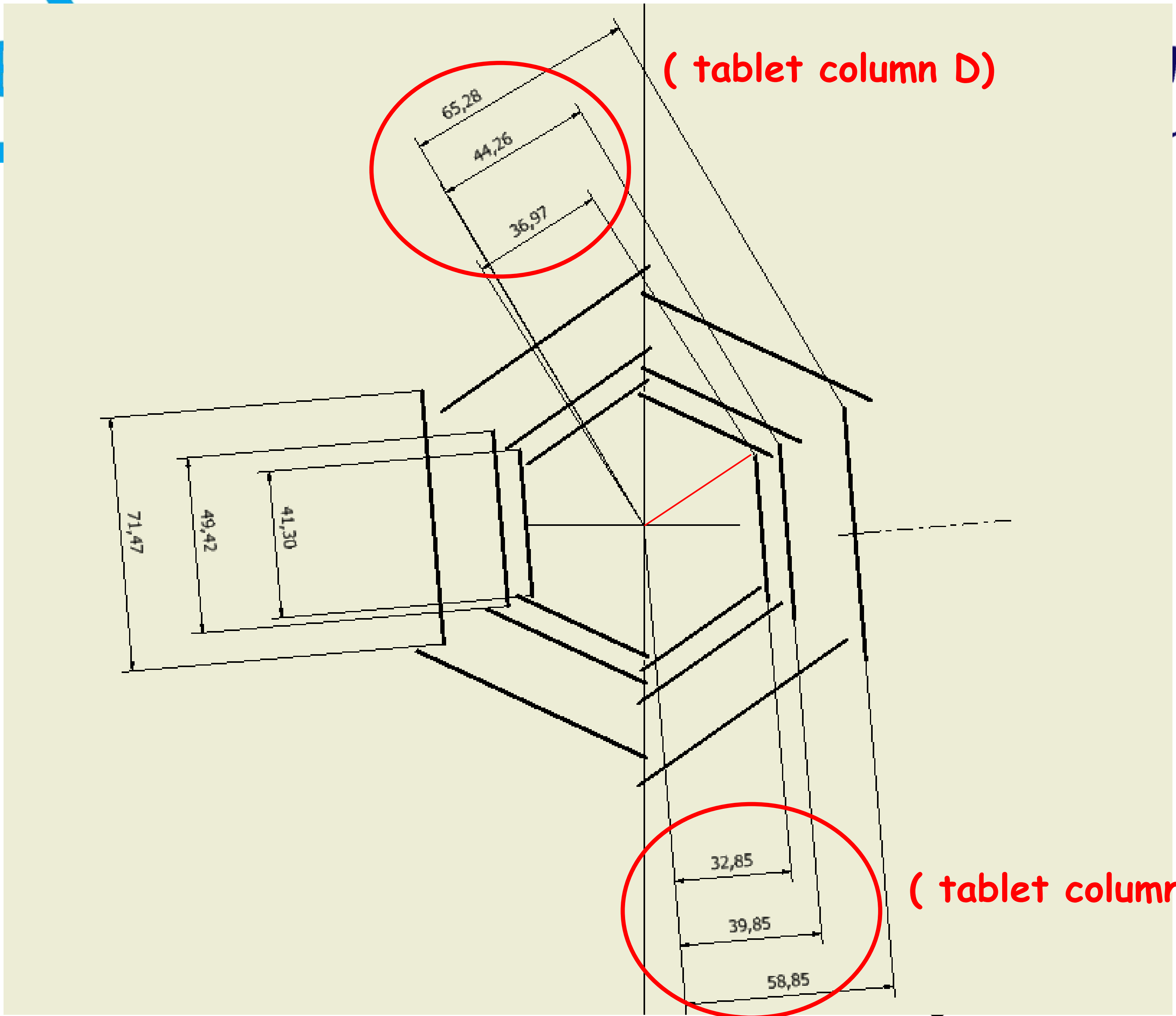
SVT - Dimensioni e copertura angolare sensori

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Layer	Radius piano y-z sensore barrel SuperB	Radius piano y-z punto estremo sensore wedge SuperB	Radius punto estremo laterale sensore SuperB	Lunghezza orizzontale sensore tangente cono 300 mrad SuperB	Lunghezza sensore barrel SuperB (tabella Londra)	Lunghezza totale sensore barrel SuperB	Lunghezza totale sensore totale SuperB	Lunghezza estensione sensore oltre 300 mrad SuperB column (G-E)/2	Lunghezza estensione sensore oltre 350 mrad BaBar	Angolo intercettato nel punto ingombro estremo sensore con piano y-z (rad)	Angolo intercettato nel punto ingombro estremo laterale sensore (rad)	Shift Layer asse Z (mm)	Angolo intercettato nel punto ingombro estremo sensore con piano y-z+shift (rad)	Angolo intercettato ingombro fisico sensore estremo laterale +shift (rad)
0	15,10	-	17,30	97,63	-	104,00	104,00	3,19	-	0,283	0,321	0	-	-
1	32,85	-	36,97	212.39	214,78	223,36	223,36	5,48	21.69	0,286	0,320	+2	0,284	0,325
2	39,85	-	44,26	257.65	262.78	265,78	265,78	4.06	2.51	0,291	0,322	-2	0,293	0,326
3	58,85	-	65,28	380.49	385,70	385,70	385,70	2,60	1.41	0,296	0,326	0	-	-
4A	119,85	87,91	90,54	574,60	457.95	457.95	578,23	2,05	1.96	0,295	0,303	+2	0,293	0,293
4B	123,85	91,91	94,42	597,69	479.42	479.42	599,70	1.14	1.07	0,297	0,305	+2	0,296	0,296
5A	139,85	112,18	114,25	732,47	613.04	613.04	737,46	2.72	2.58	0,295	0,300	-2	0,297	0,297
5B	143,85	116,18	118,18	756,53	635.84	635.84	760,26	2.05	1.93	0,297	0,301	-2	0,298	0,298

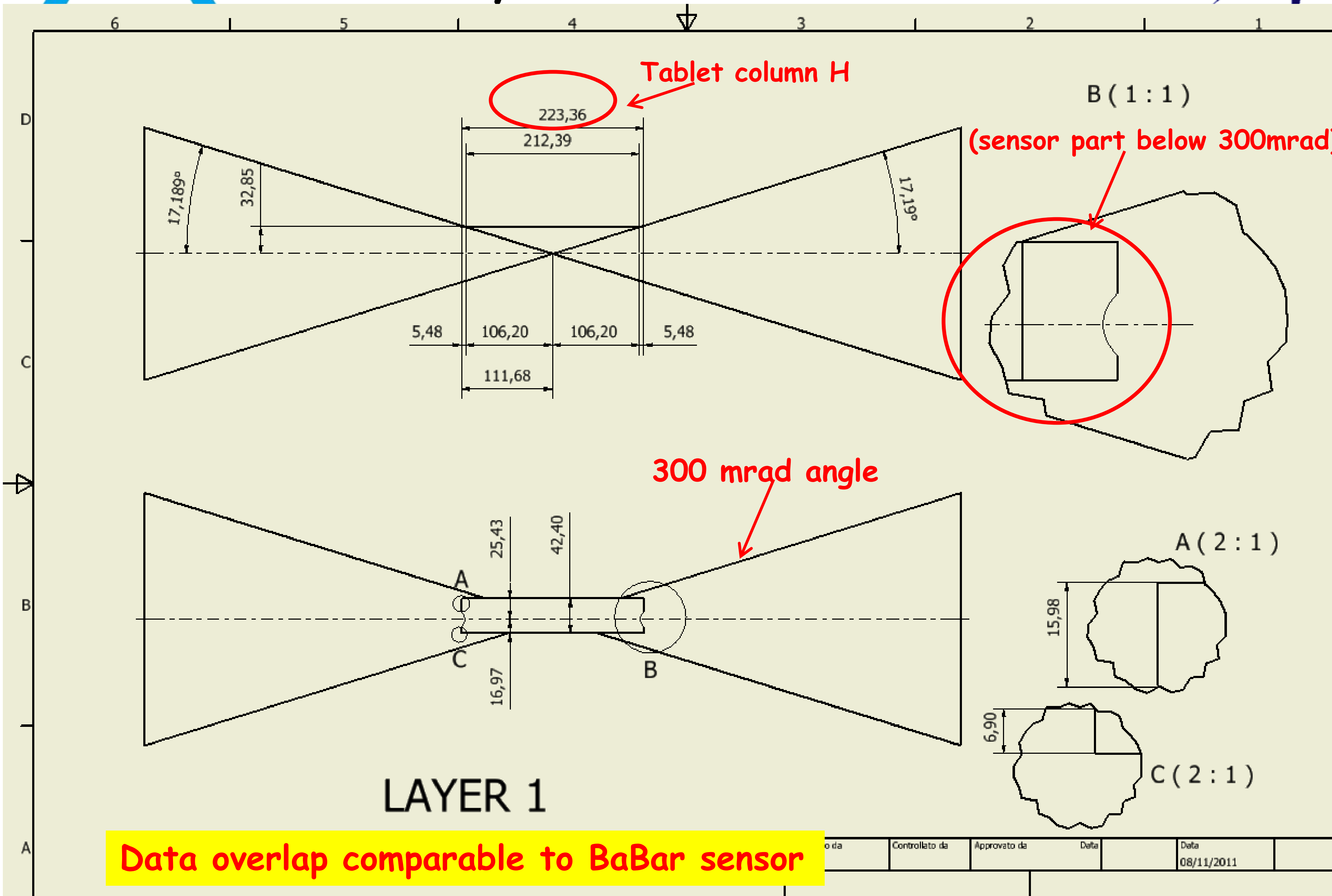
Tablet usefull for trieste group to fix sensor and fanout dimensions

Modules have sensor in symmetric position respect I.P. but are shifted along z direction to avoid middle dead space

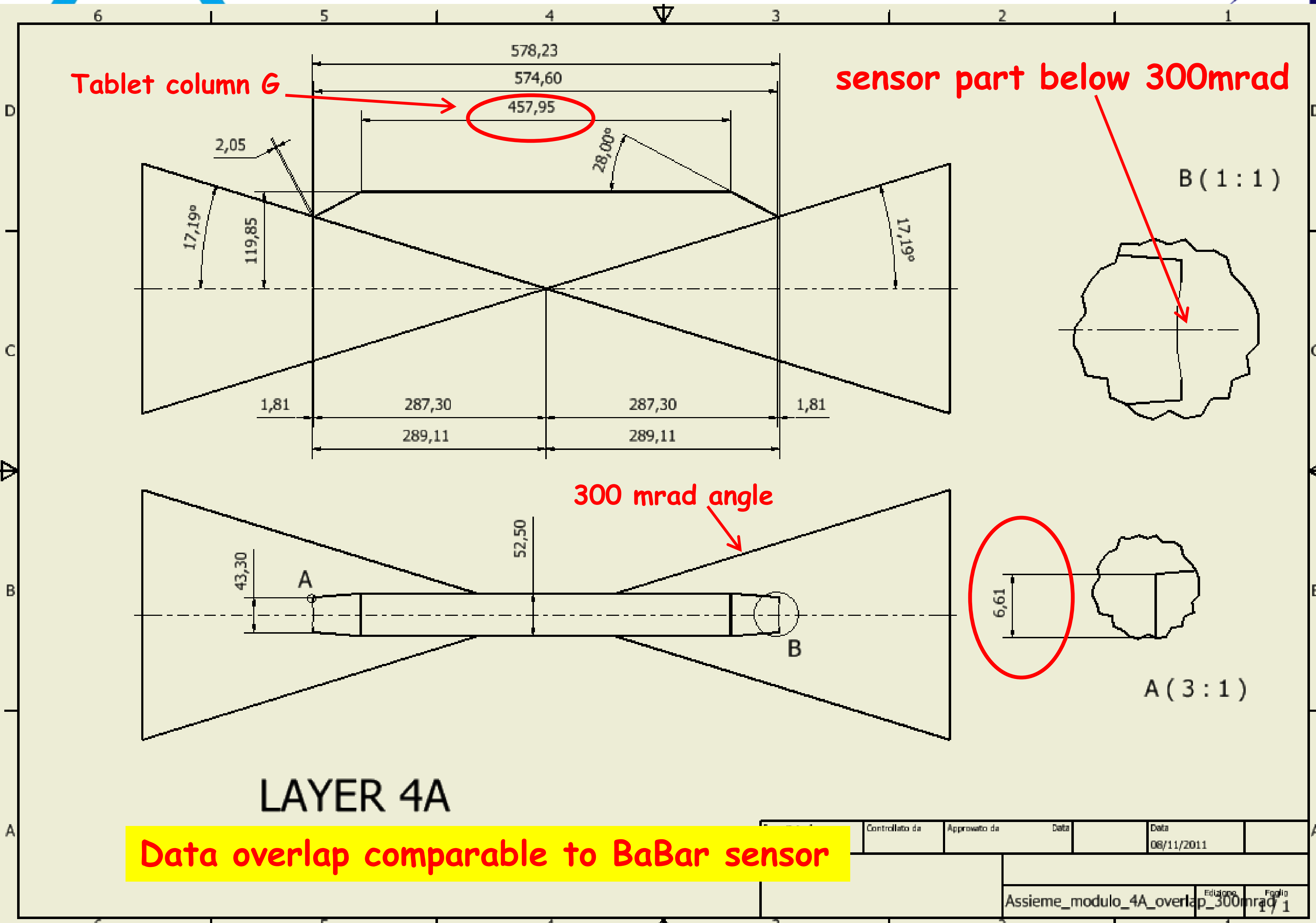
Layer 1-2-3 module radius



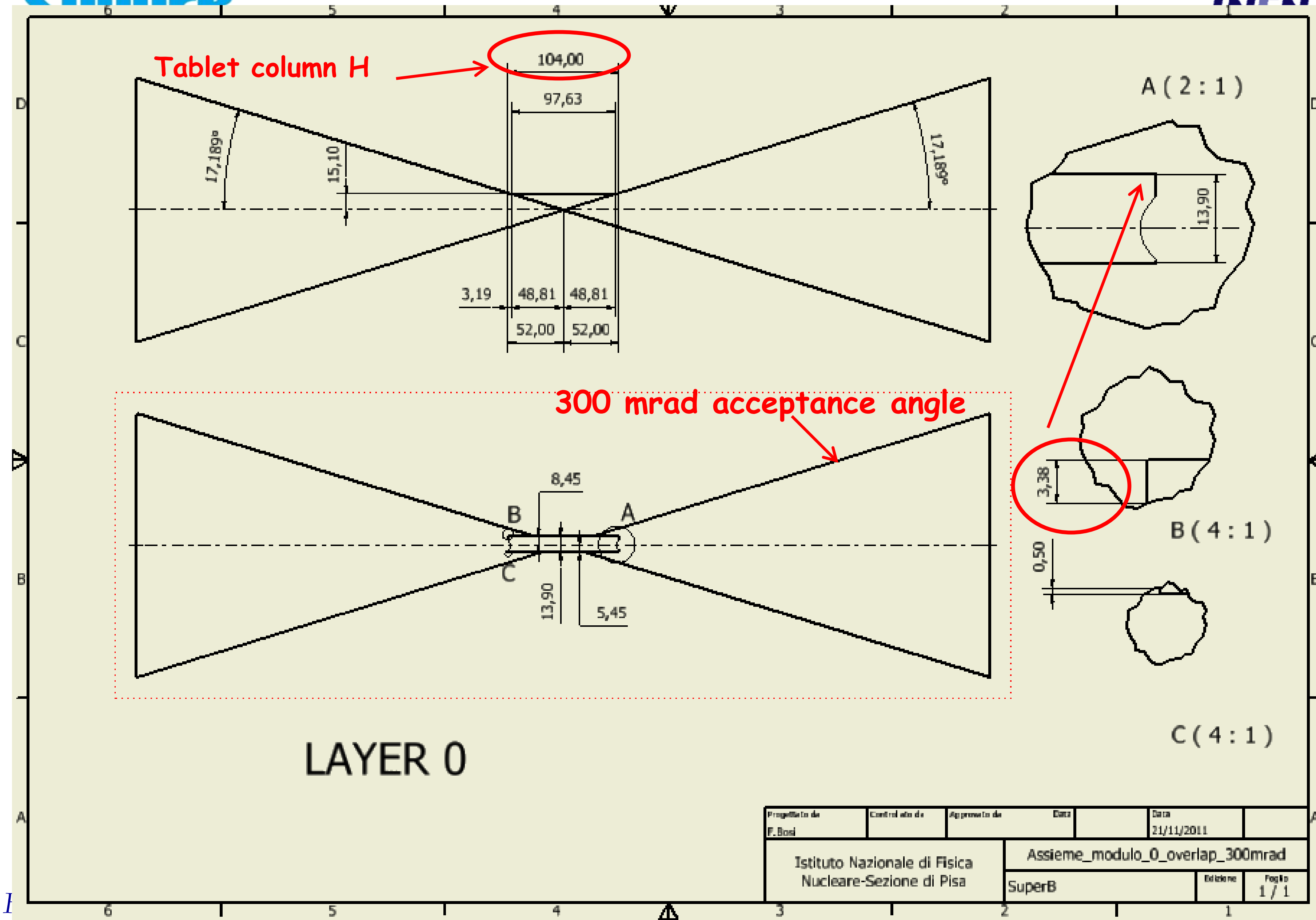
Layer 1 module



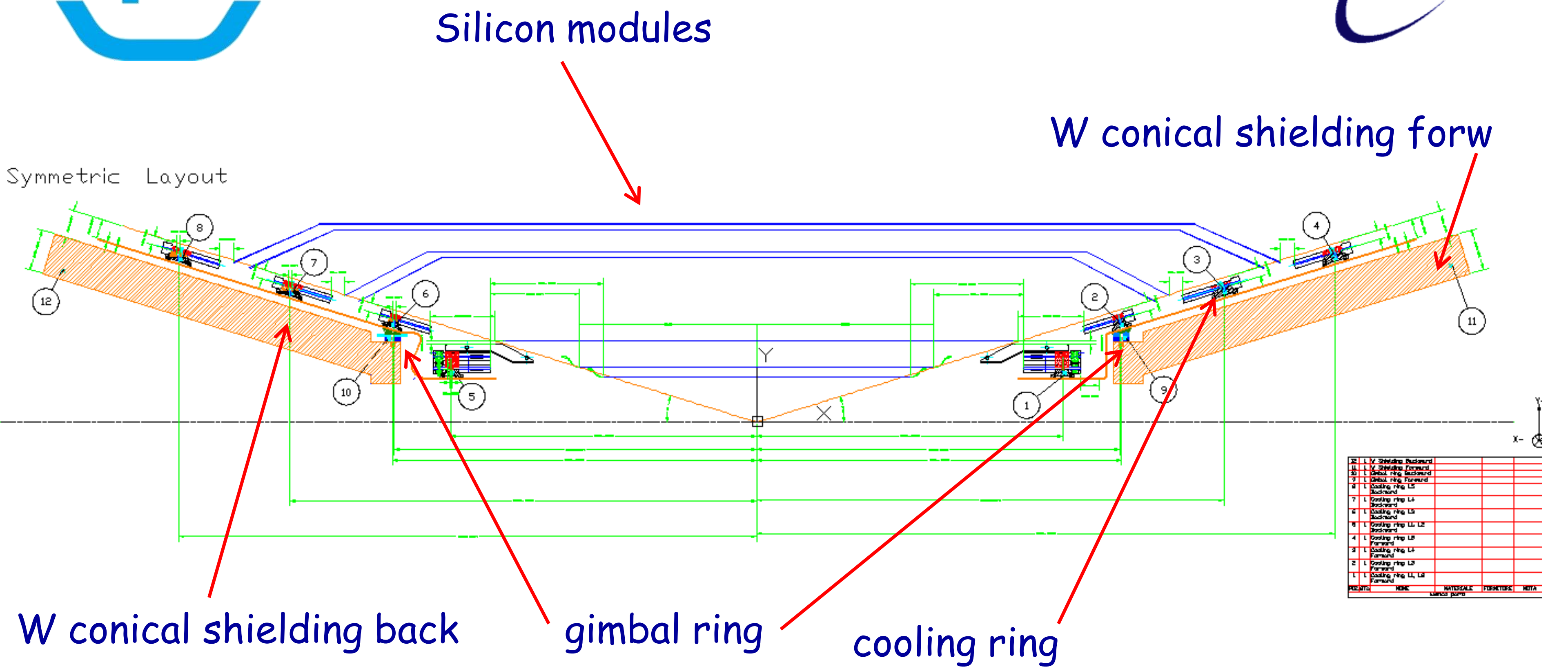
Layer 4 A module



Layer 0 module



General Layout SVT

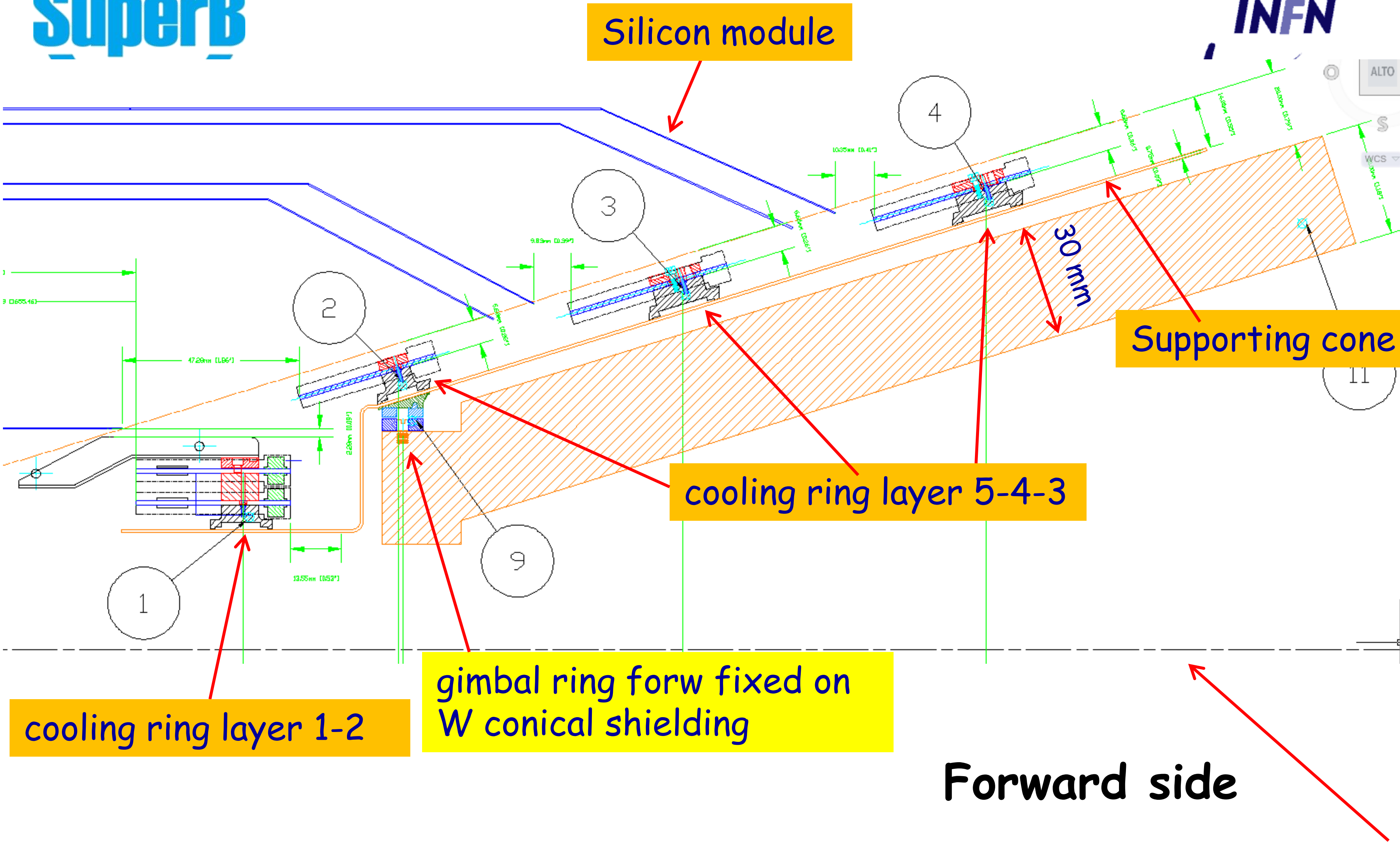


This design provides :

- symmetrical C.F. supporting cones forw-back
- symmetrical cooling ring forw-back
- W conical shielding coupled to gimbal ring and supporting SVT

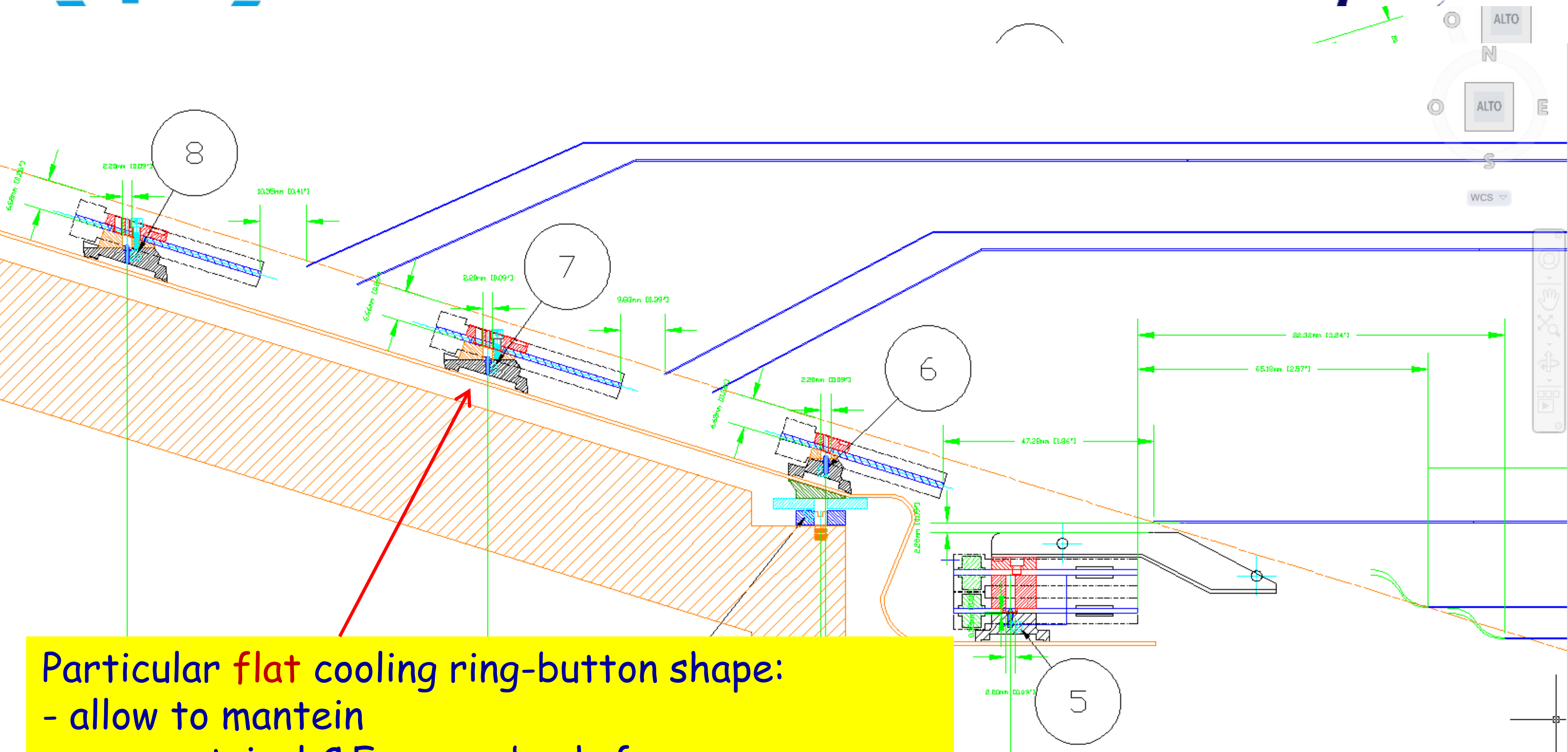
We used the same BaBar HDI dimension for L 1-2-3-4-5

General Layout SVT



Forward side

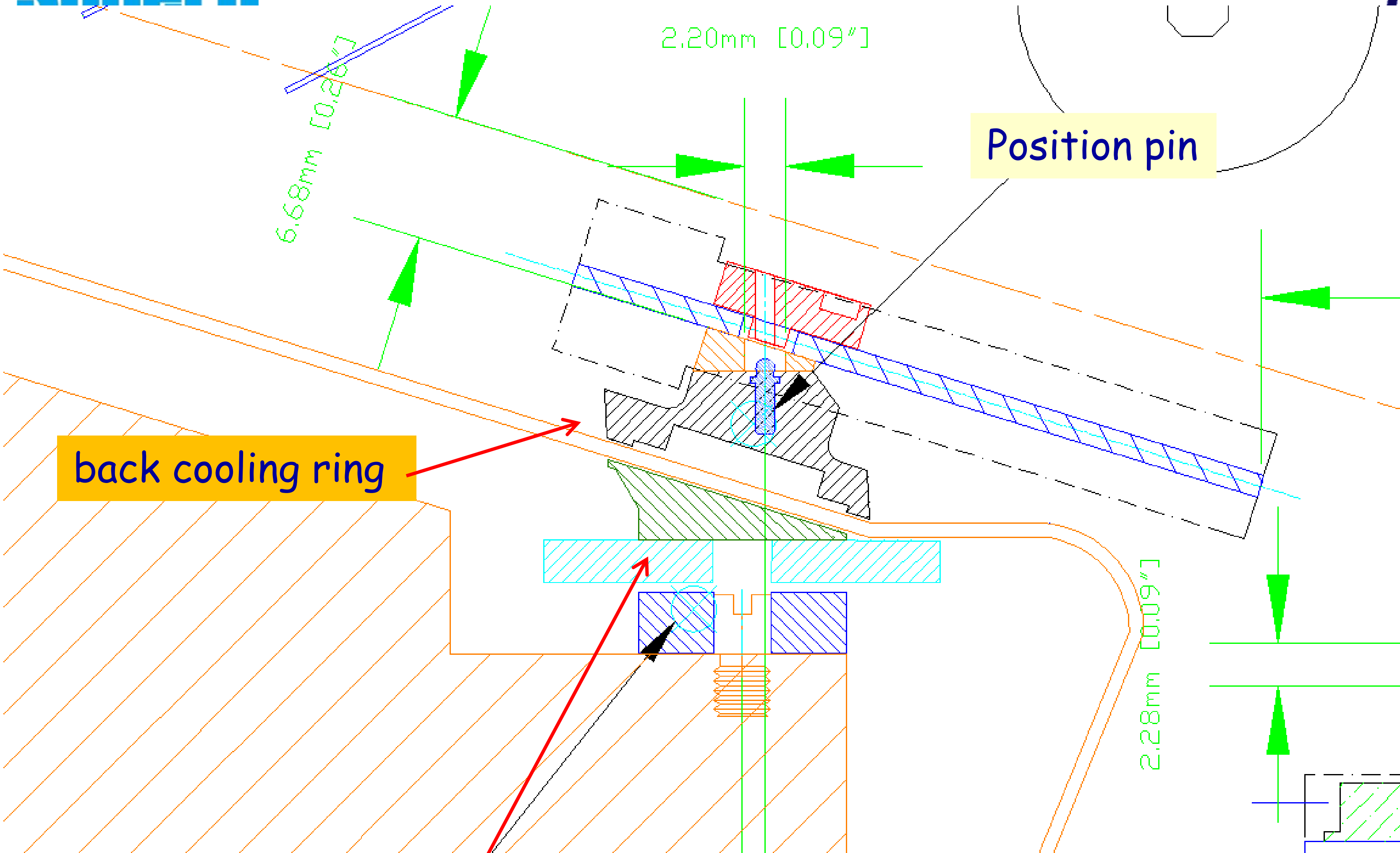
General Layout SVT



Particular flat cooling ring-button shape:
- allow to mantein
 a symmetrical C.F. cones back-forw
(less mask for production)
- avoid an over-constrain of the module fixing

backward side

General Layout SVT



back gimbal ring allow C.F. cone sliding constrain

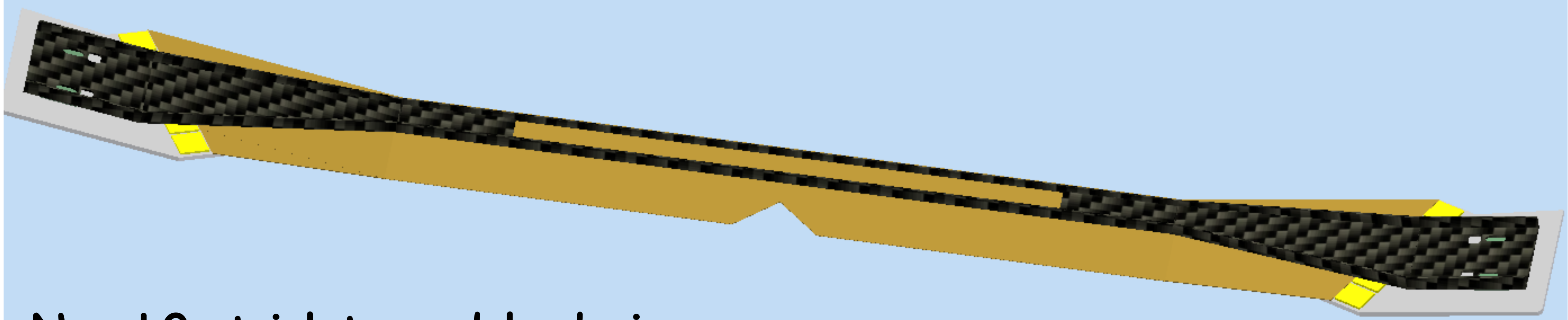
12

L0 design

Update on the L1-L5 design by London workshop :

- New L0 striplets design with Hdi/kapton inclinated 10°
- Changed length and component Be beampipe
- Still some adjustment needed to optimize modules relative clearance
- Possible to gain still in diameter distance from beam-pipe
- No conflict with L1-2 SVT modules

L0 striplets design



New L0 striplets module design

HDI/kapton inclinated 10° (17.8° previous design)

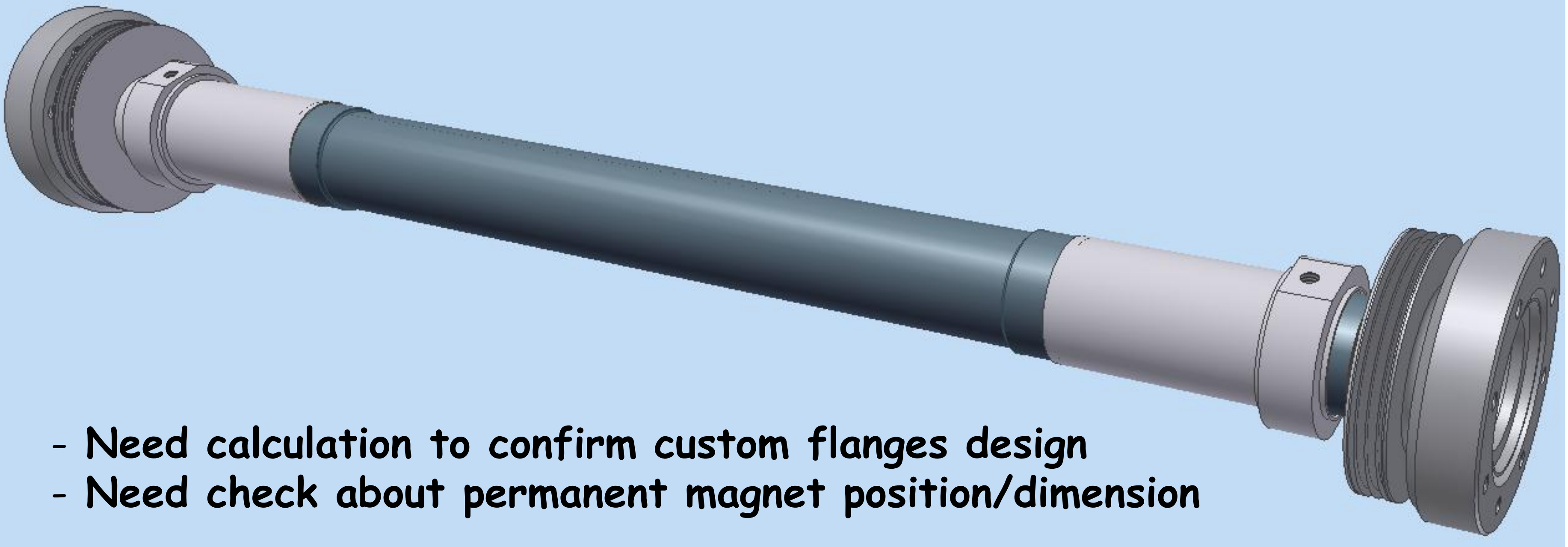
Si sensor :
W=13.9 mm
L=104 mm
R=15.1 mm

Possible larger width of 0,3mm for safer overlap in the actual design

Be Beam pipe

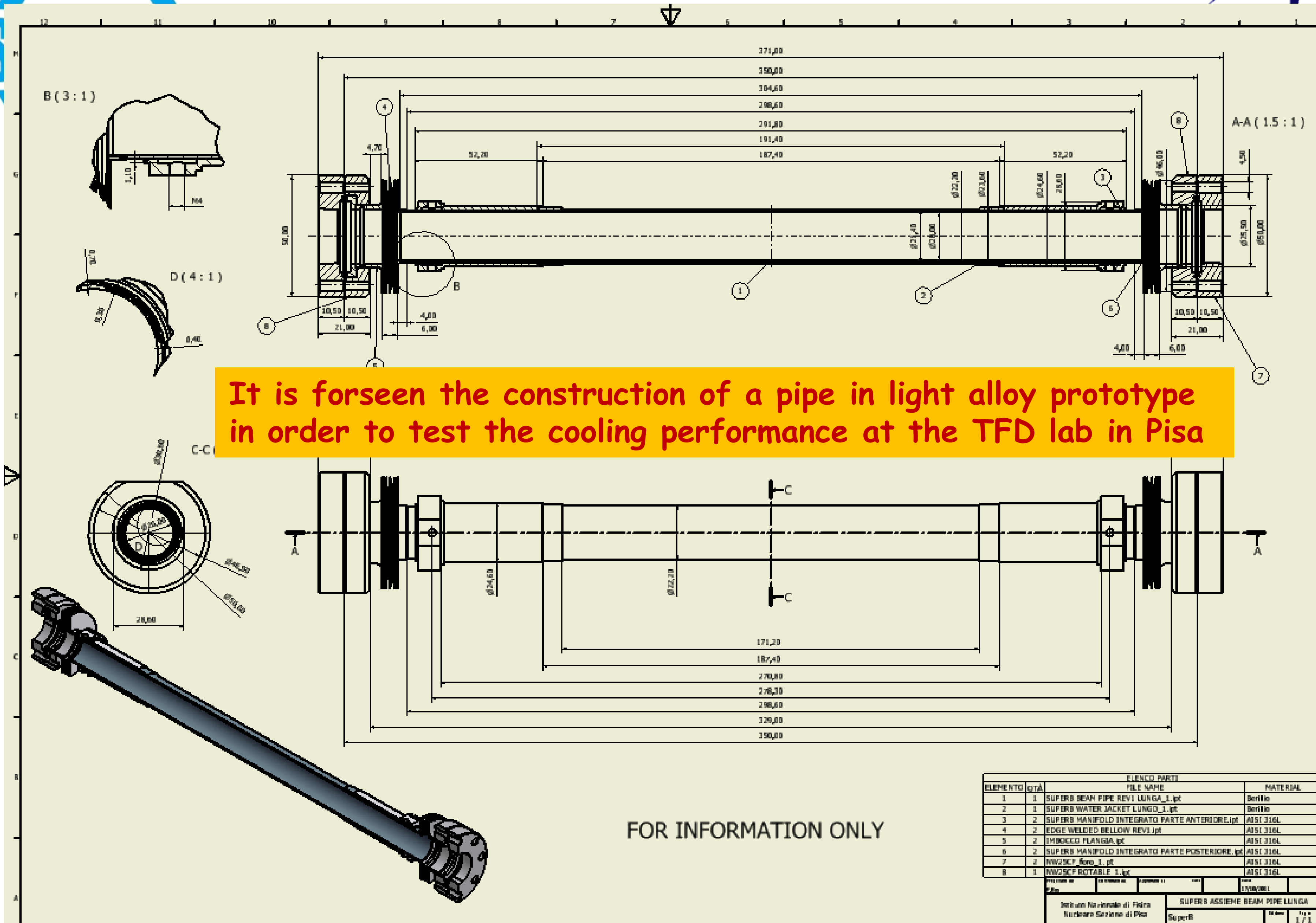
- New lenght to match L0 striplets design L=304 →350 mm :
  (+23 mm/side, M.Sullivan has to approved……..)

- CF flanges not standard :
  - reduced in diameter (4 mm)
  - reduced in thickness (1.5 mm)
  - more screw with reduced diameter



- Need calculation to confirm custom flanges design
- Need check about permanent magnet position/dimension

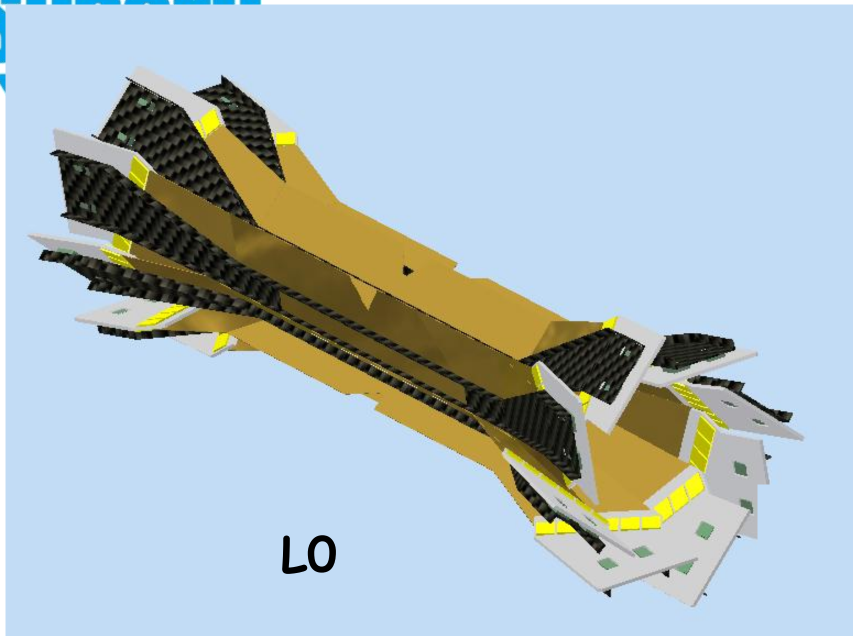
Be Beam pipe

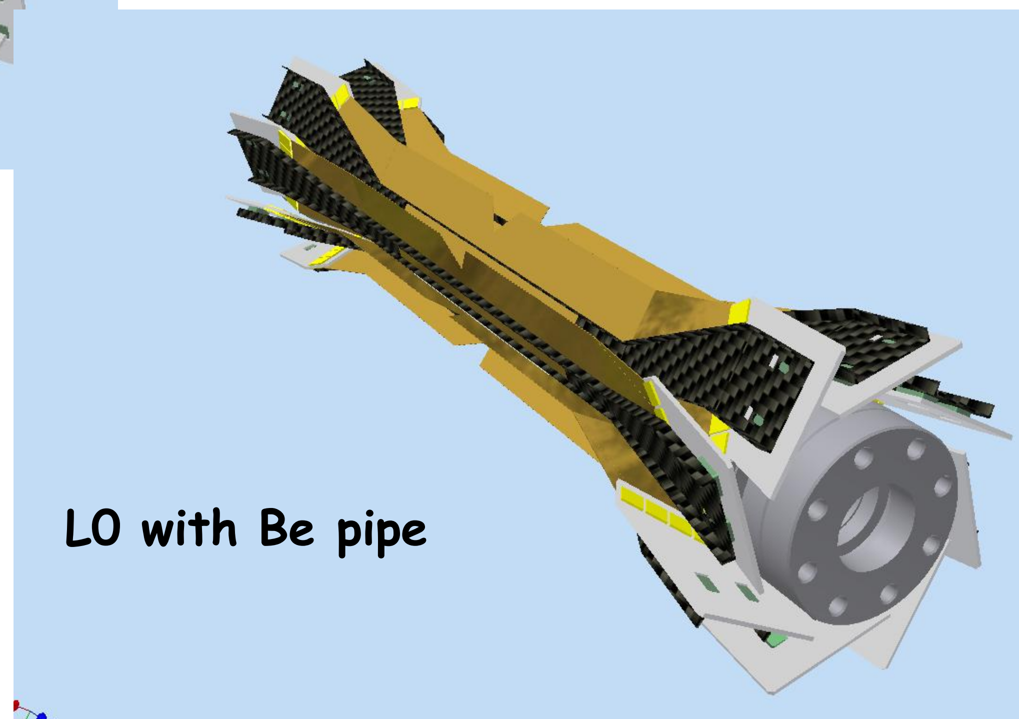


ELEMENTO	QTÀ	FILE NAME	MATERIAL
1	1	SUPERB BEAM PIPE REV1 LUNGA_1.ipt	Berillio
2	1	SUPERB WATER JACKET LUNGO_1.ipt	Berillio
3	2	SUPERB MANIFOLD INTEGRATO PARTE ANTERIORE.ipt	AISI 316L
4	2	EDGE WELDED BELLOW REV1.ipt	AISI 316L
5	2	IMBOCCO FLANGIA.ipt	AISI 316L
6	2	SUPERB MANIFOLD INTEGRATO PARTE POSTERIORE.ipt	AISI 316L
7	2	NW25CF_foro_1.ipt	AISI 316L
8	1	NW25CF ROTABLE 1.ipt	AISI 316L

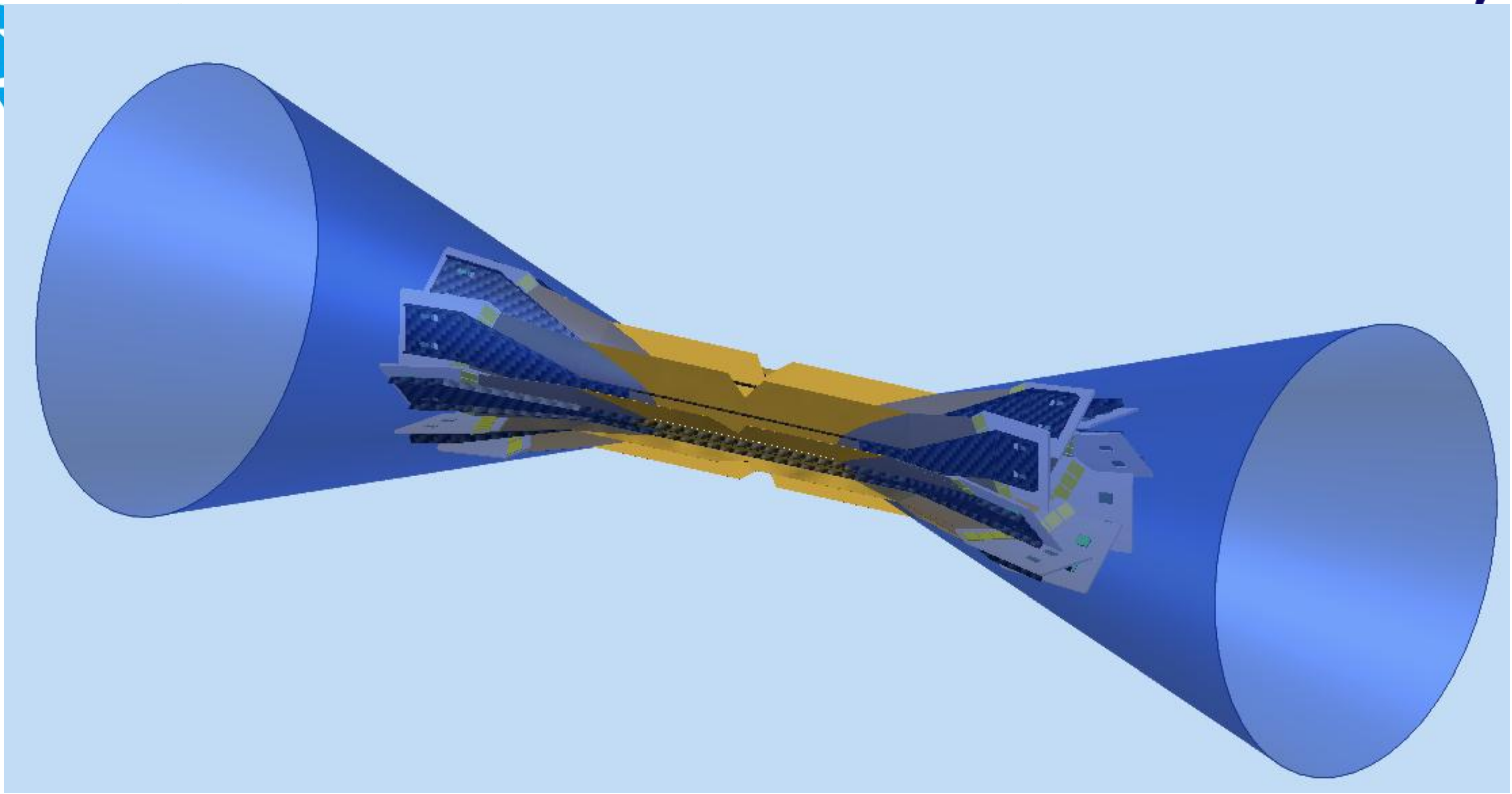
It is forseen the construction of a pipe in light alloy prototype in order to test the cooling performance at the TFD lab in Pisa

New L0 striplets design



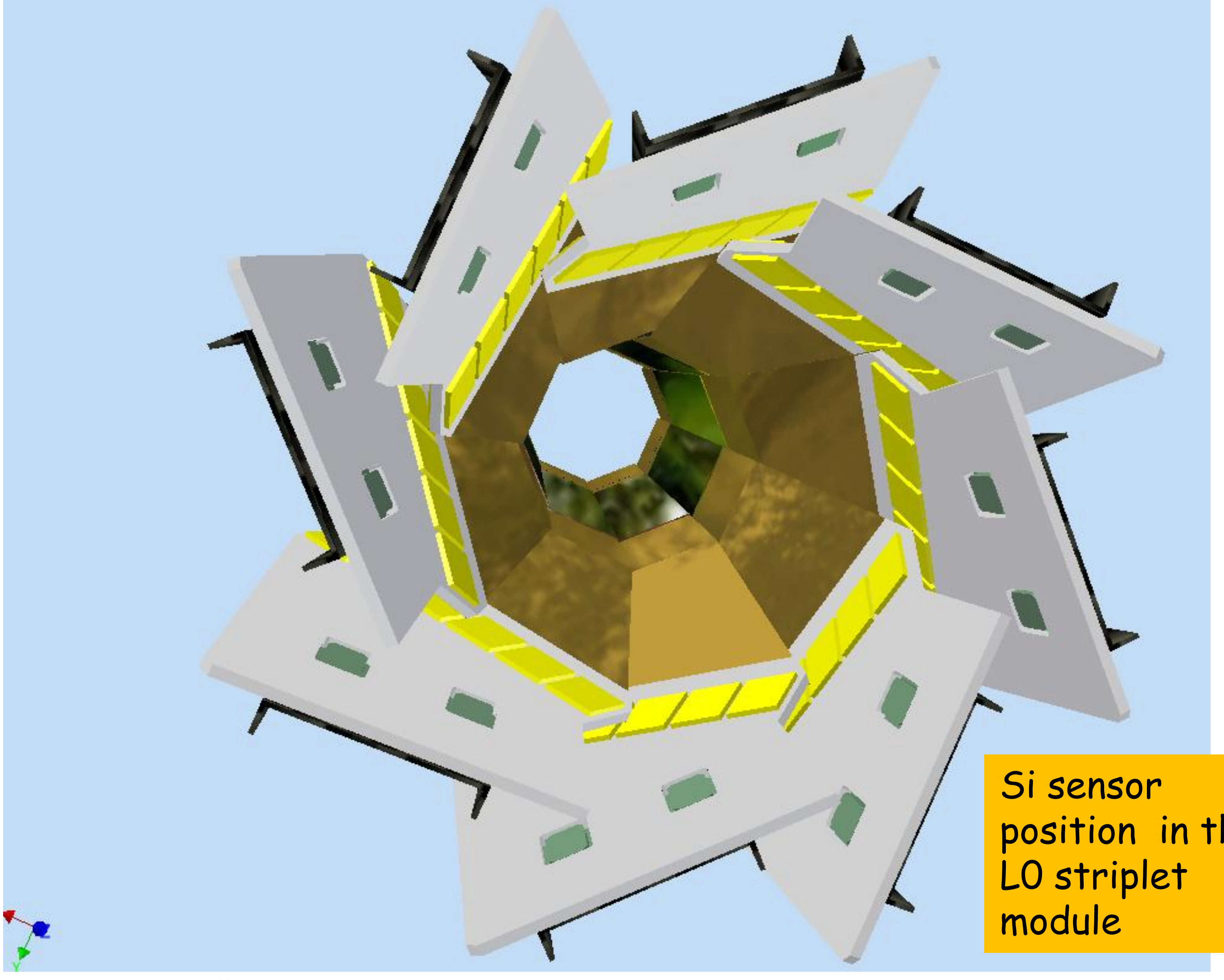


L0 striplets new design



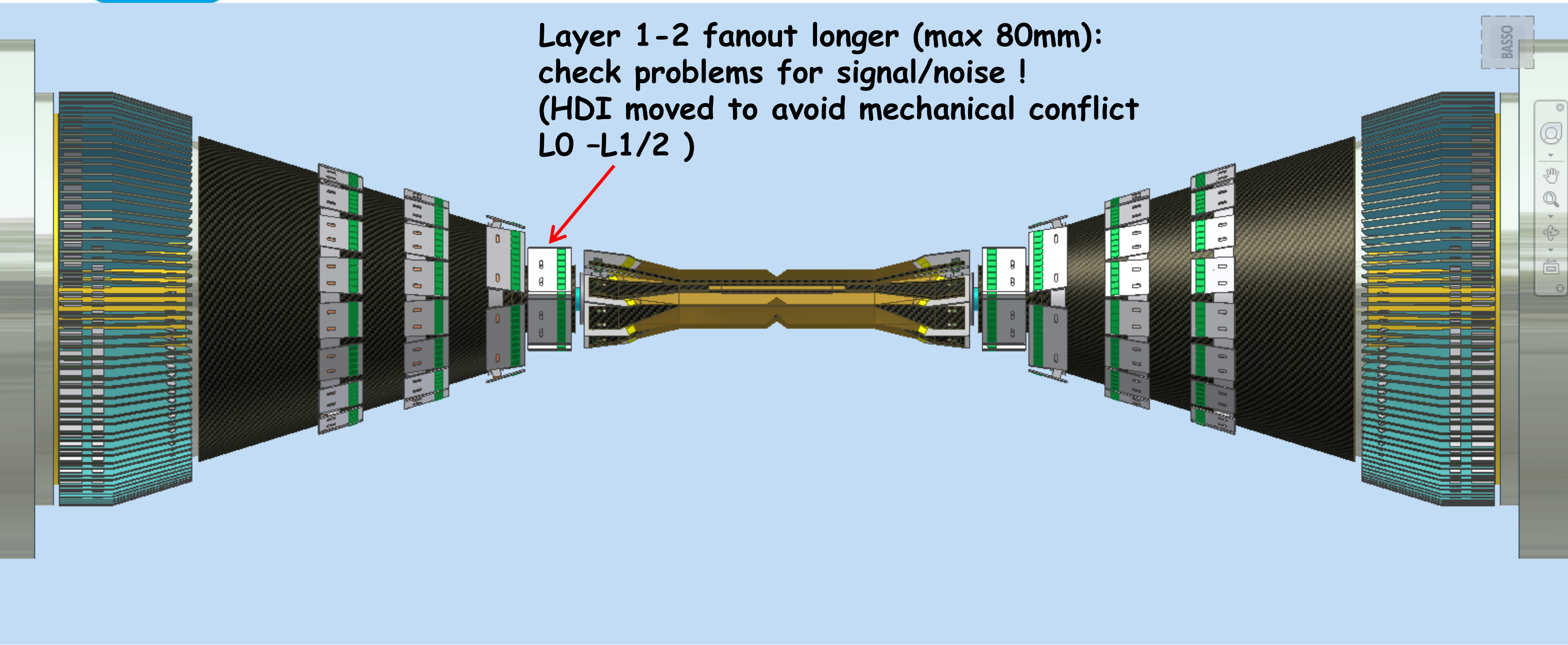
All L0 HDI are contained below the 300 mrad acceptance angle

L0 design



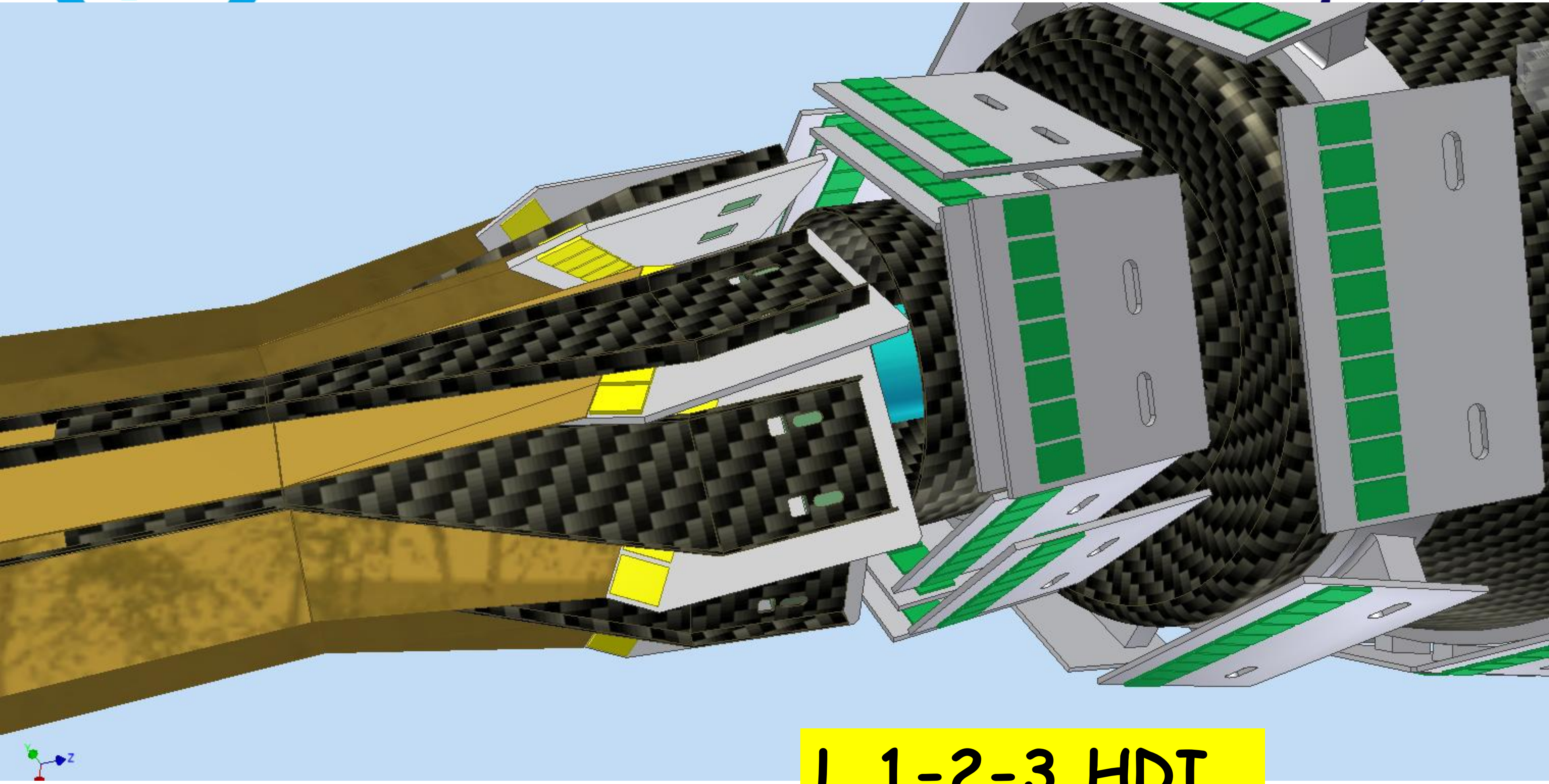
Si sensor position in the L0 striplet module

SVT HDI – L0 HDI



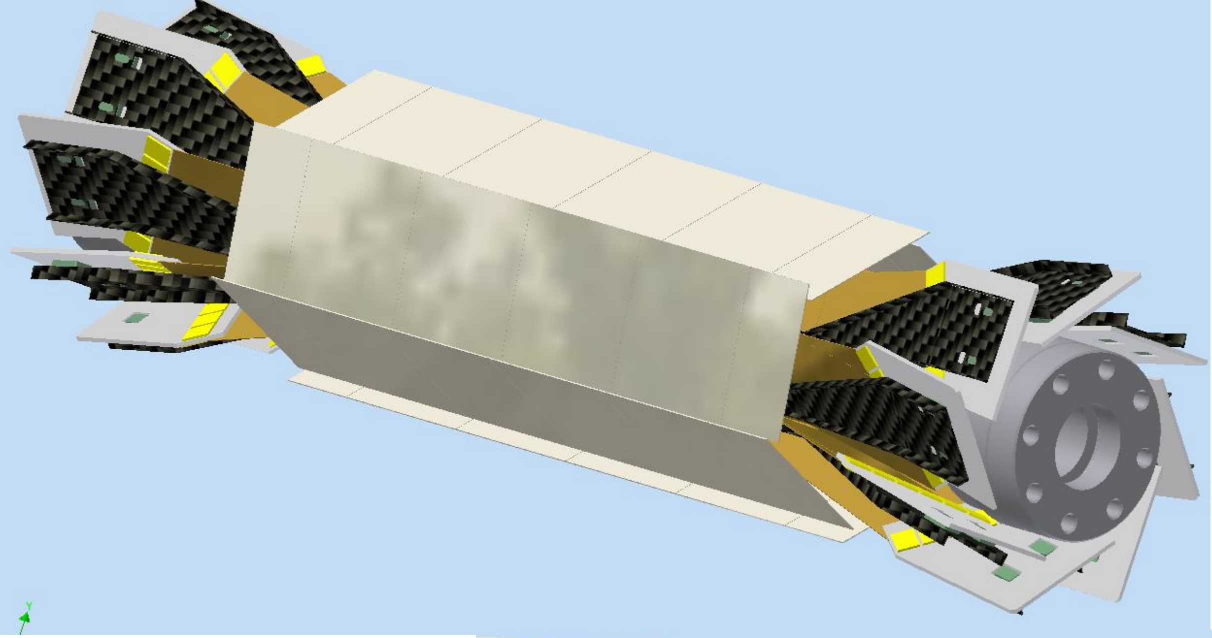
Relative positions between SVT HDI and L0 HDI

SVT HDI – L0 HDI



Crowed region !

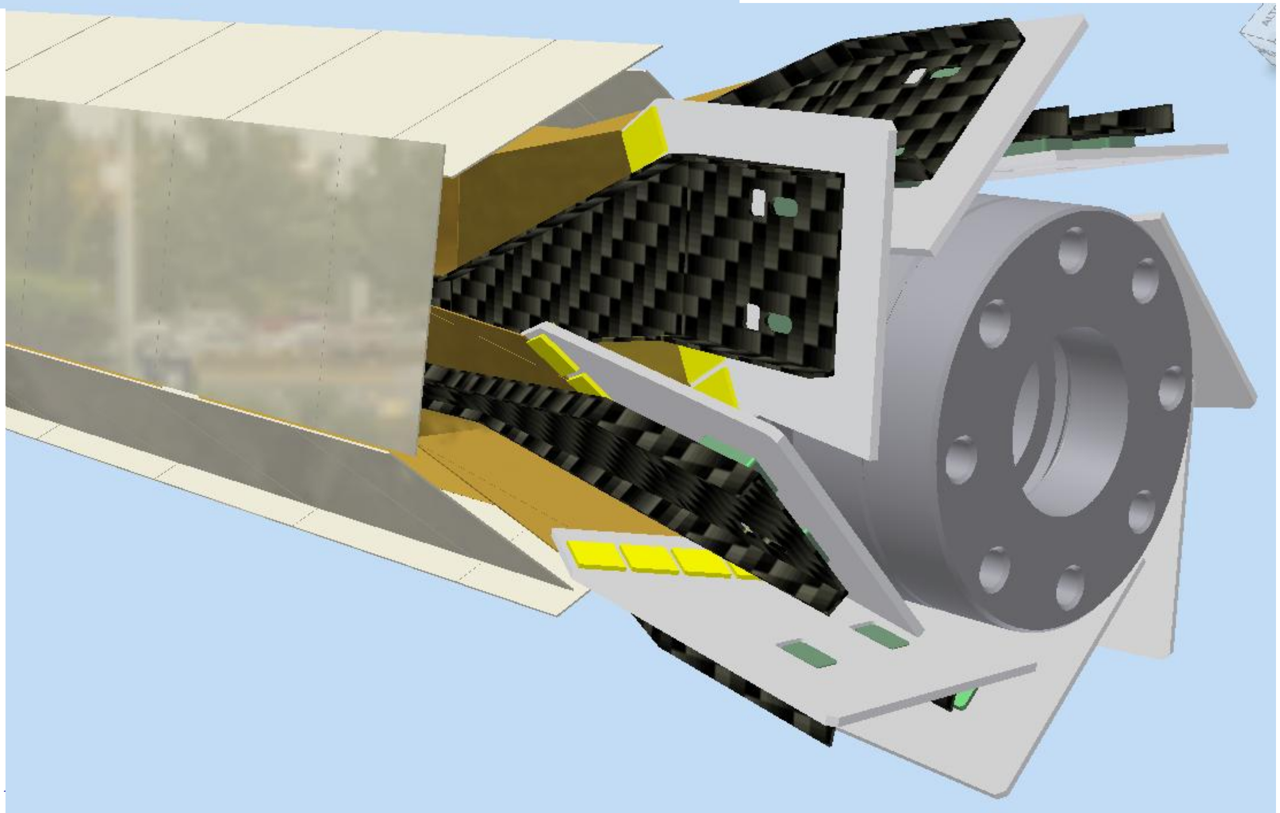
L 1-2-3 HDI and L0 HDI



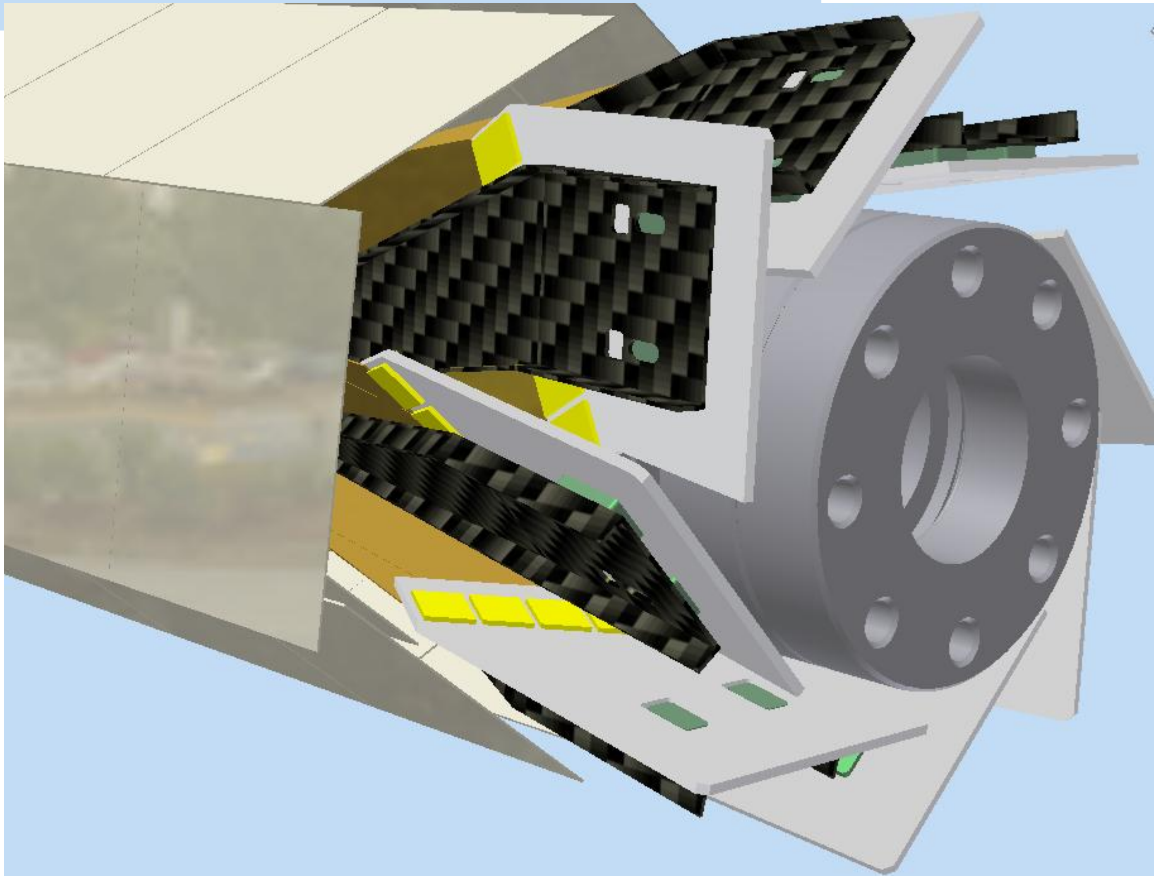
New L0 striplets design

Layer0/Layer1

No conflict !



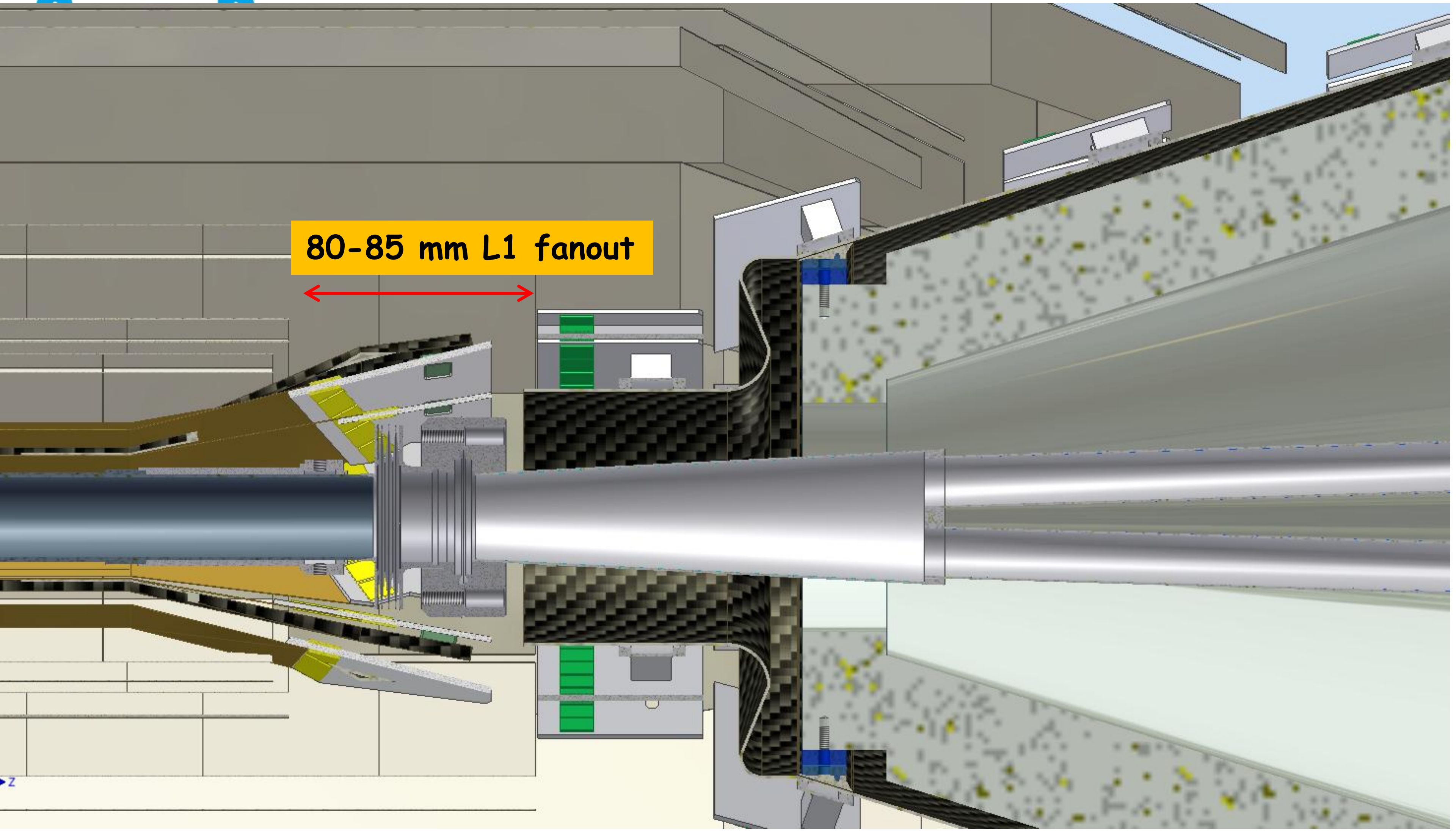
L0 striplets design



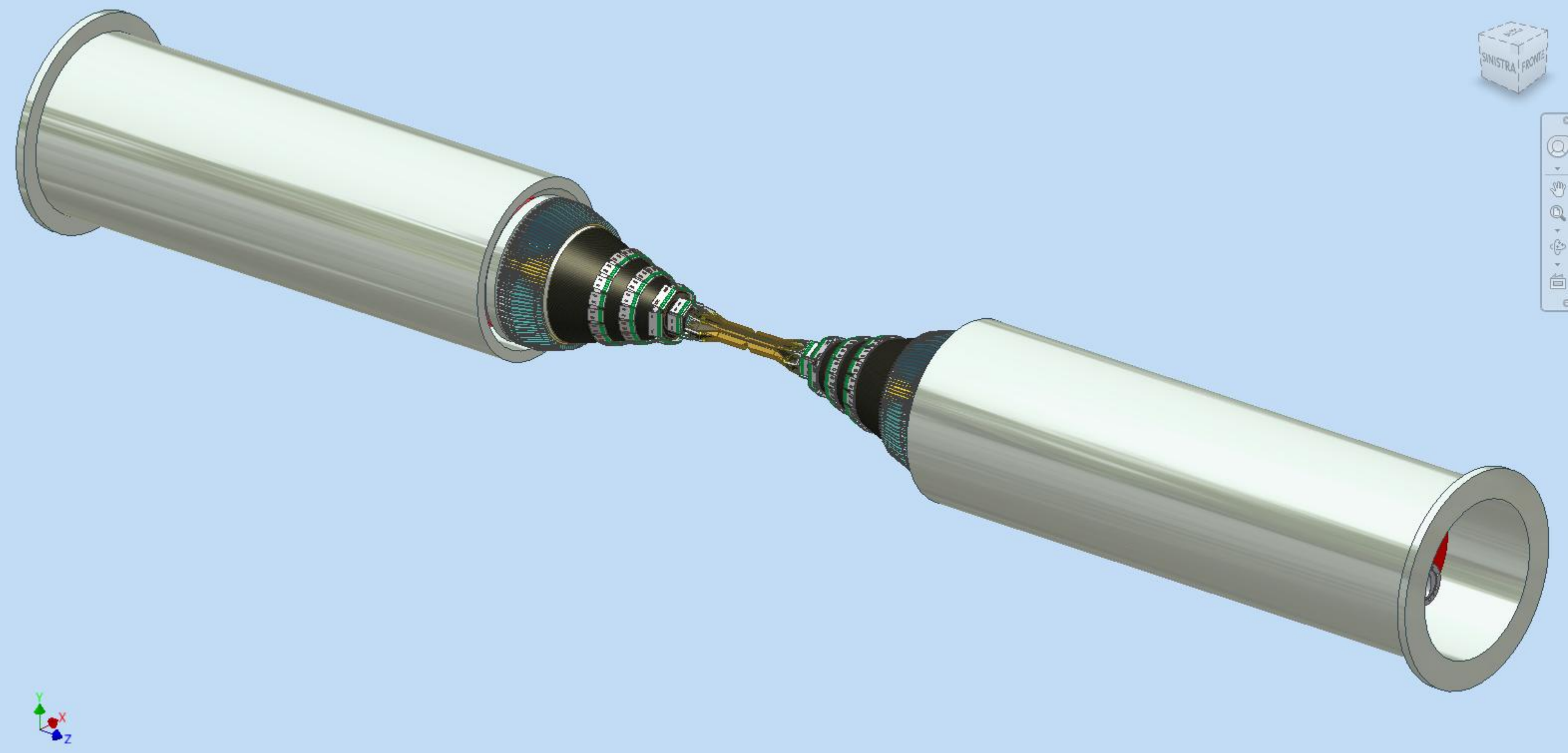
Layer0/Layer2

No conflict !

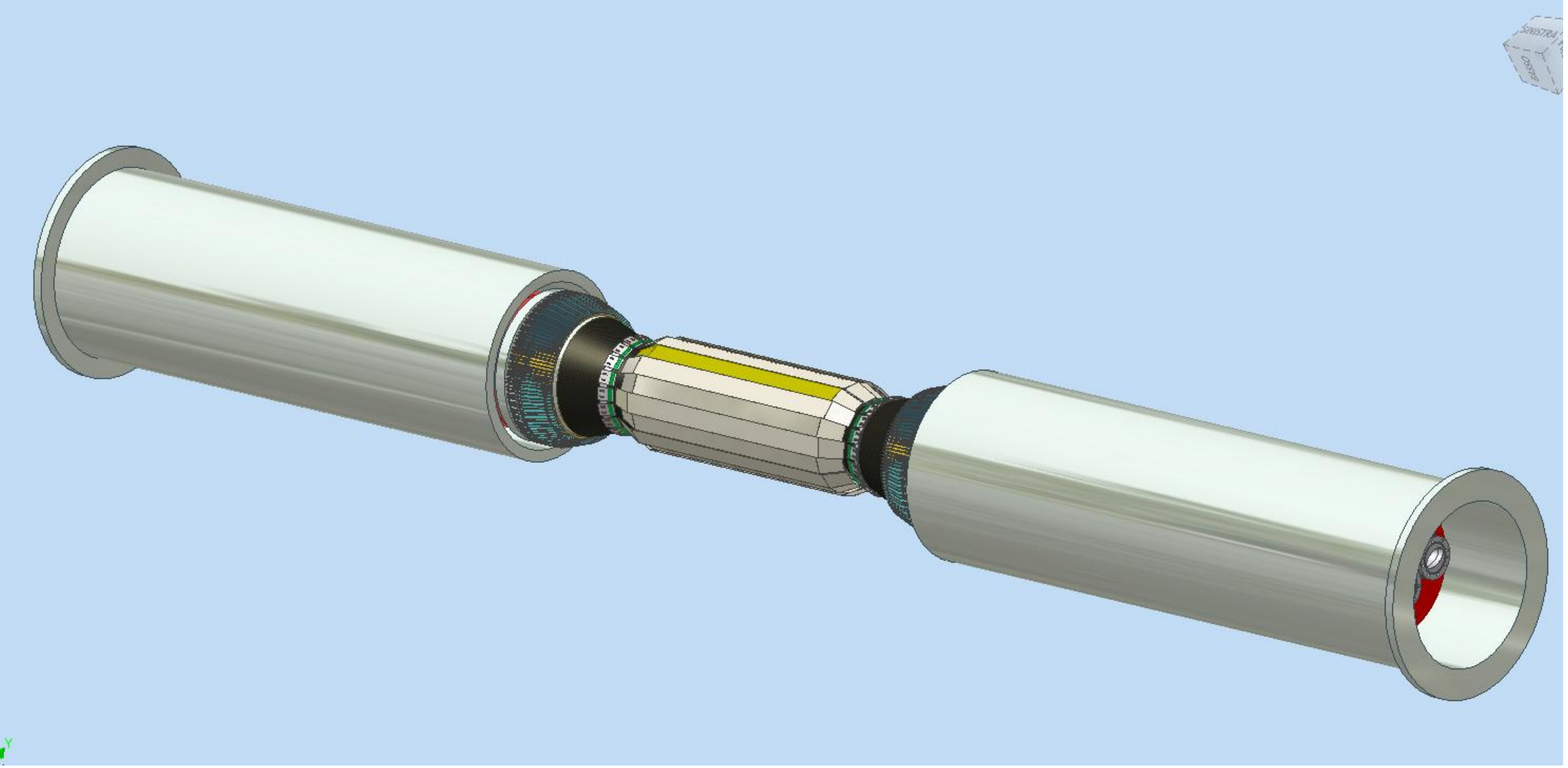
I.R. Layout



I.R. Layout

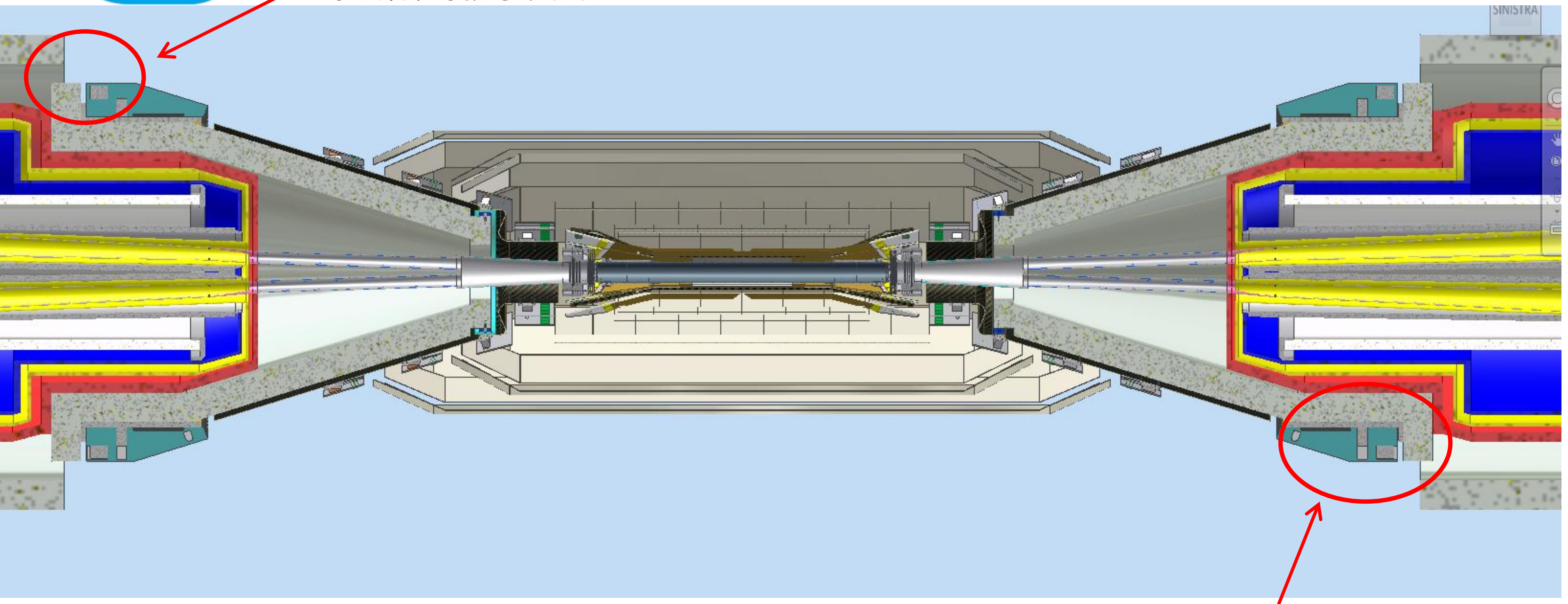


I.R. Layout



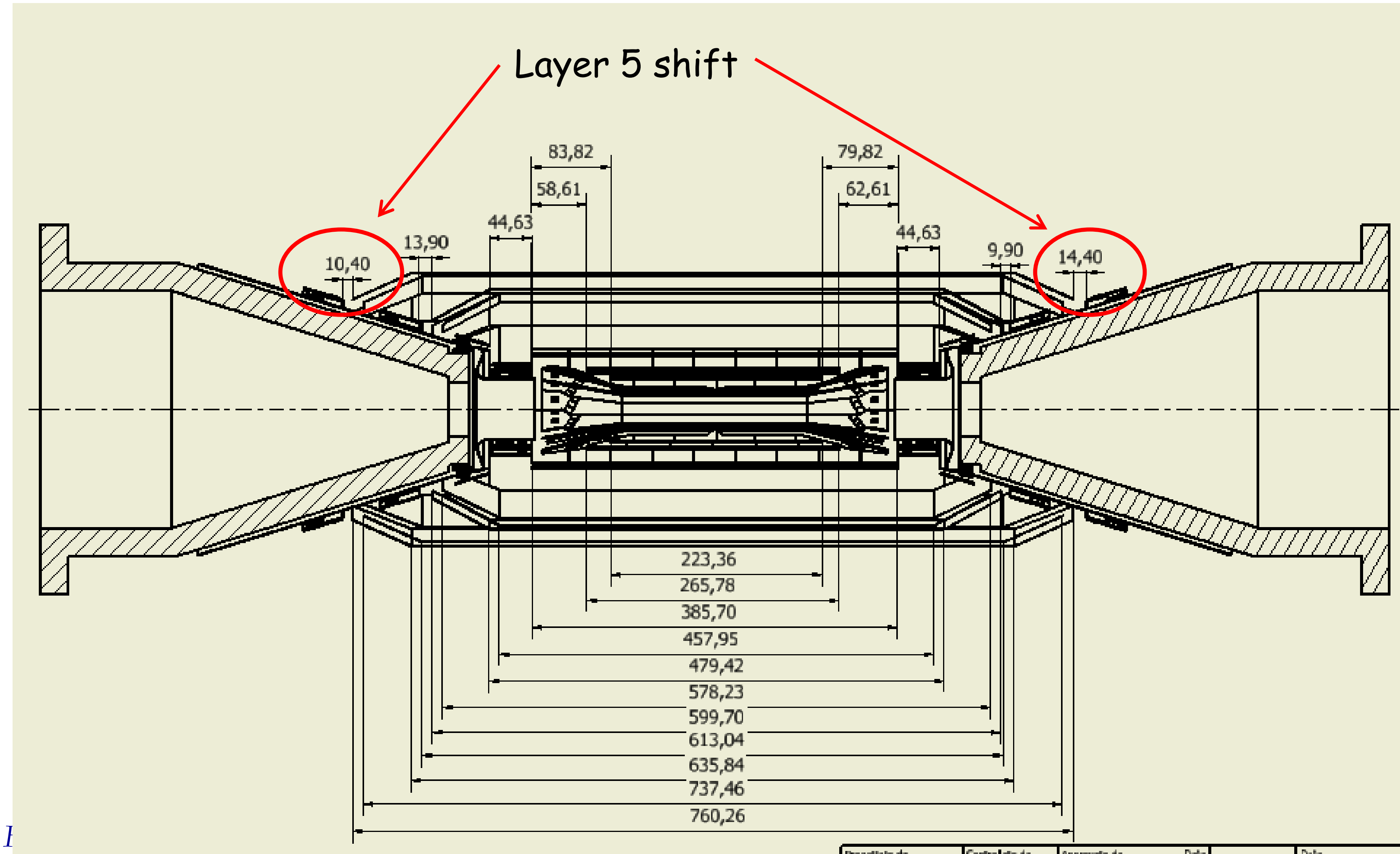
I.R. Layout

W conical shield indipendent from cilindrical shield

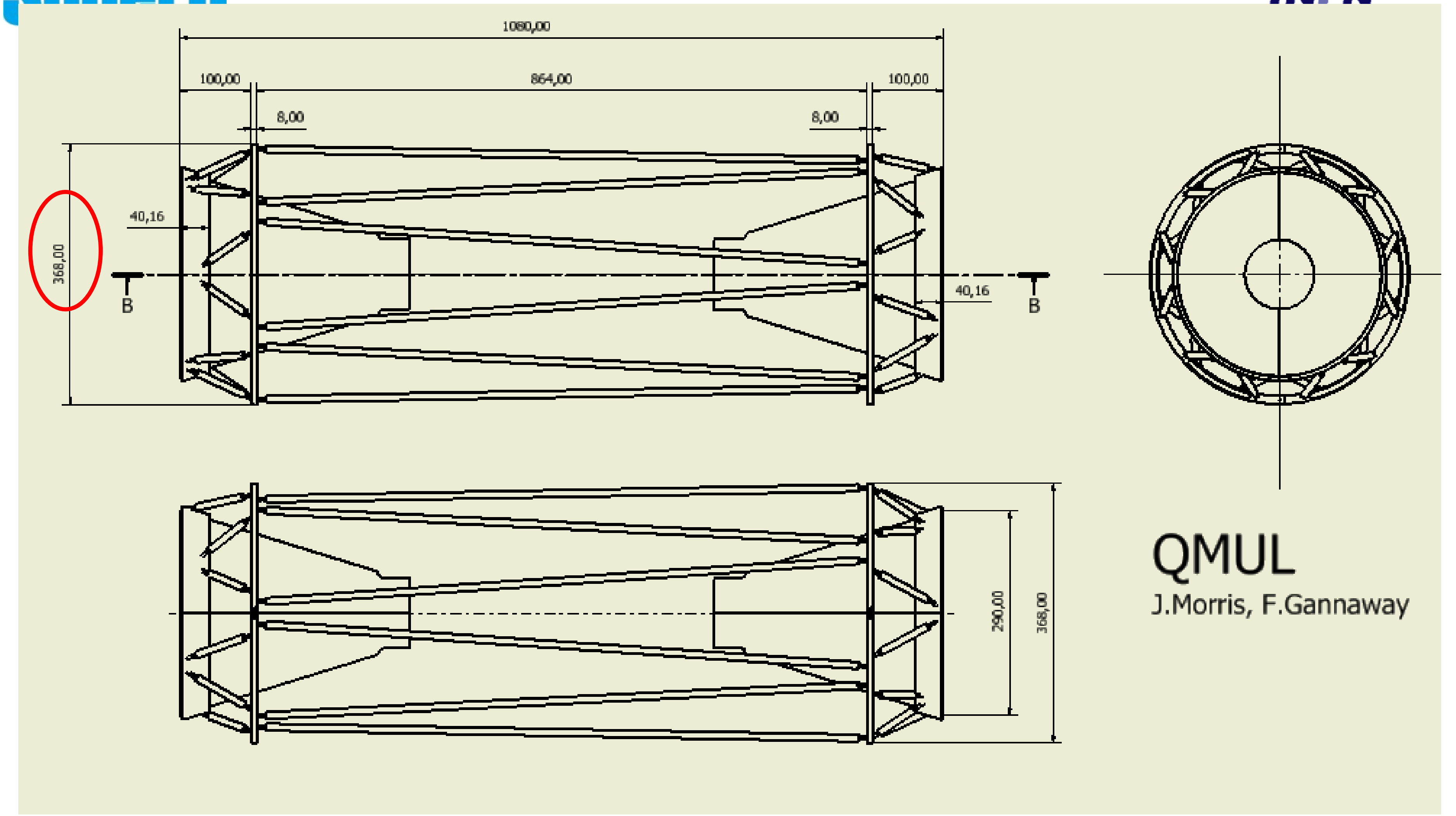


Transition card with radial dimension useful to remain below ext diam W conical shield to allow movement respect to cilindrical shield

I.R. Layout

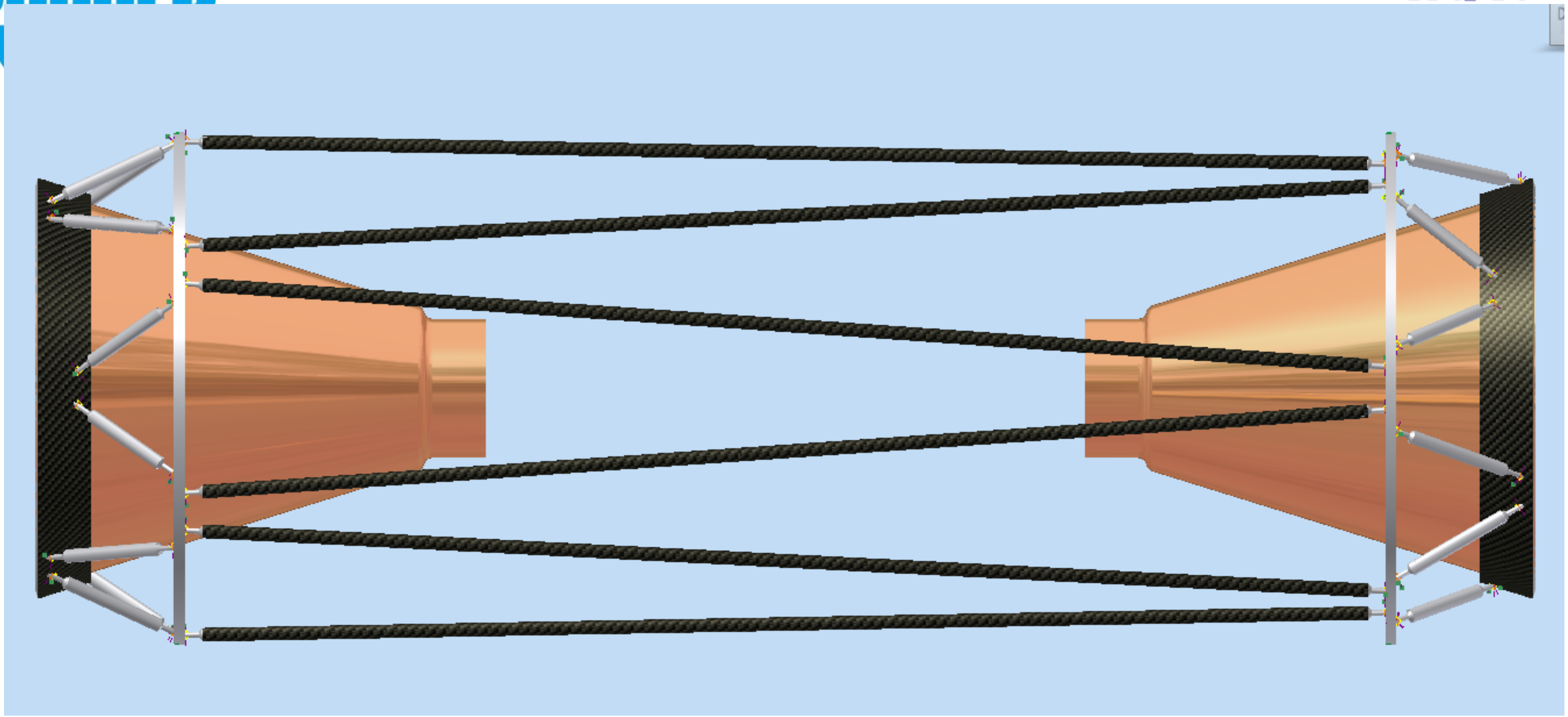

Layer 5 shift
83,82
79,82
58,61
62,61
44,63
44,63
13,90
10,40
9,90
14,40
223,36
265,78
385,70
457,95
479,42
578,23
599,70
613,04
635,84
737,46
760,26
Progettato da
Controllato da
Approvato da
Data
Data

Space Frame/Supporting Cones



Space Frame, version 2

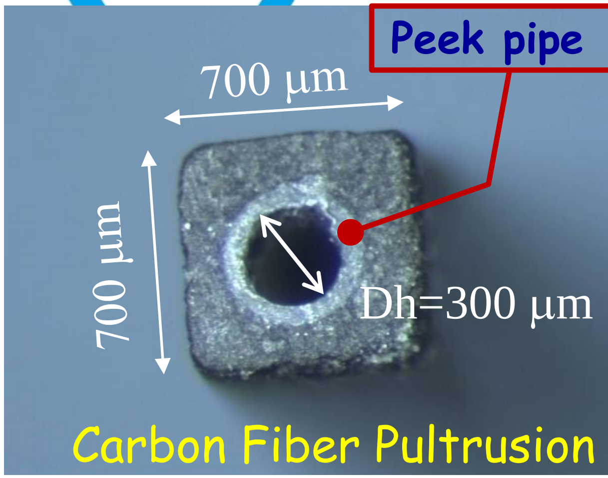
Space Frame/Supporting Cones



J. Morris and F. Gannaway are working on the version 3 of the C.F. cones and space-frame having the new position of HDI/cooling ring

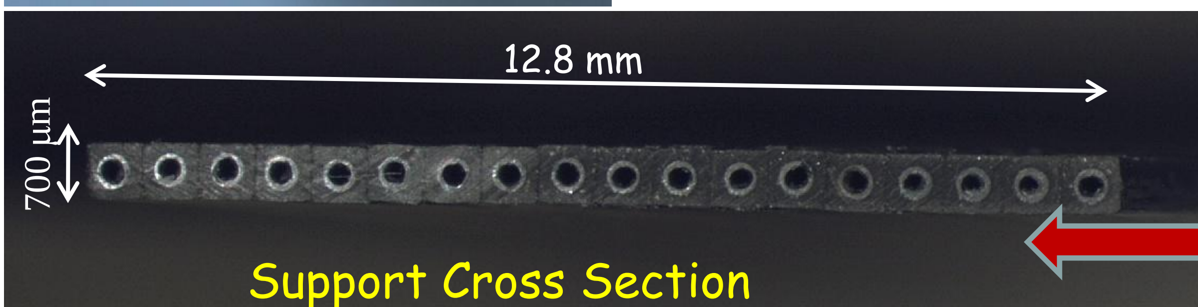
Space Frame, version 2

Work on Module MAPS supports



The single base microchannel unit

A square CF micro-tube with an internal peek tube 50 μm thick used to avoid moisture on carbon fiber



Full micro-channel module

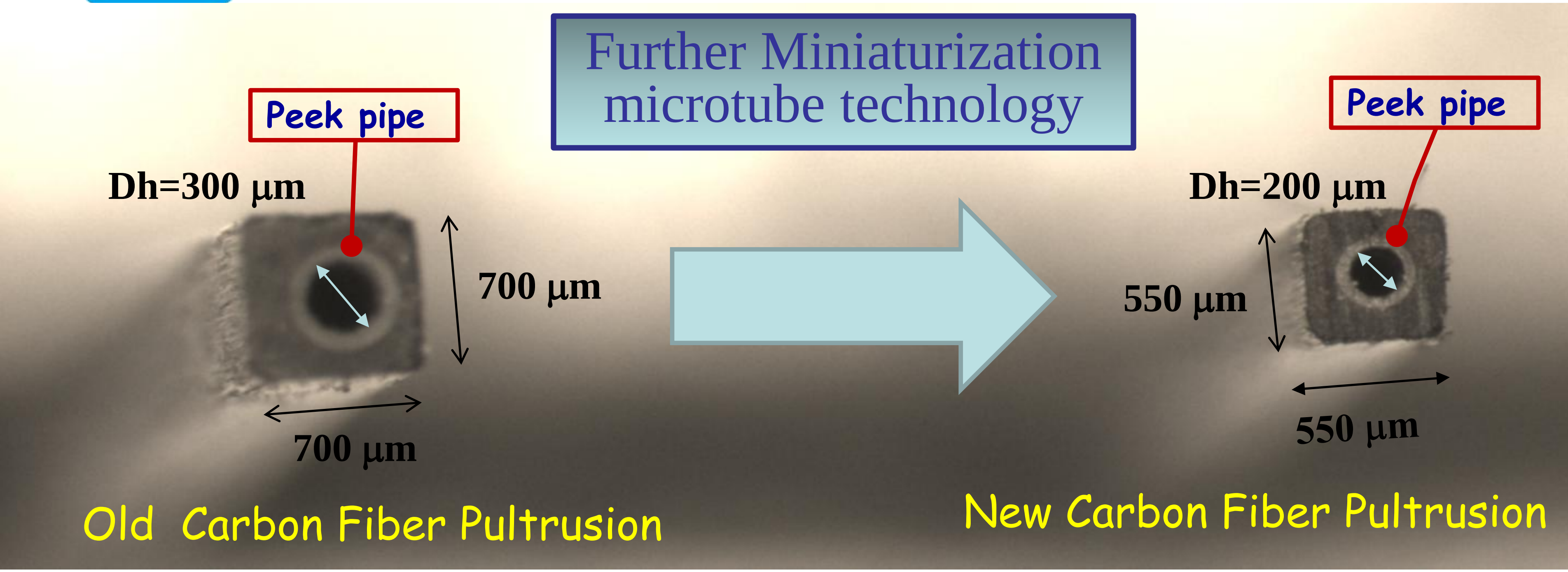
The total radiation length (*) of this support is 0.28 $\%X_0$

Net micro-channel module

Same dimensions of full micro-channel but vacancies of tubes in the structure.
The total radiation length (*) is 0.15 $\%X_0$

(*): Material of the support structure: (All C.F. material + peek tube + Water)

Work in progress



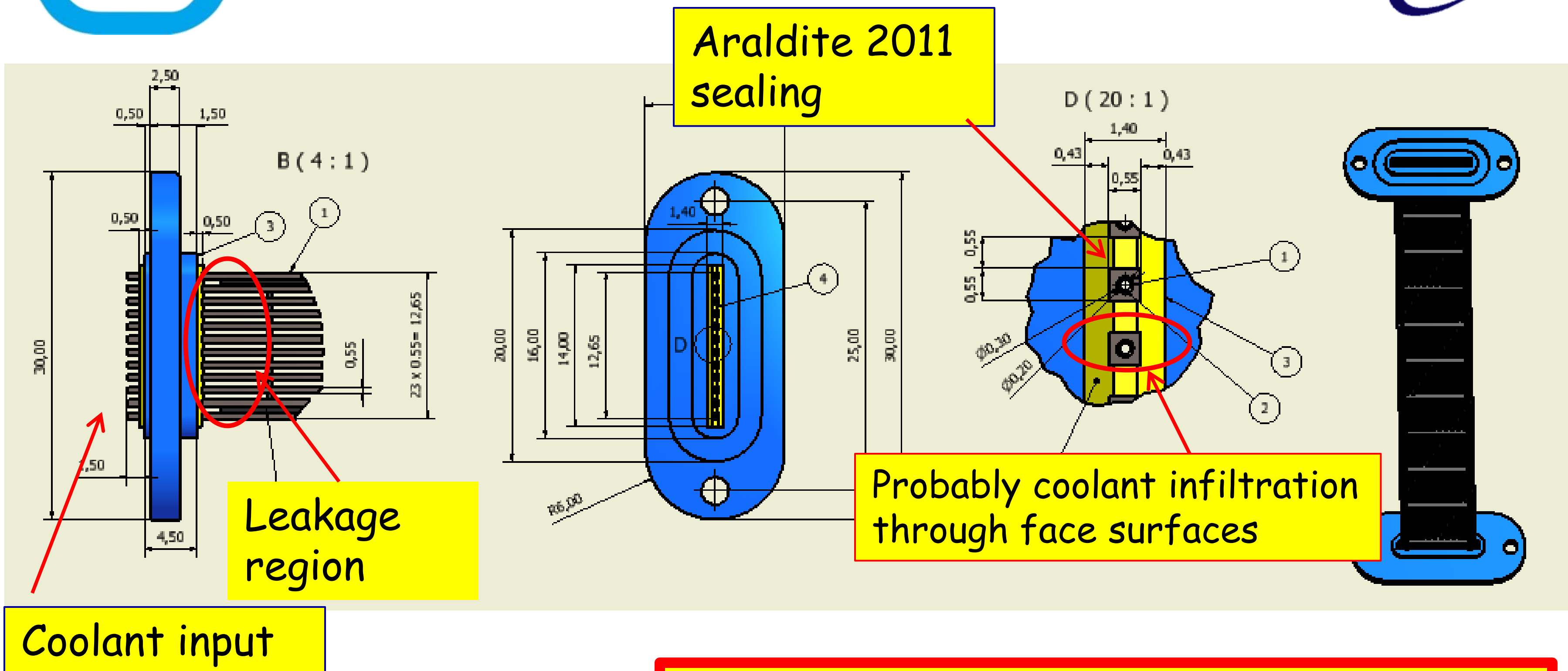
Full Module	$X = 0{,}28\ \%\ X_0$
Net Module	$X = 0{,}15\ \%\ X_0$

→

Full Module	$X = 0{,}22\ \%\ X_0$
Net Module	$X = 0{,}11\ \%\ X_0$

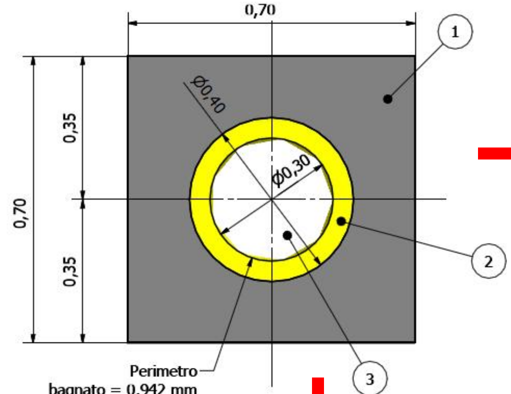
Module Microtubes 550 μm th, Full and Net version tested at the TFD lab

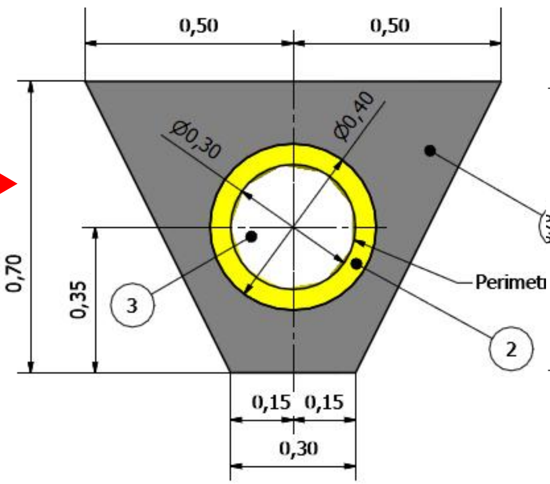
Pixel maps module support

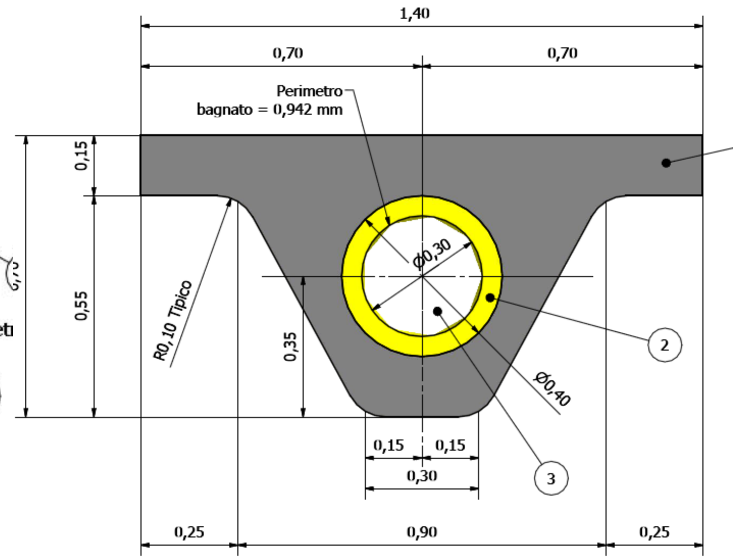


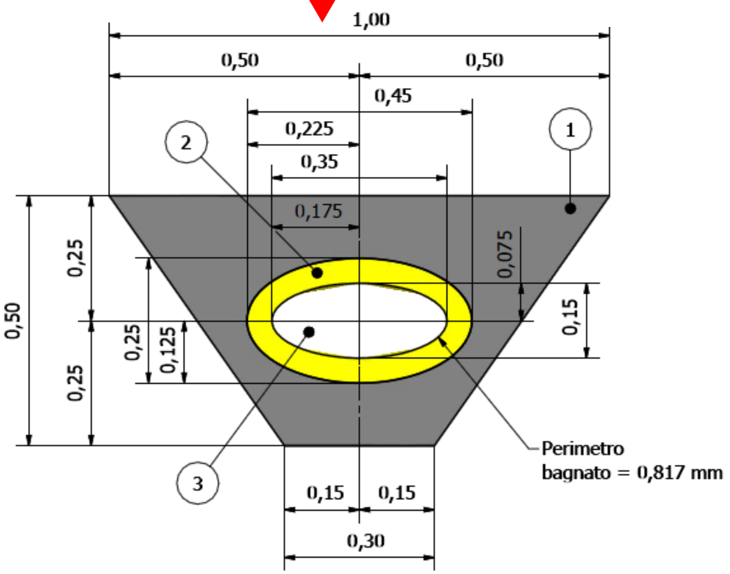
Leakage problem: → The leakage is due to a poor rate of resin respect to the carbon fiber that allow the coolant pass trough the pultrusion at the face plane region of the microchannel ; NEED A NEW PRODUCTION !

Pixel maps module support





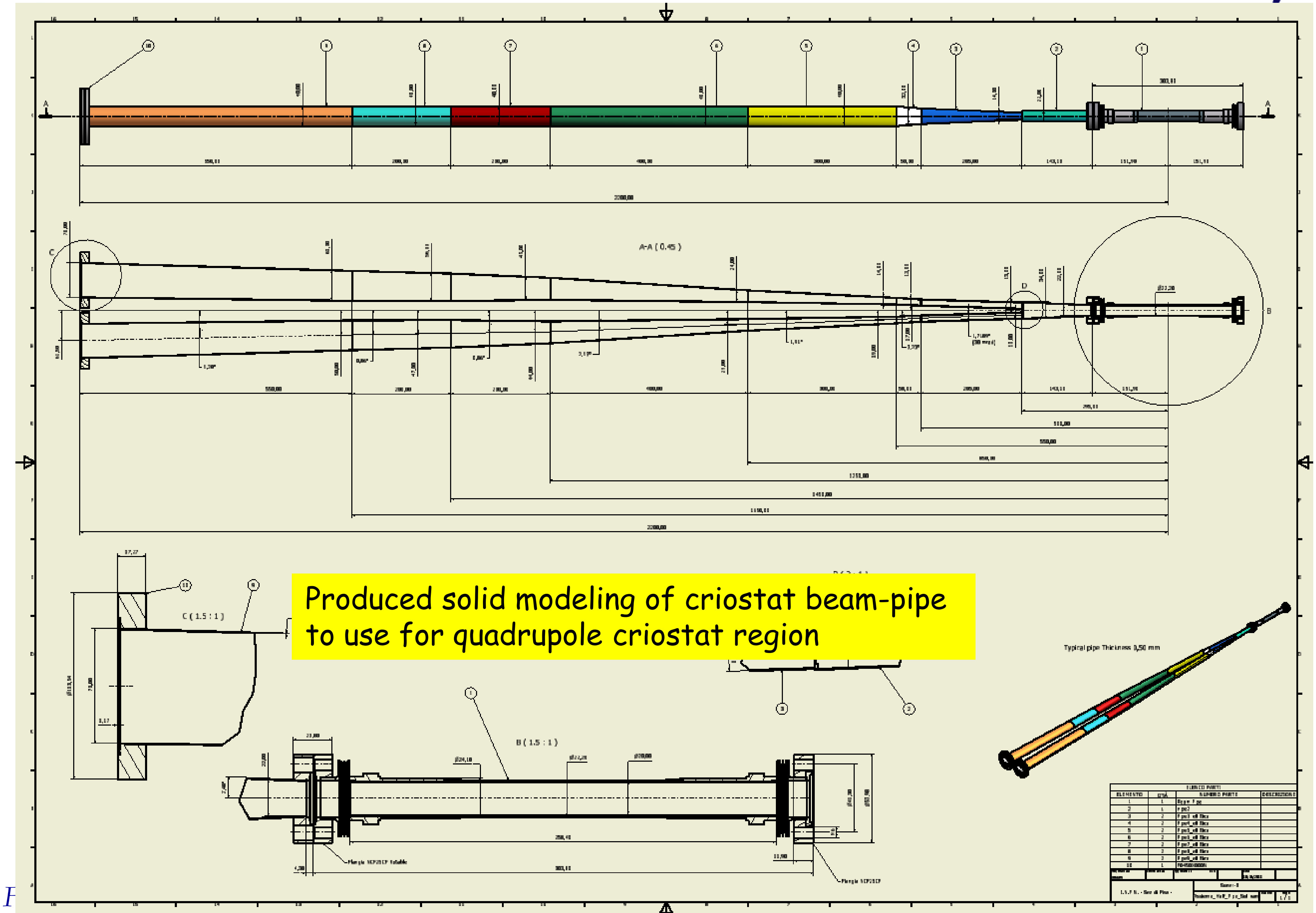




At the same time:

Developing a new microchannel profile with higher performance in thermal exchange due to the larger exchange surface

Beam pipe



Produced solid modeling of criostat beam-pipe to use for quadrupole criostat region

I.R. Architecture/quick demounting

- Present I.R. design has the goal to assume W conical shield independent from cylindrical shield to move less mass for quick demounting operation (all SVT components have minor diameter respect to W conical shield int.diam.) .

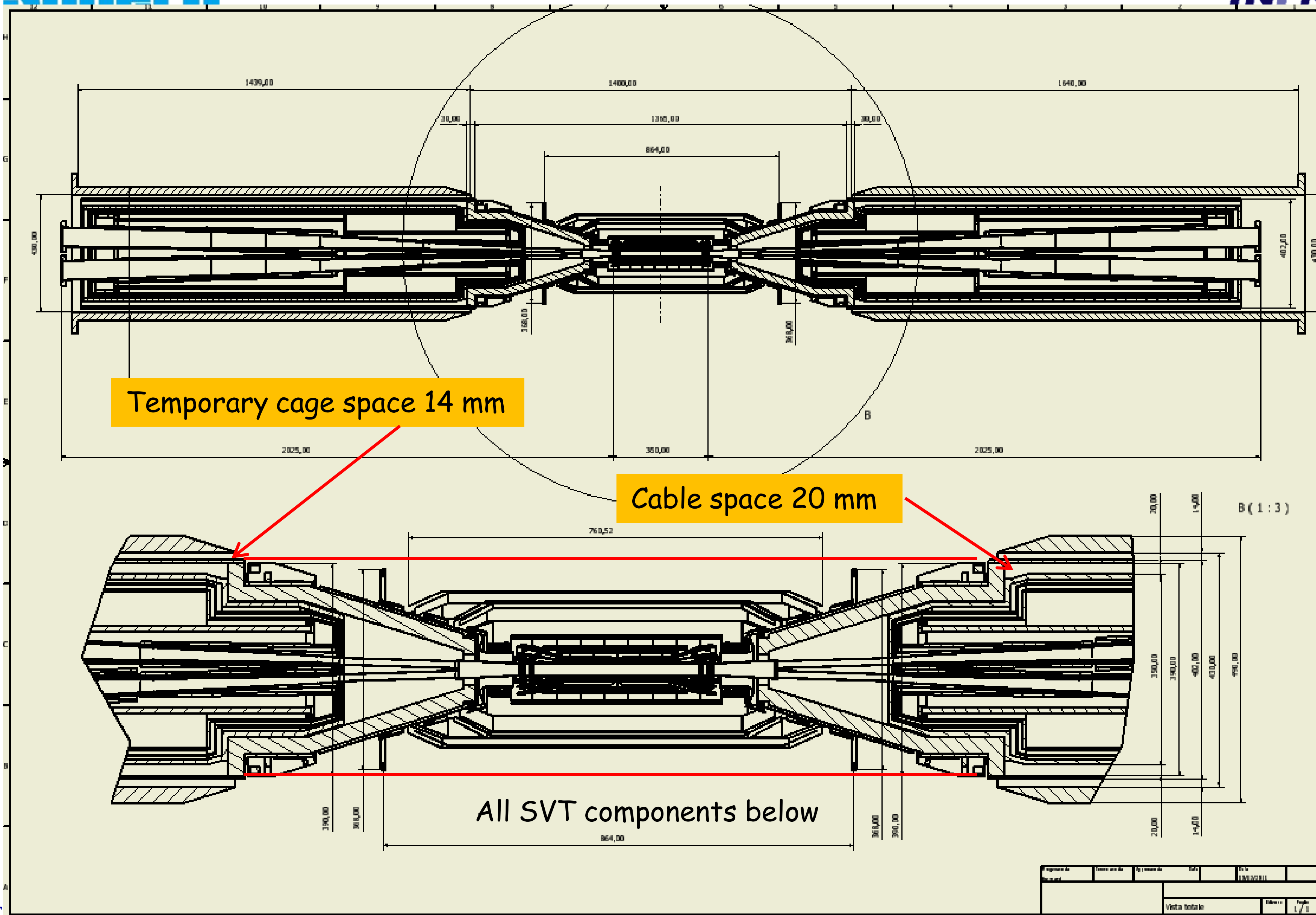
-In this configuration, criostat forw/back+SVT+L0+Be pipe+conical shield forw/back are one body (like in BaBar) but, in SuperB, to gain in X0, is not present the C.F. BaBar supporting tube and the Be pipe and SVT are the weak part of the mechanical chain .

-Quick demounting plans to insert-remove a temporary cage to make rigid SVT /Be pipe during sliding operation to replace L0 in short time.

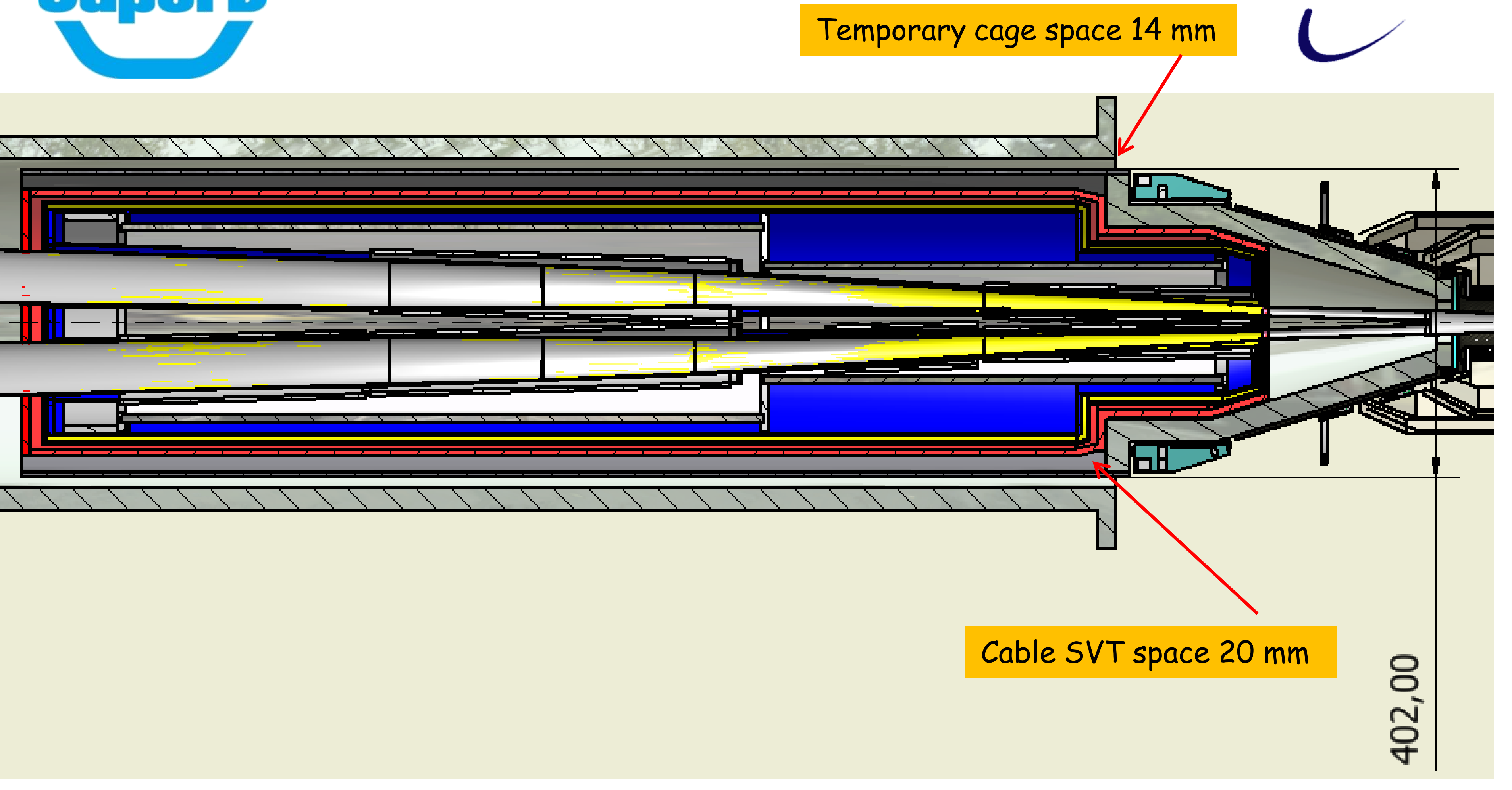
-Has been asked to assume R=245 (+10 mm respect now) as internal diameter of D.C. in order to have minimum radial space to design the mechanics of operation.

-The temporary cage should put together the two opposite W conical shield from a remote region (FCAL) previous blocking the external tube forw/back to the internal part of cylindrical W shield.

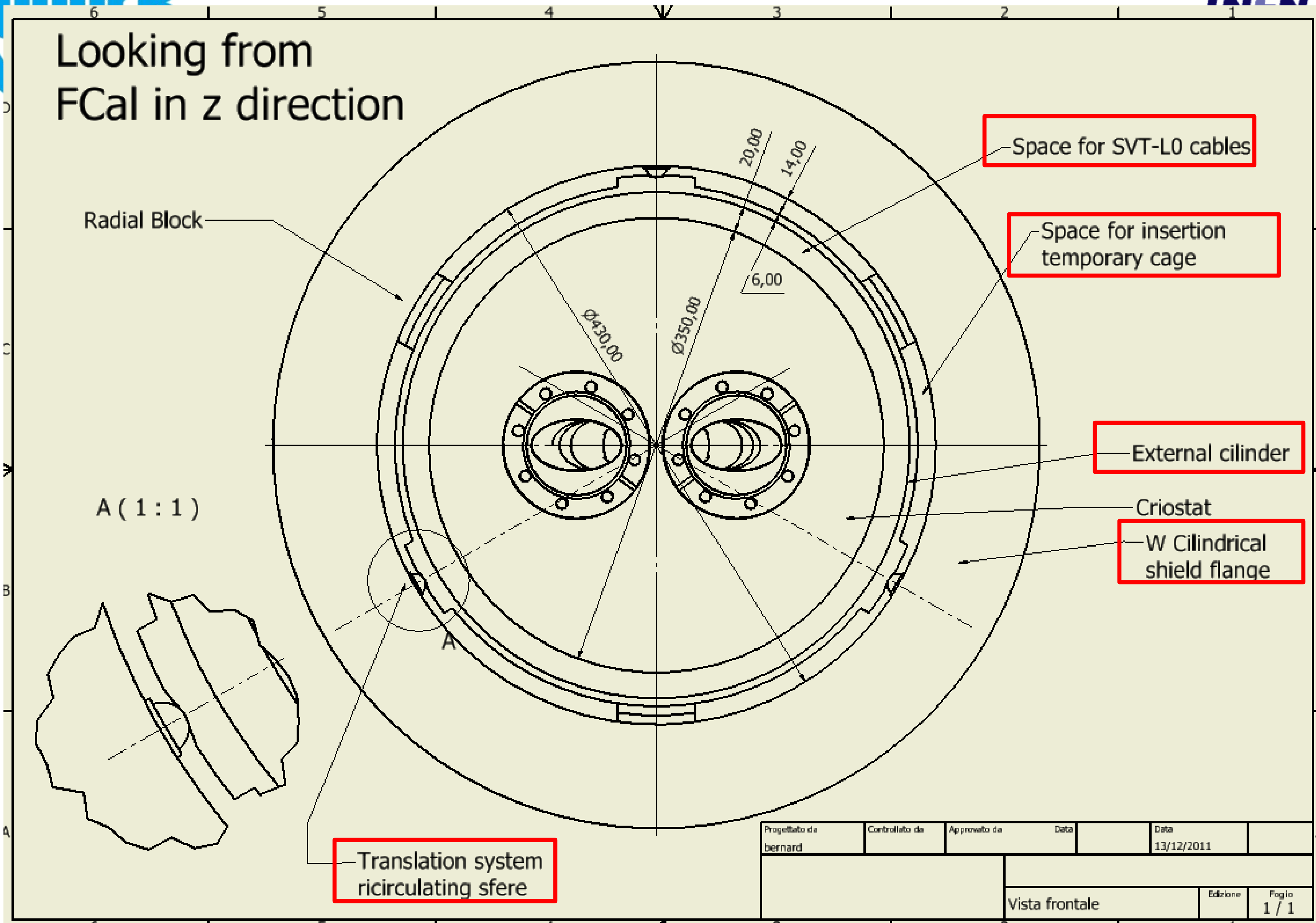
Quick demounting



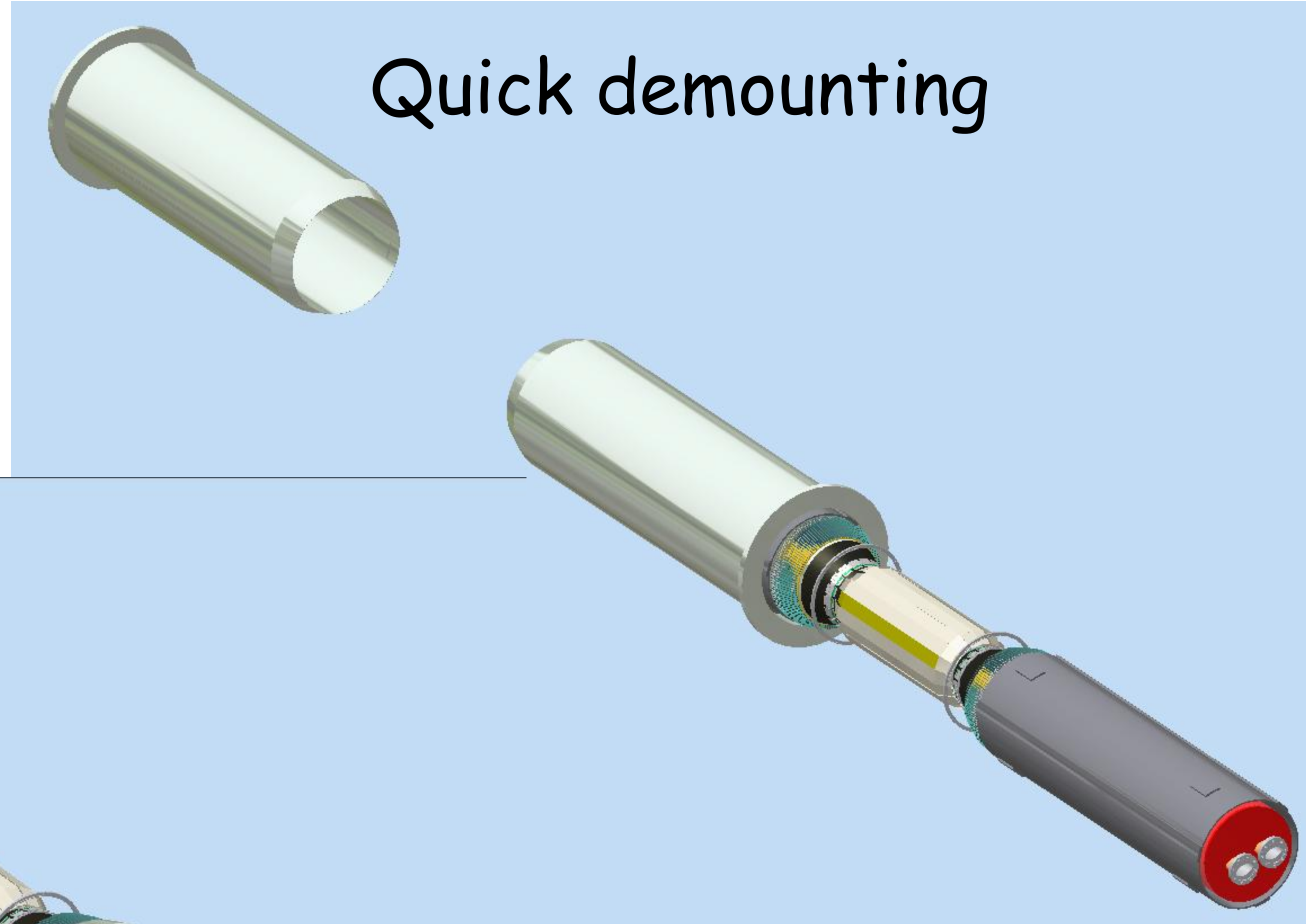
Quick demounting

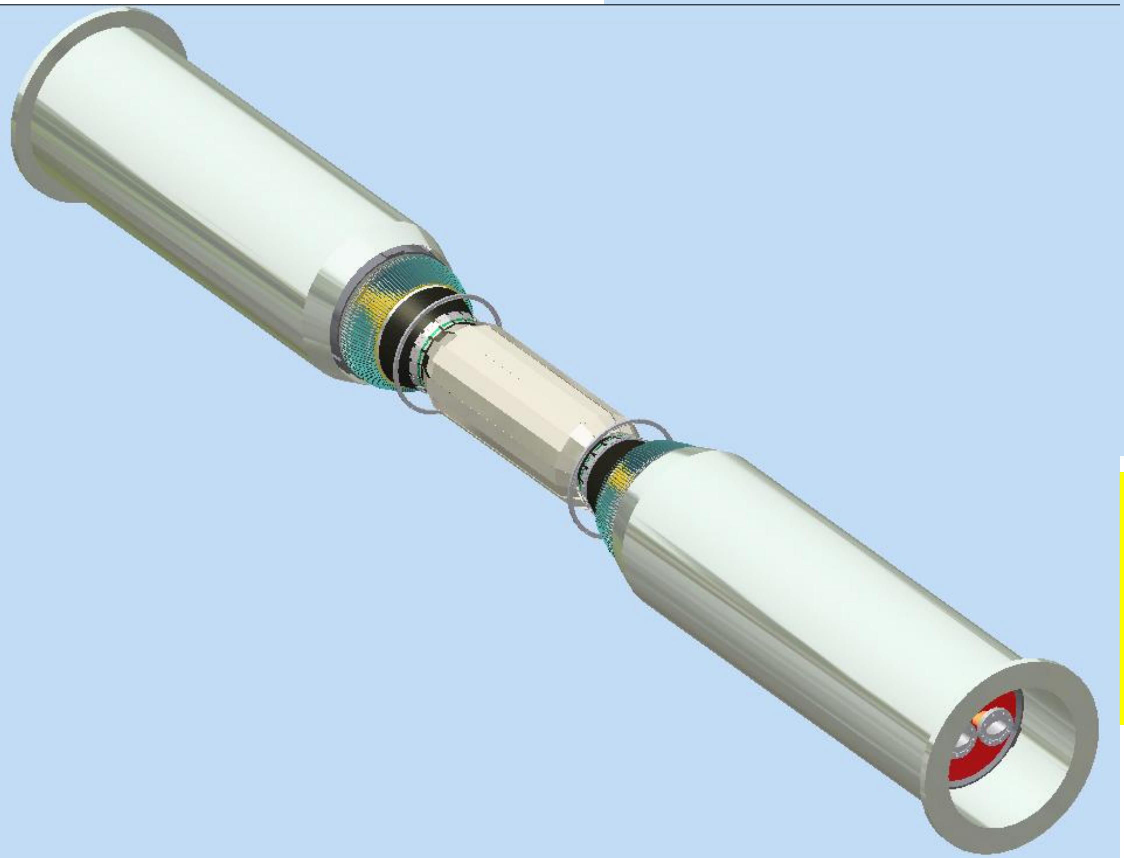


Quick demounting



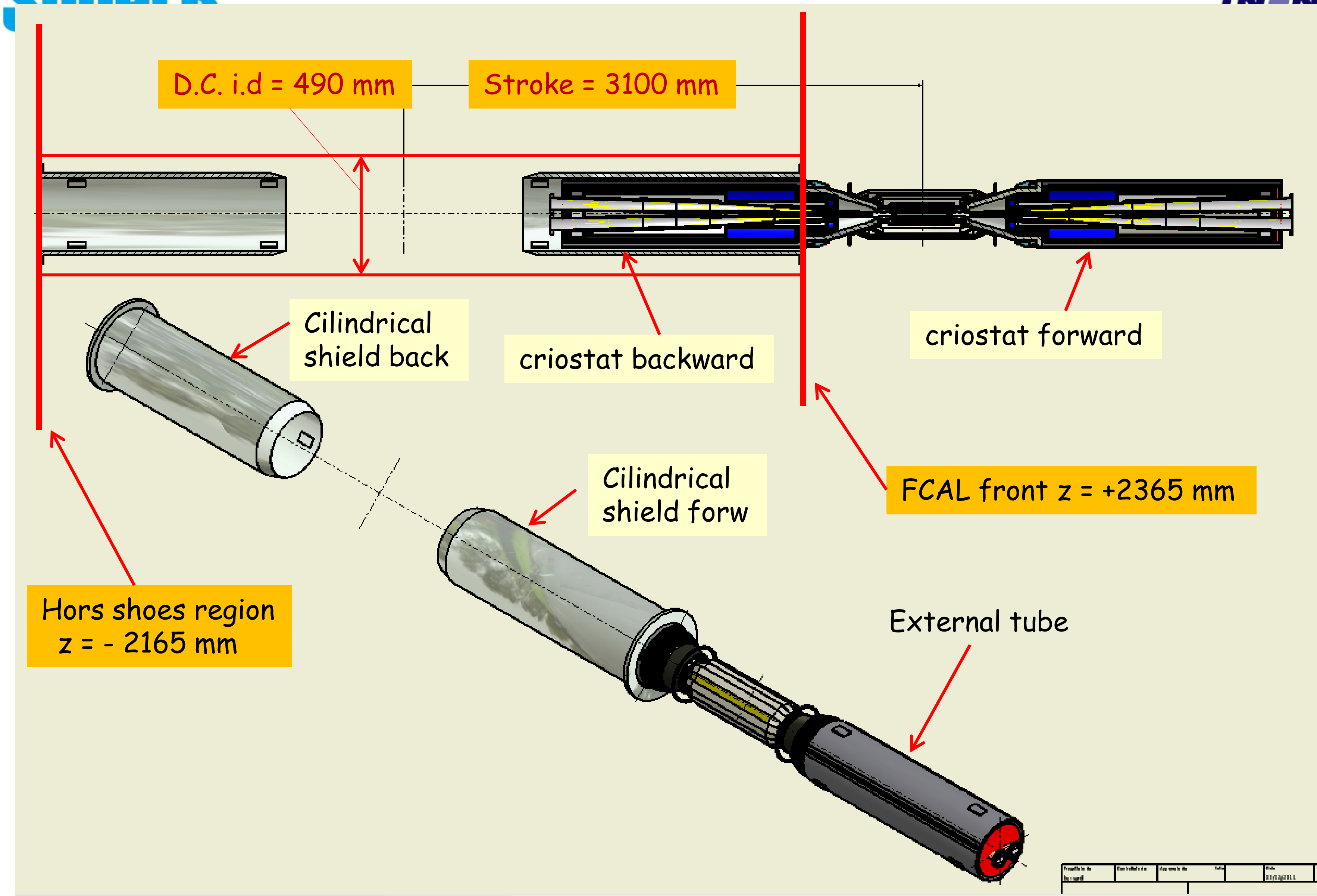
Quick demounting





SVT
1) In experimental condition
2) In removal condition at the end of stroke

Quick demounting



Conclusion

1) A lot of work realized on to eliminate SVT-L0 conflict and on the architecture of I.R. that allow possible start the preparation of TDR on this issues .

2) Strong effort has to be put on the quick demounting operation that is still at beginning study; this issue will be the main effort of next month.

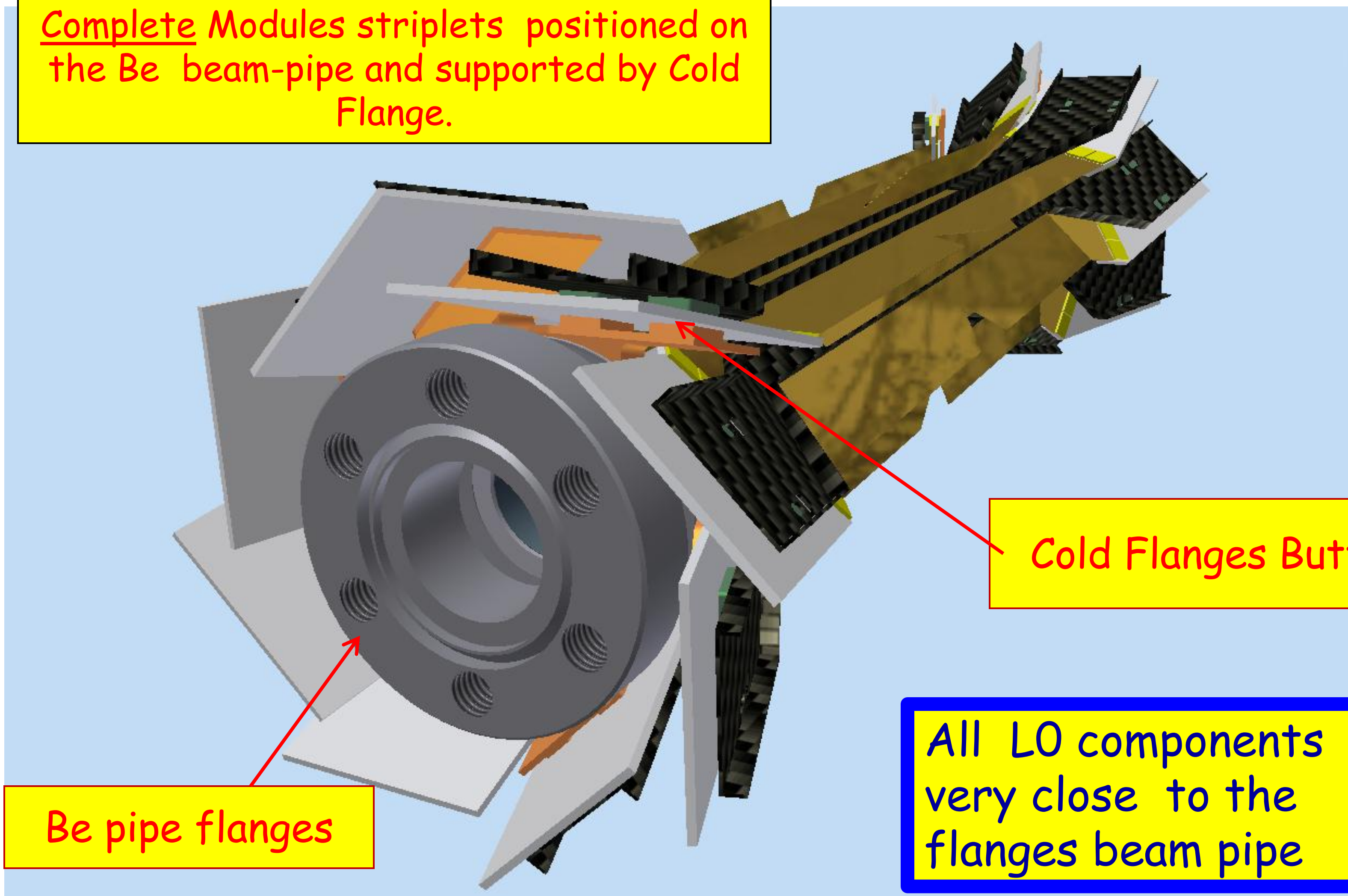
2) N.1 new engineer A. Bernardelli working in Pisa on SVT

3) N.1 Engineer S.Coelli at 50% will be operative at beginning of next year at INFN Milan to work on trans. card support , cooling simulation etc.

4) Good collaborating work with QMUL and real progress on the space-frame and supporting cones design

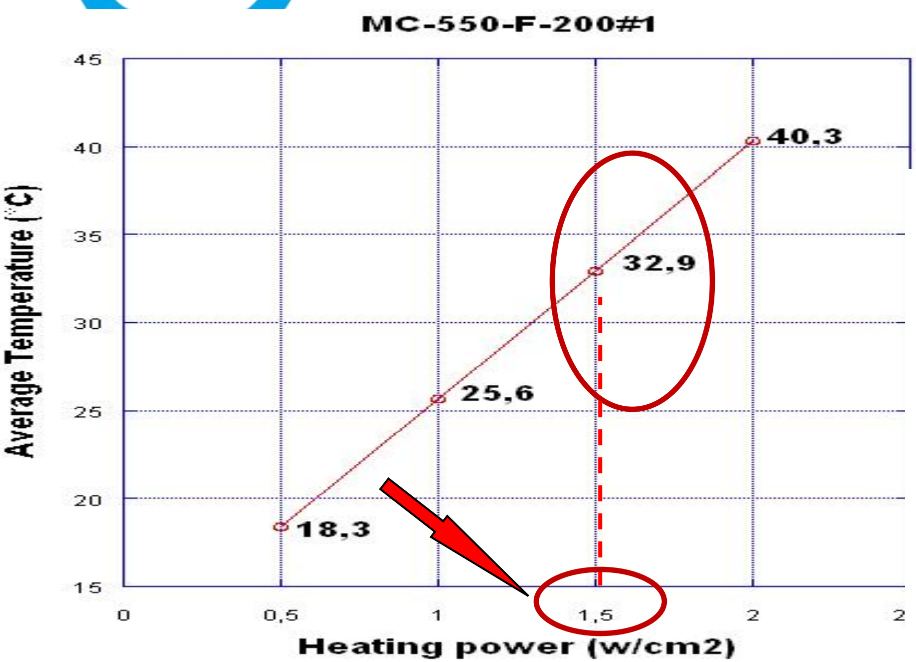
BACKUP

Module Striplets

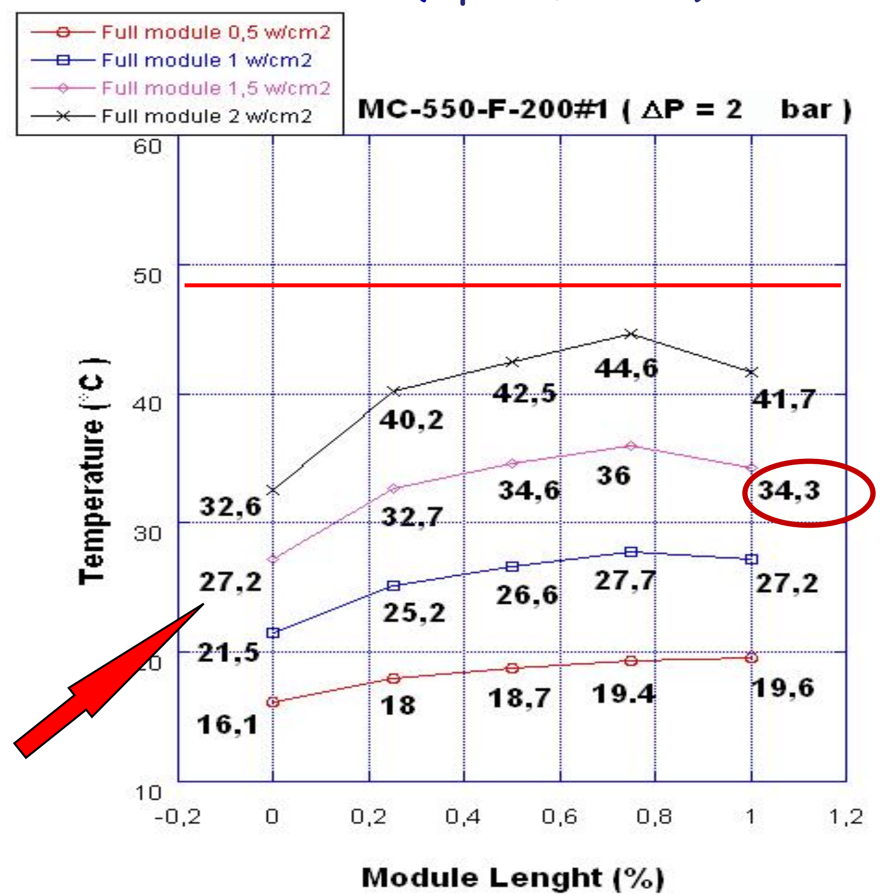


Full module H=550μm test results

Tests performed on full module sample (length = 120 mm) with water-glycol @ 10 °C as coolant (Δp =2,0 atm).

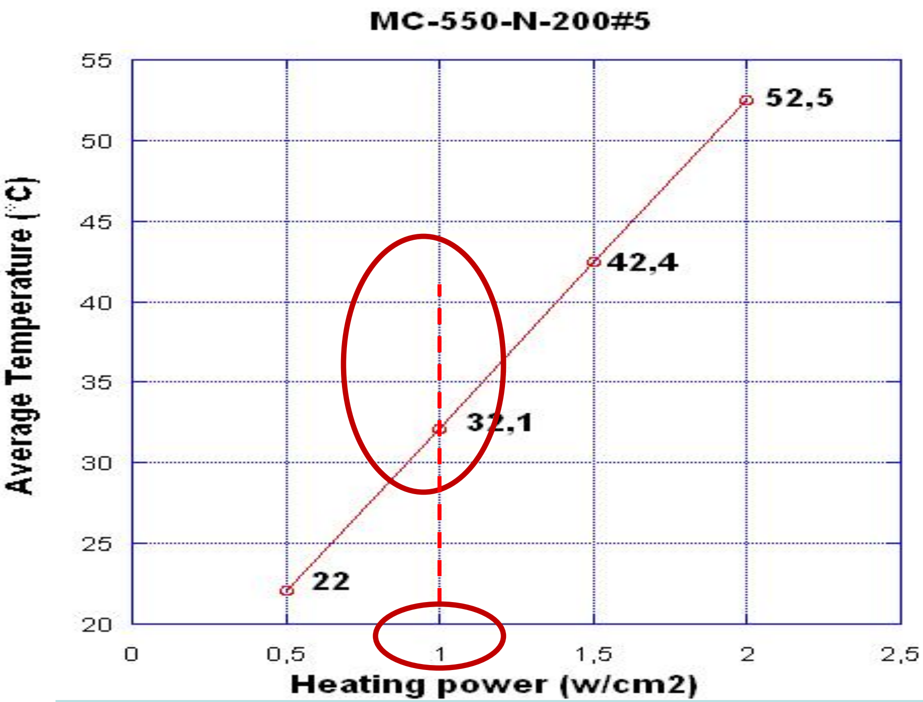


Average module Temperature vs Specific Power



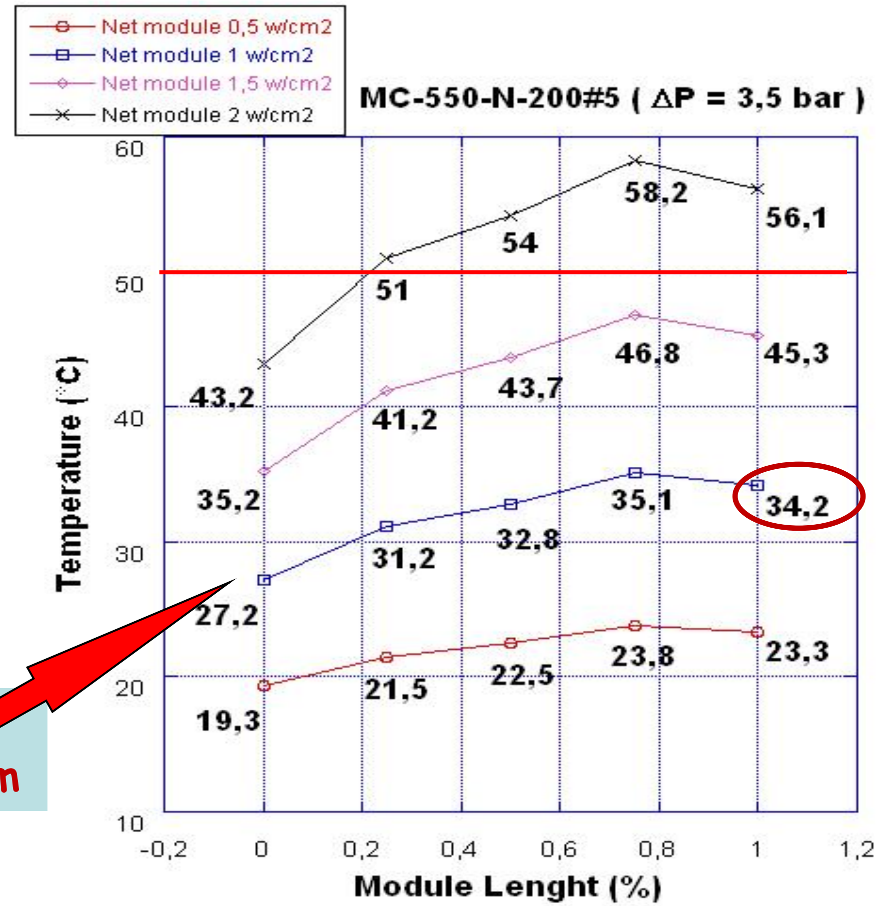
Temperature along the module: ΔT = 7,1 °C at 1.5 W/cm² and Δp =2.0 atm

Net Module H=550μm test results



Average module Temperature vs Specific Power

Tests performed on net module sample (length = 120 mm) with water-glycol @ 10 °C as coolant (Δp =3,5 atm).



Temperature along the module:
ΔT = 7.0 °C at 1.0 W/cm^2 Δp =3.5 atm

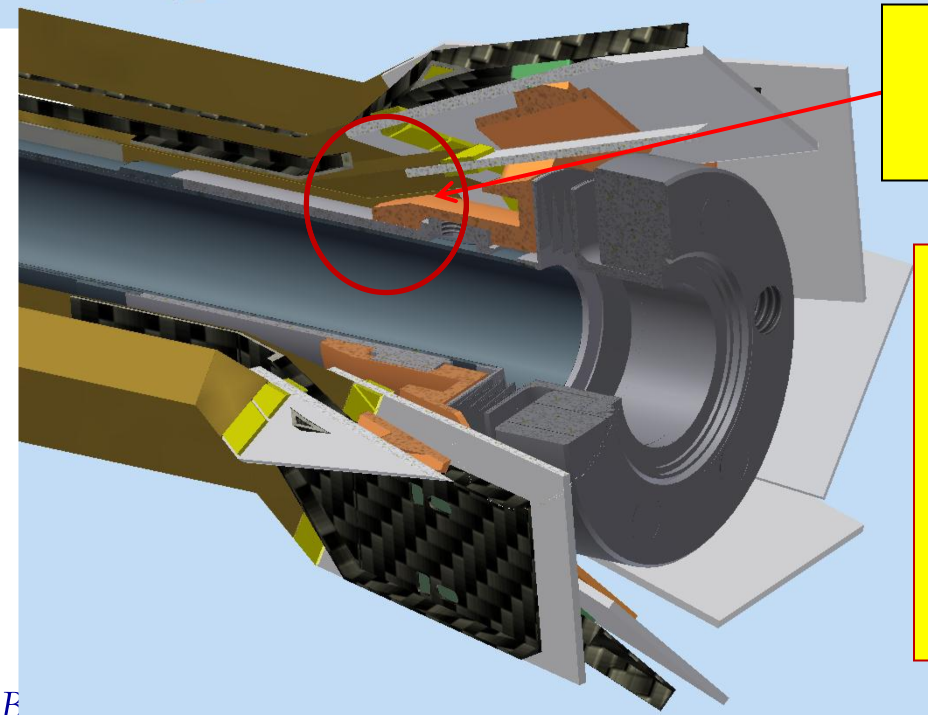
Microchannel Module Comparison Data

Comparison List

		% X0	T max °C	Specific Power W/cm2	Hydraulic. Diam. μm	Flow rate g/min	Δ Temperature °C
1	Microchannel FULL Module support H=700 μm		35.8	2.0	300	244	5.3
2	Microchannel NET Module support H=700 μm	0.15	38.3	1.5	300	128	6.70.28
3	Microchannel Full Module support H=550 μm	0.22	34.3	1.5	200	33*	7.1*
4	Microchannel NET Module support H=550 μm	0.11	34.2	1.0	200	24	7.0

Tests performed on net module sample (length = 120 mm) with water-glycol @ 10 °C as coolant at Δp =3,5 atm (Δp not valid for value *).

Radiation Monitor position



Possible position for radiation monitor.

Not yet defined the position of radiation monitor, its design depends still by definition of many other I.R. components, anyway we will try as soon as possible, to place the overall dimension on the general layout.