Update on SVT Mechanics

F. Bosi

INFN-Pisa

on behalf of the SuperB SVT Group

Outline

- SVT : ribs and fanout models
- L0 striplets : cold flanges + Be pipe (L=370 mm)
- L0 pixel module support : micro-tube development
- I.R. general layout update/quick demounting
- Work by Milano & QMUL
- Conclusion

SVT L1-5 Layout design

Modelling ribs for Layer 1-5

1) L5B longer about 230 mm respect Babar dimensions !

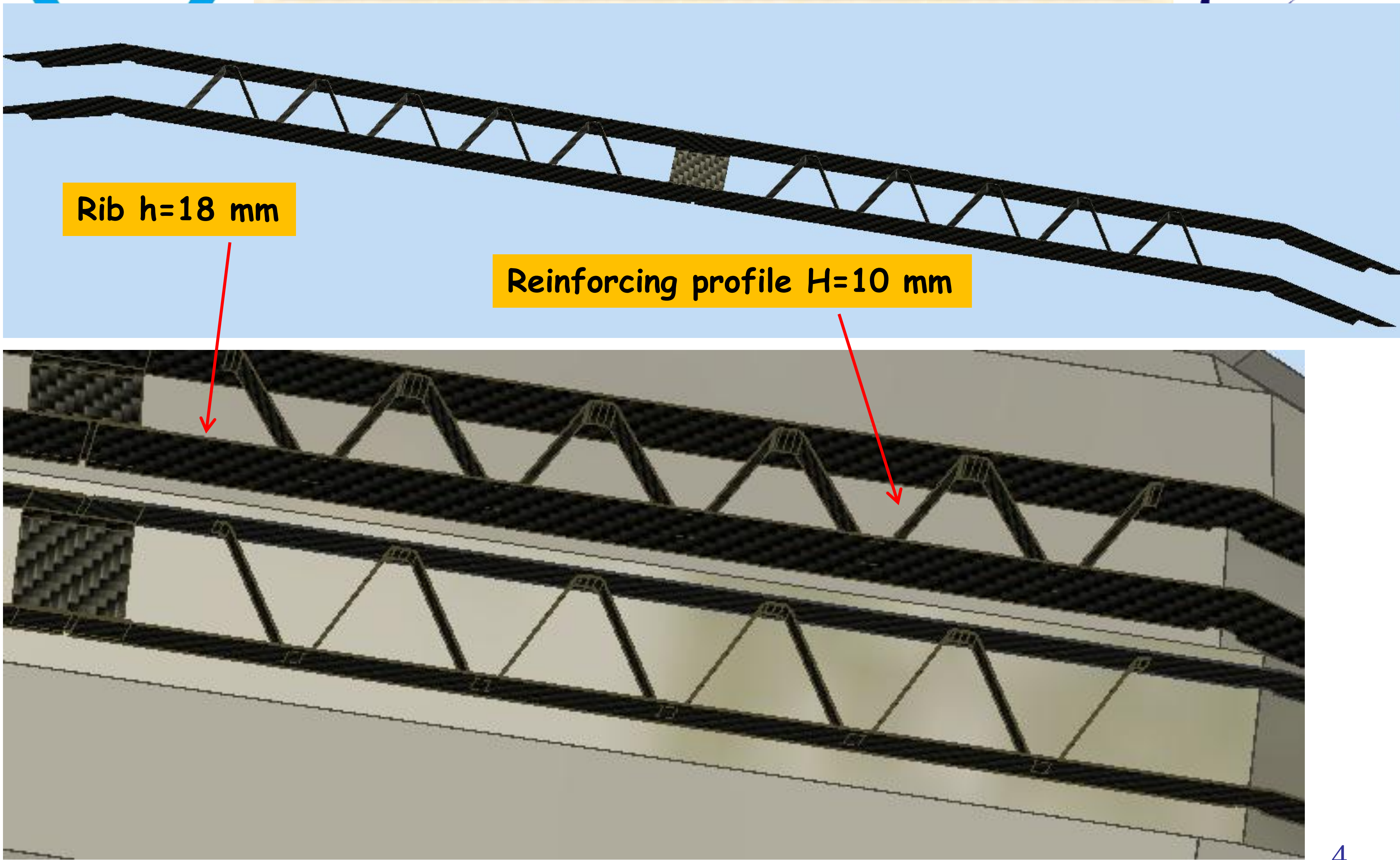
(L5B total length about 760mm)

- Need ribs more height and also with a reinforced profile along the barrel sensors (soon structural simulation to dimension the right height !)

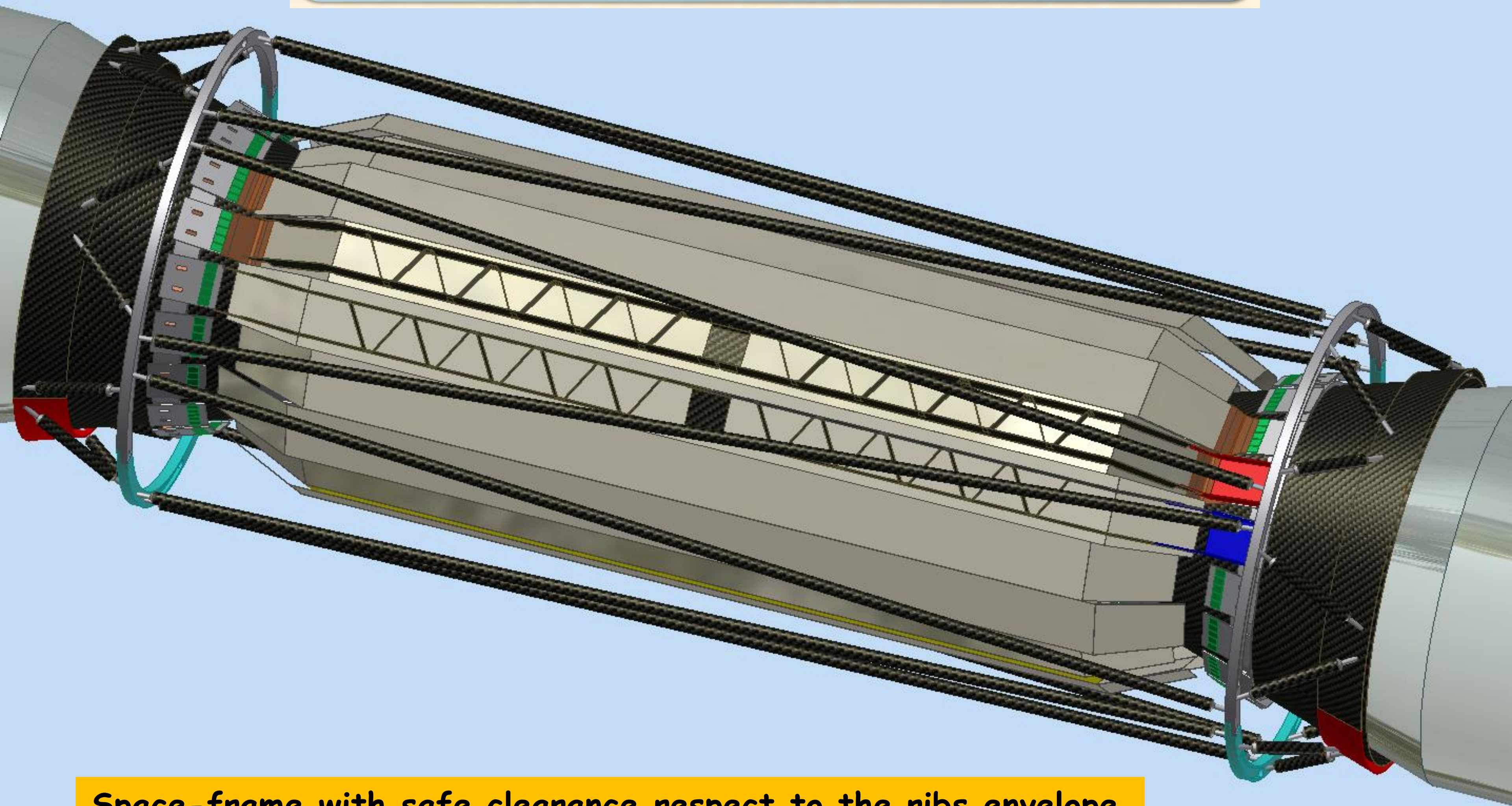
-Actual design: ribs h=18 mm and snake reinforcement h=10mm , dimensions respectful of space-frame design (clearance of few mm)

- Work in progress for final dimensioning (needs structural simulation to dimension the right height !)

RIBS L4/5

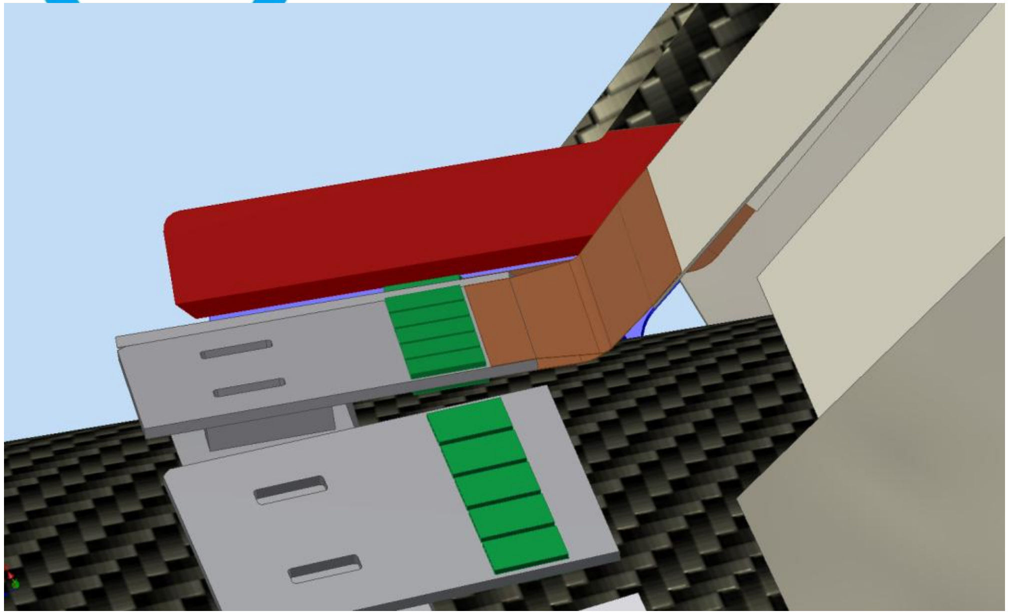


Ribs L5

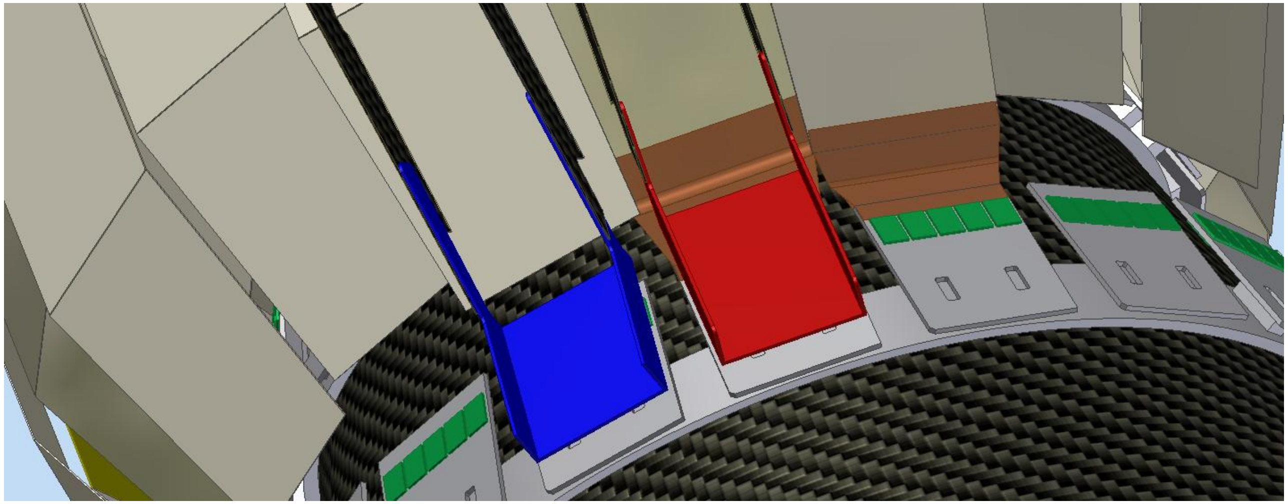


Space-frame with safe clearance respect to the ribs envelope

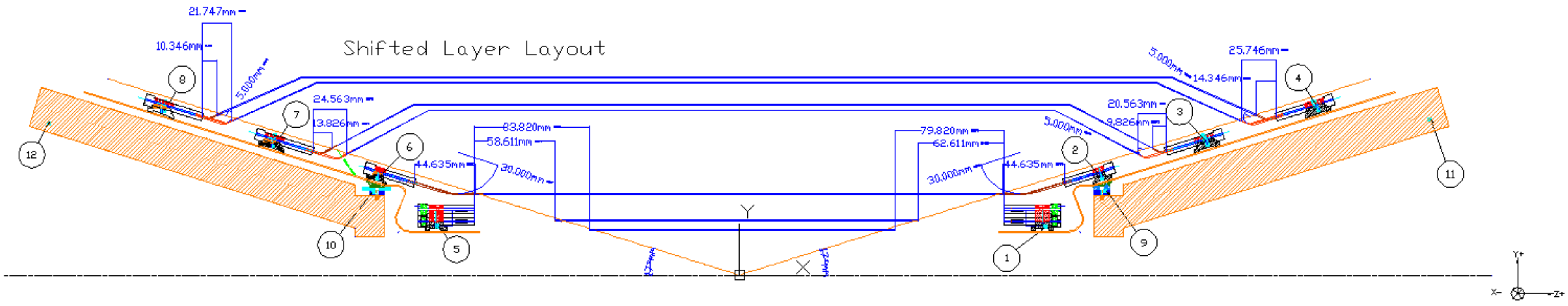
Fanout

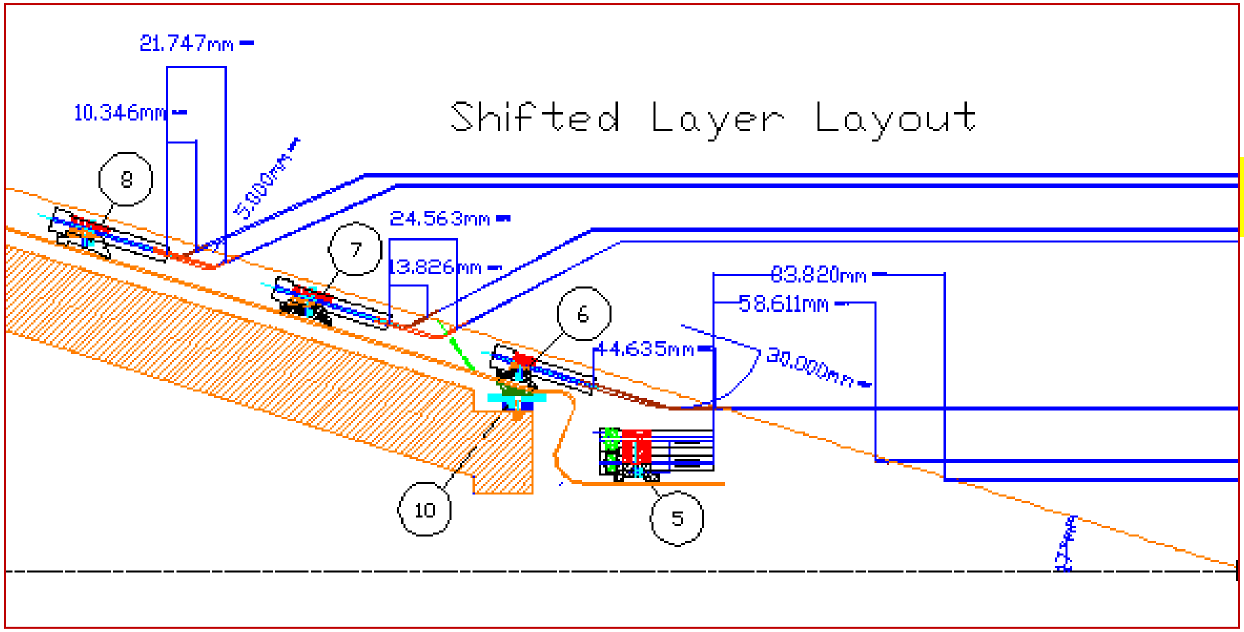


No particular problem to model fanout layer 4-5



SVT L1-5 Layout design





Fanout dimensions fixed !

SVT L1-5 Layout design

Modelling ribs -fanouts for L1-2-3

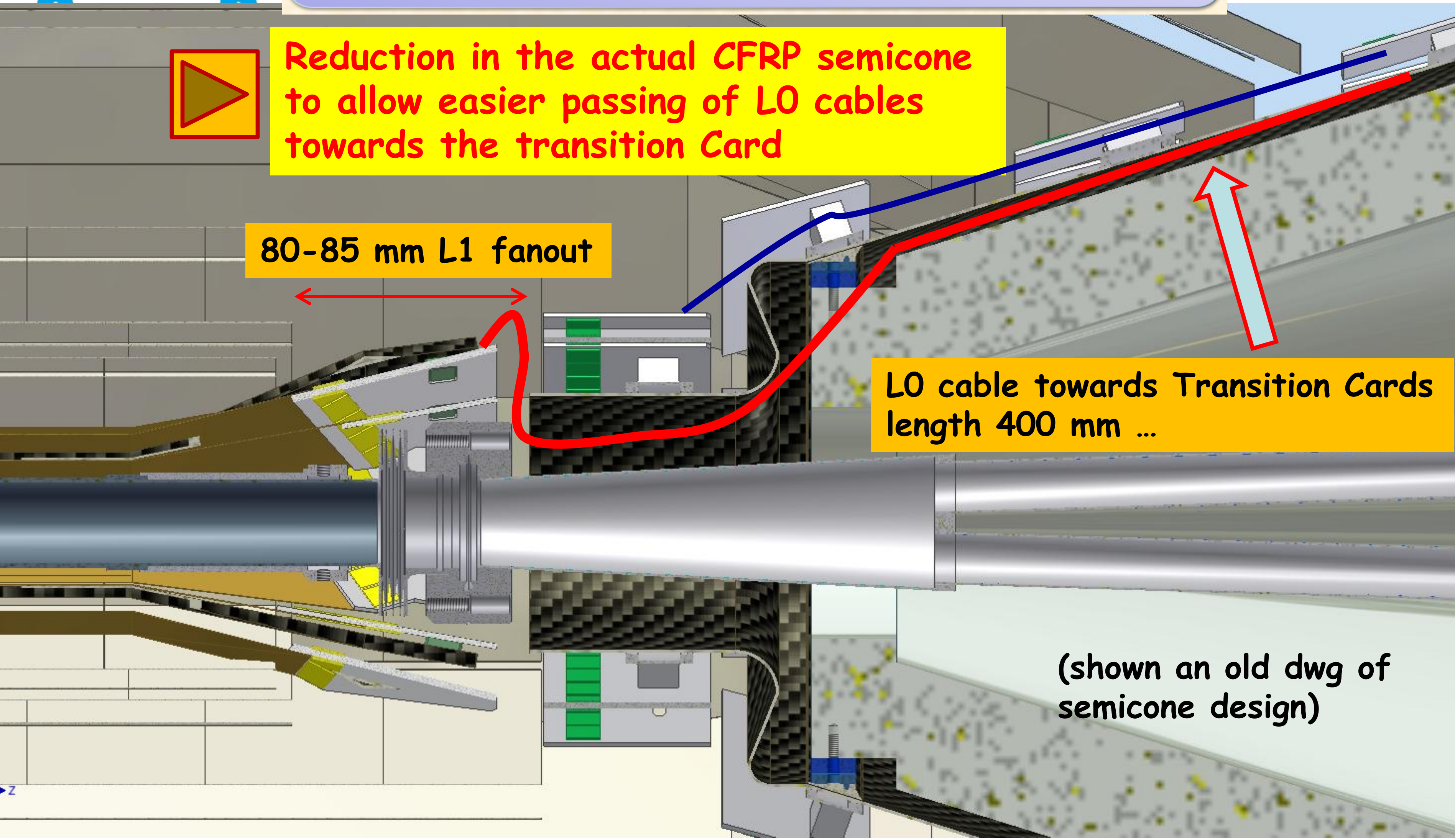
1) L1-2-L3 fanouts shape very peculiar :

   -They need to round around the L0 Hybrid and probably ribs will be used like constrain to hold the fanout on the right shape

   - Region very crowded with small clearance between components!

L0/L1-2 cable routing

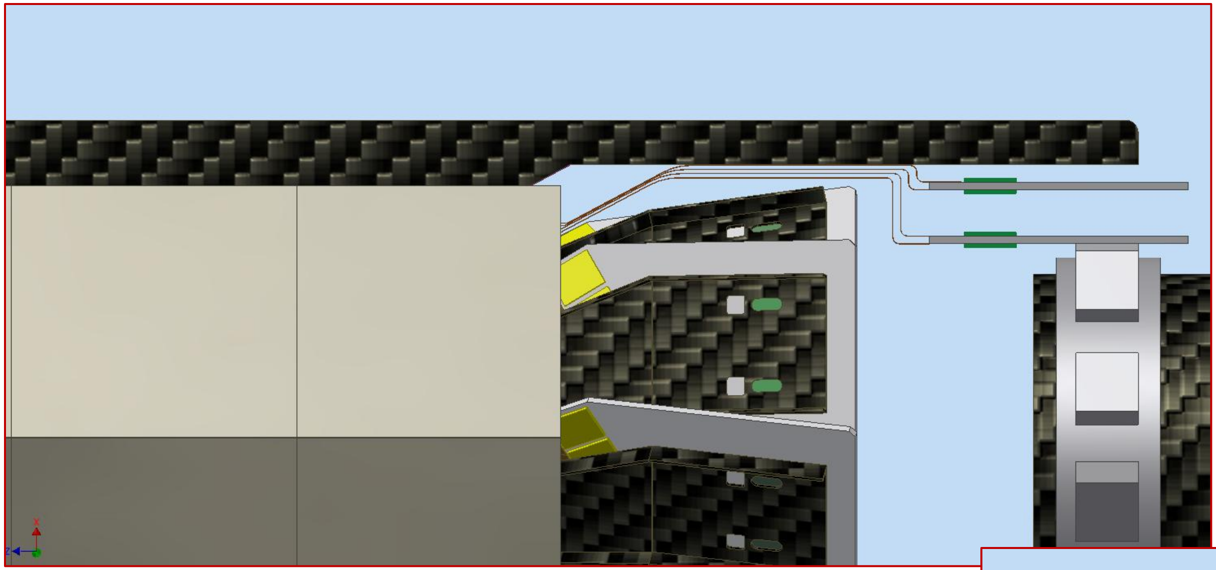
Reduction in the actual CFRP semicone to allow easier passing of L0 cables towards the transition Card



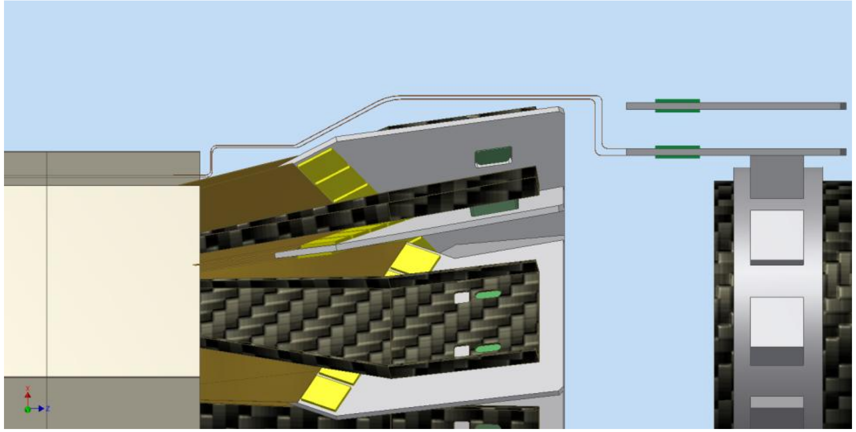
Design of new gimbal ring/conical-shield to allow L0 cable to reach transition cards

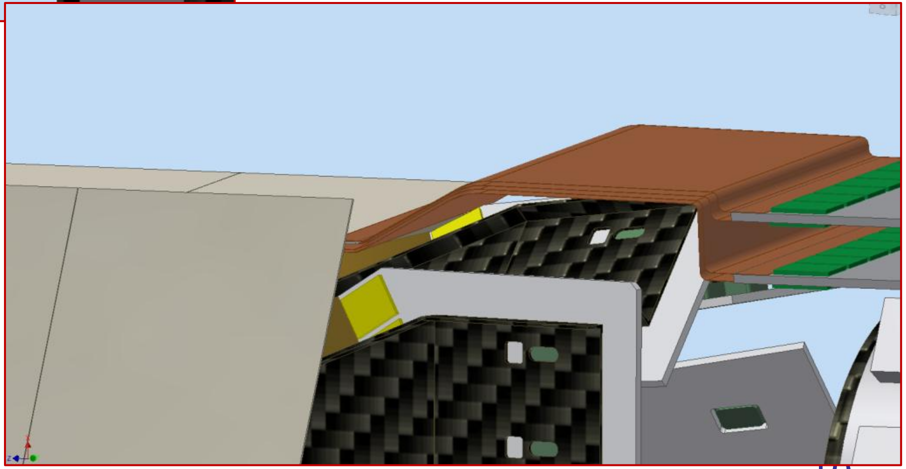
SVT L1-5 Layout design

Position kapton ribs f L1-2 respect L0



Check problems signal/noise for L1-2 fanouts !

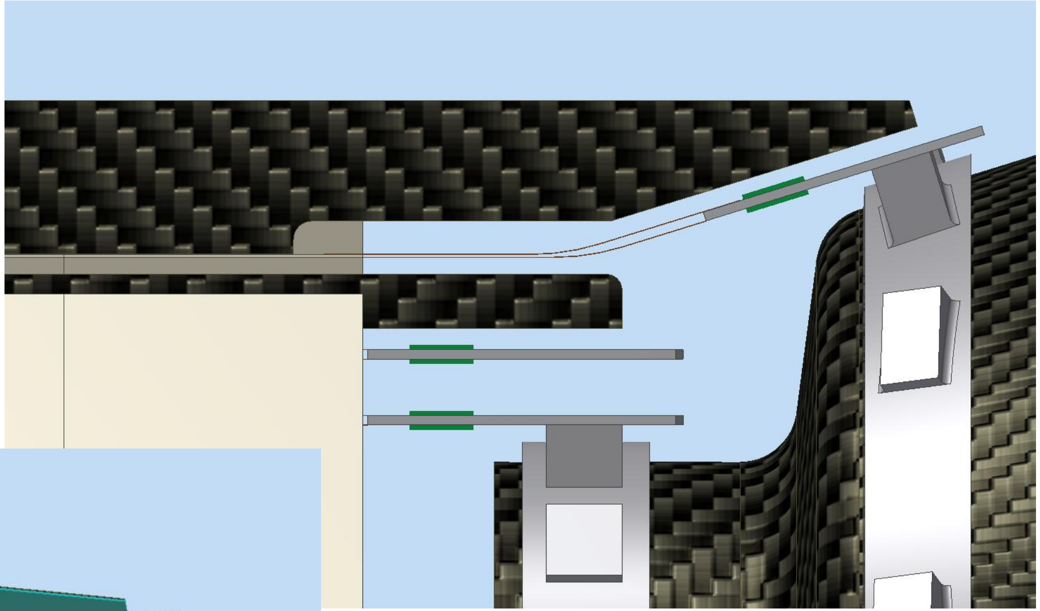


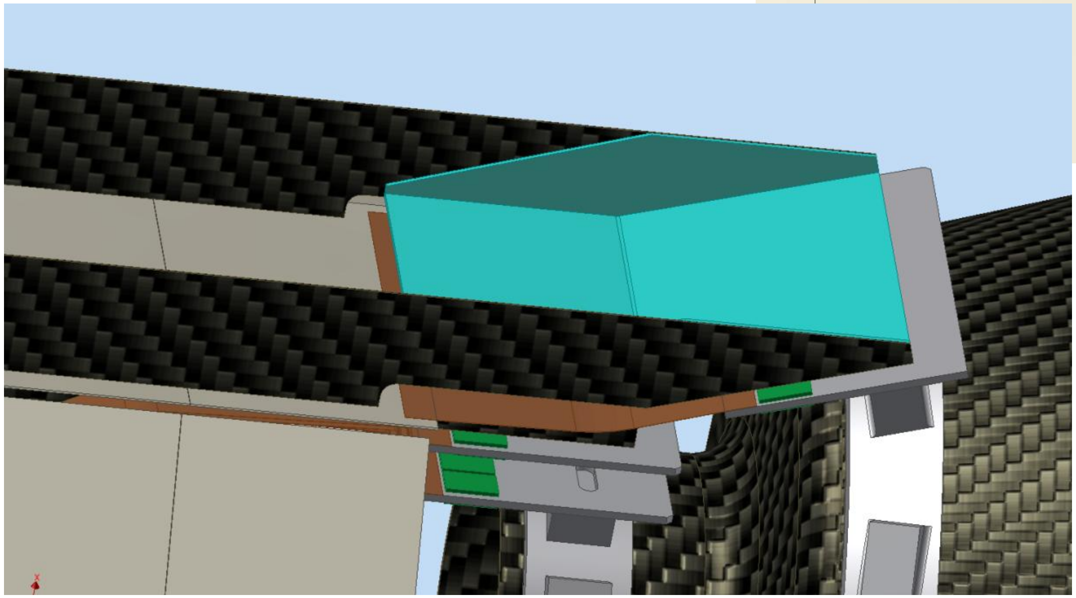


SVT L1-5 Layout design

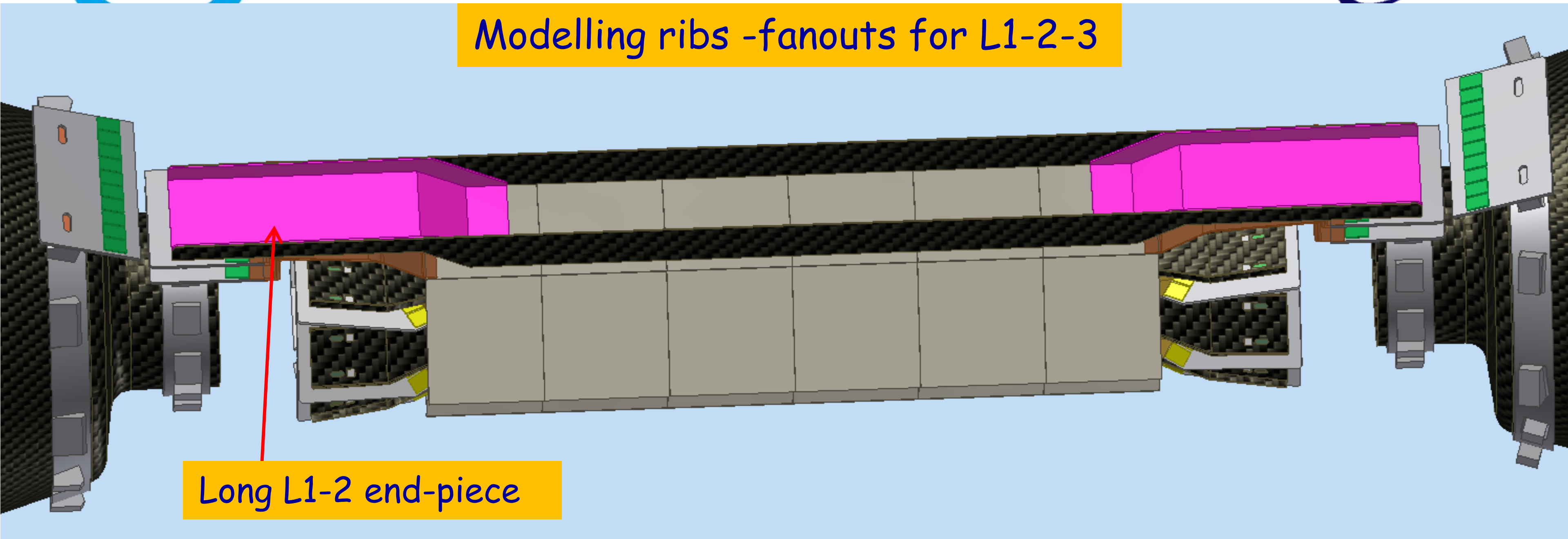
Ribs -fanouts for L3

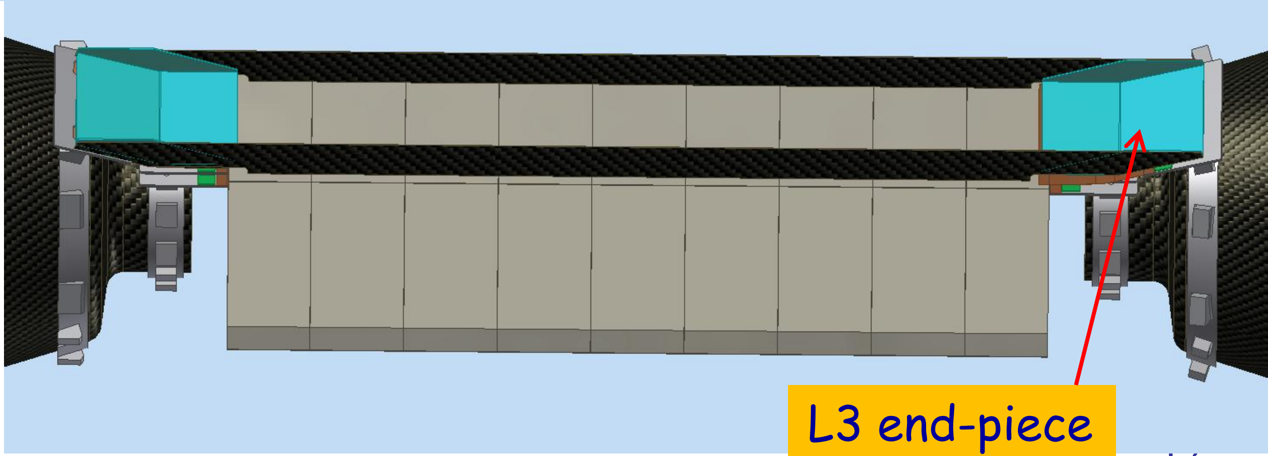
Clearance L3/L1-2 assumed like Babar



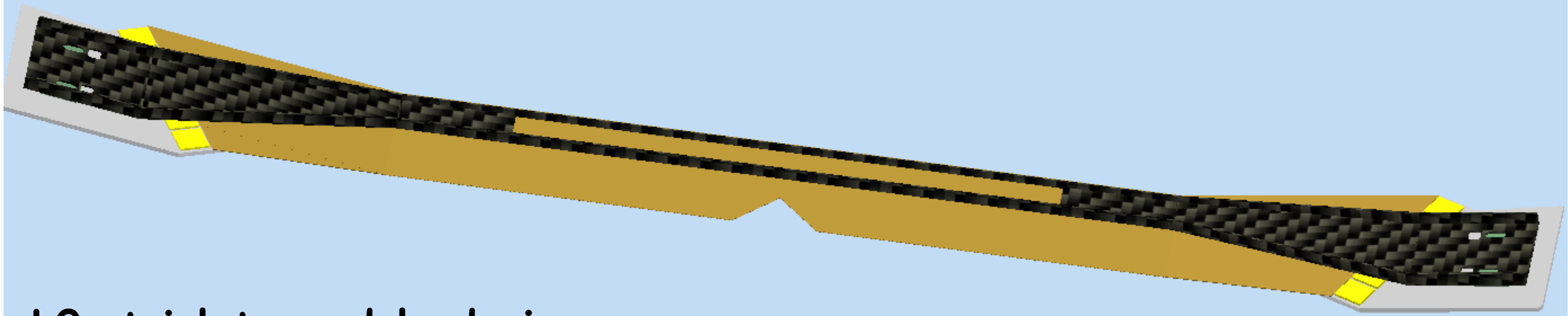


SVT L1-5 Layout design





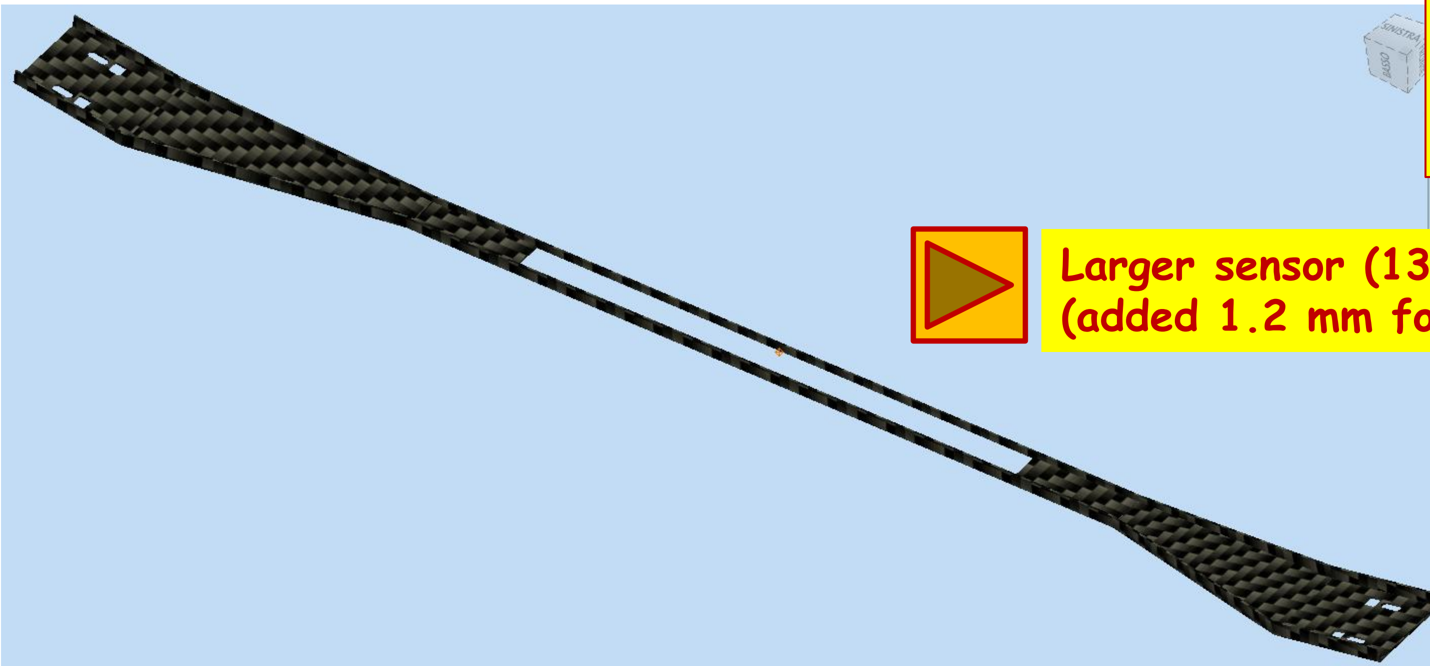
Striplets module design



L0 striplets module design

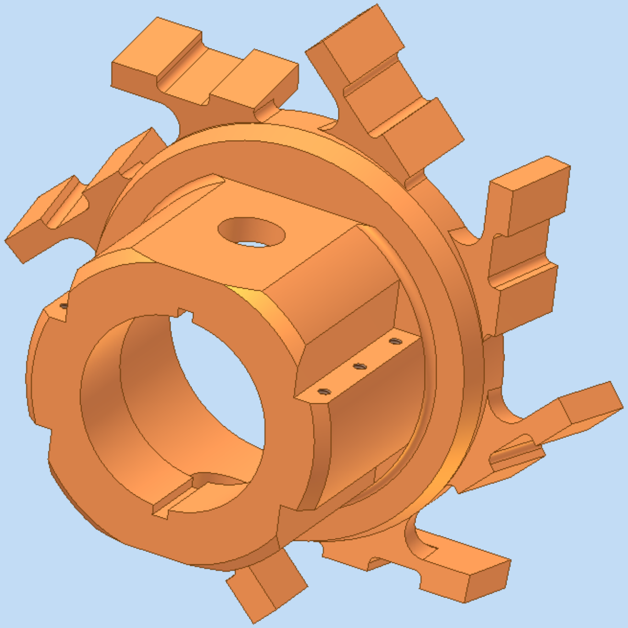
HDI/kapton inclinated 10°

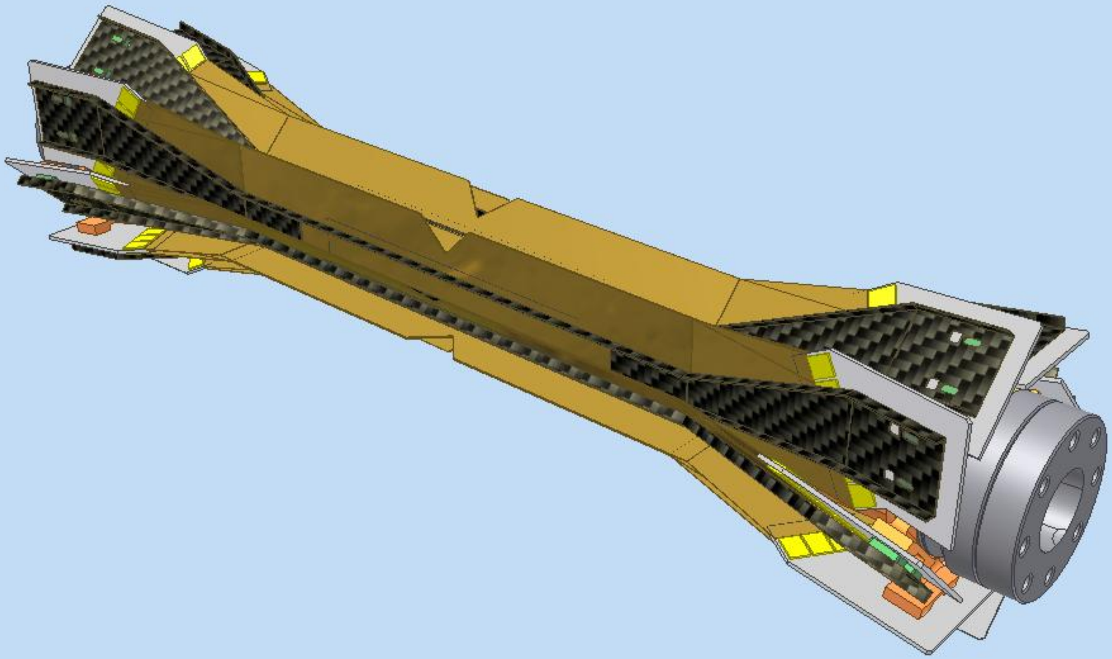
Si sensor :
W=15.1 mm
L=104 mm
R=15.1 mm

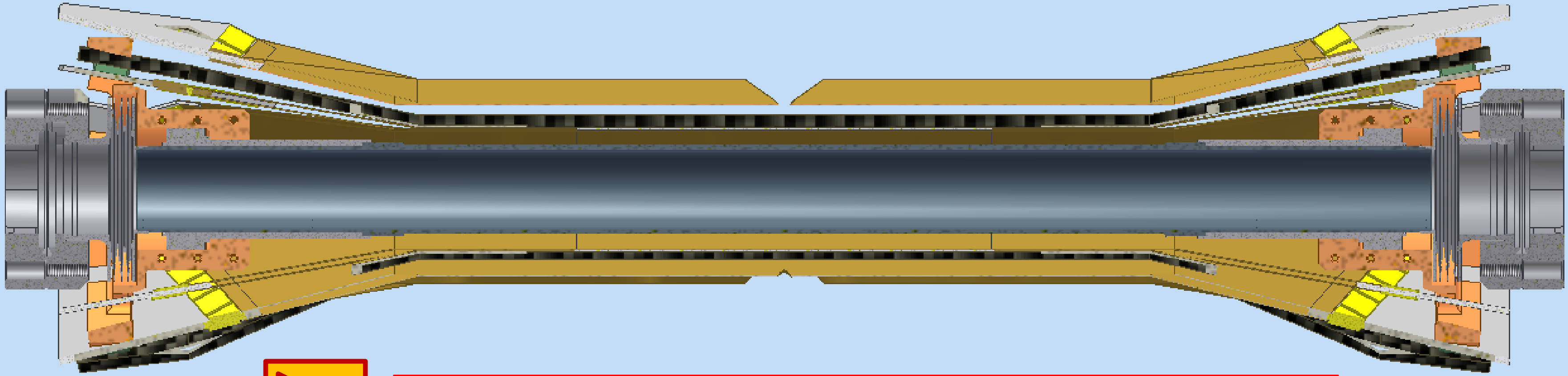


Larger sensor (13.9 ⟶15.1 mm)
(added 1.2 mm for dead space)

L0 striplets

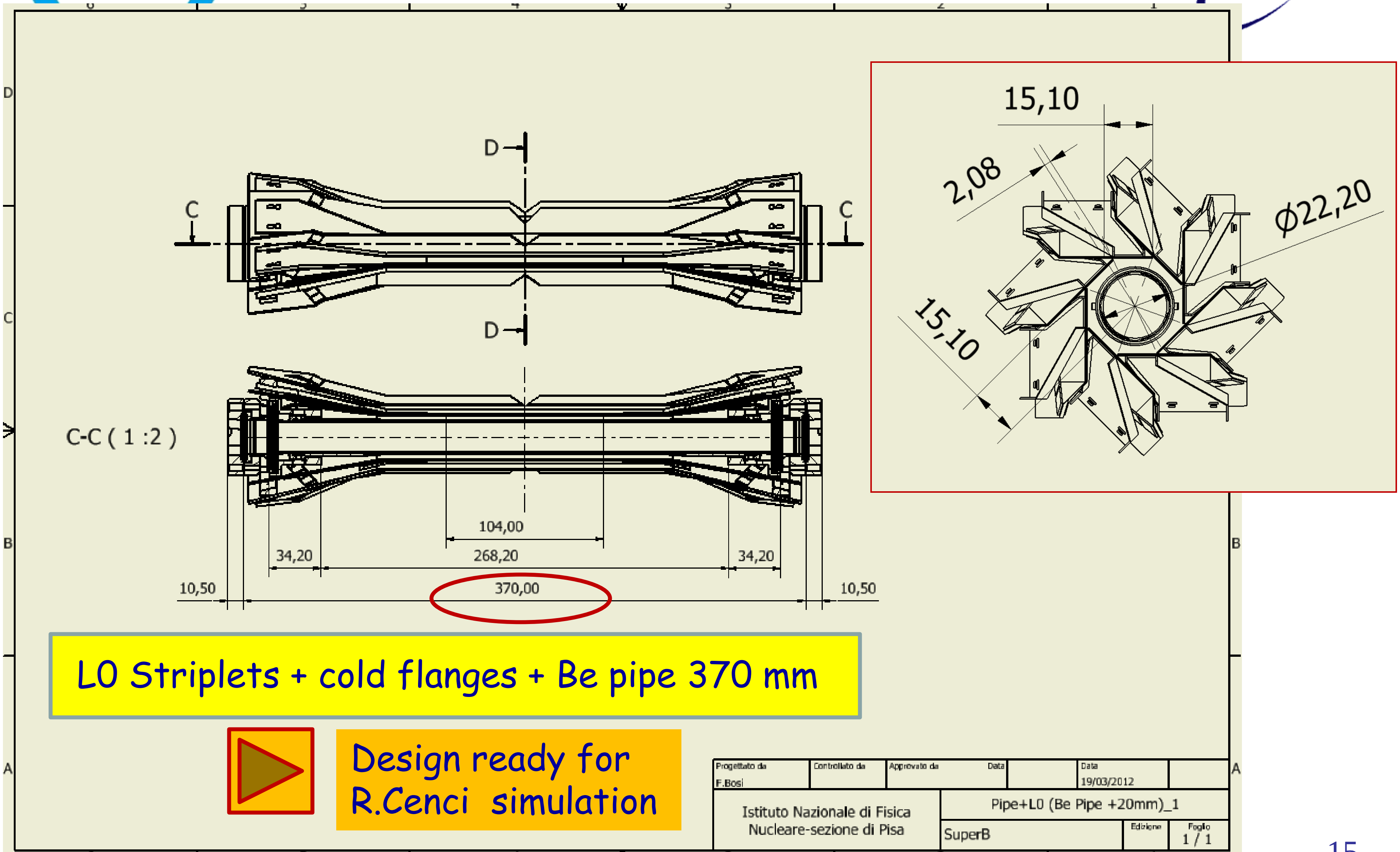






L0 Striplets + cold flanges + Be pipe 370 mm

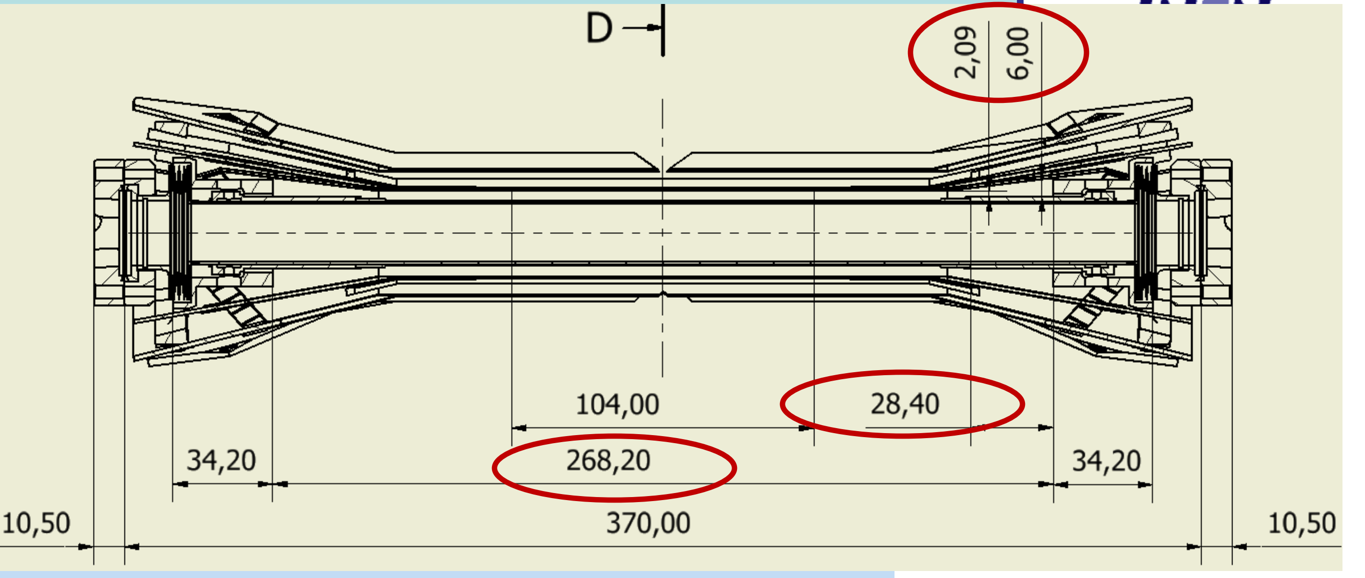
L0

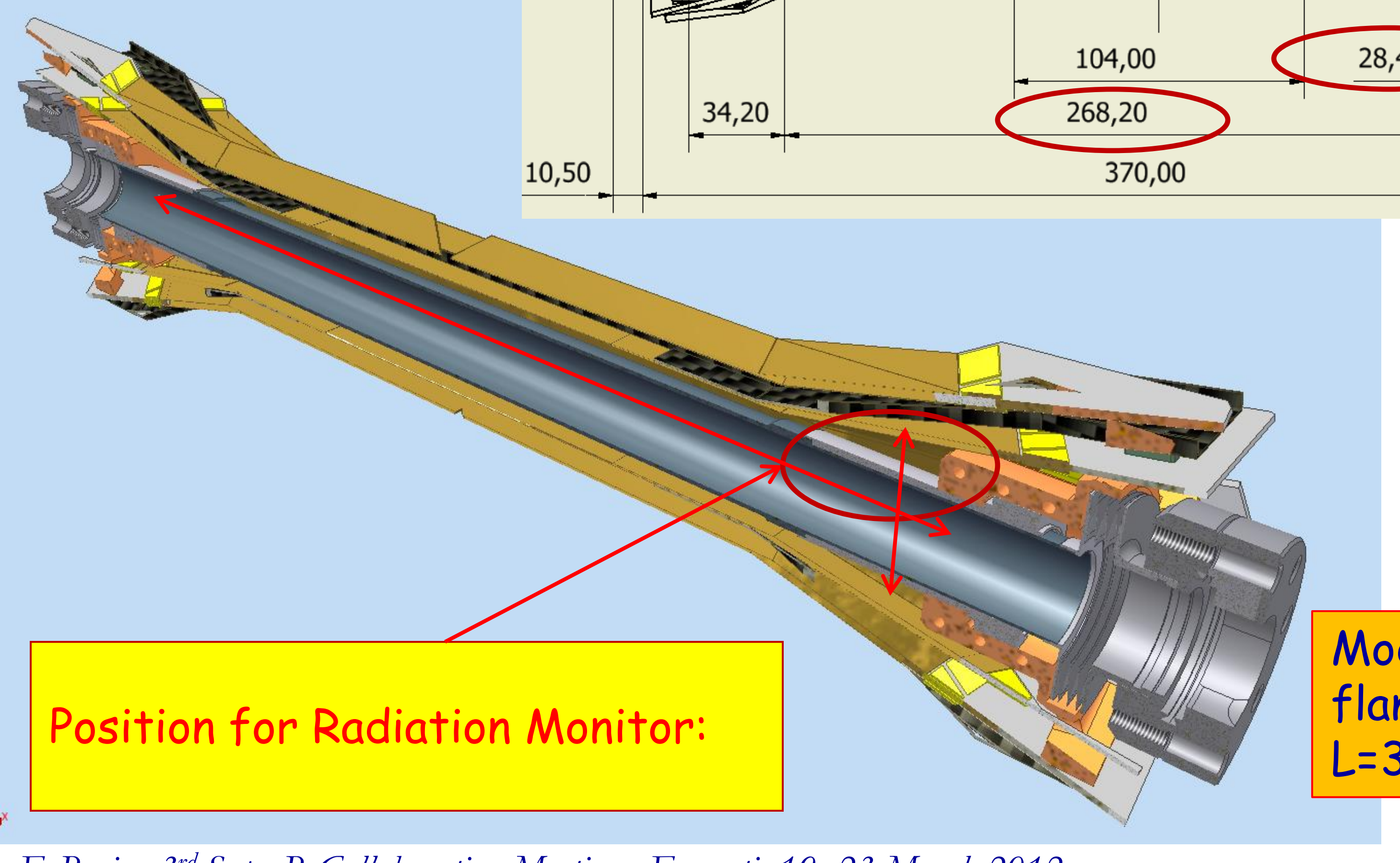


L0 Striplets + cold flanges + Be pipe 370 mm

Design ready for
R.Cenci simulation

L0 striplet

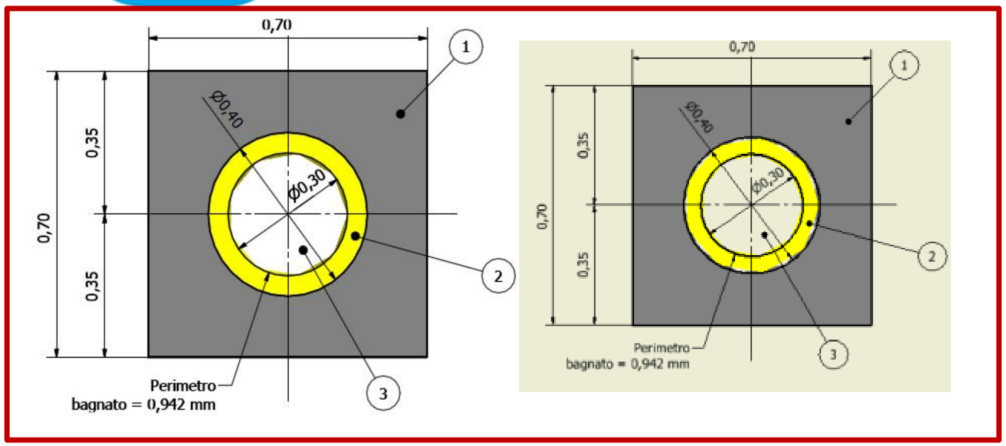


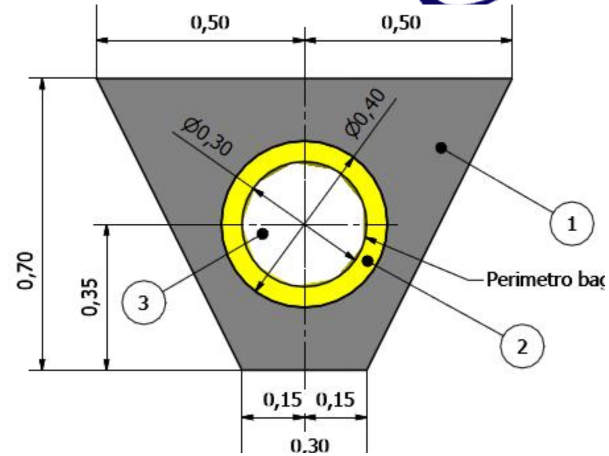


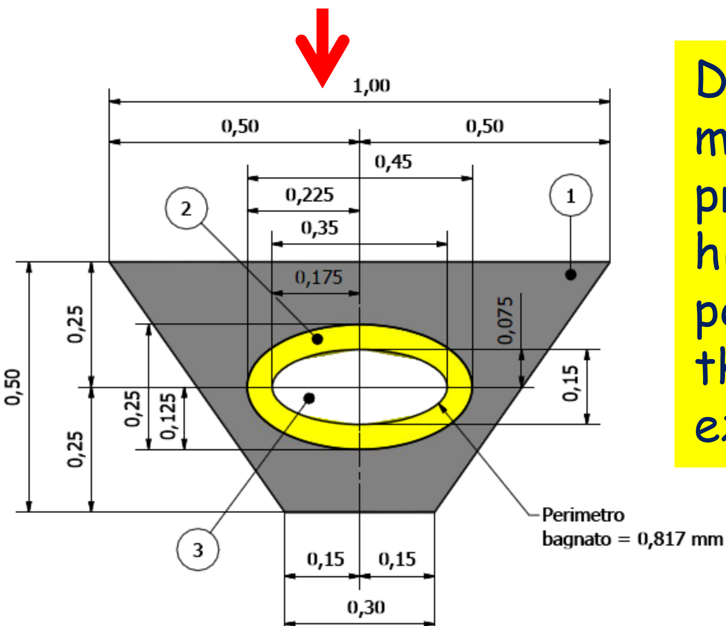
Position for Radiation Monitor:

Modelling L0 cold flanges on Be pipe L=370mm

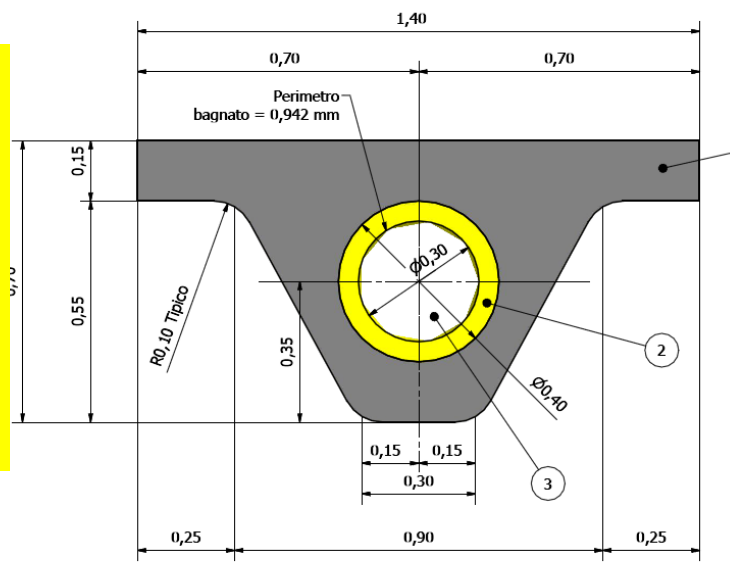
Pixel maps module support





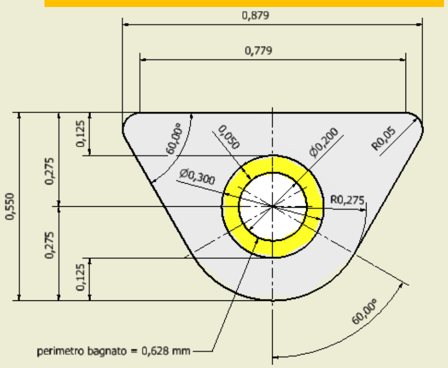


Developing a new microchannel profile with higher performance in thermal exchange/X_0



Micro-tube development

Trapezoidal 0.55



SUPERFICI:

S1 Carbon Fiber = 0,2671 mm2
S2 Peek = 0,0393 mm2
S3 H20 = 0,0314 mm2

RAPPORTO SUPERFICI:

(S1+S2)/S3 = (0,2671+0,0393)/0,0314 = 9,758

PERCENTUALE DI X0:

Xo Carbon Fiber = 28 cm
Xo Peek = 25 cm
Xo H20 = 36,08 cm

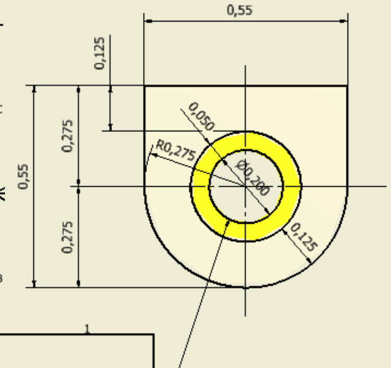
CALCOLO SU 1,40:
Carbon Fiber = 0,2671/1,40 = 0,1908
Carbon Fiber = (0,1908/280)x100 = 0,0681 % di X0
Peek = 0,0393/1,40 = 0,0281
Peek = (0,0281/250)x100 = 0,0112 % di X0
H20 = 0,0314/1,40 = 0,0224
H20 = (0,0224/360,8)x100 = 0,0062 % di X0

PERCENTUALE TOTALE X0 (1,40) Net : 0,0855 % di X0

CALCOLO SU 0,879:

Carbon Fiber = 0,2671/0,879 = 0,3039
Carbon Fiber = (0,3039/280)x100 = 0,1085 % di X0
Peek = 0,0393/0,879 = 0,0447
Peek = (0,0447/250)x100 = 0,0179 % di X0
H20 = 0,0314/0,879 = 0,3572

Square-Round 0.55



SUPERFICI:

S1 Carbon Fiber = 0,1994 mm2
S2 Peek = 0,0393 mm2
S3 H20 = 0,0314 mm2

RAPPORTO SUPERFICI:

(S1+S2)/S3 = (0,1994+0,0393)/0,0314 = 7,6019

PERCENTUALE DI X0:

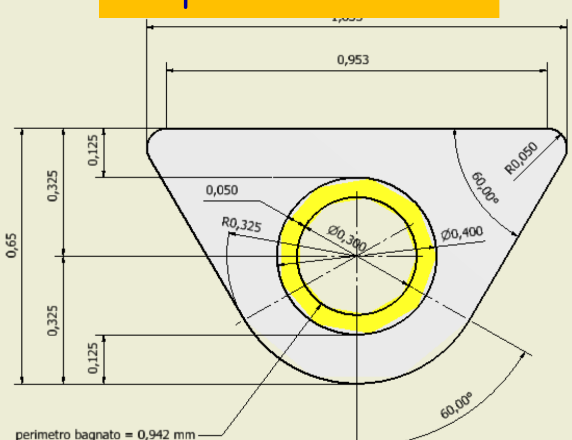
Xo Carbon Fiber = 28 cm
Xo Peek = 25 cm
Xo H20 = 36,08 cm

CALCOLO SU 1,10:
Carbon Fiber = 0,1994/1,10 = 0,1813
Carbon Fiber = (0,1813/280)x100 = 0,0647 % di X0
Peek = 0,0393/1,10 = 0,0357
Peek = (0,0357/250)x100 = 0,0156 % di X0
H20 = 0,0707/1,40 = 0,0143
H20 = (0,0314/360,8)x100 = 0,0087 % di X0

PERCENTUALE TOTALE X0 (1,10) Net : 0,089 di X0

CALCOLO SU 0,55 :
Carbon Fiber = 0,1994/0,55 = 0,3625
Carbon Fiber = (0,3625/280)x100 = 0,1295 % di X0
Peek = 0,0393/0,55 = 0,0715
Peek = (0,0715/250)x100 = 0,0286 % di X0
H20 = 0,0707/0,55 = 0,1285

Trapezoidal 0.65



SUPERFICI:

S1 Carbon Fiber = 0,3474 mm2
S2 Peek = 0,055 mm2
S3 H20 = 0,0707 mm2

RAPPORTO SUPERFICI:

(S1+S2)/S3 = (0,3474+0,055)/0,0707 = 5,6917

PERCENTUALE DI X0:

Xo Carbon Fiber = 28 cm
Xo Peek = 25 cm
Xo H20 = 36,08 cm

CALCOLO SU 1,40 :
Carbon Fiber = 0,3474/1,40 = 0,2481
Carbon Fiber = (0,2481/280)x100 = 0,0886 % di X0
Peek = 0,055/1,40 = 0,0393
Peek = (0,039/250)x100 = 0,0157 % di X0
H20 = 0,0707/1,40 = 0,0505
H20 = (0,050/360,8)x100 = 0,0140 % di X0

PERCENTUALE TOTALE X0 (1,40) Net : 0,1183 % di X0

CALCOLO SU 1,053:
Carbon Fiber = 0,3474/1.053 = 0,3299
Carbon Fiber = (0,3299/280)x100 = 0,1178 % di X0
Peek = 0,055/1,053 = 0,0522
Peek = (0,0522/250)x100 = 0,0209 % di X0
H20 = 0,0707/1,053 = 0,0671
H20 = (0,0671/360,8)x100 = 0,0186 % di X0

PERCENTUALE TOTALE X0 (1,053) Full: 0,1573 % di X0

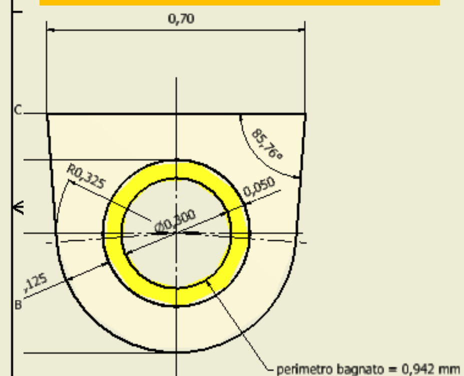
DIAMETRO IDRAULICO:

Dh = = 0,300 mm

Progettato da	Controllato da	Approvato da	Data	Data
F.Bosi				11/02/2012

Istituto Nazionale di Fisica Nucleare-Sezione di Pisa — Assieme_tubo_trapezio_065_040 — SuperB — Foglio 1 / 1

Square-round 0.65



SUPERFICI:

S1 Carbon Fiber = 0,2599 mm2
S2 Peek = 0,055 mm2
S3 H20 = 0,0707 mm2

RAPPORTO SUPERFICI:

(S1+S2)/S3 = (0,2599+0,055)/0,0707 = 4,4540

PERCENTUALE DI X0:

Xo Carbon Fiber = 28 cm
Xo Peek = 25 cm
Xo H20 = 36,08 cm

CALCOLO SU 1,40:
Carbon Fiber = 0,2599/1,40 = 0,1856
Carbon Fiber = (0,1856/280)x100 = 0,0663 % di X0
Peek = 0,055/1,40 = 0,0393
Peek = (0,039/250)x100 = 0,0157 % di X0
H20 = 0,0707/1,40 = 0,0196
H20 = (0,0196/360,8)x100 = 0,0054 % di X0

PERCENTUALE TOTALE X0 (1,40) Net: 0,0874 di X0

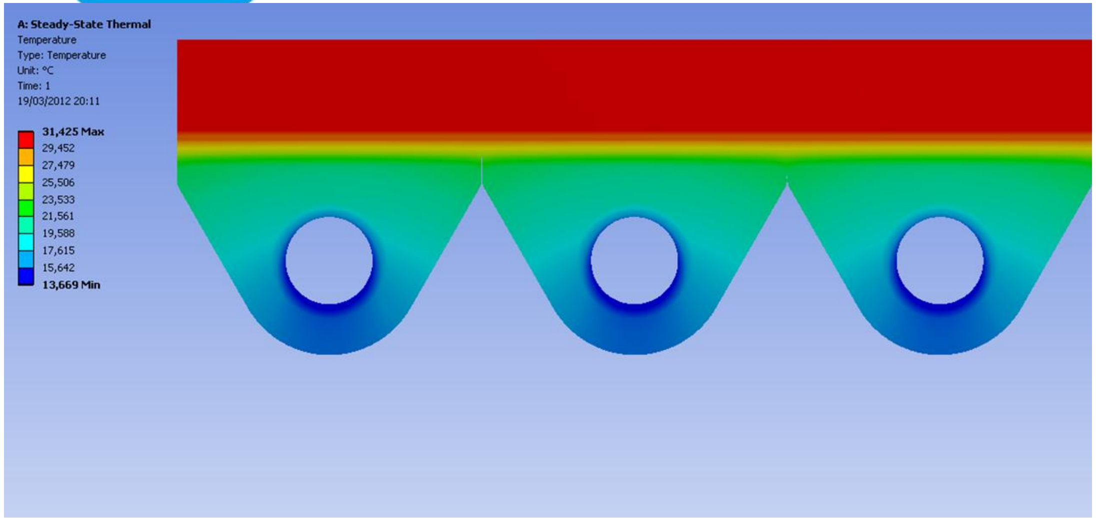
CALCOLO SU 0,70:
Carbon Fiber = 0,2599/0,70 = 0,3713
Carbon Fiber = (0,3713/280)x100 = 0,1326 % di X0
Peek = 0,055/0,70 = 0,0786
Peek = (0,0786/250)x100 = 0,0314 % di X0
H20 = 0,0707/0,70 = 0,101
H20 = (0,101/360,8)x100 = 0,028 % di X0

PERCENTUALE TOTALE X0 (0,879) Full: 0,192 % di X0

DIAMETRO IDRAULICO:

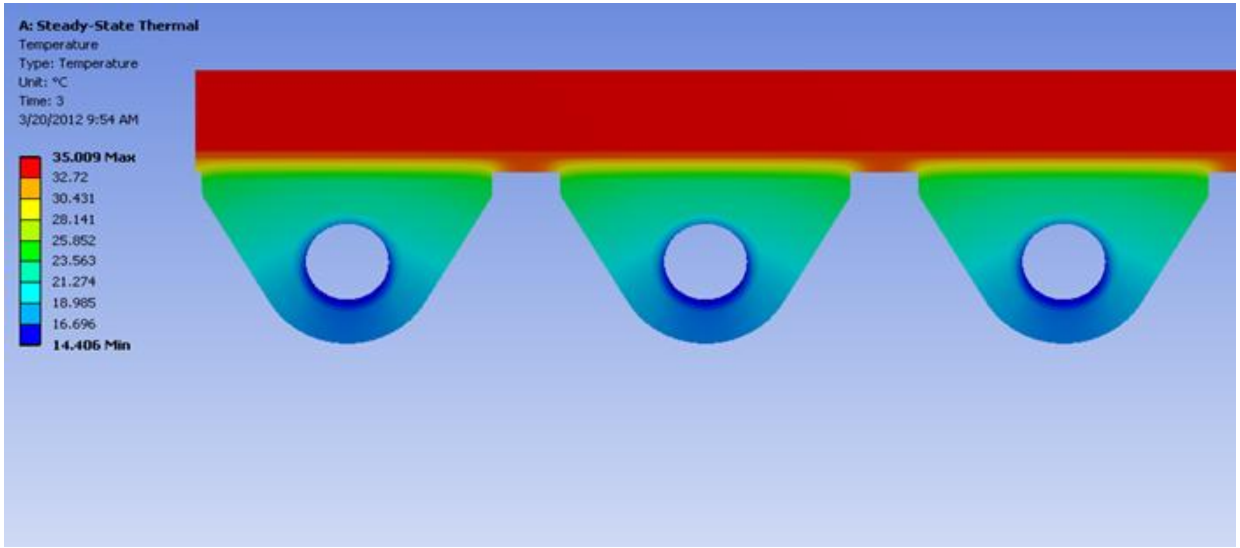
Dh = = 0,300 mm

Thermal simulation



Trapezoidal Full

W=1.5 W/cm^2
T coolant=10 °C

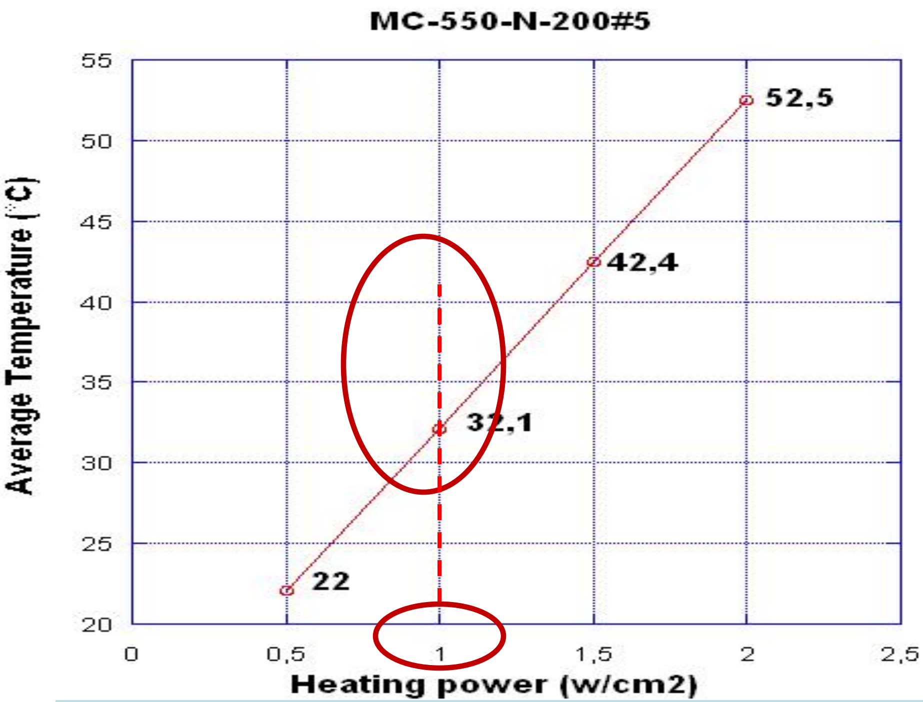


Trapezoidal Net

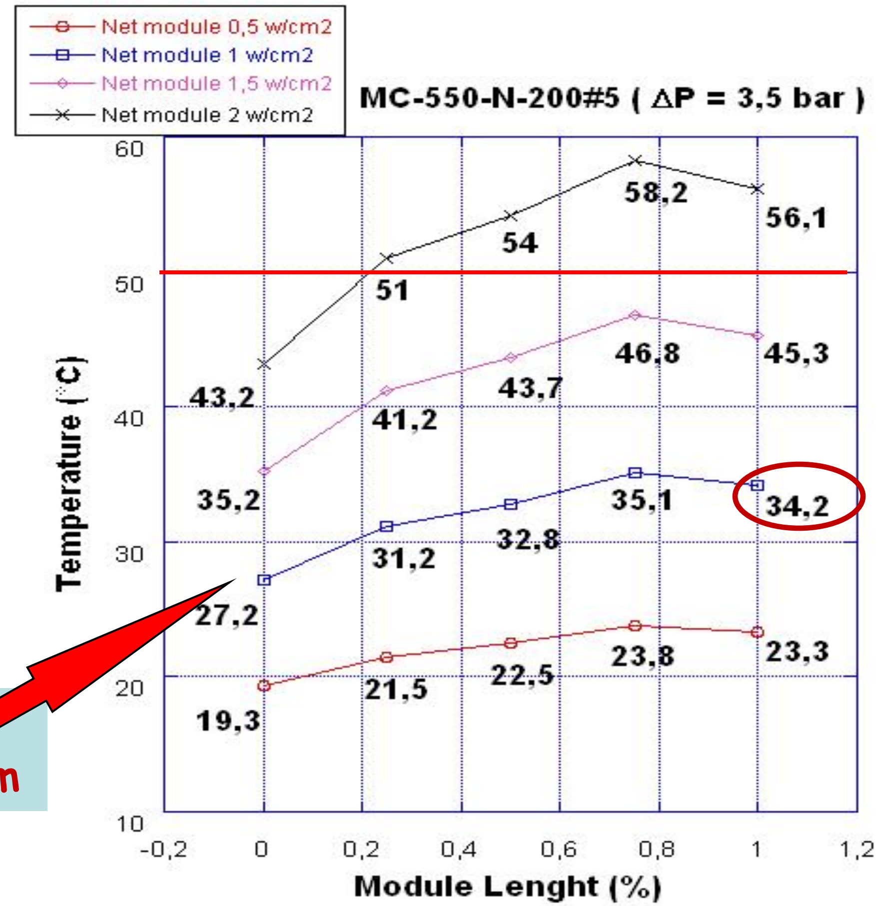
Thermal simulation / X_0

			% X0 tot		W/cm^2	0,5	1	1,5	2
		N° MC							
Quadrato 0,7 mm (full)		18	0,241300431		T [°C]		22,03	28,08	34,12
Quadrato 0,7 mm (net)		10	0,134055795		T [°C]	20,26	30,38	40,51	50,63
Quadrato 0,55 mm (full)		23	0,192561102		T [°C]	16,1	22,18	28,29	34,41
Quadrato 0,55 mm (net)		12	0,100466662		T [°C]	20,9	31,64	42,37	53,11
Trapezio 065_40 (net)		10	0,129312491		T [°C]	18,38	26,69	35,01	43,33
Trapezio 065_40 (full)		12	0,15517499		T [°C]	17,19	24,3	31,43	38,55
Trapezio 0,55 mm (full)		14	0,130882981		T [°C]	17,76	25,42	33,09	40,76
Trapezio 0,55 mm (net)		12	0,112185412		T [°C]	18,87	27,63	36,41	45,18
Quadrato tondo 0,7 mm (full)		18	0,189068288		T [°C]	16,08	22,13	28,2	34,28
Quadrato tondo 0,55 mm (full)		23	0,171383647		T [°C]	16,14	22,26	28,41	34,56
Quadrato tondo 0,55 mm (net)		12	0,089417555		T [°C]	20,91	31,67	42,42	53,18

Net Module H=550μm test results



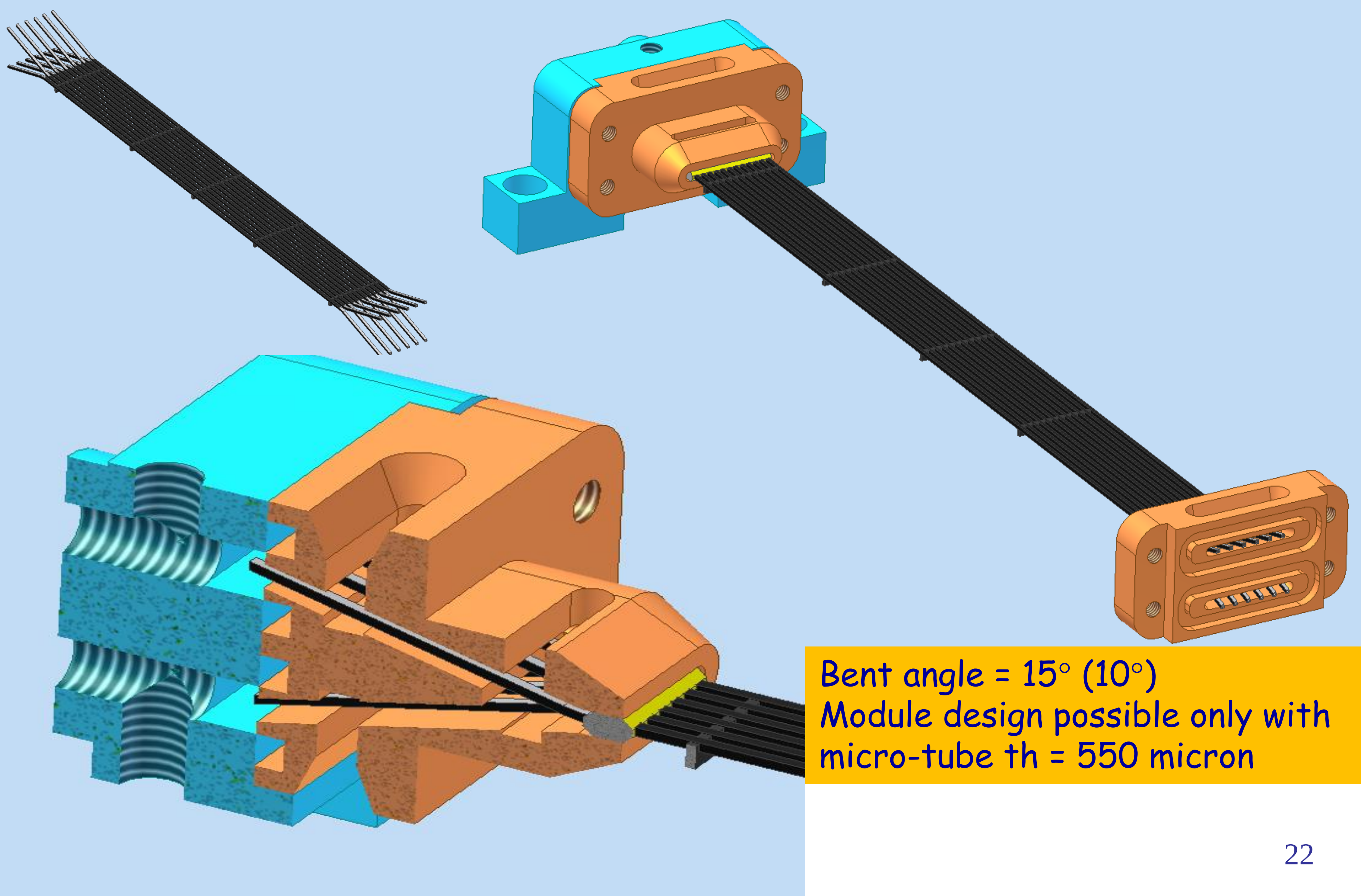
Tests performed on net module sample (length = 120 mm) with water-glycol @ 10 °C as coolant (Δp =3,5 atm).



Average module Temperature vs Specific Power

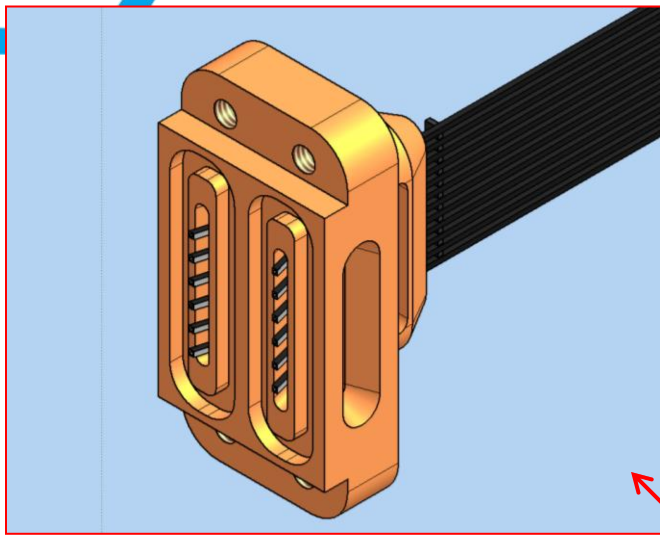
Temperature along the module:
ΔT = 7.0 °C at 1.0 W/cm² Δp =3.5 atm

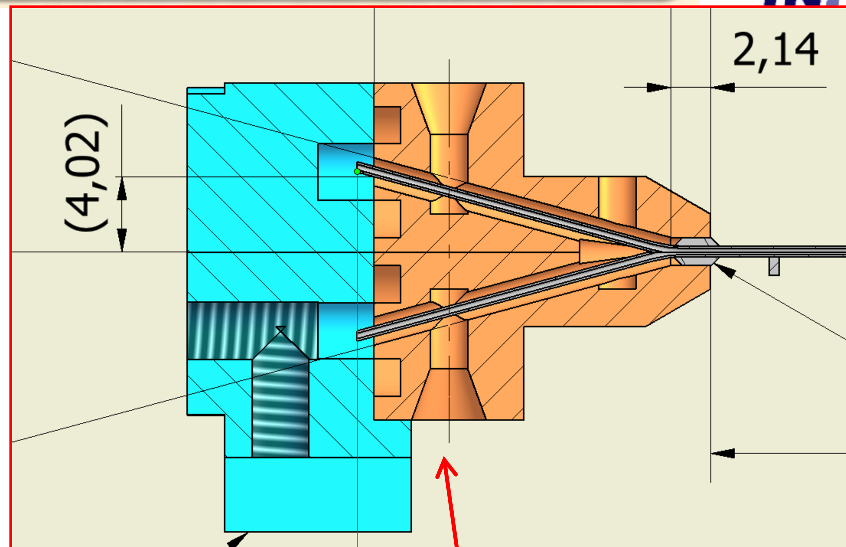
Opposite flux bent module

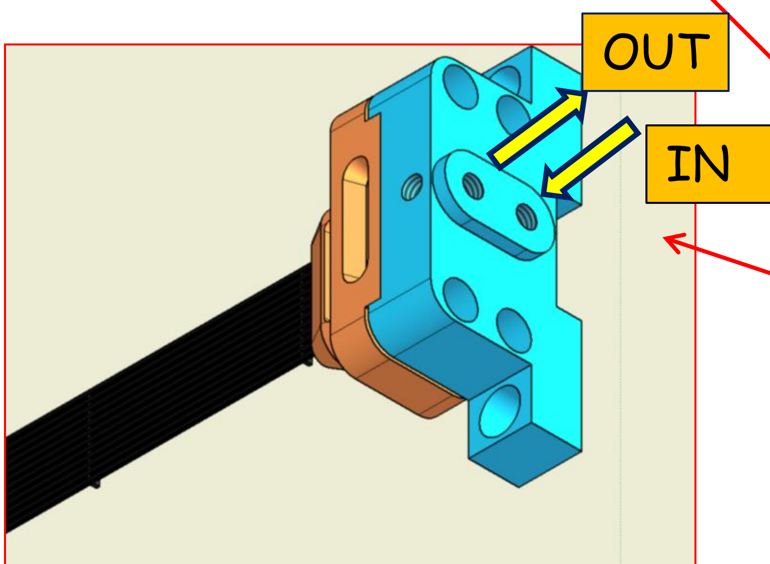


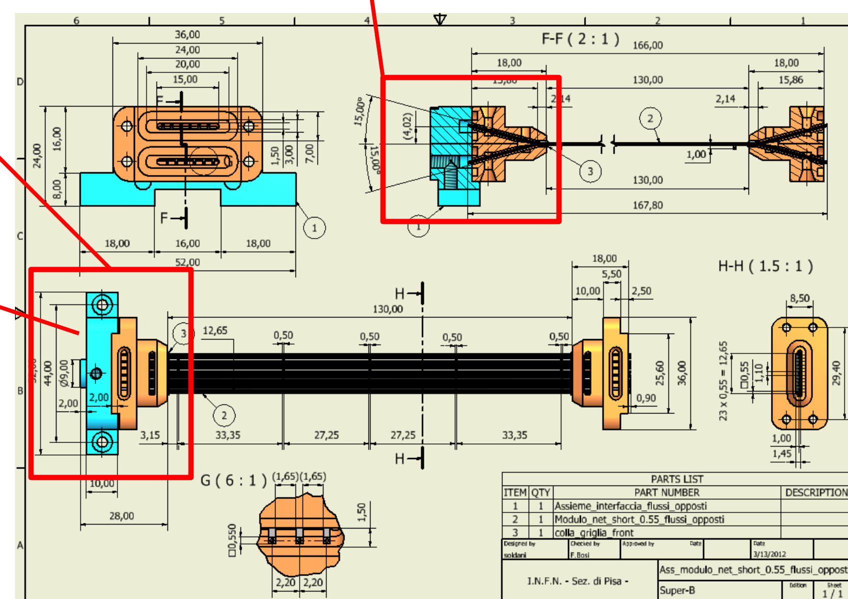
Bent angle = 15° (10°)
Module design possible only with micro-tube th = 550 micron

Opposite flux bent module

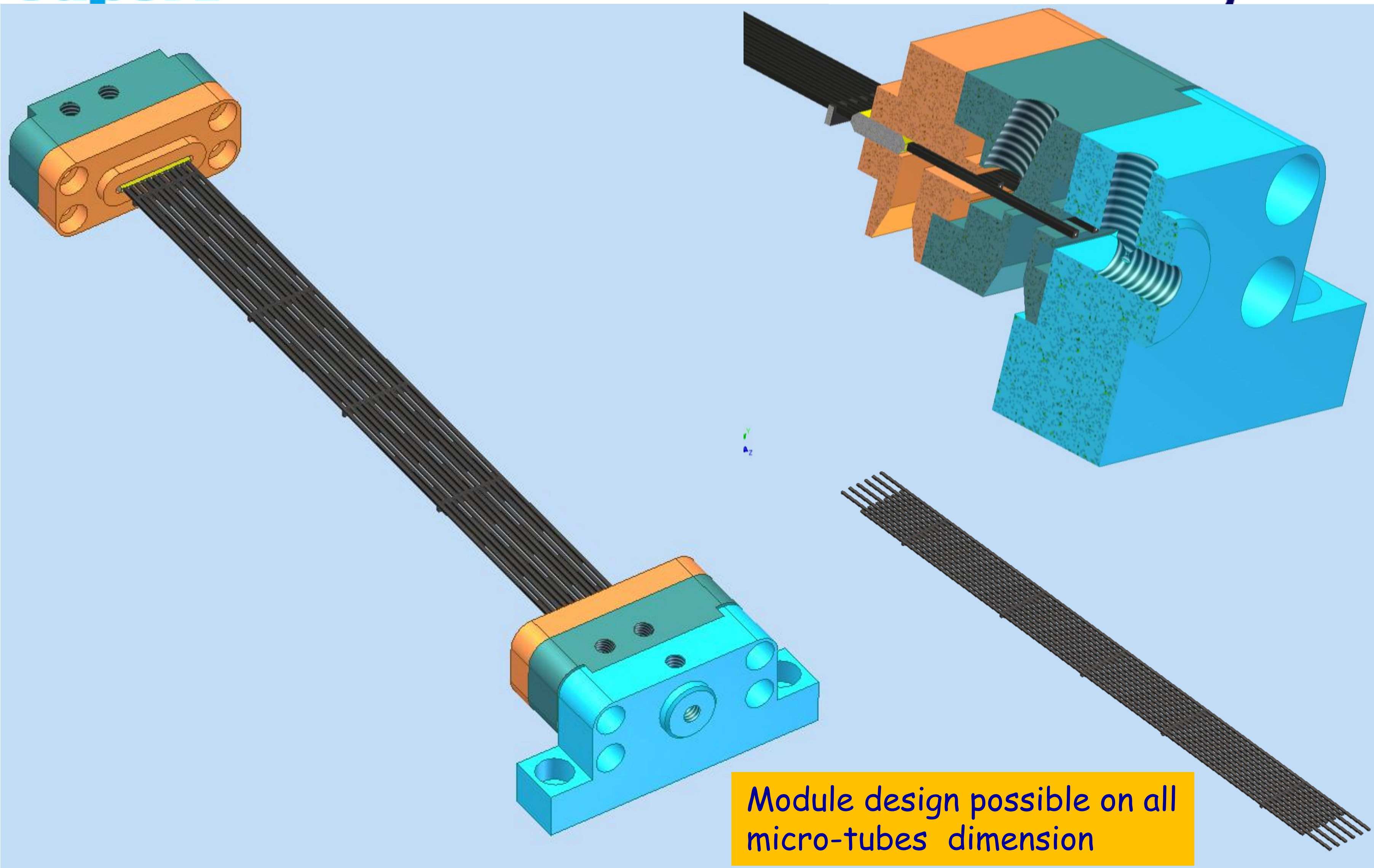






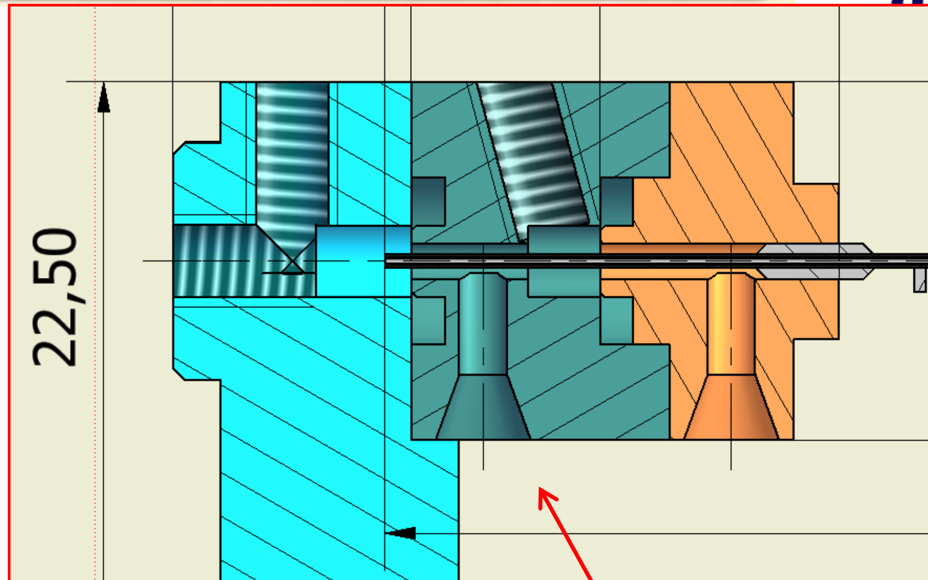


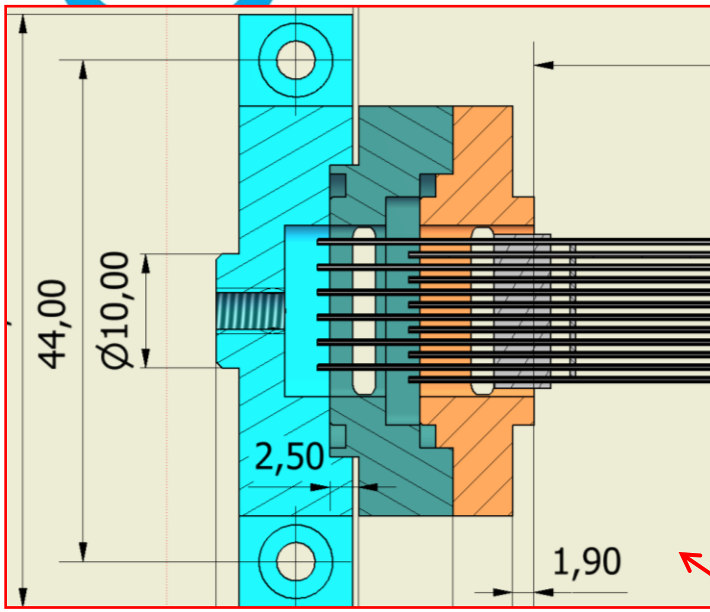
Opposite flux flat module

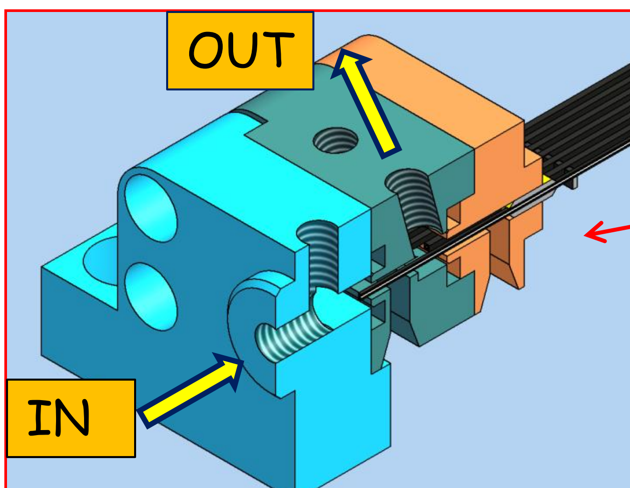


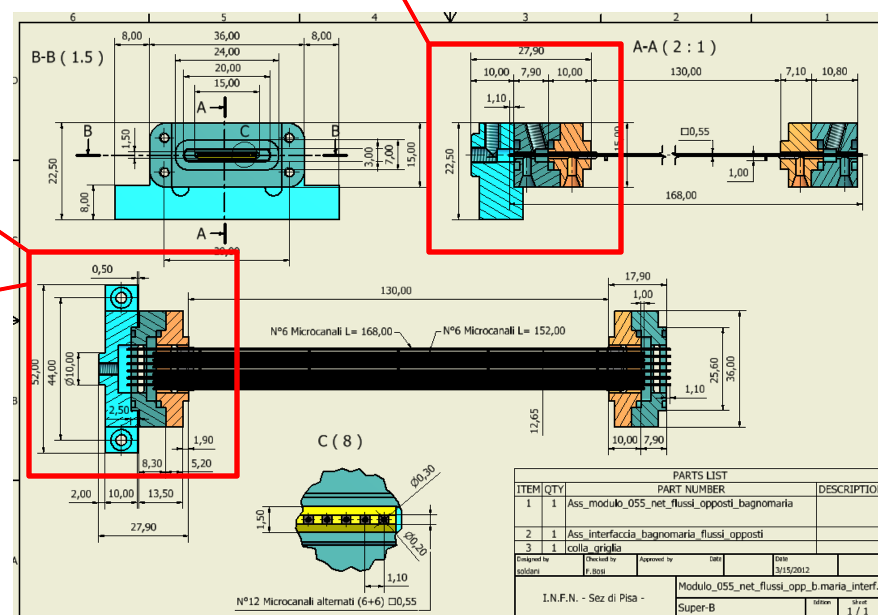
Module design possible on all micro-tubes dimension

Opposite flux module flat module



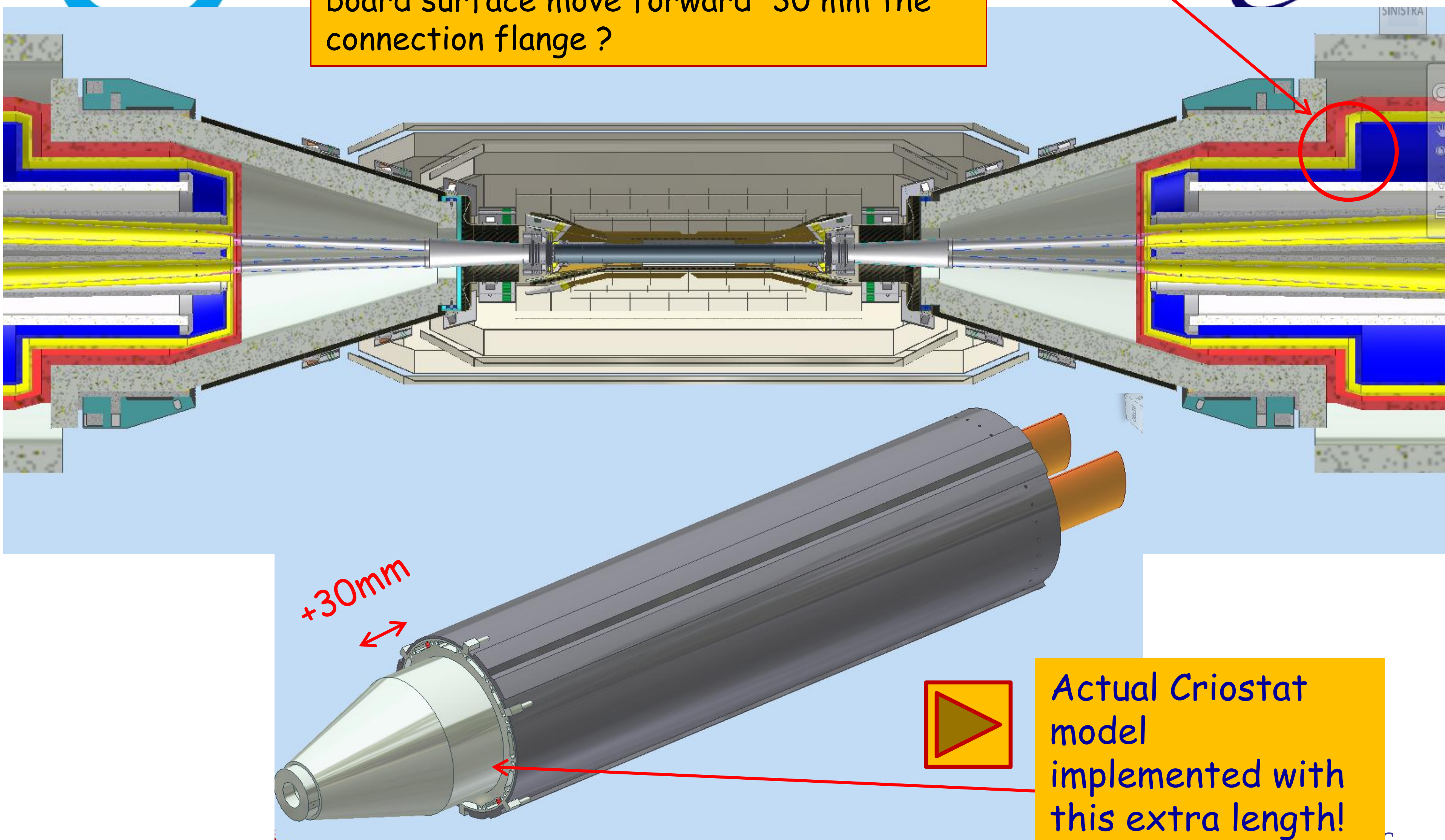






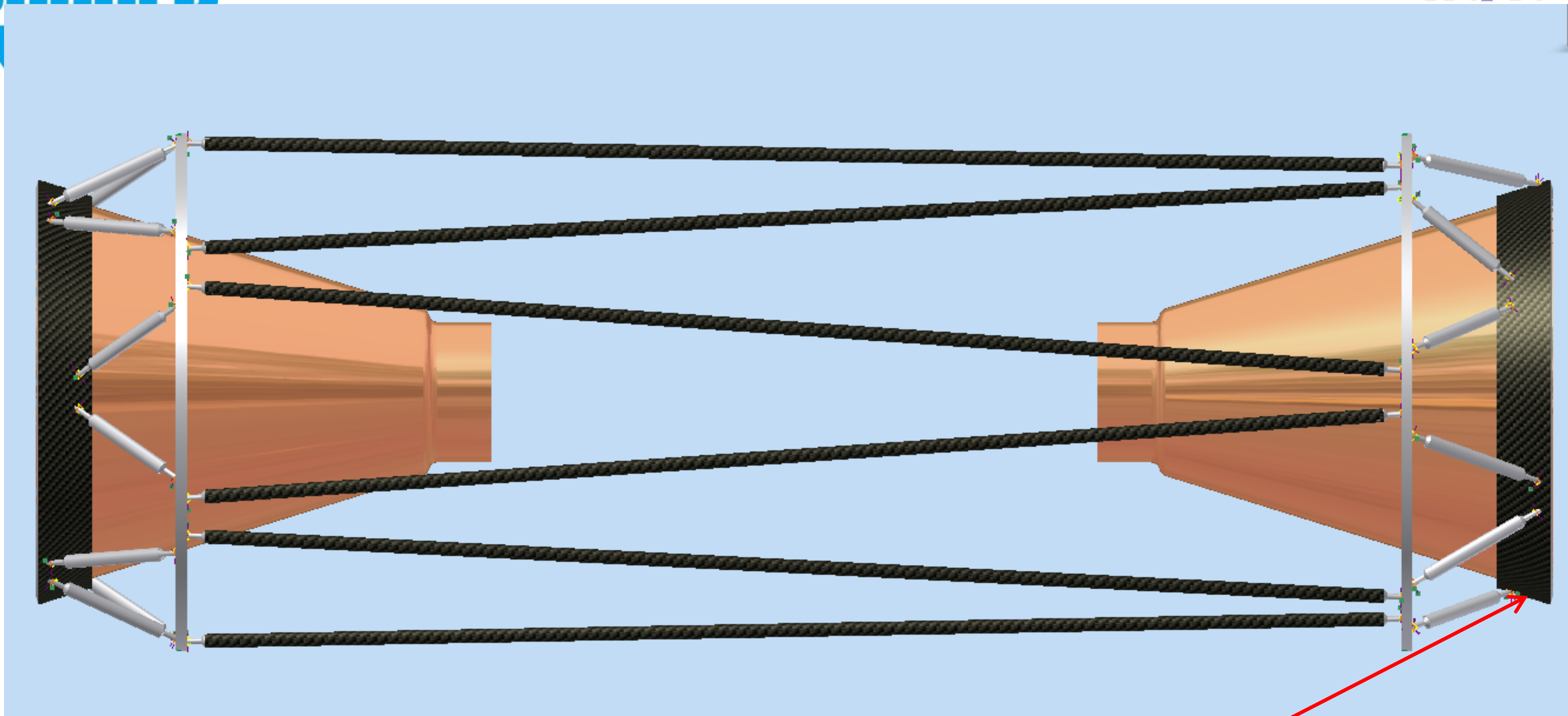
Transition Card

• In order to increase Transition Card board surface move forward 30 mm the connection flange ?



Actual Criostat model implemented with this extra length!

Space Frame/Supporting Cones



J. Morris and F. Gannaway are working on the technological aspect of C.F. Space-frame flanges :

- sandwich structure/full C.F. section
- choice of the best C.F tube
- …….

Space Frame, version 2

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.) .

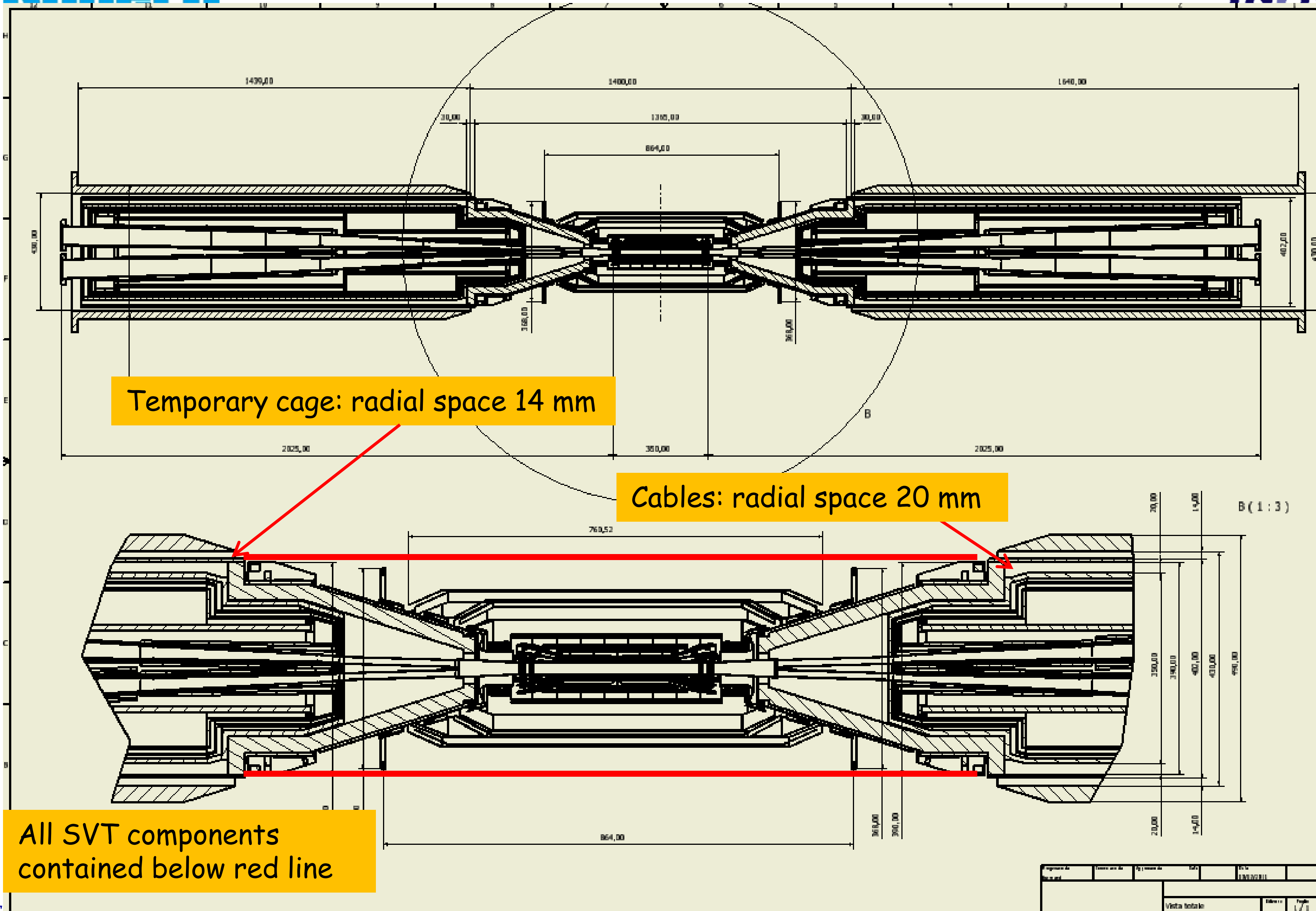
-In this configuration, criostat forw/back+SVT+L0+Be pipe+conical shield forw/back are one body (like in BaBar) but, in SuperB, to gain in X0, is not present the C.F. BaBar supporting tube and the Be pipe and SVT are the weak part of the mechanical chain .

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

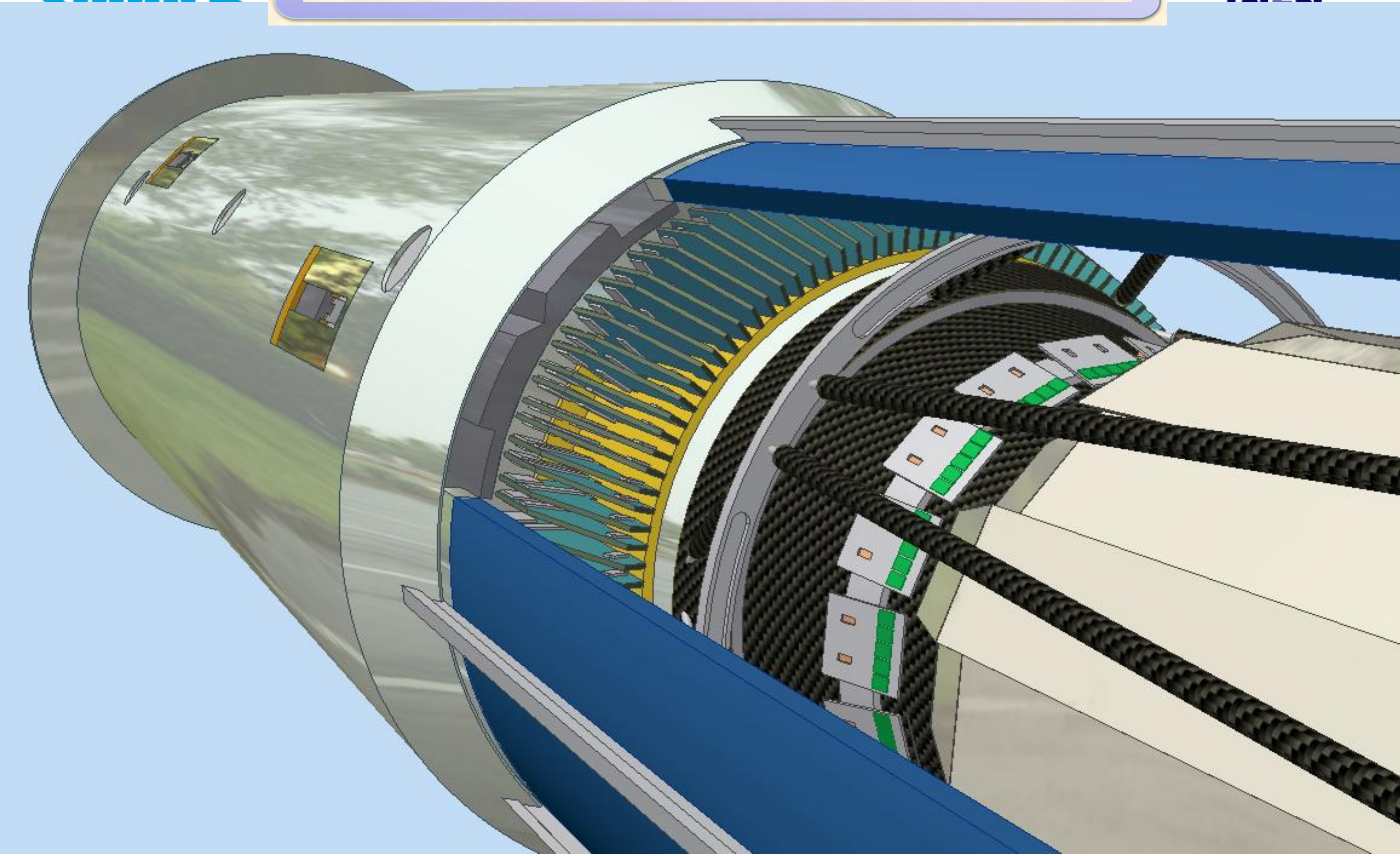
-Has been asked to assume R=245 (+10 mm respect now) as internal diameter of D.C. in order to have minimum radial space to design the mechanics of operation.

-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

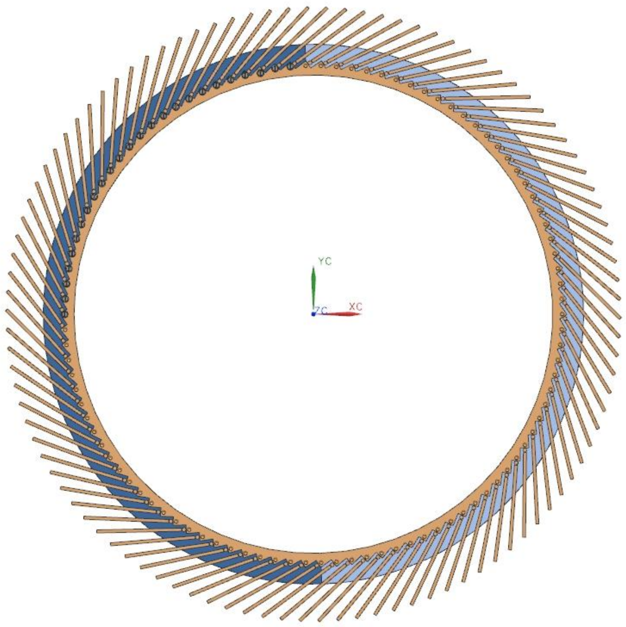


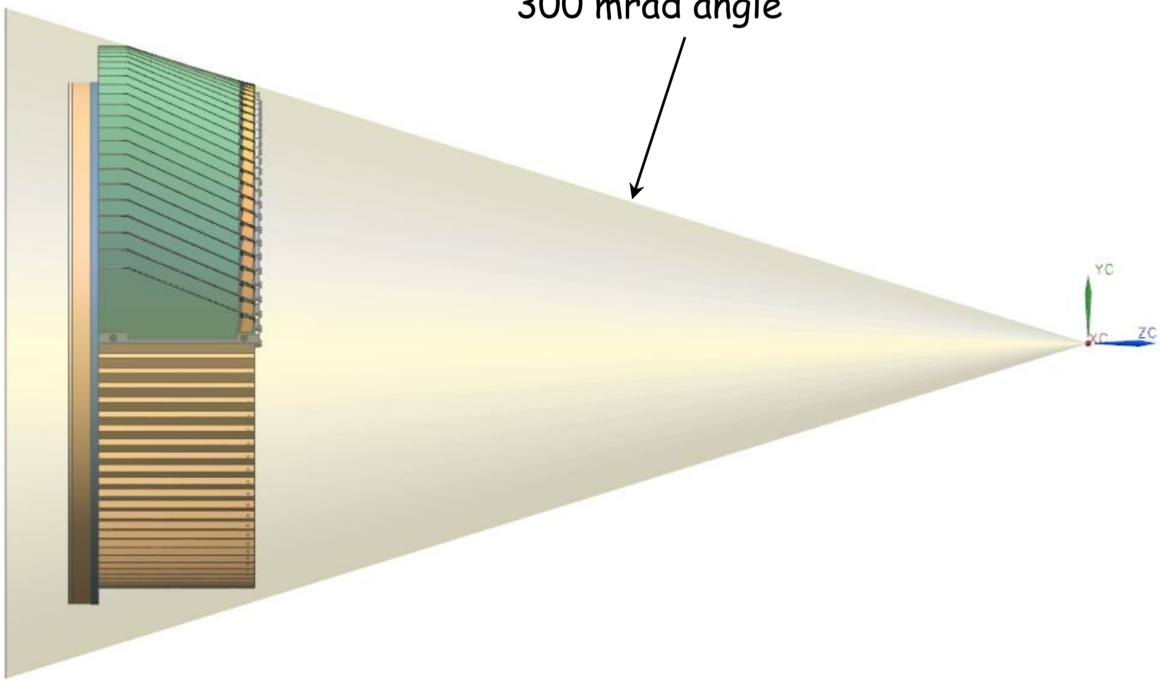
Transition Card



Istituto Nazionale
di Fisica Nucleare
Sezione di Milano

Transition cards
Alternative design: Turbine layout – n. 102 cards
(Hypothesis: only 18 cards for layer 5 instead of 36)





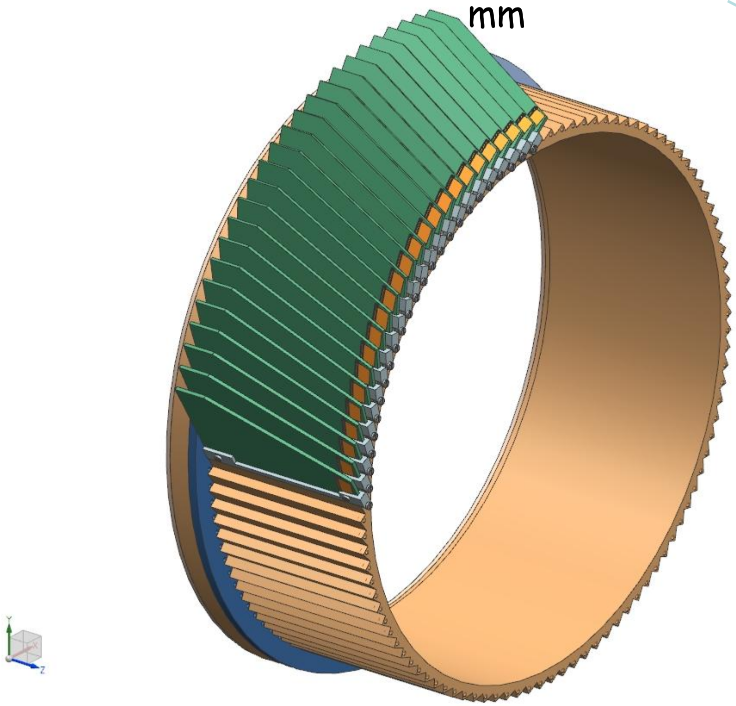
M. MONTI   S. COELLI

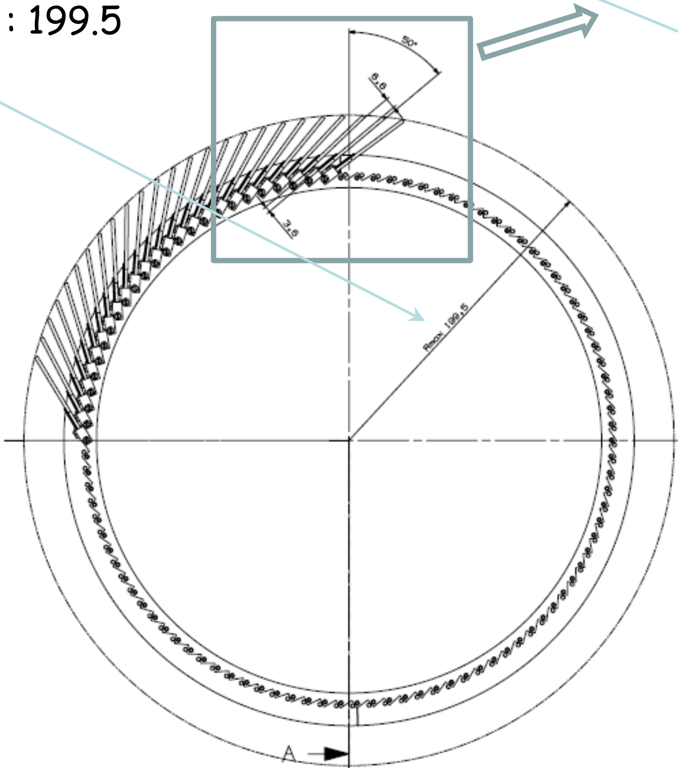
31

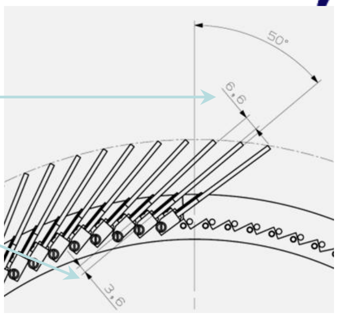
Transition cards – Turbine layout

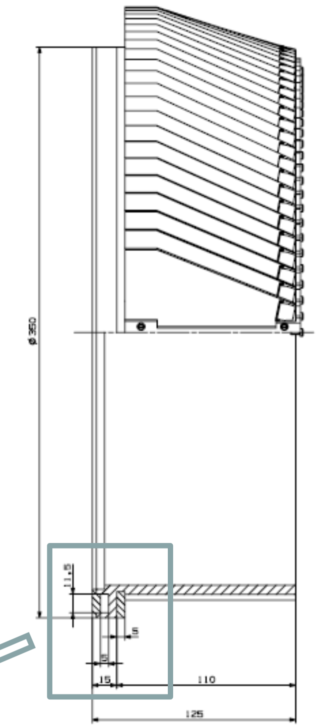
Max gap: 6.6 mm
Min gap : 3.6 mm

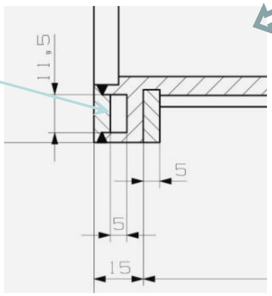
Max envelope radius : 199.5 mm











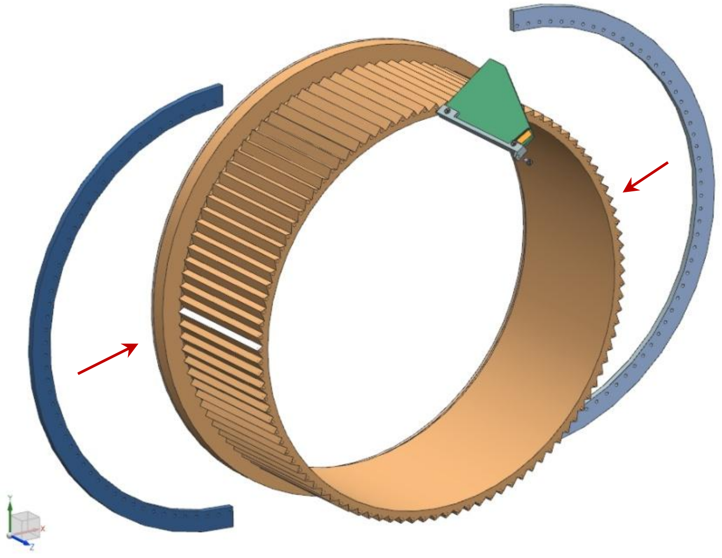
cooling space in back flange

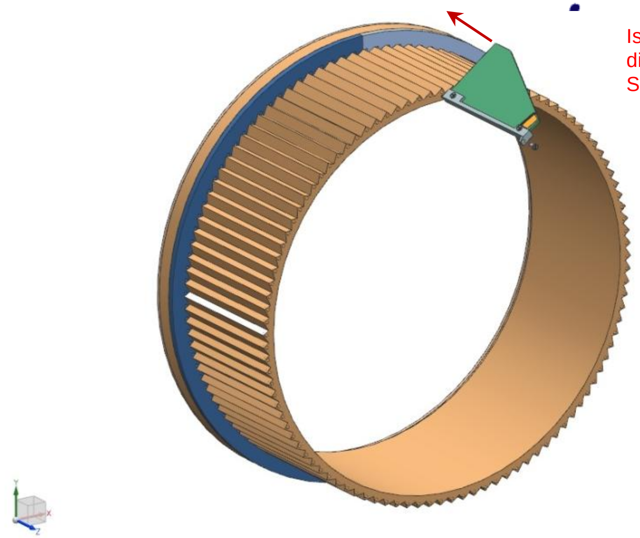
M. MONTI S. COELLI

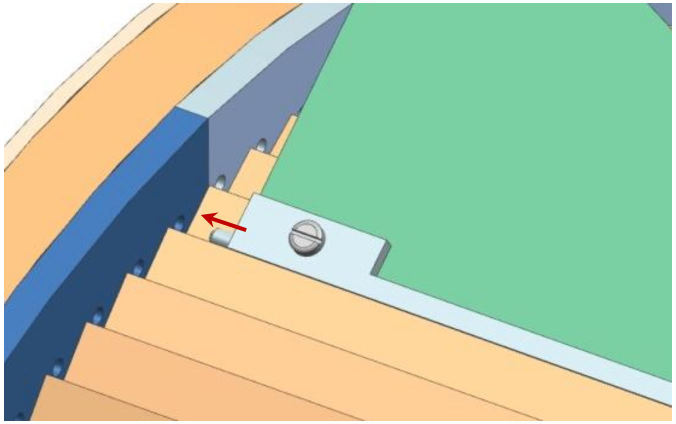
INFN Istituto Nazionale di Fisica Nucleare Sezione di Milano

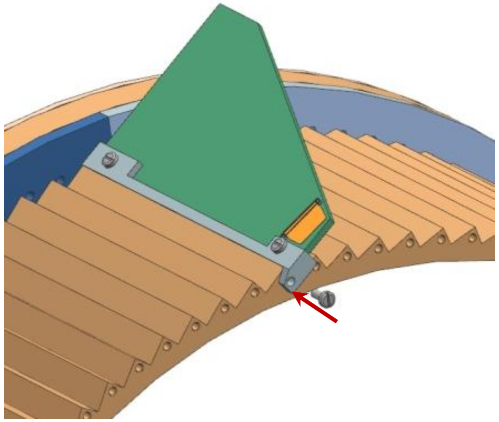
Transition cards – Turbine layout assembling

Istituto Nazionale
di Fisica Nucleare
Sezione di Milano







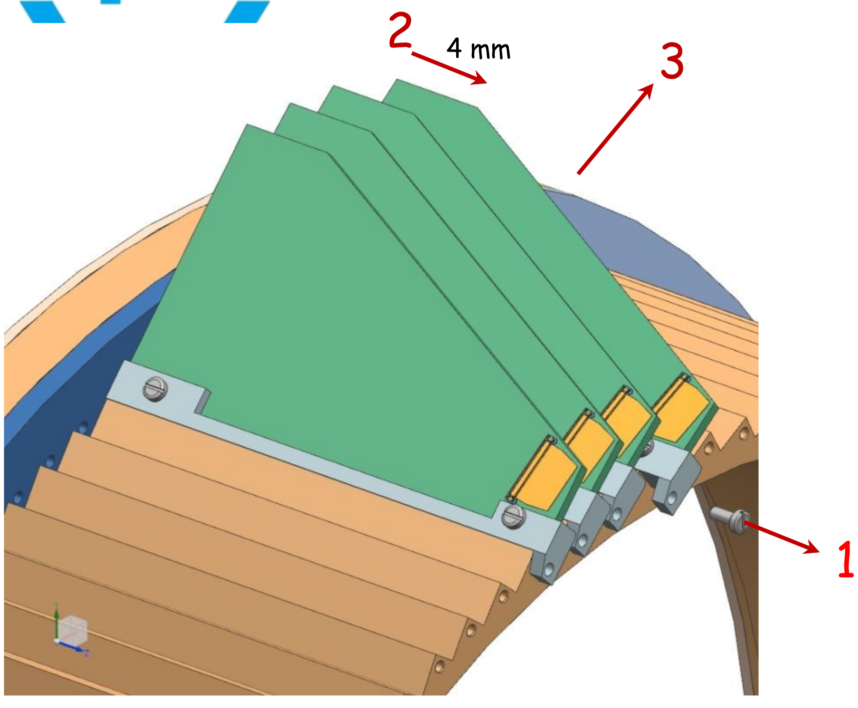


M. MONTI S. COELLI

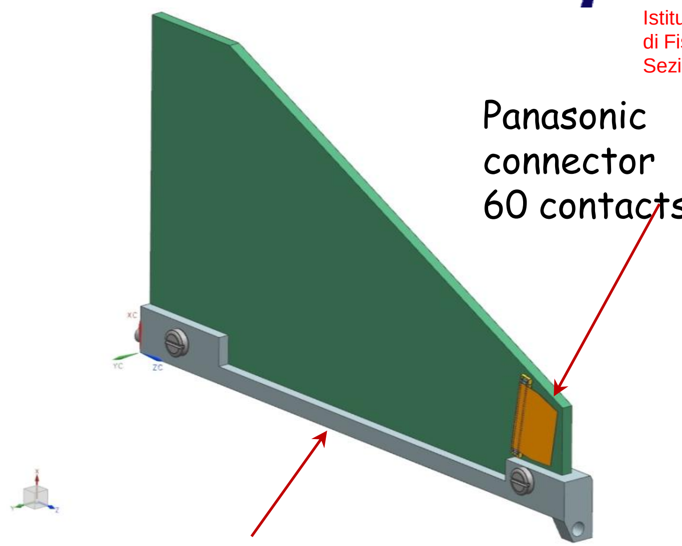
33

Transition cards – Turbine layout

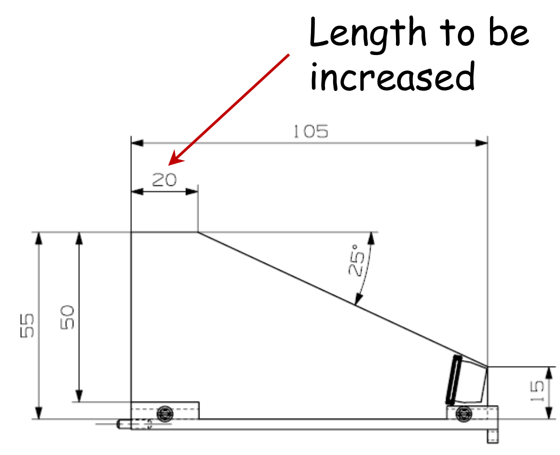
Istituto Nazionale
di Fisica Nucleare
Sezione di Milano



Transition Card dismantling



Transition Card support



M. MONTI S. COELLI

34

Conclusion

1) Ribs/fanouts SVT design completed .

2) L0 striplets-cold flanges and Be pipe new design

3) Gimbal ring design still to define

Quick Demounting solution

4) Good collaboration with QMUL and Milano, good progress on the transition card issue

5) Need to start work on writing TDR

BACKUP

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