Layer0 Module (MAPS – Striplets) Mechanics Status

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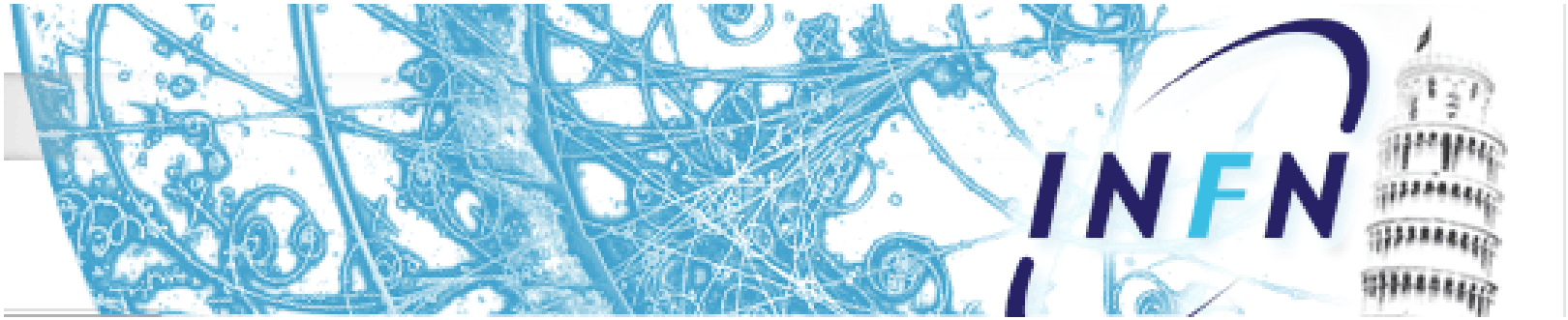
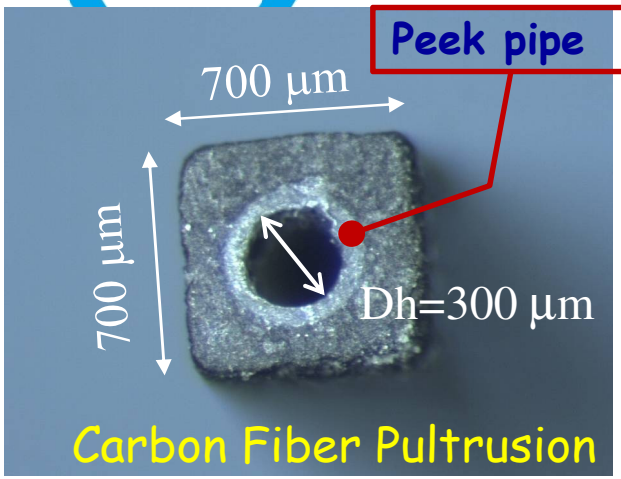


Outline

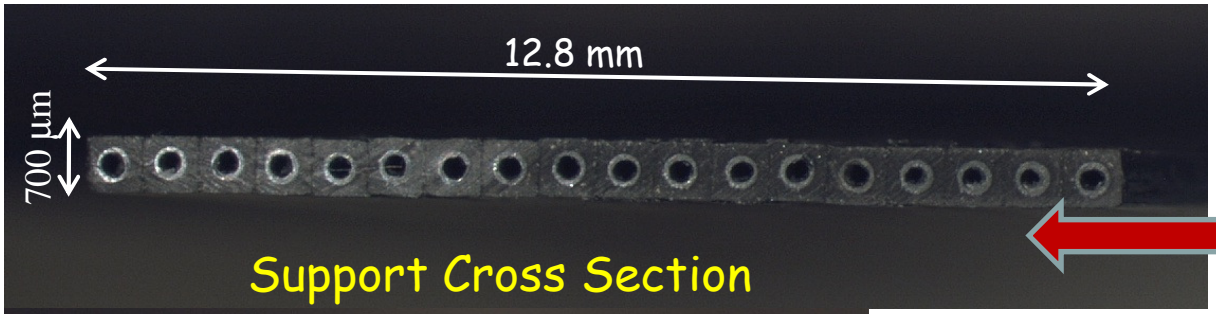
- Work on the L0 supports (MAPS version)
- Work on the L0 supports (Striplets version)
- Conclusions

Module MAPS supports summary



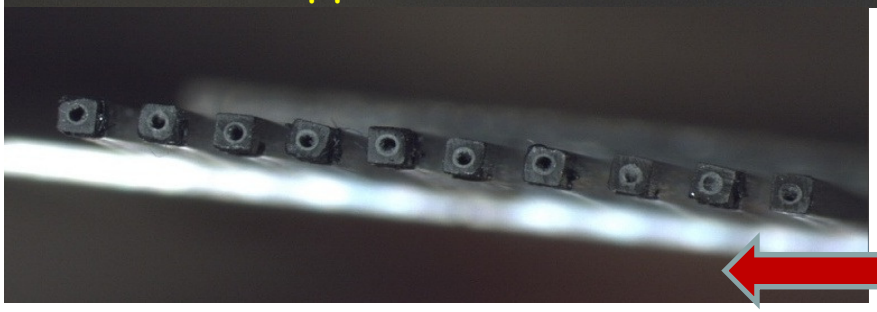
The single base microchannel unit

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

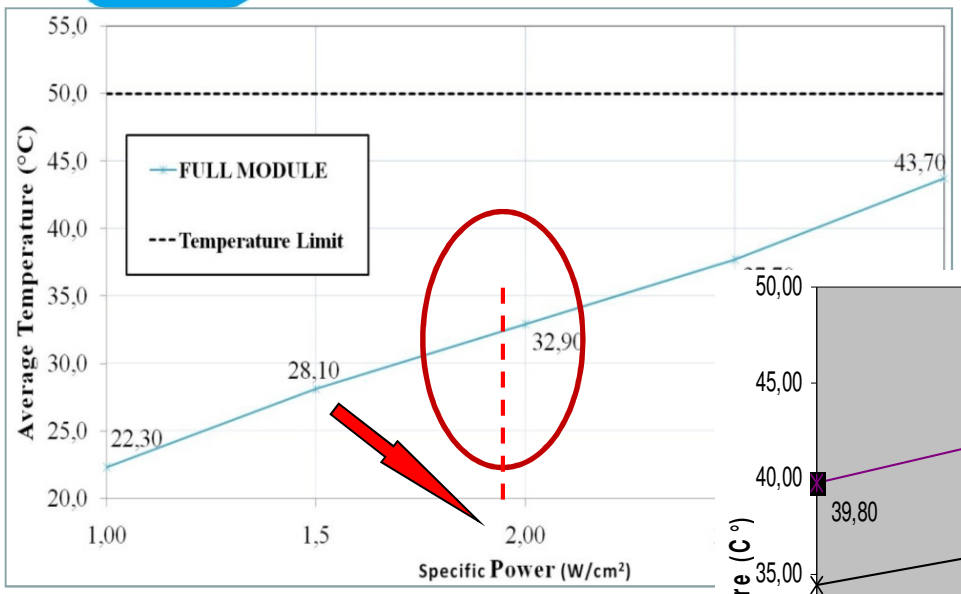


Net micro-channel module

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

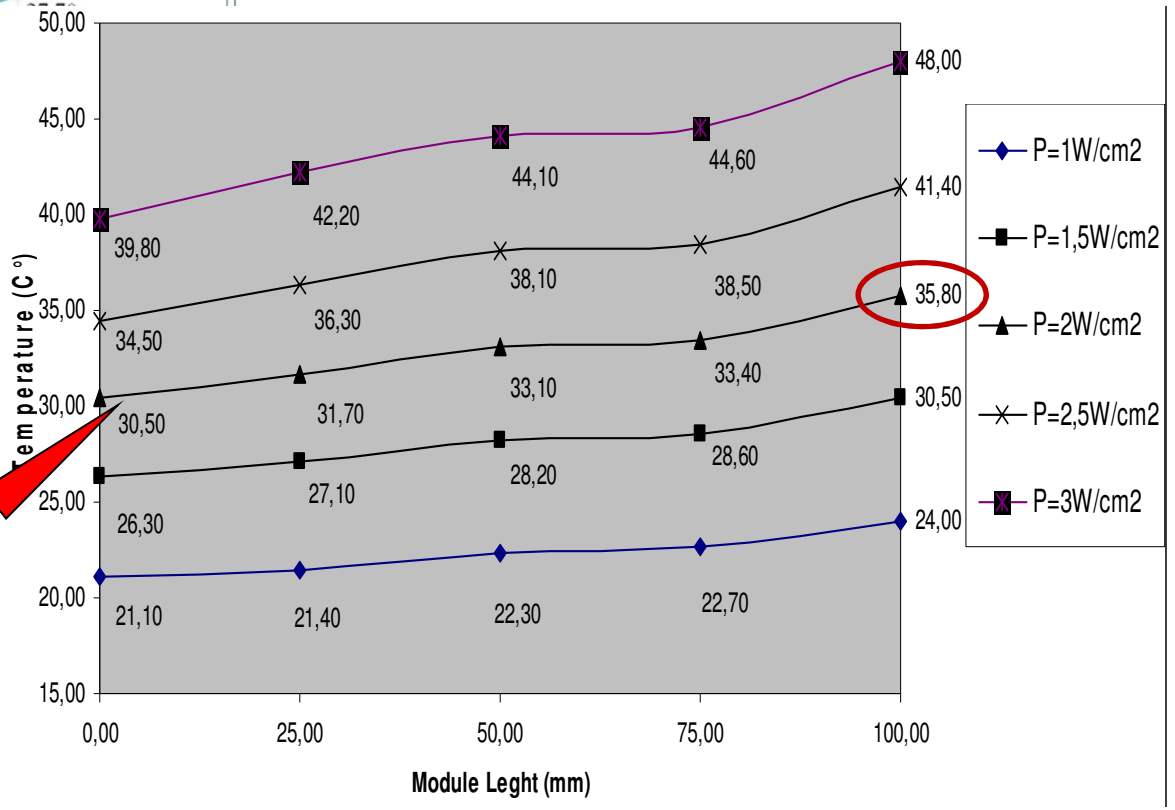
(*): Material of the support structure: (All C.F. material + peek tube + Water)

Full module test results



Average module Temperature vs Specific Power

Tests performed on full module sample (length = 120 mm) at $\Delta p = 3.6$ atm.



Temperature along the module: ΔT = 5,3 °C at 2W/cm² and Δp =3,6 atm

Net Module test results

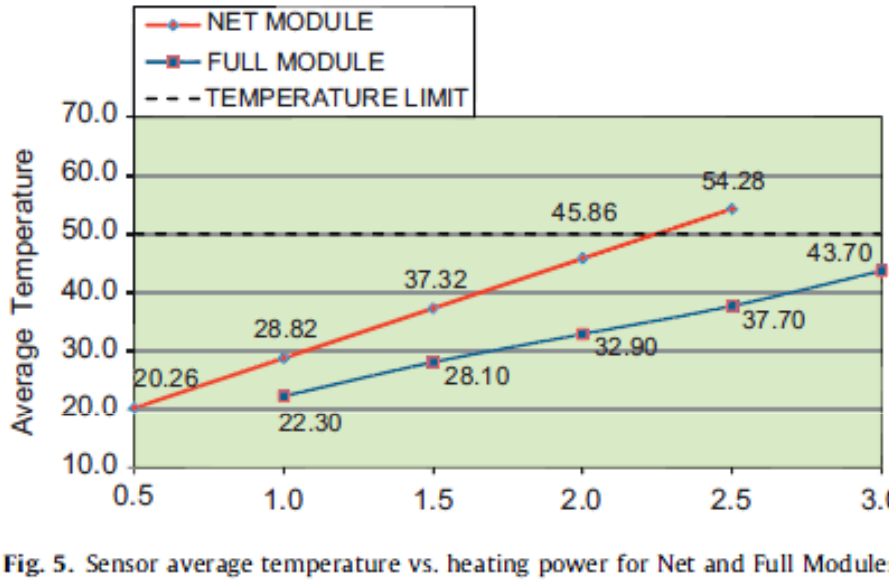
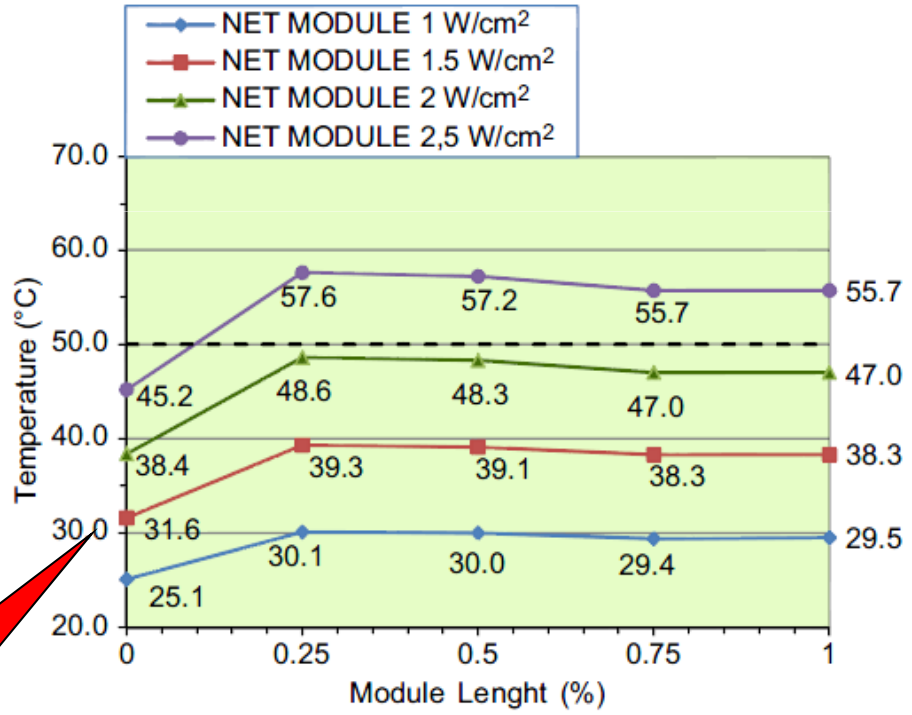


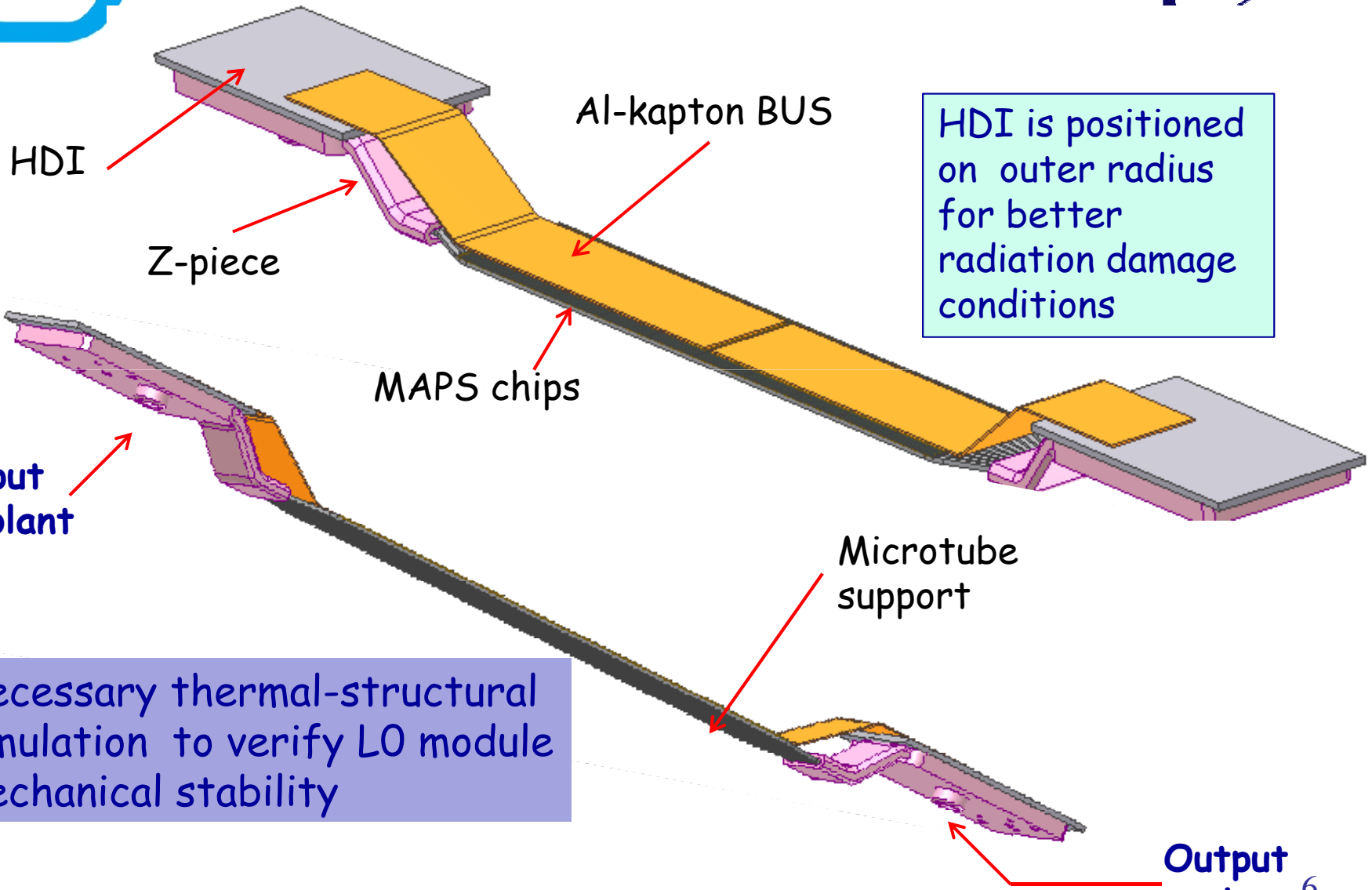
Fig. 5. Sensor average temperature vs. heating power for Net and Full Module

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



Data shown that Net Module is able to cool power up to about 1.5 W/cm² below the max required Temperature (50 °C).
This goal can also be achieved with a greater safety factor by reducing the inlet coolant temperature.

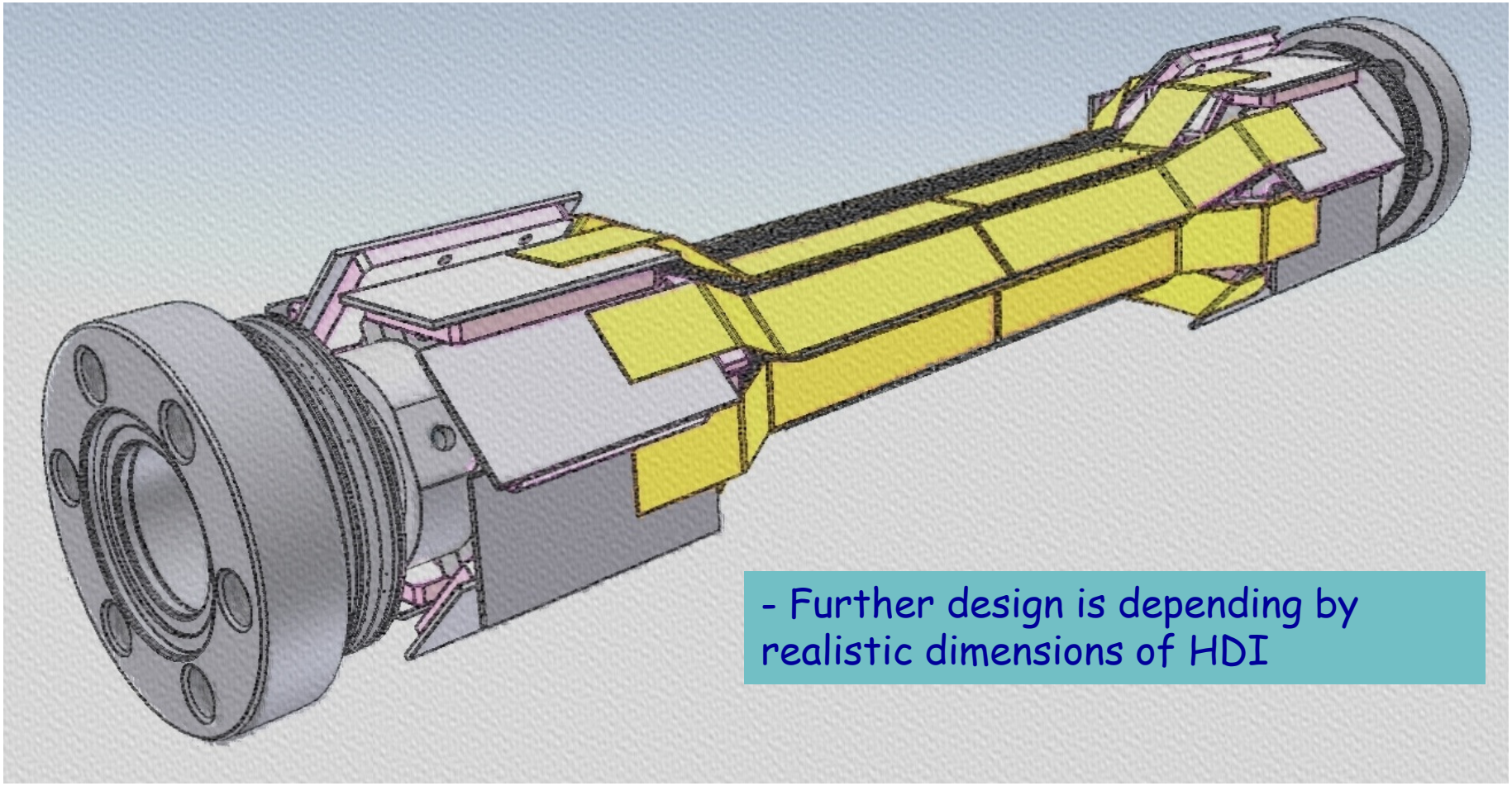
MAPS L0 module Design



HDI is positioned on outer radius for better radiation damage conditions

Necessary thermal-structural simulation to verify L0 module mechanical stability

L0 on Beam Pipe



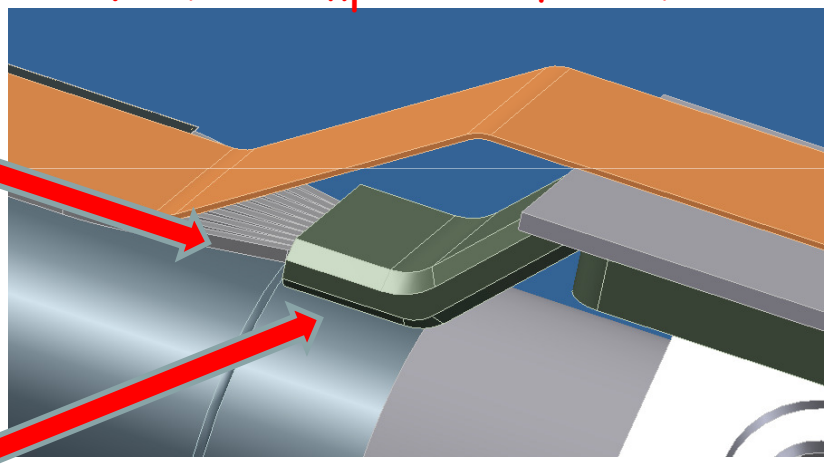
- Further design is depending by realistic dimensions of HDI

MAPS Module
Work actually in progress

1) Microchannel CFRP in lamination process.

Italian company (Plyform , (NO) is producing a laminated microchannel prototype (H=700 μm and Dh=300 μm), mask already realized, I have no idea of the quality of the final product . This is important for the shaping of the microtube .

We are tryng to realize this shape also with poor polimerization microtube from pultrusion .



2) Z-piece prototype

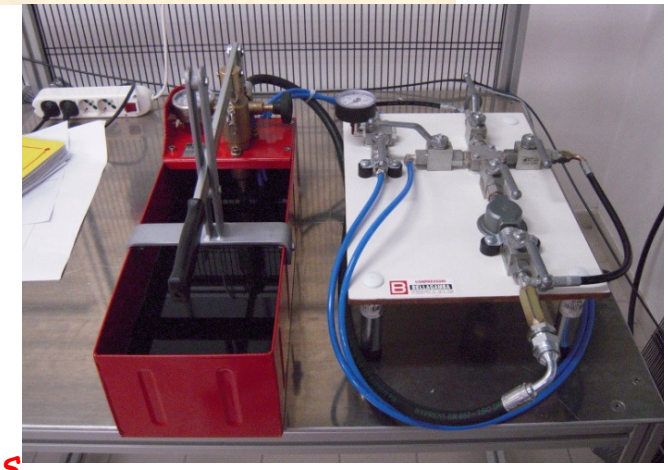
Finally in construction - strong delay for design revision - rapid prototyping technology in ABS material , c/o Poggipolini (Bo) .

3) Breaking test on microchannel (structural test)

At the moment the test has been performed on N.3 prototypes in order to measure the breaking pressure of the microchannel fed with cold fluid. We set a circuit test able to push fluid up to 150 atm. , data acquisition Movicon with digital pressure transducers in input-output with 0.5% max error.

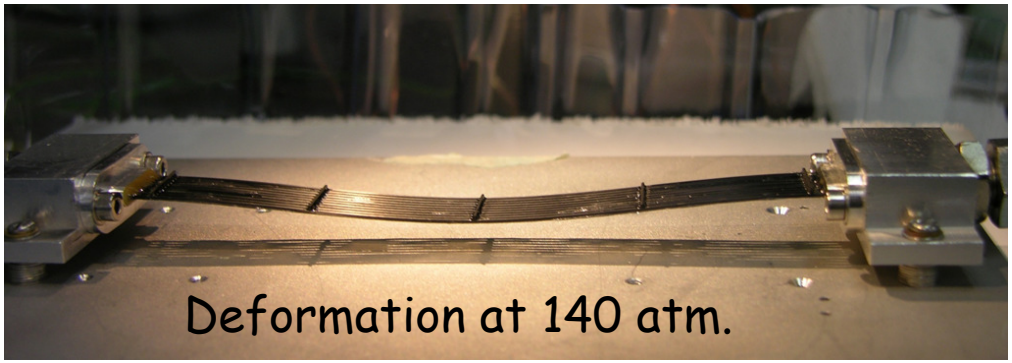
Breaking Test on CFRP microchannel

The test was realized on Net module and Full module prototypes.
We found a very poor leak of coolant from the hydraulic interface sealing realized with Araldite 2011 at 20 atm and 30 atm *.
No leak from the microtube at pressure lower than 90 atm (light exude at this pressure).
From the structural point of view the test has been performed up to 140 atm and at this pressure the flanges of hydraulic interface deformed enough to extrude the seal and to produce a failure of the sistem.

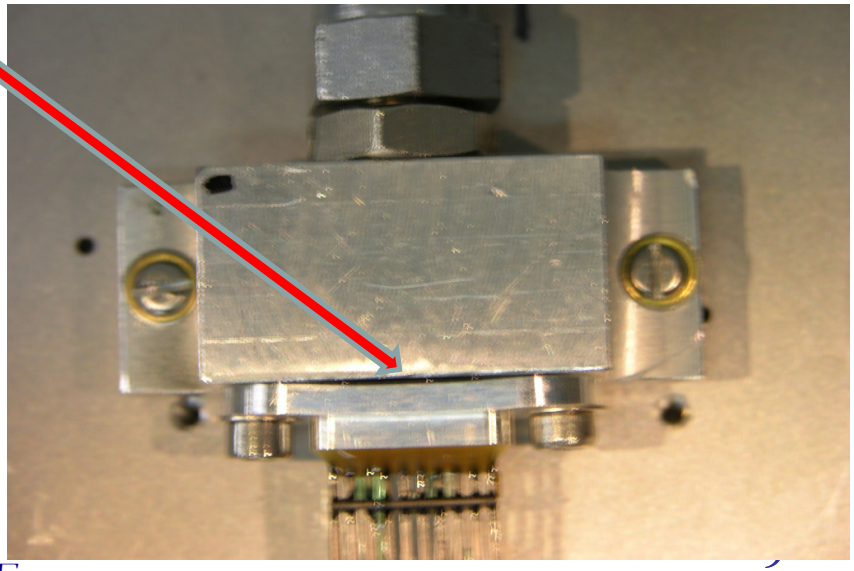


- Hydraulic equipment

Precise data next time, tests still on!

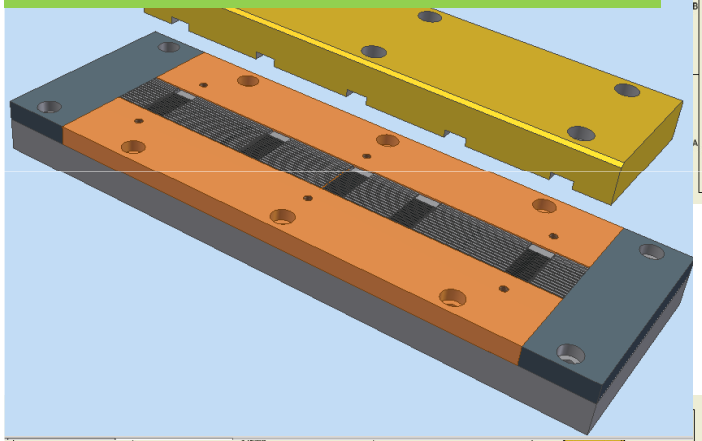


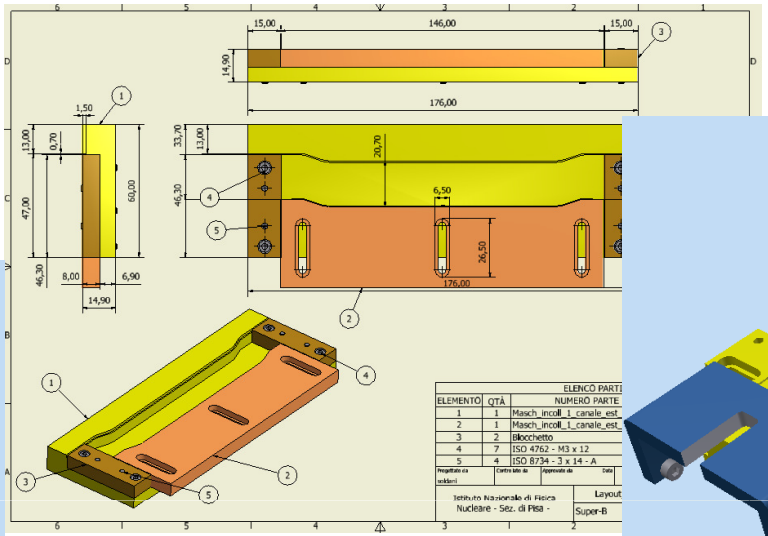
Deformation at 140 atm.

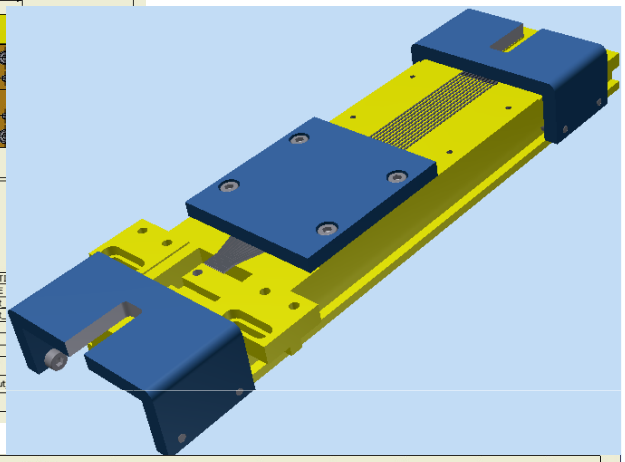


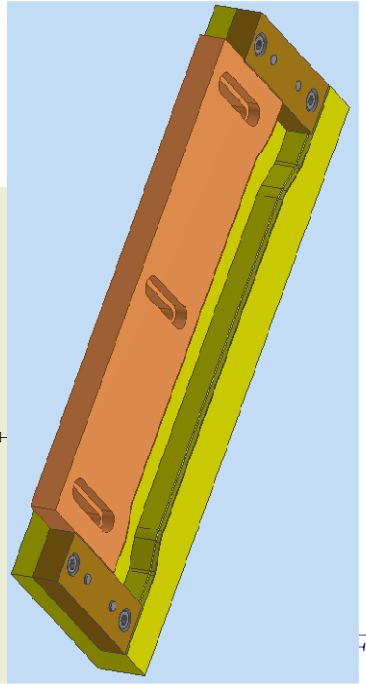
Work in progress

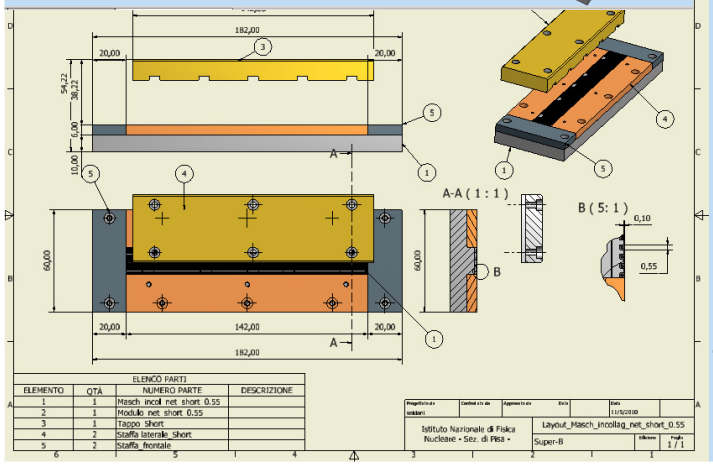
Masks design for microchannel shaping from pultrusion : mechanics in construction !

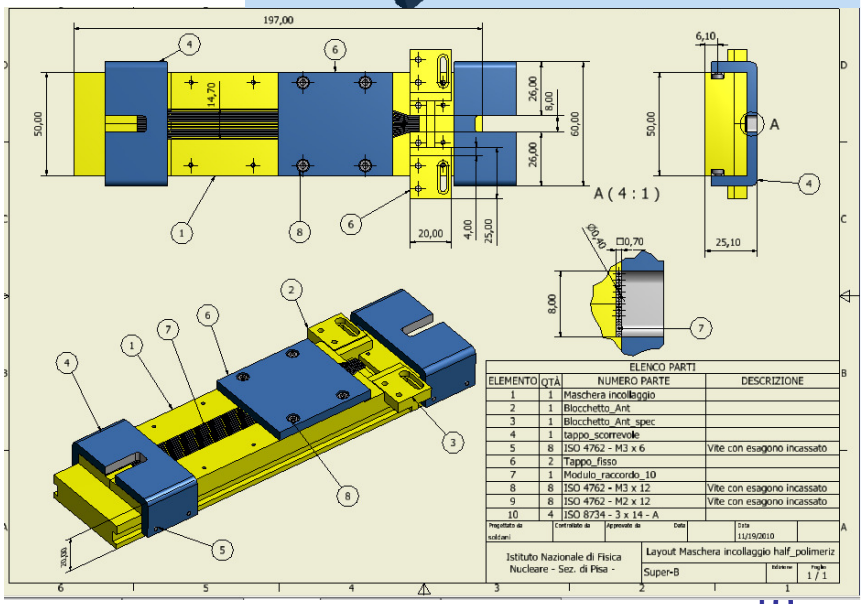






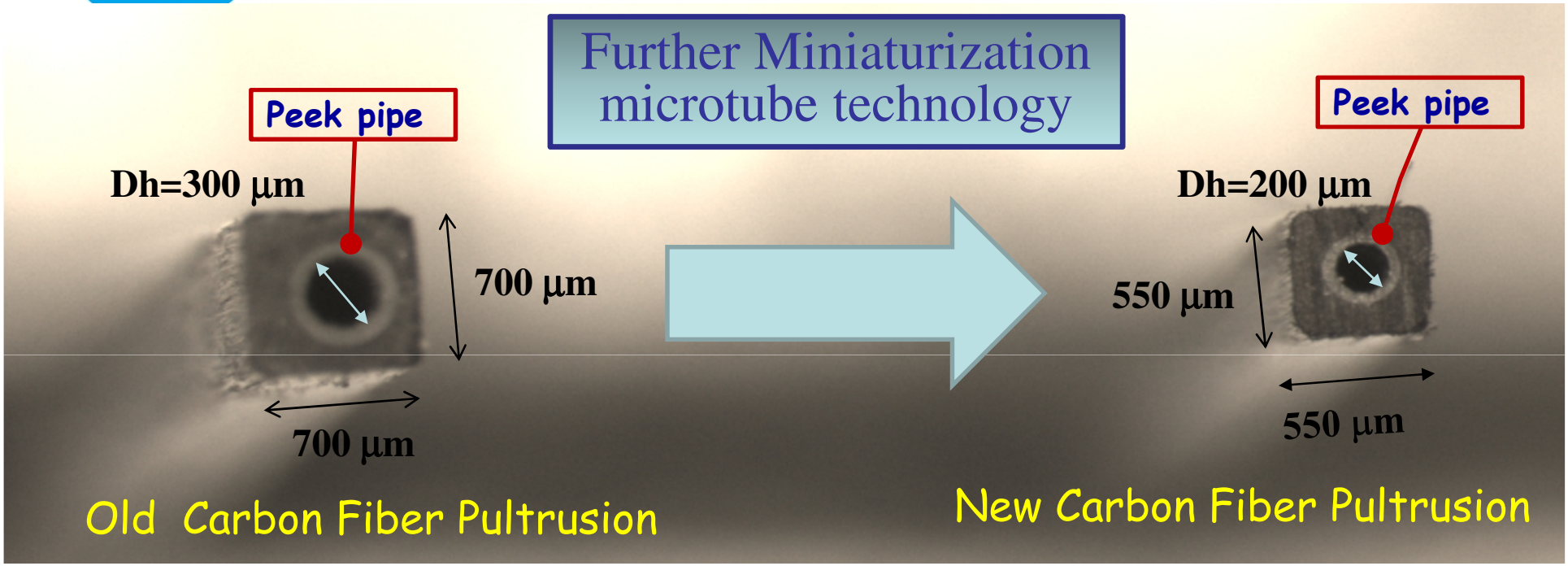






Work in progress

Further Miniaturization
microtube technology



Full Module	X = 0,28 % X_0
Net Module	X = 0,15 % X_0

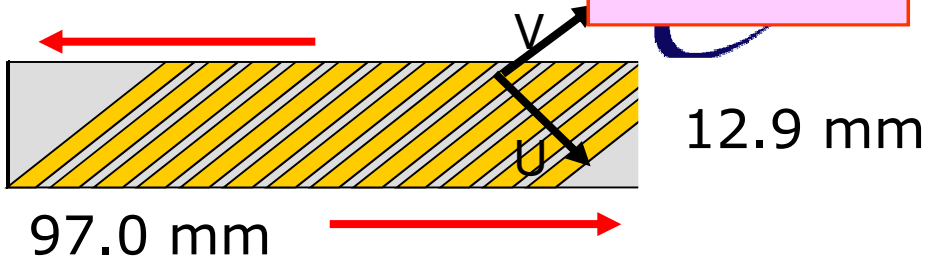
Full Module	X = 0,22 % X_0
Net Module	X = 0,11 % X_0

Module Microtubes 0,55mm th, Full and Net version, realized the mechanical mask for construction , almost ready N.2 prototipes each type. Structure very delicated at delamination, soon new hydraulic test campaign!

Layer 0 striplets design

CDR design is being revised for TDR!

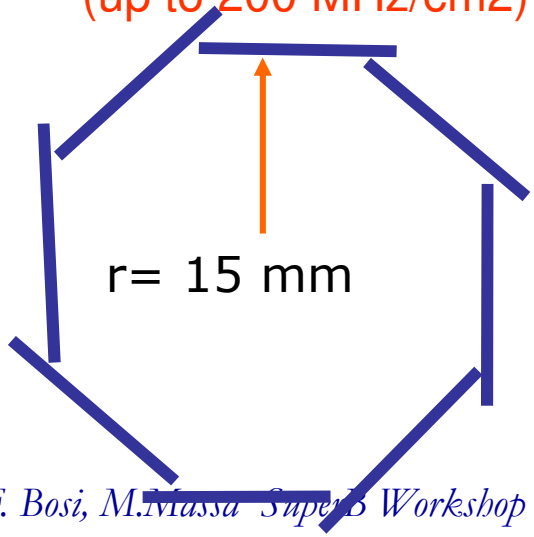
(Lab.) Geometrical acceptance: 300 mrad both in FW and BW
Distance from the i.p. : R=15 mm

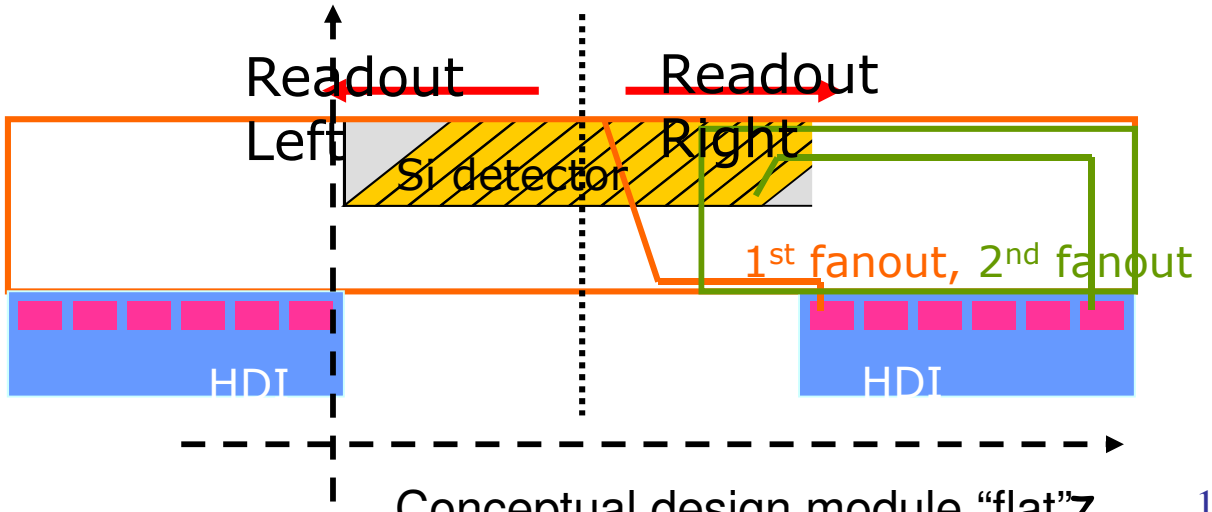


Choosing an Octagonal shape:

- Module active area = 12.9 x 97.0 mm2
  (includes 4% area overlap for alignment)
- double sided Si detector, 200 μm thick with striplets (45° w.r.t det. edges)
  readout pitch 50 μm
- multi-layer fanout circuits (similar to SVT modules, z side) are glued on each sensor,
  connecting Si strips to Front End Electronics
  (fanout extends twice wider than the detector, to allow a minimum of 50 μm between metal traces ~ 700 strip/readout side!).
- In a module needed ~2 fanouts/side !

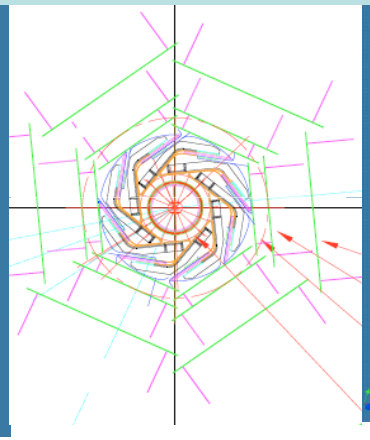
- A new readout chip is needed to cope with the high background rate (up to 200 MHz/cm2)

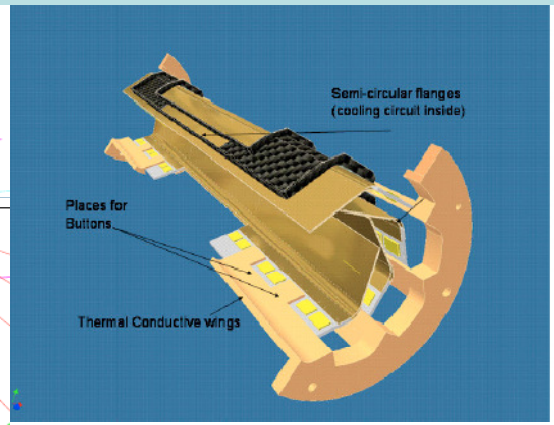


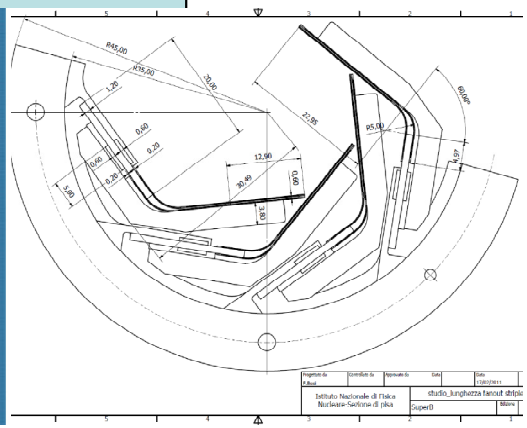


Module Striplets

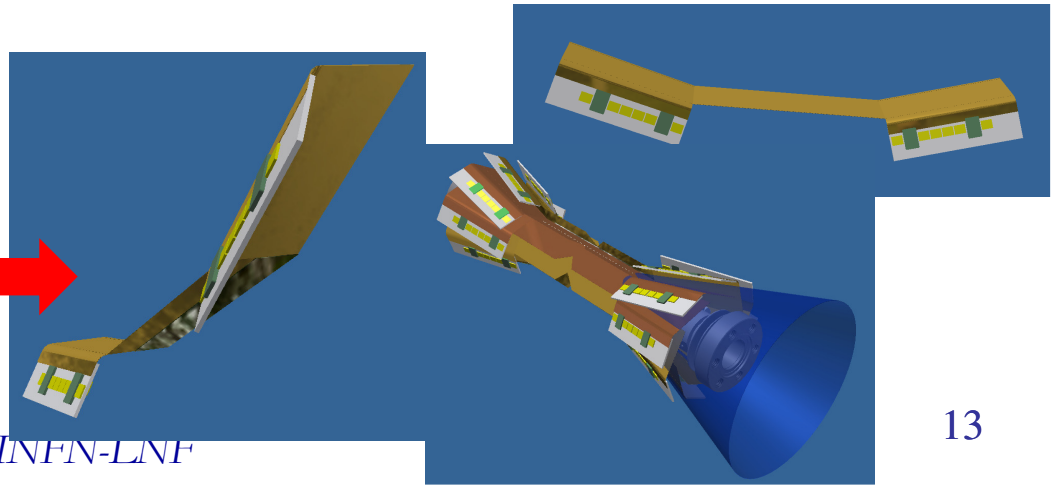
The Striplets module layout designed for CDR (HDI in lateral position) was lately discarded because too much passive material in active region (below 300 mrad).





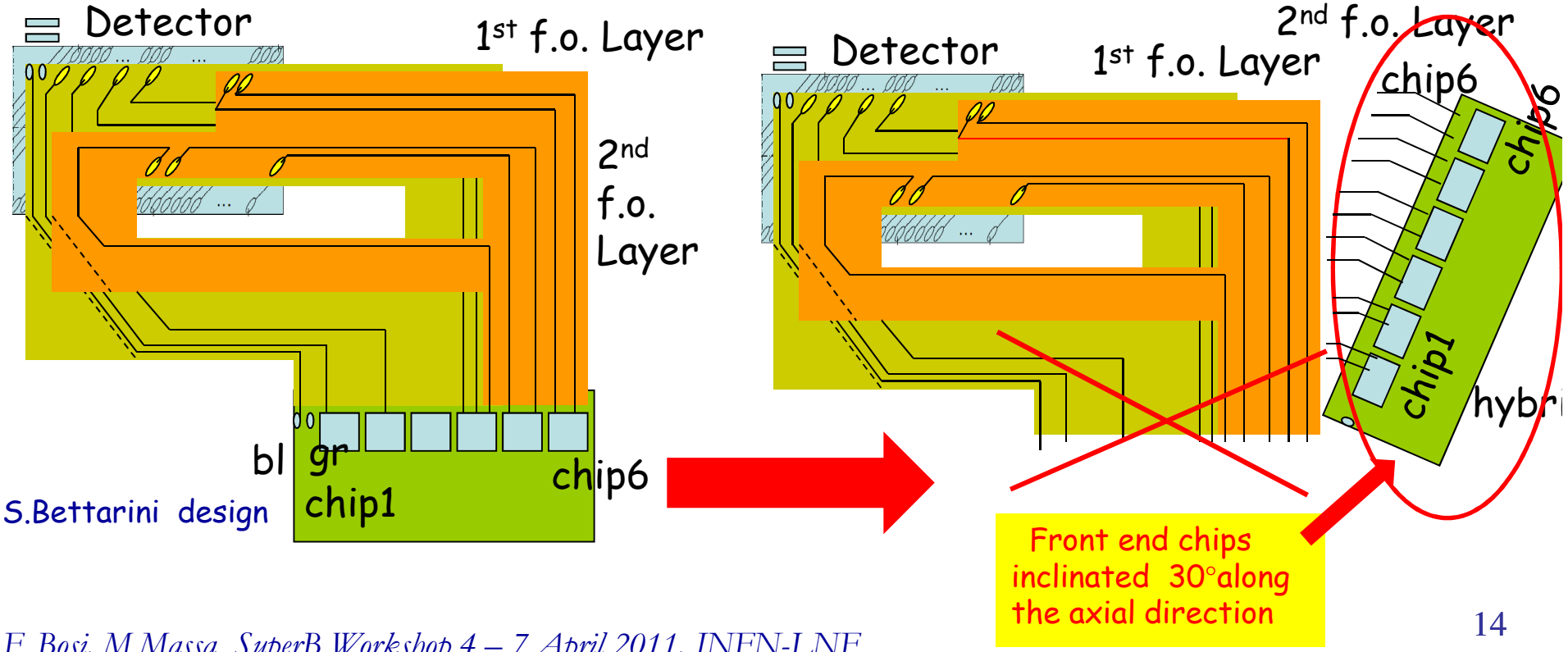


Several module layout has been studied to hold passive material below 300mrad, also with fantasy…… but not solution found with lateral HDI

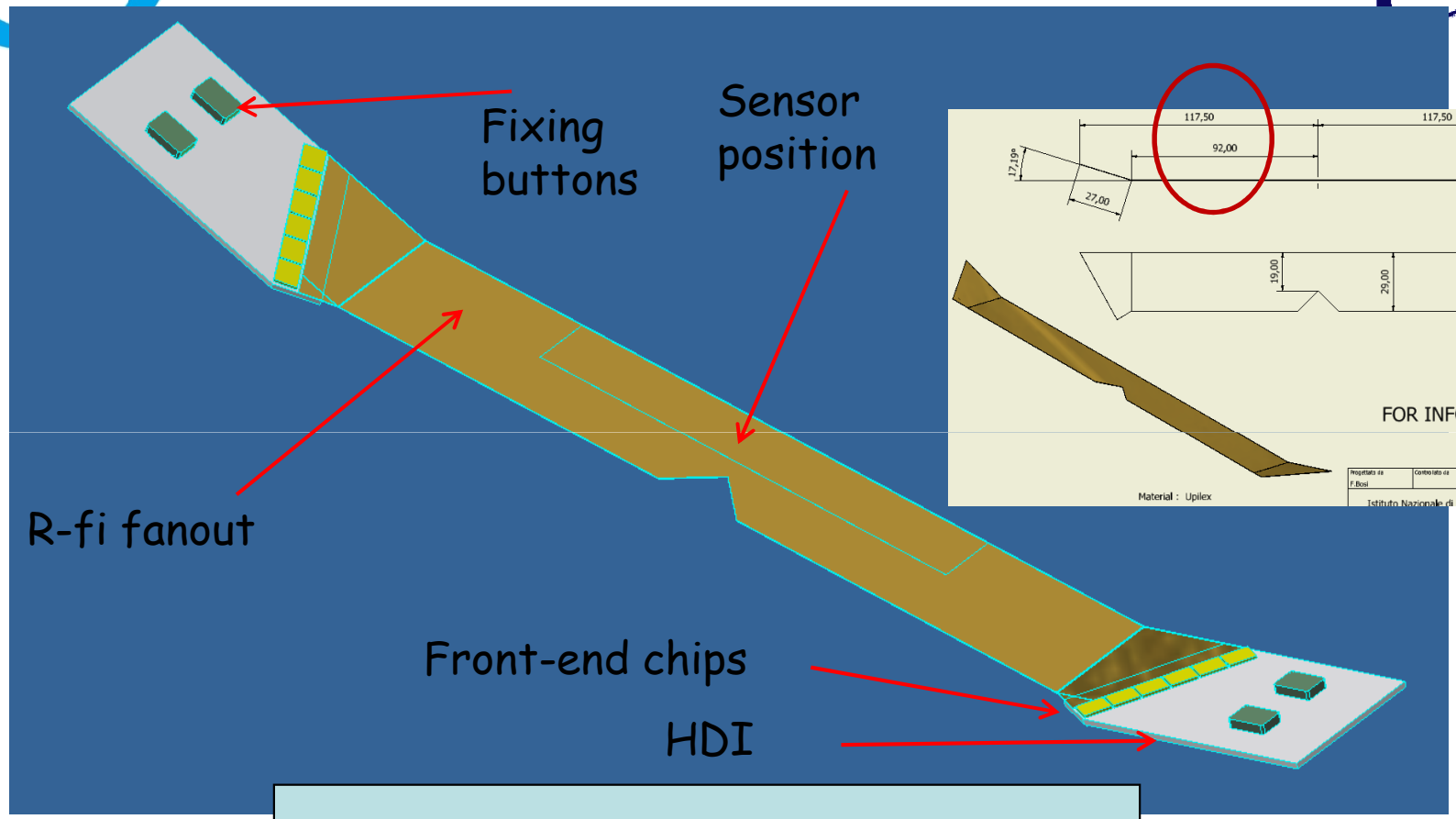


Module Striplets

The problem has been solved with a layout that provides the HDI in a axial position with front end chips distribuited in a 30° inclinated direction, in order to limitate the lateral space of HDI

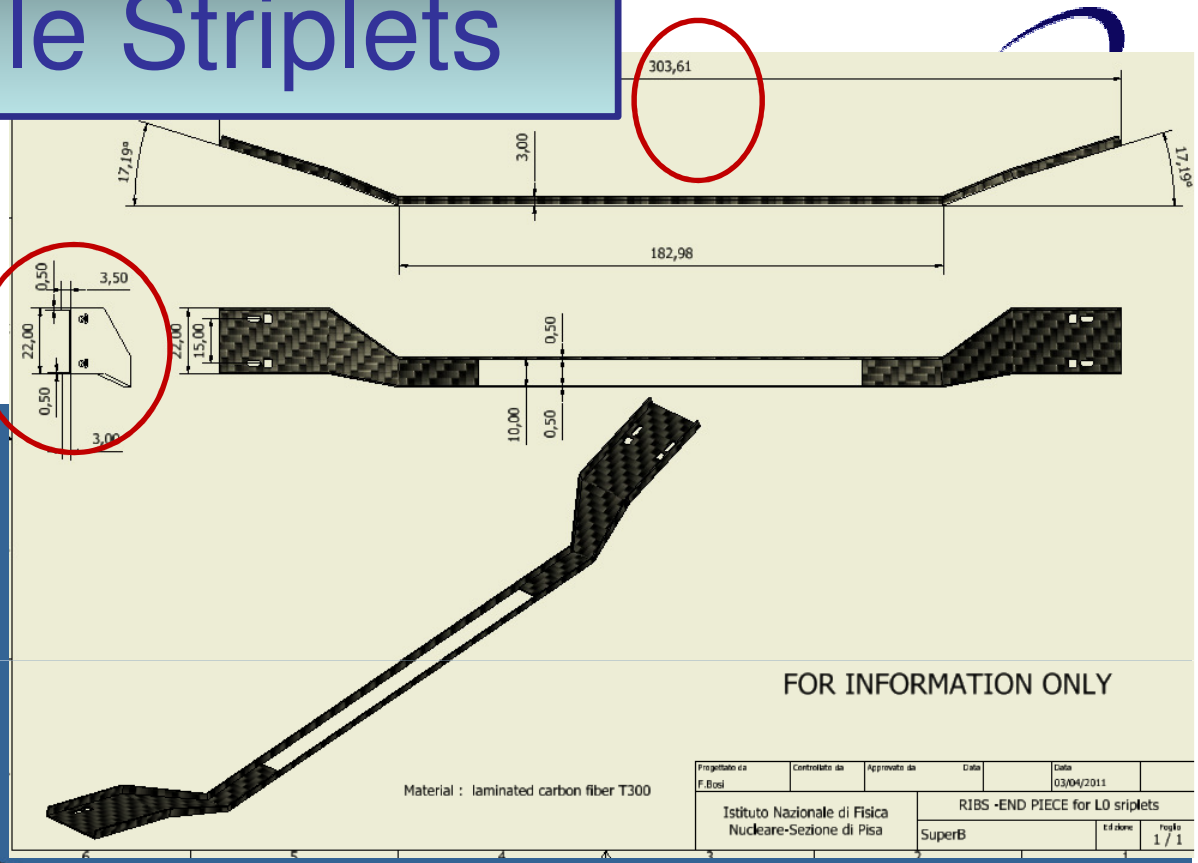


Module Striplets



Final solution –HDI in axial direction inclinated at 300 mrad, with front-end chips 30° oriented

Module Striplets



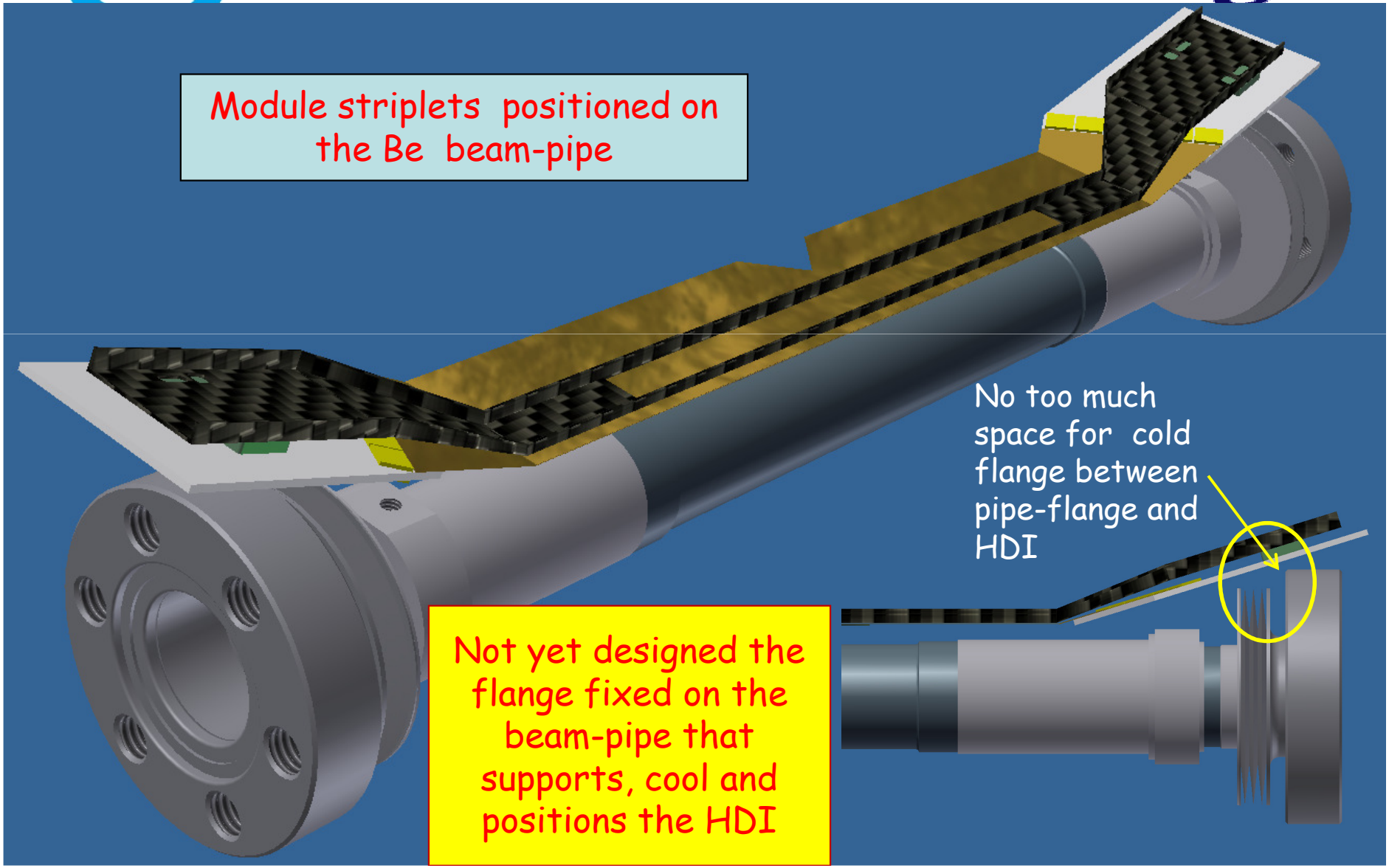
Low mass ribs for active region

Button-hole for screws and final glueing to the buttons

A CFRP structure , glued on the fanout-sensor and HDI buttons, these structure has to freeze the exact positions of all components

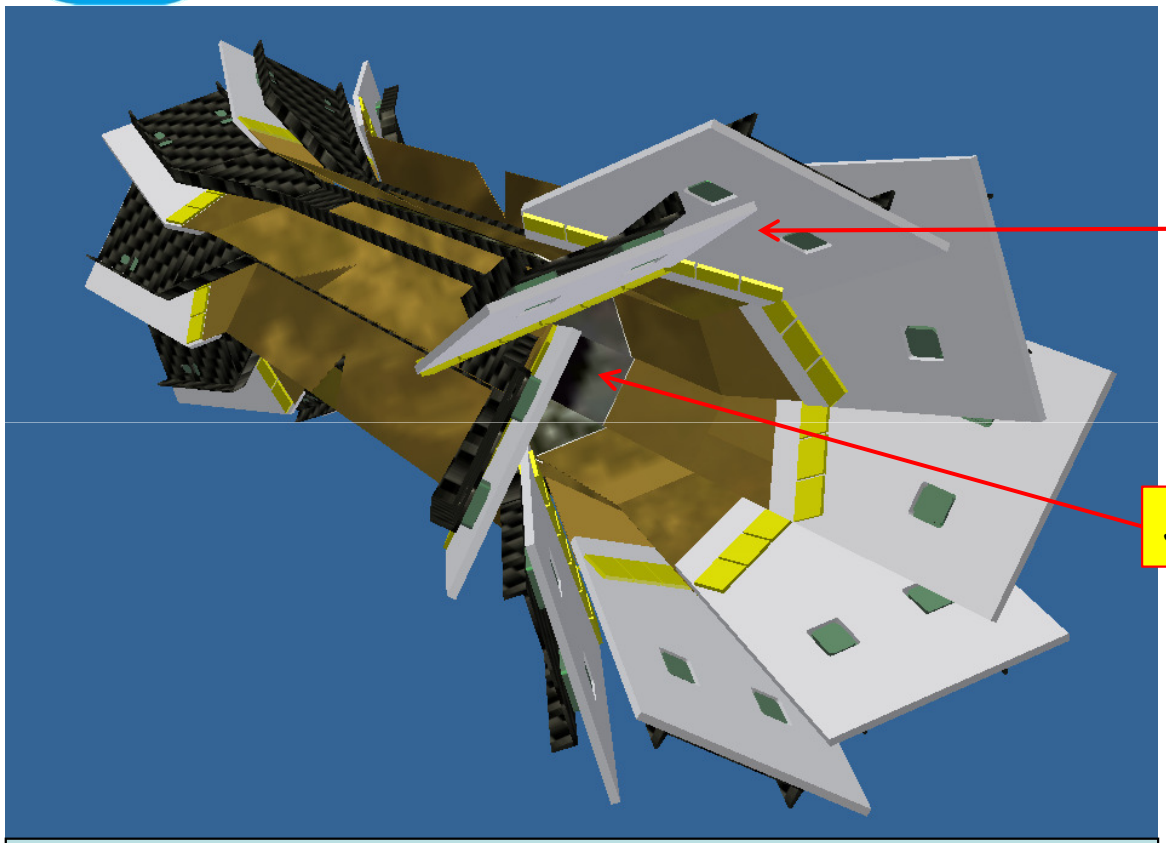
Module Striplets

Module striplets positioned on the Be beam-pipe



Not yet designed the flange fixed on the beam-pipe that supports, cool and positions the HDI

Module Striplets



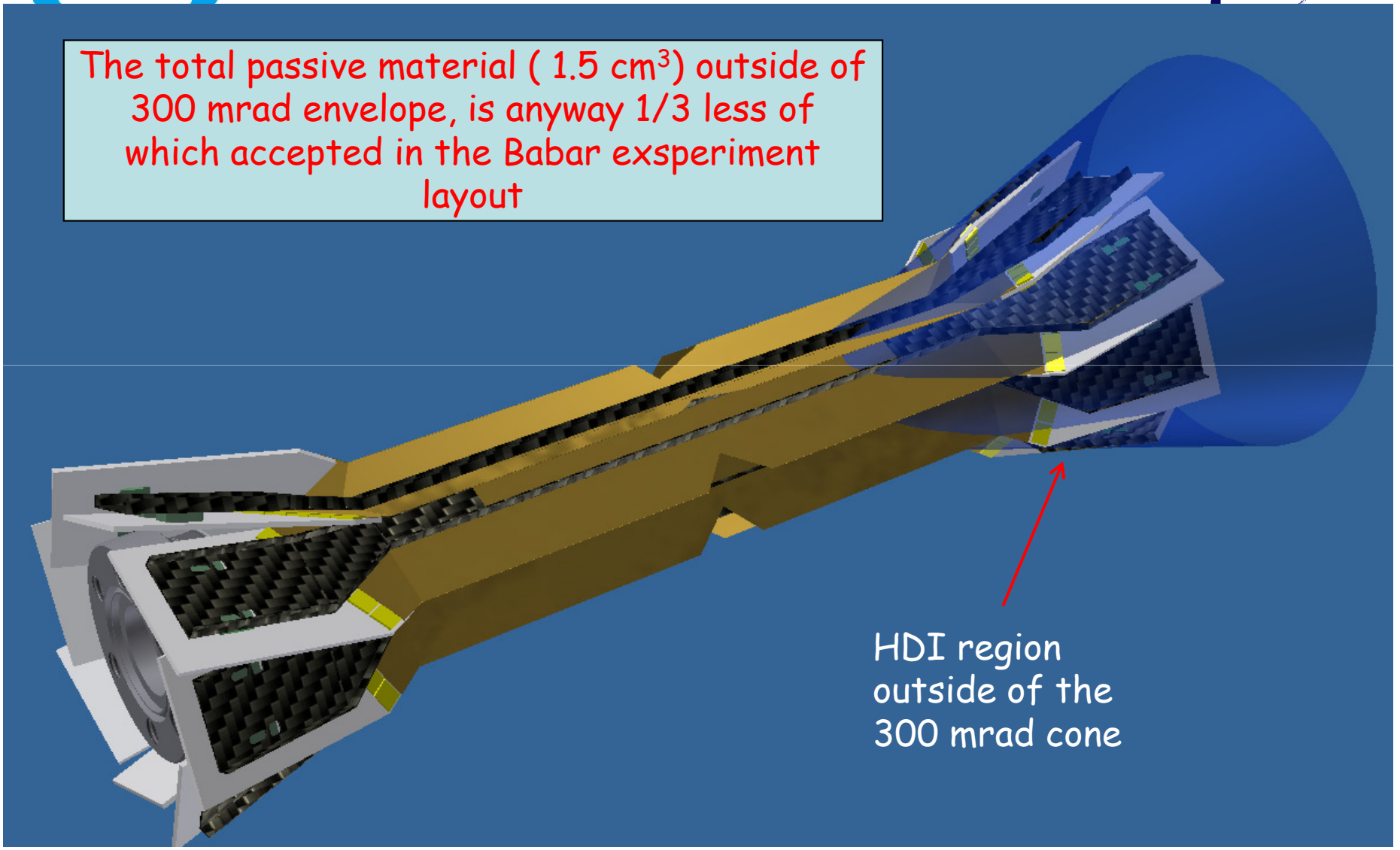
Surfaces devoted to couple to the support flange fixed on the beam-pipe

Sensors

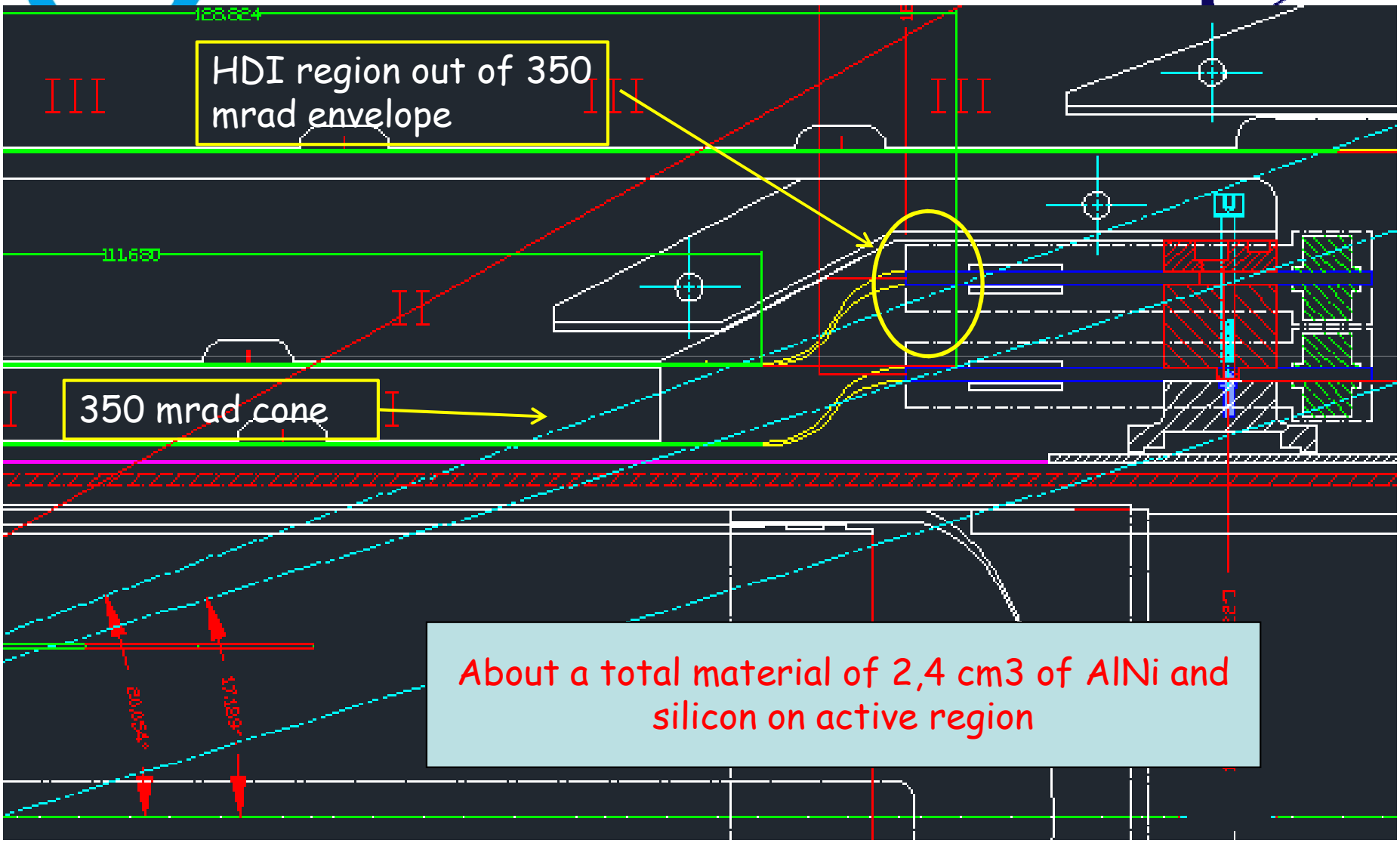
In this view are missing the z fanouts in order to be able to see sensors and back side HDI

Module Striplets

The total passive material (1.5 cm^3) outside of 300 mrad envelope, is anyway 1/3 less of which accepted in the Babar exsperiment layout

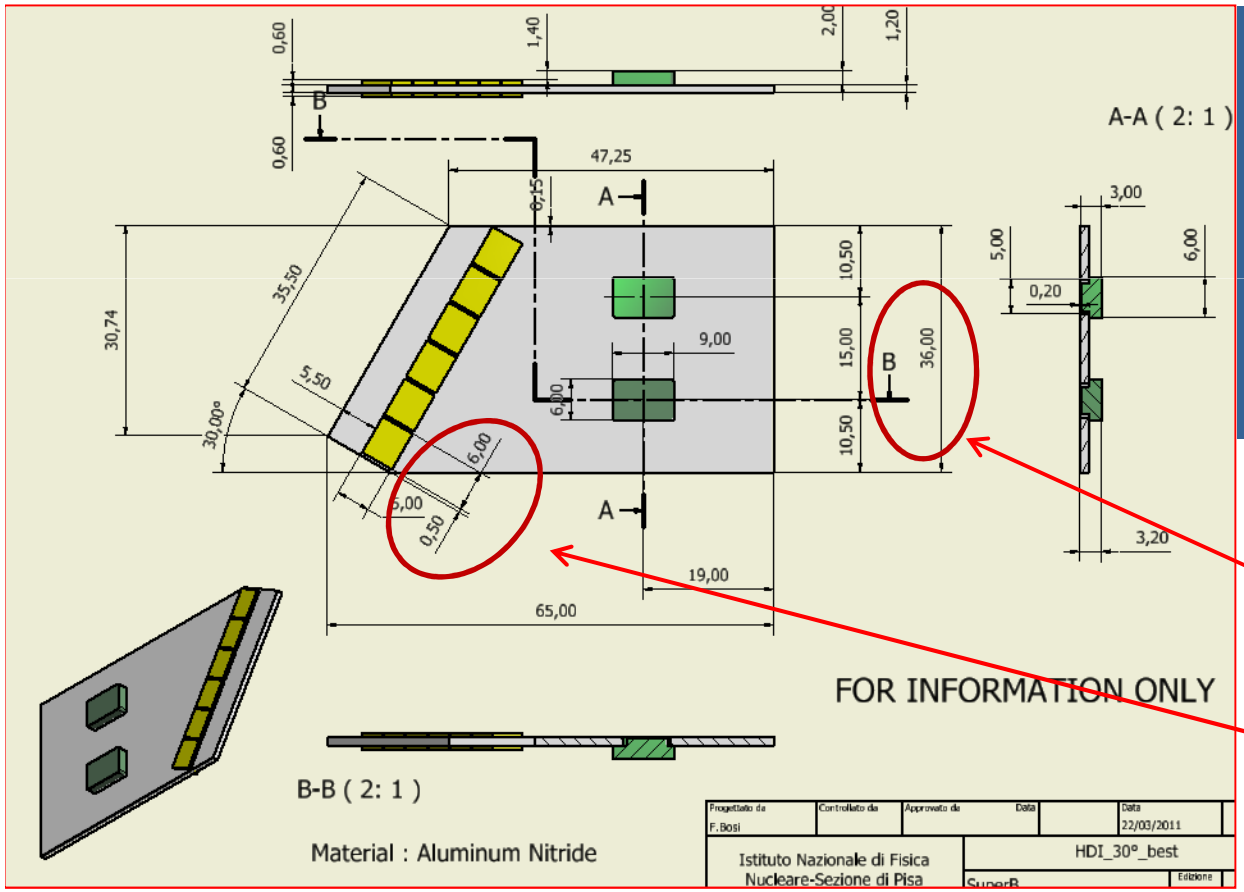


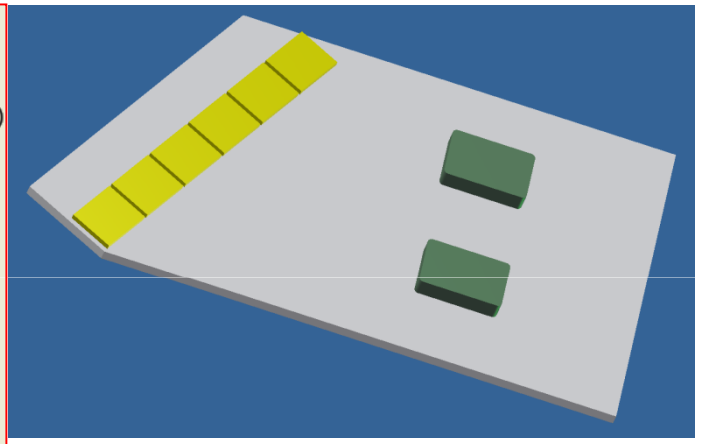
Module Striplets



Module Striplets

Discussion about the dimension of HDI, front-end chips and the space between two adjcent front-end chip devoted for bonding.

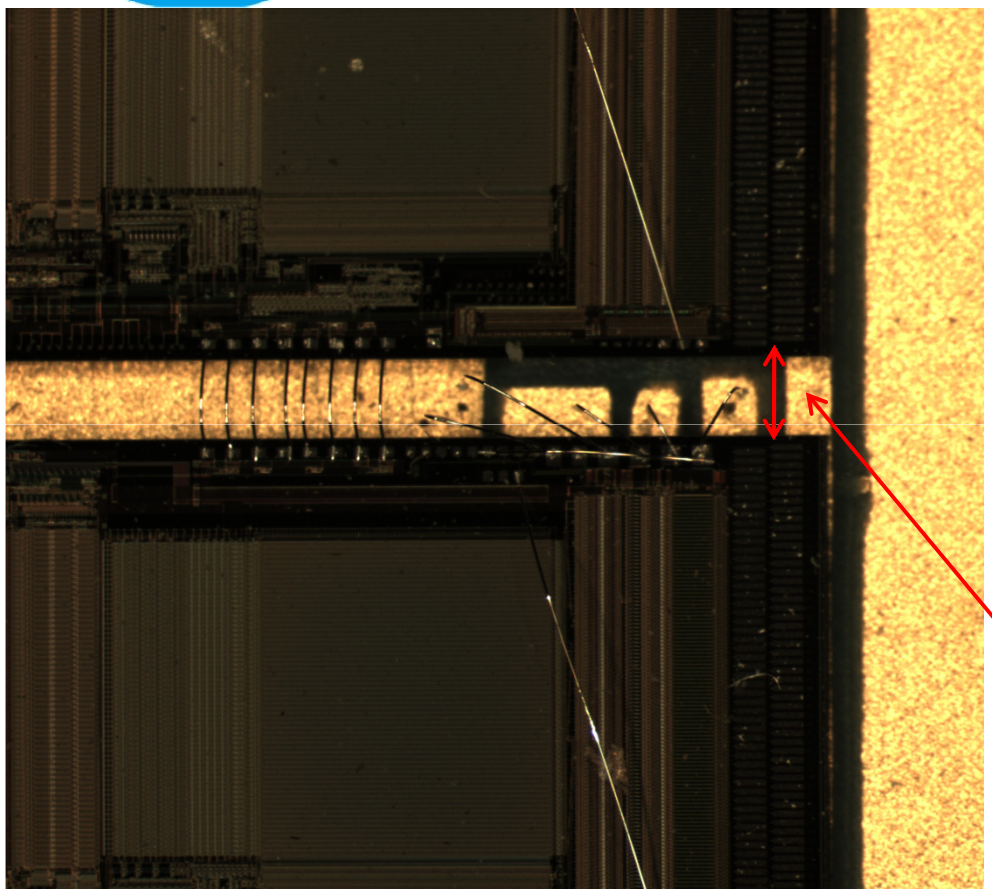




widht of HDI important to limitate material in the 300 mrad envelope

Chip front 6mm but could be 5.5 mm with strip pitch less than 50 micron (42 micron?)

Module Striplets

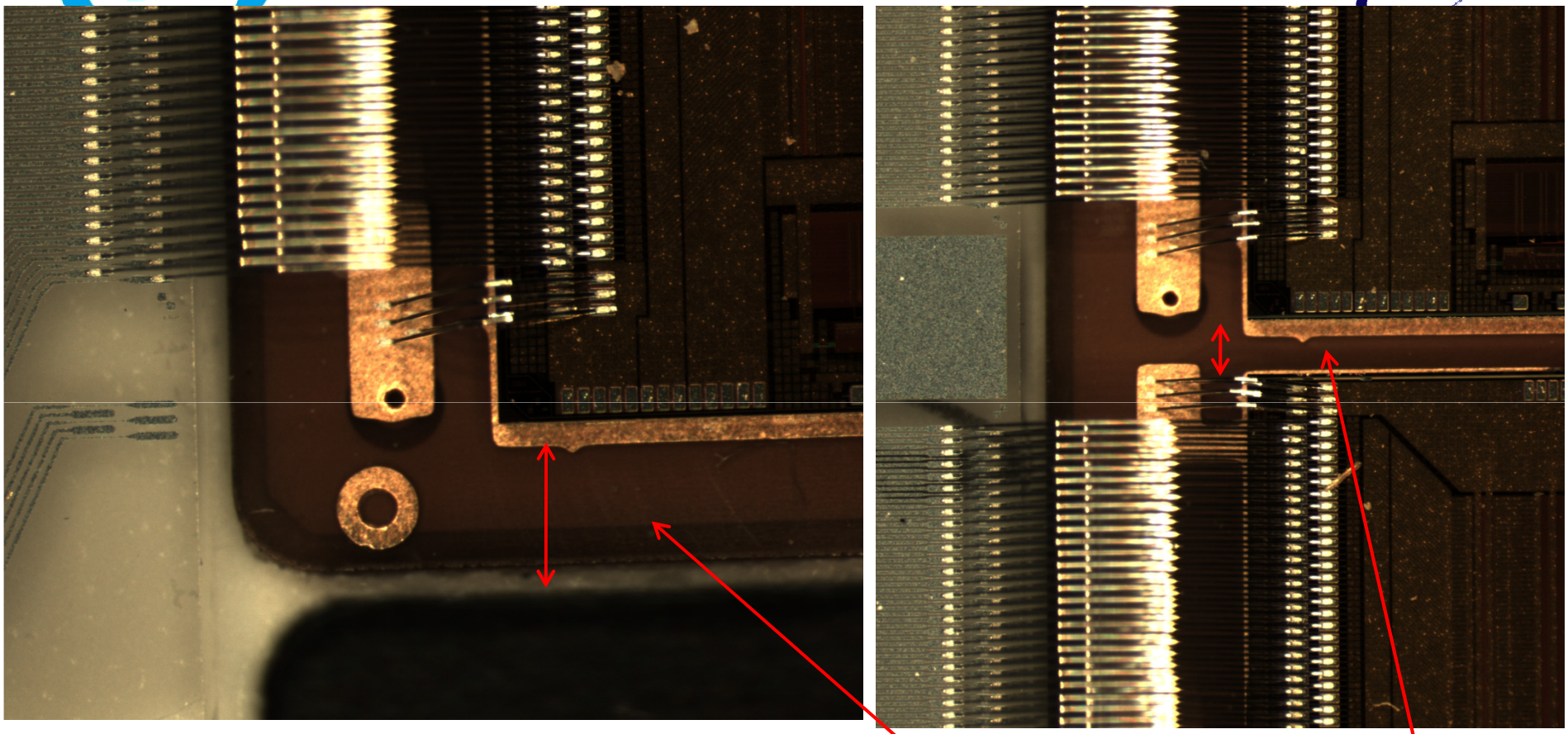


800 micron chip interspace

750-1280 micron from the chip edge

dimension of Babar experiment

Module Striplets



dimension of CMS experiment

1100-850 micron from the chip edge

250 micron chip interspace- circuit under the chip

Work to do

1) Design of the L0 support flanges for striplets module positioned on the beam-pipe.

2) Need to define the general architecture of the SVT and L0 supports . Need interaction between machinist and detector engineer, important contact with M.Sullivan in order to set general layout of I.R.

3)Fine engineering design of Be pipe, contact with Electrofusion company for appropriate brazing technology and weldeable joint feasibility.

3) Start with engineering work to design the mechanics for quick demounting of the SVT +L0 from the I.R.

Conclusions

1) Test on Full and Net microchannel module have been performed with accettable results

2) In good progress work to improve thermal exchange and X_0 of the microchannel support in pultrusion and laminated process for the thin microtube (base tube L=550 μm , Dh= 200 μm)

2) In good progress work to design module striplets layout

3) Our Goal is to construct a full scale system L0(maps-strplets) +Al. beam-pipe model to test by thermal point of view at the TFD lab.

4) Need adding work and engineering help to proceed in the design of general support architecture system of I.R. and in the quick demounting of the L0 in the SuperB experiments

BACKUP