DT Scientific Tea
Atlas IBL Detector
PH/DT-PO activities

May 14th 2012

Summary

DT Involvements

•IBL thermal set up

→Objectives
→IBL mock Up (CF stave, rings, cooling system)
→Beam pipe manufacturing
→Thermal tests
→Set up manufacturing (Tubes, flanges, read out system)
→Set Up upgrade

•Flex fixation on stave

→Objectives
→FEA Studies
→Plasma
→Flex assembly process
→Metrology with Tesa

•IBL 3D model (integration and PP0 design)

→IBL Integration
→PP0 Design

DT People involved

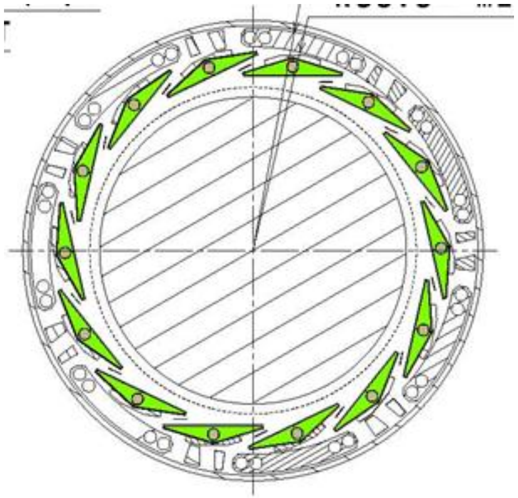
BAULT, Christophe
CATINACCIO, Andrea
DAVID, Eric
LENOIR, Philippe
PETAGNA, Paolo
WERTELAERS, Piet
BRAEM, Andre
CARRIE, Patrick
DAVID, Claude
GLASER, Maurice
MANOLESCU, Florentina
MCGILL, Ian
MERLET, Frederic
OLESEN, Gert
PONS, Xavier
SCHNEIDER, Thomas
VAN STENIS, Miranda
MAPELLI, Alessandro
VERLAAT, Bart;
ZWALINSKI, Lukasz

GYS, Thierry
HONMA, Alan
JORAM, Christian
CANTIN, Bernard
DUMPS, Raphael
FRAISSARD, Daniel
KOTTELAT, Luc
LOOS, Robert
PIEDIGROSSI, Didier
BENDOTTI, Jerome
BRUNEL, Bernard
CHARRA, Patrick
DIXON, Neil
FOLLEY, Adrian
GIUDICI, Pierre-Ange
ONNELA, Antti
PEREZ GOMEZ, Francisco
DAGUIN, Jerome
HELLER, Matthieu
LA ROSA, Alessandro
MANDELLI, Beatrice

The IBL Detector

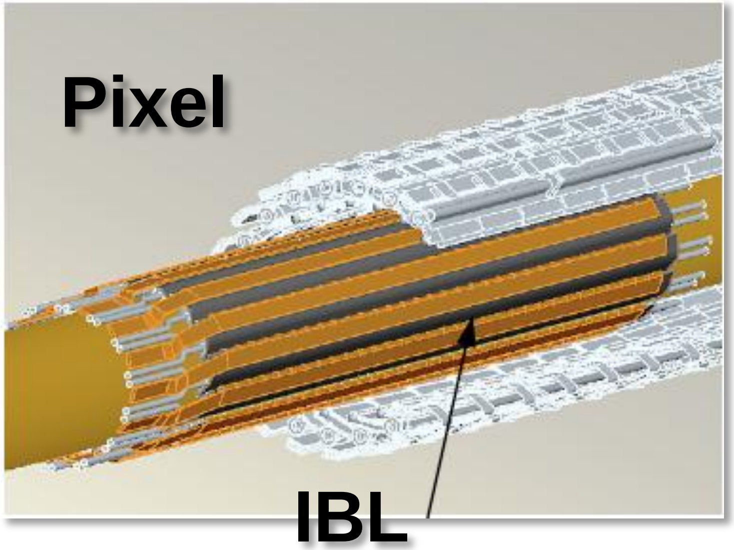
→ **Installation of a 4th pixel layer inside the current pixel detector:**

- **Performance of current pixel detector will degrade before main tracker upgrade (Phase 2)**
- **Maintain physics performance in high occupancy environment (higher granularity, r/o bandwidth)**
- **Increase radiation hardness (IBL fluence ~ 5x B-Layer fluence)**

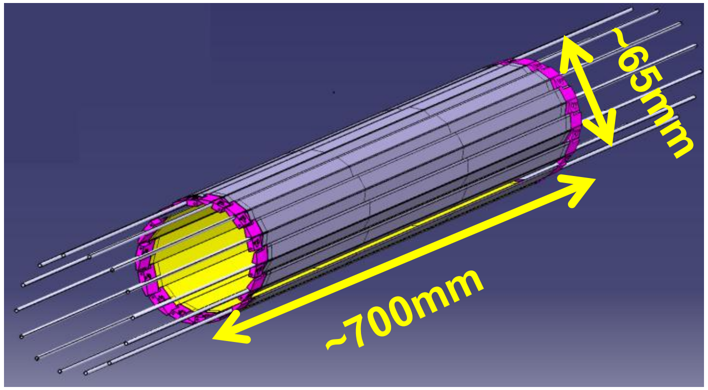


→ **Insertable B-Layer**

- **250 Mrad and 5×10^{15} $n_{eq}cm^{-2}$**
- **installation originally planned for 2015-2016… advanced (in 2011) to 2013 (Fast-track IBL)**



- **IBL mounted on new beam pipe**
- **14 staves, 32 pixel sensors / stave.**
- **Front-end chip: FE-I4, IBM**



→IBL is entering now the construction phase!

IBL thermal Set Up
Objectives

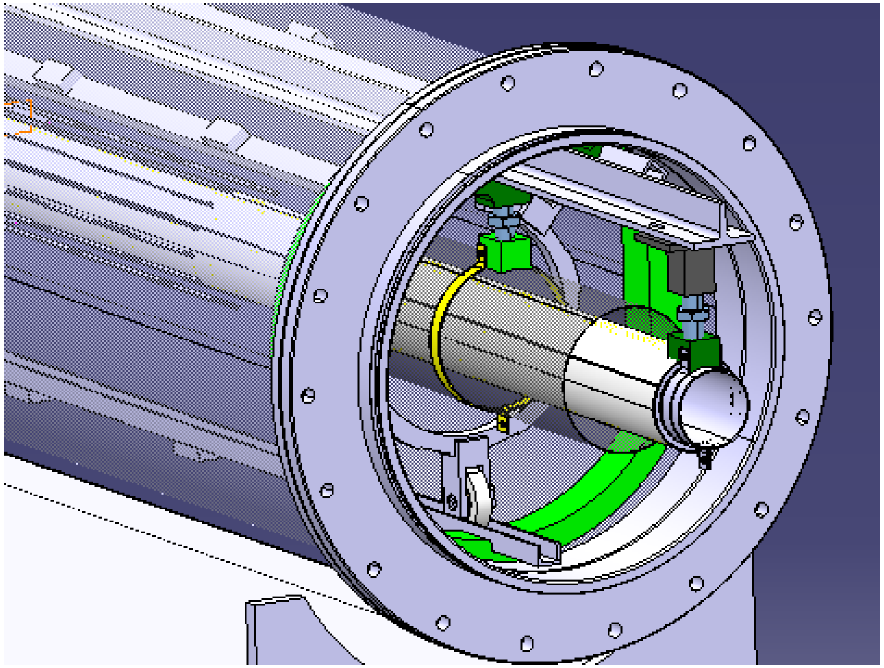
→The IBL Thermal set up has to represent the IBL detector thermal behavior

→Upgradable Mockup for Thermal tests

-Build mockup with functioning stave (thermally)

-Build consistent thermal setup

-Set up able to realize running nominal condition, bake out and accidental scenarios



→All Parts have to be thermally representative:

-Modules

-Beam pipe

-Staves

-Environment

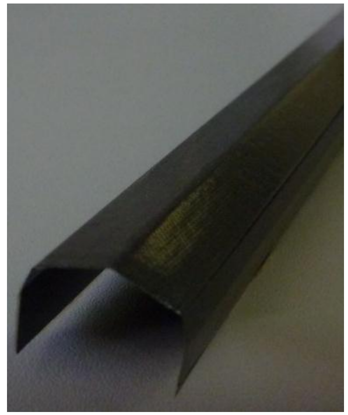
-...

IBL thermal Set Up

Stave Prototypes

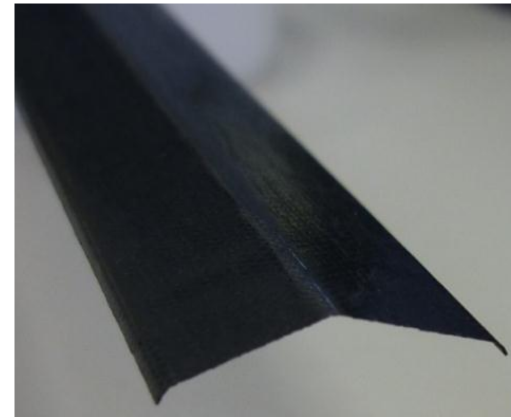
→5 prototypes:

EOS Peek 1000



Omega T300

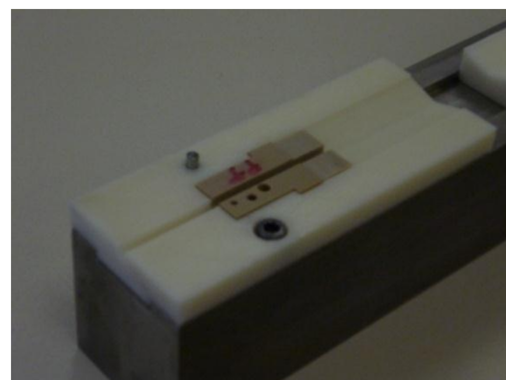
Poco Foam



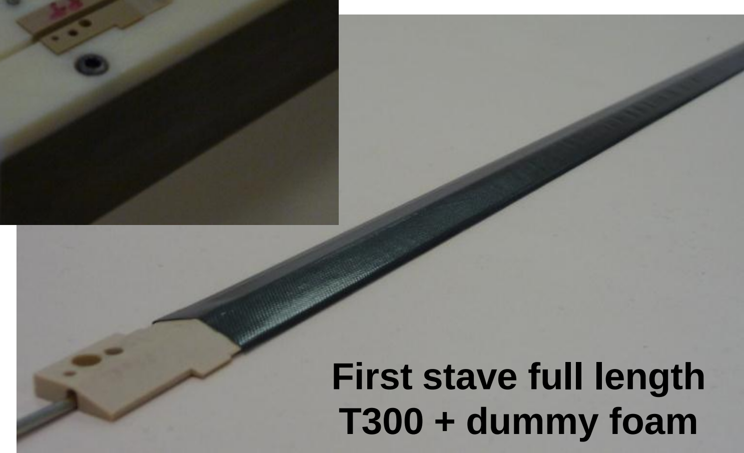
Omega K13C

Face plate 1 ply vs 3 plies K13C

Foam glued in the carbon skin



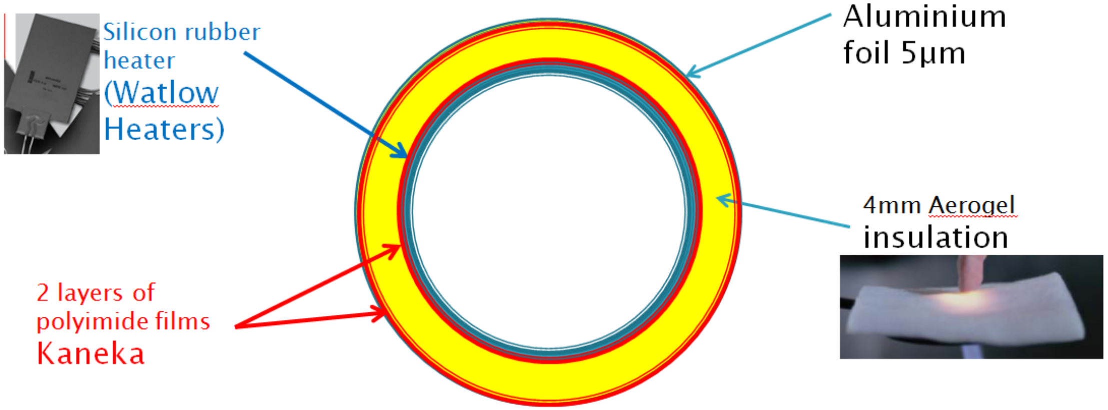
Stave assembly tool



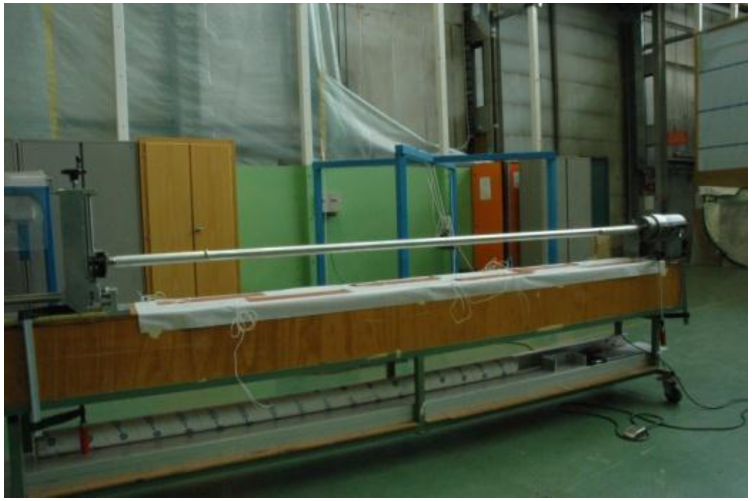
First stave full length T300 + dummy foam

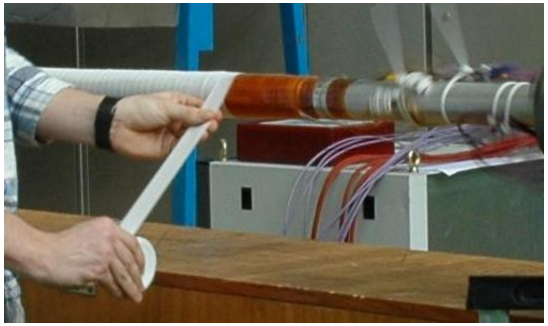
IBL thermal Set Up

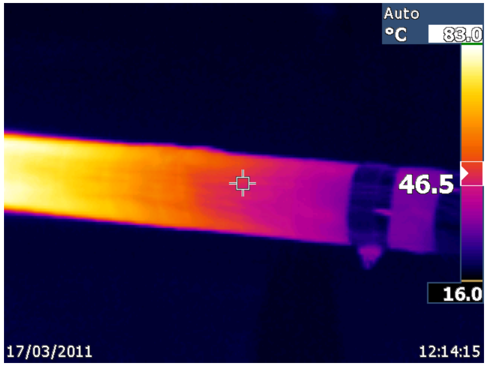
Beam pipe manufacturing

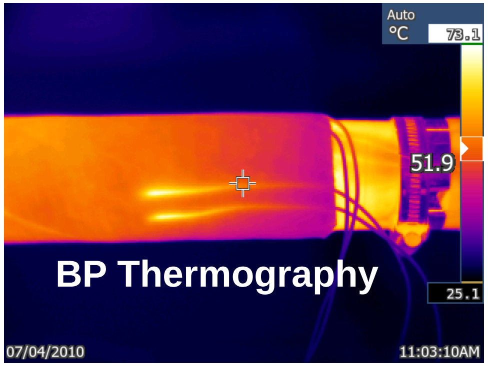


BP Assembly



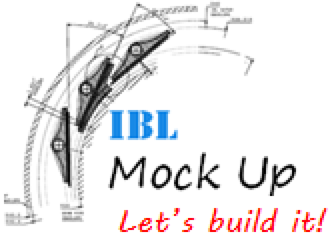


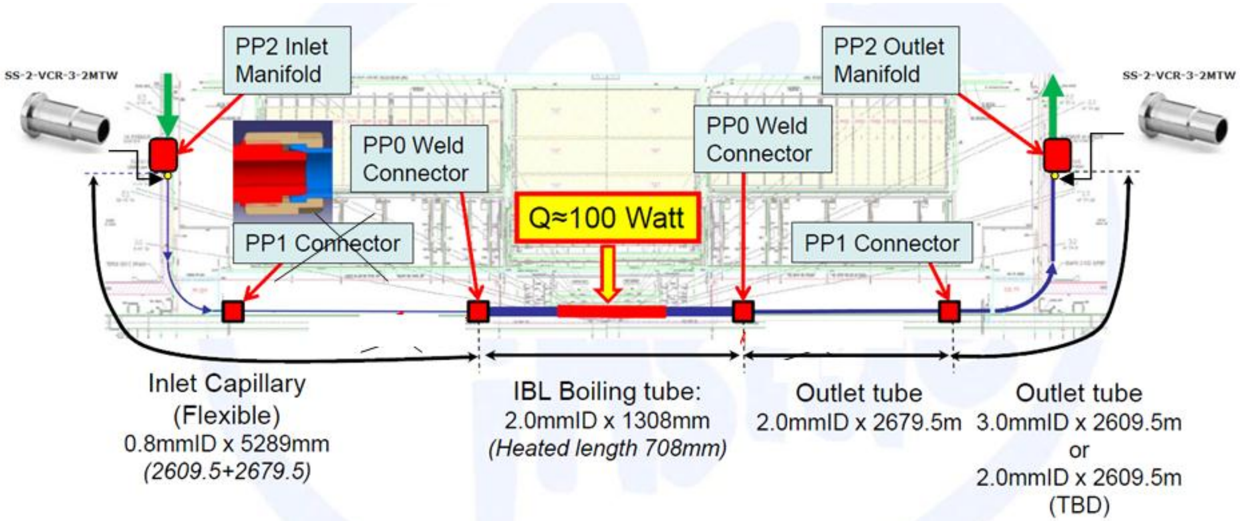


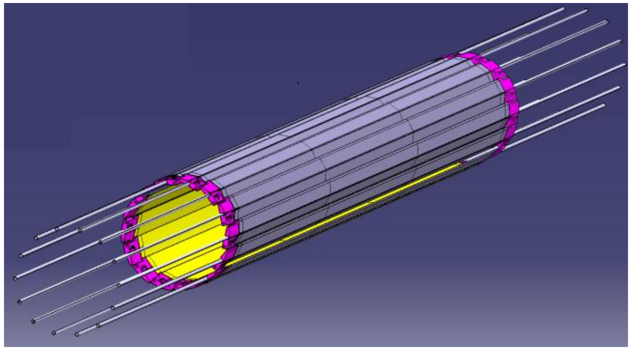


IBL thermal Set Up

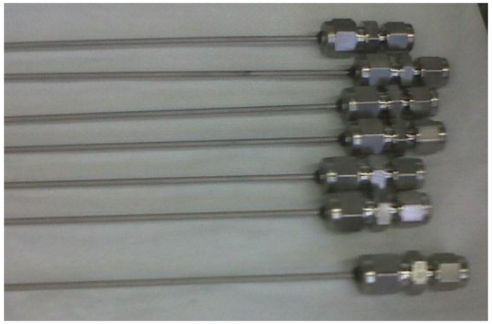
Cooling lines manufacturing

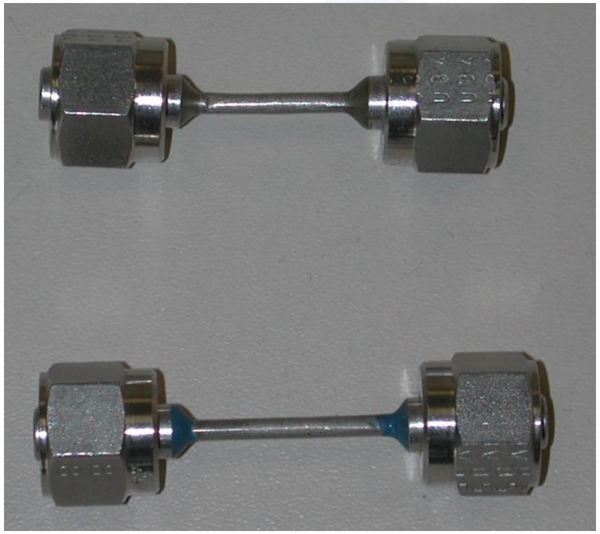






- 100% PH-DT job
- R&D realised for Ti/SS fittings
- 7 lines fully operational

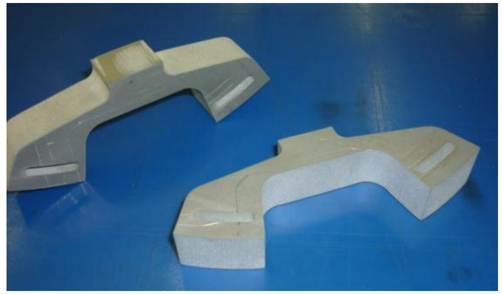
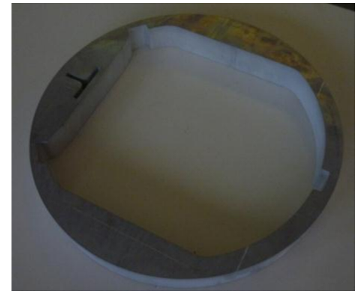
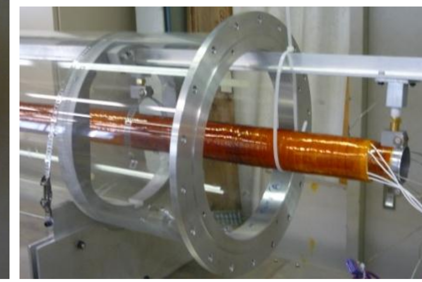




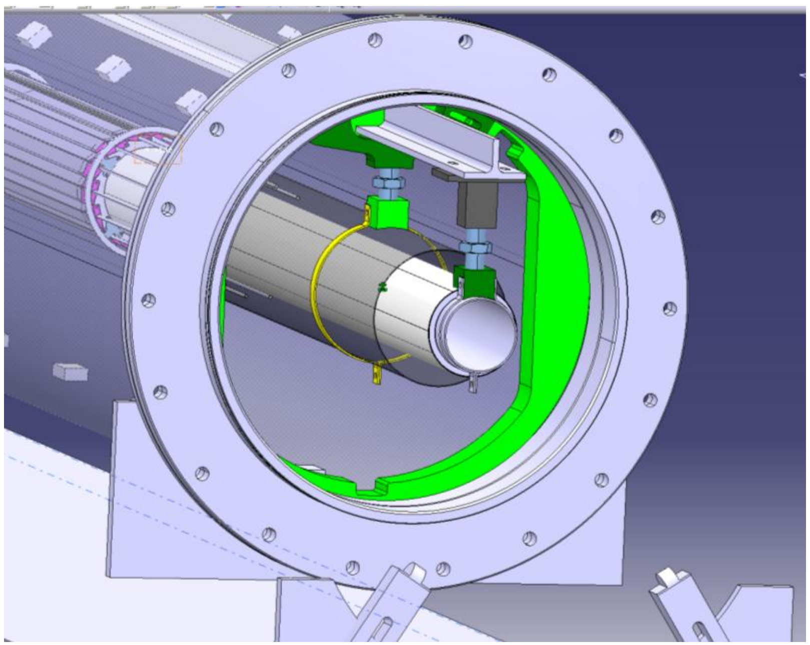
IBL thermal Set Up

Set up manufacturing

IBL Mock Up *Let's build it!*

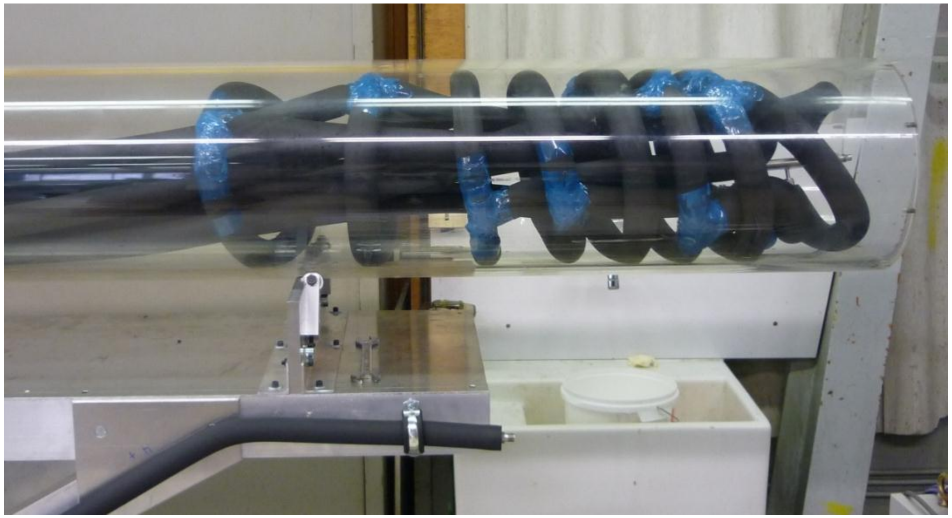
Upgradable mock-up to simulate real thermal conditions: located in SR1

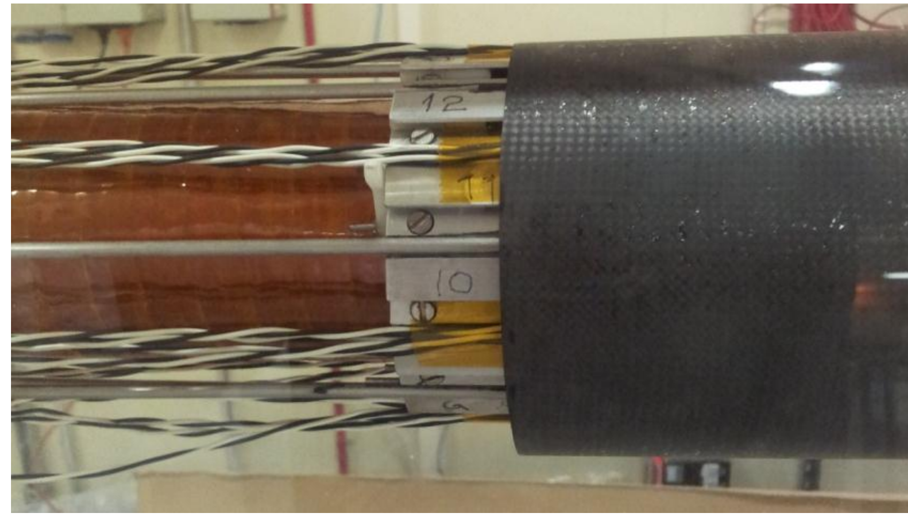


The full 3D model is stored on Smarteam

IBL thermal Set Up

Set up manufacturing





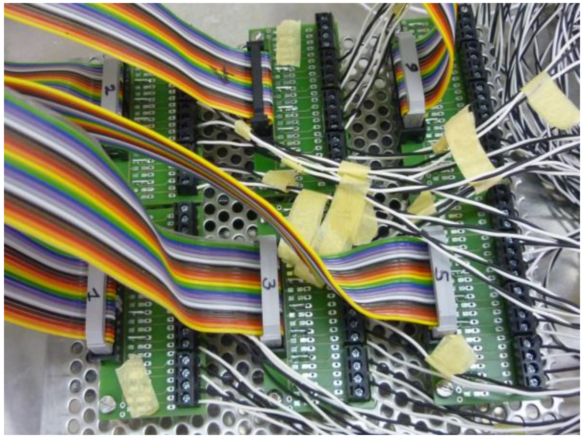
We are now entering in a testing phase:

→Cooling lines pressure test will be done soon
→DAQ ready (up to 64 NTC sensors)
→Vacuum up to 3 Millibars

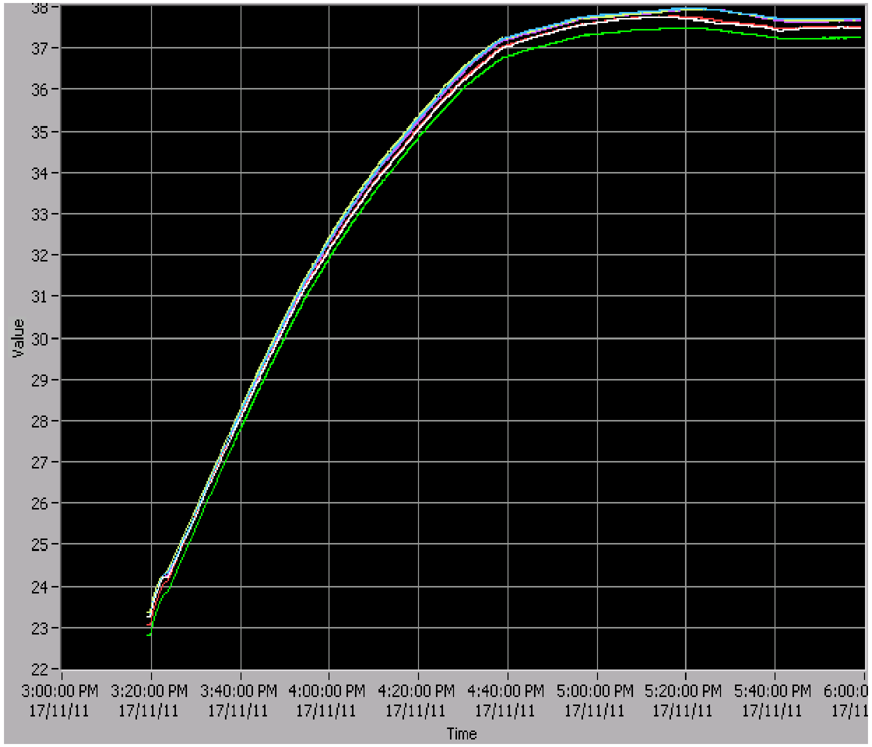
→Able to simulate bake out conditions (beam pipe ~250˚C, dry atmosphere, cooling on)

IBL thermal Set Up

Thermal tests



DAQ system



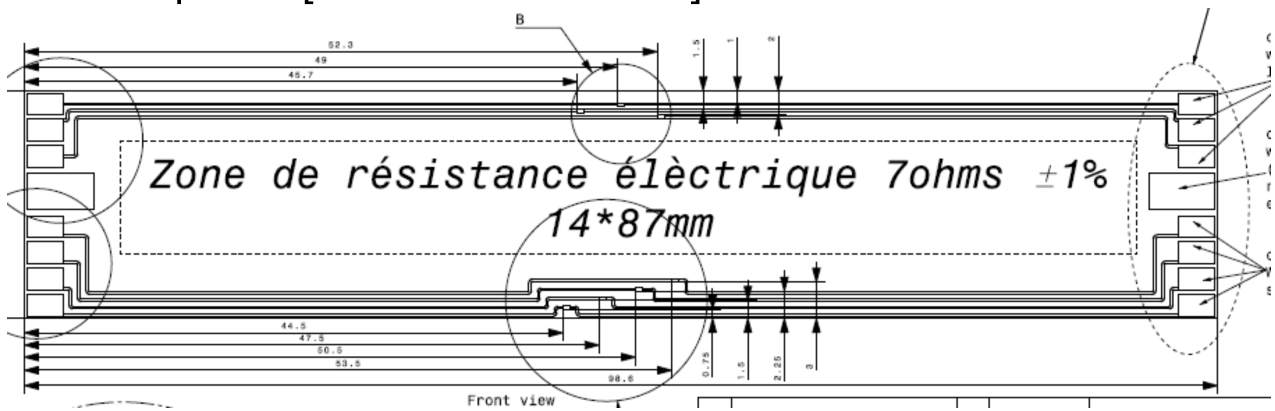
→**Able to simulate bake out conditions (beam pipe ~250˚C, dry atmosphere, cooling on)**

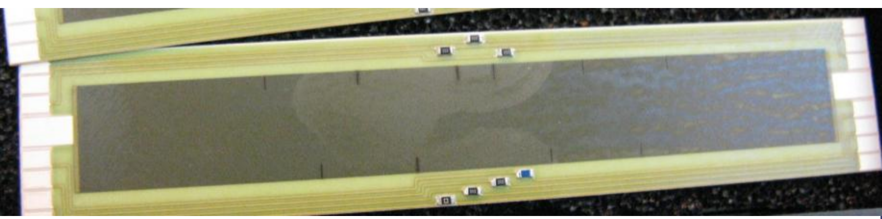
IBL thermal Set Up

Dummy modules thermally active

IBL Mock Up *Let's build it!*

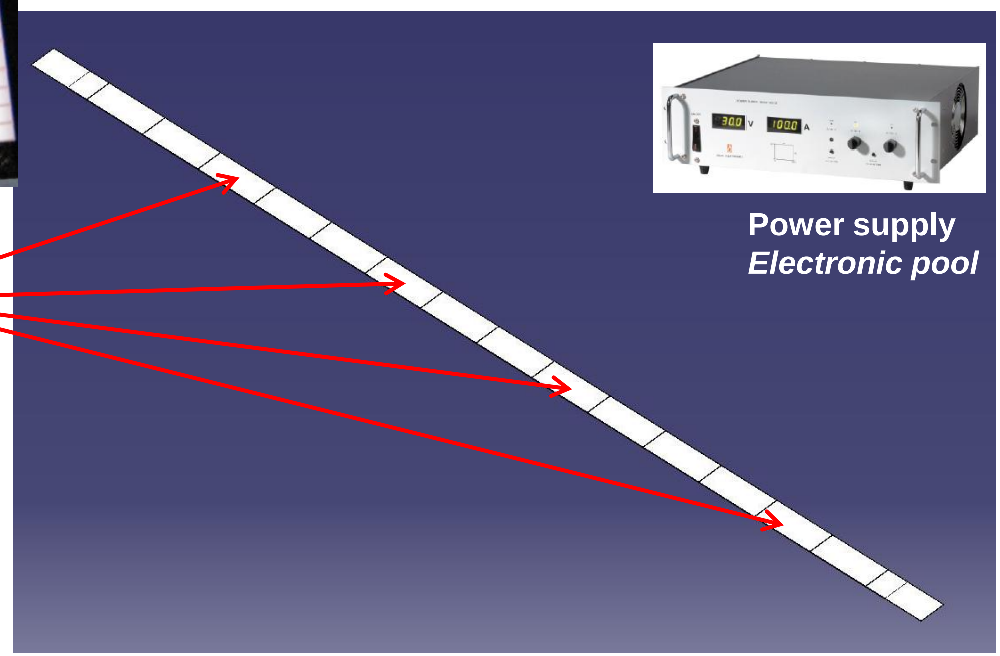
- Stave module heat dissipation [*With Rui de Oliveira*]





- New set up DAQ

PT1000 sensors

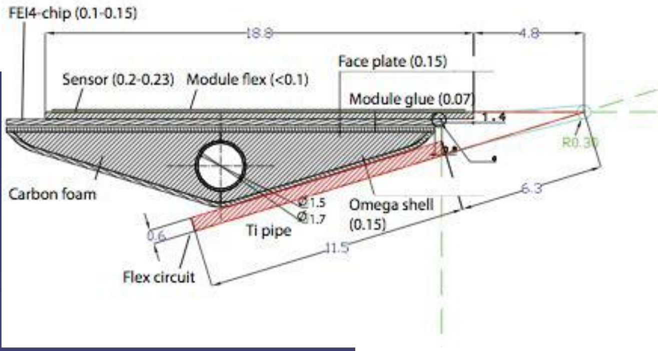


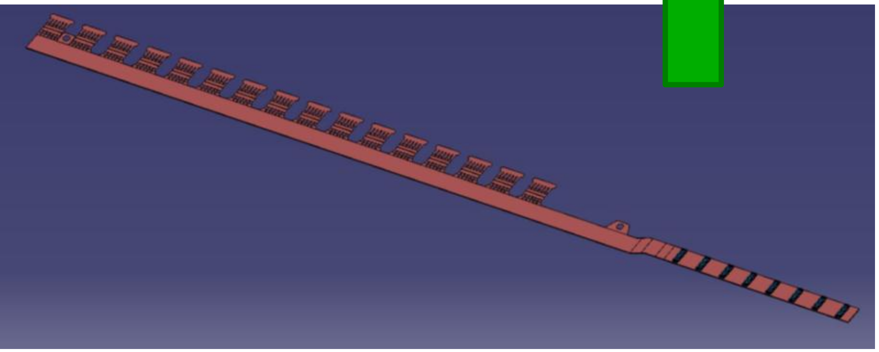
IBL Flex to stave assembly

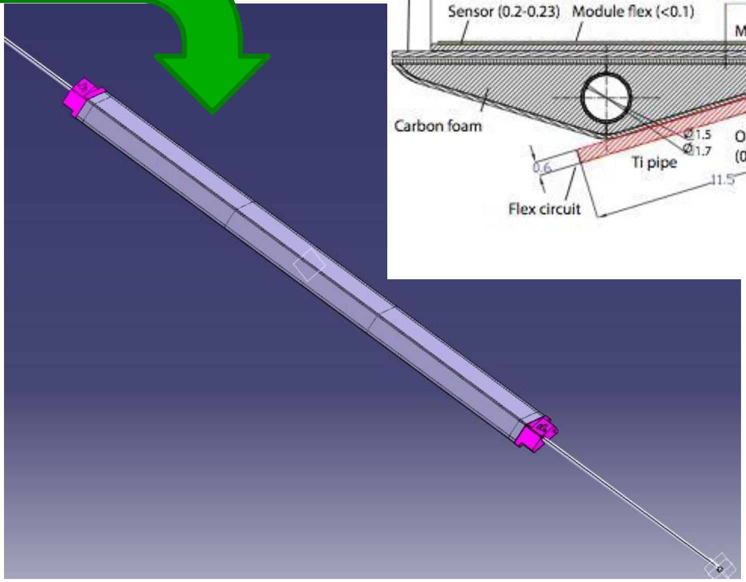
Objectives

<u>Work Package</u>: Design and development of a flex fixation on the stave.

→Mechanical qualification of the fixation (Through tests)
→Reliable and accurate loading process (design + validation of mounting tools)
→Demonstration through prototypes







Better than +/-0.3mm

About +/-0.1mm

IBL Flex to stave assembly

Flex fixation on stave: ***Initial studies***

<u>Stress in the glue</u>:

The total force considered :

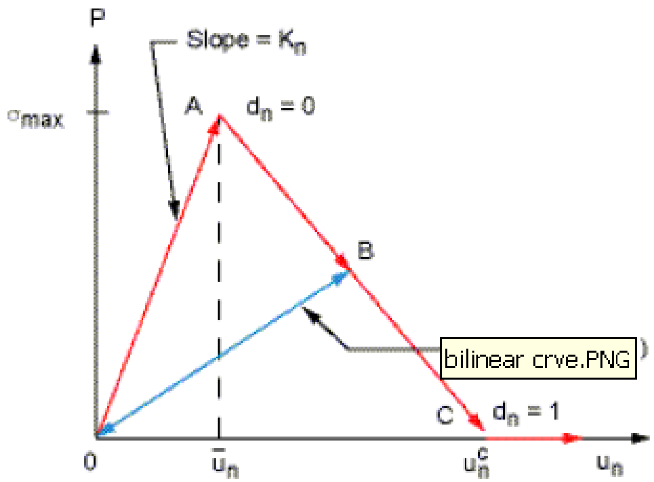
F=(ES)/L * (thermal contraction)= (11500*0.6*11.5)/175 * 0.27 = 125N

→Stress due to CTE Mistmatch
→Radiation hardness: 250 Mrad
→Integration issues
→Material Budget issues
→Electronics compatibilities

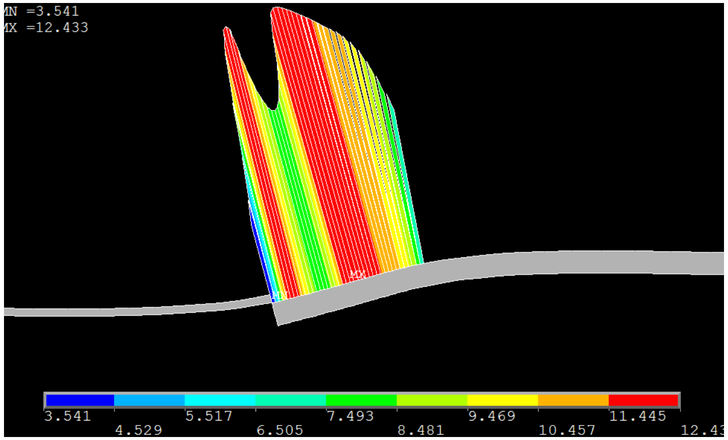
→ A glued joint has been selected.

IBL Flex to stave assembly

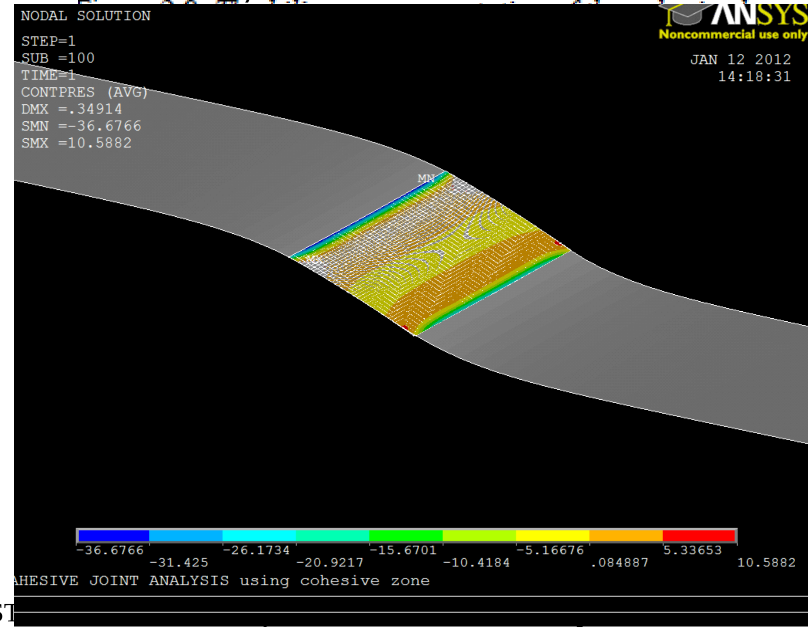
FEA Studies

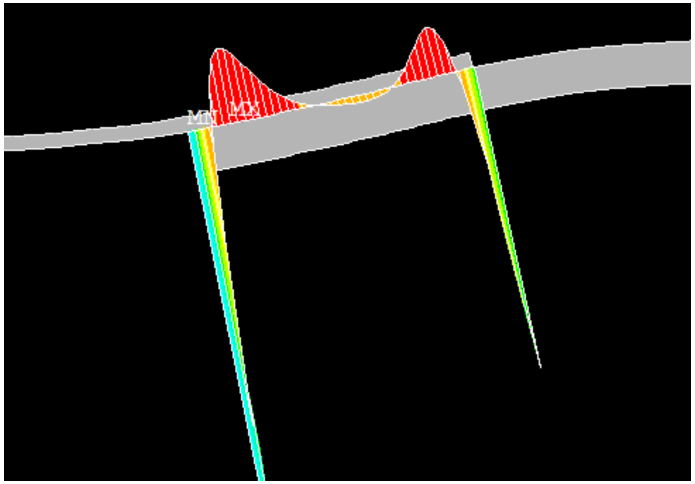


Bi-linear model, able to simulate debonding



Single lap shear stress





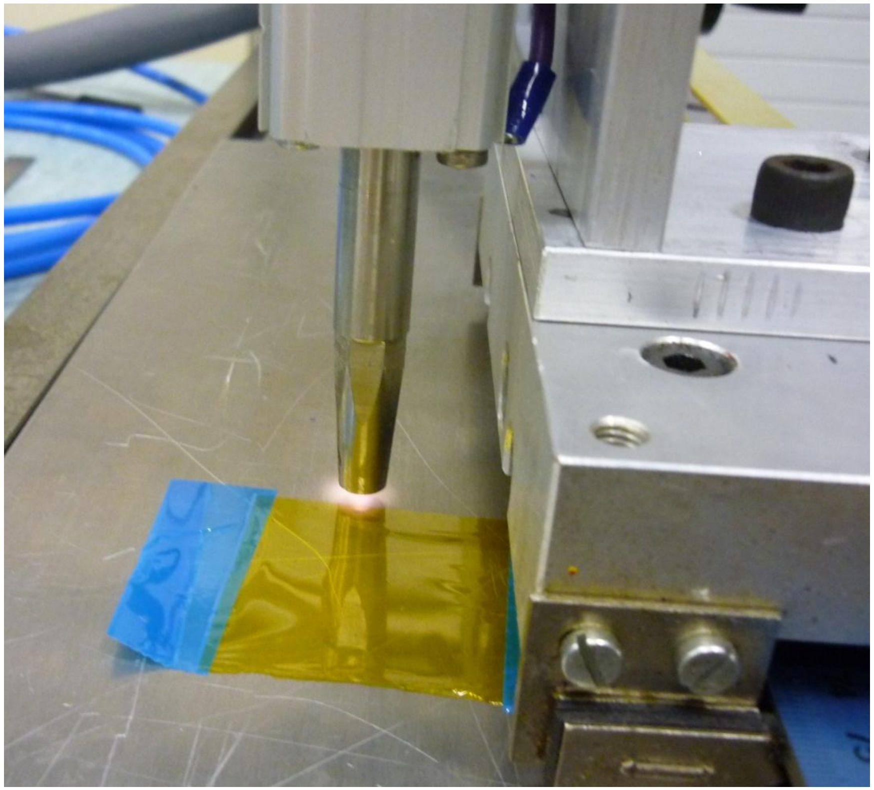
Single lap peel stress

DTST

IBL Flex to stave assembly

Atmospheric Plasma tests

→**Goal: Increase the kapton / CF glued joint strength.**



Plasma Blaster from Tigres

Plasmatreat

→**Wettability tests**
→**Mechanical tests:** double/single lap joints and peel tests on Kapton and CF.
→Different glues tested (Staycast / Scotchweld / Araldite / DP 460...)
→Different plasma parameters (Head speed, ...)

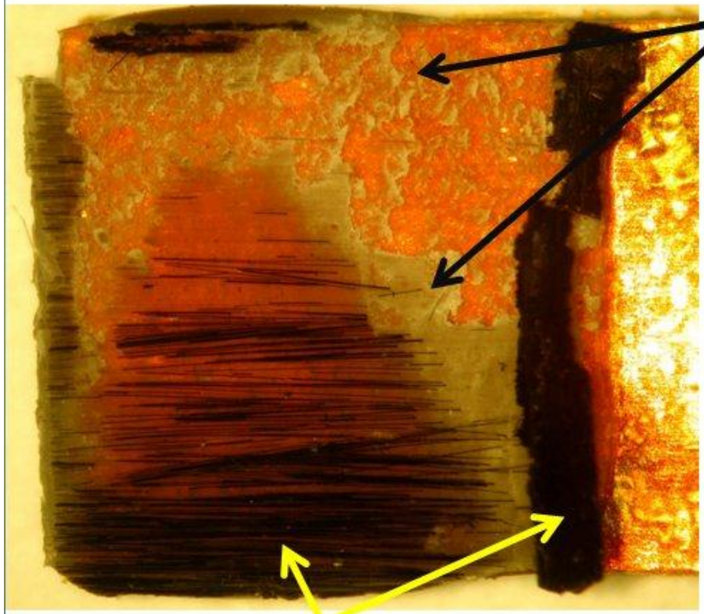
IBL Flex to stave assembly

Glued joint studies

→Adhesive or Cohesive rupture??

Pictures taken under microscope:
Didier Piedigrossi

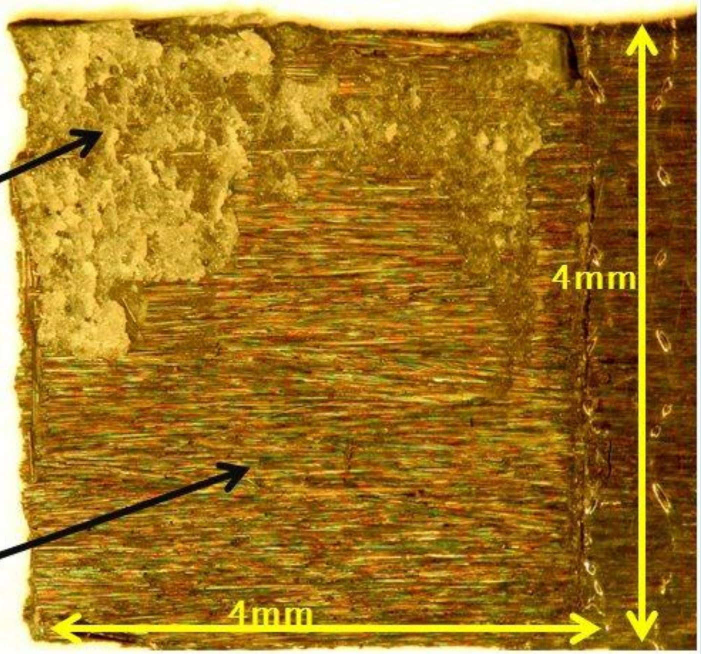
- Kapton



A lot of fibres stay on the kapton

Most of the glue is on kapton, but a certain amount stays on fibres

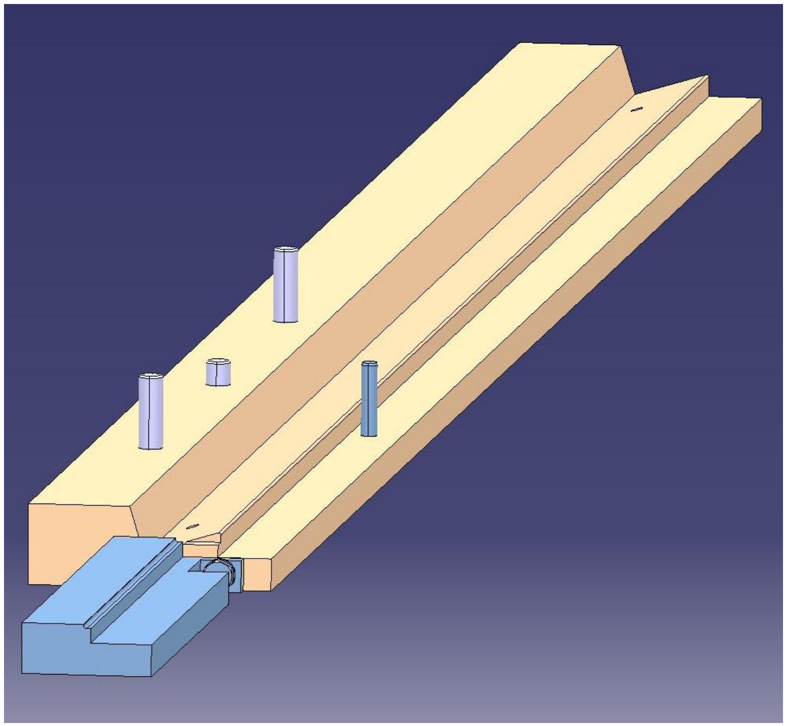
- Carbon fibres

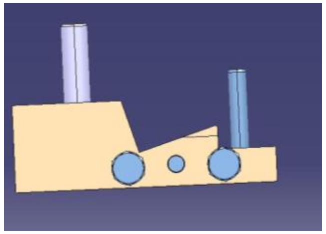


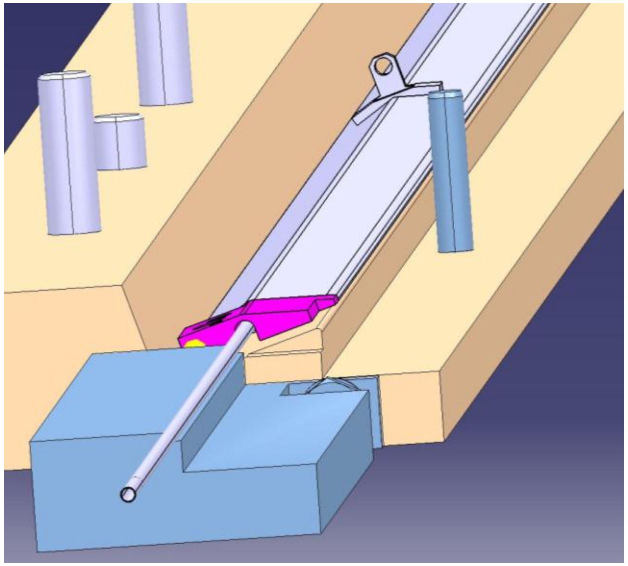
No glue on the carbon

IBL Flex to stave assembly
Flex assembly process

Concept: Hold the stave in position. The omega glued surface is horizontal.







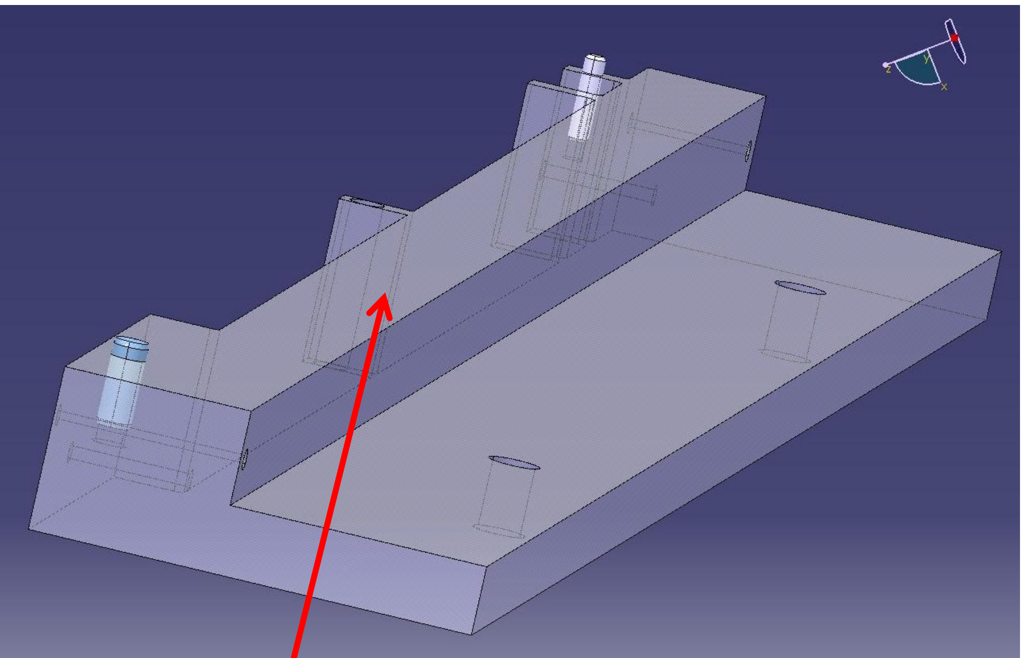
Stave support
Aluminium

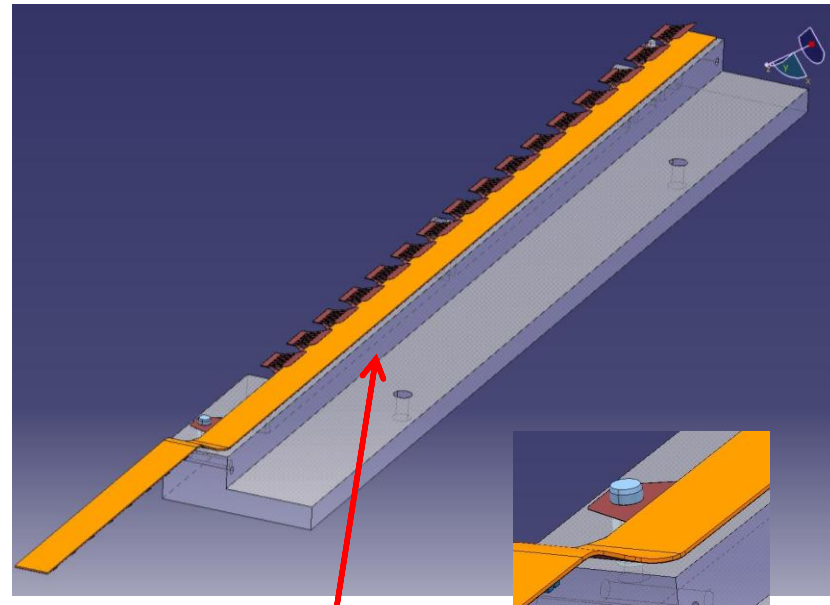
IBL Flex to stave assembly

Flex assembly process

IBL FLEX Let's build it!

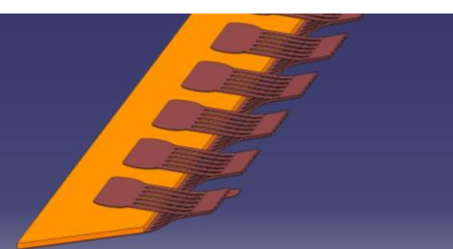
Pins to guide the flex ears

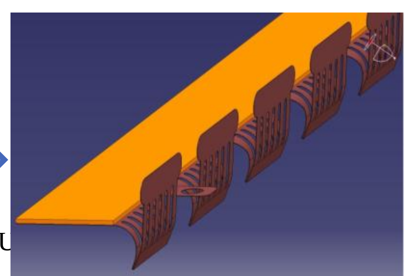




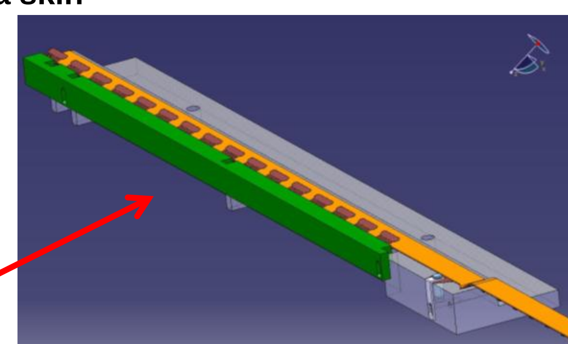
This orange plan is going to be glued on the omega skin

Flex is here





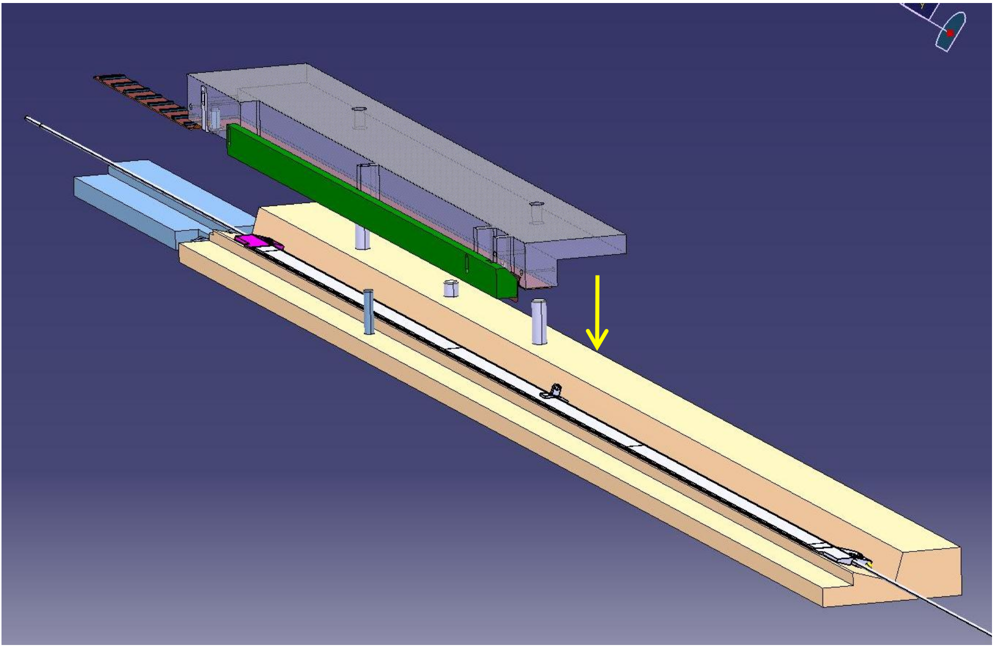
This green part is added to fold all wings at the same time

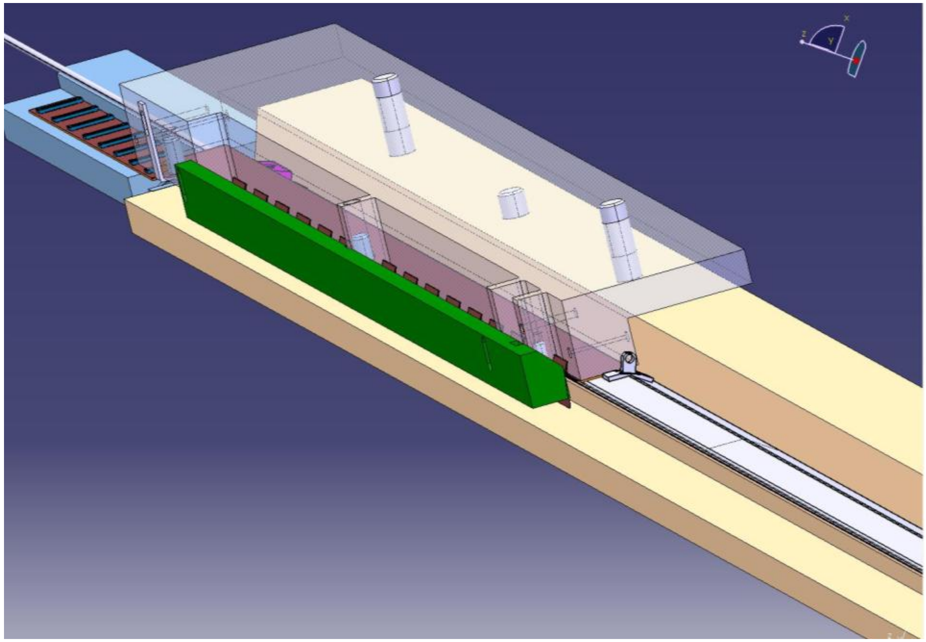


IBL Flex to stave assembly

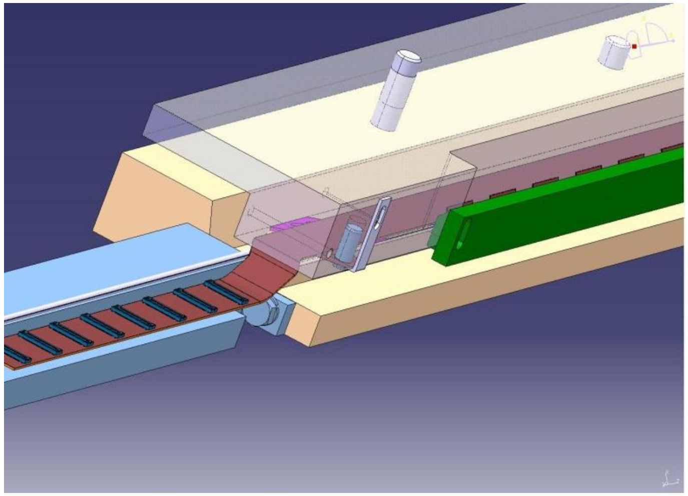
Flex assembly process

Now we glue the flex on the stave.





The polymerisation is realized @35˚C, in a oven, under a pressure of 0.14bar.



IBL Flex to stave assembly

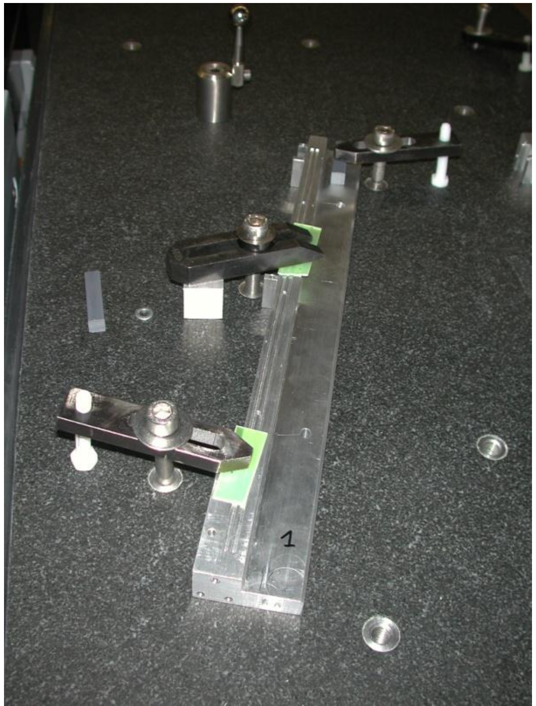
Metrology with TESA machine

→**Flex loading tool checked with TESA (Bd 154)**

→**3D measurements (holes, planes, cylinders, etc...)**

→**Accuracy ~30 microns**

→It allowed us to check holes position on 800mm long tools.



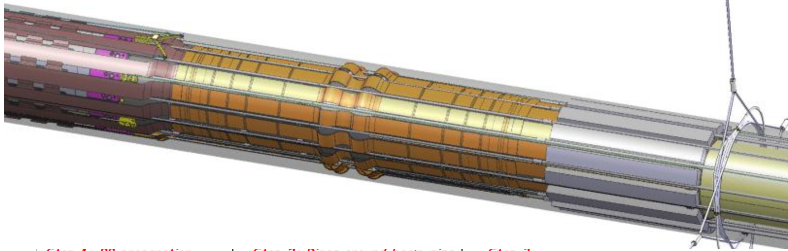
IBL Integration

3d model integration

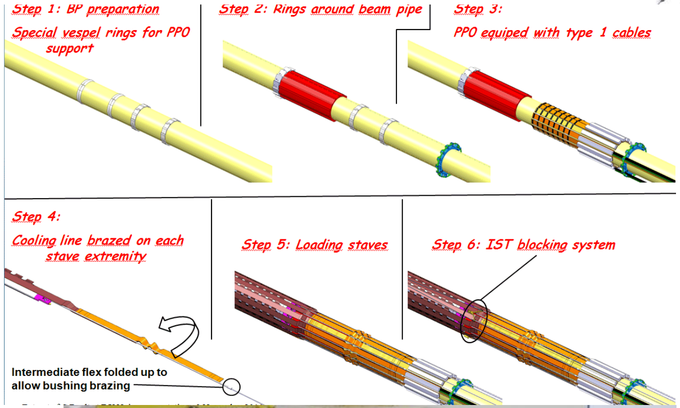
•**Involved in WG3 (integration and installation)**

•**Full IBL 3D models are regularly updated in Smarteam**

•**Design coming from LPNHE Paris, UniGe, LAPP Annecy, INFN and PH-ADO**



•**Define assembly sequence of main components**



•**Check insertion process on a scale 1 mockup**

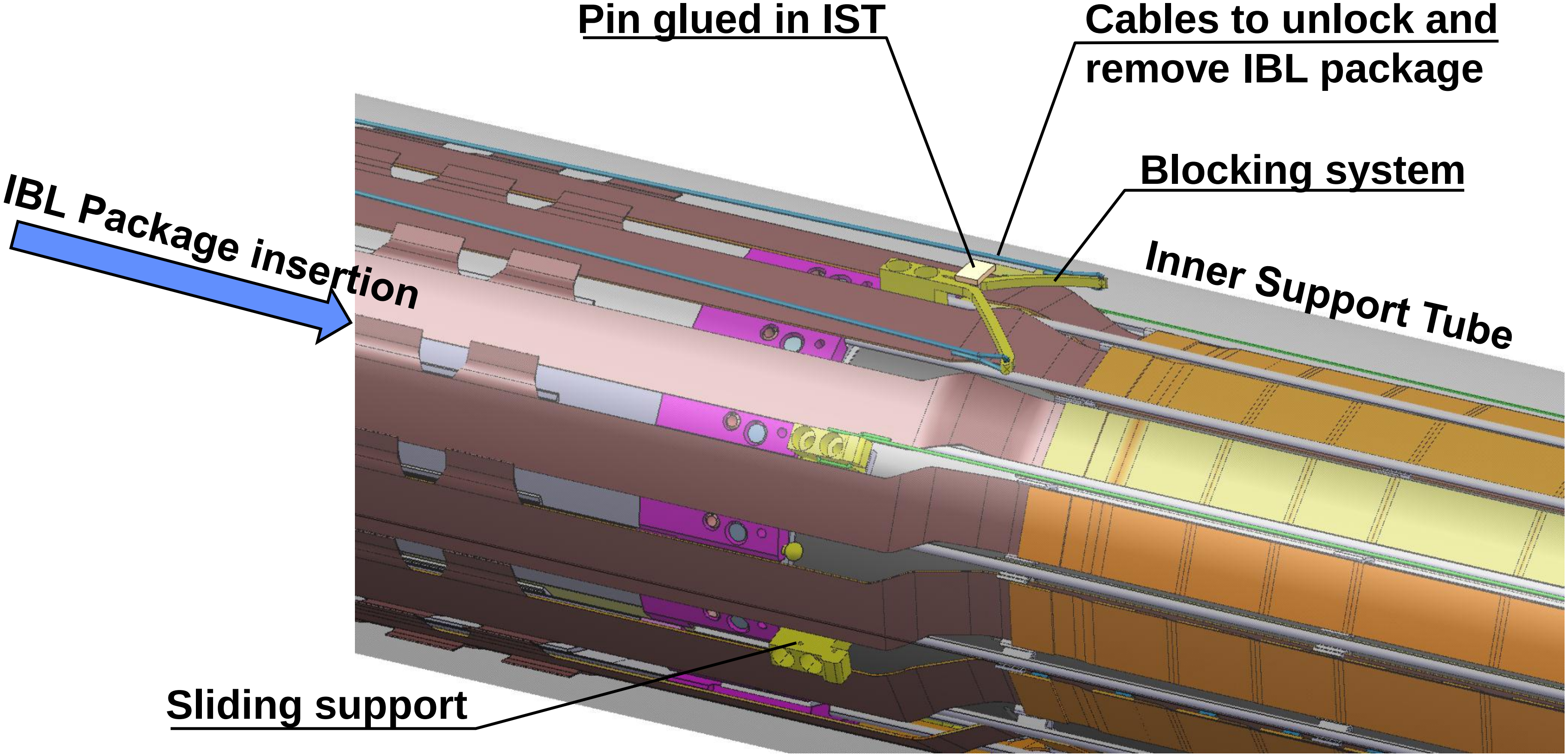
IBL Integration

Design of PP0 region

•**Locking system of IBL package in IST:**

3D design validated.

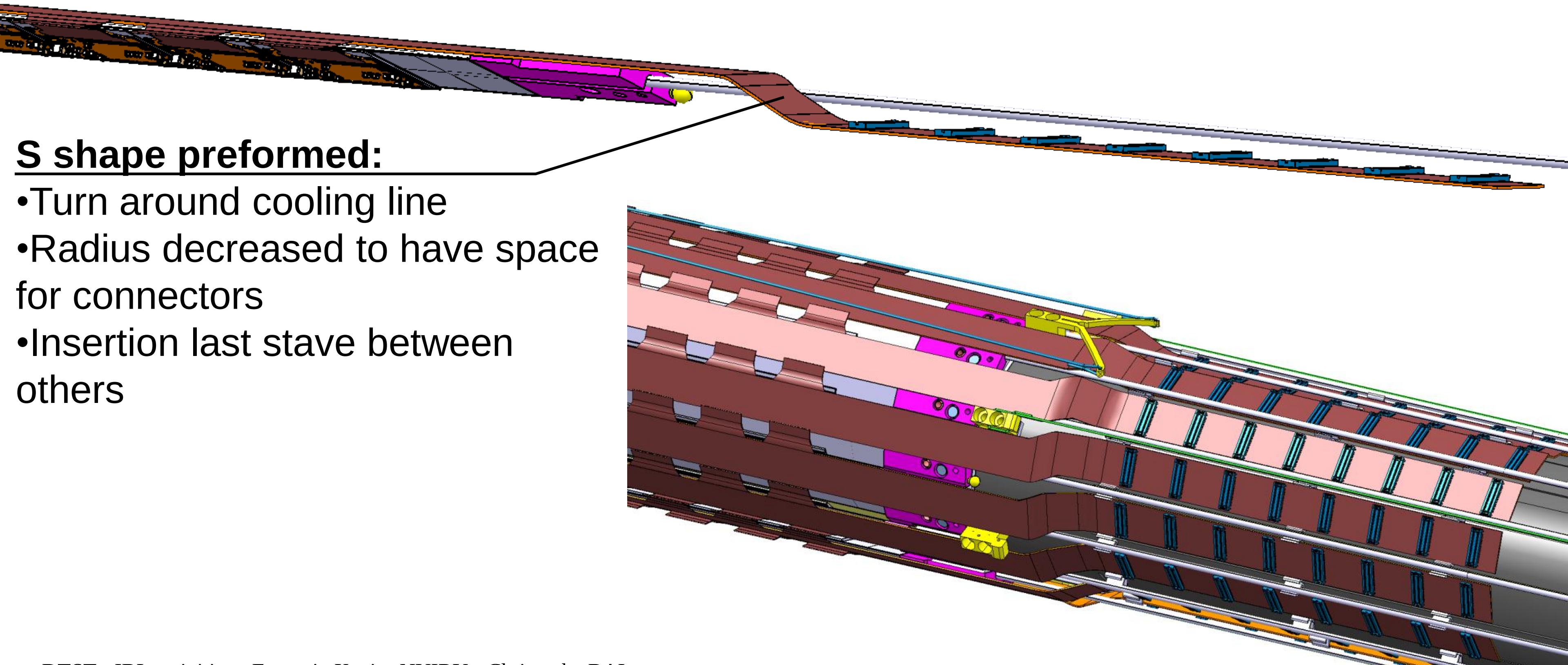
Manufacturing of first prototype done, and will help to validate the concept on scale 1 mockup



IBL Integration

Design of PP0 region

•**Integration and shape design of the IBL flex Electronic circuit:**
(involved in WG2 with electronic flex designers, module designers…)
→We had to study 2 circuit's concepts (monolayer and multilayer).
→Now, multilayer is the baseline
→First prototypes have been manufactured to test loading tool.



<u>S shape preformed:</u>

•Turn around cooling line
•Radius decreased to have space for connectors
•Insertion last stave between others

IBL Integration

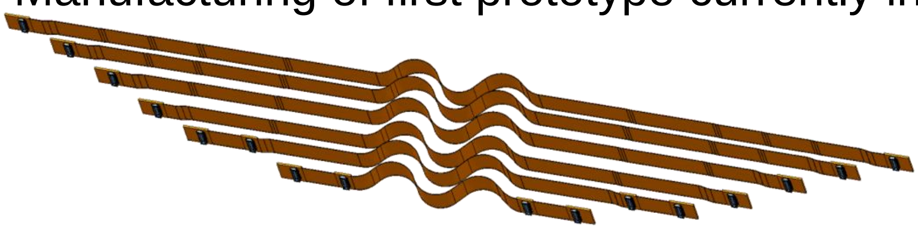
Design of PP0 region

•**Corrugated flex to compensate thermal contraction/dilatation:**

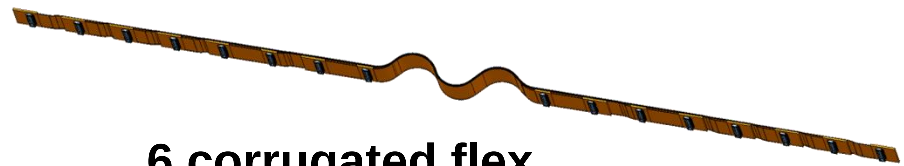
Design of intermediate flex allowing 10mm relative translation.

Composed of 6 layers of Kapton/Cu, preformed in a corrugated shape to have maximum flexibility

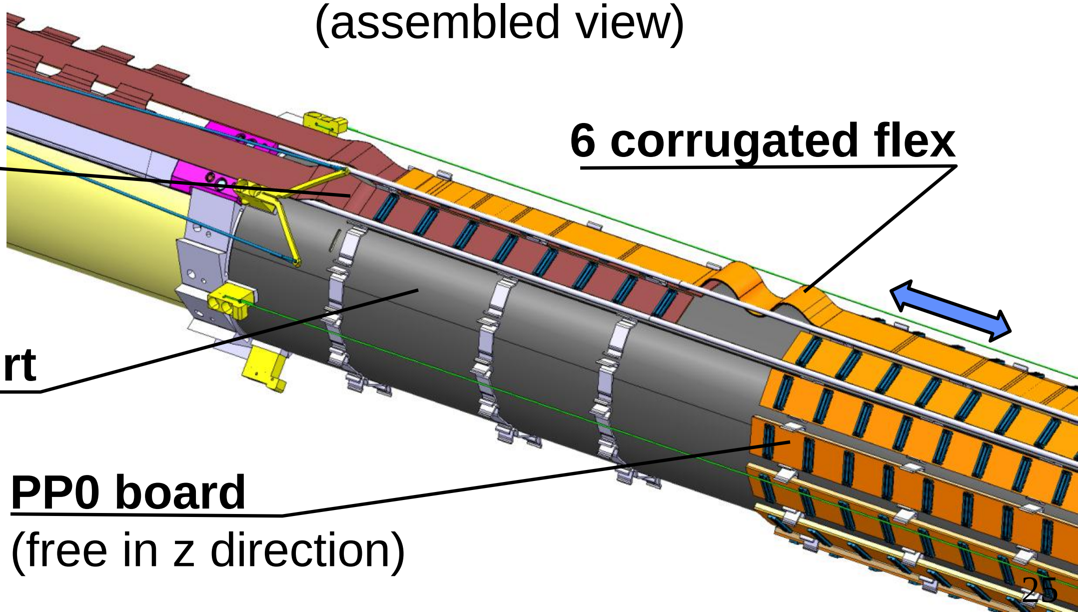
Manufacturing of first prototype currently in progress



6 corrugated flex
(exploded view)



6 corrugated flex
(assembled view)



IBL Integration

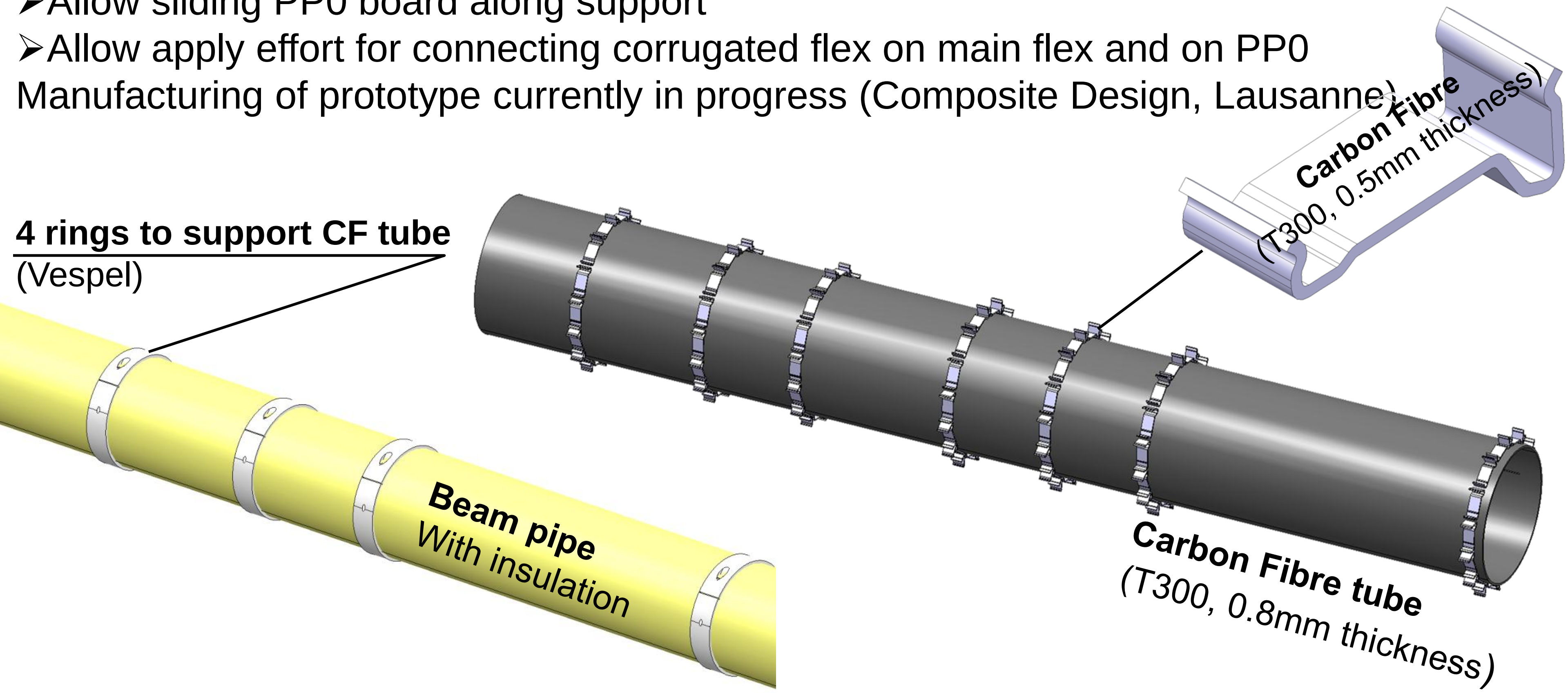
Design of PP0 region

•**PP0 sliding support:**

Objectives are:

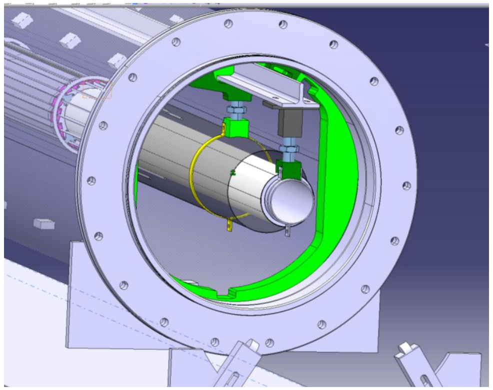
- ➢Support flex fixed on stave in cantilever part,
- ➢Support PP0 board,
- ➢Allow sliding PP0 board along support
- ➢Allow apply effort for connecting corrugated flex on main flex and on PP0

Manufacturing of prototype currently in progress (Composite Design, Lausanne)

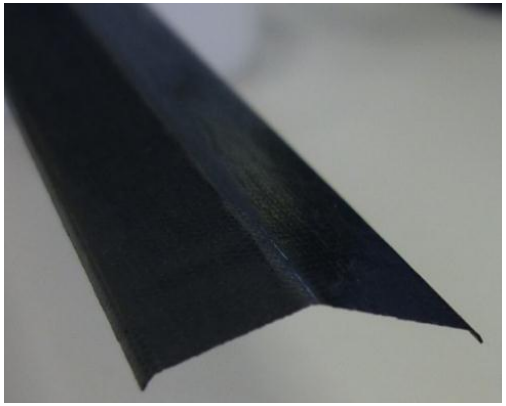


Summary

→IBL project allowed us to work in the following fields:
-Mechanics (Simulation / Design / Fabrication / Integration)
-Thermal
-Materials
-Electronics



→IBL Project was an opportunity to work with high performance materials:
-Carbon fibers
-High performance glues
-Large investigations on Kapton / Carbon Fibres joints



Thanks for your attention!