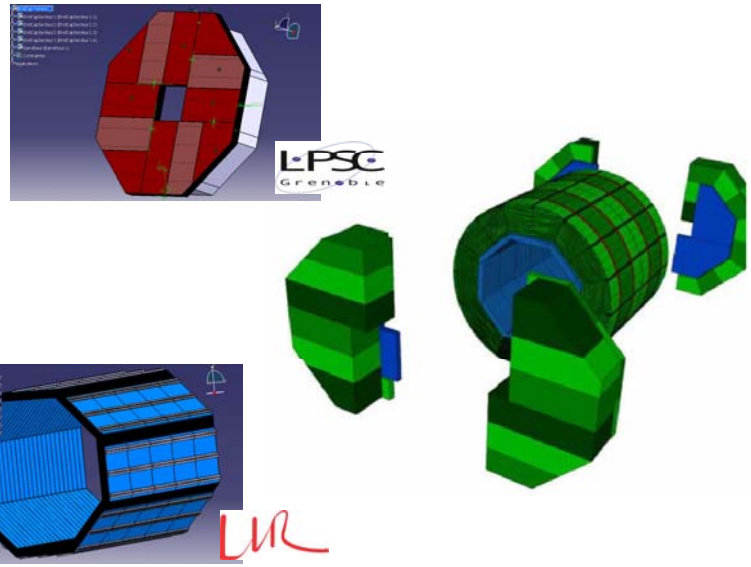
# Mechanical R&D ECAL



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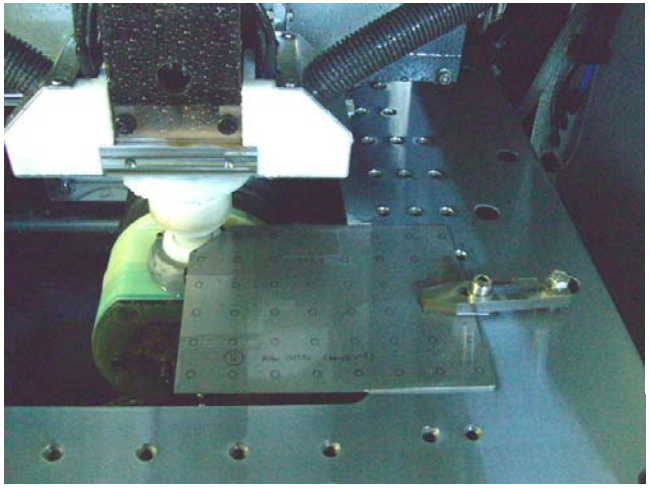
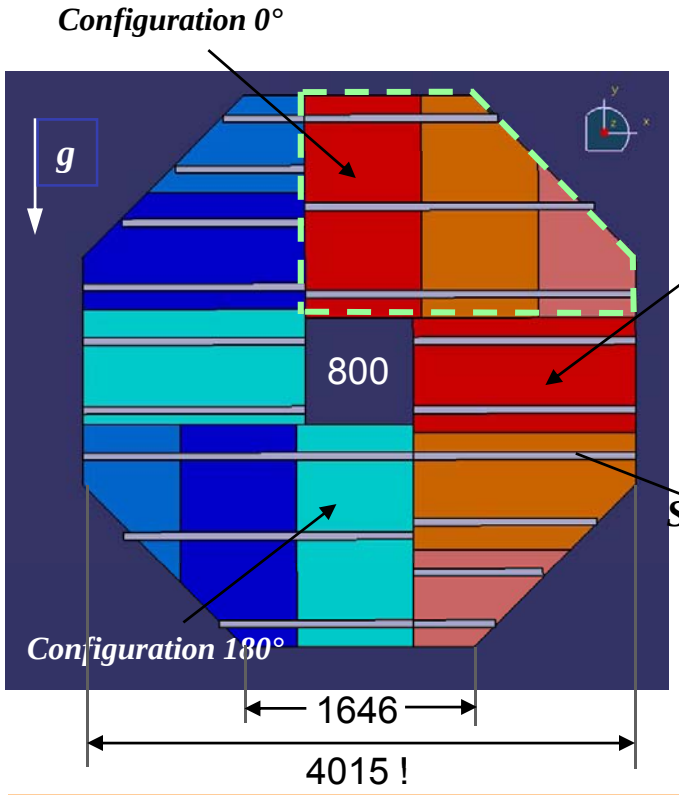
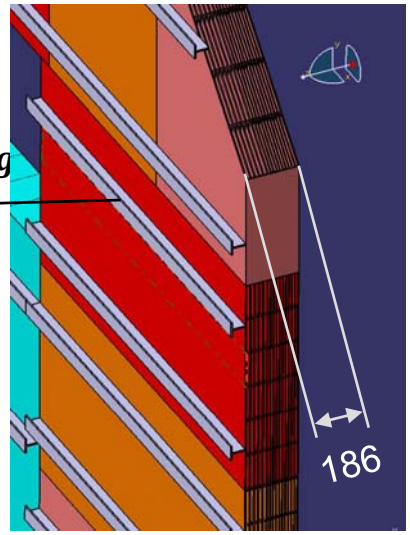
# ECAL - End-Caps

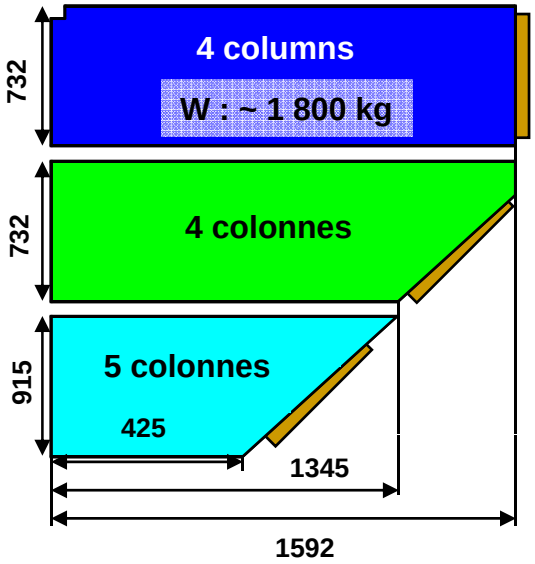
- The same principle than barrel with an alveolar composite/ tungsten structure, with different shapes and different sizes (end of slabs)
- Difficulty: getting shape for W plates
- 12 modules-3 distinct types (780 cells & detectors slab)



*W wire erosion cut test*



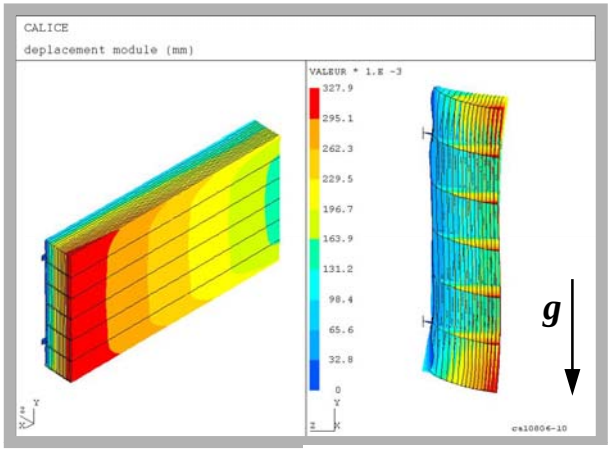

Weight of each End-Cap : ~ 16 T

# Design of module …

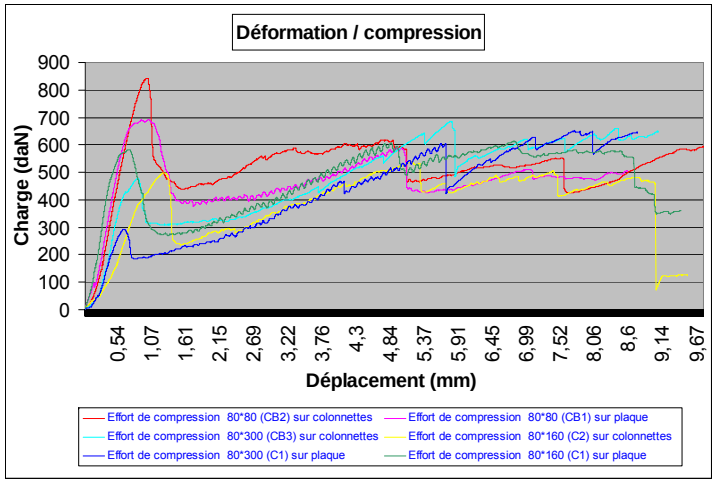
… based on mechanical simulations :

*Linear Analysis of "full scale" ECAL modules (barrel and End-caps)*

- Global simulations : global displacements and localization of high stress zone for different solutions (dimensions)
- Local simulations : more precise simulations and study of different local parameters to design correctly each part of this structure (thickness of main composite sheets, fastener's behaviour…)
- Check and validate simulation results by destructive tests for each issues



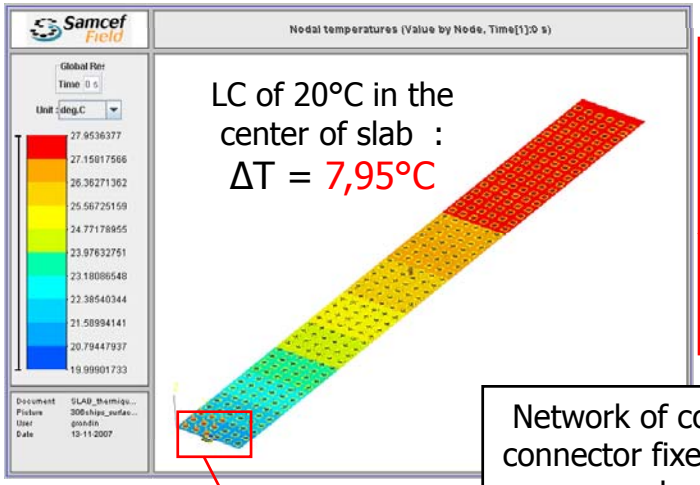

***End-Cap module***
***Configuration 90°***



# Thermal analysis of slab

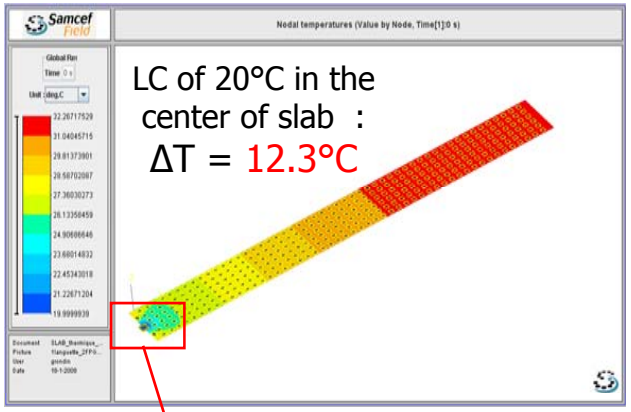
Simulation of heat conduction just by the heat copper shield :

Influence of the FPGA dissipation (DIF) on current design of cooling system (Limit Condition of 20°C) :



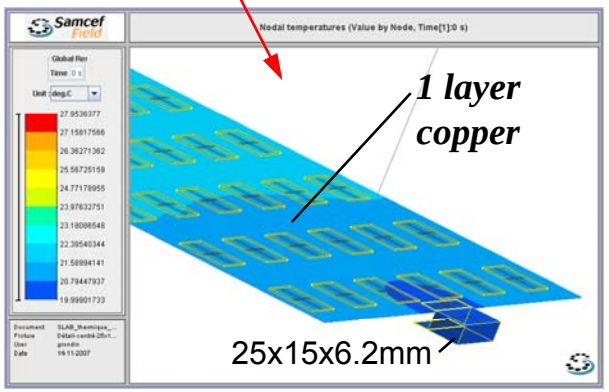

← **Φ= 0,27 W/layer**
(25 µW per channel)
**$\Phi_{FPGA}$ = 3 W/layer** →

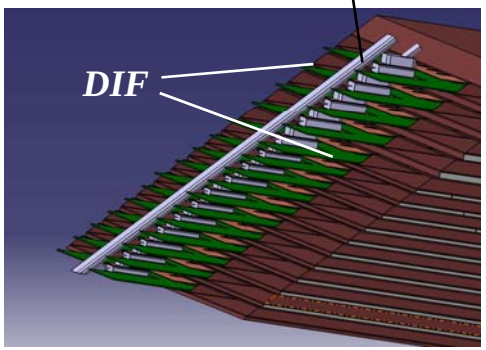
**Copper layer :** λ = 400 W/m/K
S = 180*0,4 mm2 ; L = 1,55 m

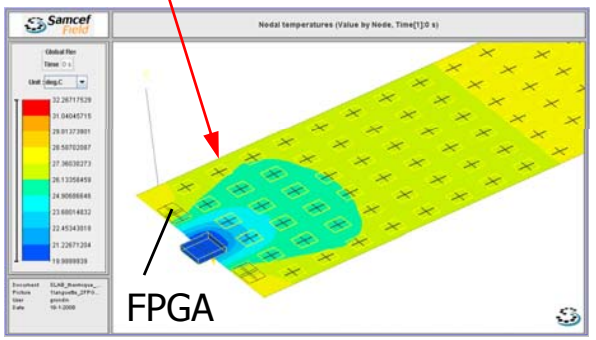



Network of contact areas / connector fixed on the layers 2

Cooling pipe

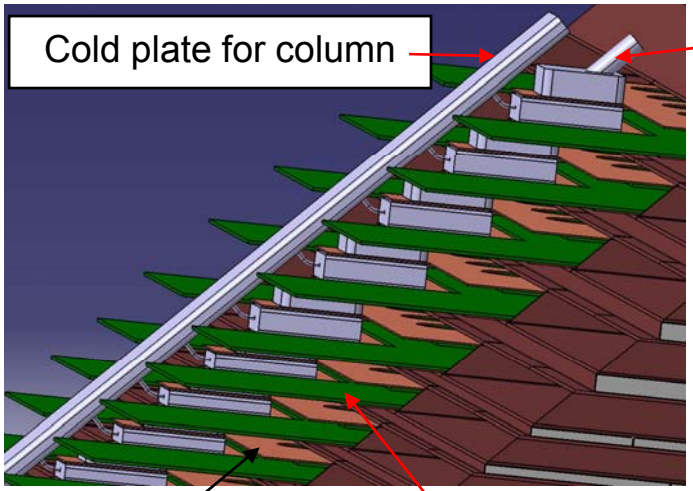


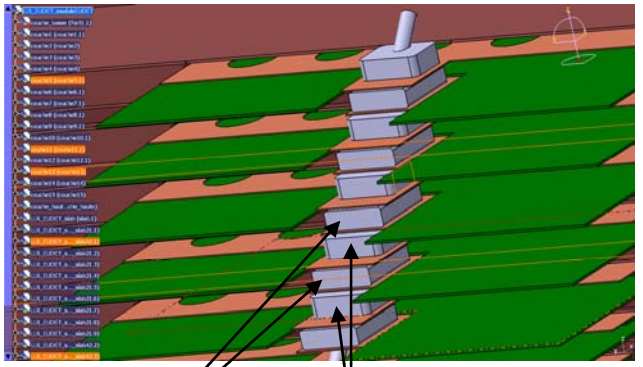



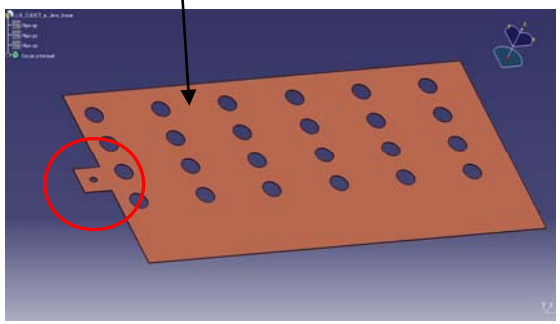



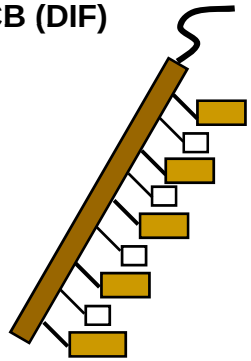
# Design of module …

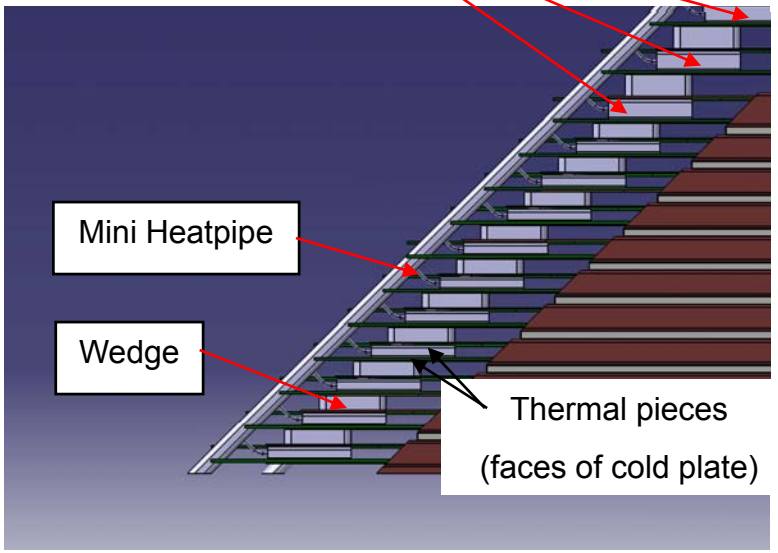
… taking into account thermal analysis of slab



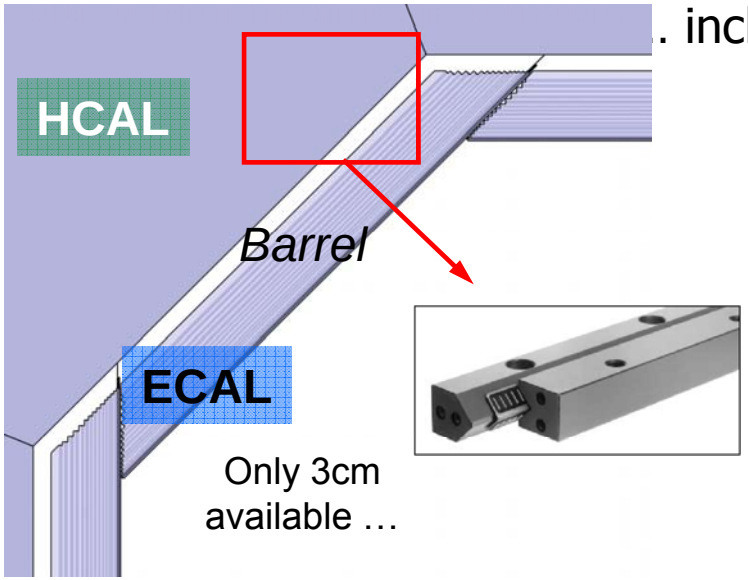








**A column,**
**(25 mm wide minimum)**
**to ensure quick thermal system's connection**

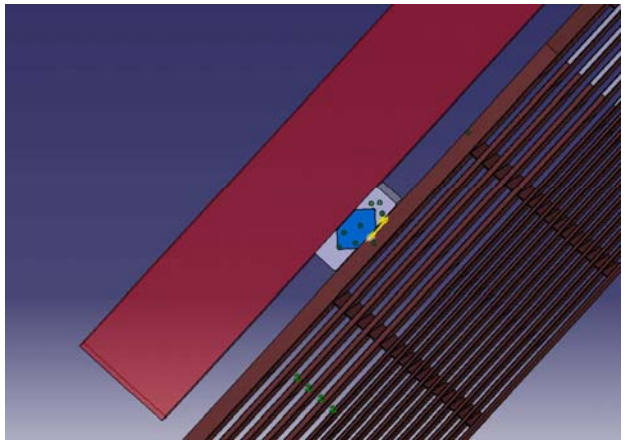
# Design of module …

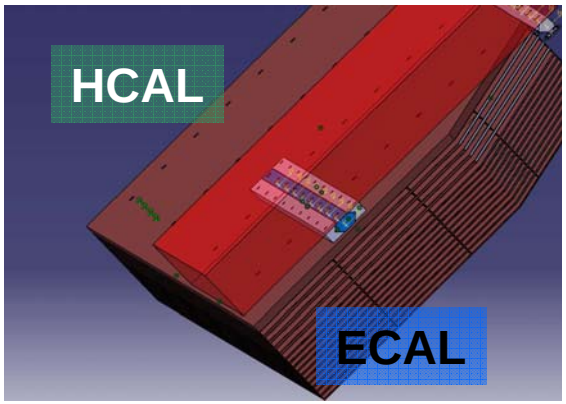



. including ECAL/HCAL interfaces (+ inlet/outlet) :

- Choice of fasteners : rails screwed through the medium of inserts. Non magnetic (B=4T !)
- Mechanical simulations of the ECAL/HCAL interface to take into account of its influence
- Design of connection system (power supply + cooling + outlets) and of DIF cards support

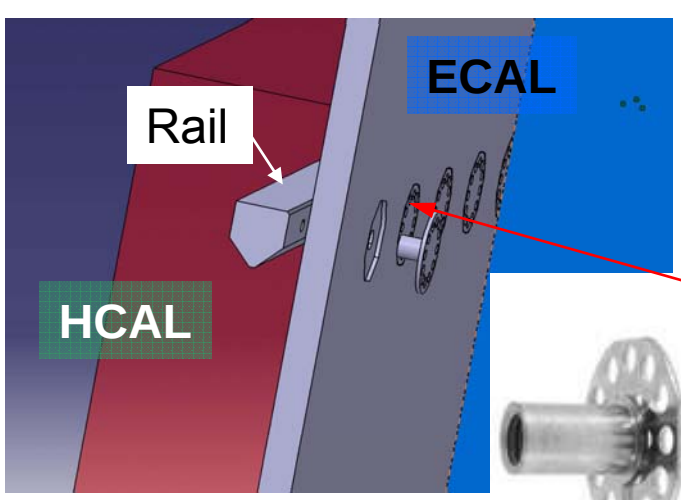
Choices will have to comply with specificities of barrel and End-caps (size, wires, cooling ...)

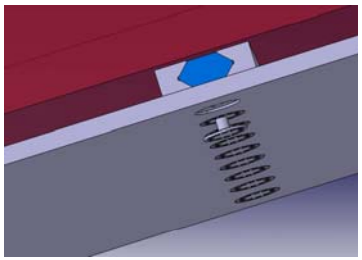





***ECAL/HCAL – End-Cap***
***Configuration 0° - central module***

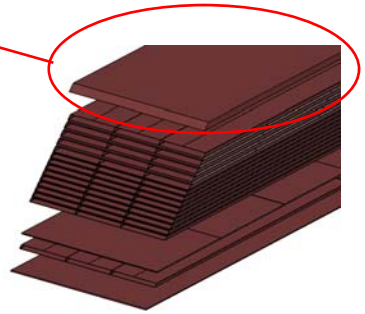
# Interface ECAL/HCAL (1/3)





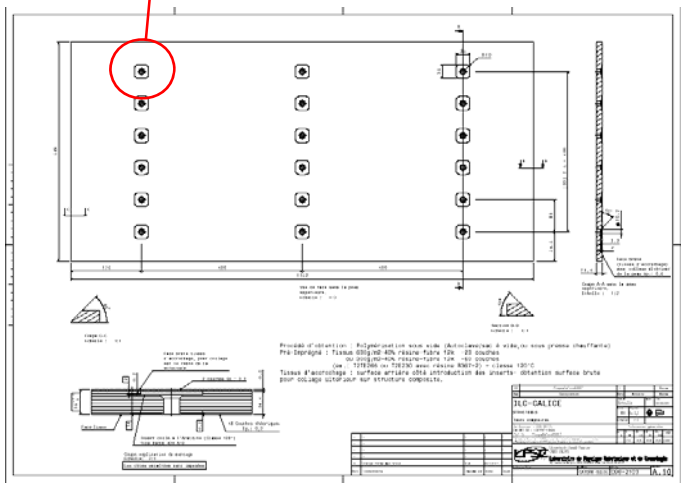
Insert



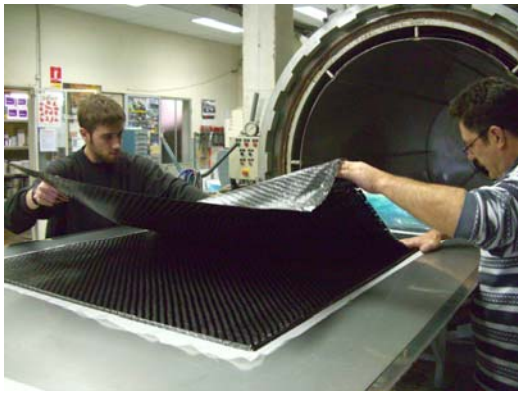
*principle #2* : assembled structure :
This principle allows to introduce metallic inserts before assembling in 15 mm thick composite plate.
Inserts are glued into the plate (epoxy resin)

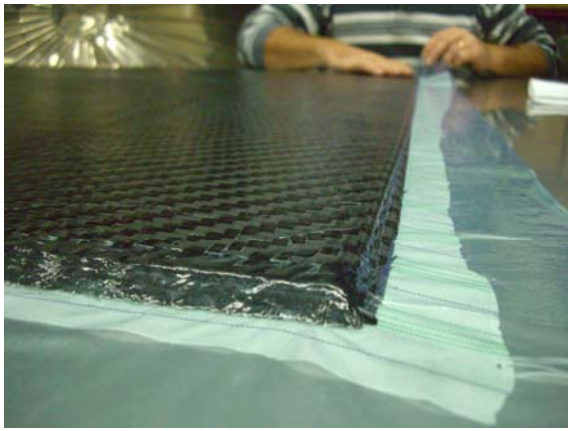
➡ Rails fixed by the way of inserts directly on ECAL modules.

***Detailed drawing of the 15mm thick plate (uniform dispatch of 18 inserts)***



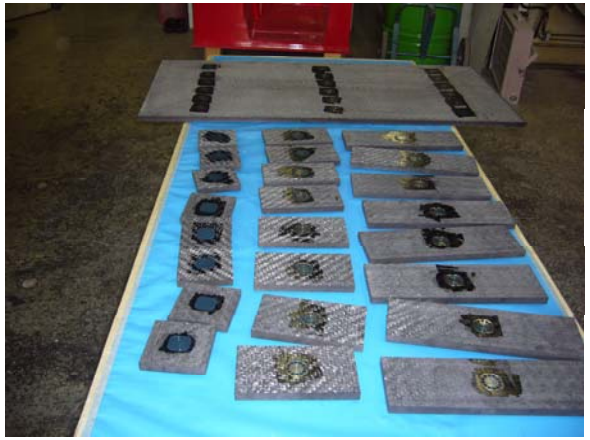
# Interface ECAL/HCAL (2/3)





***Winter 2007-08***

***Fabrication and destructive tests of 15mm thick composite samples with inserts ( For Eudet demonstrator)***



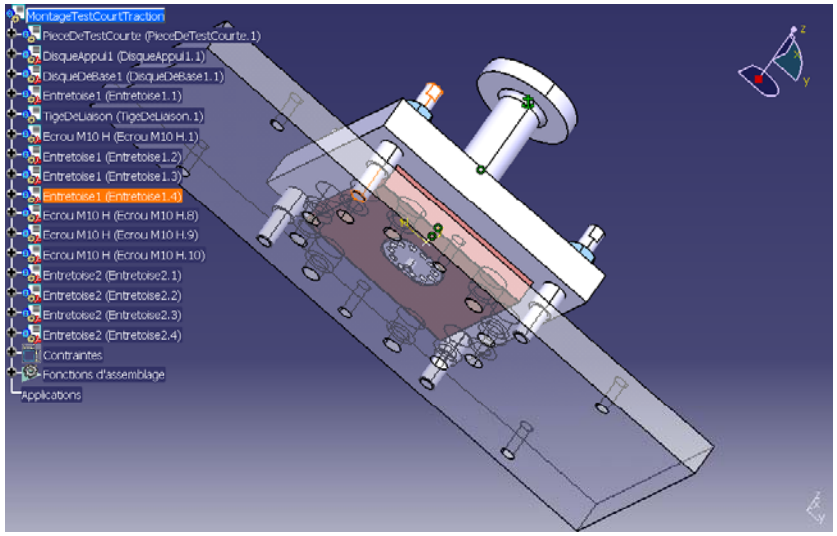
**ILC - ECAL Mechanical R&D**

***1 for loading test with rails - 1 for mechanical tests with inserts***
***Next one in february 2008 for Eudet***

# Interface ECAL/HCAL (3/3)

Mechanical tests of interface (february 2008):

- Destructive tests of fastening elements:
  until breaking of interface in order to evaluate constraints and elongations under different loading cases:
  - Tensile / Compression
  - Cutting / Bending
- Study and fabrication of testing tools: OK
- Check and validate simulation results by destructive tests for each issues
- Similar type of tests to be performed for characterization and calculation of inter-alveoli thin sheets of composit




***tools for tensile and compression tests***

***Machine for destructive tests***

# EUDET - Mechanical R&D - ECAL



## Modules: *studies*

- *Finite Element Model of modules to estimate the overall deflection, with new cells 180x8.6 (common to CALICE end-cap studies).*
- *Optimization of composite sheets : studies of main parameters for thick plates*
- *Fasteners design (rails, facilitated insertion of modules) and inserts drawings* : OK
- *Cooling system and technology: Thermal study - design and test of heat pipes*

## Modules: *Tests*

- Metrology and Machining tests of tungsten plates. OK
- Moulding of the composite parts 15mmm & 2mm thick with metal inserts: OK
- Destructive tests on composite samples with inserts: OK
- Destructive tests on the mechanical interface ECAL/HCAL : OK
- Prototype of the cooling system's connection kit for slabs : *summer 2008*...

**Confirmations are to be given for thermal studies: FPGA consumption and position…**

- Fastening system ECAL/HCA: rails: march 2008
- Destructive tests on the mechanical interface ECAL/HCAL : april 2008

Other studies & tests on going on Composite Structures & Services for **CALICE (End-Caps)**