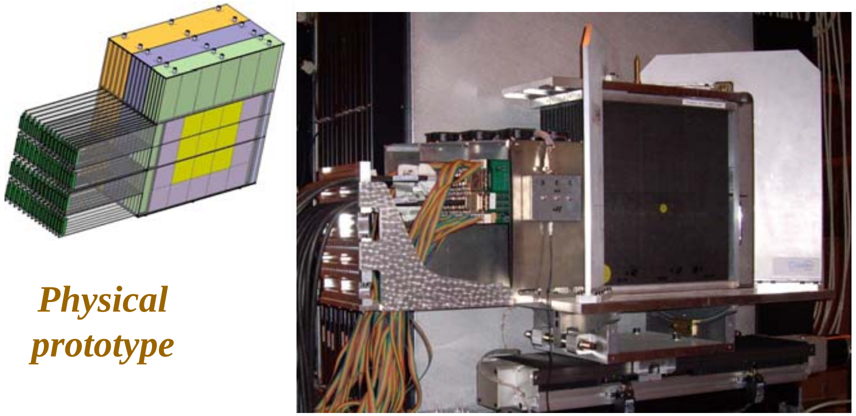
Status of mechanical studies of EUDET Module

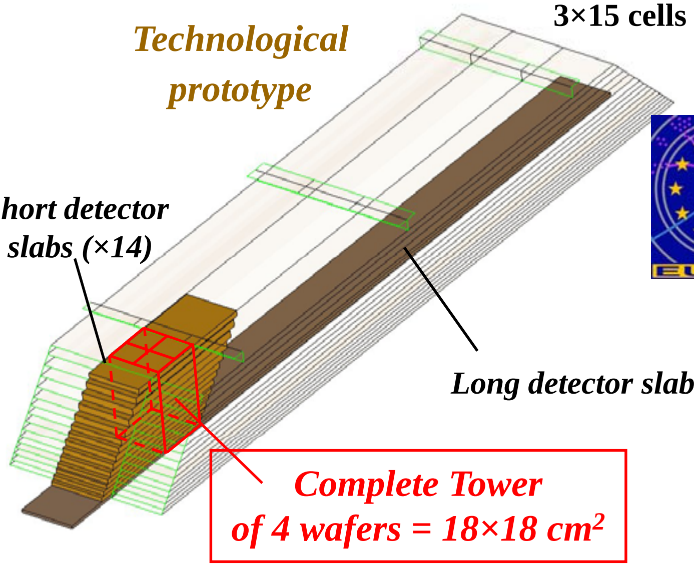
Marc Anduze – LAL – 06/02/2008

Technological prototype : EUDET module

- Logical continuation to the physical prototype study which validated the main concepts : alveolar structure , slabs, gluing of wafers, integration
- Techno. Proto : study and validation of most of technological solutions wich could be used for the final detector (moulding process, cooling system, wide size structures,…)
- Taking into account industrialization aspect of process
- Finest cost estimation of one module



Physical prototype



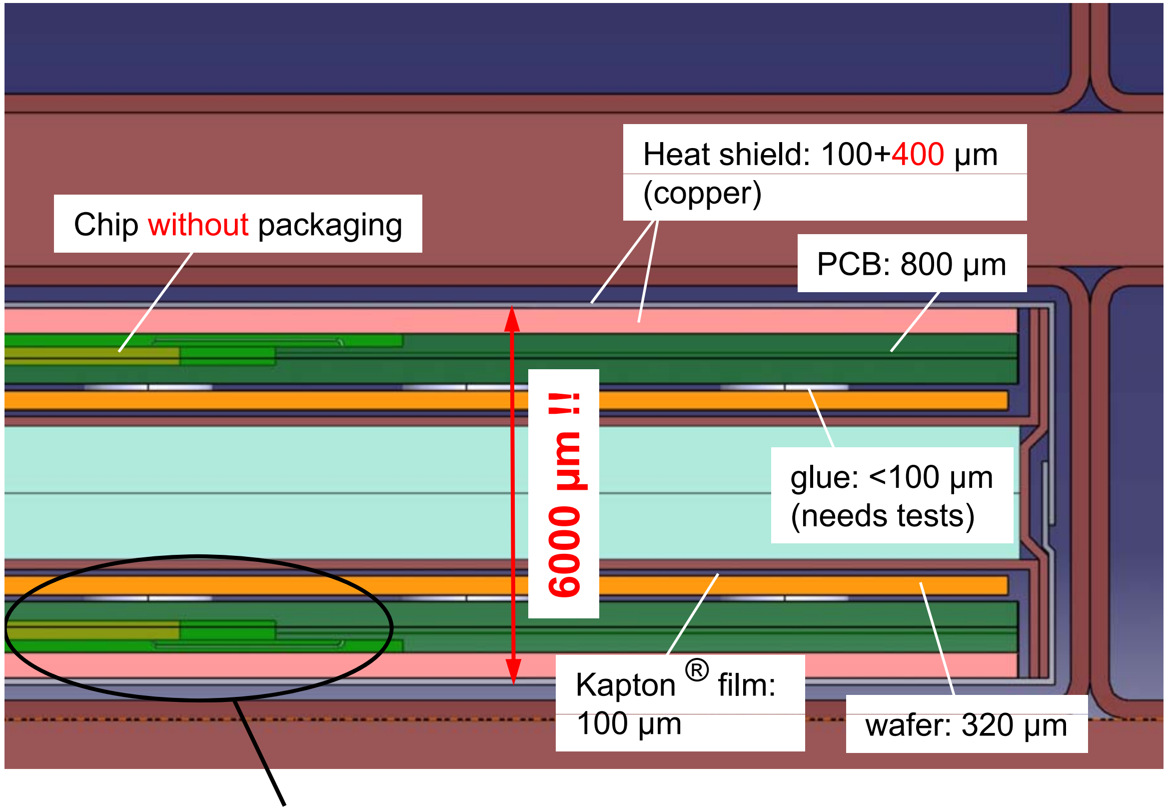
- **3 structures : 24 X_0**
  (10×1,4mm + 10×2,8mm + 10×4,2mm)
- **sizes : 380×380×200 mm3**
- **Thickness of slabs : 8.3 mm (W=1,4mm)**
- **VFE outside detector**
- **Number of channels : 9720 (10×10 mm²)**
- **Weight : ~ 200 Kg**

- **1 structure : ~ 23 X_0**
  (20×2,1mm + 9×4,2mm)
- **sizes : 1560×545×186 mm3**
- **Thickness of slabs : 6 mm (W=2,1mm)**
- **VFE inside detector**
- **Number of channels : 45360 (5×5 mm²)**
- **Weight : ~ 700 Kg**

Design of slab (cross section)

The expected alveolar thickness is 6.5 mm **if** :

Design EUDET Slab



Chips and bonded wires
inside the PCB

- ⇨ Gaps (slab integration) : 500 µm ?
- ⇨ Heat shield : 400 µm ?

  but real thermal dissipation ?

  (active cooling ?)
- ⇨ PCB : 800 µm (tolerances : ± ?)

  but chips embedded in PCB ?
- ⇨ Thickness of glue : <100 µm ?

  study of the size of dots
- ⇨ Thickness of wafer : 320 µm – (± ?)

  30 matrix ordered (90×90 mm^2)
- ⇨ Kapton® film HV feeding :

  100 µm - OK *(DC coupling)*
- ⇨ Thickness of W : 2100 µm (± 80 µm)

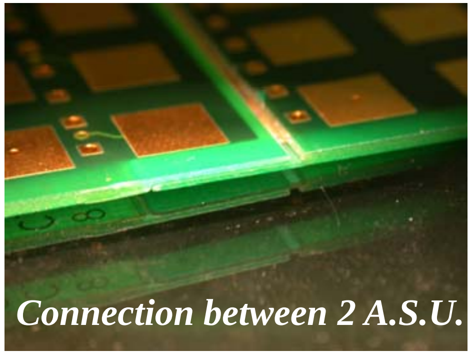
Several technological issues
have to be studied and validated

Detector slab - principle

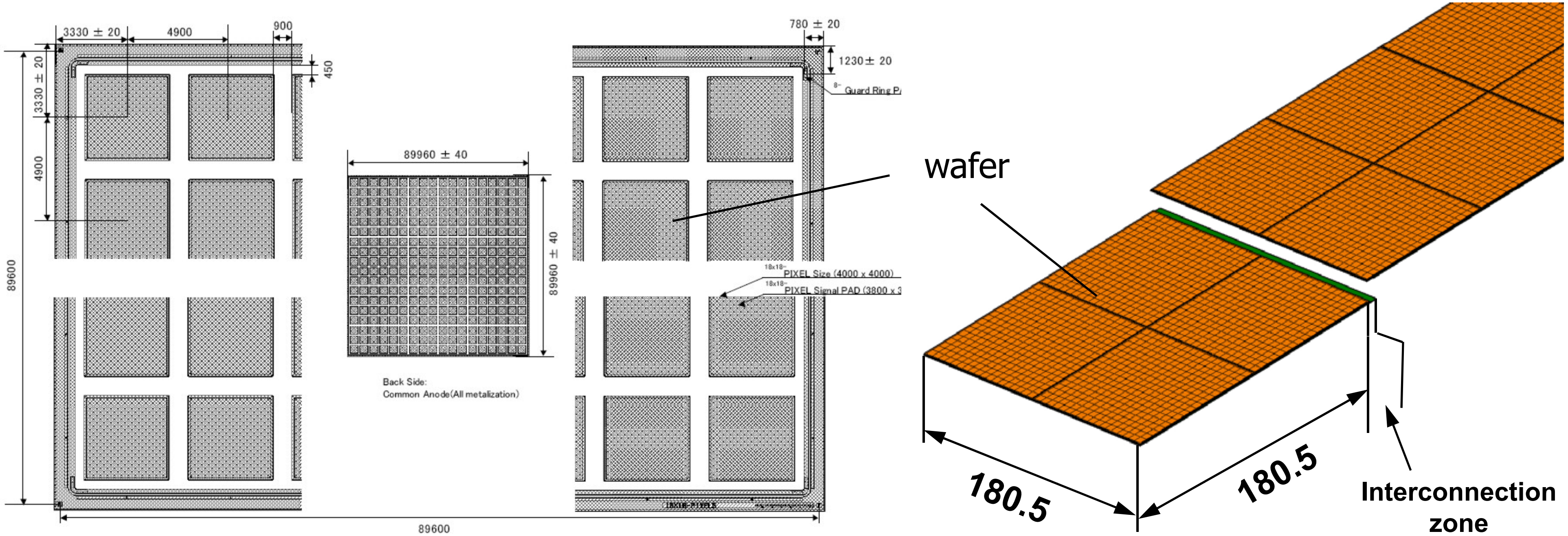
Long slab is made by several short PCBs :

A.S.U. : Active Sensors Unit

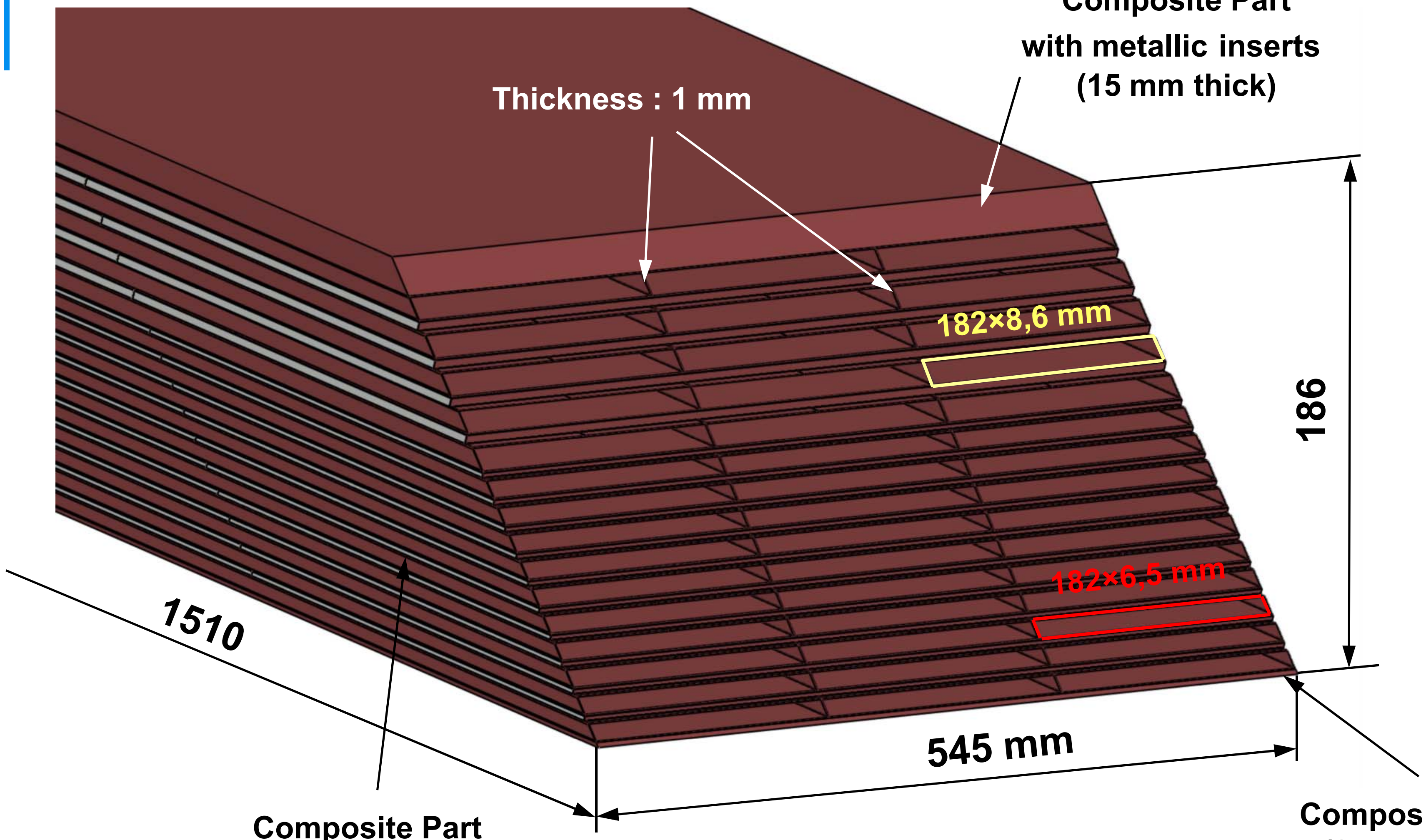
- Design of one interconnection **« inside »** the thickness of PCB
- Easier development : study, integration and tests of A.S.U in parallel with other components of the project
- The length of each long slab will be obtained by the size of one "end PCB"



Connection between 2 A.S.U.



Alveolar structure (1/2)



Thickness : 1 mm

Composite Part with metallic inserts (15 mm thick)

Composite Part (1 mm thick)

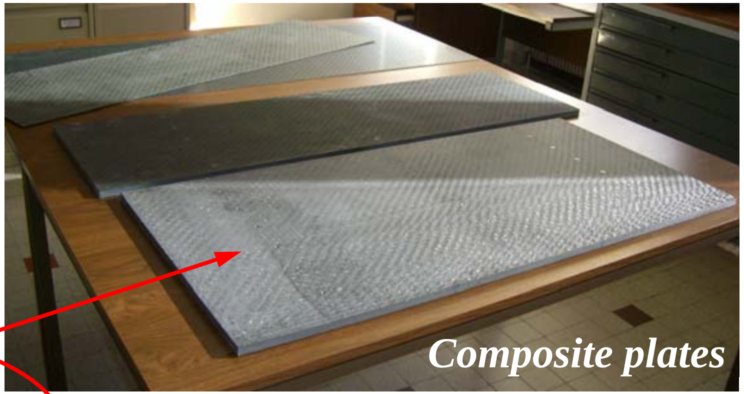
Composite Part (2 mm thick)

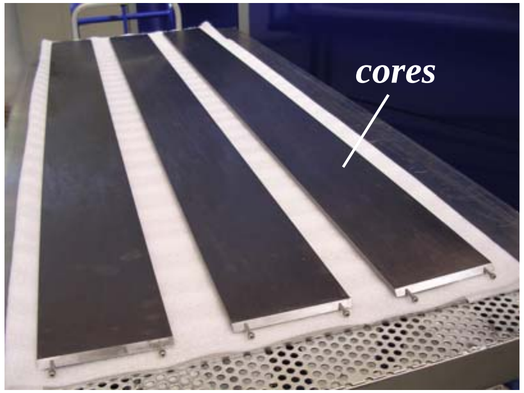
Weight ~ 650 Kg

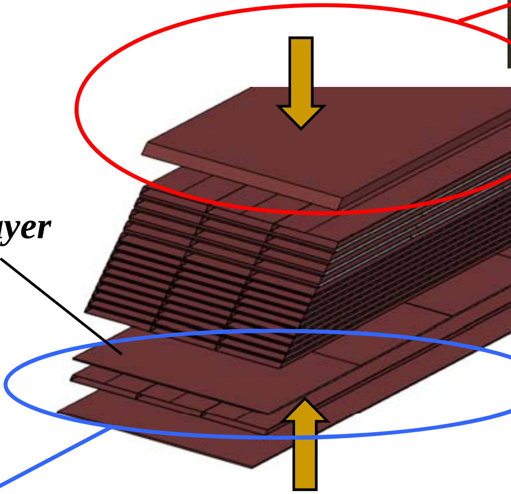
Alveolar structure (2/2)

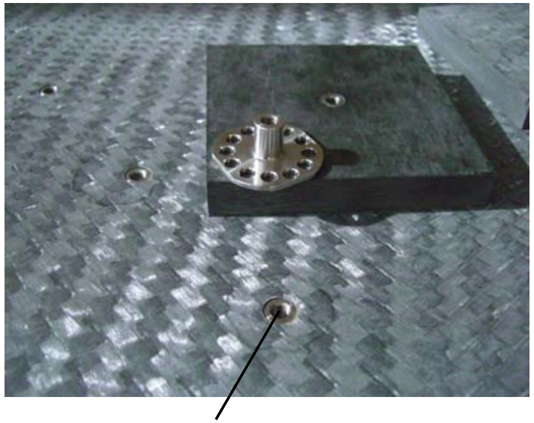
Assembled structure : Each alveolar layer are done independently, cut to the right length (with 45°) and assembled alternatively with W plates in a second curing step

(2 width of cells : 126 mm and 182 mm)

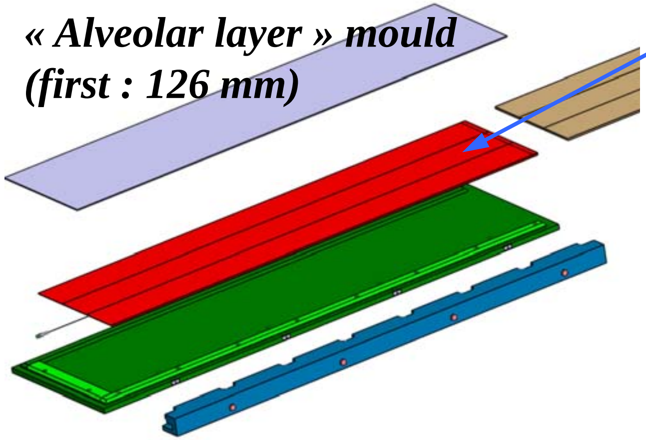








Fastening system (inserts)



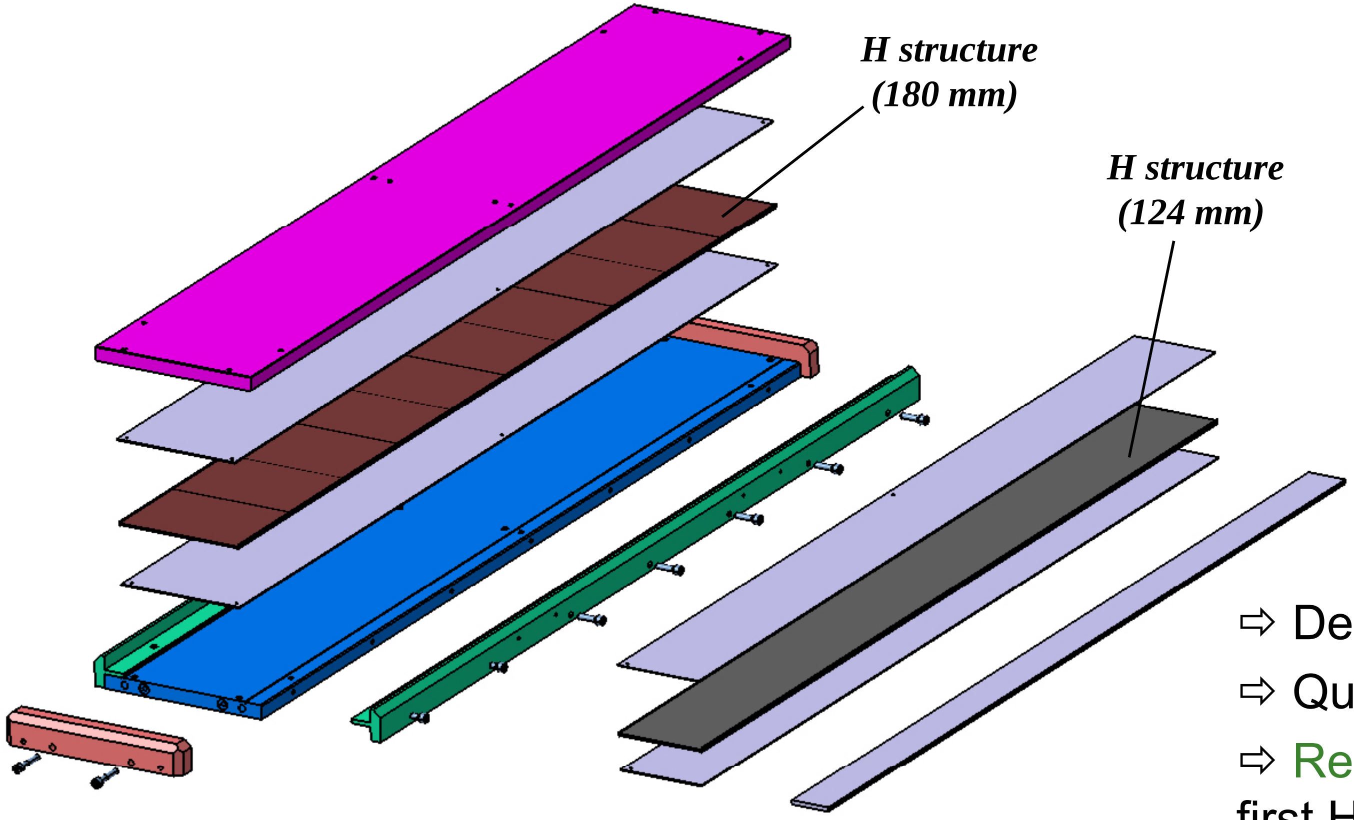
« Alveolar layer » mould (first : 126 mm)

- ⇨ Global design : OK
- ⇨ "Alveolar layer" mould machining : on going
- ⇨ Design of assembly mould : on going
- ⇨ Ready : 4 composite plates (15mm and 2 mm)

Composite H structure

Study and manufacturing of one mould for whole structures (feb 2008):

- Same principle than the mould used to do H physical prototype structures (autoclave)
- One long mould for both long and short H structures and 2 width (124 and 180 mm)



⇨ Design : OK

⇨ Quotation : on going

⇨ Ready (W + C) to mould first H structure (1300×124)

Destructive tests

Mechanical tests of interface (feb 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 composite

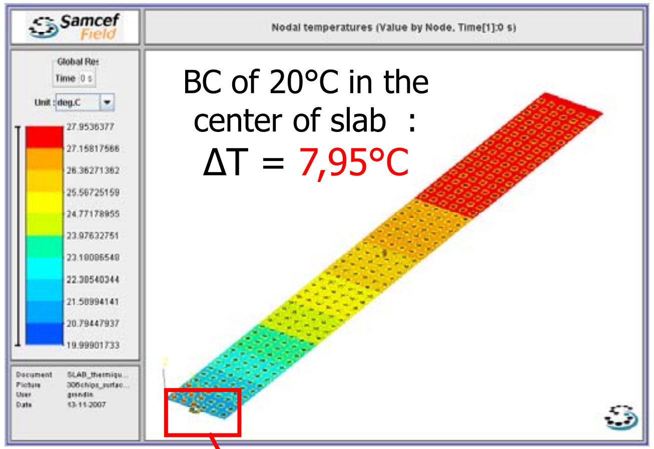
tools for tensile and compression tests

Machine for destructive tests

Test pieces (interface)

Thermal analysis of slab

Simulation of heat conduction just by the heat cooper shield :
Influence of the FPGA dissipation (DIF) on current design of cooling system

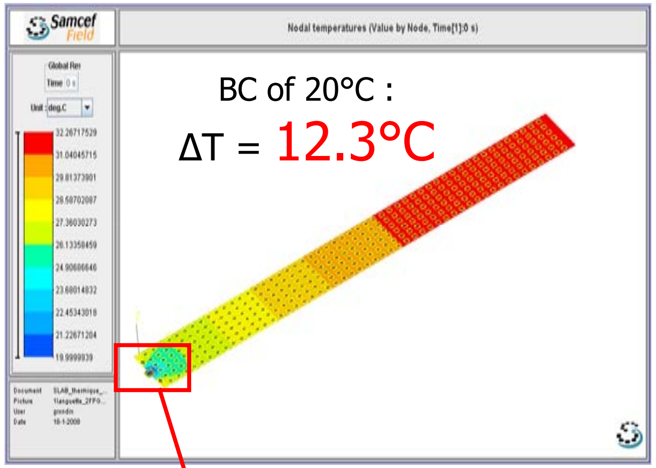


BC of 20°C in the center of slab :
ΔT = 7,95°C

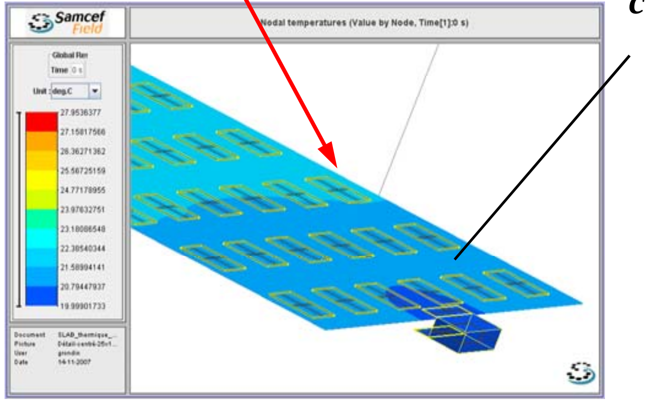
Φ_{chip} = 0,27 W/layer
(25 µW per channel)

Φ_{FPGA} = 3 W/layer

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

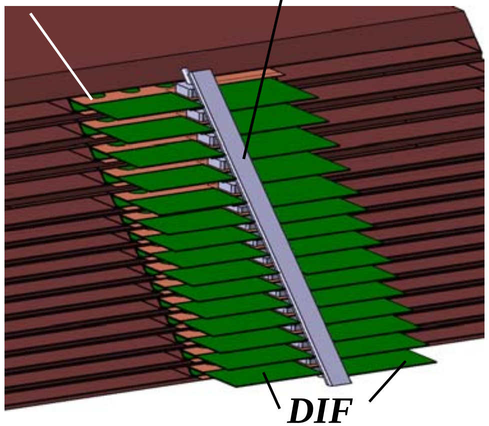


BC of 20°C :
ΔT = 12.3°C

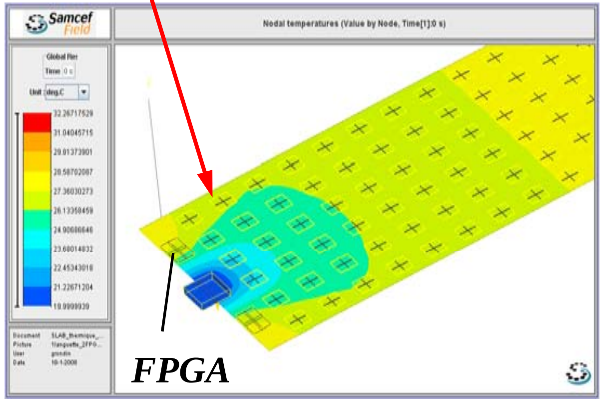


copper

Cooling Pipe



DIF

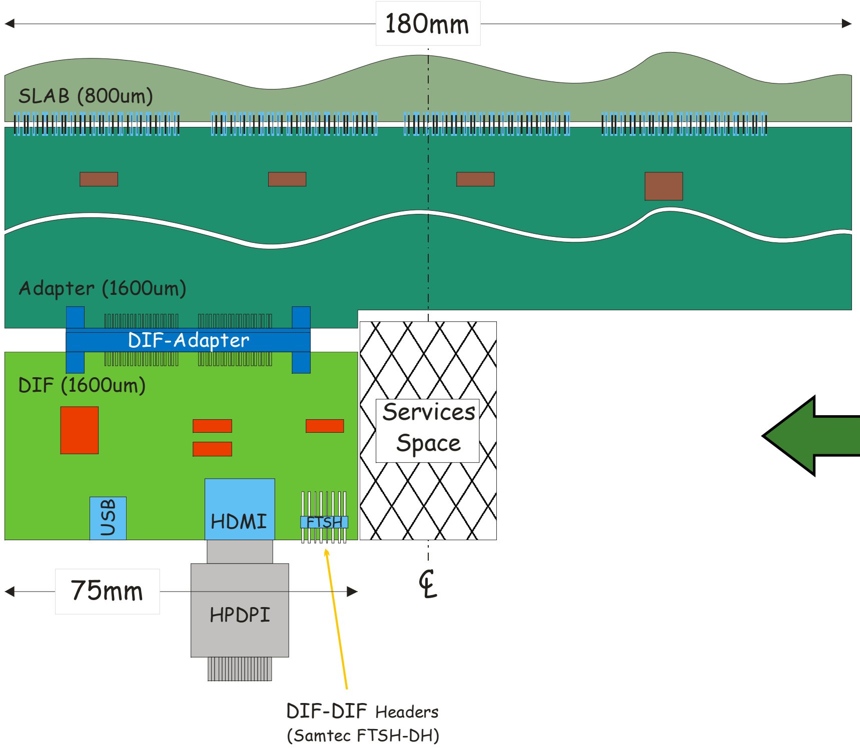


ΔT and **size** of cooling pipe increase (ΦT = 8.1 W to 98.1 W)

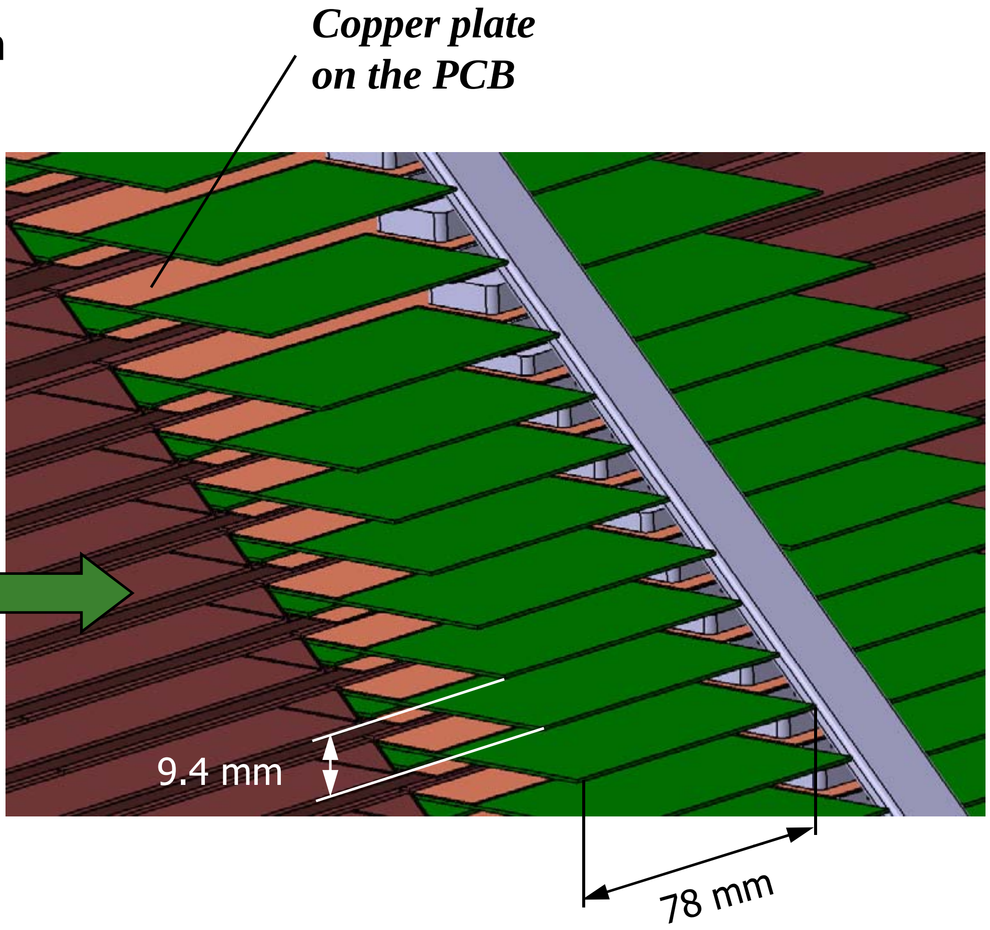
Design of interface slab/DIF ?

Current Module design compatible with this proposal from Cambridge?

- Adapter board (size, thickness …)
- Components size
- Connectors size
- Fastening devices / back-end system
- Discussions with Julien?



(from Maurice Goodrick, Bart Hommels)



Organization for EUDET

4 Laboratories are sharing out tasks in accordance with their wishes and localization:

Assembling of A.S.U. (industrialization, gluing and tests) + backend system (DIF support) + services

Tests of wafers

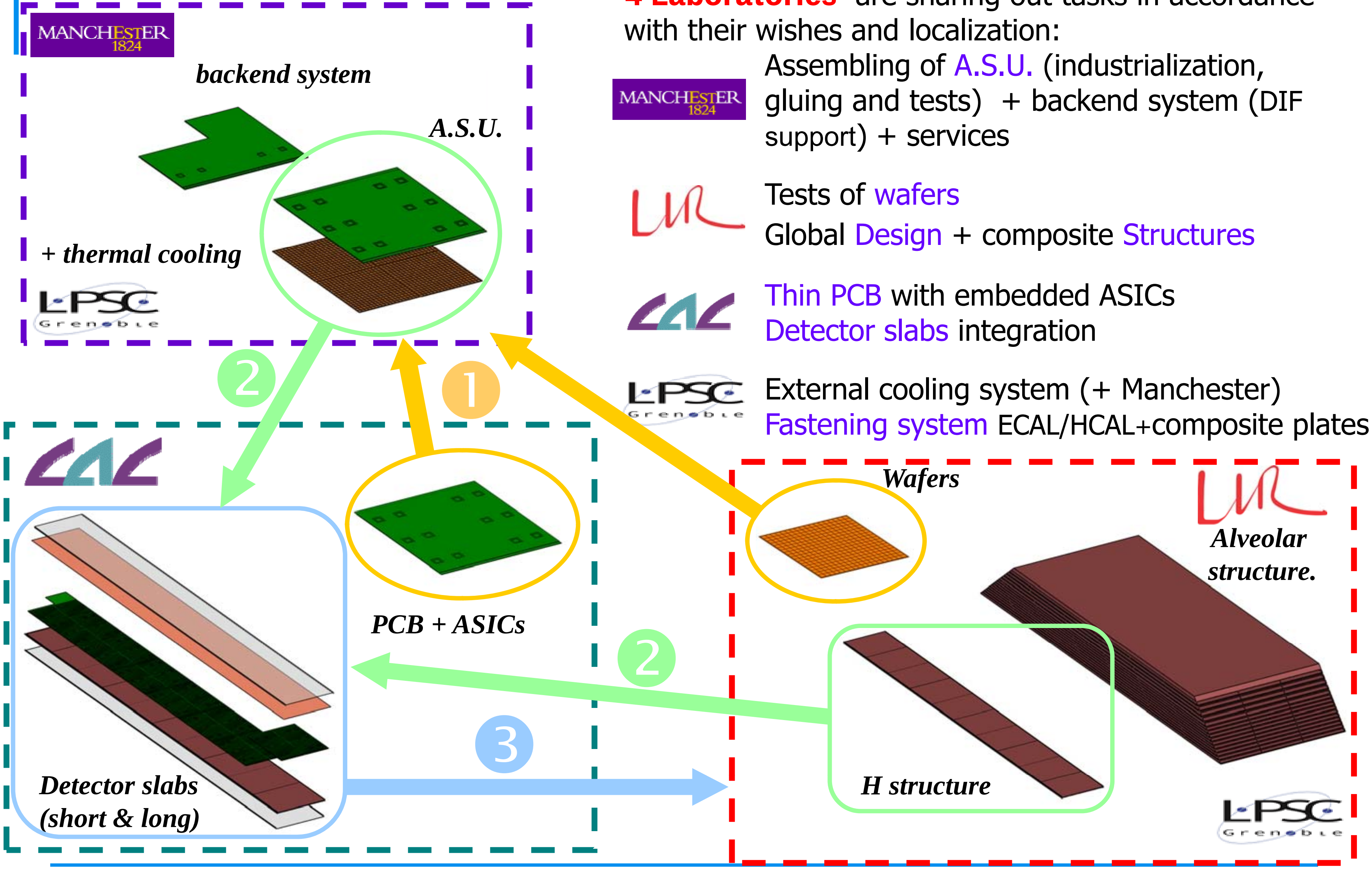
Global Design + composite Structures

Thin PCB with embedded ASICs

Detector slabs integration

External cooling system (+ Manchester)

Fastening system ECAL/HCAL+composite plates



Schedule

Assembling of **A.S.U.** (industrialization, gluing and tests) :	
first gluing studies (glass on PCB)	**March 08**
first resistive tests according to the size of the dot	**March 08**
Backend system (DIF support)	**Jan 09 ?**
Services (cooling system participation ?)	**Jan 09 ?**
Tests of **wafers :**	
reception 30 first wafers	**April 08**
set-up ("mechanical box")	
Global Design	
Composite **Structures** :	
mould + first H structure (126 mm)	**March 08**
"alveolar layer" mould + first layer	**April 08**
assembly mould	**June 08**
demonstrator (2 or 3 layers – 126mm)	**Sept 08**
Thin PCB with embedded ASICs	**Jan 09 ?**
Detector slabs **integration**	**Jan 09 ?**
External **cooling system** (+ Manchester)	**June 08**
Fastening system ECAL/HCAL	**March 08**
composite plates	**Feb 08**