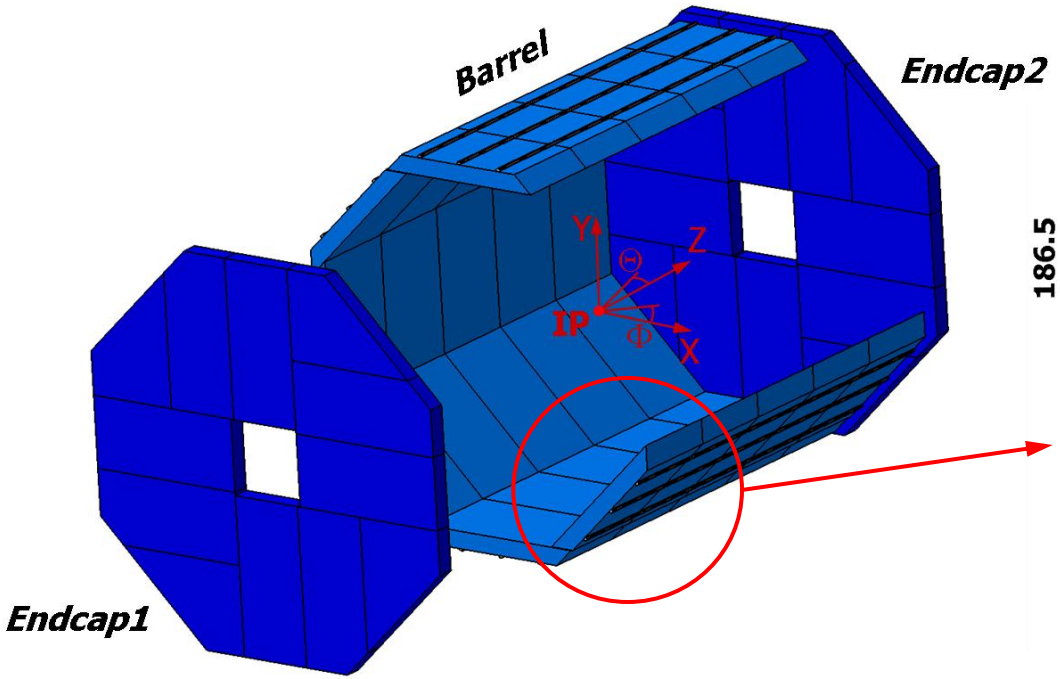
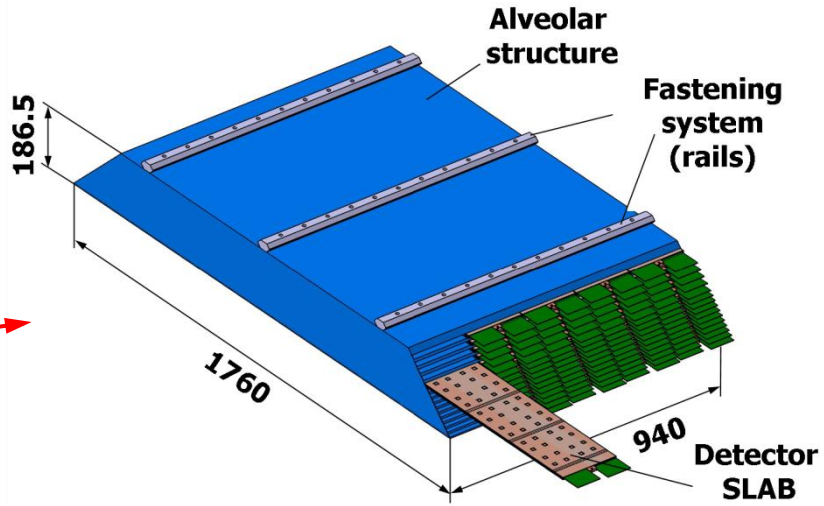
- ECAL -
SLAB Assembly

Marc Anduze – 06/12/2012

ECAL – Baseline

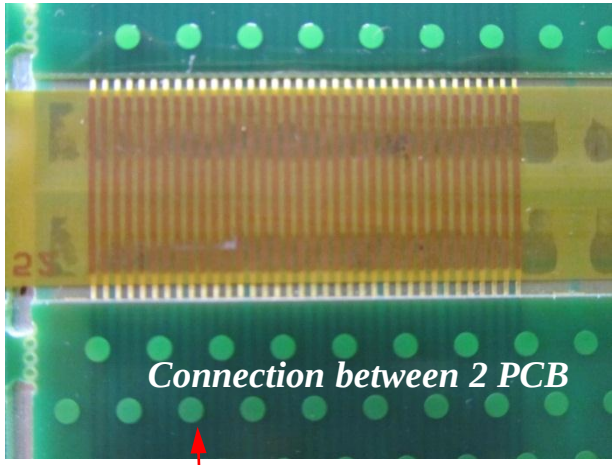
- The future ECAL consists of 1 barrel of (40 identical trapezoidal modules) and 2 endcaps (3 different modules).
- Principle of the design is based on several self-supporting structures where detector devices (slabs) are slid into each cell
- main quantities : - absorbers : W (~80 tonnes) …
  - detector : Si (~300 000 wafers), FE (~1.2 M ASICs), ASU (~ 73000 PBCs) …

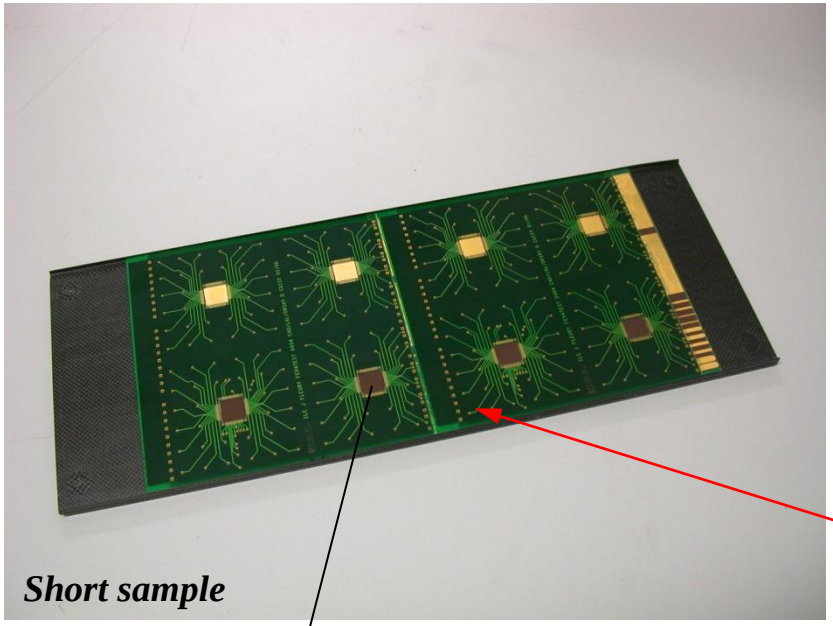




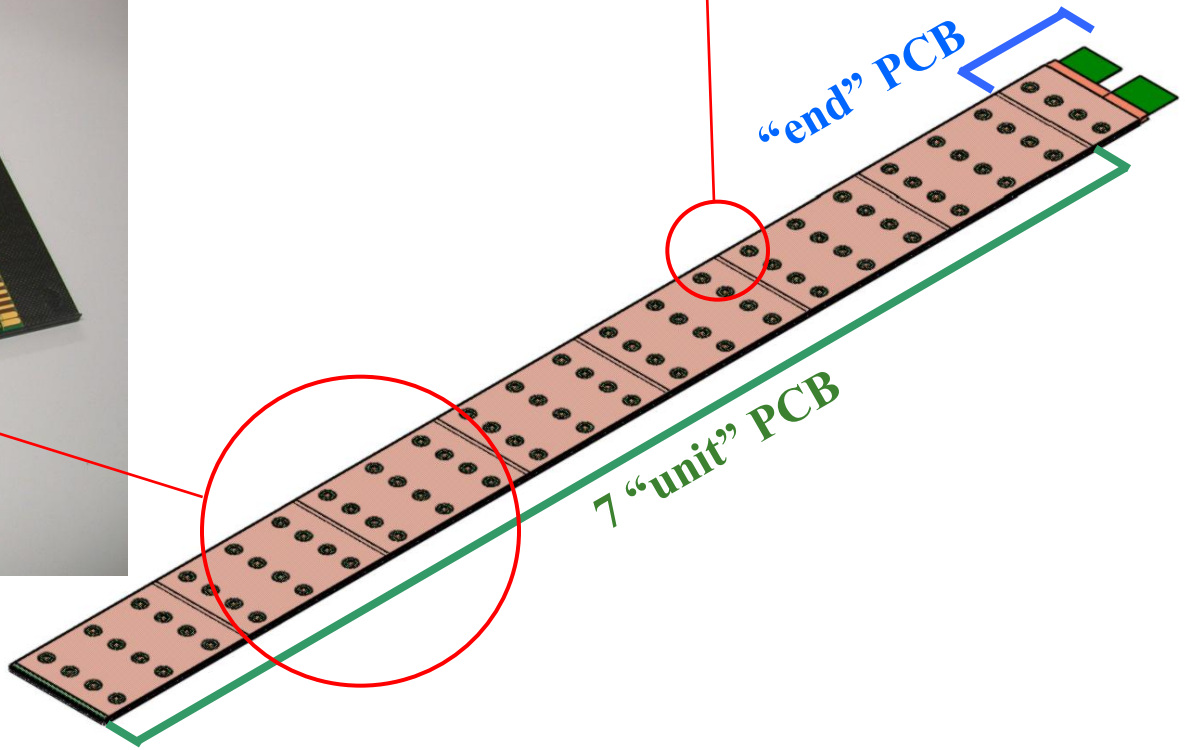
Detector slab - principle

- Long slab is made by several short PCBs :
  - Design of one interconnection
  - Development easier : study, integration and tests of short PCB (with chips and wafers) before assembly
  - The length of each long slab will be obtained by the size of one "end PCB" (tools)



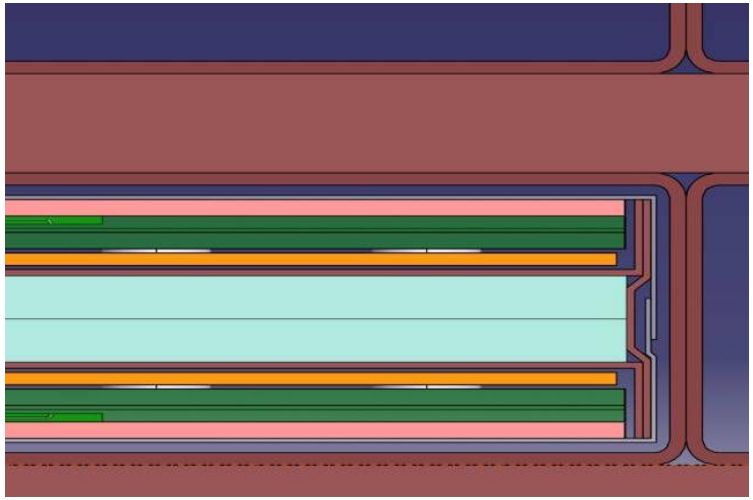


Chip « inside »

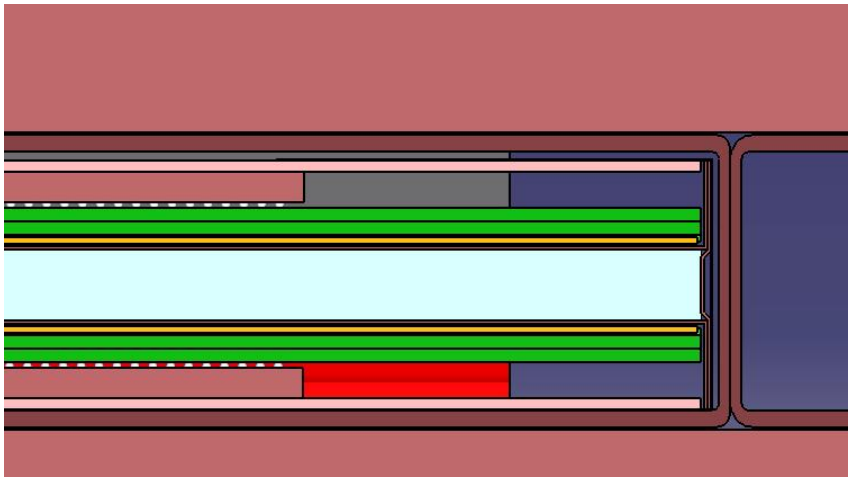


Detector slab – options

- 2 designs :



Chip embedded



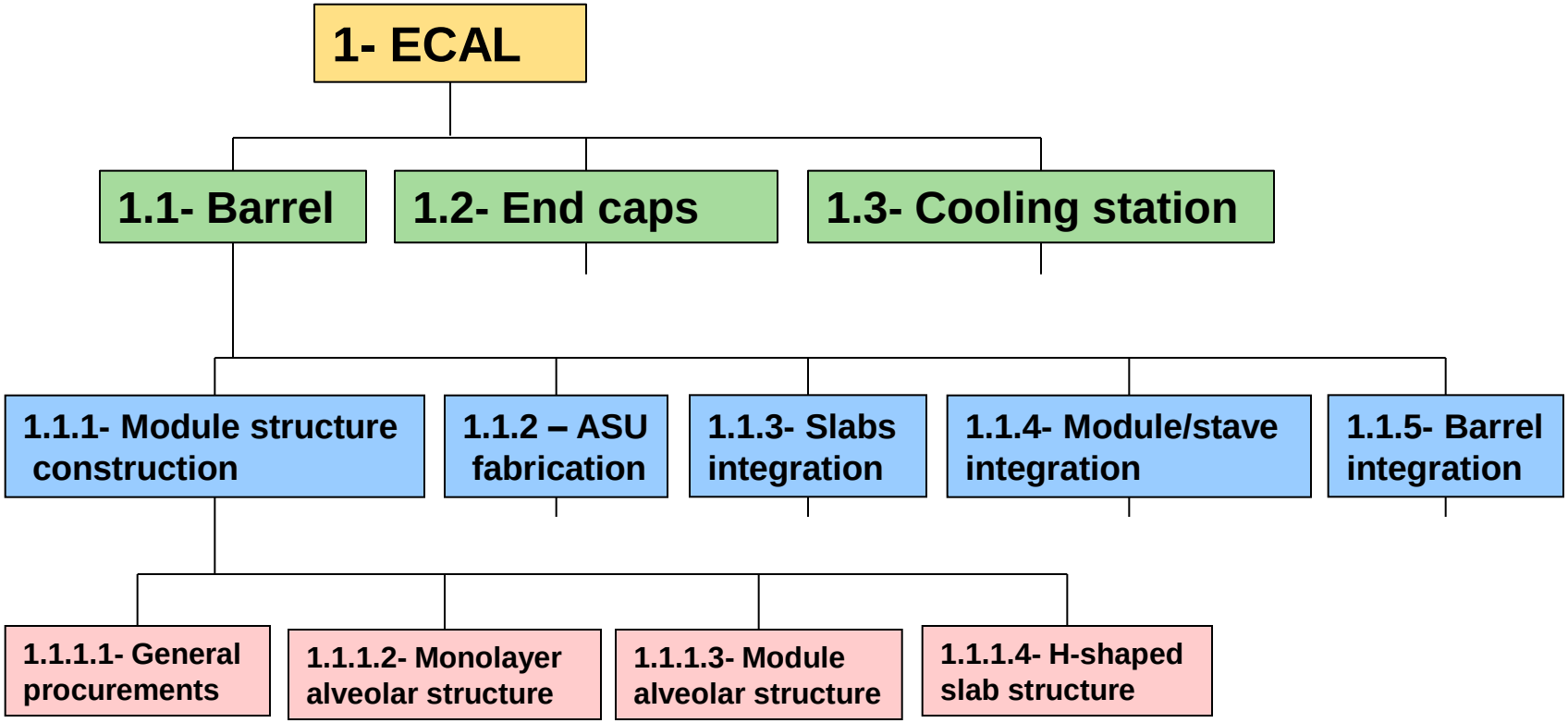
Chip with BGA packaging

⇨ Gaps (slab integration) : 500 µm
⇨ Heat shield : 500 µm
⇨ PCB : **1200 µm ?** (flatness problems)
⇨ Thickness of glue : **100 µm ?** (gluing problems @ LPNHE)
⇨ Thickness of wafer : 325 µm
⇨ Kapton® film HV : 100 µm
⇨ Thickness of W : 2100/4200 µm (± 80 µm)

⇨ Gaps (slab integration) : 500 µm
⇨ Heat shield : 500 µm
⇨ PCB : **1600 µm**
⇨ BGA thickness : **1700 µm**
⇨ Thickness of glue : **100 µm ?** (gluing problems @ LPNHE)
⇨ Thickness of wafer : 325 µm
⇨ Kapton® film HV : 100 µm
⇨ Thickness of W : 2100/4200 µm (± 80 µm)

Work Breakdown Structure

- The WBS is a decomposition of the project into phases, deliverables and work packages. It is a tree structure, which shows a subdivision of effort required to achieve an objective (tasks)



Tasks repartition in 2008 (1/2)

WAFERS (glue studies)	MANCHESTER 1824	LAL	LLR	LPSC Grenoble
01- Study of the size of dots (glue)				
02- Gluing tools (for 4 wafers on unit PCB)				
03- Design of a gluing robot (industrialization)				
04- Study of gluing process				
05- Gluing of all wafers on unit PCB				
06- Cosmic tests of unit PCB glued				
LONG PCB				
07- Assembling of several unit PCB (study of the stitching)				
08- Cosmic tests and calibration of long PCB				
SLAB				
09- Assembling tools of long PCB to put on “H” structure				
10- Integration of the heat shield (copper)				
11- Integration of all components (shielding, end-caps …)				
12- Thermal study of one slab behavior				
13- Thermal tests on real equipped slab (sensors) on alveolar structure				
14- Global thermal Simulations				
15- Transport and works tools (slab on alveolar structure)				
16- Fastening system of the slab				
17- Back-end System (inlet/outlet + connector DIF0 + thermal aspect)				

Tasks repartition in 2008 (2/2)

COMPOSITE STRUCTURES	MANCHESTER 1824	LAL	LLR	LPSC Grenoble
18- Global design of EUDET module structures				
19- design of "H" mould				
20- Fabrication of all "H" structures				
21- design of "one alveolar layer" mould V1 (124 wide) and V2 (180)				
22- Fabrication of moulds V1 and V2				
23- Fabrication of first "one alveolar layer" unit				
24- Destructive tests (study of thin composite sheets)				
25- Mechanical behavior using optical fibers on composite layers (BRAGG)				
26- supplying of W plates				
27- dimensional inspection of each W plates				
28- design of fastening system ECAL/HCAL (metal inserts)				
29- Study and fabrication of thick composite plates (2 mm and 15 mm)				
30- Design of assembling mould V1 et V2				
31- validation of the concept with one test structure and tests				
32- transport tools + XYZ support table				
33- Fabrication of all alveolar composite layers				
34- Mechanical simulations (global and local points)				
35- Fabrication / industrialization process				

Example :

- The part of the ECAL-WBS : SLAB assembly

2.1.2	**Active Sensor Unit fabrication (ASU)**	**49800**				
	Procurements for current design ***(Hwafer 90 mm and ASIC with 64 channels)***					
	Processed wafers 9x9 cm²	199200			Industry several suppliers	0,243
	ASIC	796800			Industry	0,013
	PCB electricaly tested	49800			Industry	0,4
	Inter-connection kapton	90000			Industry	0,004
	HT Kapton	6000			Industry	0,10
	Copper sheets in shape	6000			Industry	
	Aluminium cover in shape	6000			Industry	
	Wafer test set-up	10			Industry	20
	Asic test set-up	5			Industry	500
	PCB test set-up	5				5
	storage boxes	1660,00				0,40
	Gluing and position robot	10				100
	ASU test set-up	5				5
	Operations					
	Wafers tests	39840	wafer	Specific automatic set-up	HOME	
	ASIC tests	789000	ASIC	Specific automatic set-up	HOME/Industry	
	Bonding	1250000	ASIC		Industry	0,004
	PCB tests with ASIC	50000	PCB	Specific automatic set-up	HOME/Industry	5000 days
	Transport and storage				HOME/Industry	
	Gluing operation (+ polymerisation time)	50000	ASU	Gluing robot + clean room	HOME/Industry	10 minutes
	ASU tests *(ASU=PCB+Wafers(4)+ASIC(16))*	50000	ASU	Specific automatic set-up	HOME/Industry	
2.1.3	**Slabs integration**	**3000**				
	Procurements for current design ***(H with 2 layers of detection)***					
	Storage	200	boxes	boxes / 15	Industry	0,6
	Operations					
	Inter-connection operation	6000		Specific automatic set-up	HOME/Industry	
	Slab integration	3000		Specific tooling	HOME/Industry	
	Slab test					
	Transport & storage					
	Follow-up					