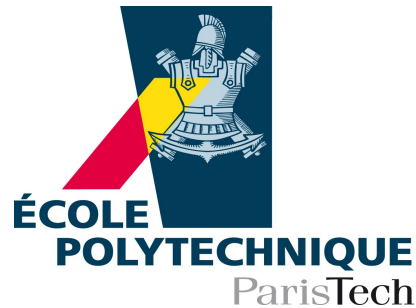


Status of CALICE silicon-tungsten ECAL technological prototype

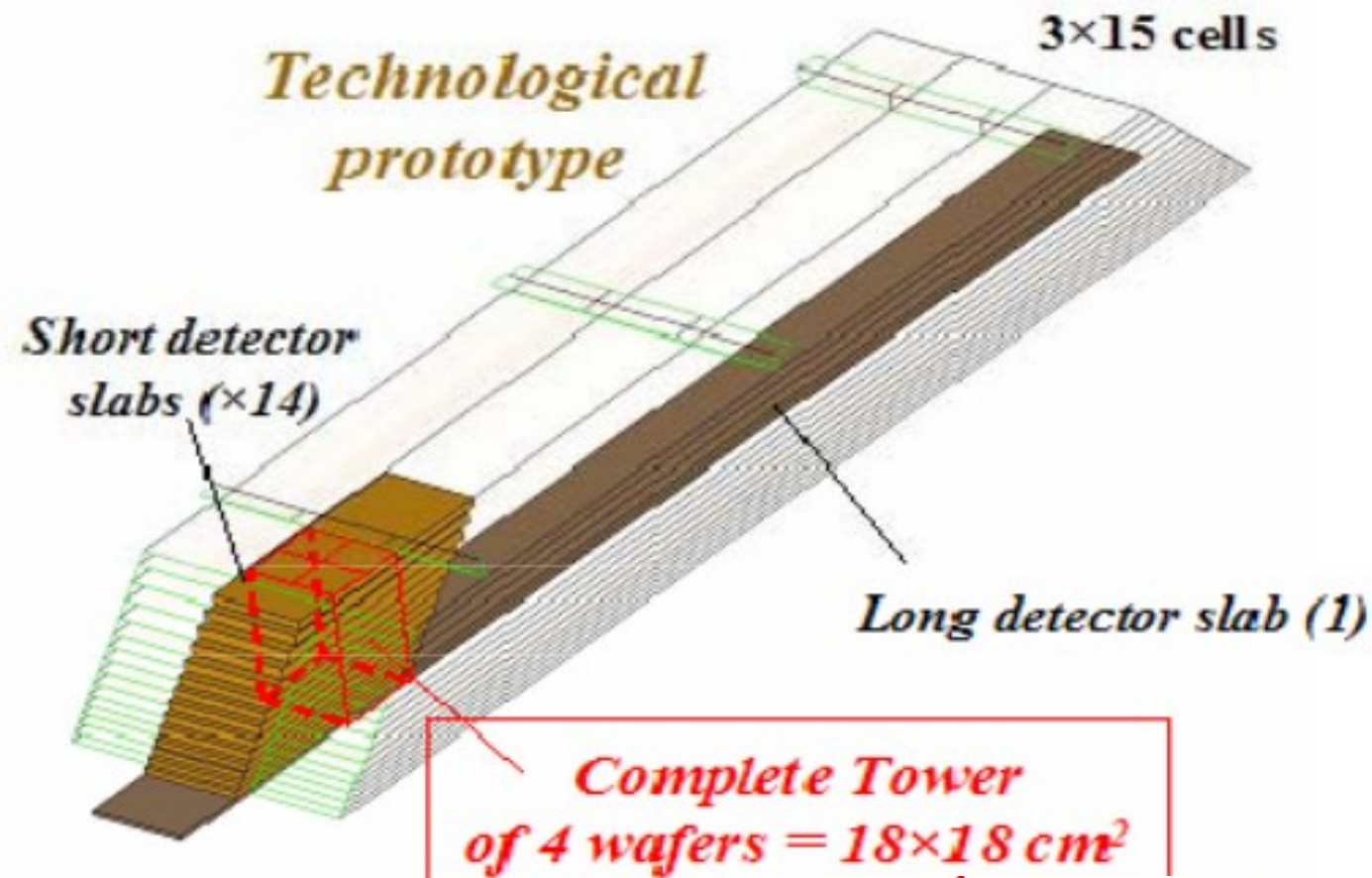
Daniel Jeans
Laboratoire Leprince-Ringuet, Ecole polytechnique

for the CALICE SiW ECAL groups

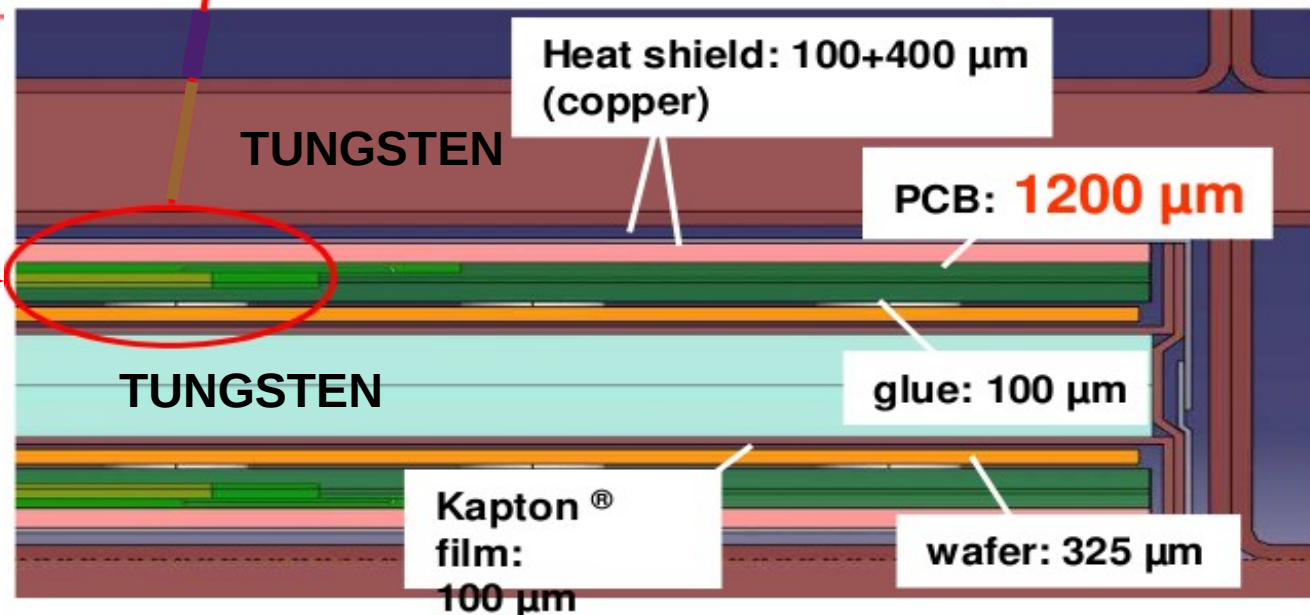


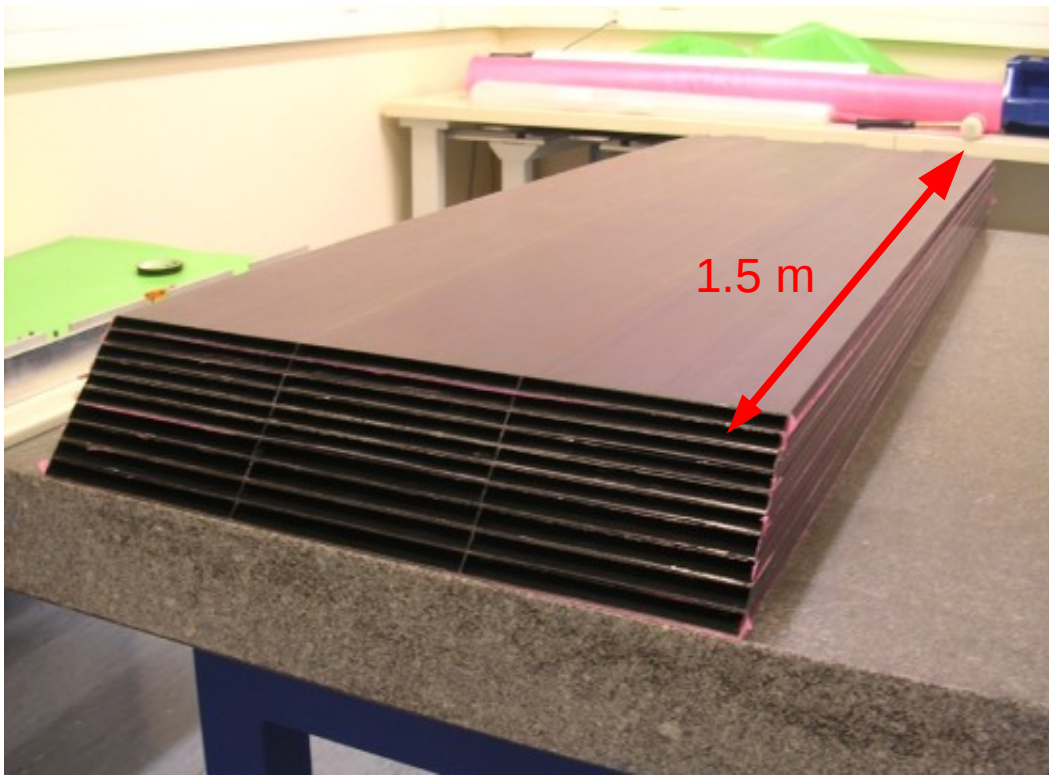
In2p3

overview



Integrated FE electronics





Mechanical structure

Carbon fibre composite alveolar layers
almost finished ~2 (of 15) still to do

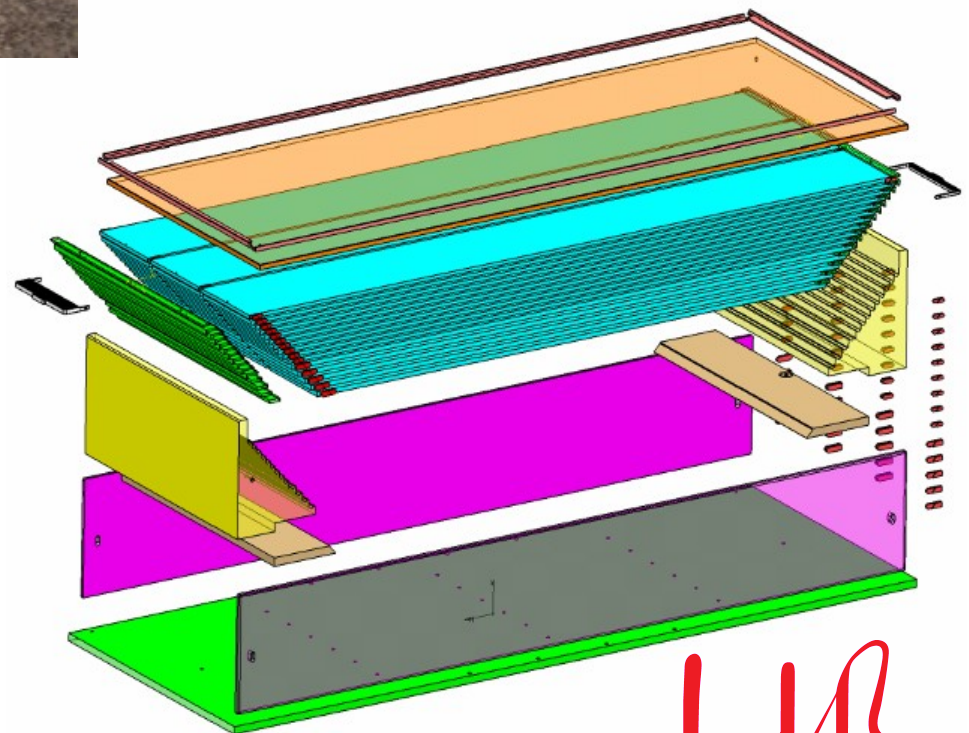
Assembly mold received

Next steps: assemble full structure
CF layers + tungsten

* “dry run” (no epoxy) of assembly in autoclave
understand thermal properties

* final assembly and curing
-> by end of year

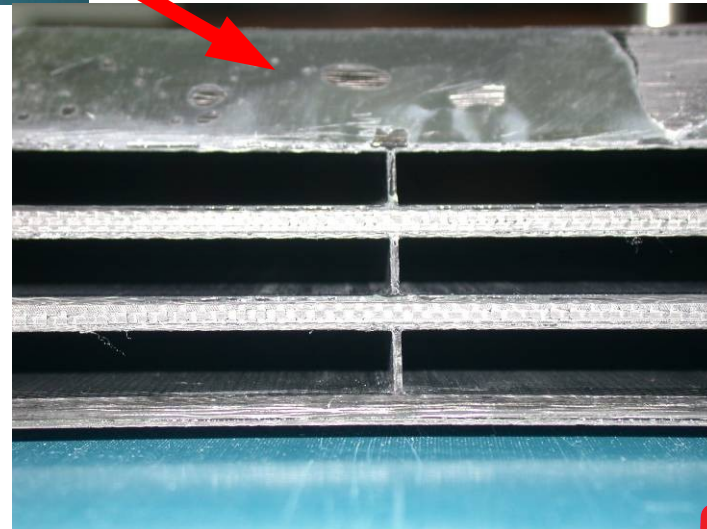
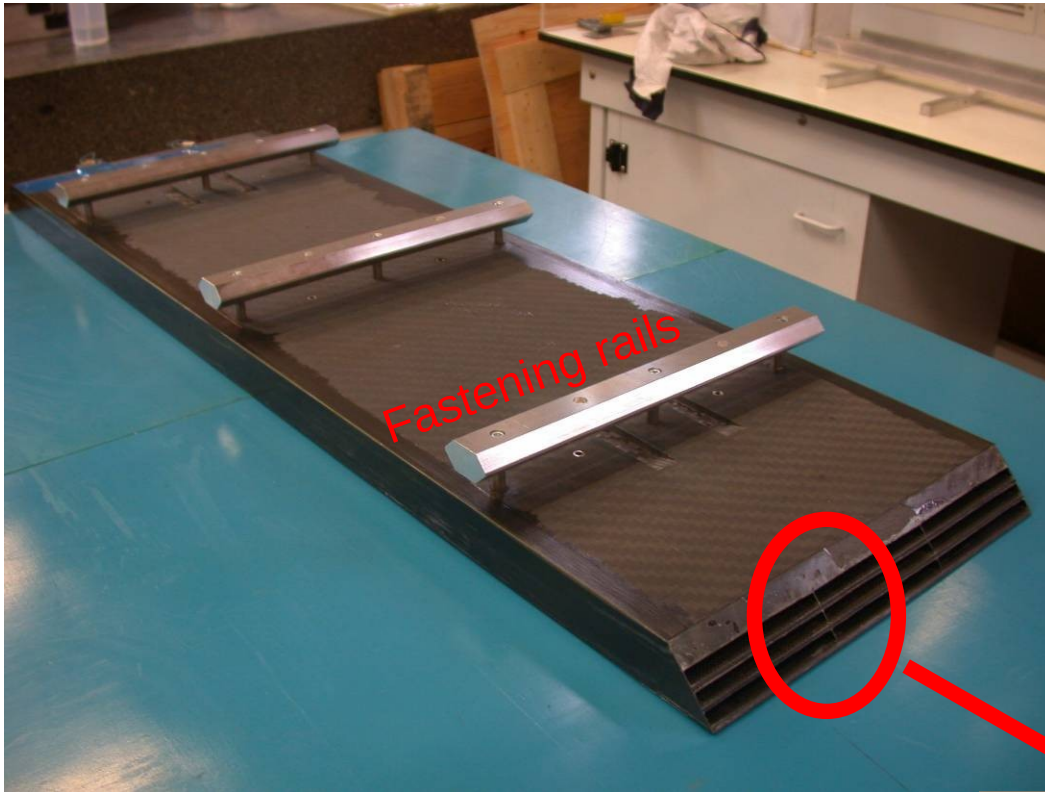
Then make “H” structures



LM

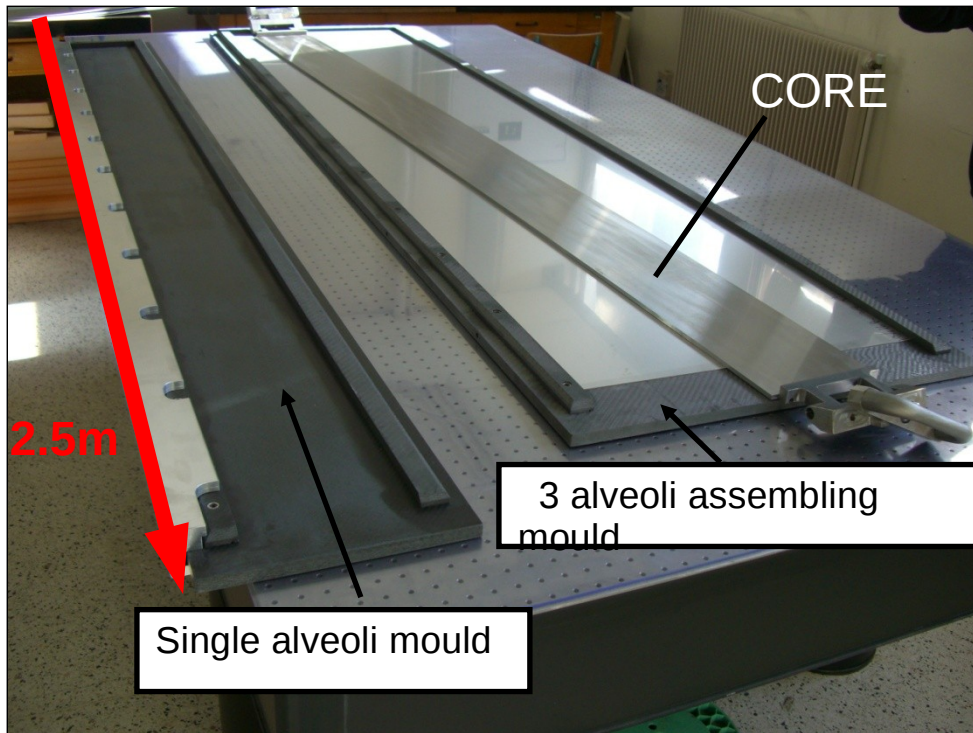
Mechanical structure

Reminder:
small “demonstrator”
module already produced

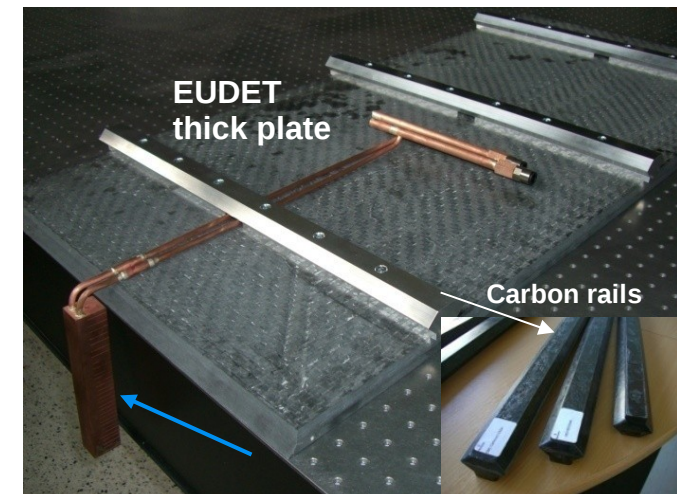


LM

ECAL endcaps require alveoli up to 2.5m long: studies in progress



First attempt:
extraction of “core” after curing not possible
-> change to Al core for next attempt

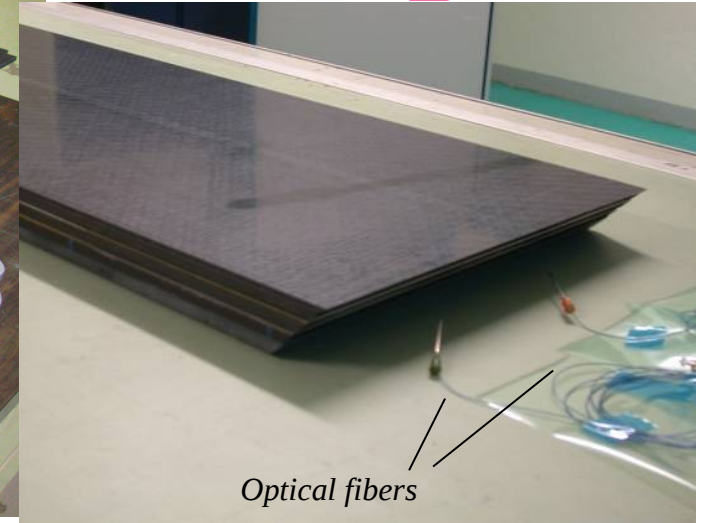
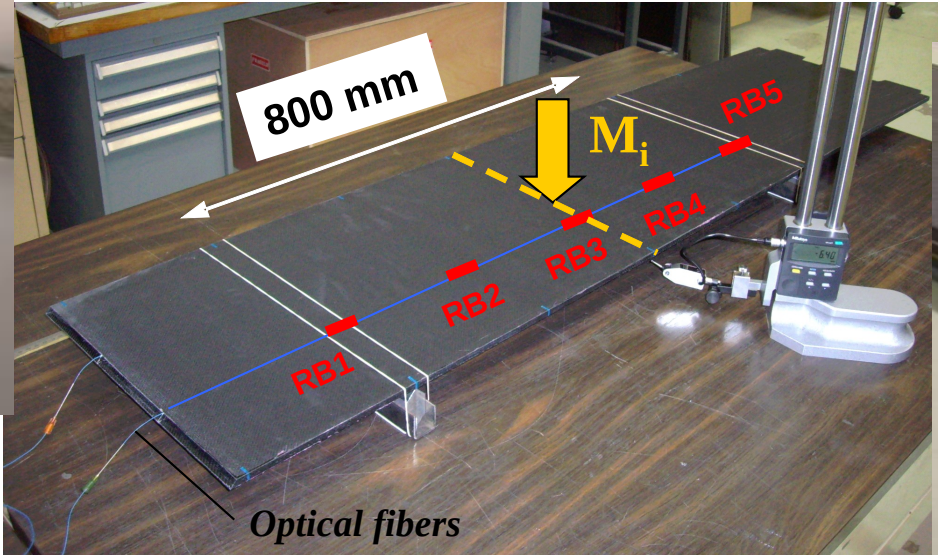


A column (cooling pipe), (25 mm wide minimum) to ensure quick thermal system's connection

Mechanical tests using optical fibres with Bragg grating

LM

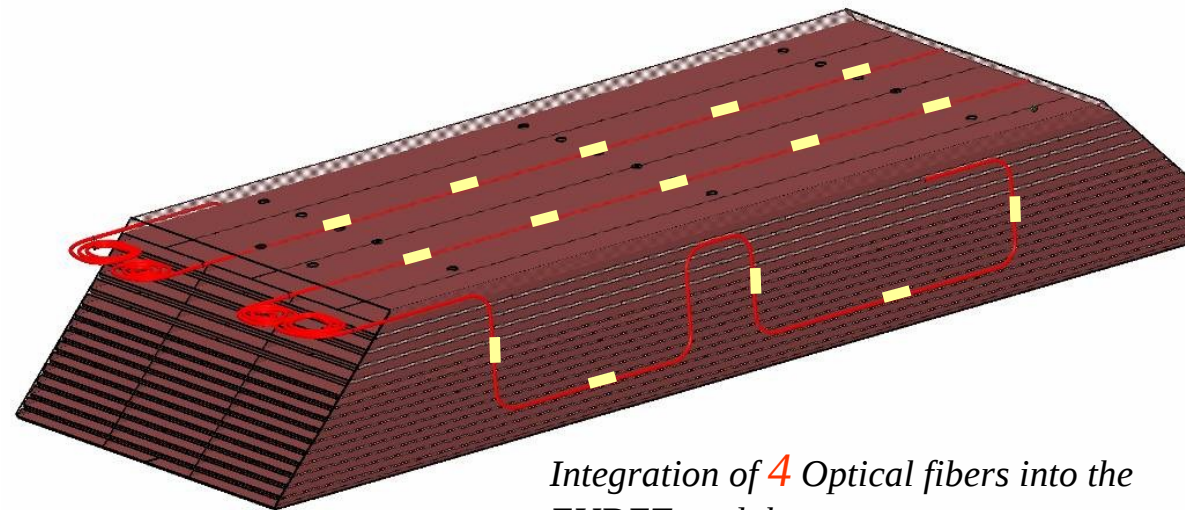
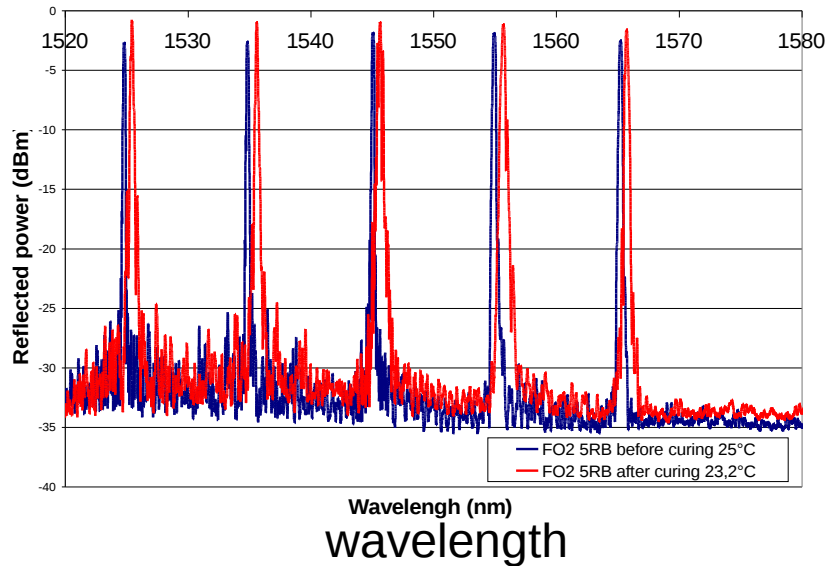
Fibres integrated into composite structure
Allows measurement of deformations and stresses



Bending 3pts tests to validate the principle on alveolar layer

*Preparation of similarly tests on demonstrator
+ destructive tests !!!*

RB1 RB2 RB3 RB4 RB5



*Integration of 4 Optical fibers into the
EUDET module :
Correlation : Tests + Simulations*

cooling system

design and construction

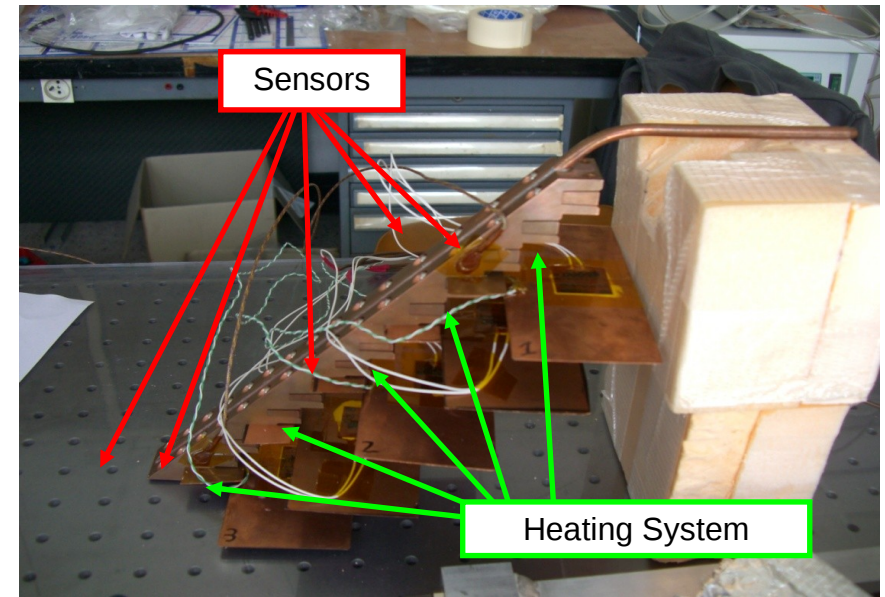


Extract heat produced by FE electronics and DAQ
at only one end of module

Equalise temperature along detector slab
500 micron copper heat drain

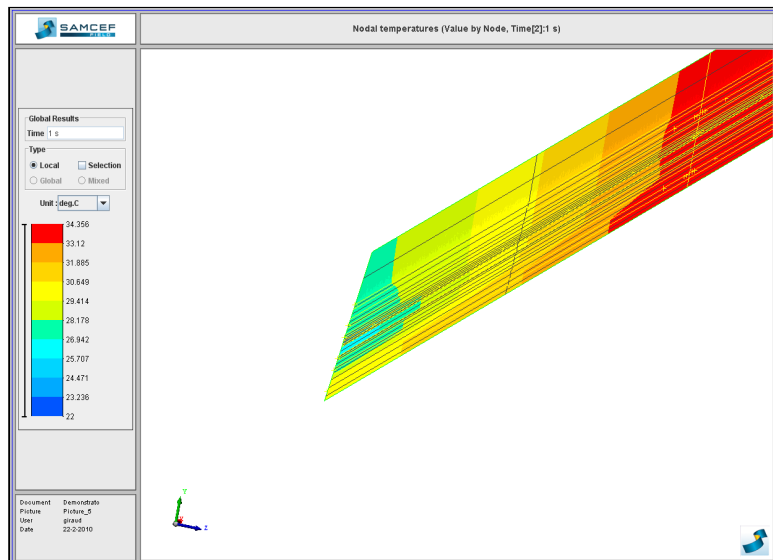
Water-based cooling system
< atmospheric pressure (leaks)

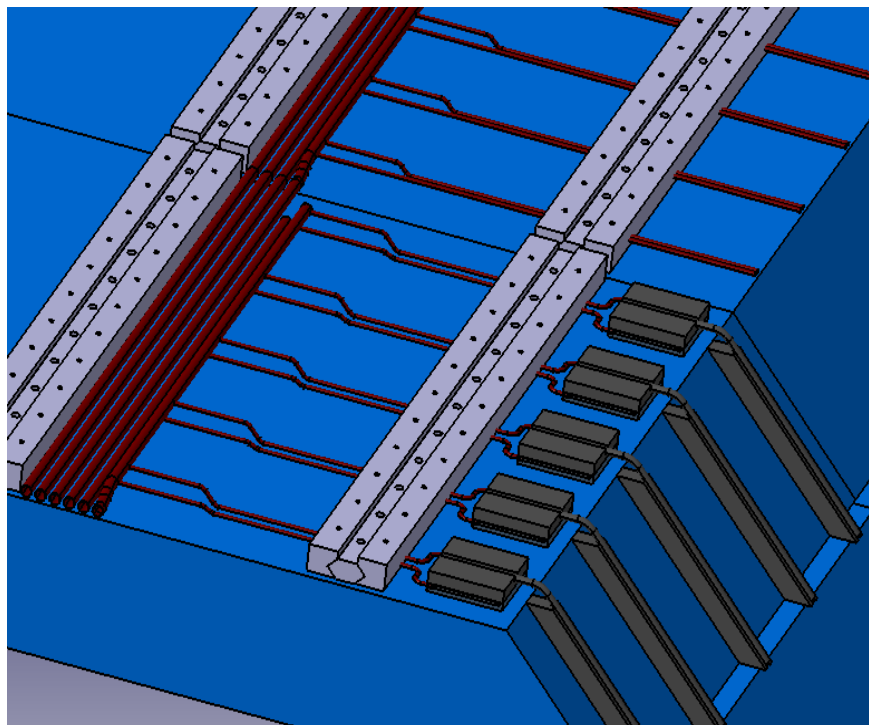
Two systems under study:
Direct water circulation in heat exchanger block
Intermediate Caloduc 2-phase heat pipe



Thermal tests

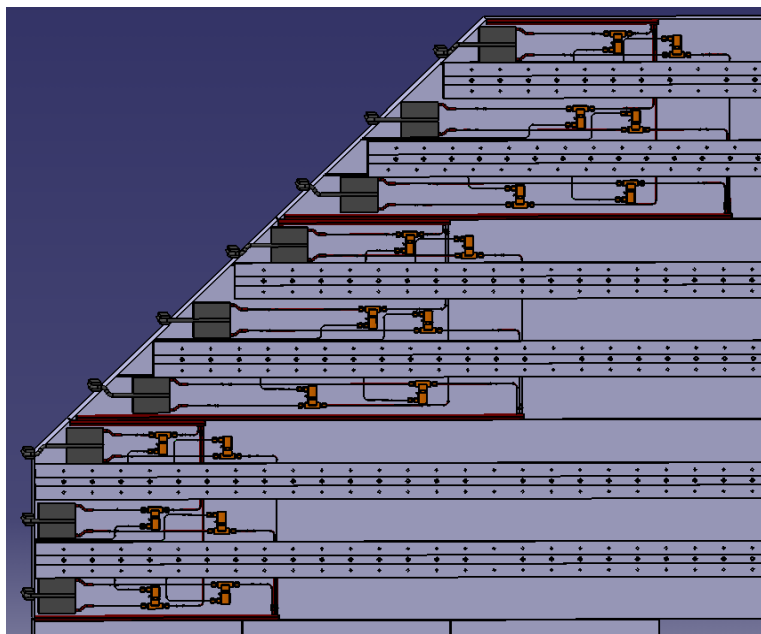
Thermal simulations





Barrel

Endcap



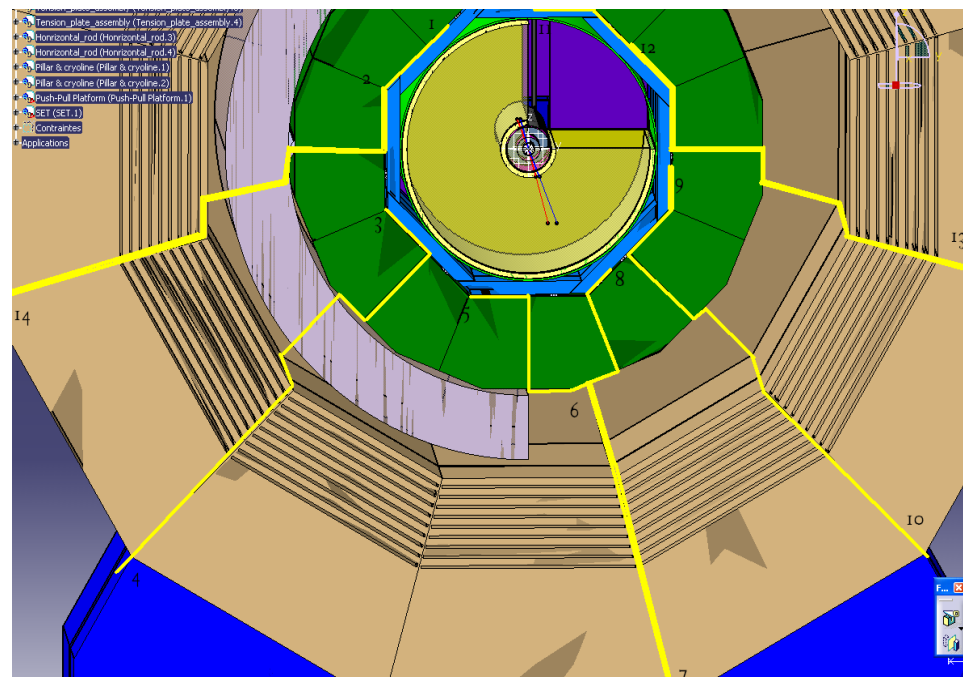
Integration of cooling system

Into ILD-like detector

In ECAL-HCAL gap

Extract up to 150W per column

Passage of pipes to exterior



Silicon sensors



- PIN diode matrix in high resistivity silicon
Segmented into $5 \times 5 \text{ mm}^2$

- move towards industrialisation

Discussions with several possible manufacturers

HPK (with Japan colleagues), OnSemi, PerkinElmer...

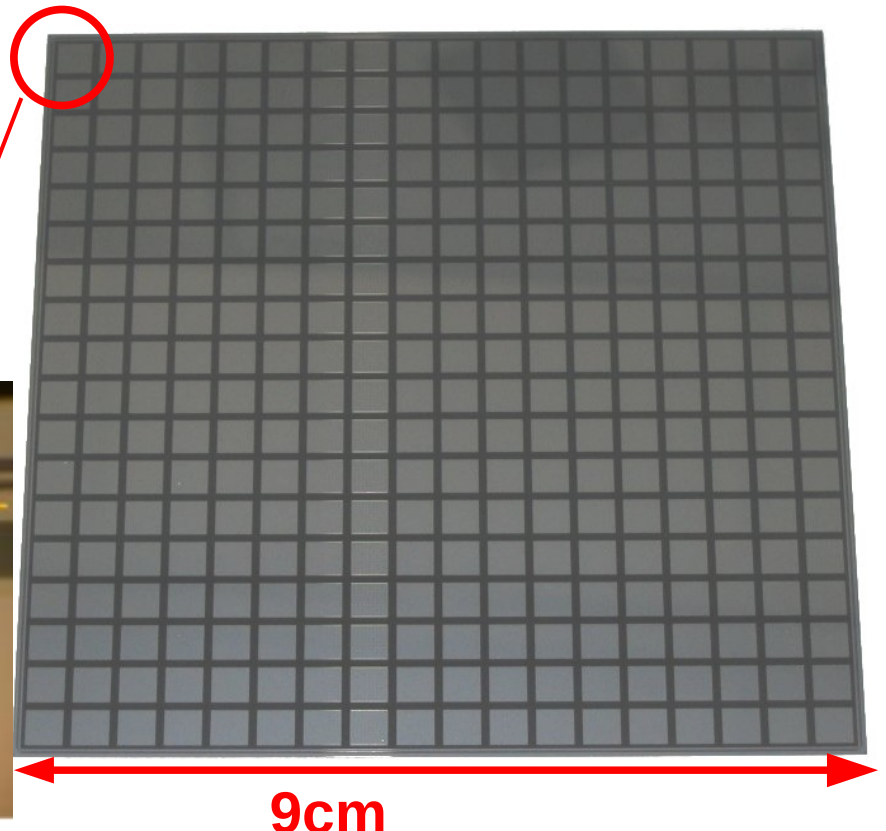
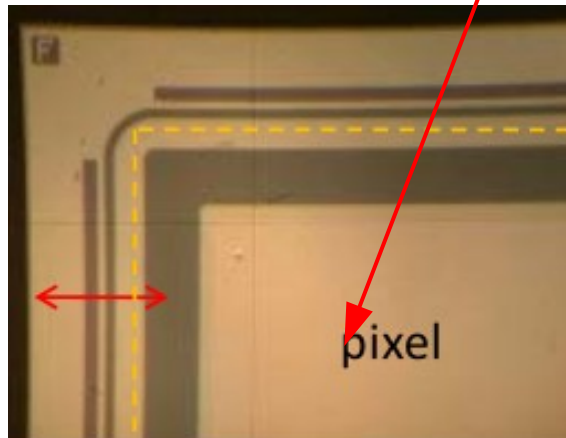
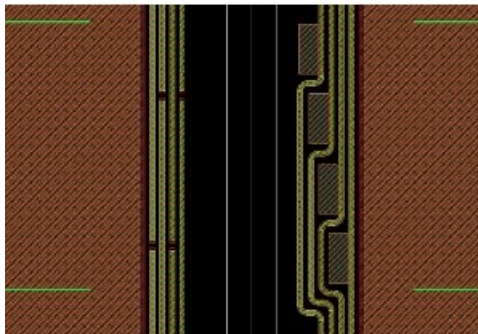
Understand and reduce price

Relax some requirements (leakage current, dead pixels, breakdown voltage...)

Give manufacturers freedom to alter some design details
(sensor size, thickness, guard ring design...)

Small production runs for Technical Prototype
now have 40 sensors from Hamamatsu
(~160 sensors in total, several manufacturers)

- study of cross-talk effects at sensor edge
Guard ring design



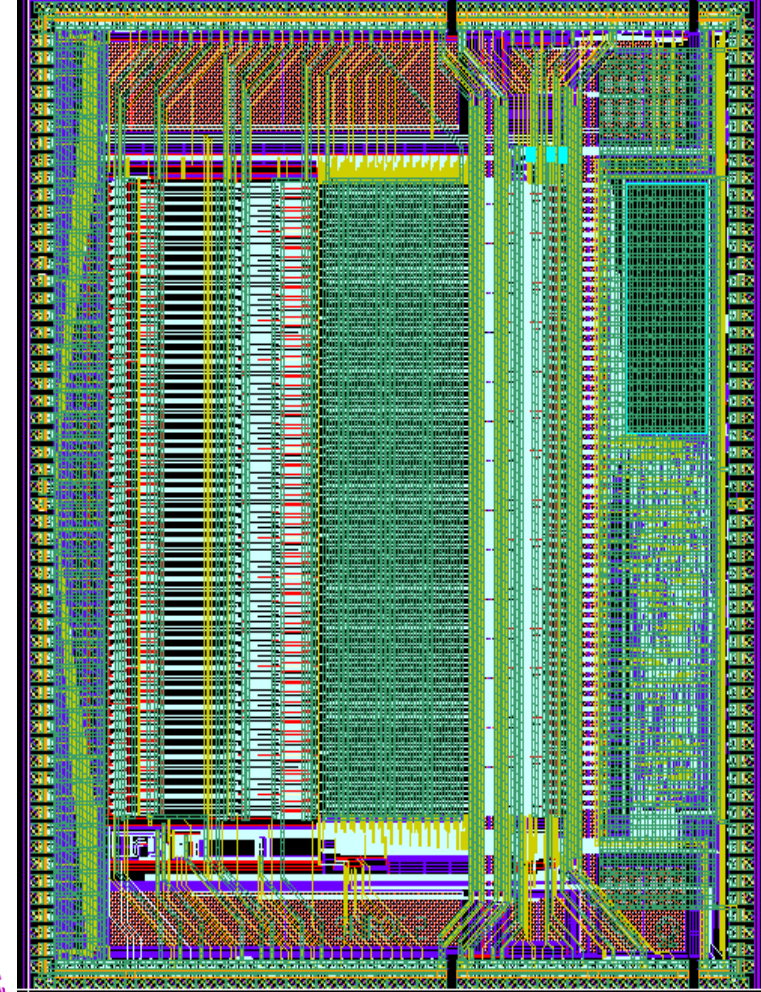
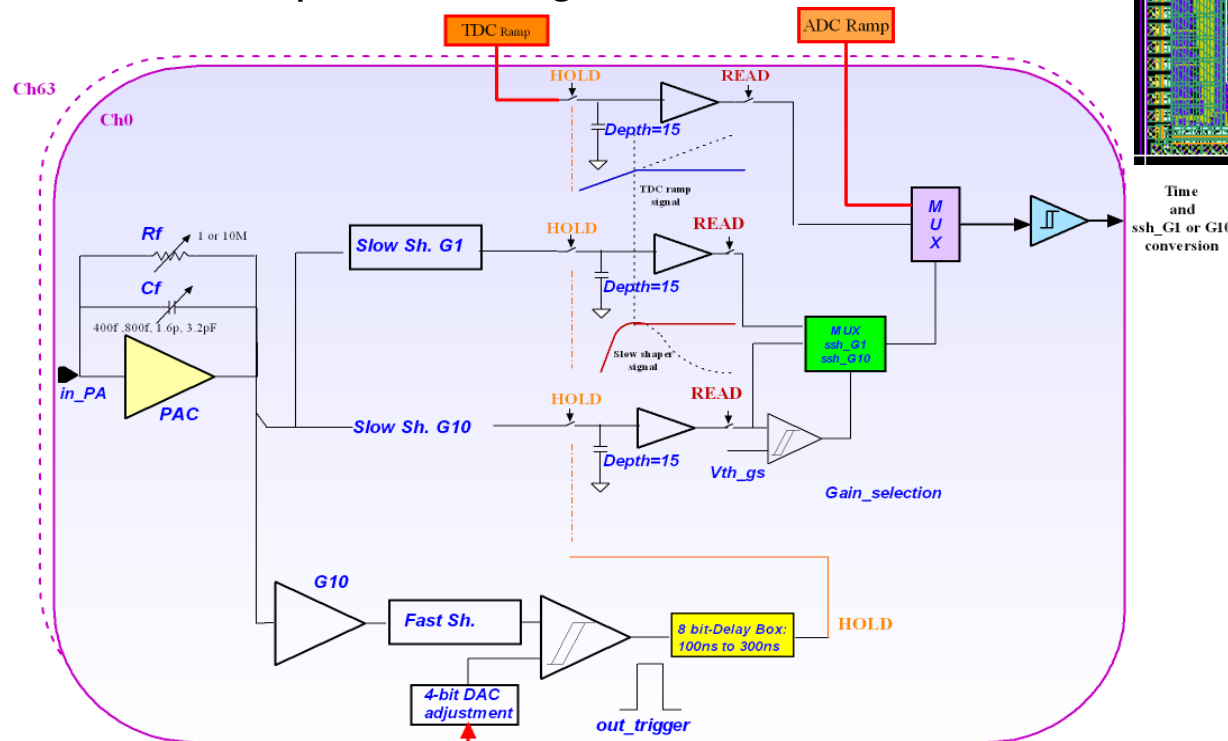
Front End electronics

SKIROC2 chip has been manufactured

- 64 channels
- hi/lo gain
- 12 bit ADC
- ~25 microW/channel (power-pulsed)
- >1500 produced

A few packaged for easier testing
Tests underway

Will be used unpackaged in detector
Probe station required for large-scale tests



Time and
ssh_G1 or G10
conversion

Omega

PCB

holds silicon sensors, embedded FE electronics

strong constraint on thickness

keep effective Moliere radius small

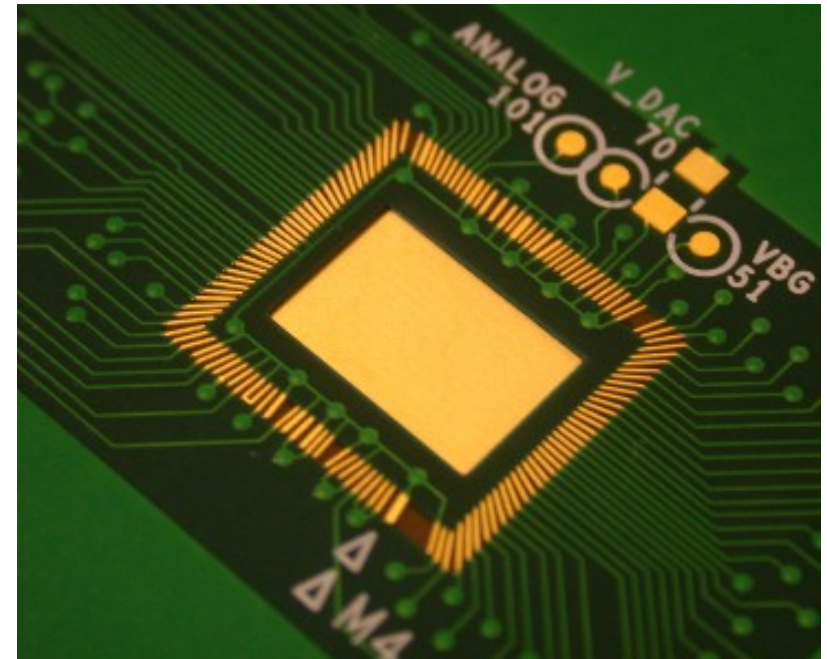
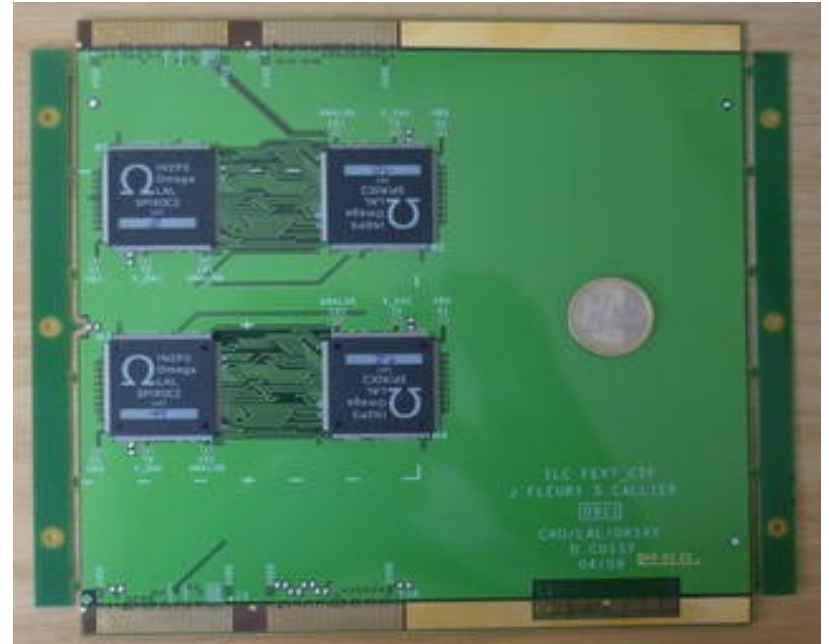
1 PCB (18x18 cm²) will hold
4 silicon sensors (9x9cm²)
16 SKIROC2 chips (unpackaged)
1024 channels

Several prototypes produced in different configurations
(e.g. packaged chips)

Production of boards for prototype will be
50% France
50% Korea

Wire bonding of SKIROC2 to PCB will be @ CERN

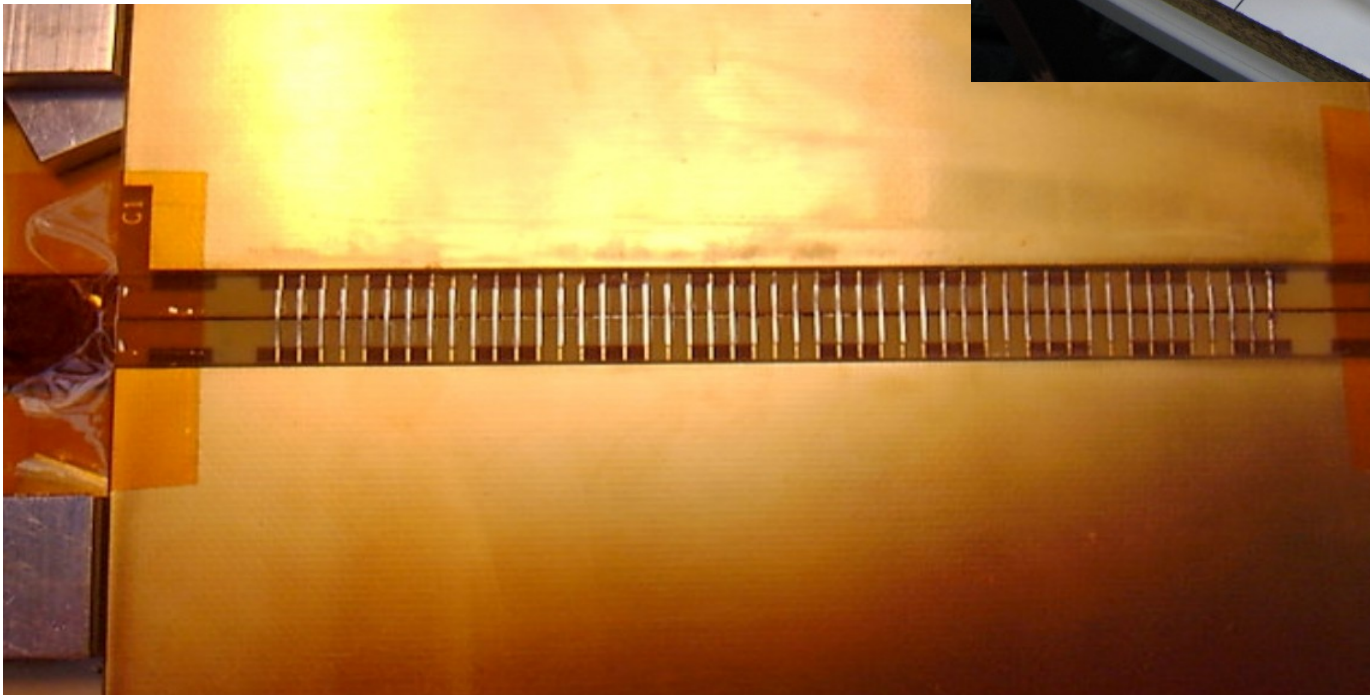
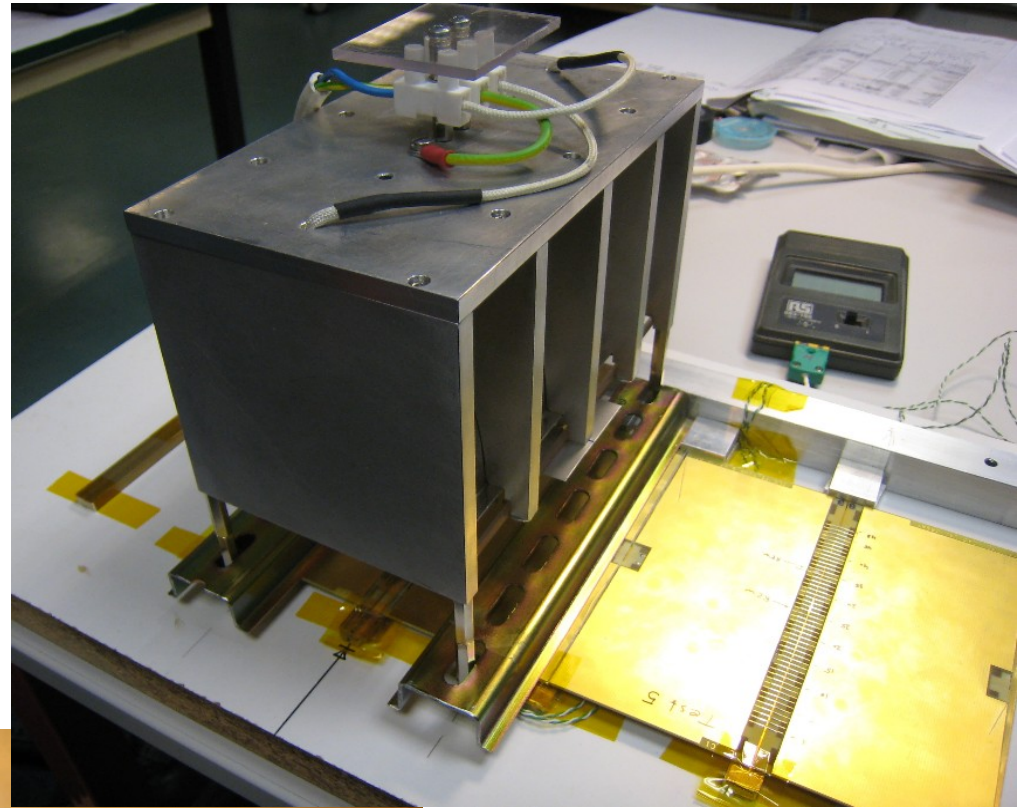
Omega



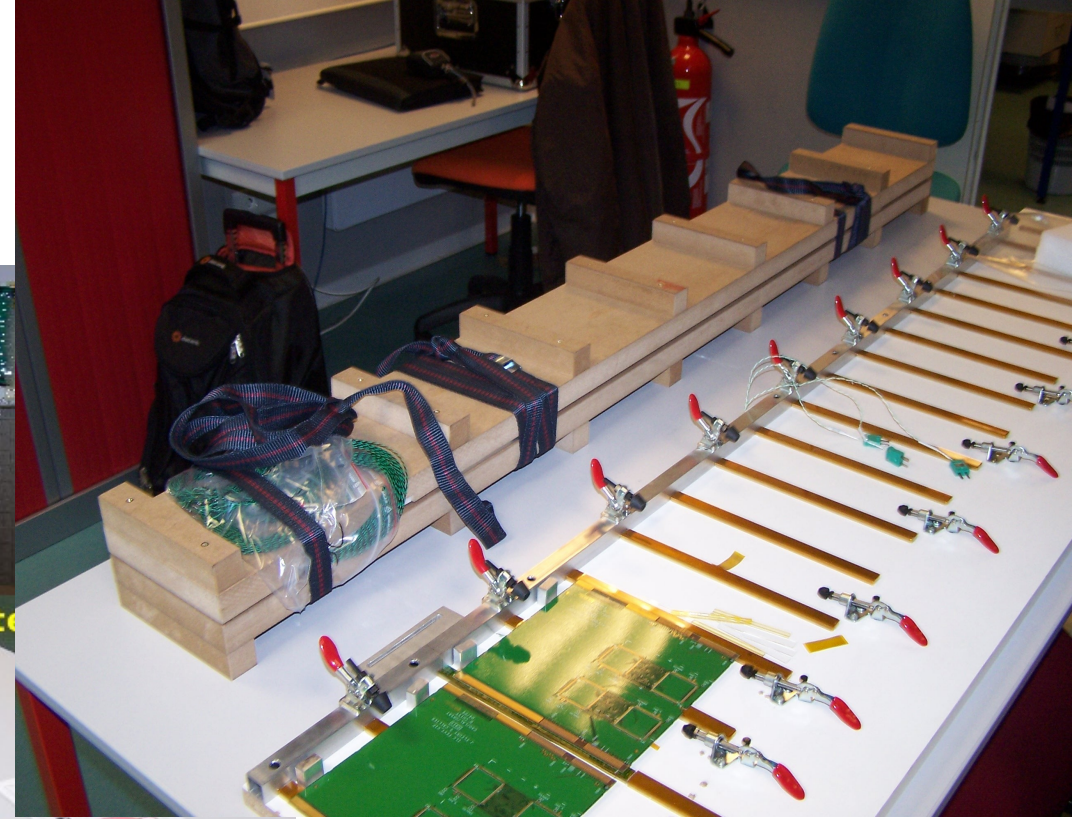
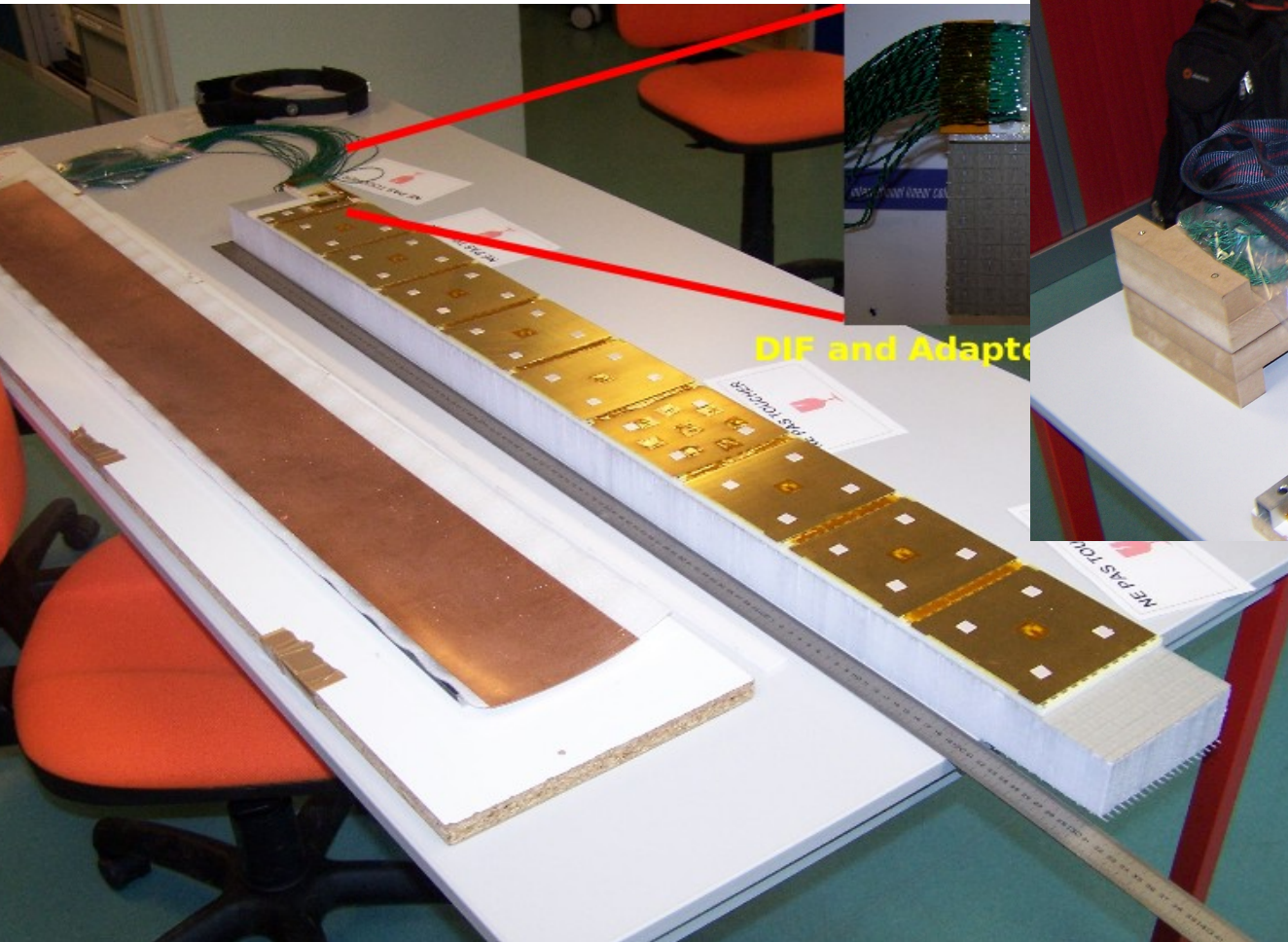
Slab soldering

Halogen lamp soldering

Tested on thermal module



Integration of detector slabs

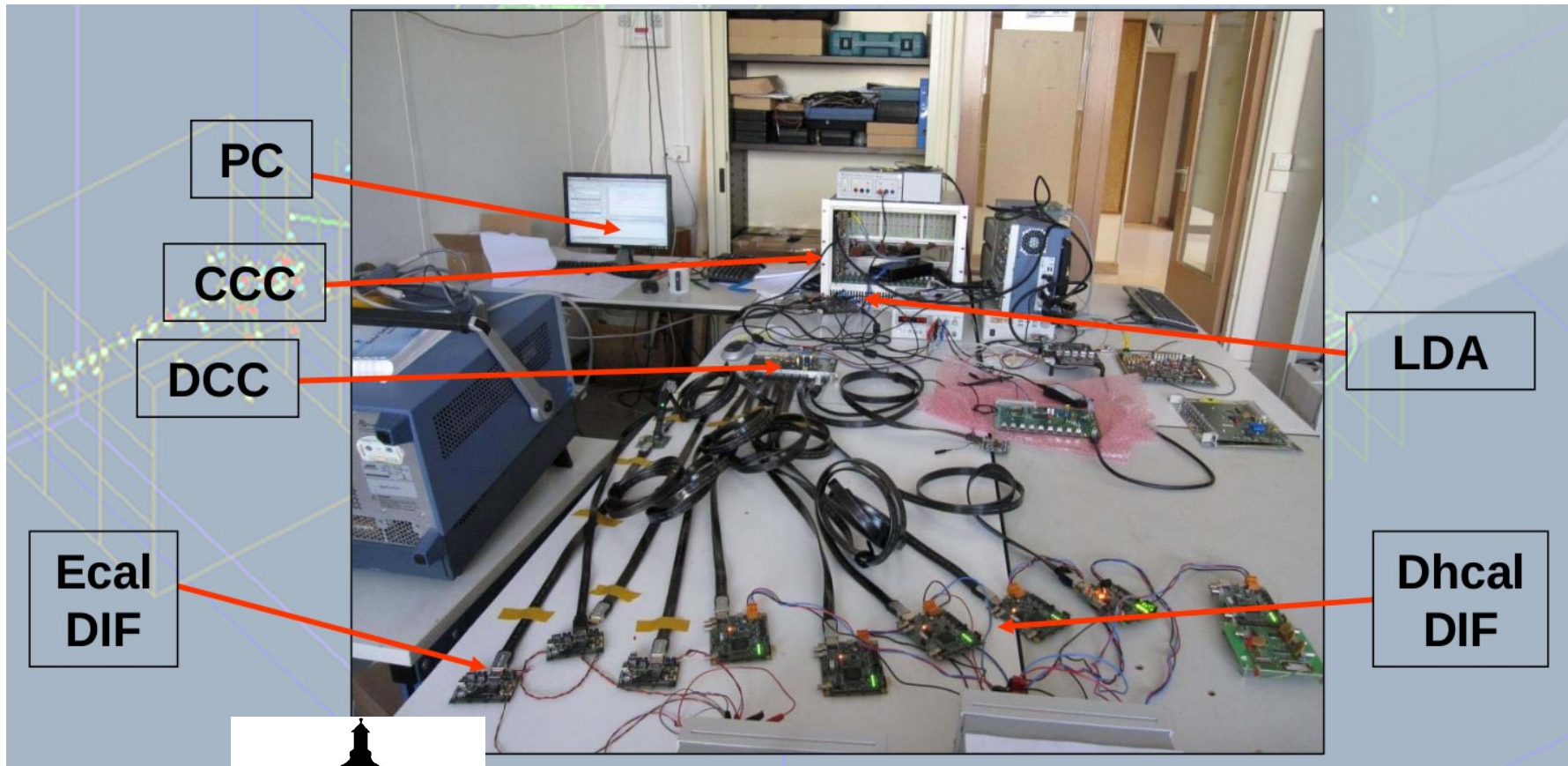


Equipping of dedicated room at LAL will start soon
Slab assembly
Insertion into structure

DAQ

Common CALICE system

Becoming operational: see talk by V. Boudry



Summary

Mechanical structure finished by end of year
endcap mechanics studies progressing

Cooling system studies for prototype (and for ILD) well advanced

Moving towards industrialisation of sensors

new FE ASIC (SKIROK2) produced
testing underway

FE board coming in near future

Dedicated room for slab construction in preparation

Tests of first detector slabs 1st half 2011