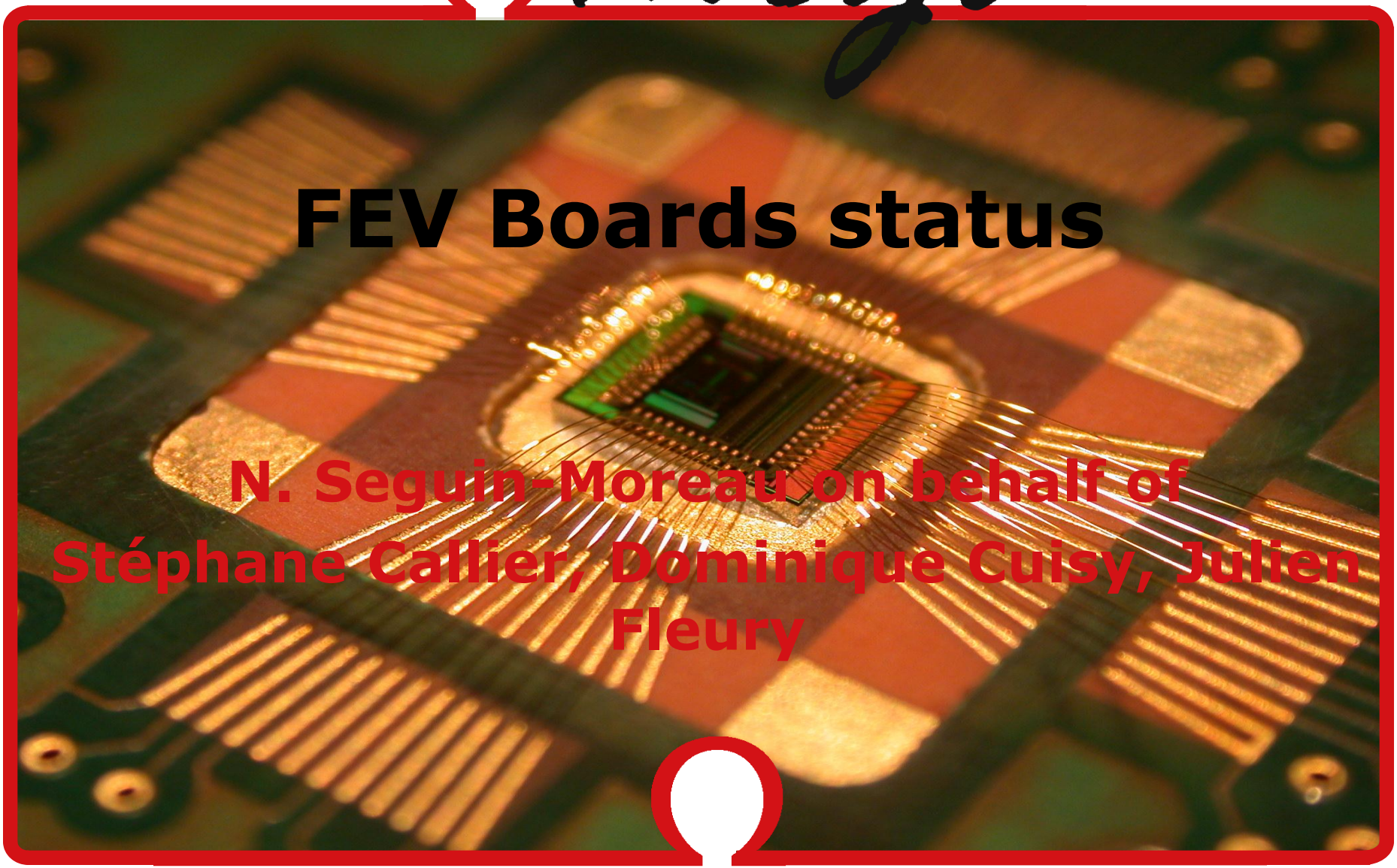
IN2P3 CSNSM LAL LPN IPN rsay

Omega



FEV Boards status

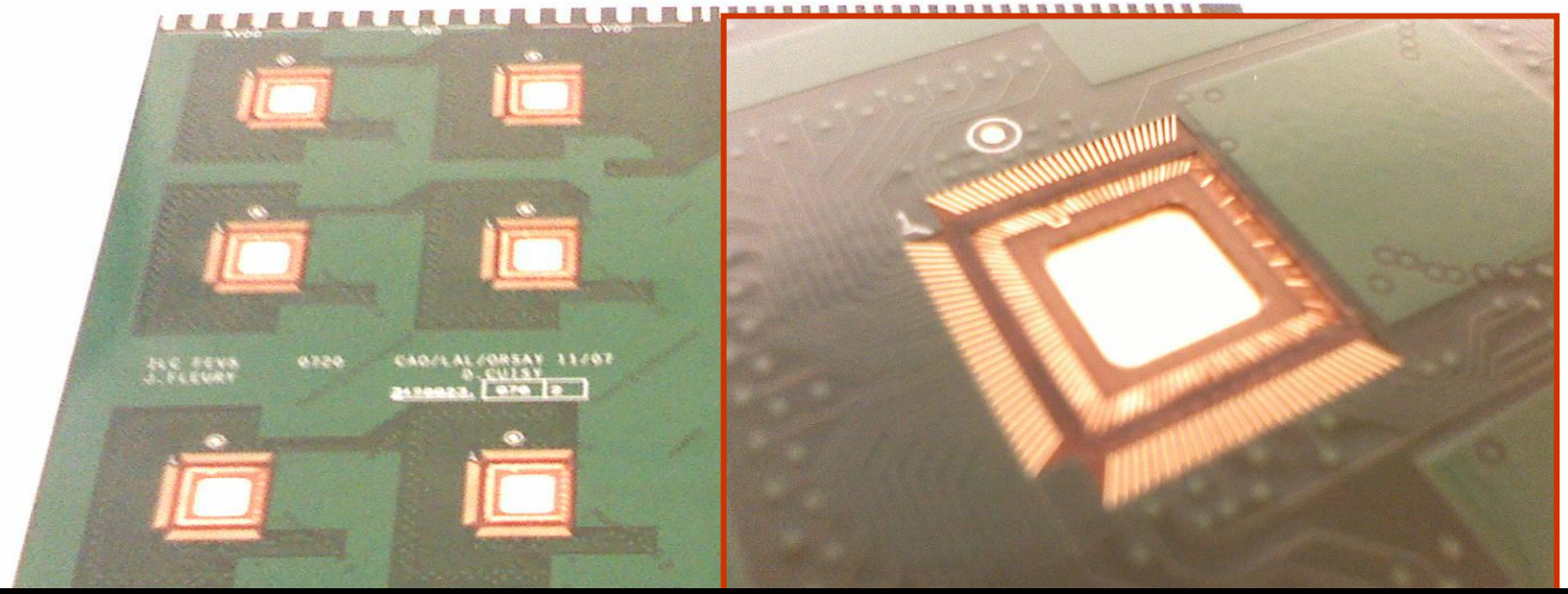
N. Seguin-Moreau on behalf of Stéphane Callier, Dominique Cuisy, Julien Fleury

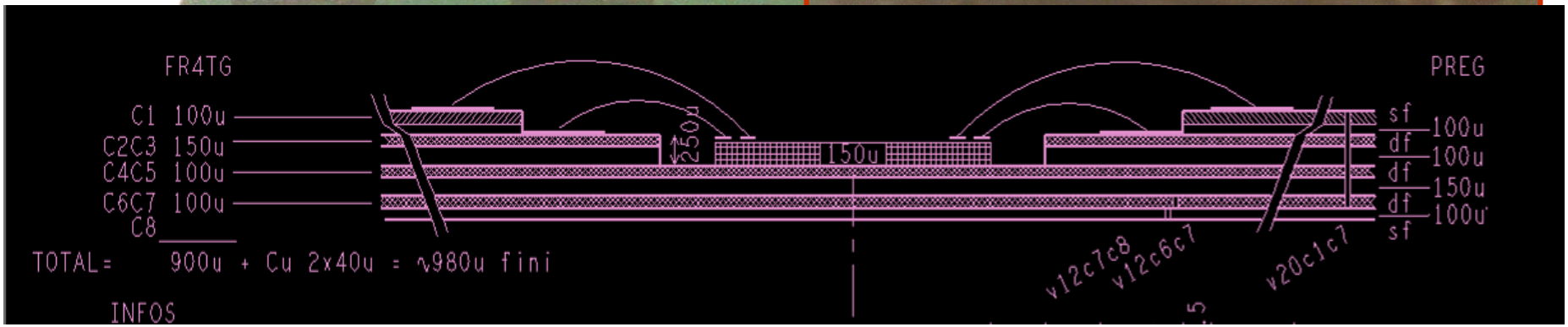
Orsay MicroElectronics Group Associated

Reminder : FEV5 with HARDROC1

HARDROC1: 240 staggered pads

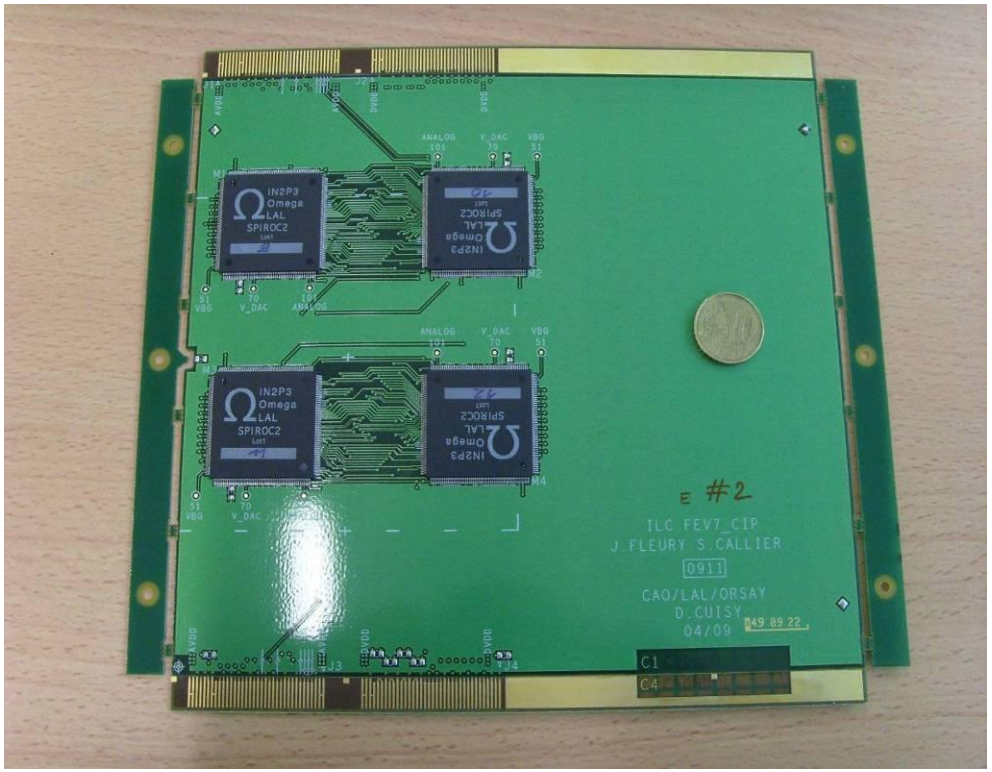
FEV5: too difficult to manufacture, bad quality of the bonding pads





FEV7-CIP: with SPIROC2 in TQFP208

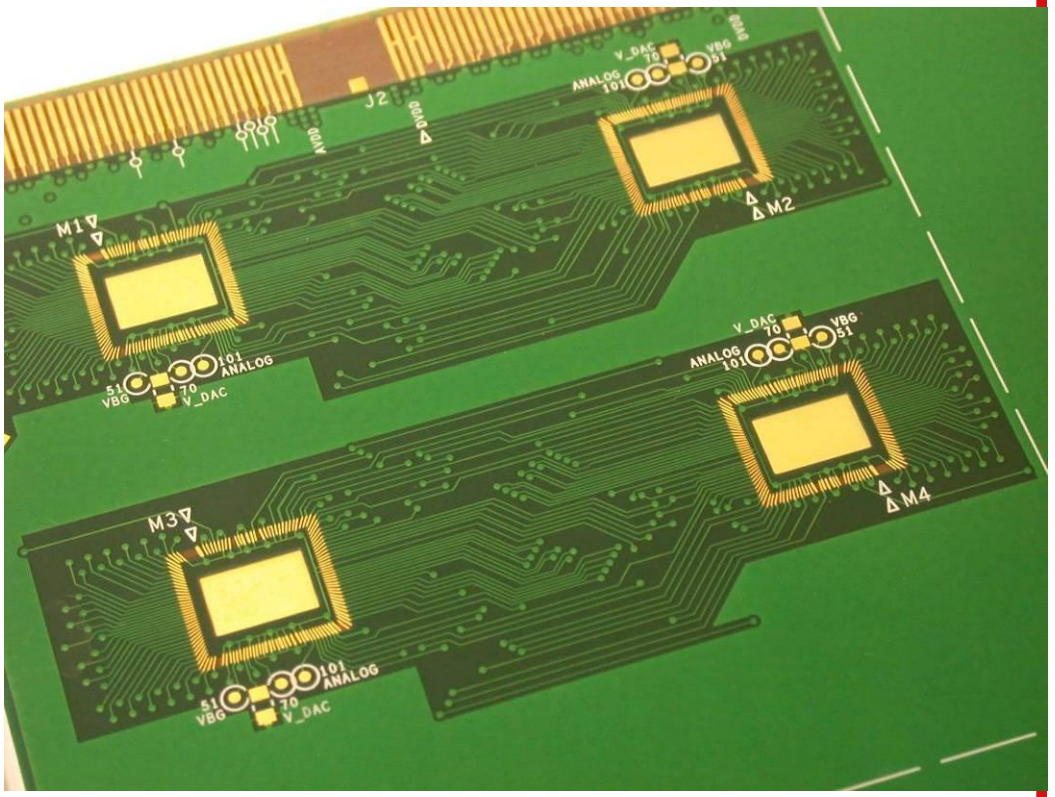
- Easy to manufacture
- Interconnexions tests: perofmed successfully (P. Cornebise)
- Perfect for DIF debug
- Fits the H structure



- 2 boards are equipped with 1 chip and 1 PCB equipped with 4 chips
- On the board access to :
  - Analogue Output
  - DAC and Bandgap Output
- On the connector, access to :
  - Every common digital line

FEV7-COB: with SPIROC2 COB

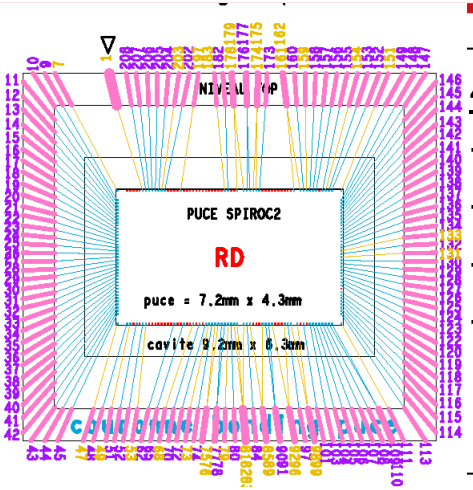
- Front End Board using Chip-On-Board (spiroc2=208 pads)
- Nearly Identical to Chip-In-Package FEV7
  - Schematics identical
  - Same number of channels
  - Same pinout on Adapter Board/Slab Connector
- Except :
  - Pads connections to chip pins
  - Position of Wafer on the bottom side
  - Thickness: thinner to comply with H alveolar structure



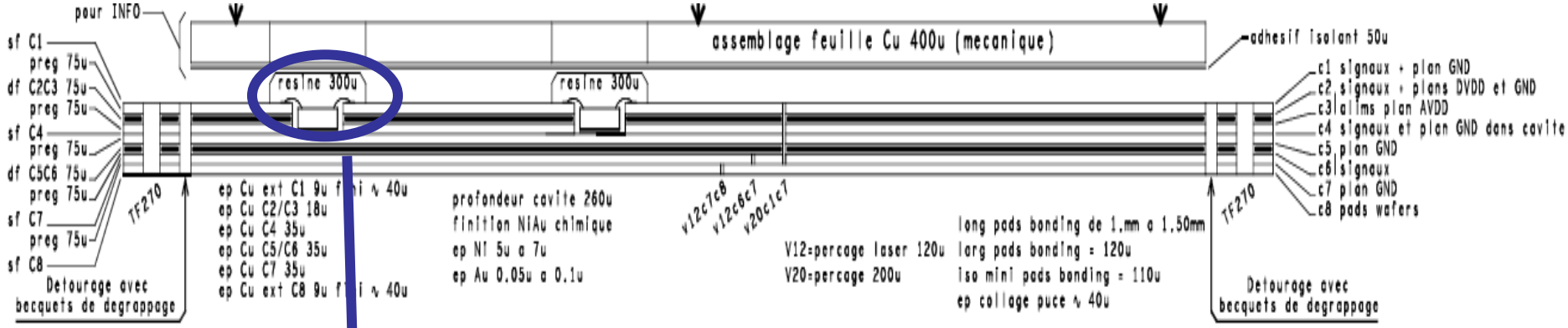
FEV7 COB: Chip Embedding

Pile-up

TOP	GND + Input chip signal
C2	horizontal routing + DVDD + GND
C3	AVDD
C4	GND + vertical routing
C5	GND (pads signal shielding)
C6	pads routing
C7	GND (pads shielding)
BOT	PADS



4 drilling sequences :
- Laser C7-C8 120µ filled
- Laser C6-C7 120µ
- Mechanical C1-C7 200µ
- Mechanical C1-C8 (for PCB fastening)

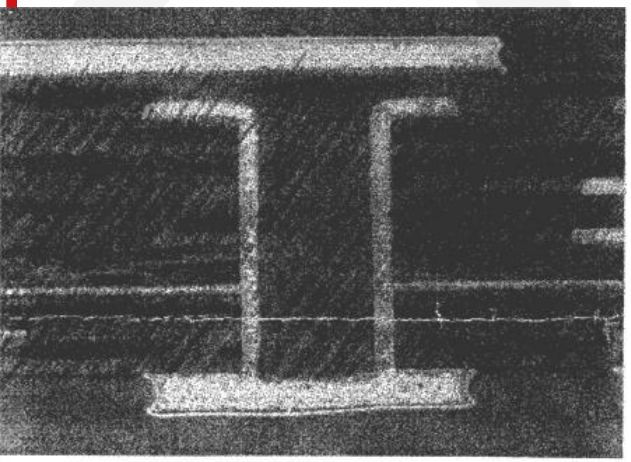
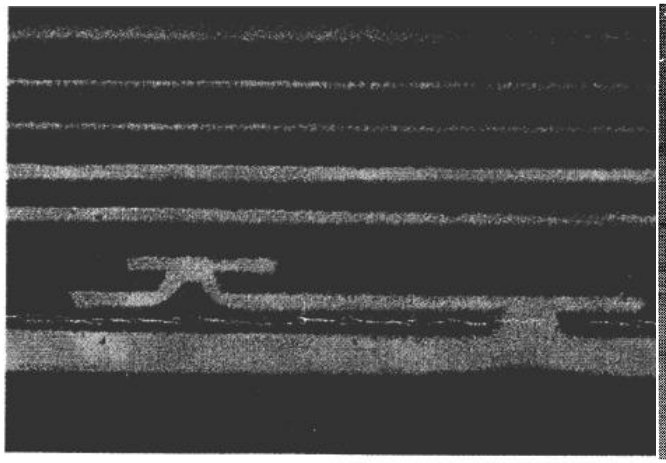
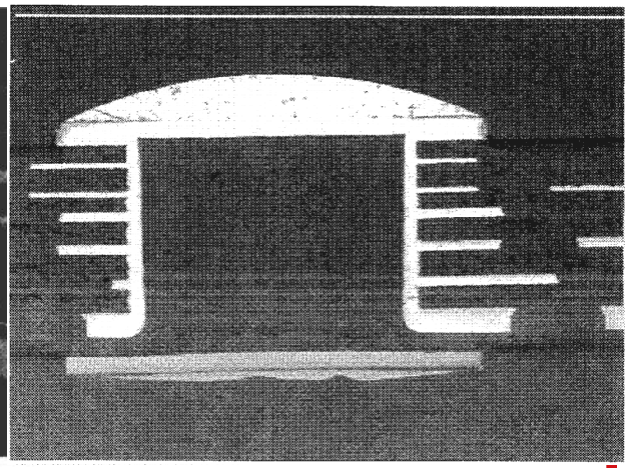


Resin (300µm) for chip protection

PCB Thickness ~781µm

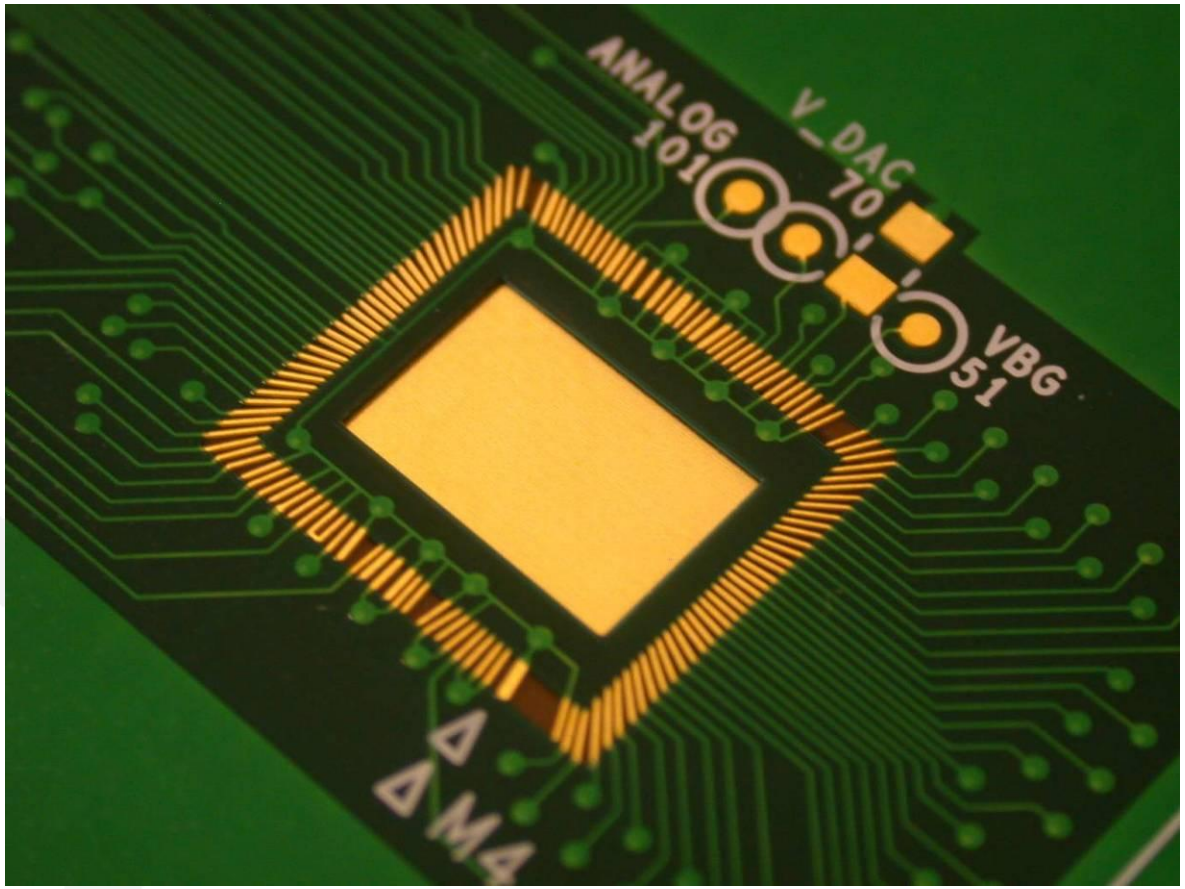
FEV7-COB Report

- 2 Manufacturers :
  - Elvia : 6 PCB received (2 batchs)
  - Protechno : 6 PCB received (2 batchs)
- Mechanical report :
  - Manufacturers Measurements :
    - 0.83mm Elvia, 0.93 Protechno
  - LLR Measurements :
    - between 0.83 & 0.94 for **both** boards
- Plated Through Hole Cross Section :

FEV7-COB: BONDING

- 2 PCB FEV7-COB fully bonded



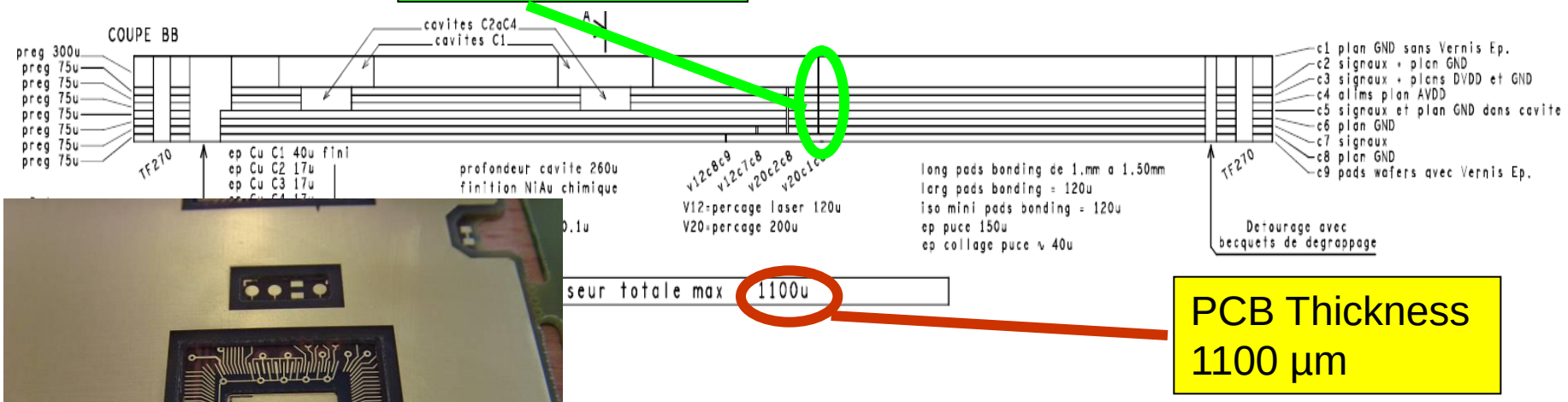
  - We have an official agreement with CERN for free bonding
    - Reminder : 1830 € for 2 boards (8 chips -> ~800 wires to bound)
  - Still resin pb for chip protection: to be solved
    - We have to keep a low thickness of the cabled PCBs

FEV7- COB2:

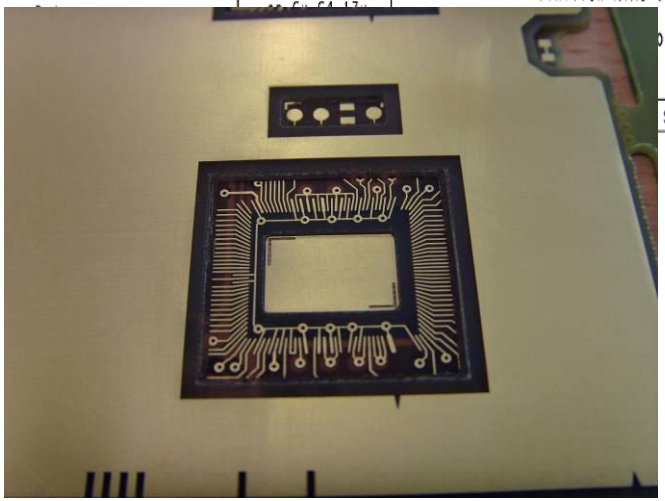
Pile-up: 10 layers	
Top	cover layer connected to GND
C2	GND + Input chip signal
C3	horizontal routing + DVDD + GND
C4	AVDD
C5	GND + vertical routing
C6	GND (pads signal shielding)
C7	pads routing
C8	GND (pads shielding)
BOT	PADS

4 drilling sequences :
- Laser C8-C9 120µ filled
- Laser C7-C8 120µ
- Mechanical C2-C8 200µ
- Mechanical C1-C9 (for PCB fastening)

Drilling sequence



PCB Thickness 1100 µm



- No solder mask on TOP layer
- Fit the H structure, access to the analog signals
- TOP electrically linked to GND

=> **too difficult to manufacture (same pbs as for FEV5)** => FEV8

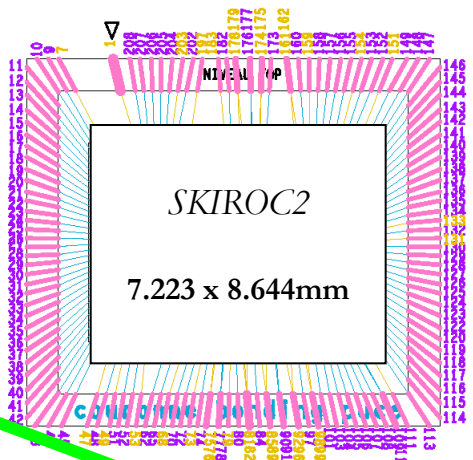
FEV8: Chip Embedding

Pile-up:

8 layers +FLOATING Mechanical interposer on the TOP

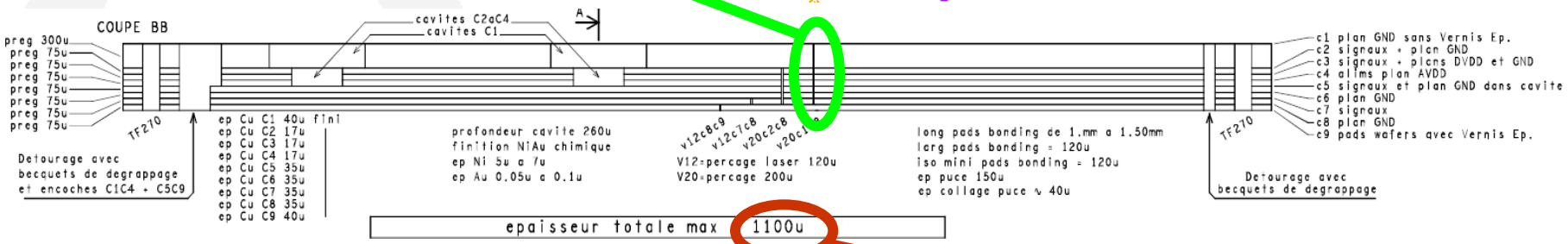
C1	GND + Input chip signal
C2	horizontal routing + DVDD + GND
C3	AVDD
C4	GND + vertical routing
C5	GND (pads signal shielding)
C6	pads routing
C7	GND (pads shielding)
C8	PADS

FEV 8



4 drilling sequences :
- Laser C8-C9 120µ filled
- Laser C7-C8 120µ
- Mechanical C2-C8 200µ
- Mechanical C1-C9 (for PCB fastening)

Drilling sequence removed

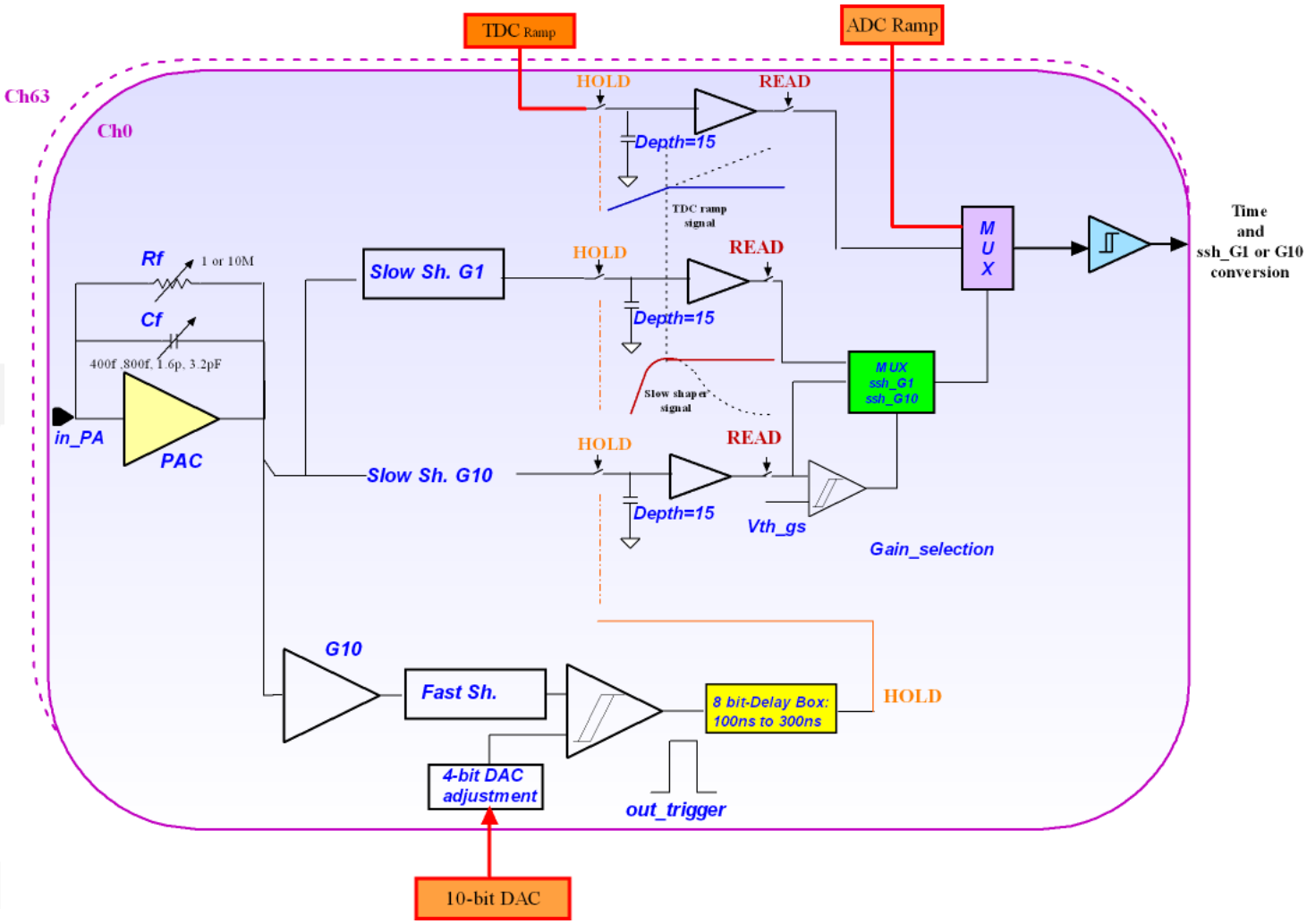


- PCB currently under design
- Fits the H structure, access to the analog signals
- Currently under design in collaboration with our Korean colleagues
- Will be equipped with SKIROC2 chips

PCB Thickness 1100 µm

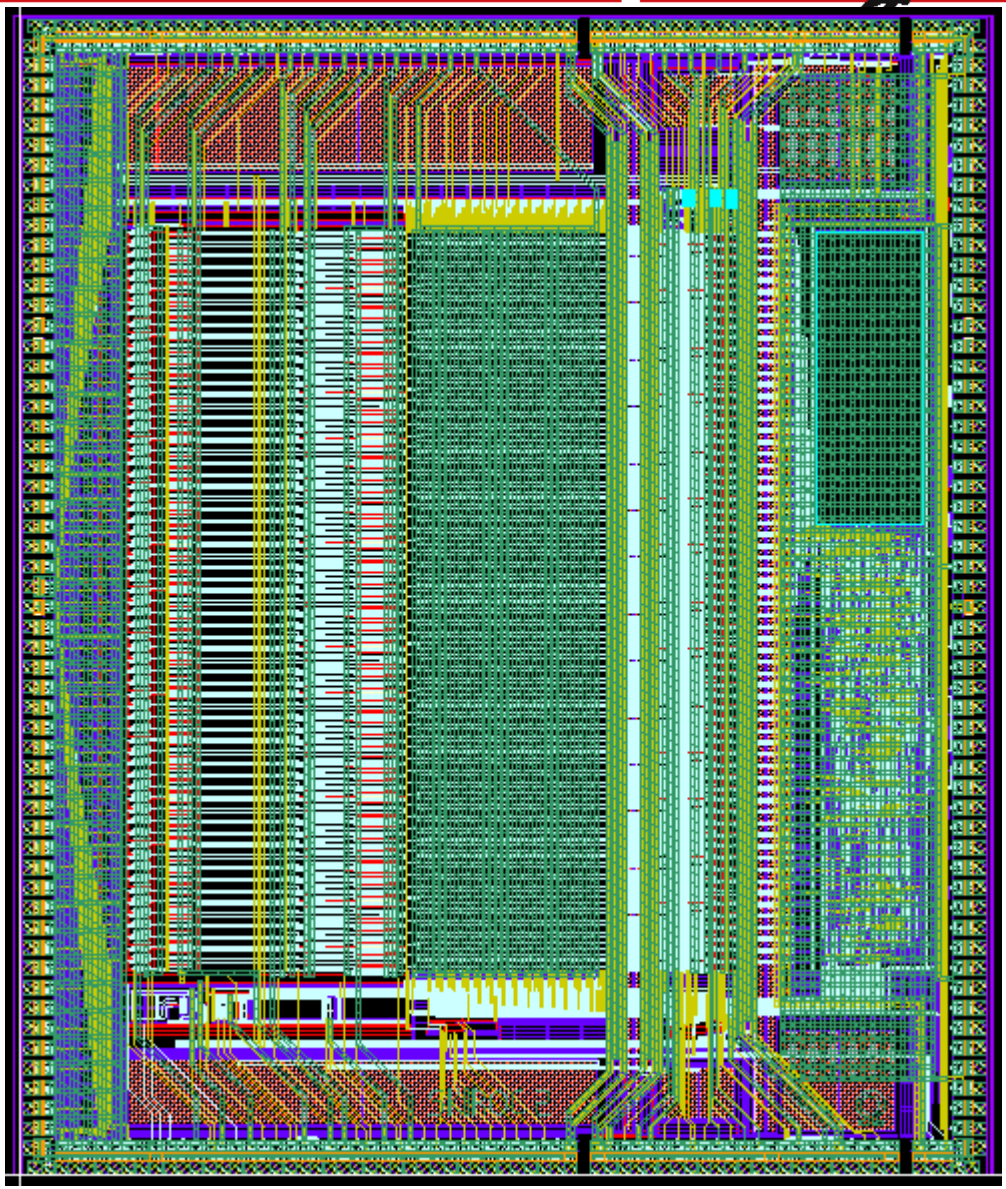
SKIROC2 (1)

- 64 inputs, 1/2 Mip to 2500 Mip (keeping the same gain)
- Analogue signal-to-noise ratio : 17 (1500 e^- noise for 1 MIP)



SKIROC2 (2)

- Submitted in the prod run (March 2010):
  - 1200 SKIROC2
  - Wafers sent this week to I2A technology (Fremont-USA) for thinning, dicing and packaging)
- 250 pads
  - 3 NC
  - 17 for test purpose only
- A few samples will be packaged in a ceramic 240 pins package to be tested easily on a testboard
- First tests foreseen next October

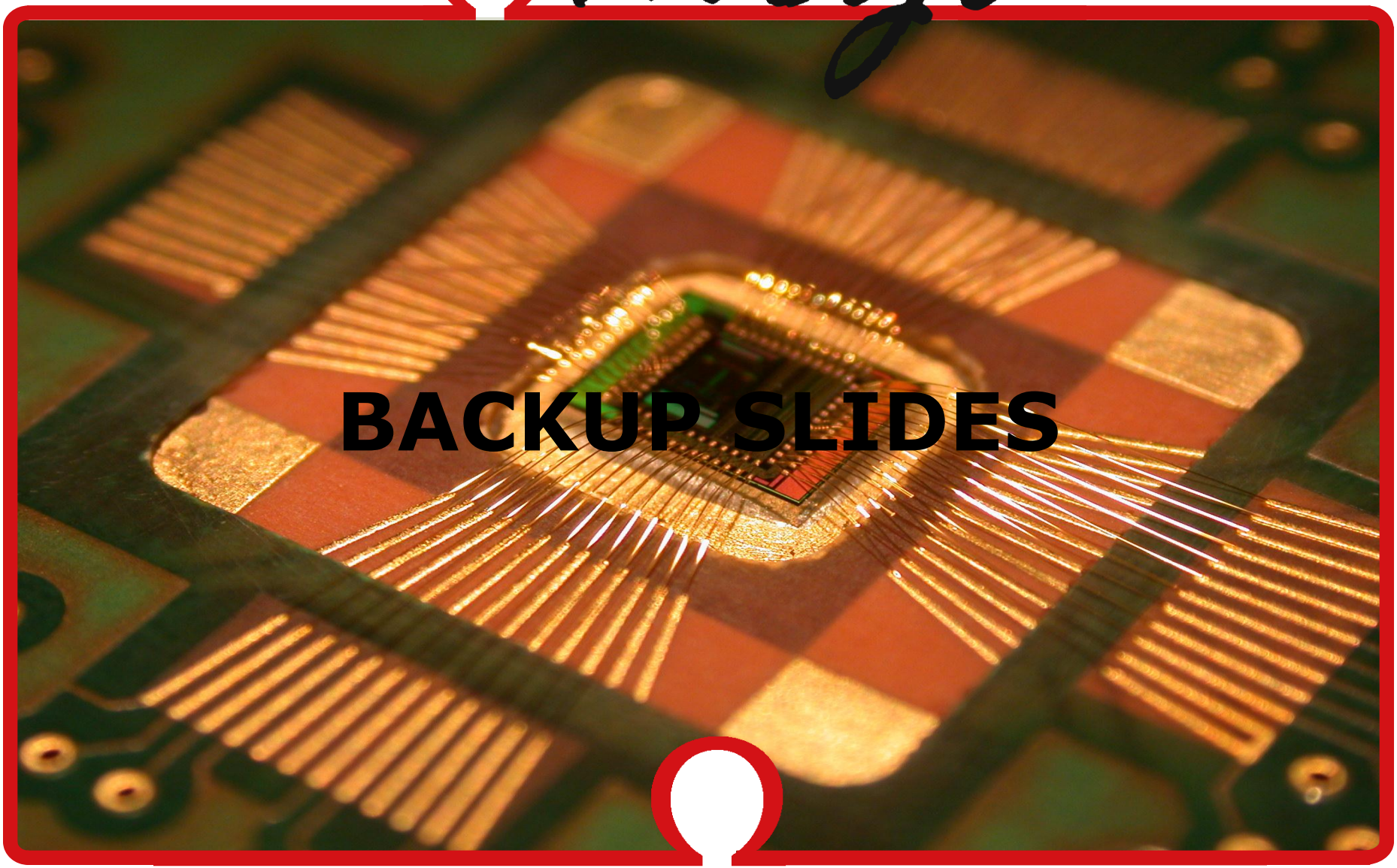


Summary

- No manufacturing critical issue with
  - FEV7-CIP
  - FEV7-COB
- No bonding issue with FEV7-COB for both manufacturers
- Next FEV8 will have 16 Skiroc2 chips
  - 1024 channels on 180 mm x 180 mm board
  - Our Korean colleagues (Sung Kyun Kwan University) should take in charge half of the next FEV8 production
- First tests of packaged SKIROC2 expected in October

IN2P3 CSNSM LAL UR IPN rsay

Omega



BACKUP SLIDES

Orsay MicroElectronics Group Associated

FEV7 Board(s)

5 mm x 5 mm pads size
180 mm x 180 mm wafer size
-> 324 pads on a ¼ board

36 channel areas

use of SPIROC2 (36 ch)
in SKIROC mode
-> 144 Channels (4 x 36)
will be used for Wafer Characterization

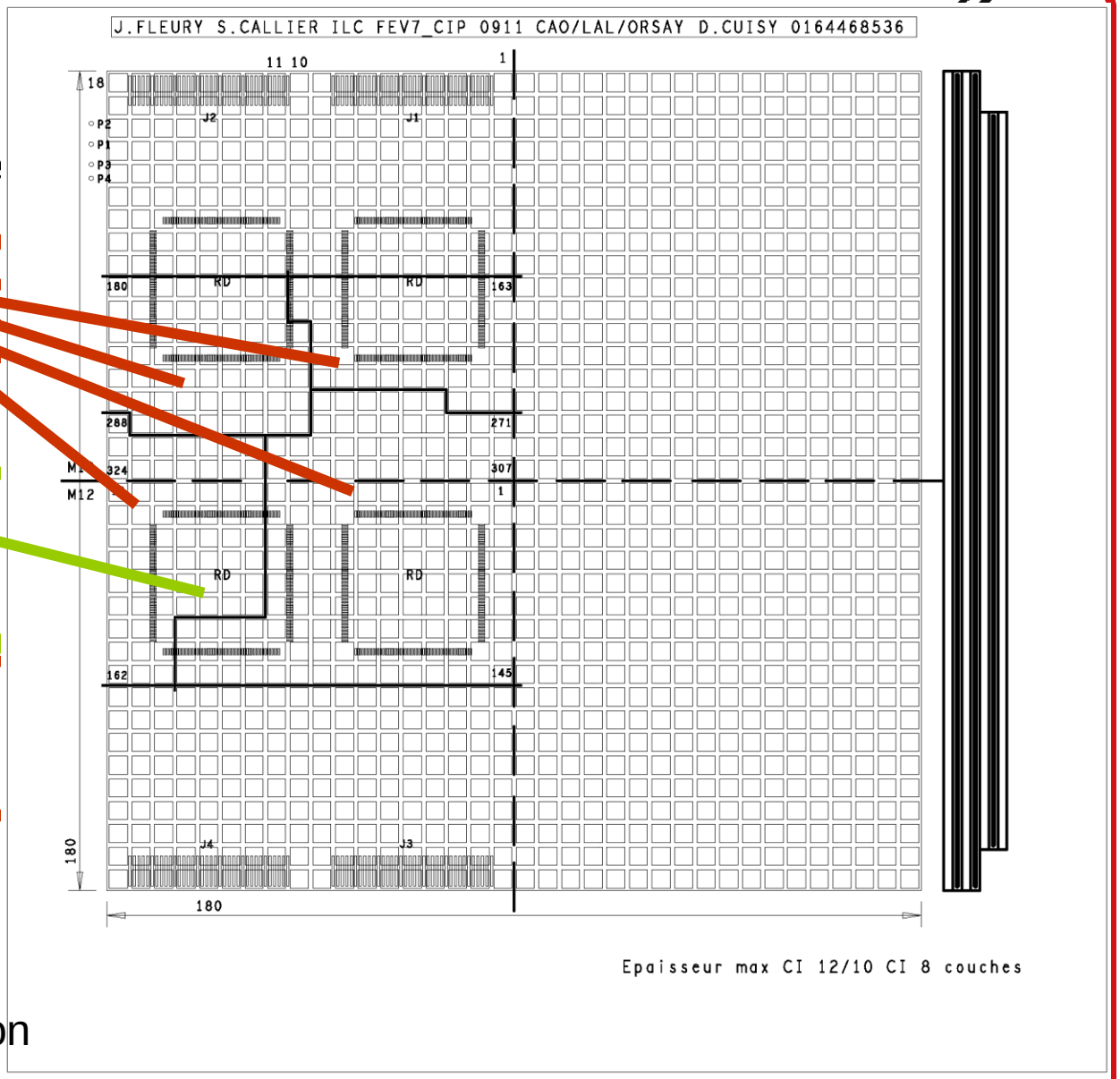
Chip in Package version

4 PADS merged

Why such a board ?
- Due to the troubles with FEV5 manufacturing

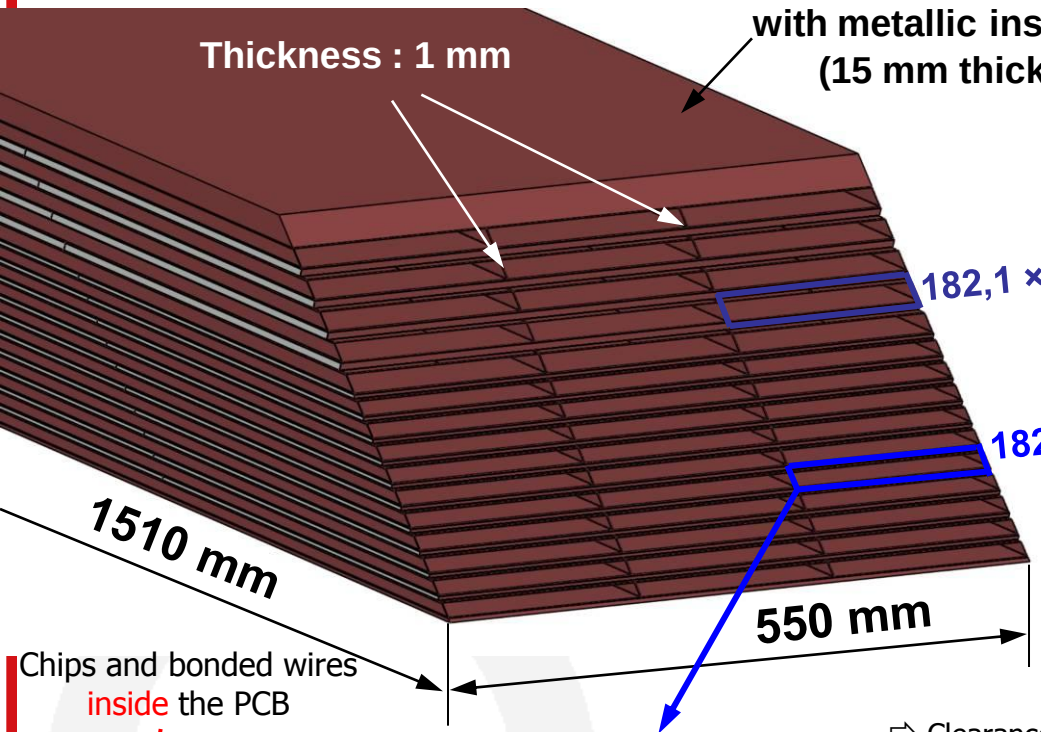
9 PADS merged

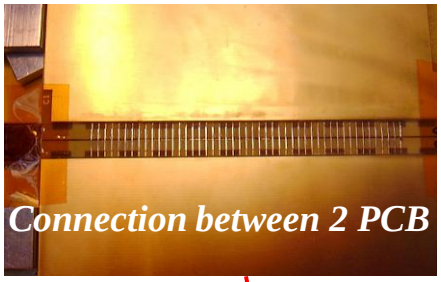
Purpose :
- Interconnexion tests
- Allow SLAB + DIF debug
- Allow mechanical integration

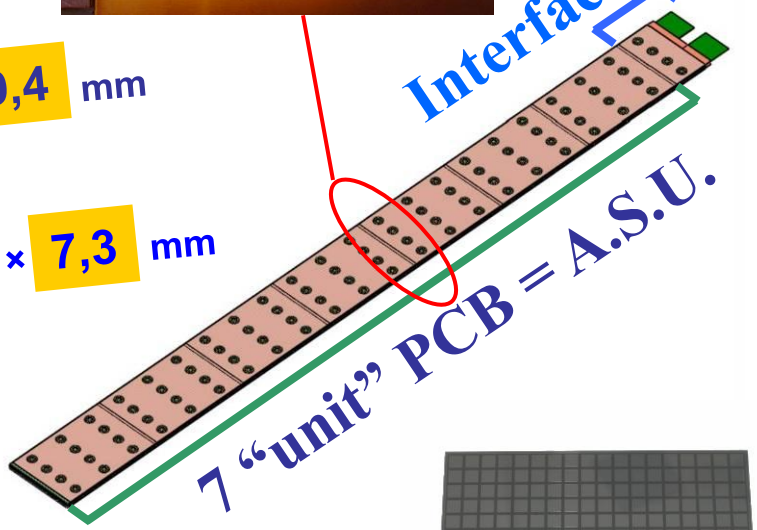


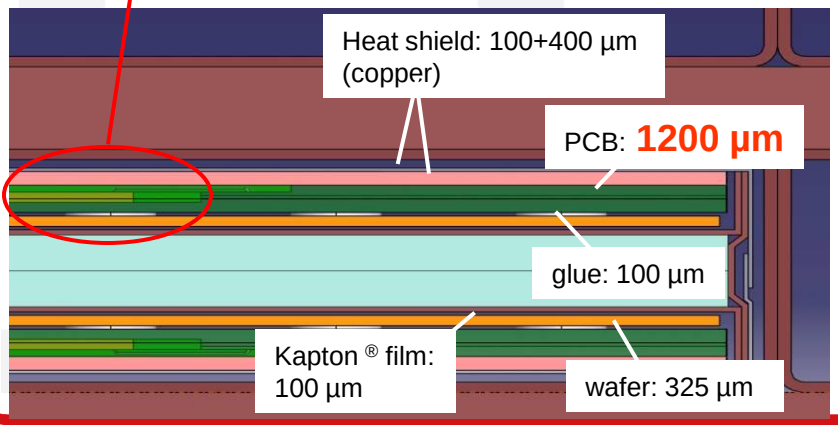
Wafer footprint

E-CAL DESIGN

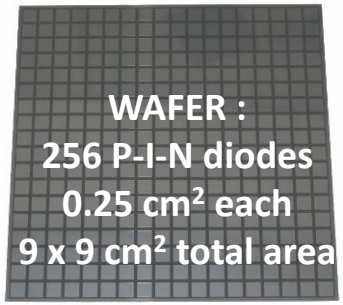








- ⇨ Clearance (slab integration) : 500 µm
- ⇨ Heat shield : **400 µm ?** →
- ⇨ PCB : **1200 µm ?** → design possibilities
- ⇨ Thickness of glue : 100 µm
- ⇨ Thickness of wafer : 325 µm
- ⇨ Kapton® film HV : **100 µm ?** → tests
- ⇨ Thickness of W : 2100/4200 µm (80 µm)



See talk by Remi Cornat

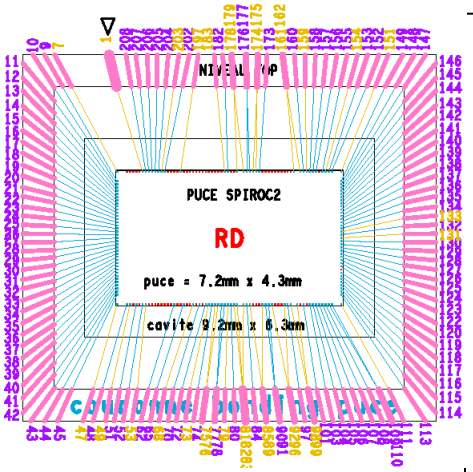
Courtesy :
Marc Anduze – LLR

FEV7 Test

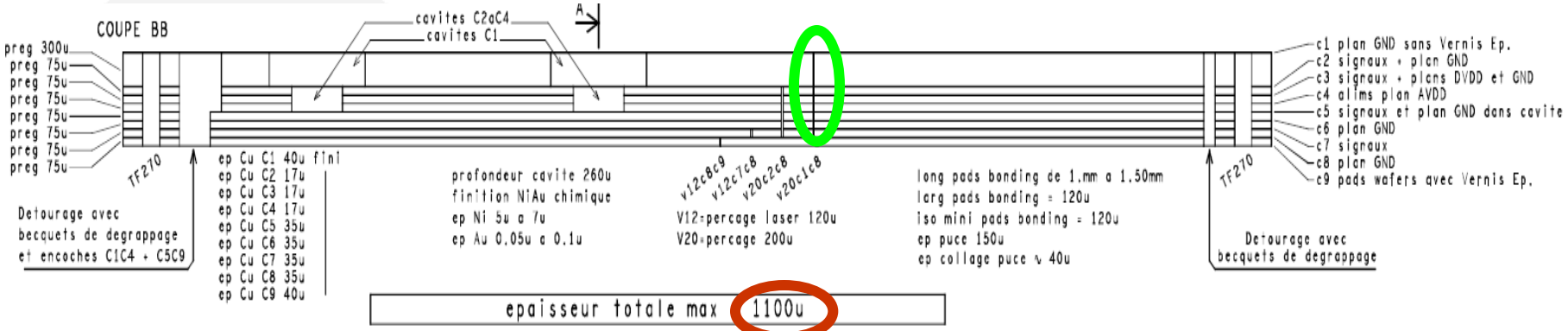
- First Step : Electrical tests (continuity / shorts)
- Second Step : Slow Control Loading
- If OK, we can start real tests ! ☺
  - Check all Analogue Channel Outputs
  - Ensure Discriminators, Masks, Calibration Tests Input work accurately
  - ADC Tests
  - Analogue and Digital Measurements
- Then, tests with 2 PCBs
  (-> need interconnection techniques)
- Finally, tests with Wafers
  (-> need of wafer/pcb assembly)

FEV7 COB2: Chip Embedding

Pile-up	
Top	GND cover layer
C2	GND + Input chip signal
C3	horizontal routing + DVDD + GND
C4	AVDD
C5	GND + vertical routing
C6	GND (pads signal shielding)
C7	pads routing
C8	GND (pads shielding)
BOT	PADS



5 drilling sequences :
- Laser C8-C9 120µ filled
- Laser C7-C8 120µ
- Mechanical C2-C8 200µ
- Mechanical C1-C8 200µ
- Mechanical C1-C9 (for PCB fastening)



PCB Thickness 1100 µm

FEV7_COB Prices

FEV7_COB 0901	XXXXXX	QTE 10	QTE 50	QTE 100	OUTILLAGE	QTE 10 TOTAL HT
APPARATUS						
ELVIA	03--06	2774	10140	19890	850	3621
PROTECNO	27--05	4400	13400	25100	521	4921
ELCO	19--05	5230	15050	21800	1130	6360
PHOTOCHEMIE	02--06	10290	30800	61600	614	10904
EXCEPTION	X	X	X	X	X	X
ATLANTEC	X	X	X	X	X	X
CERN	22--04	4700	X	X	660	5370
le 03/06/09 D.CUISY CAO/LAL/ORSAY						

FEV7-COB2 Cost

- FEV7-CIP & FEV7-COB board manufactured by 2 companies to ensure successful result

- FEV7-COB2 prices

FEV7_COB2 09xx	XXXXXX	QTE 10	QTE 50	QTE 100	OUTILLAGE	QTE 10 TOTAL HT
ELVIA	29--10	3325	12980	26240	900	4225
PROTECNO	23--10	13000			600	13600
le 30/10/09 D.CUISY CAO/LAL/ORSAY						

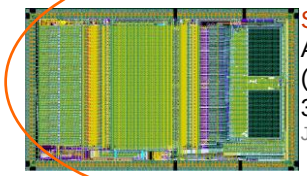
- We have lost 1 manufacturer !!

Engineering run

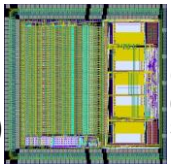
- **Reticle size : 18x25 mm2**
  - 50-55 reticles/Wafer
  - 25 wafers needed

- **Final arrangement:**
  - **« Calice » chips produced:**
    - **7 Hardroc 2b** => ~9000 chips
    - **1 Spiroc 2a** => ~1200 chips
    - **1 Spiroc 2b** => ~1200 chips
    - **1 Skiroc 2** => ~1200 chips
  - **Additionnal chips produced:**
    - 1 Spaciroc : JEM EUSO experiement
    - 1 Maroc 3 : for PMT readout
    - 3 Spiroc 0 (SPIROC « light » version)
    - => **cost reduction** for CALICE

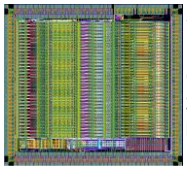
- **Production run launched last week**



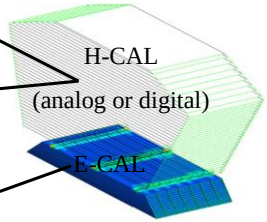
SPIROC
Analog HCAL
(SiPM)
36 ch. 32mm²
June 07

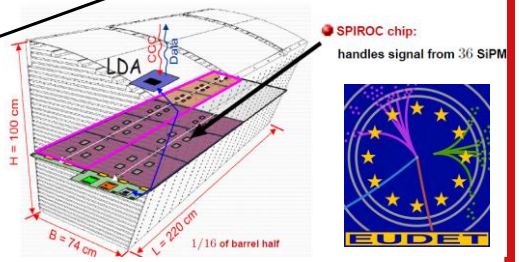


HARDROC
Digital HCAL
(RPC, µmegas or GEMs)
64 ch. 16mm²
Sept 06

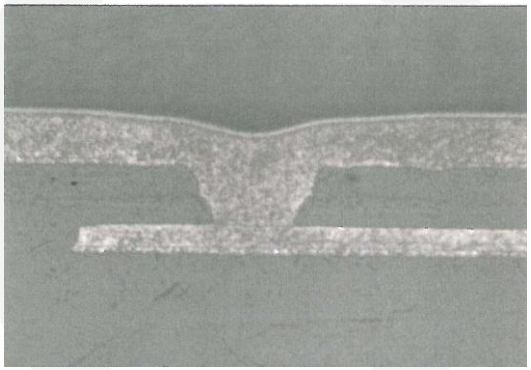


SKIROC
ECAL
(Si PIN diode)
36 ch. 20mm²
Nov 06

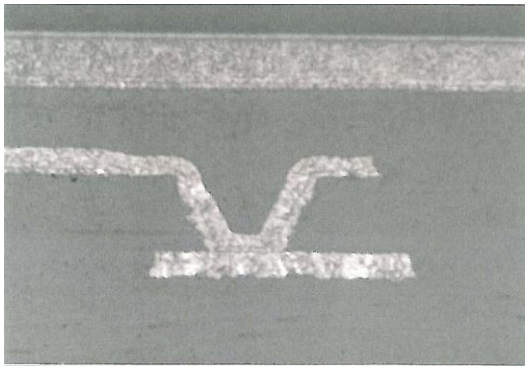




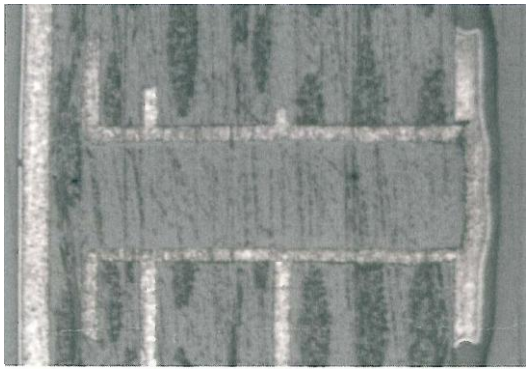
- 2 Manufacturers :
  - Elvia : 10 PCB received
  - Protechno : 10 PCB received
- Manufacturers report :
  - Thickness Measured : 0.90mm to 1.00mm (0.96 desired)
  - Metal minimum thickness on vias : 25µm
- Plated Through Hole Cross Section :



Blind via (C7-C8)



Buried via (C6-C7)



Mechanical (C1-C7)