

DHCAL with MICROMEKAS

Catherine Adloff



Overview

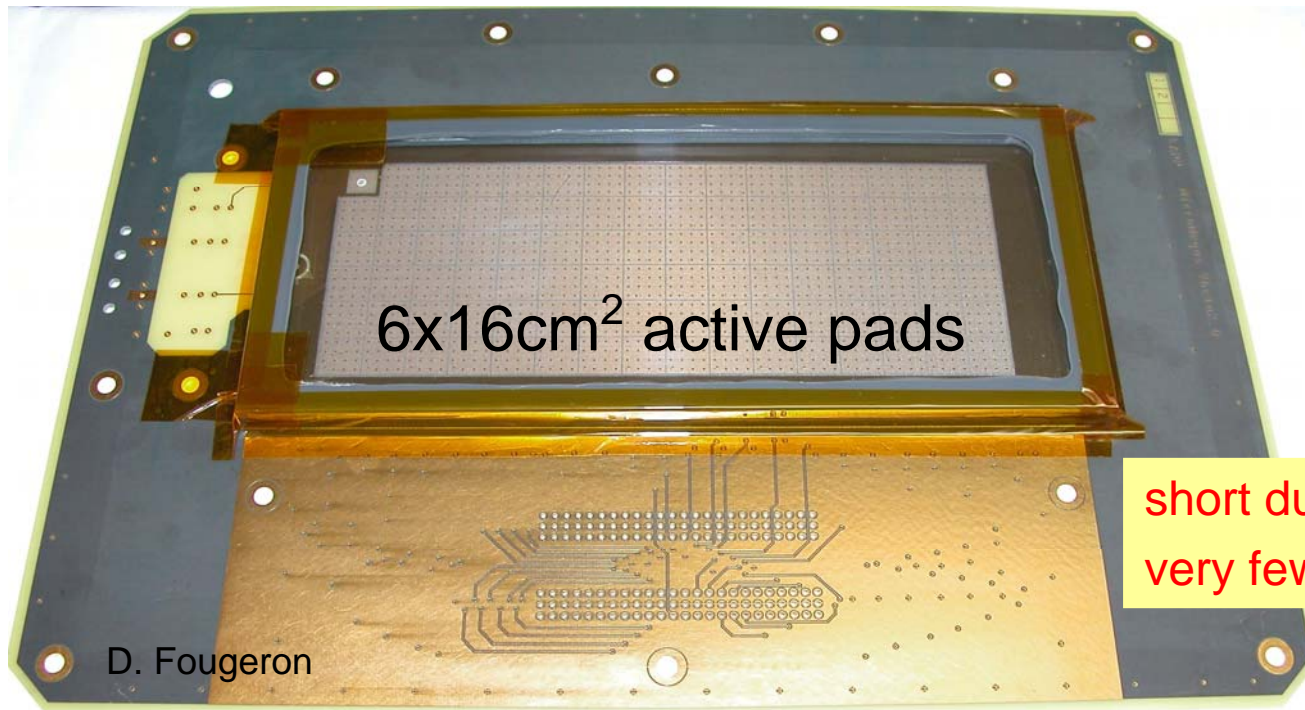
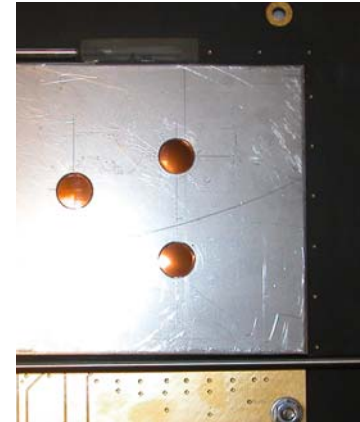
- MicroMegas with Analog Readout
- MicroMegas with Digital Readout
 - HARDROC
 - New ASIC from IPNL
- Near future
 - Mini calorimeter prototype
 - ASU
 - DIF
 - Design of a 1m² MicroMegas

MicroMegas Prototypes

- PCB and bulk from CERN (*Rui de Oliveira*)
 - 325 LPI mesh
 - spacers : 120 μm height
300 μm diameter
 - pads : 0.98x0.98 cm^2 , 200 μm between pads
- The chamber
 - 95% Argon, 5% Isobutane
 - conversion volume (3mm)
 - a top in Stainless Steel with a copper drift cathode
- The pad readout : analogue
 - Gassiplex board : 6 gassiplex chips - 96 channels
Electronics card built for CAST by DAPNIA (P. Colas, Philippe Abbon)
 - VME sequencer and ADC from CAEN
 - CENTAURE acquisition (SUBATECH, Nantes, D.Roy)

MicroMegas Prototypes

- PCB routing with great care (4 layers)
- Stainless Steel top with holes for X-rays
- 5 μ m thick copper drift cathode
- Chamber assembly in clean environment



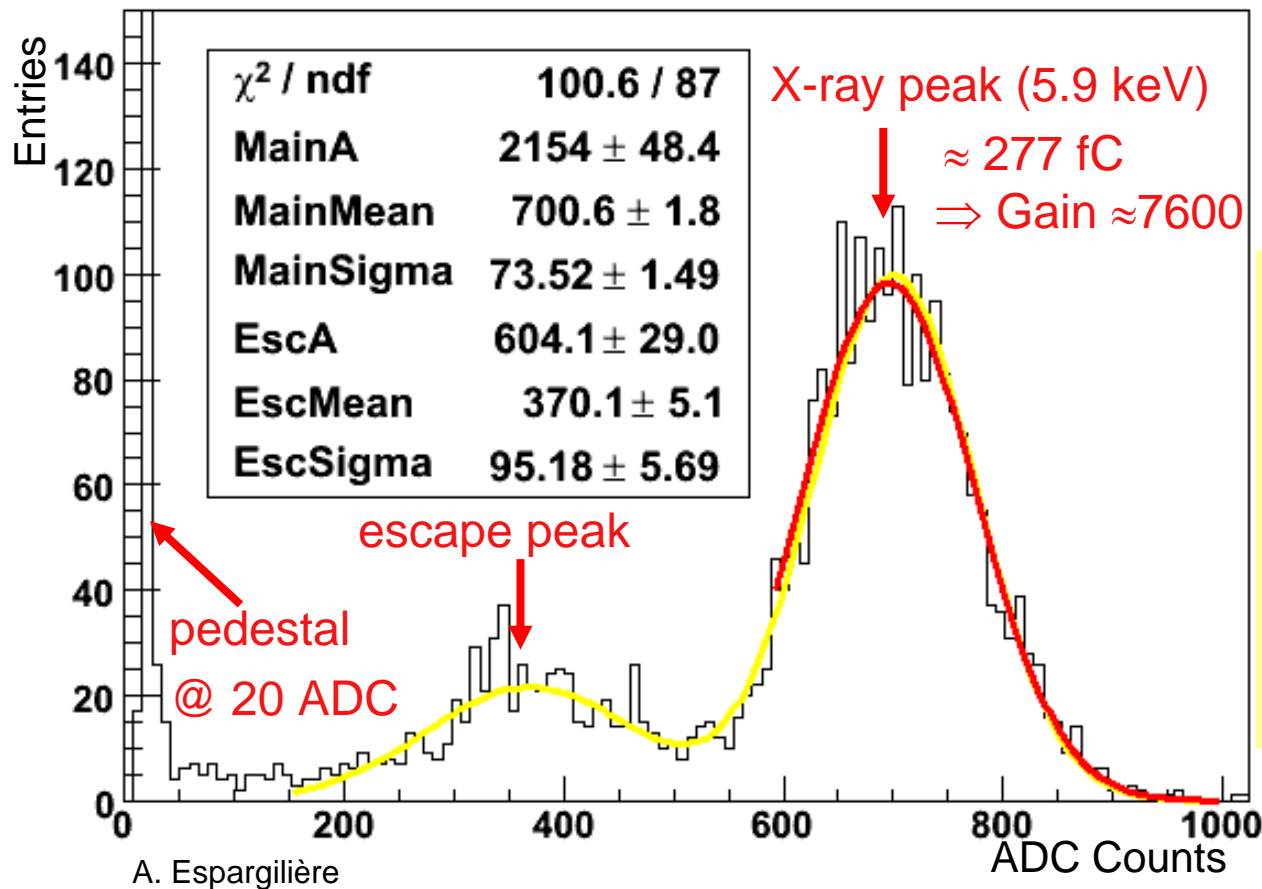
short dust burning time !
very few sparks during functioning

X-ray Results

- ^{55}Fe source (5.9 keV \rightarrow 228e⁻ in drift volume)
- Trigger on mesh : preamp (T output) + fast ampli

all pads : 96 entries for each trigger

V_{mesh}	= 420 V
V_{drift}	= 470 V
E_{mesh}	= 35 kV/cm
E_{drift}	= 167 V/cm

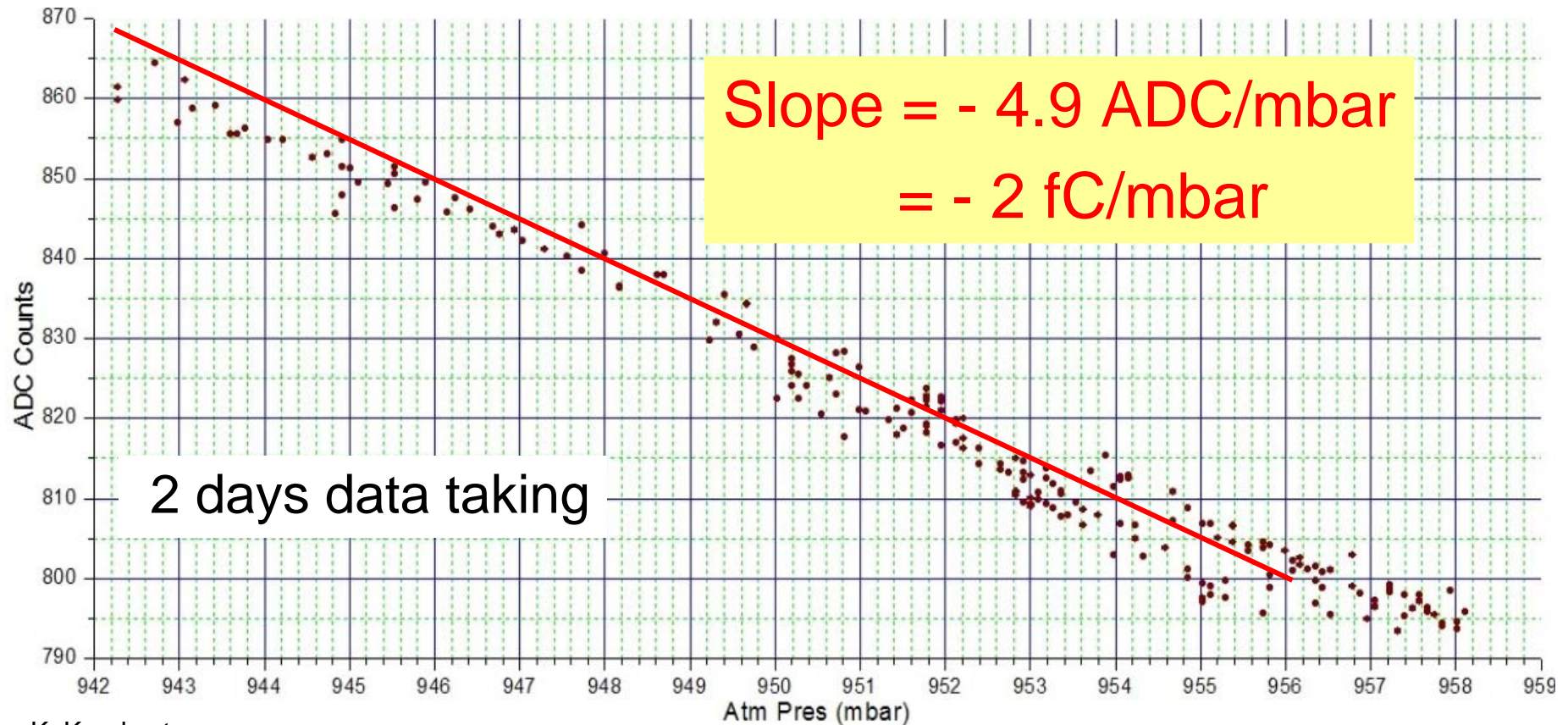


Already done :

- Response versus V_{mesh}
- Response versus V_{drift}
- Gas flow dependencies
- Time stability
- HV supply dependencies

X-ray Results

- Time Stability



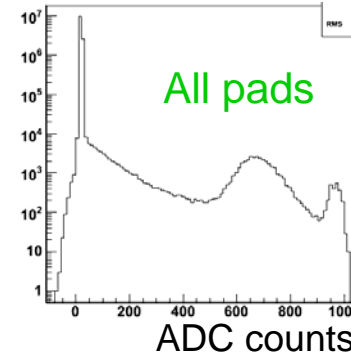
Gain ↘ when Atmospheric Pressure ↗

X-ray + Cosmics

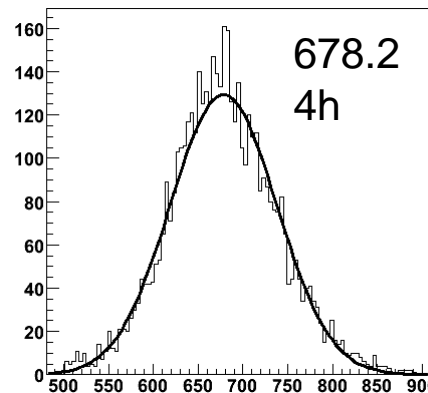
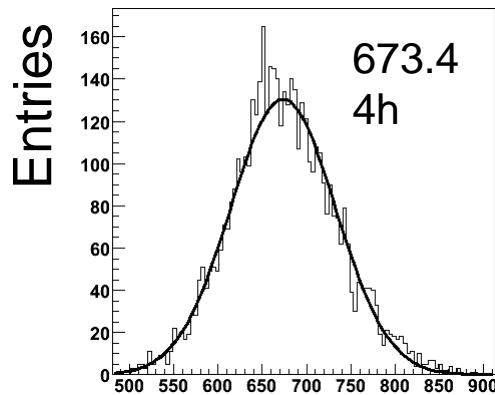
- ^{55}Fe source (5.9 keV \rightarrow 228e⁻ in drift volume)
on top of one pad **for gain monitoring**
- Trigger on mesh : preamp (T output) + fast ampli
or
Trigger on 3 scintillators coincidence

$$\begin{aligned} V_{\text{mesh}} &= 400 \text{ V} \\ V_{\text{drift}} &= 450 \text{ V} \\ E_{\text{mesh}} &= 33 \text{ kV/cm} \\ E_{\text{drift}} &= 167 \text{ V/cm} \end{aligned}$$

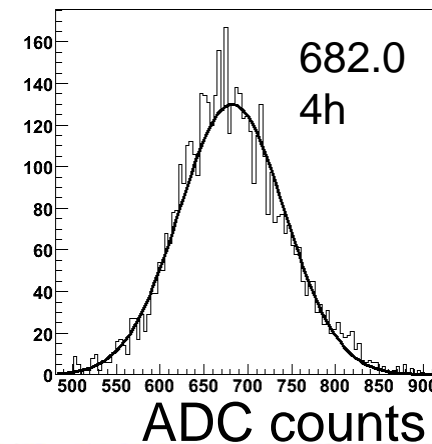
Example : 1 night data taking
2 chambers



Pad with source only:
P = 967mbar



P = 966mbar

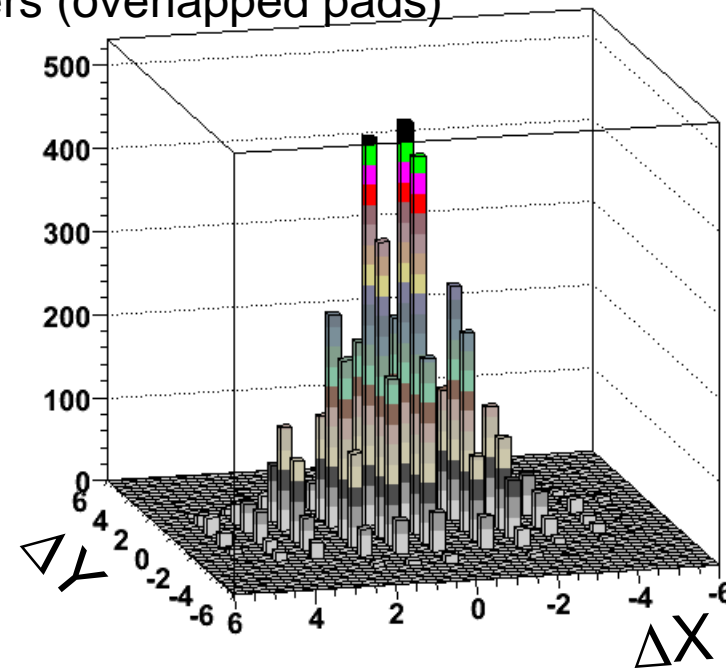
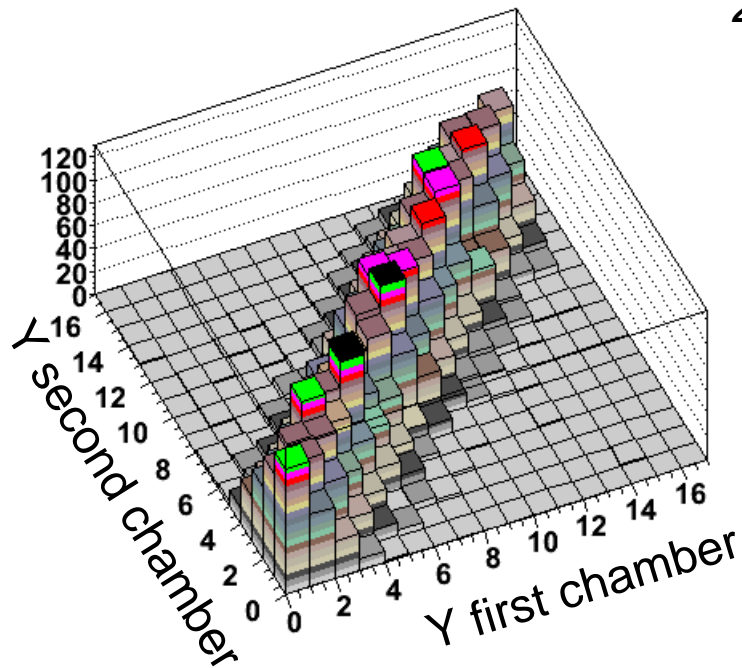


X-ray + Cosmics

- Pad with source cut out
- Muon selection : ADC > 40 (see January slides)

Example : 1 night data taking

2 chambers (overlapped pads)

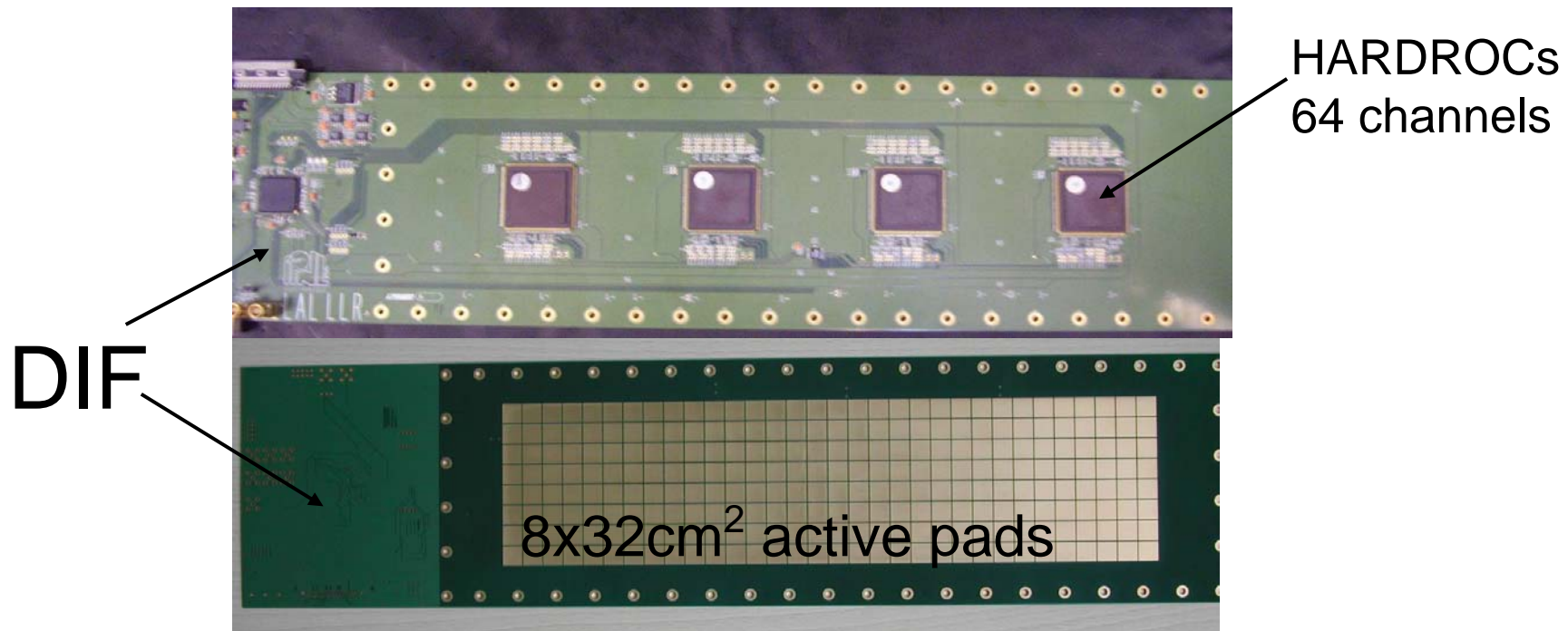


Ready for cosmics acquisitions for days with 4 prototypes!

- pad homogeneity
- X-talk studies
- prototypes disparity
- efficiency measurements

MicroMegas 8cmx32cm

- With digital readout (4 HARDROC ASICs)
IPNL-LLR PCB (500 μm interpad)

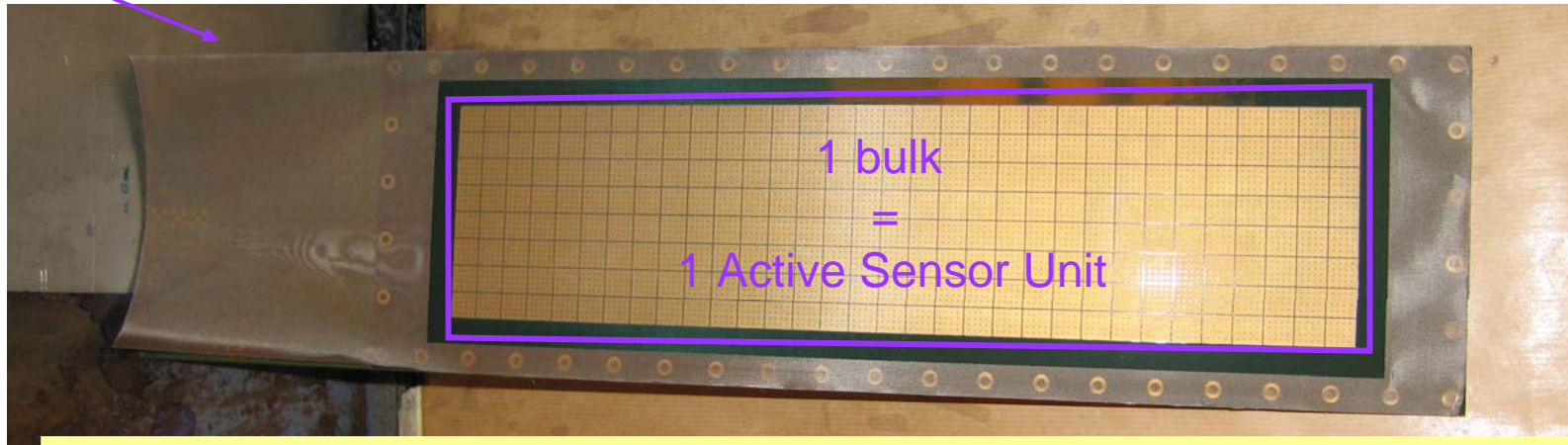


Toward a DHCAL!
(also equipped with RPC : IPNL)

MicroMegas 8cmx32cm

- The first bulk with ASICs on PCB active part !

DIF

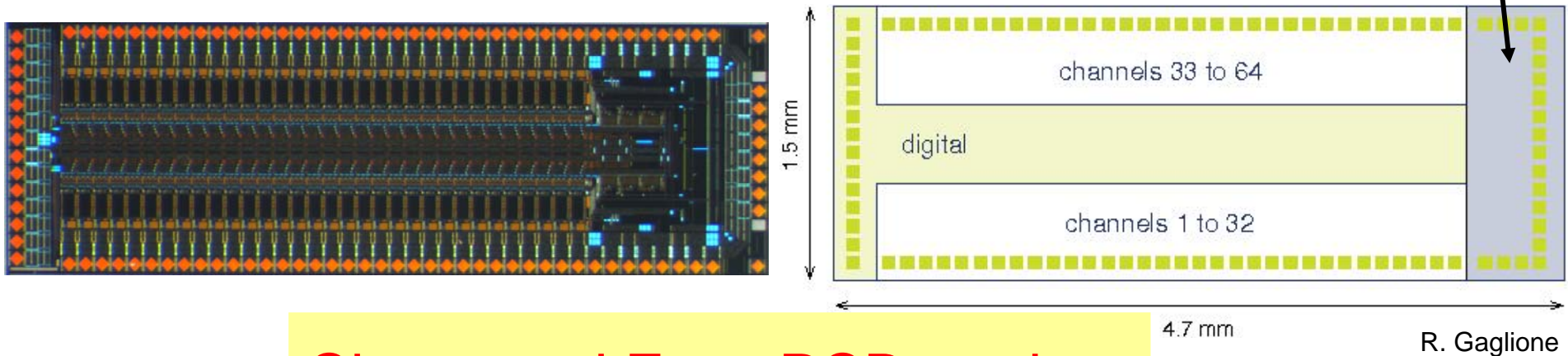


under test right now at IPNL (H. Mathez):
Power Supply ✓ USB Interface ✓

New ASIC from IPNL

- 0.35 μm CMOS technology
- 64 Analog Inputs
- 3 thresholds (DAC 8 bits)
- Covers a large dynamic range
 - RPC : 100 fC to 10 pC (gain= 0.1mV/fC)
 - MicroMegas : 10 fC to 200fC (gain= 5mV/fC)
- Power pulsing

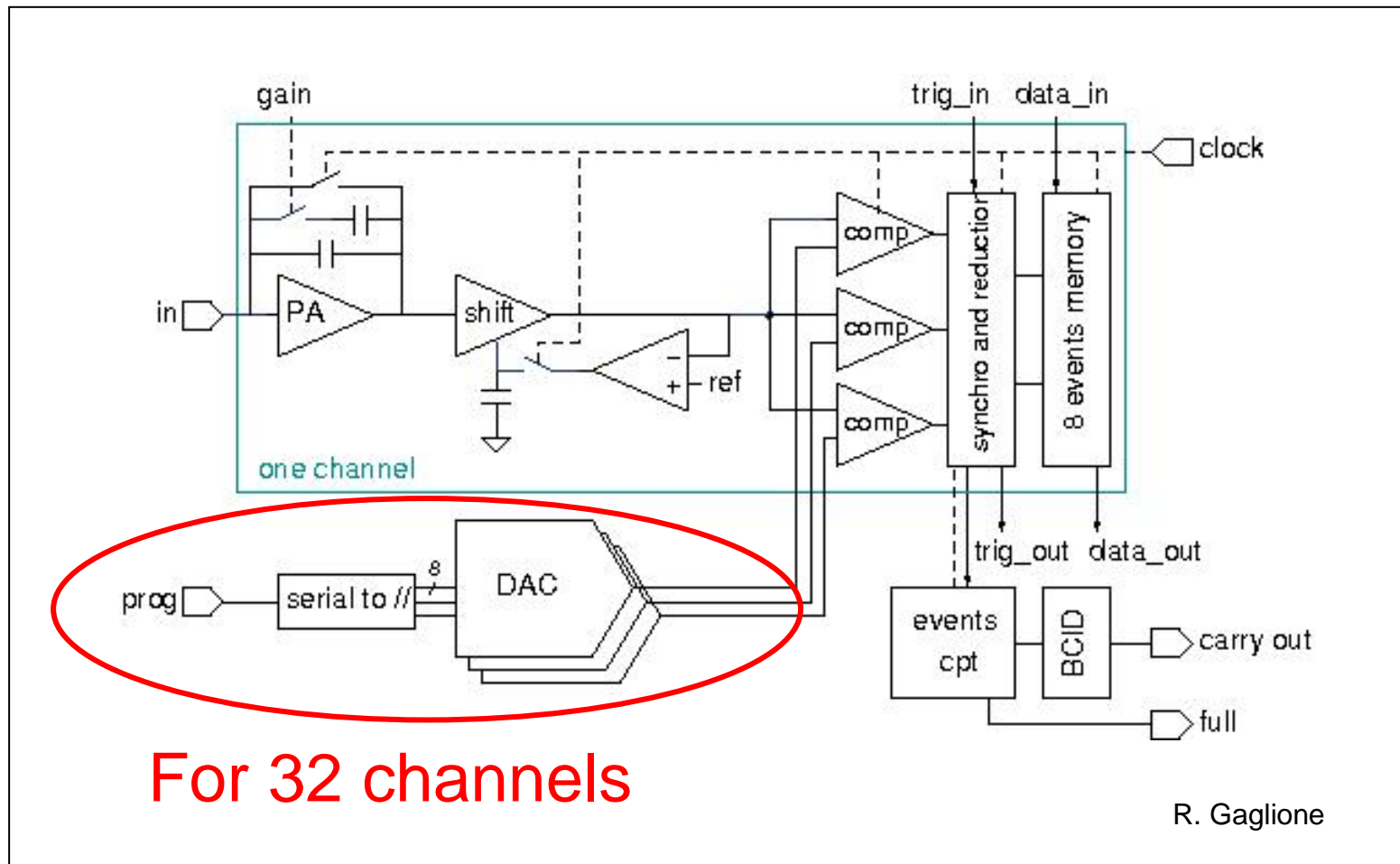
DACs
Power pulsing
Power supplies
Analog control



Cheap and Easy PCB routing

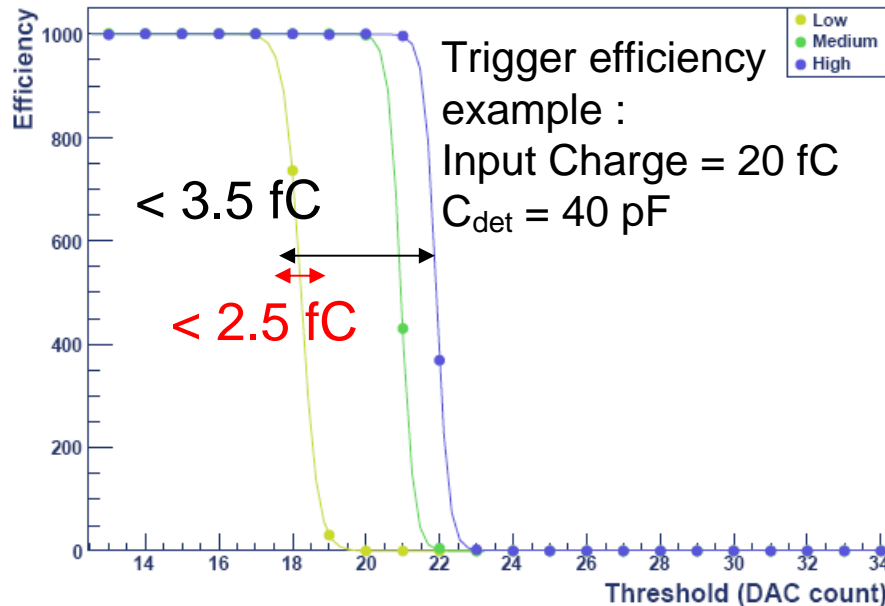
New ASIC from IPNL

- Schematic

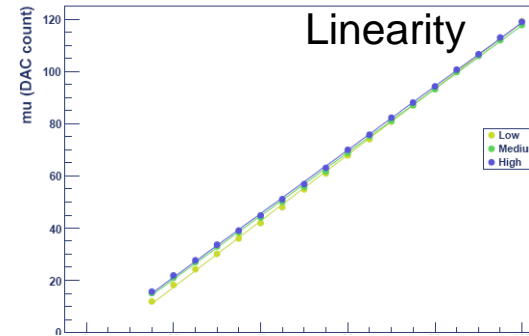


New ASIC from IPNL

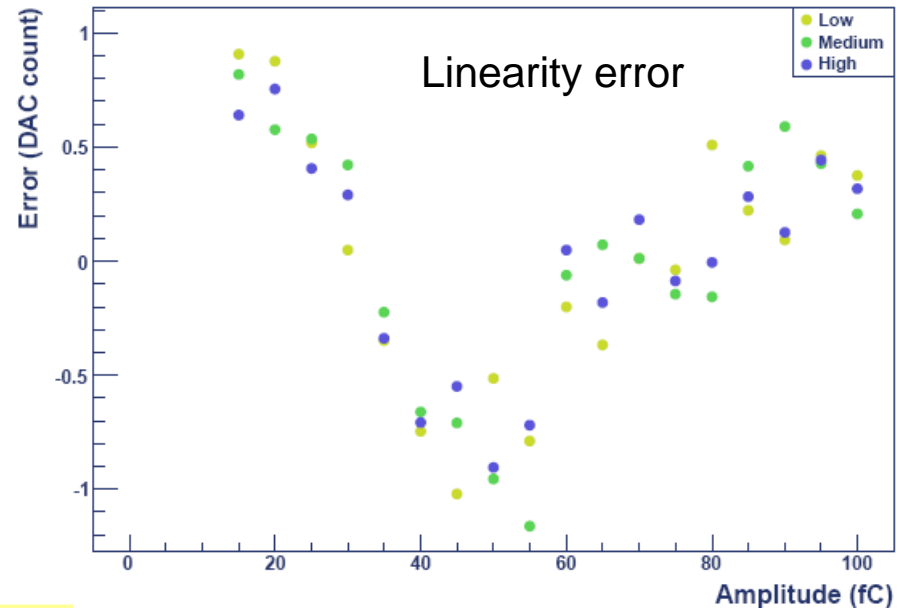
- First Results
(MIP @ 30 fC)



Noise for one comparator $< 2.5 \text{ fC}$
Total dispersion $< 3.5 \text{ fC}$



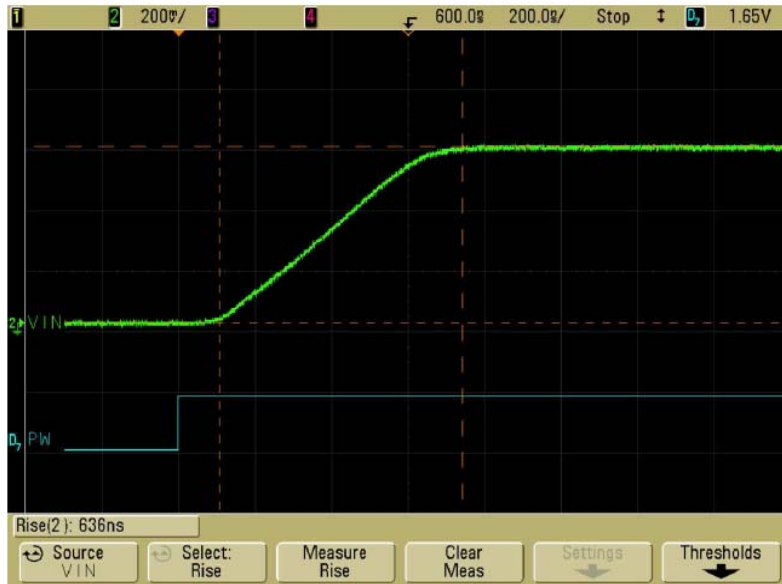
R. Gaglione



Linearity error $< 1.6 \text{ fC}$
(MIP @ 30 fC)

New ASIC from IPNL

- Power Pulsing



Preamp
Bias Voltage

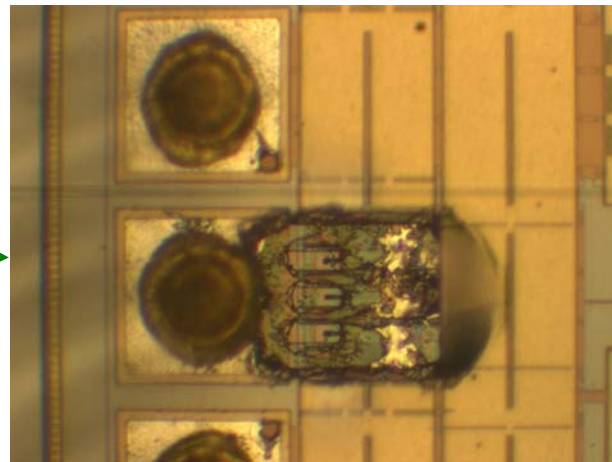
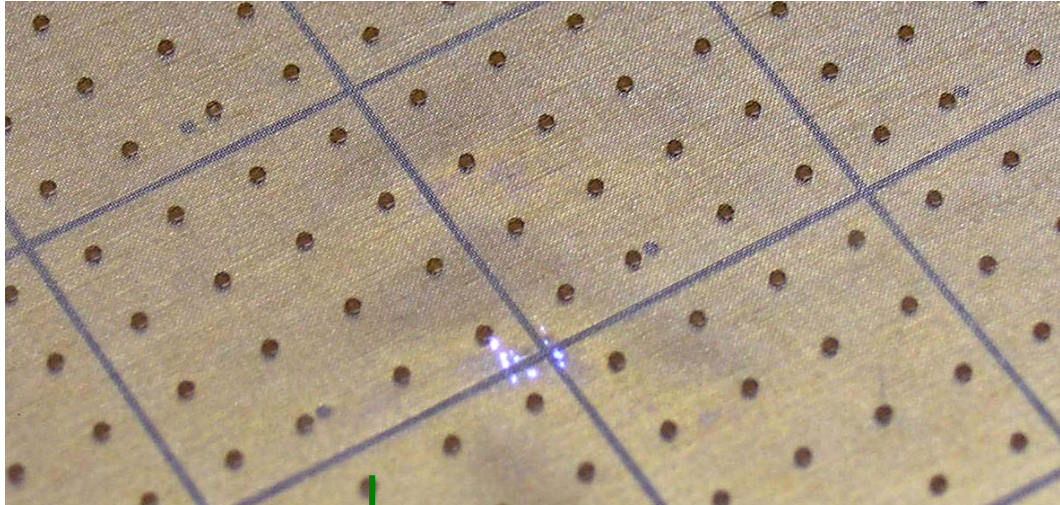
Wake up time < 800 ns

- Power Consumption :
1 mW/channel

⇒ 10 μ W/Channel with power pulsing
500 W for a 50 Million channels DHCAL

New ASIC from IPNL

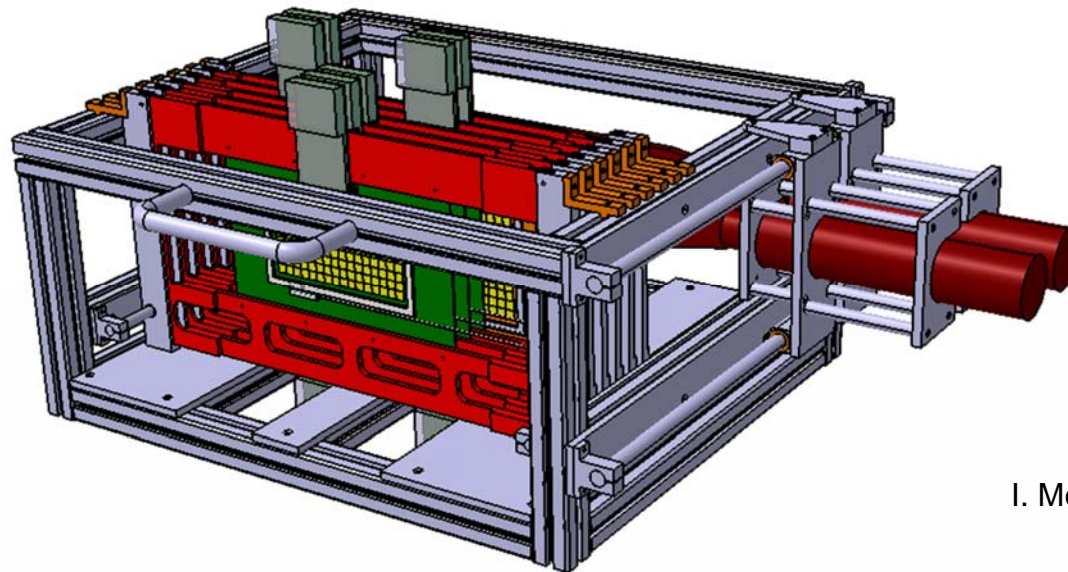
- Some nasty tests with the previous 4 channels



⇒ **strong** protection
for sparks
is compulsory
(see Gassiplex card)

Mini calorimeter prototype

- Test Beam : **August 2008 at CERN**
 - 3 MicroMegas-Gassiplex 6cmx16cm ✓
 - 2 MicroMegas-Gassiplex 12cmx32cm ✓
 - Stainless Steel Absorbers



I. Monteiro

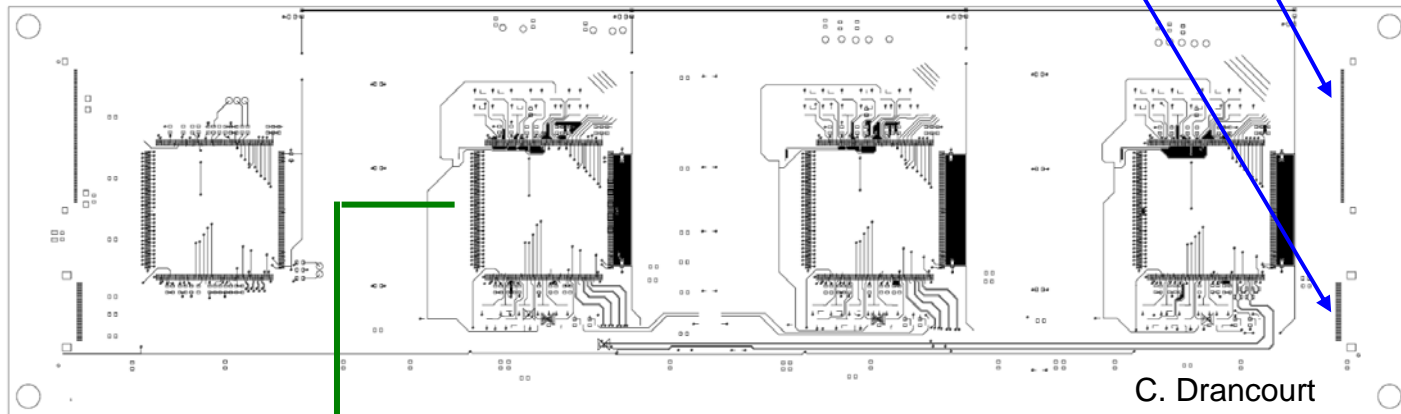
Mini calorimeter prototype

- Test Beam : **November 2008 at CERN**
 - 3 MicroMegas-Gassiplex 6cmx16cm ✓
 - 2 MicroMegas-Gassiplex 12cmx32cm ✓
 - 3 to 4 MicroMegas with digital Readout ASU and DIF separated
 - ASU with HARDROC 8cmx32cm
 - ASU with IPNL ASIC 8cmx8cm
 - Stainless Steel Absorbers

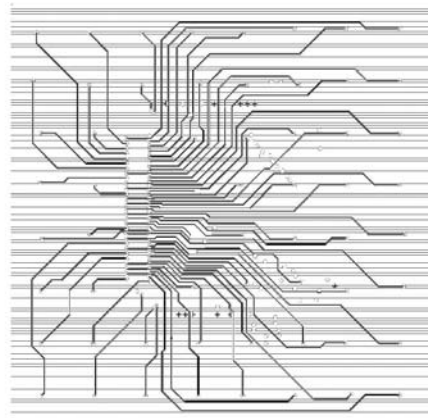
ASU with HARDROC

- Based on the IPNL 8 layers PCB with 4 HARDROCs
- No more lines or components outside the pads area (see ASU assembly)
- Analogue Input with sparks protections

Daisy chain In/Out
(hirose connectors)

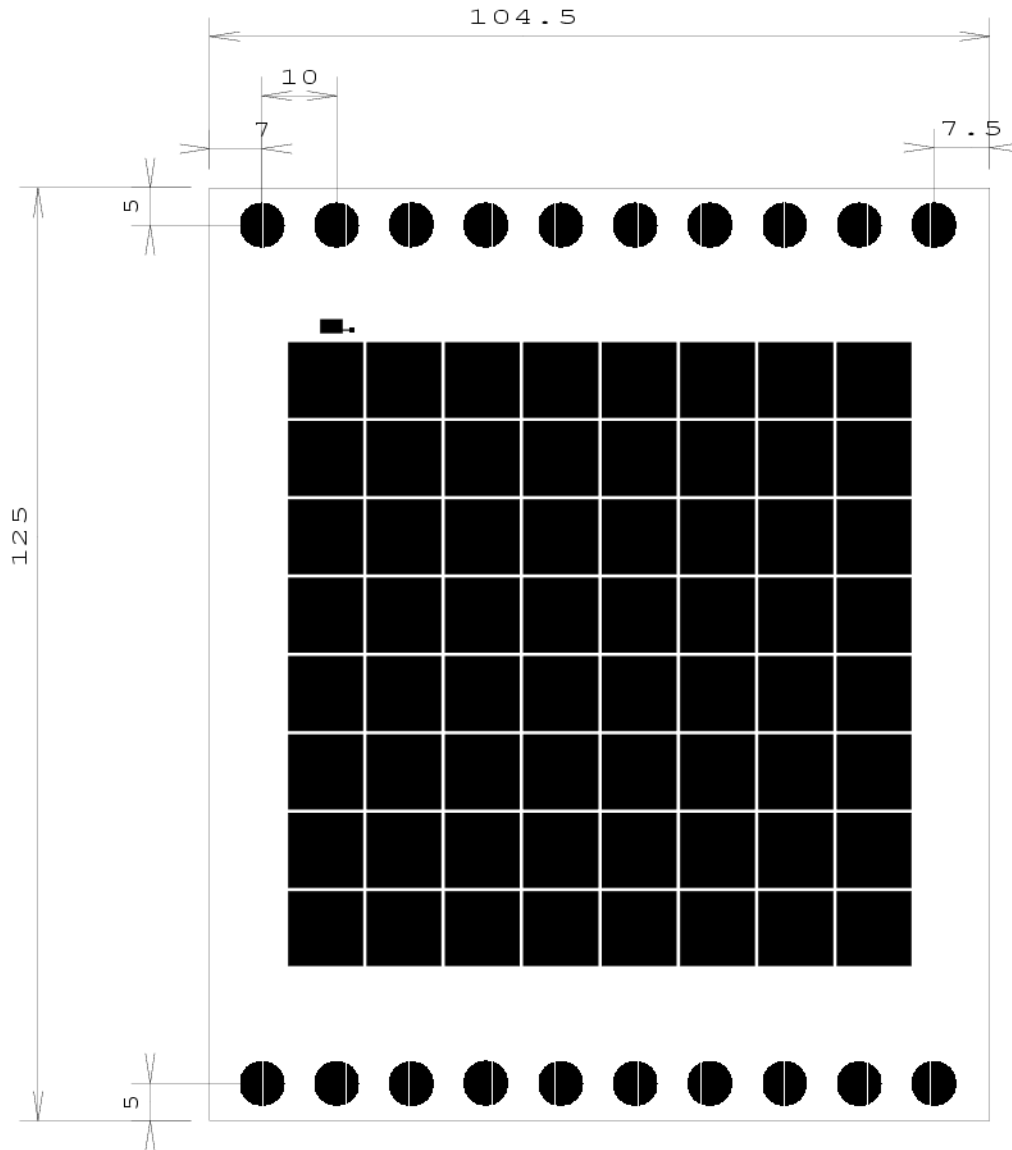


Analog Inputs

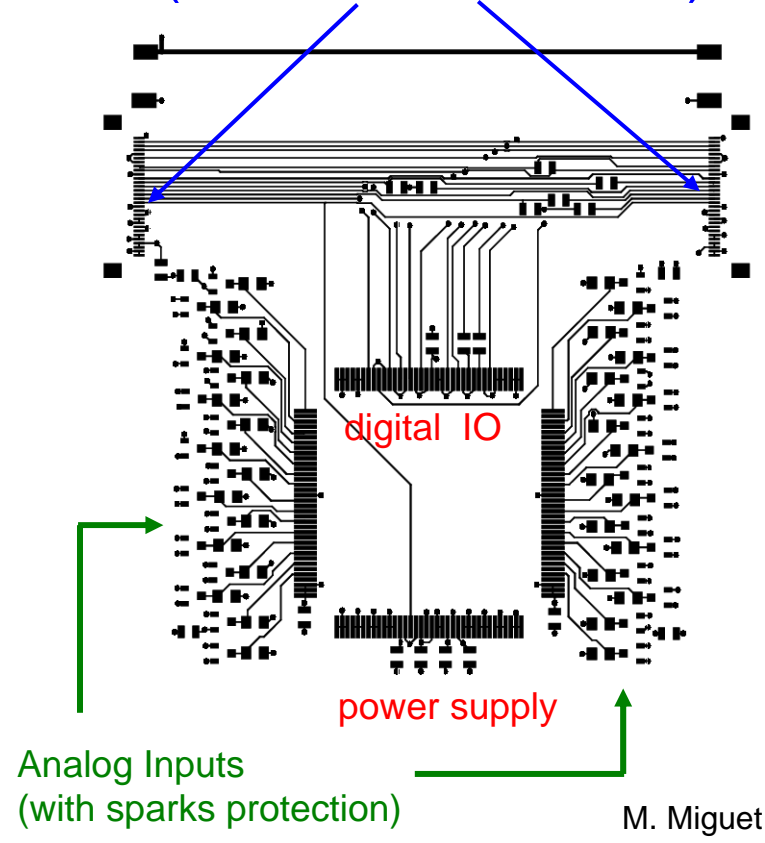


ongoing work

ASU with IPNL ASIC



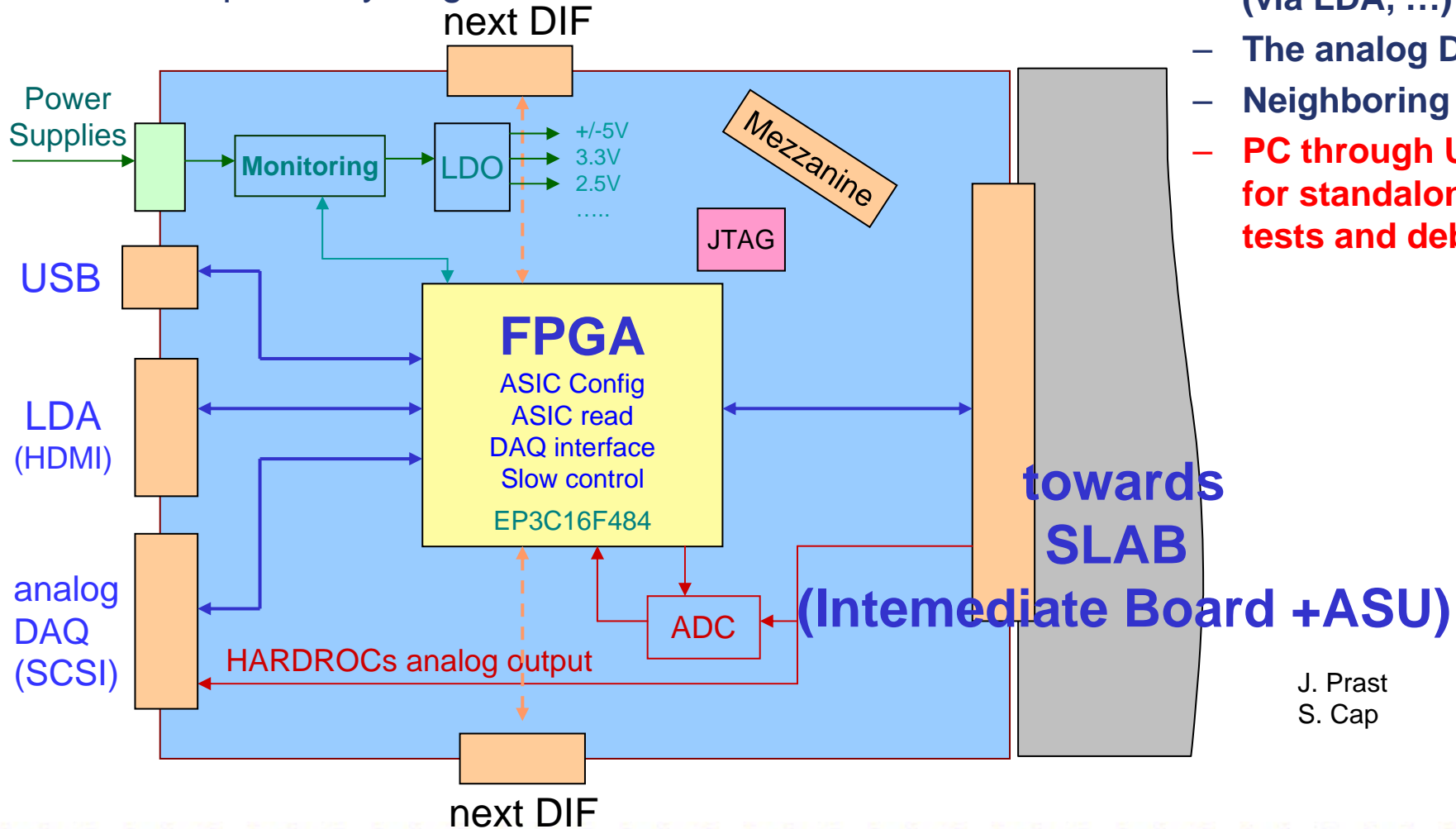
- 6 layers PCB
- Daisy chain In/Out (hirose connectors)



Digital InterFace (DIF)

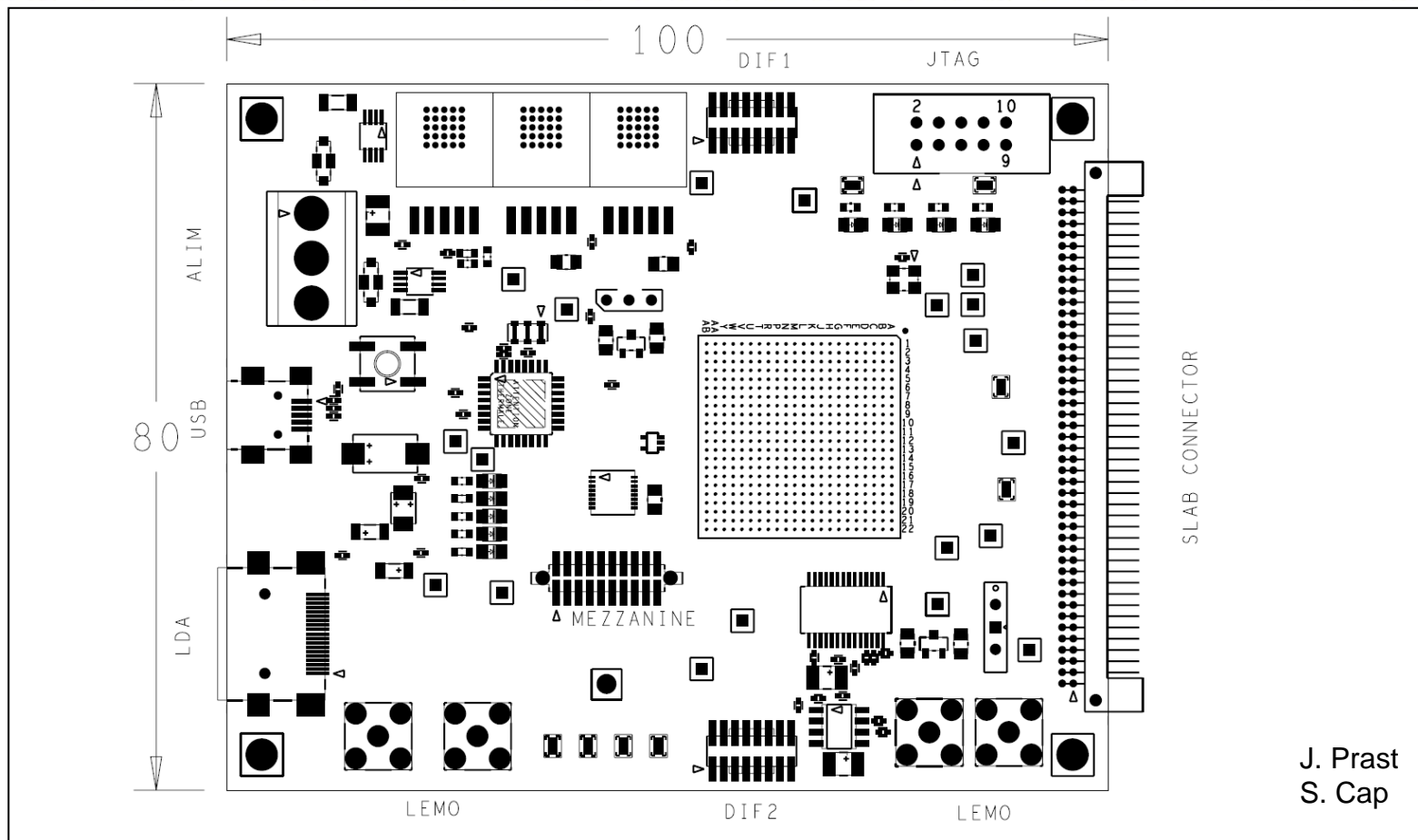
- Separated from the slab for more flexibility.
- up to 100 FE ASICs (HARDROC or IPNL ASIC) with power cycling

- Interfaces with :
 - The final DAQ (via LDA, ...)
 - The analog DAQ
 - Neighboring DIFs.
 - **PC through USB for standalone tests and debugs.**



J. Prast
S. Cap

Digital InterFace (DIF)



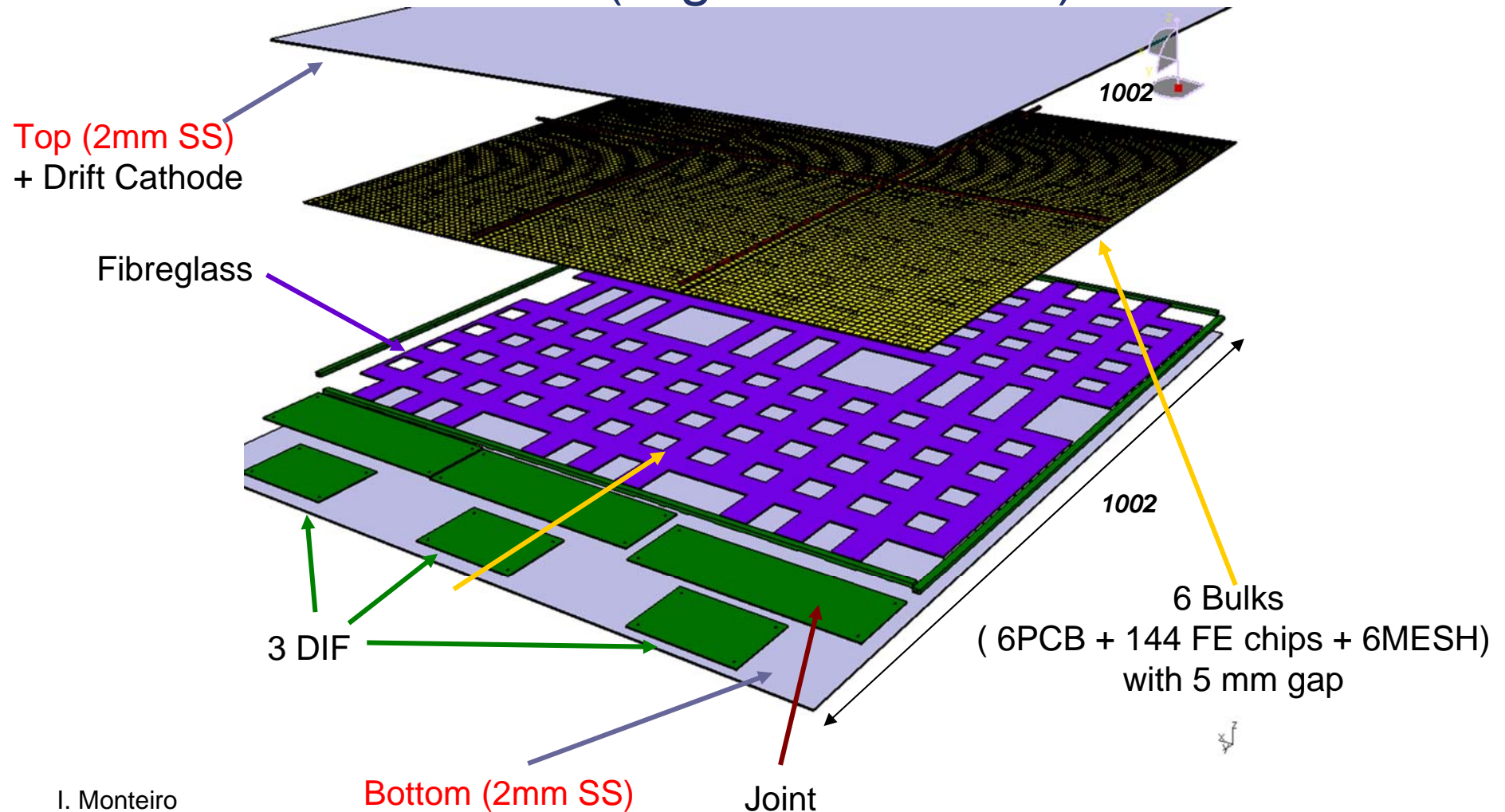
J. Prast
S. Cap

- 12 layers PCB

Ready for tests :
end of May

Design of a 1m² MicroMegas

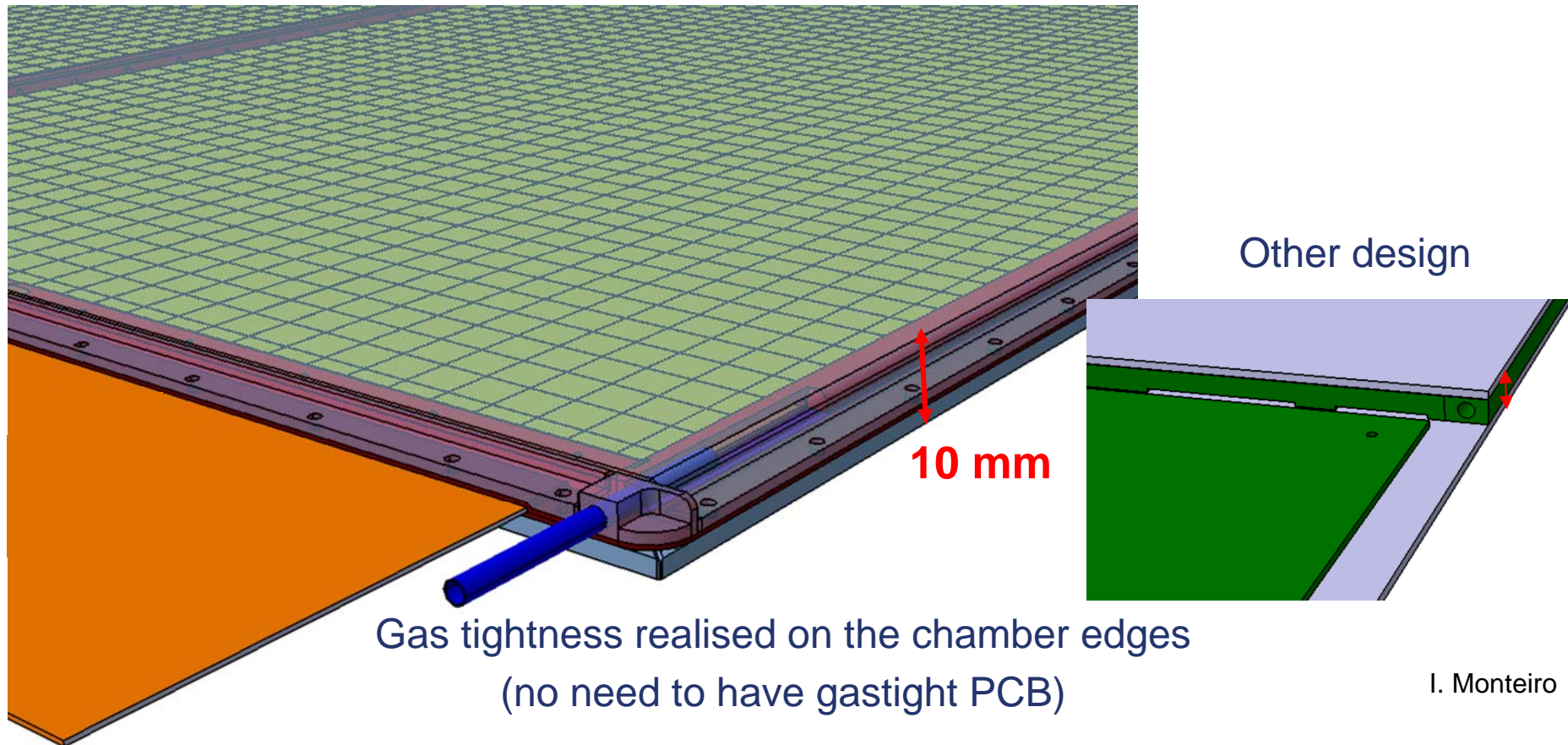
- Case with 3 DIF (Digital InterFace)



I. Monteiro

Design of a 1m² MicroMegas

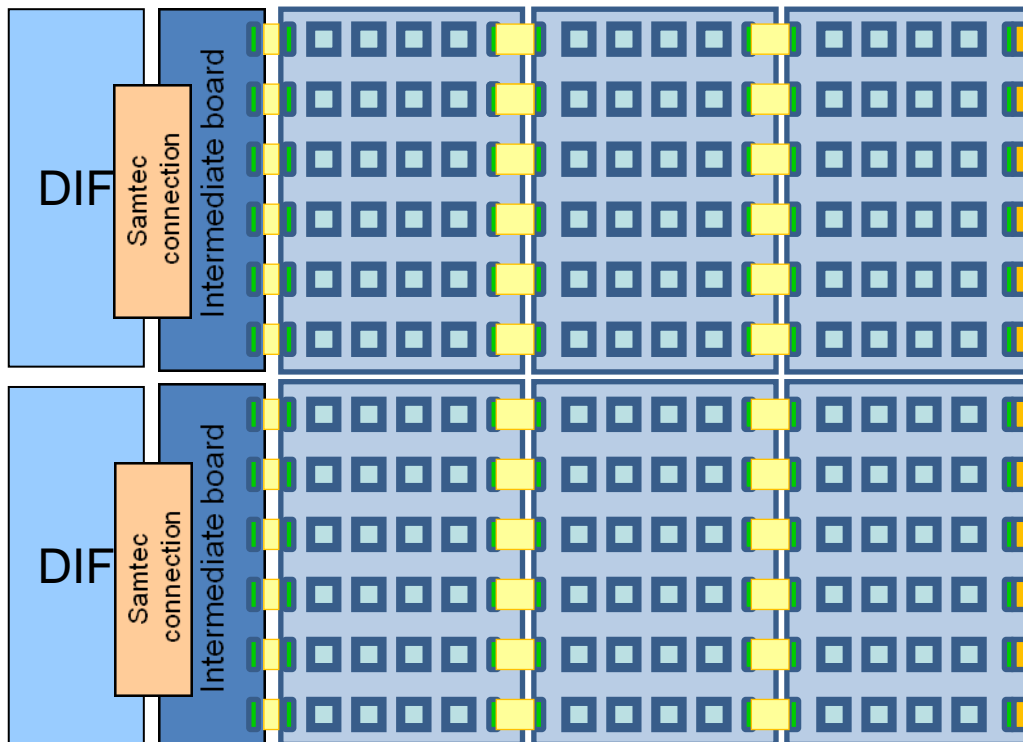
- 10 mm total thickness including
 - 4 mm SS (absorber)
 - 6 mm active volume



I. Monteiro

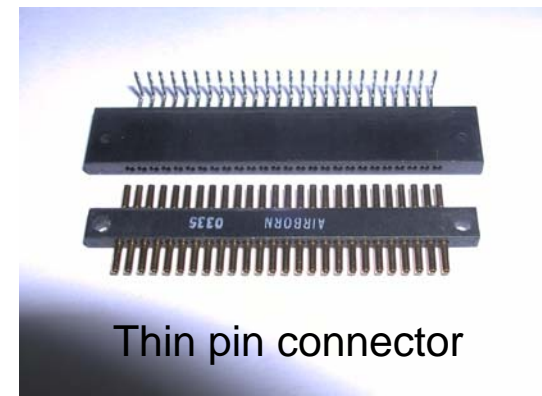
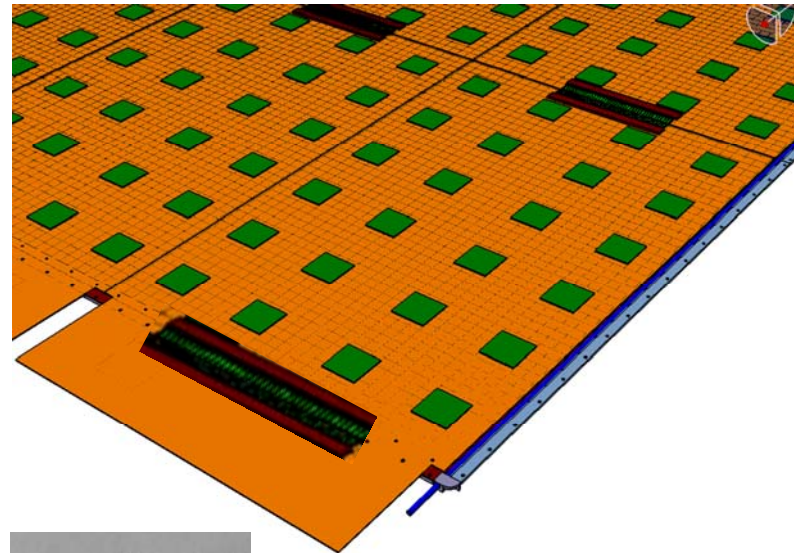
Different designs

- 2 DIF case

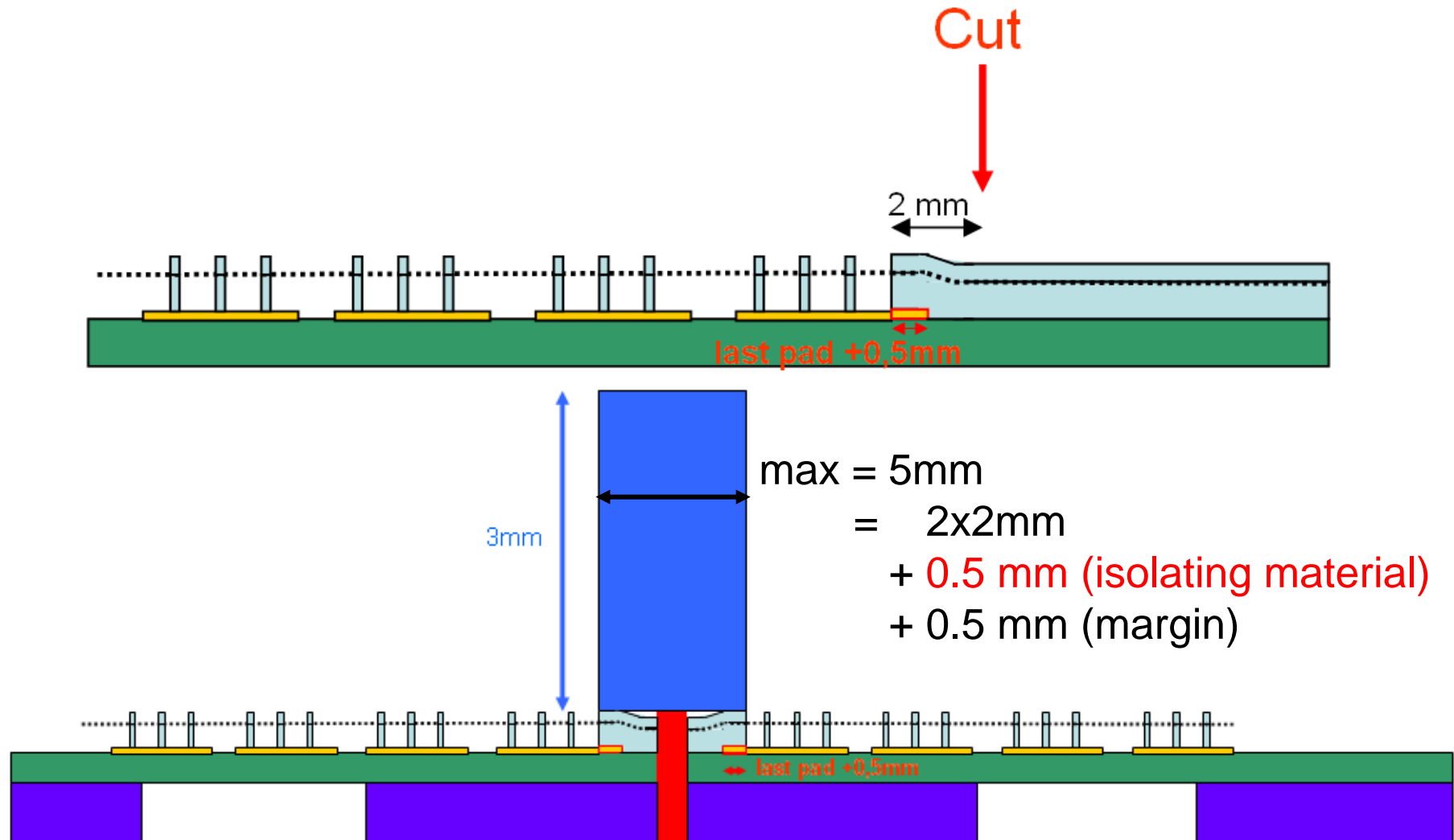


, : Flat Printed Circuit (kapton)
 : FE chip
 : Hirose connector
 : Termination board

- 3 DIF case

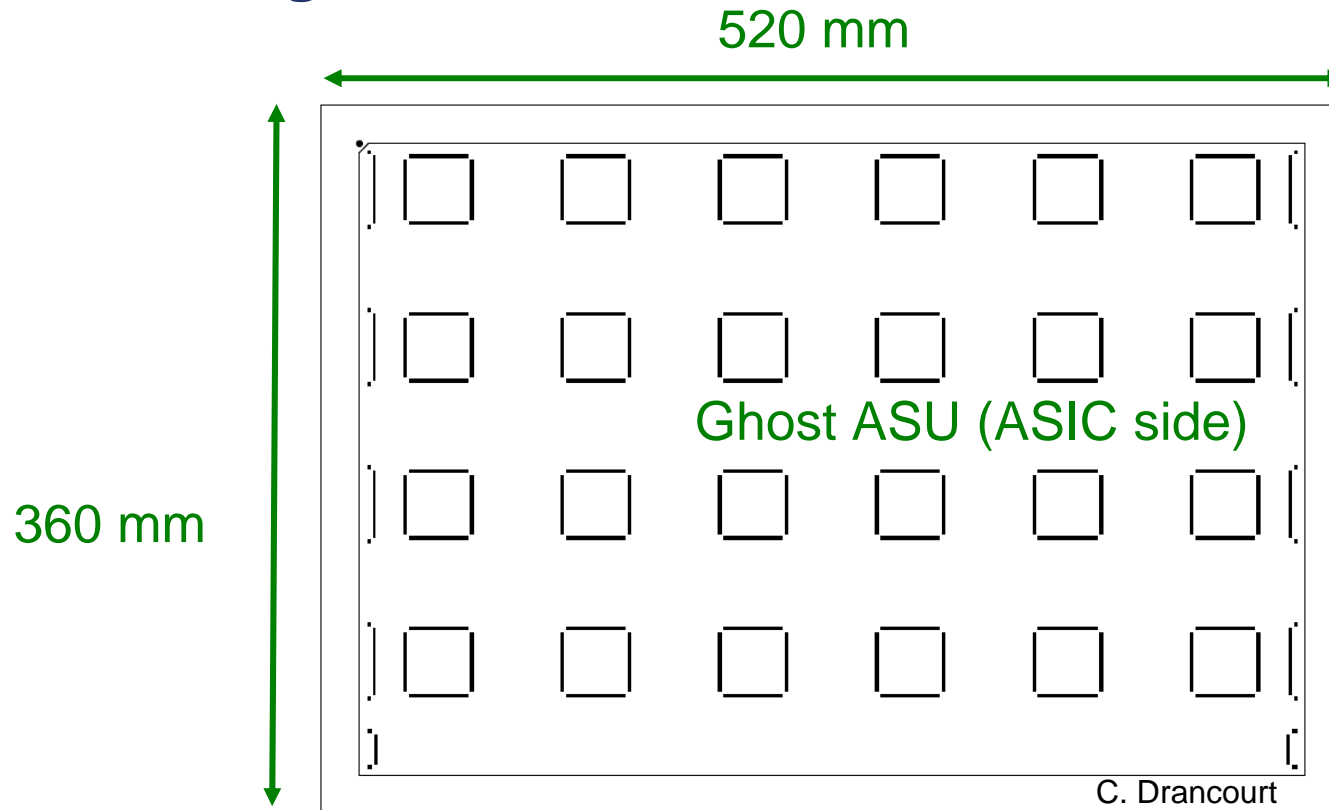


ASU Assembly

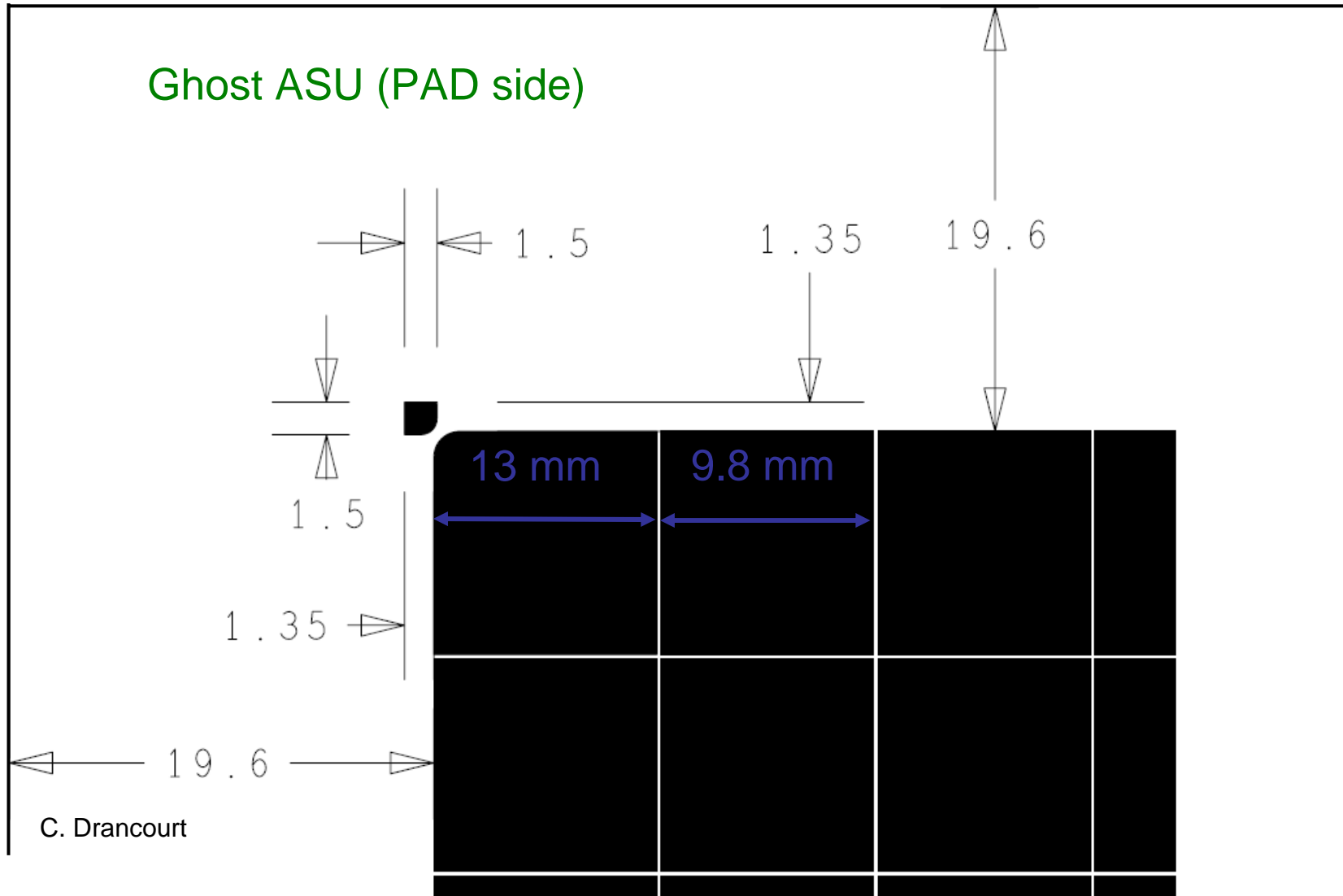


Mechanics Prototype

- 1m² prototype :
 - assembly tests with ghost ASU
 - Gastight tests



Mechanics Prototype



Conclusion

- First results on small MicroMegas prototypes
- MicroMegas Techno looks promising and competitive with other gas detectors.
- Further tests are ongoing (Cosmics and TB)
- Large area prototype under way :
towards 1m^3 (project supported by ANR)