

Overview on Micromegas TPC R&D

Achievements and prospects

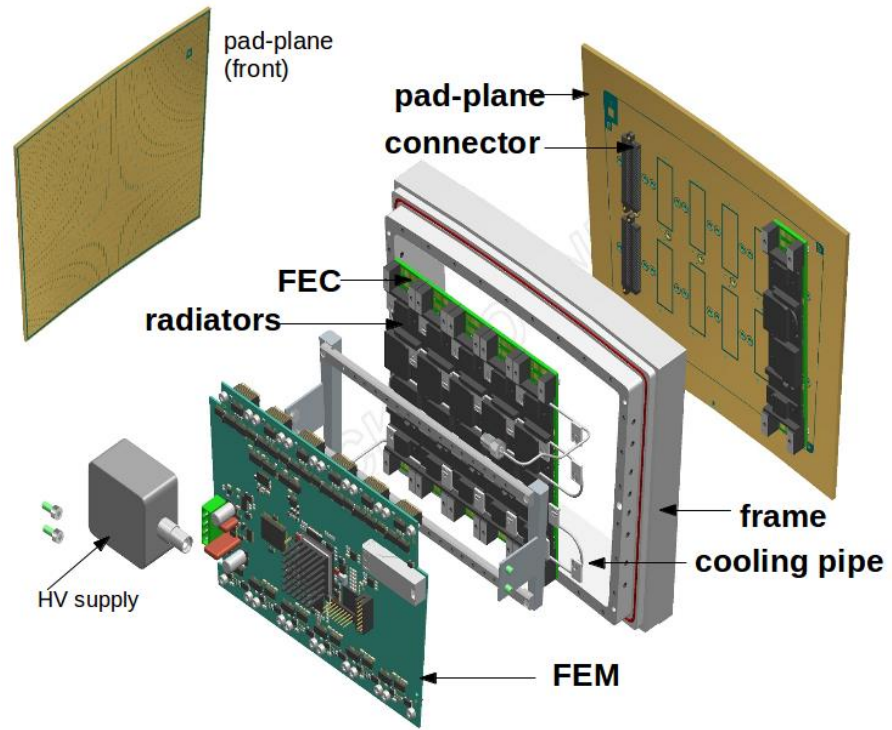
New scheme :
encapsulated resistive
anode

Tests at DESY in
November 2018

2PCO₂ Cooling

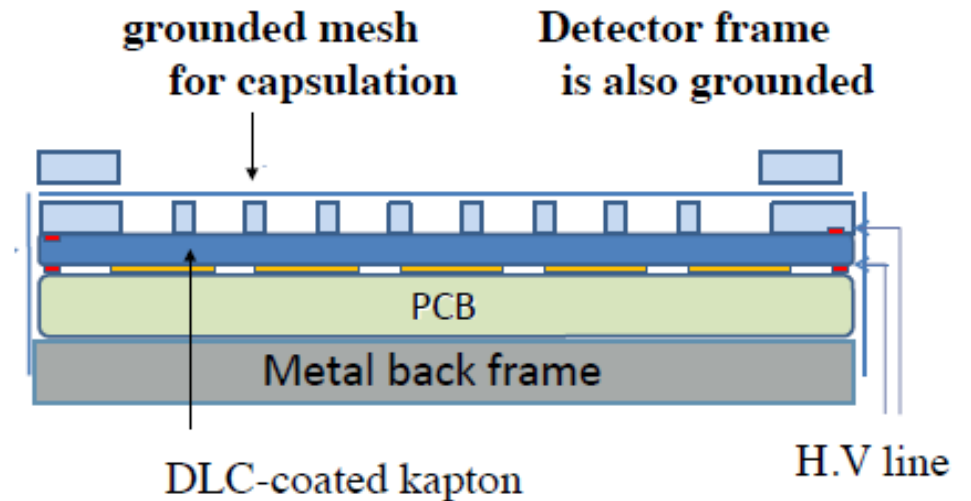
Costing scheme

Large common module,
future electronics



Encapsulated Resistive Anode Micromegas

- New scheme, to **reduce distortions** at the edges of the modules : mesh at the same potential as the frame. Also encapsulation **reduces the EMI**. Another advantage: the amplification field can be tuned independently of the drift field, providing **flexibility**. The gain can be equalized while keeping the drift field very uniform.

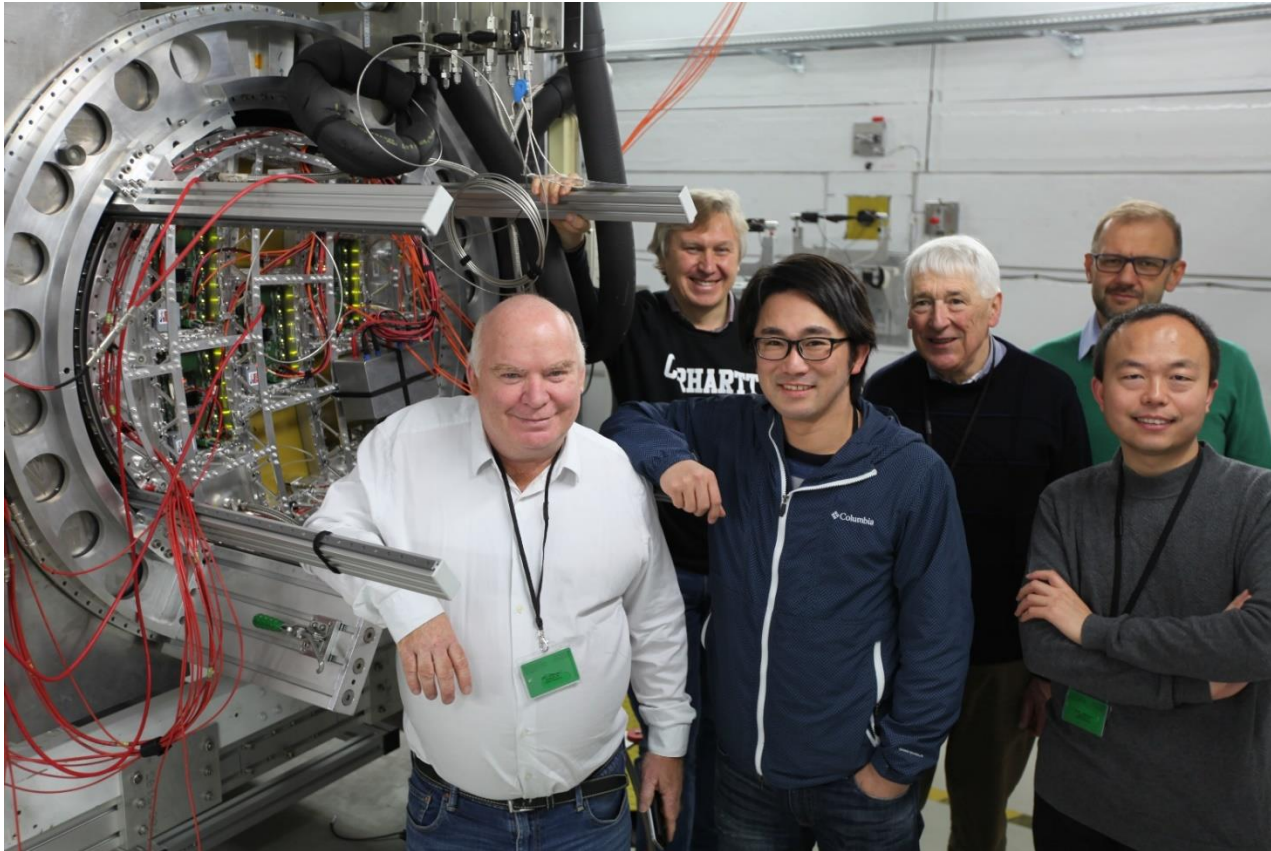


Tests at DESY in November 2018

- **Commissioning:** D. Attié, P. Colas, S. Ganjour, T. Ogawa, M. Riallot
- **Data taking: the same, plus:** X. Coppolani, S. Emery, Huirong Qi, J. Timmermans, M. Titov
- Strong support from DESY: thanks to R. Diener, V. Prahll and O. Schäfer

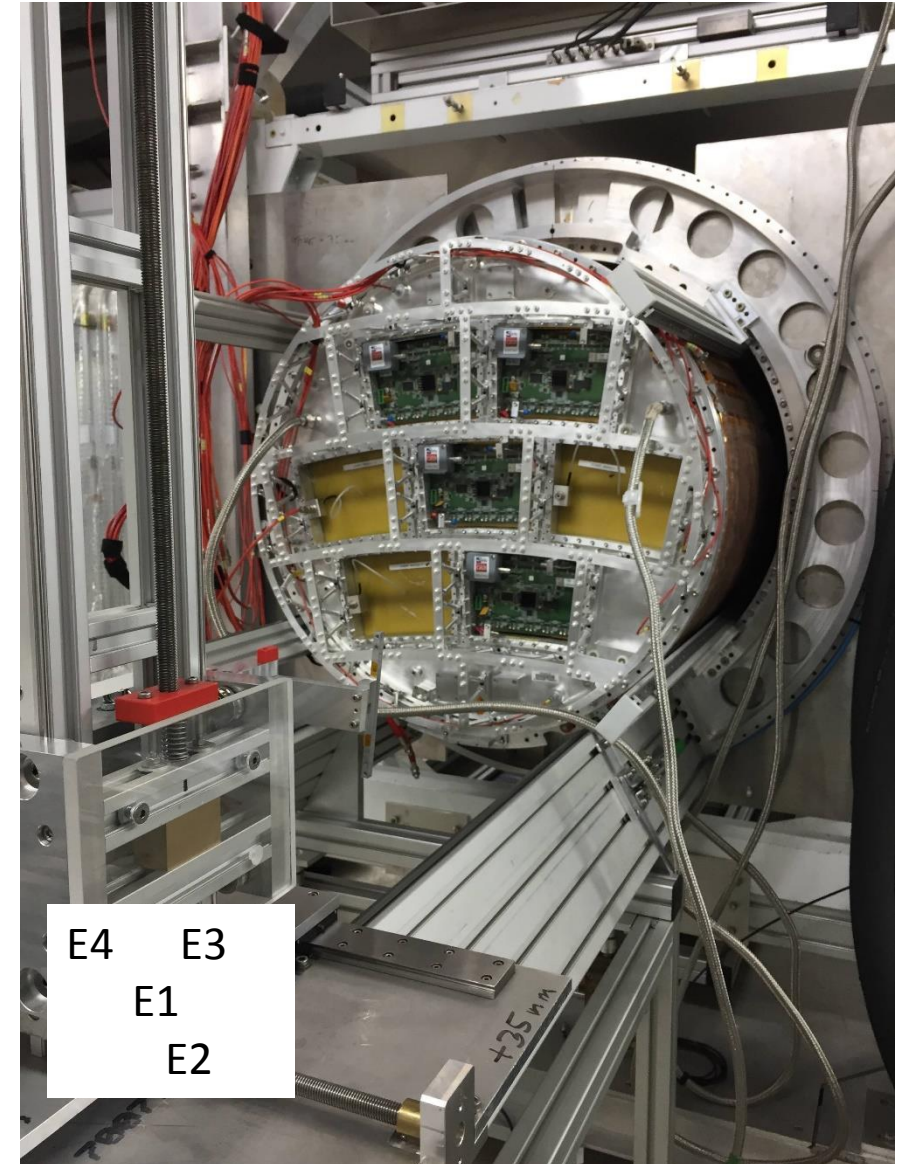
Goals of the test :

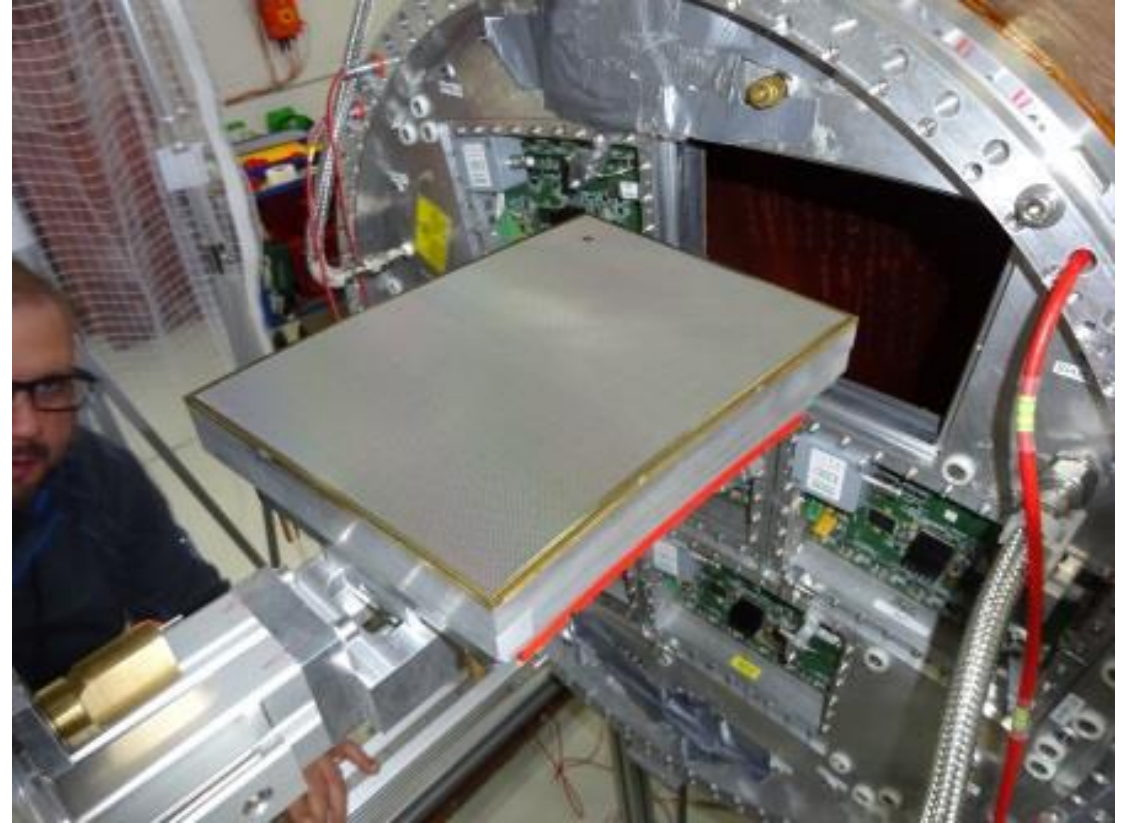
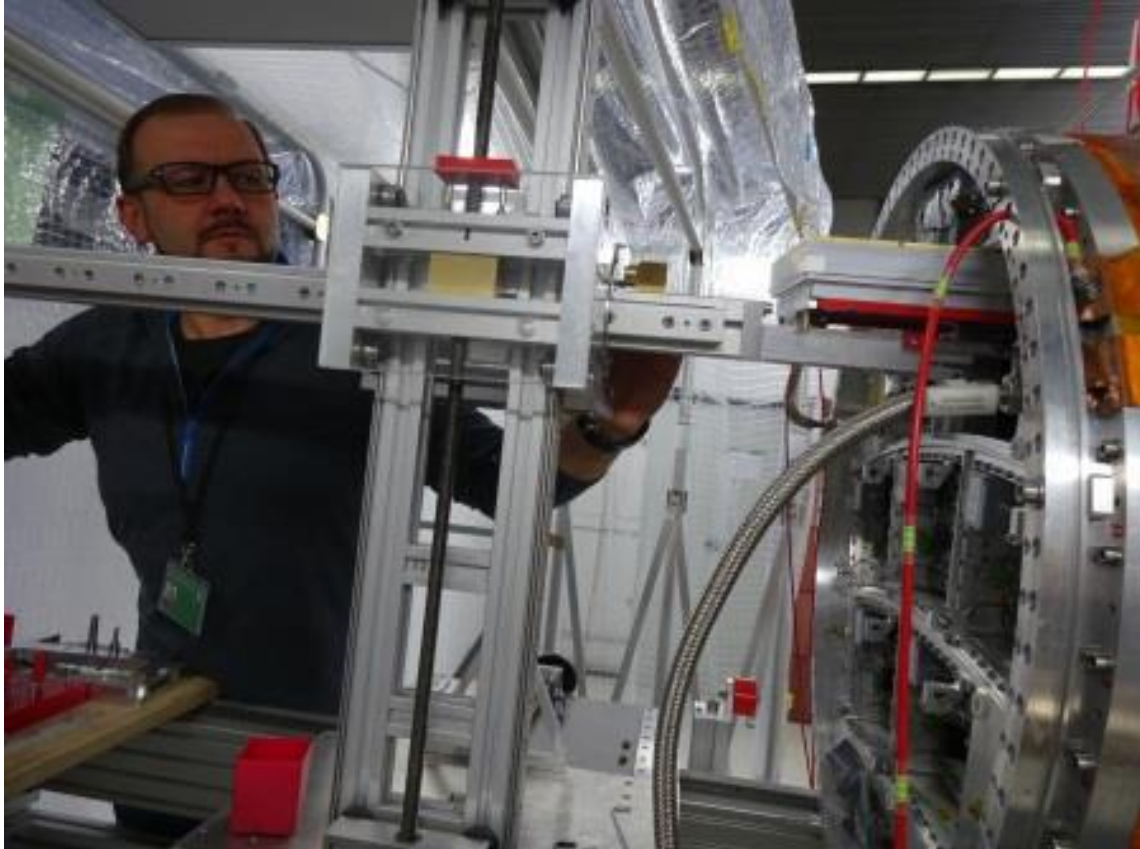
- Use LP2 endplate
- Use 2PCO2, test 1-loop operation
- Test the new scheme (encapsulated anode with grounded mesh). Proved to work already in a cosmic test at Saclay and in a T2K upgrade test at CERN.
- Use better mechanics for pad connection : 99.9% of good connections
- Make detailed studies to confirm the expected advantages of this scheme : less distortions (mesh at same voltage as frame), less noise, better flexibility

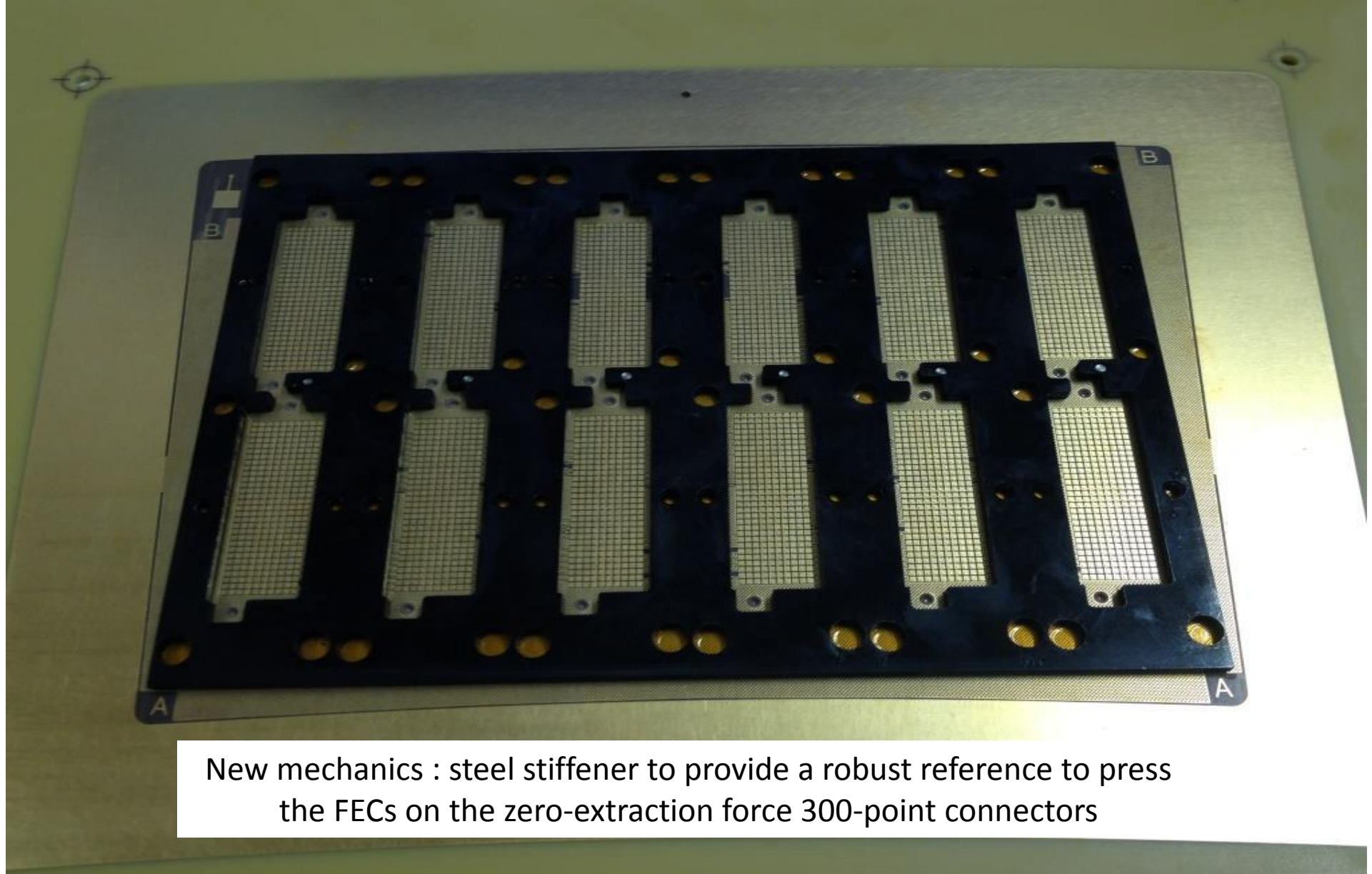


Arrival on November 13th evening
Re-test all modules on the table
Test Field cage HV on November 14
Mount 4 modules on November 14
Leak hunting on the new endplate

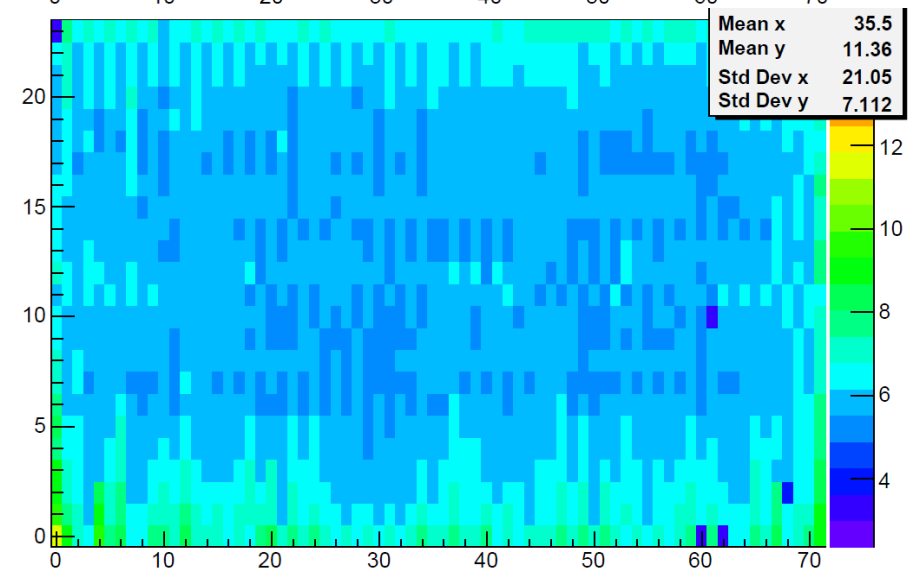
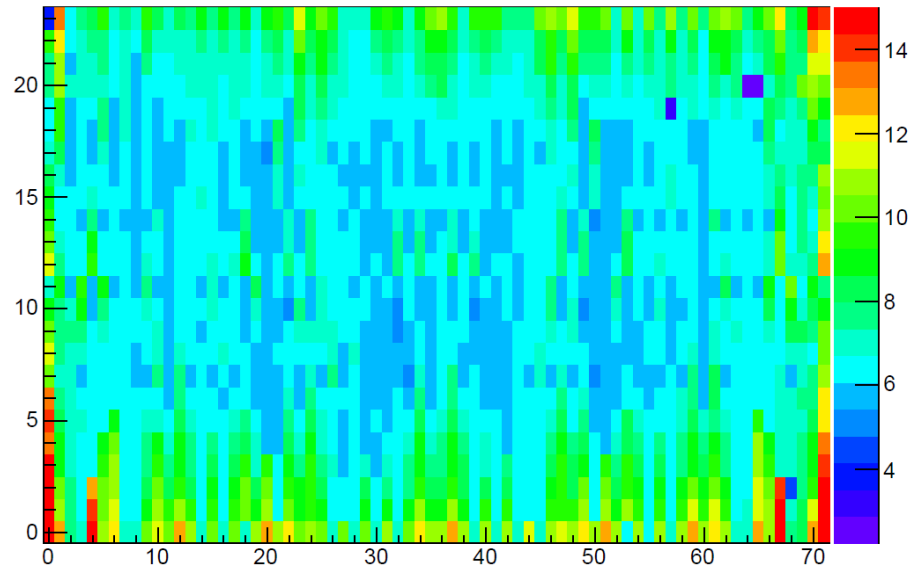
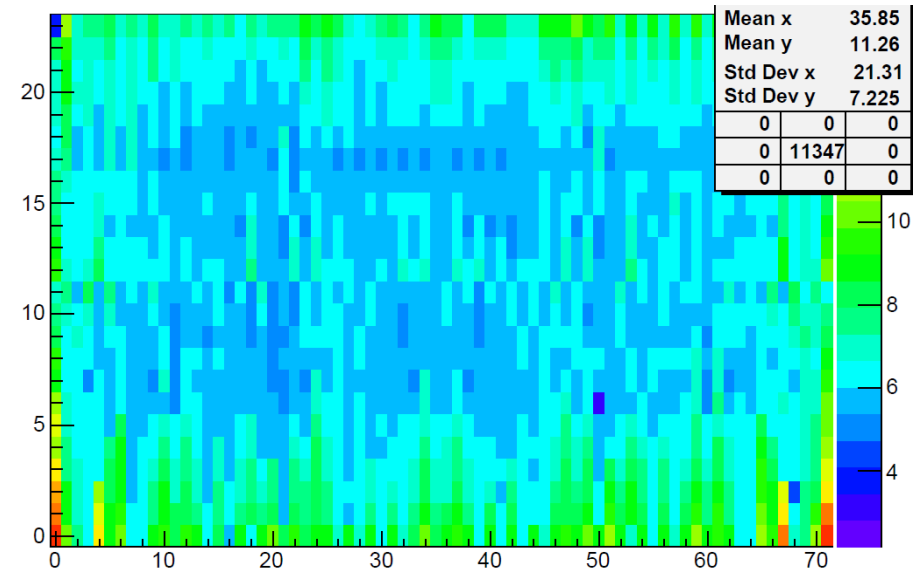
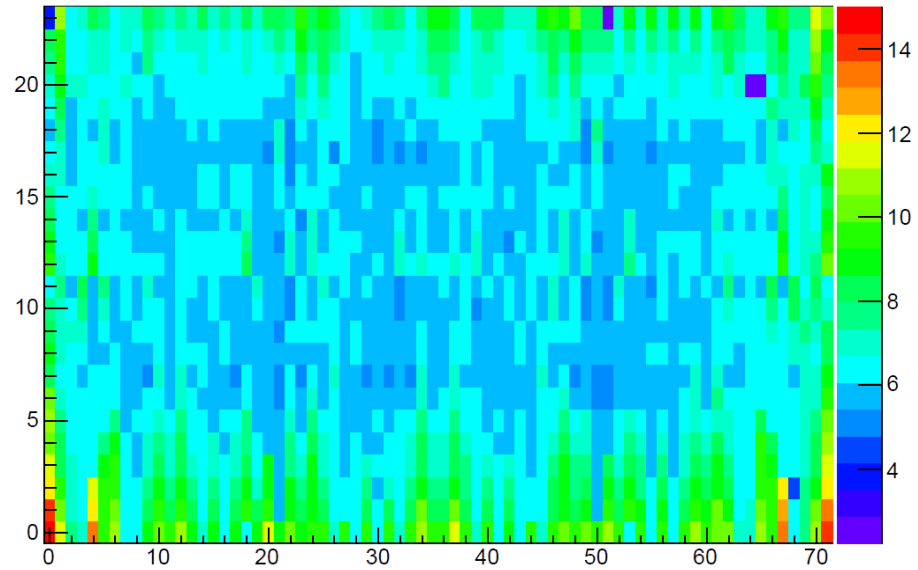
Install LV, fibers, etc...
Fill CO2 compressor for cooling
Took data until Nov. 28 morning : z scans,
B=0 and 1T, x scan, phi scan, vary
peaking time, vary central module HV







New mechanics : steel stiffener to provide a robust reference to press the FECs on the zero-extraction force 300-point connectors



The DLC (2.5 Mohm/sq, same at T2K August 2018 test) was not perfect. Base material obtained by etching the copper from a GEM base material.

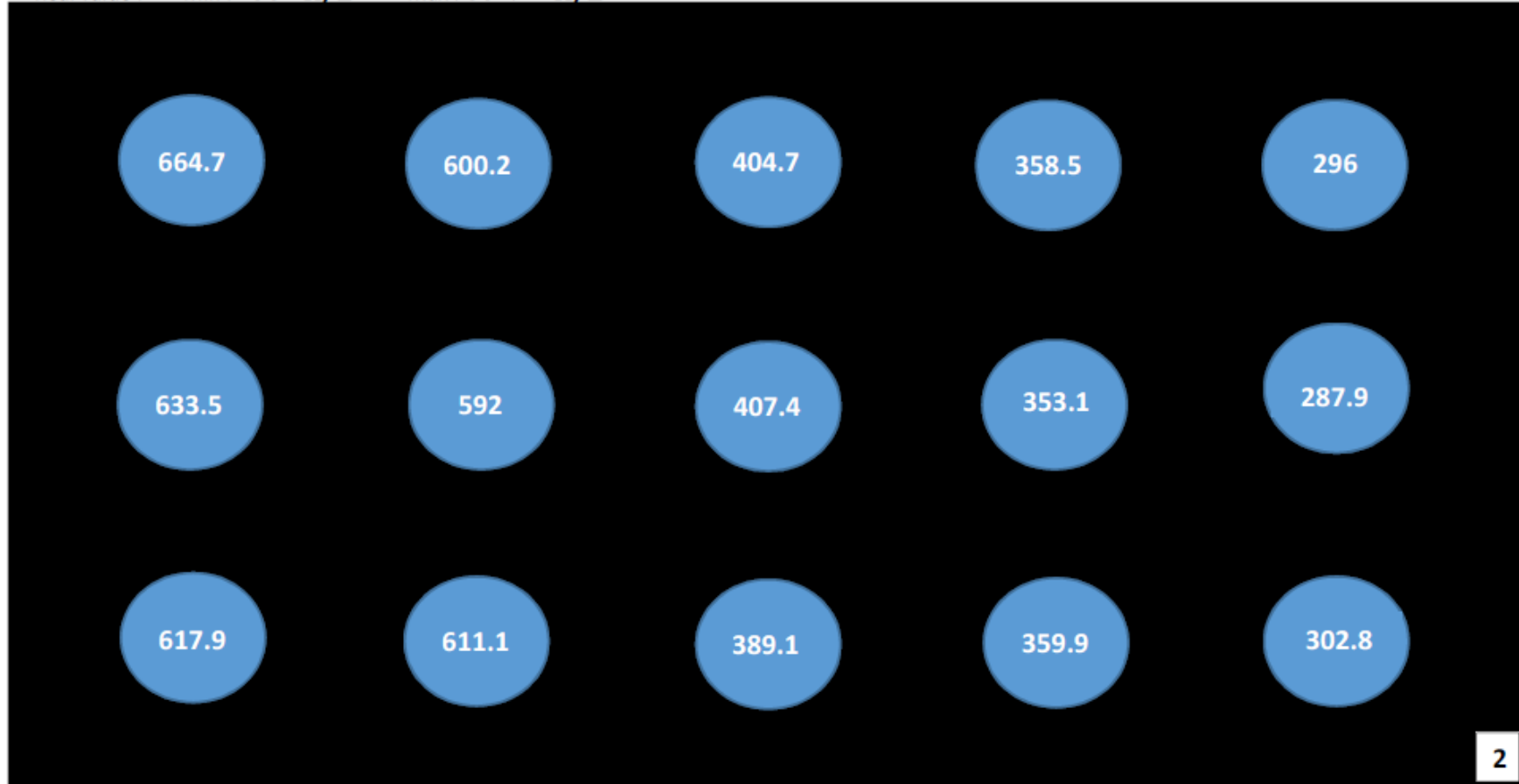
Modules numbered by decreasing quality order from E1 to E4



Theoretical value **500 k Ω /□**

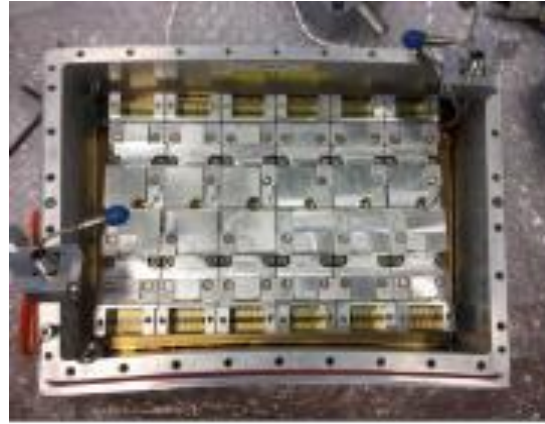
Foil size : 100x61cm

Real value : Min : **296 k Ω /□** Max : **664.7 k Ω /□**



Homogeneity of the resistivity could be improved

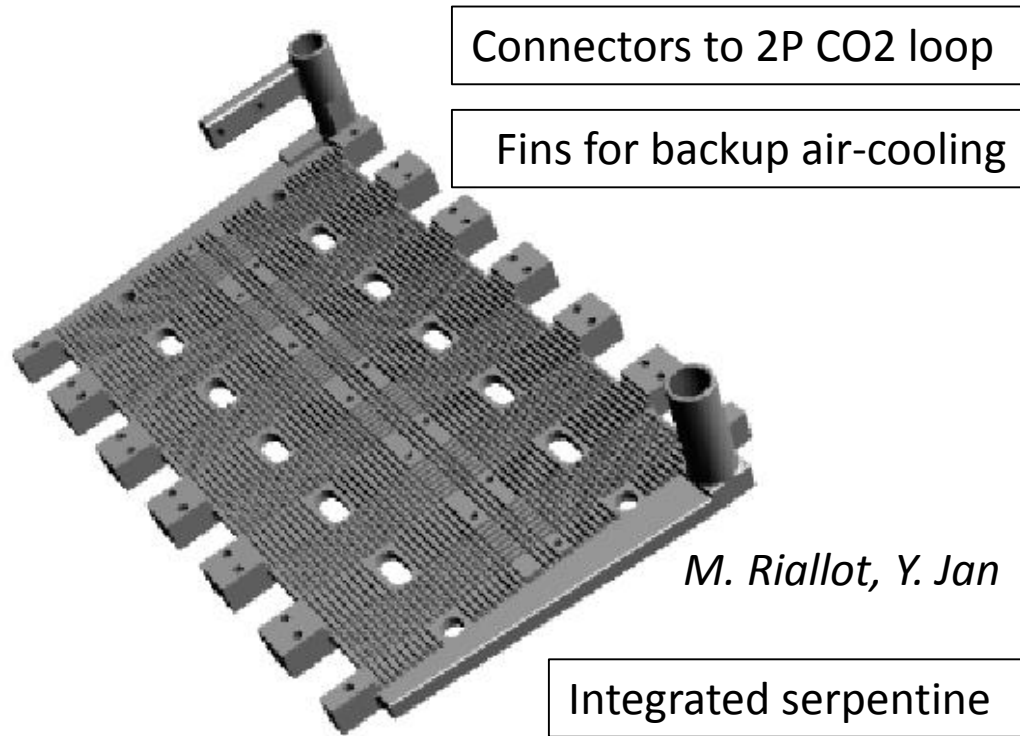
2-phase CO₂ cooling



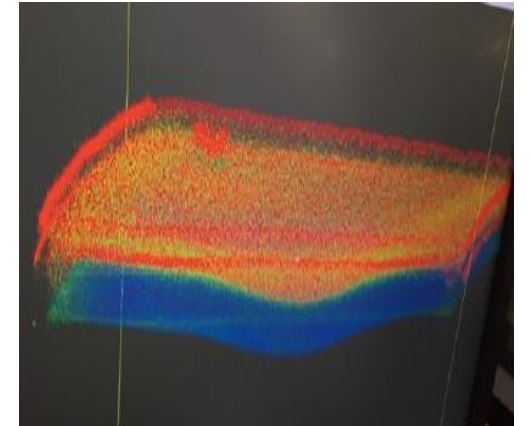
- Pioneered at Nikhef and CERN, studied at KEK.
- KEK bought a compressor (« TRACI ») for ILC and Belle II, installed at DESY Test Beam T24.
- Tested in 2014 and 2015 with 7 independent modules with a distribution by a manifold (« clarinette »). 0.8 mm inner diameter pipe
- This time (2018) tested with 4 modules in one loop. Very stable operation at 50 bar. 28-30°C on the FECS: continuous operation during 11 days without any incident.

FUTURE

- Cooling plate in 3D printing



- Module planeity studies (in progress)



M. Mur

- Large module
~40x40 cm
6000-8000 pads



FUTURE

- Electronics

Need development (probably in 65nm technology).

Broad outlines (still to be studied):

- 25-40 MHz sampling
- 9 bit low-consumption ADC
- ~200 ns peaking time shaper
- Power pulsing

Before this

Electronics for tests :

A new generation of the AFTER family: DREAM, ASTRE, etc...

Self-triggered time-stamped chip