The atmospheric pressure TPC for the ND280 Upgrade

Marco Zito
IRFU/SPP CEA Saclay

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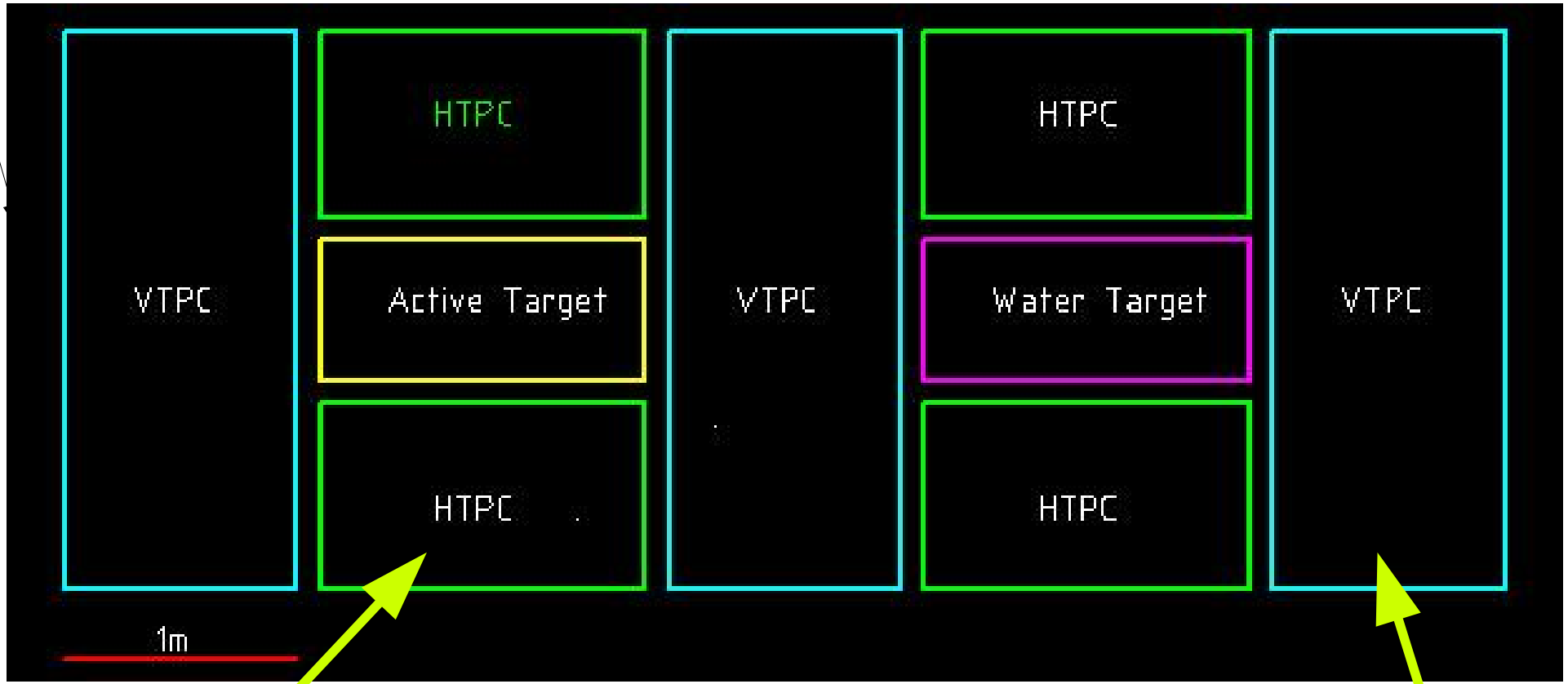
The baseline design for the upgraded ND280

All this inside the EM calorimeter and the UA1 magnet

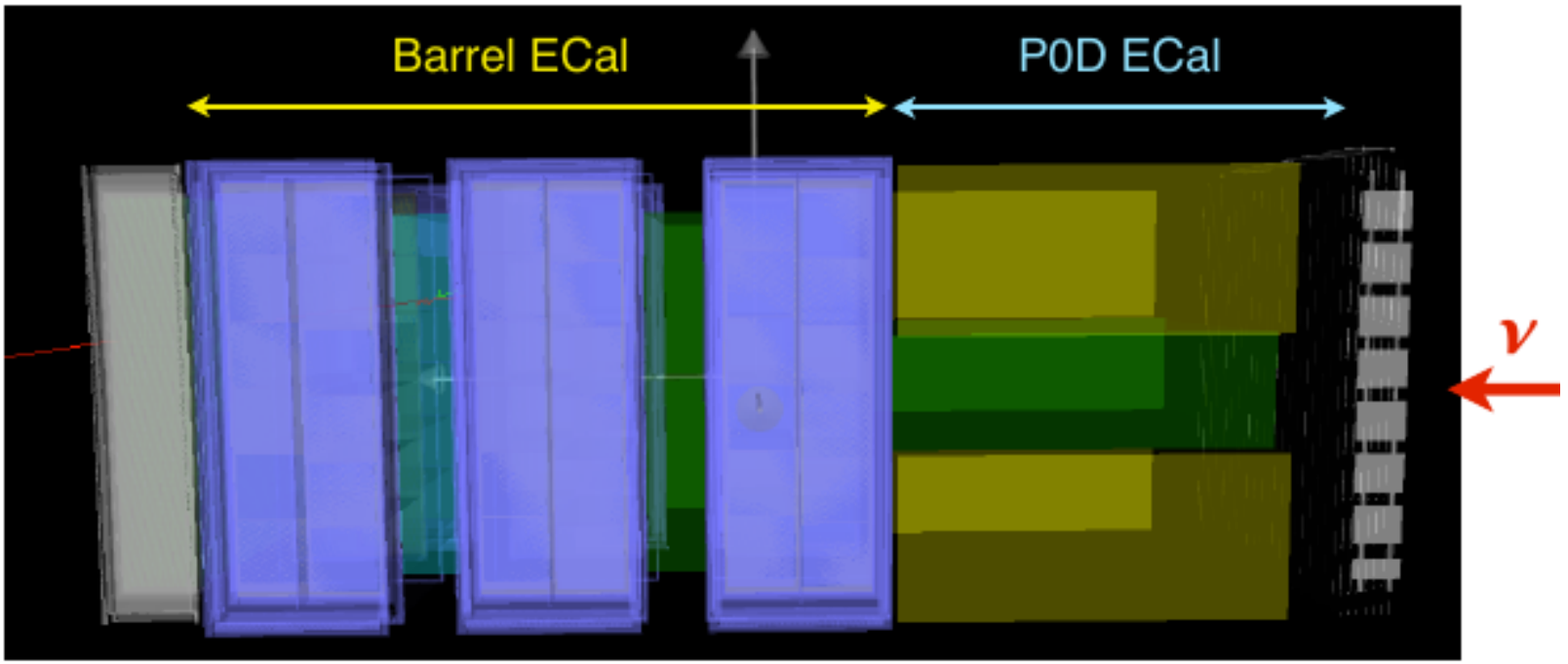


New horizontal TPC

Existing TPC

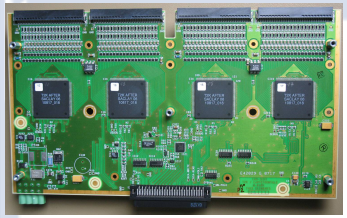
We plan to surround the TPC by scintillator planes for T0 and TOF determination. Still to be studied.

Alternative configuration

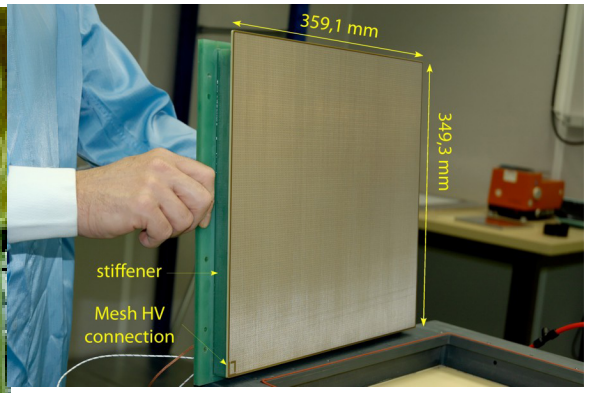


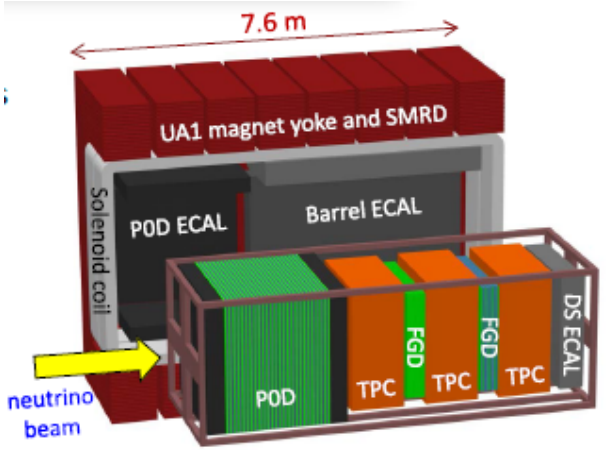
Advantages:

- Keeps present ND280 tracker in place (comparison possible) including FGD2 (water)
- Less challenging (areas, n of channels etc) for target/TPC/TOF
- Adds significant target mass (total~1+1+2 ton)
- Superior results observed in BANFF like fit
- Advantages foreseen for nue studies

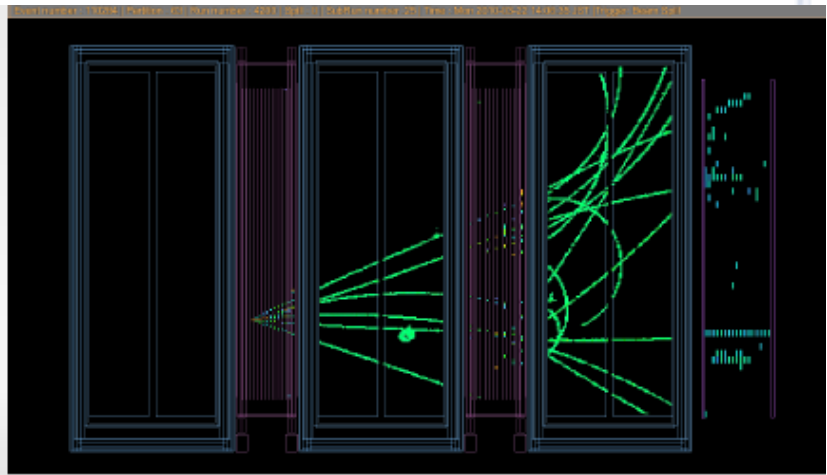


The T2K near detector TPC





- Three large TPC for the T2K near detector
- The first large TPC using MPGD
- ~9 m**2 equipped with bulk Micromegas detectors
- Playing a key role in the study of the neutrino flux and interactions (charge, momentum and dE/dx PID)
- Space resolution : 0.6 mm
- Momentum res. 9% at 1 GeV
- dE/dx: 7.8 % (MIP)



72 Micromegas and 120k channels functioning flawlessly since 2009 (dead channels 144/124272)

TPC performances

- Three large TPC for the T2K near detector
- The first large TPC using MPGD
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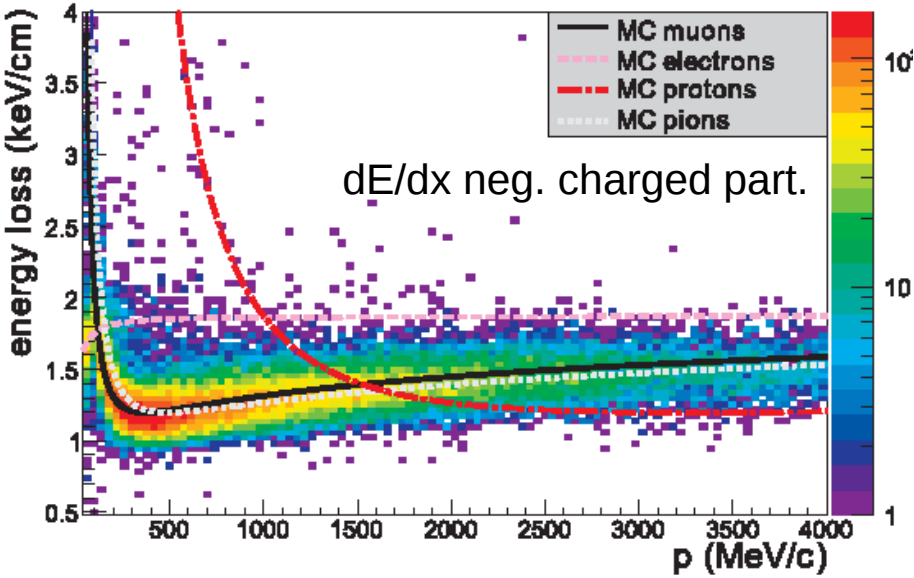
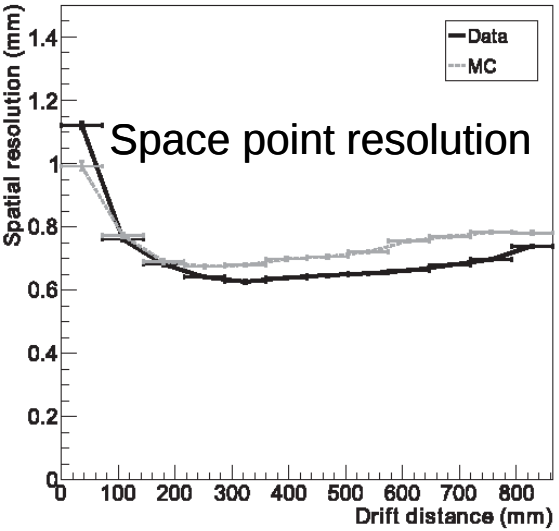
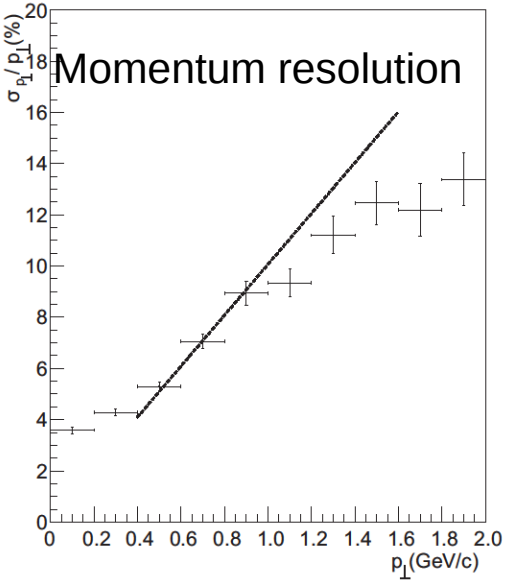
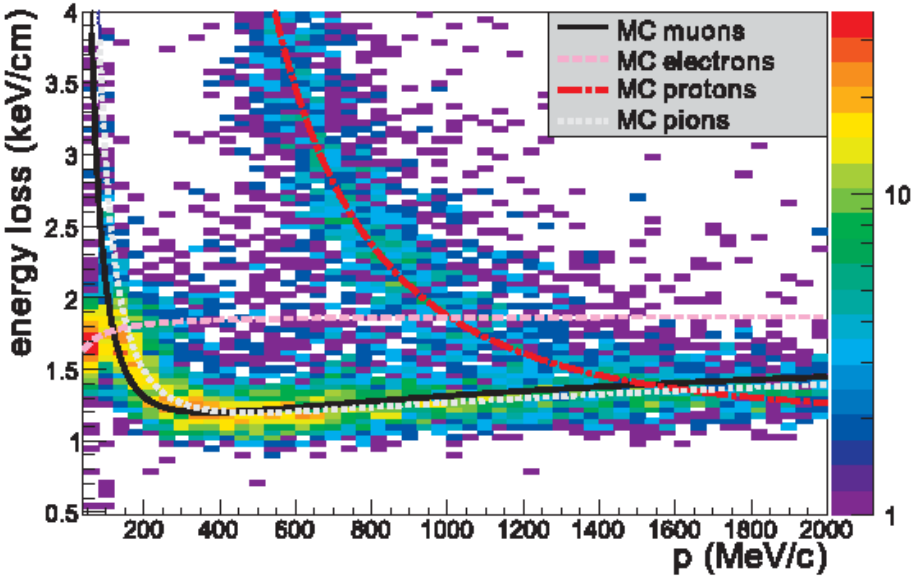


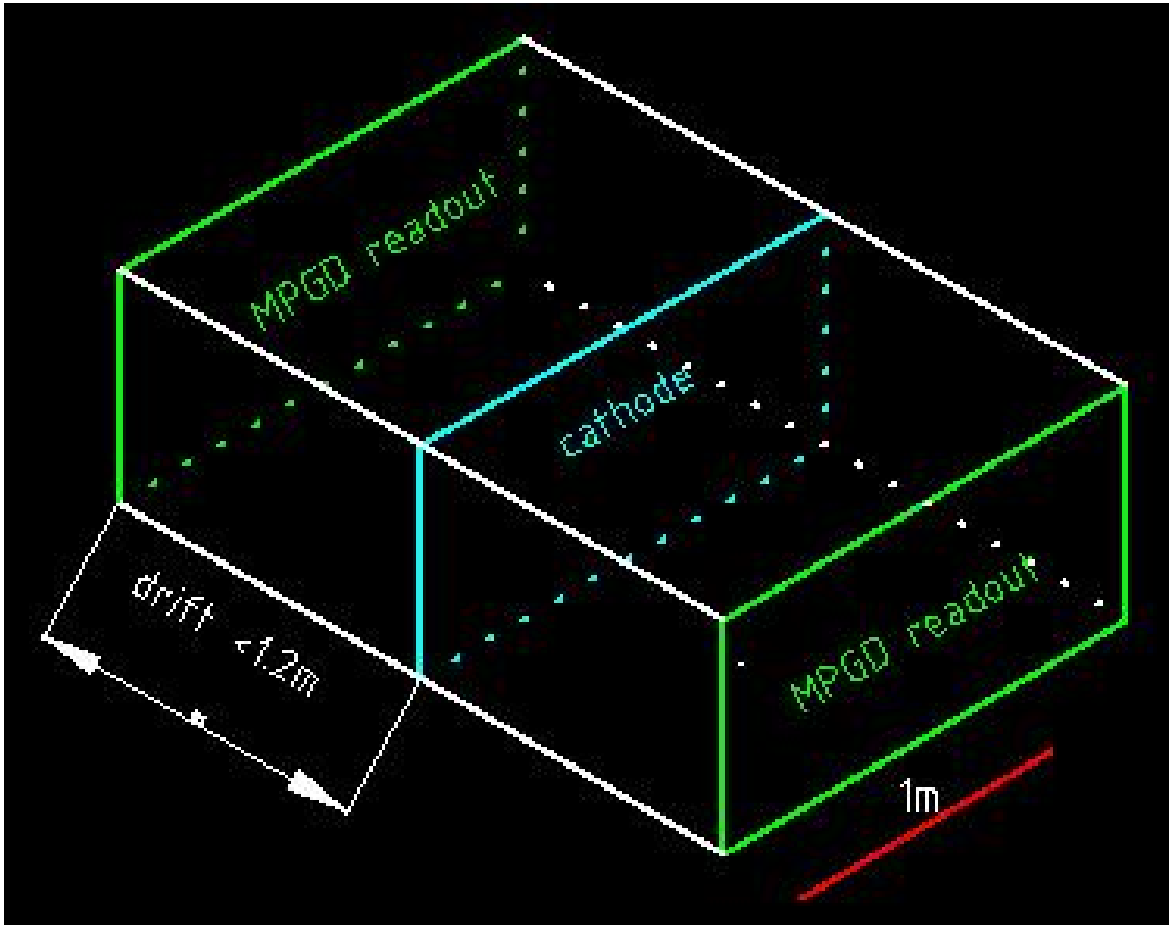






dE/dx pos. charged part.

Schematic view of the horizontal TPC



NB rough estimate for most of the parameters
Baseline configuration

The new TPCs

Parameter	Value	Comment
Overall dimensions	2 (x) x 0.8 (y) x 1.3 (z) m**3	4 identical TPC
Volume	2.1 m**3	Each
Drift Length	90 cm	Cathode in the middle
Pad area	~1 cm**2	Up to 2(?) cm**2 with resistive MM
Sensitive area tot	7.3 m**2	Tot 4 TPC
N MM	~ 66	Tot 4 TPC Assumes 35x35 cm**2 each MM
N channels	7.3 10**4	Tot 4 TPC

In the following slides, some examples of new detector features that we should consider

NB rough estimate for most of the parameters
Alternative configuration

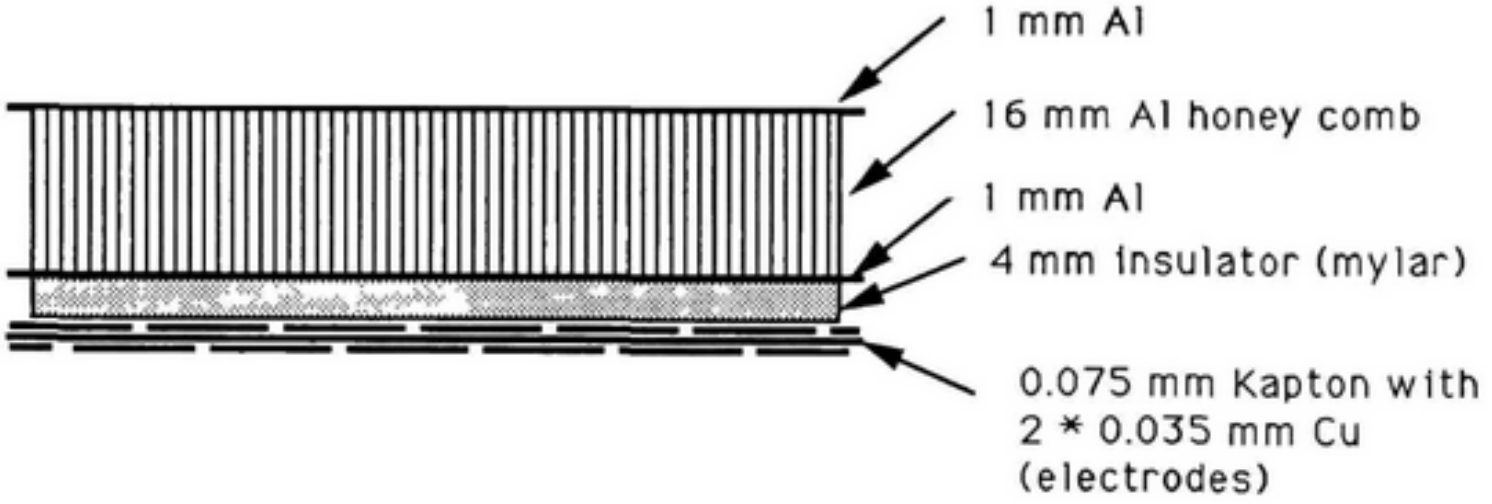
The new TPCs

Parameter	Value	Comment
Overall dimensions	1.8 (x) x0.8 (y) x 2.0 (z) m**3	2 identical TPC
Volume	2.9 m**3	Each
Drift Length	90 cm	Cathode in the middle
Pad area	~1 cm**2	Up to 2(?) cm**2 with resistive MM
Sensitive area tot	6.4 m**2	Tot 2 TPC
N MM	~ 32	Tot 2 TPC Assumes 50x50 cm**2 each MM
N channels	6.4 10**4	Tot 2 TPC

The new TPC

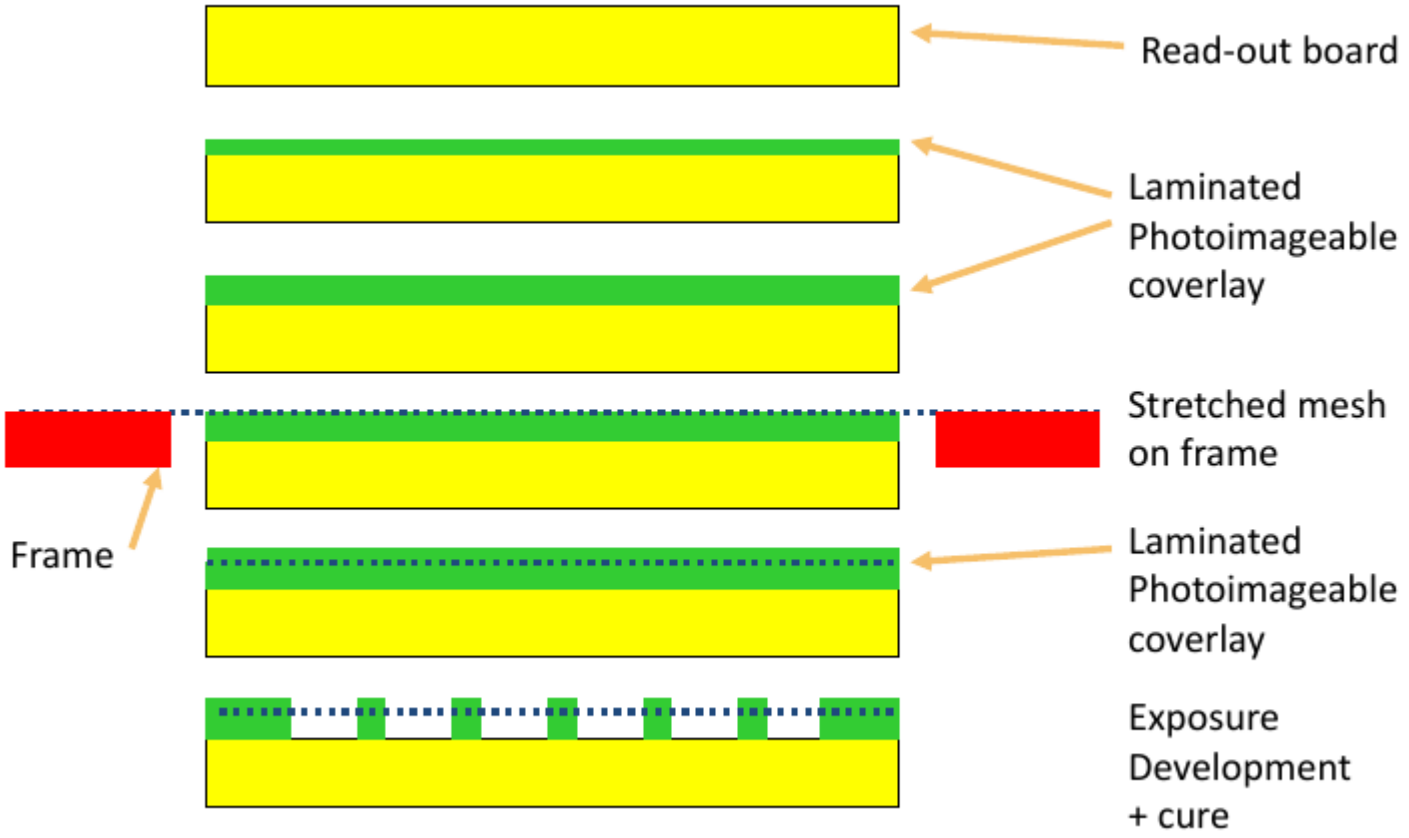
- The additional TPCs are similar in size to the existing VTPC (planned to be re-used)
- We plan to use a thin (a few cm) field cage following what was done for the Aleph and Delphi TPCs
- Several technological innovation developed by the ILC-TPC and RD51 could also be considered: resistive anode Micromegas, readout electronics on the back of the MM, low mass cooling ...

The Aleph TPC field cage



Insulator from a thin Mylar foil winded around many times using a higly resistive glue

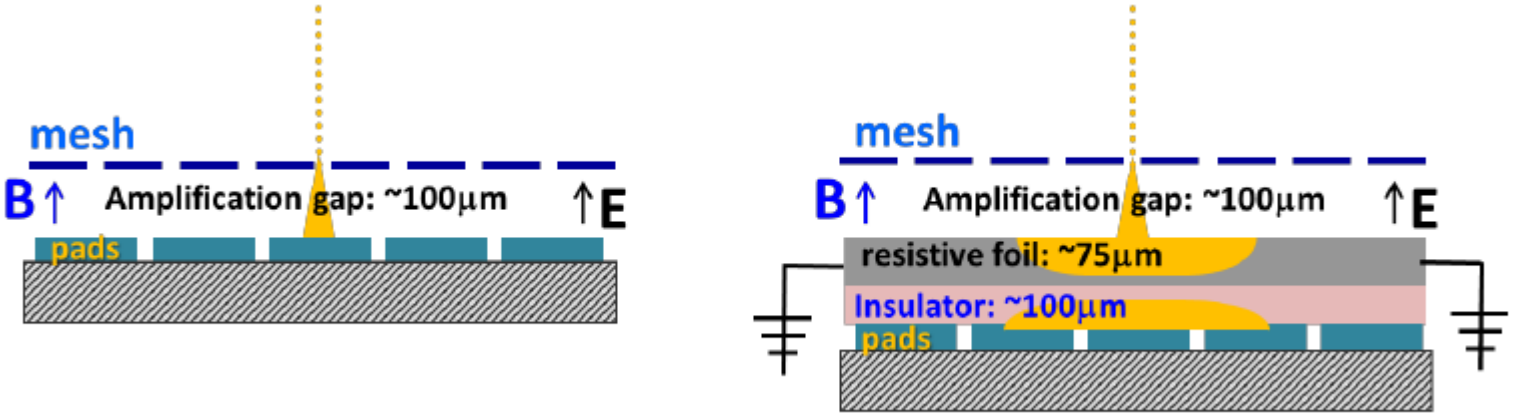
Bulk Micromegas

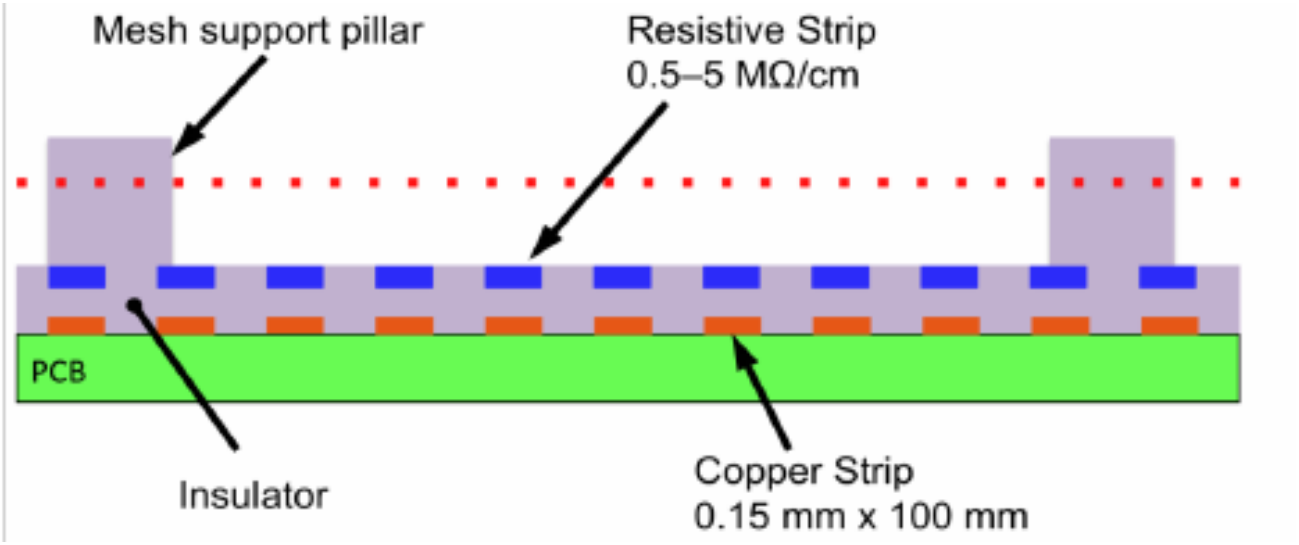


Proven technology. Saclay equipped with a new production line. Micromegas technology succesfully transferred to industry as part of the ATLAS New Small Wheel Phase I upgrade. Can also count with CERN (R. De Oliveira) workshop

Resistive Bulk Micromegas

- Several advantages (charge spread, intrinsic spark protection)
-





Fabricating large detector

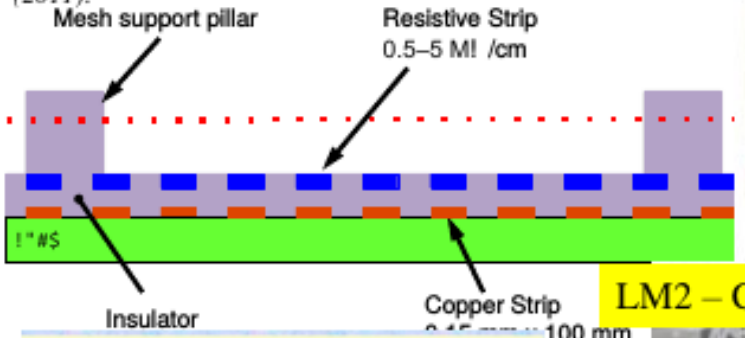
Construction of large chambers in ATLAS

Goal : 1200 m2 total detector surface

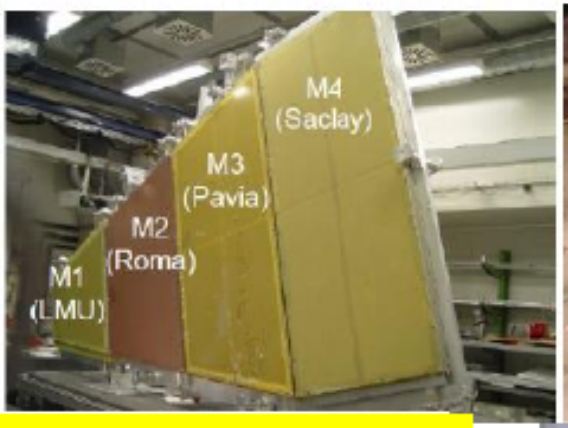
ATLAS Resistive strip technology

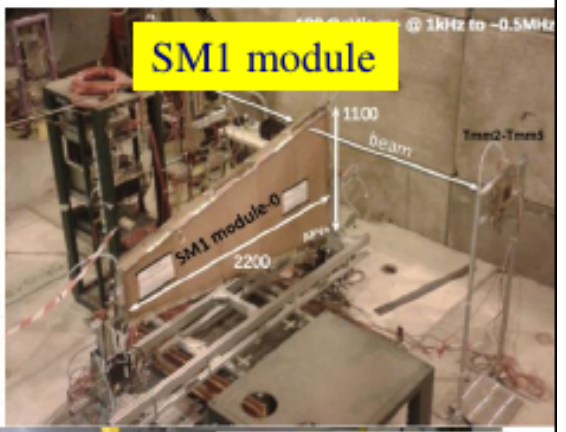
Joerg Wotschack, Mod.Phys.Lett. A28 (2013) 1340020

T. Alexopoulos, et al. Nucl. Instrum. Meth. A 640, 110-118, (2011).



Industrialization is going on through ELVIA, ELTOS

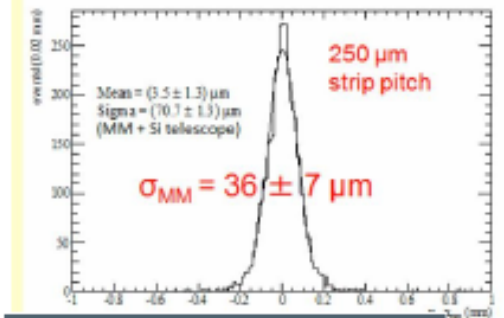


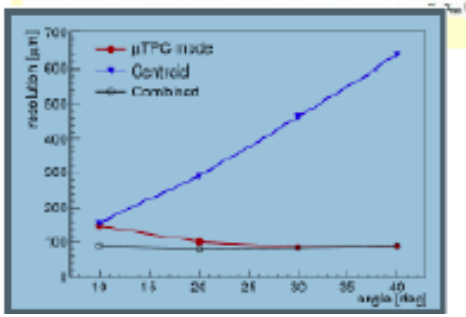


LM2 – CERN / Dubna -Thessaloniki

SM2 – Germany

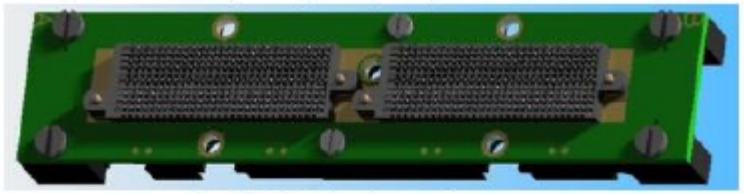
Bulk Micromegas (2008 test-beam):





At Saclay the large clean room is ready and operational
First M0 module is under construction and soon will be tested

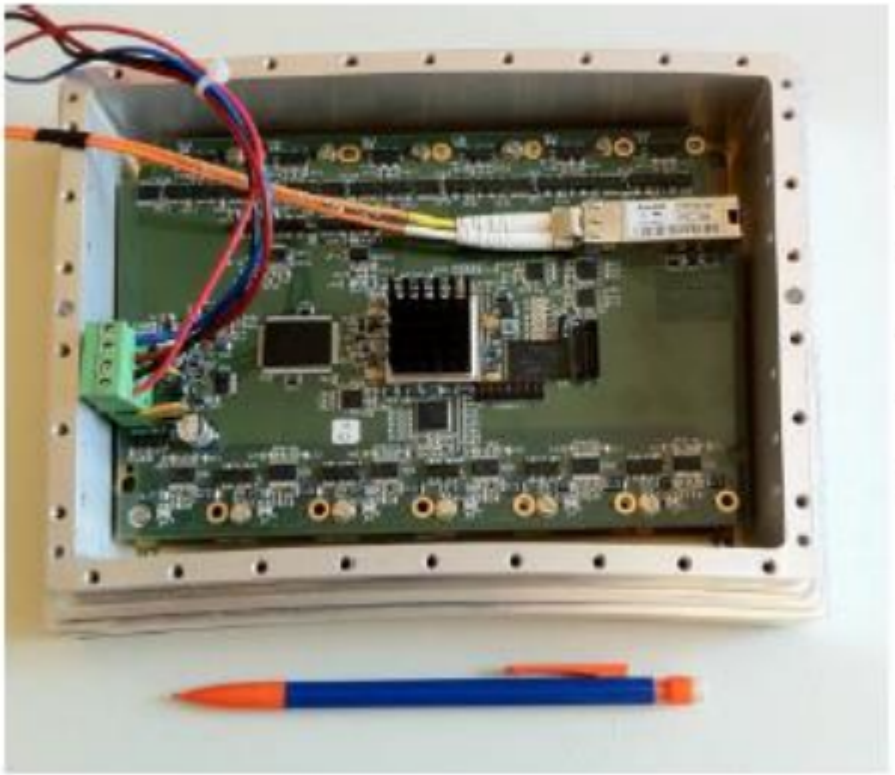
ILC TPC R/O electronics



(a) FECi Detector side connectors

(b) Component side of a FECi

(c) A FECi with its heat sink

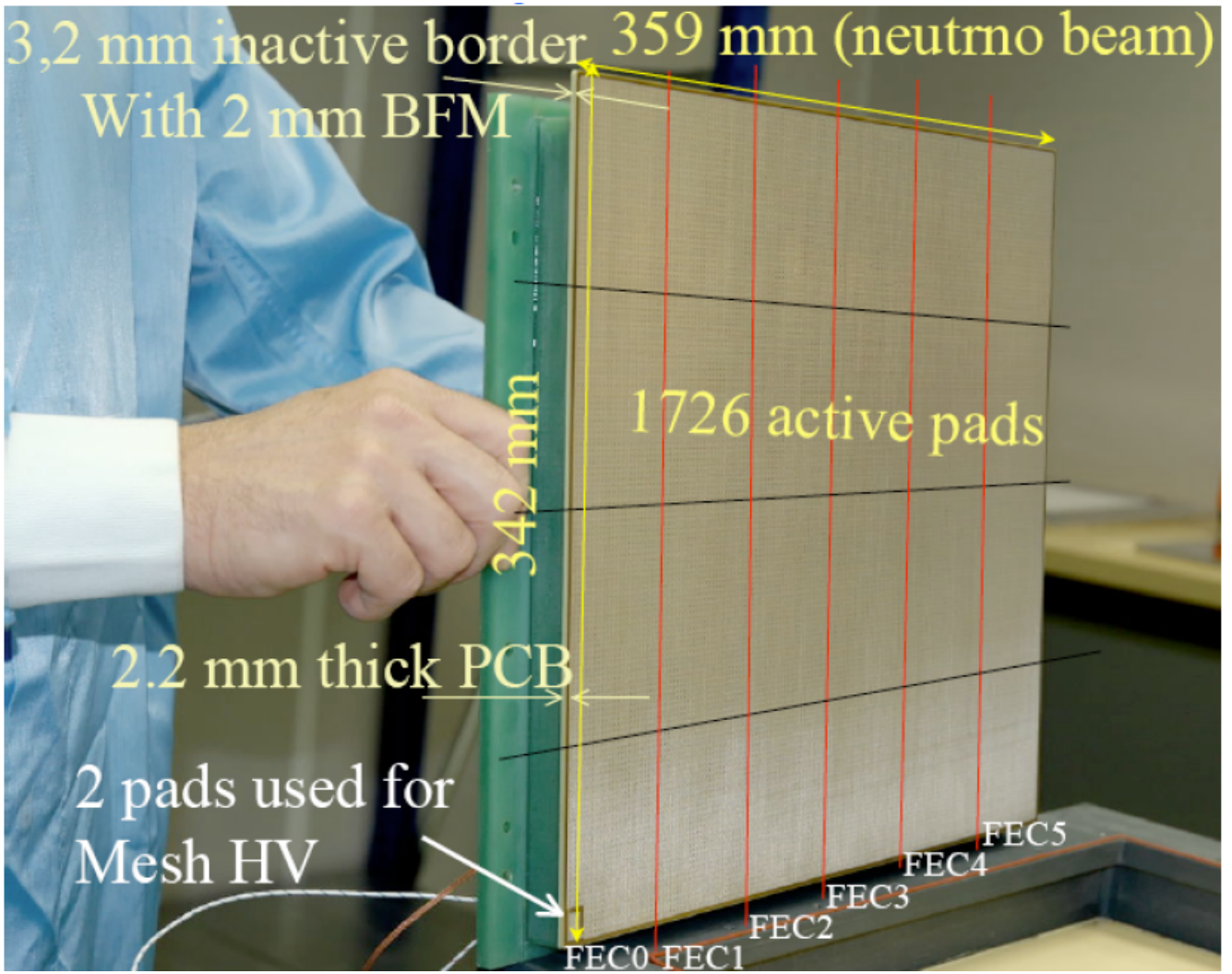


Size: 1/10 of a T2K TPC FEC, for the same number of channels. Flat readout achieved for a pad size of 3x7 mm**2. We plan to use a pad size ~100 mm*2

WP3 Micromegas readout

- Two meetings in Saclay (March and May)
- We have decided to
  - Order 5 PCB (same as T2K TPC PCB) from CERN
  - Order 1 MOhm DLC foil (see Ochi-san talk)
  - Produce several bulk Micromegas
  - Test them on a thin TPC based on the existing test bench (autumn 2017)
  - Then proceed towards the design of MM for the prototype

Module T2K


3,2 mm inactive border
With 2 mm BFM
359 mm (neutrno beam)
342 mm
1726 active pads
2.2 mm thick PCB
2 pads used for
Mesh HV
FEC0
FEC1
FEC2
FEC3
FEC4
FEC5

PCB

3.4.1.1. The PCB cross section

The PCB cross-section is given in ***figure 3.21***. Layer 2 is a shielding grid connected to the partial shielding layer 1. On both side of the 1,6 mm FR4 sheet, the same number of prepreg sheets is added for a finished PCB thickness of 2,2 -/+ 0,1 mm.

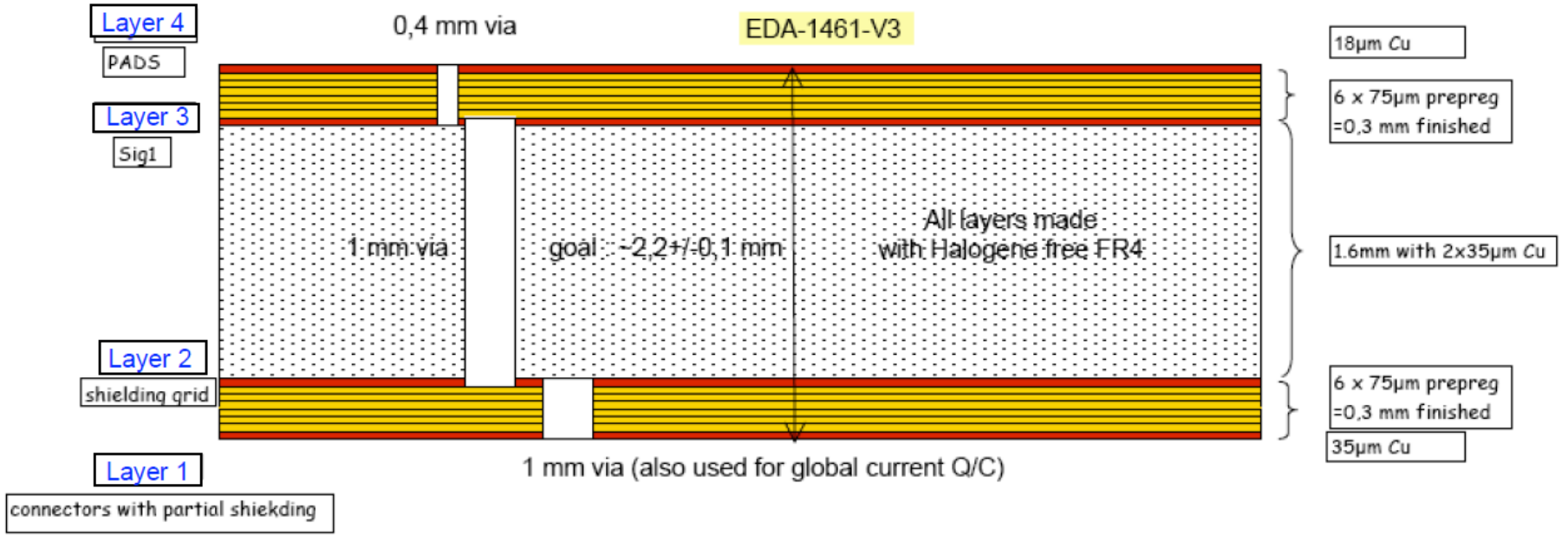


Figure 3.4 *: EDA-1461-V3 PCB cross section.*

Test bench