

DE LA RECHERCHE À L'INDUSTRIE



STATUS OF MM TECHNOLOGY TRANSFER TO



Fabien Jeanneau

- **Standard Micromegas, bulk, medium** area (up to 50x50 cm²)
 - COMPASS experiment (15 detectors) → **first prototypes**

- **Resistive μ M, bulk, precise, medium** area (up to 50x50 cm²)
 - BXY (10x10 cm²) ordered by RD51 → **finished**
 - CLAS12 forward → **first prototypes**

- **Resistive μ M, bulk, precise, large** area (<1m²)
 - Projet GéoAzur (60 telescopes) → **in progress**

- **Resistive μ M, (bulk?), precise, very large** area (>1m²)
 - ATLAS/NSW (1200 m²)



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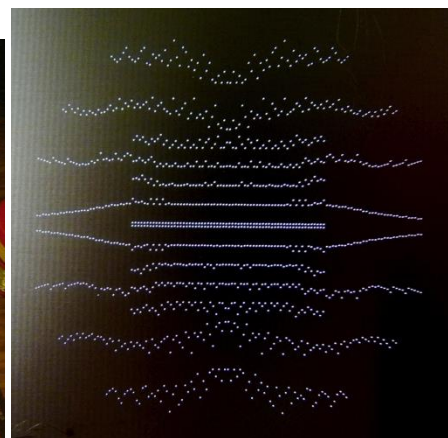
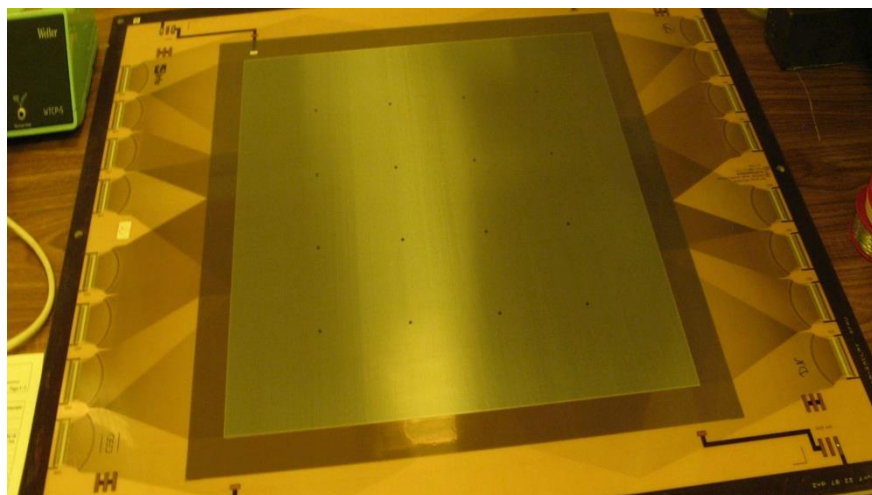
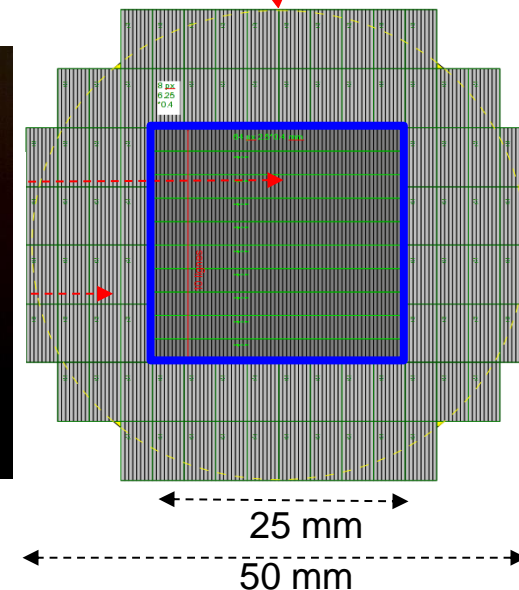
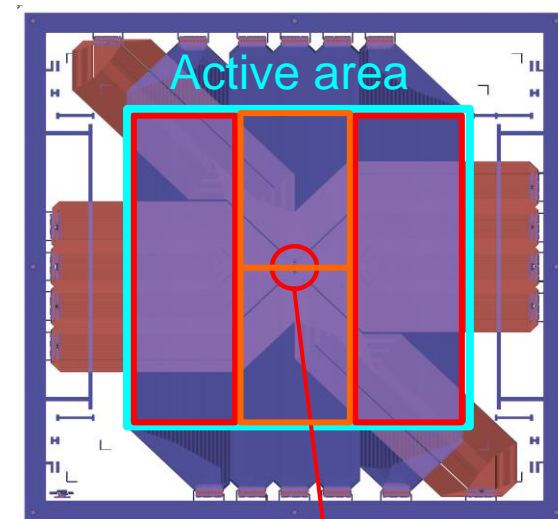
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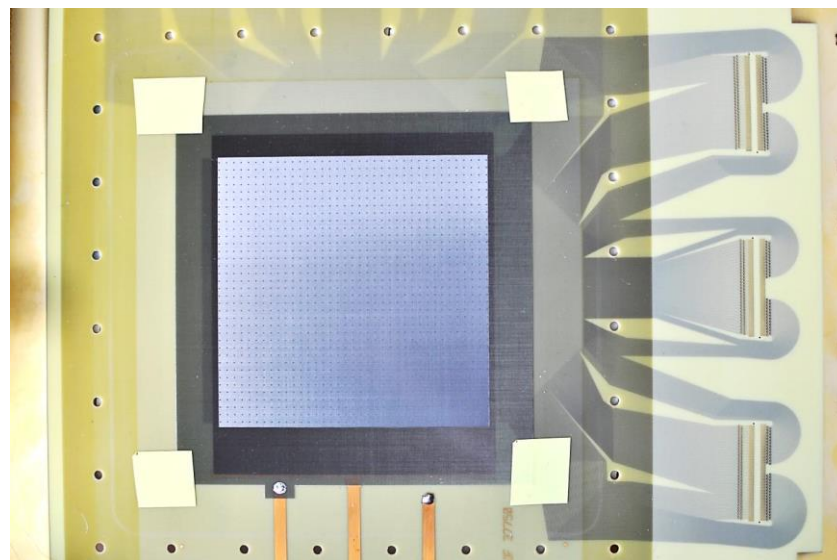
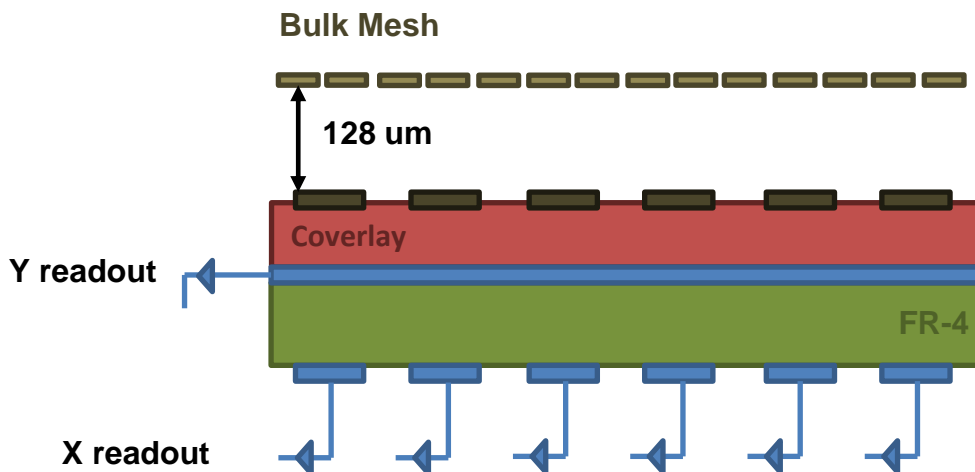
See talks of:

- *Fl. Thibault, MPGD conference, 1st july*
- *D. Neyret, RD51 collaboration meeting, 5th july*

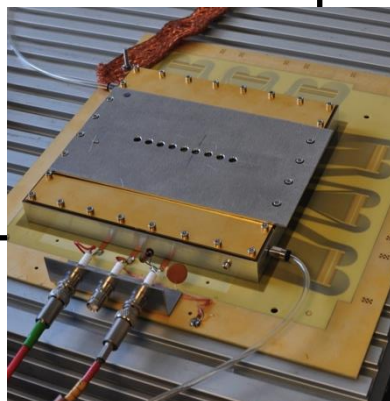
- 40 x 40 cm² active area
- 2560 readout channels
- Thin board glued on Rohacell
- 15 detectors for 2015
- Buried resistance in progress



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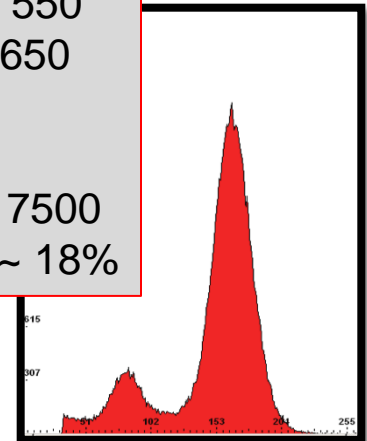


- Existing layout
- Resistive bulk (50 to 100 MOhms along the strips)
- X/Y readout
- Active area 10 x 10 cm²
 - Strip pitch: 250 μm
 - Strip width: 150 μm



HV_m: 550
HV_d: 650

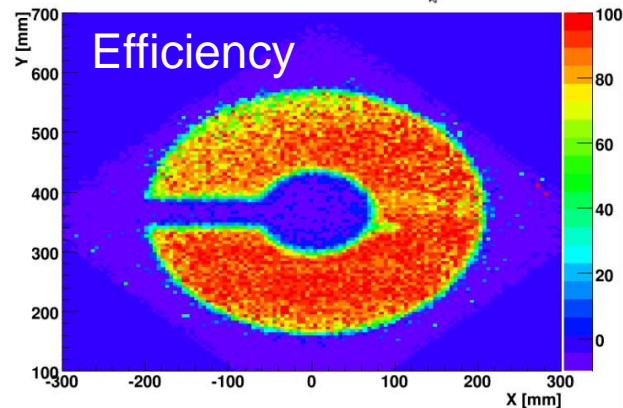
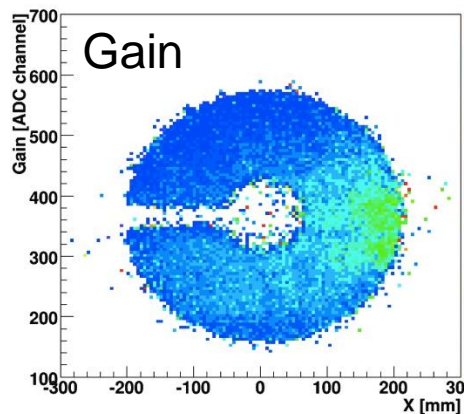
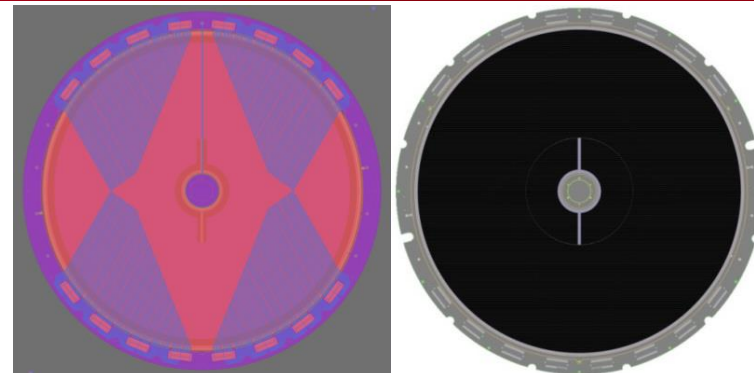
Gain: 7500
dE/E ~ 18%



See talk of G. Charles, MPGD conference, 1st july

Specifications :

- active area : 430 mm diameter disk with a 50 mm diameter hole at the center
- 100 μm PCB glued on ROHACELL (4mm)
- 500 μm pitch, 100 μm strip gap
- resistive strips



Final design production (end of 2013):

- 8 detectors: 6 + 2 spares
 - layout adjustments
 - copper layers: 5 μm
- manufacturing of resistive strips using screen printing?
- produced by ELVIA if prototypes are qualified



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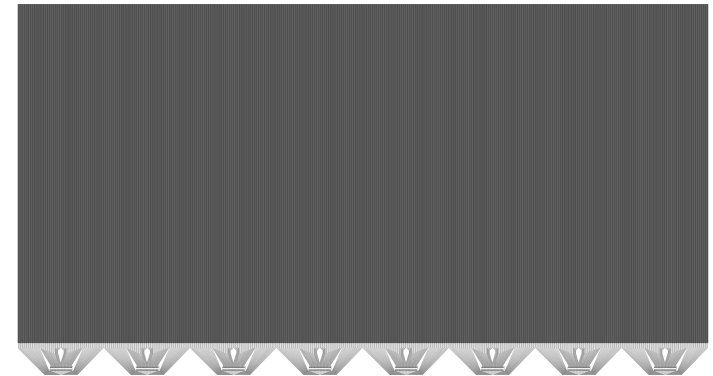
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- Muon tomography project
 - Measure of the rock density using the muons from the cosmic rays as a source
- Others applications
 - Survey of tunnels
 - Dynamics of reservoir (aquifer, oil, ...)
 - Homeland security
 - Natural risks (volcan, cliffs, ...)



- Production of 60 telescopes:
 - XY resistif readout
 - 0,5 m²
 - 5 cm drift TPC
- 6 prototypes for end of 2013:
 - 2 protos at Elvia (4 at Cern)
 - Large areas screen printing



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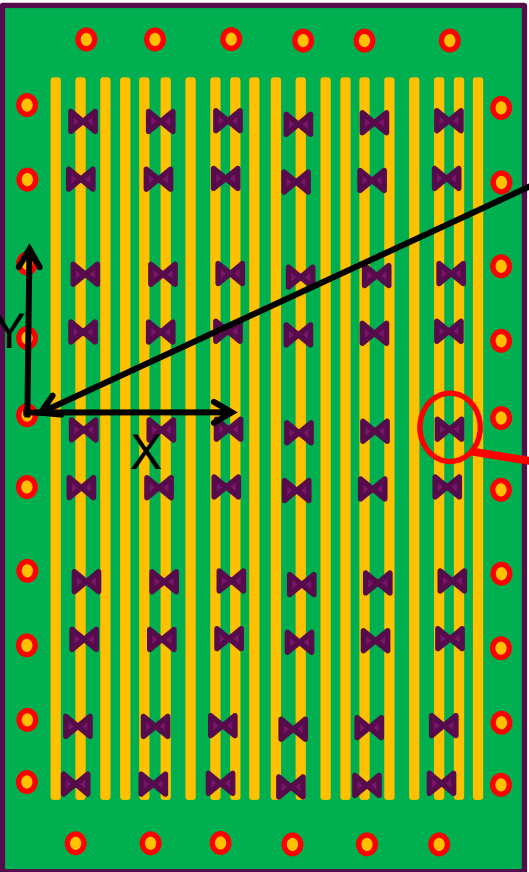
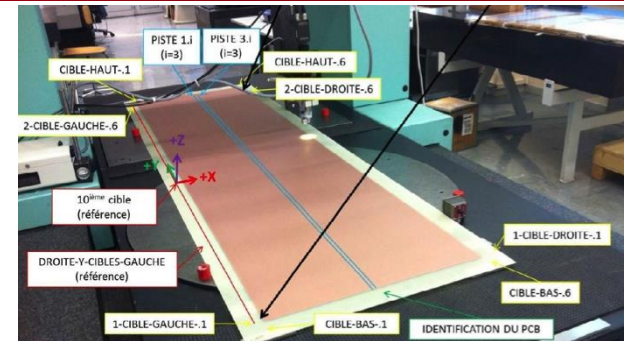
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LARGE PCB METROLOGY

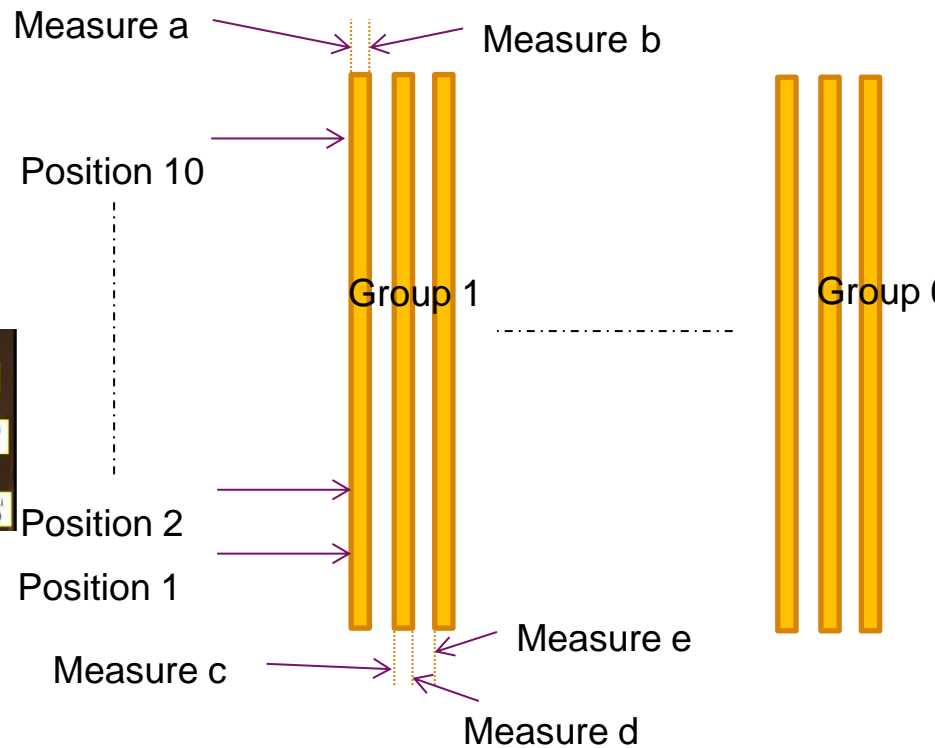
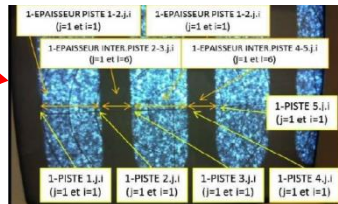
- 6 PCBs manufactured by ELVIA
 - 3 PCBs 1*0.6 meter
 - 3 PCBs 2*0.6 meter
- Optical measure at 5/6 microns precision on Olivetti Machine (CERN Metrology lab)

Measurements on groups of 3 strips (comparison with precision targets):

Pitch: 2 measures
Strip width: 2 measures
Strip gap: 2 measures
Rectitude

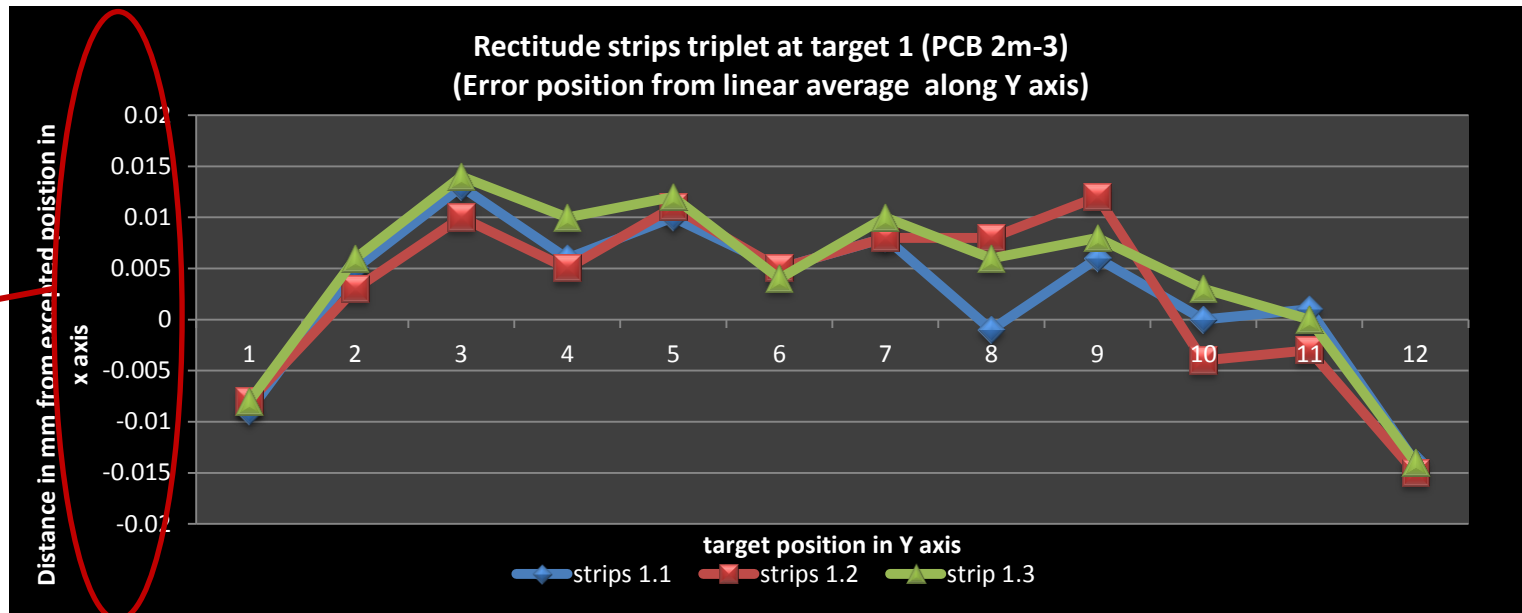


target reference



➤ 60 distributed Area

(Example of 3 neighboring strips straightness)



Rectitude
+/- 20µm



		1 meter			2 meter			
<u>rectitude error</u>	PCB 1	PCB 2	PCB 3	PCB 1	PCB 2	PCB 3	Average	
<i>mimum</i>	12.00	18.00	14.00	18.00	30.00	11.00	17.17	
<i>maximum</i>	31.00	36.00	28.00	37.00	80.00	22.00	39.00	
<i>average</i>	21.00	26.00	20.80	26.50	53.00	16.90	27.37	
<i>standart deviation</i>	5.07	4.94	3.59	4.81	16.70	3.00	6.35	

Expected:
40 µm

		1 meter			2 meter			
<u>Pitch</u>	PCB 1	PCB 2	PCB 3	PCB 1	PCB 2	PCB 3	Average	
<i>mimum</i>	390.00	390.00	392.00	392.00	393.00	393.00	391.67	
<i>maximum</i>	408.00	407.00	411.00	410.00	408.00	410.00	409.00	
<i>average</i>	400.00	399.00	400.00	400.00	400.00	400.00	399.83	
<i>standart deviation</i>	4.00	4.00	4.00	3.00	3.00	3.00	3.50	

Expected:
400 μm

		1 meter			2 meter			
<u>Strips width</u>	PCB 1	PCB 2	PCB 3	PCB 1	PCB 2	PCB 3	Average	
<i>mimum</i>	248.00	241.00	248.00	267.00	249.00	242.00	249.17	
<i>maximum</i>	278.00	271.00	280.00	285.00	274.00	274.00	277.00	
<i>average</i>	264.00	257.00	266.00	266.00	260.00	257.00	261.67	
<i>standart deviation</i>	6.00	5.00	6.00	7.00	5.00	6.00	5.83	

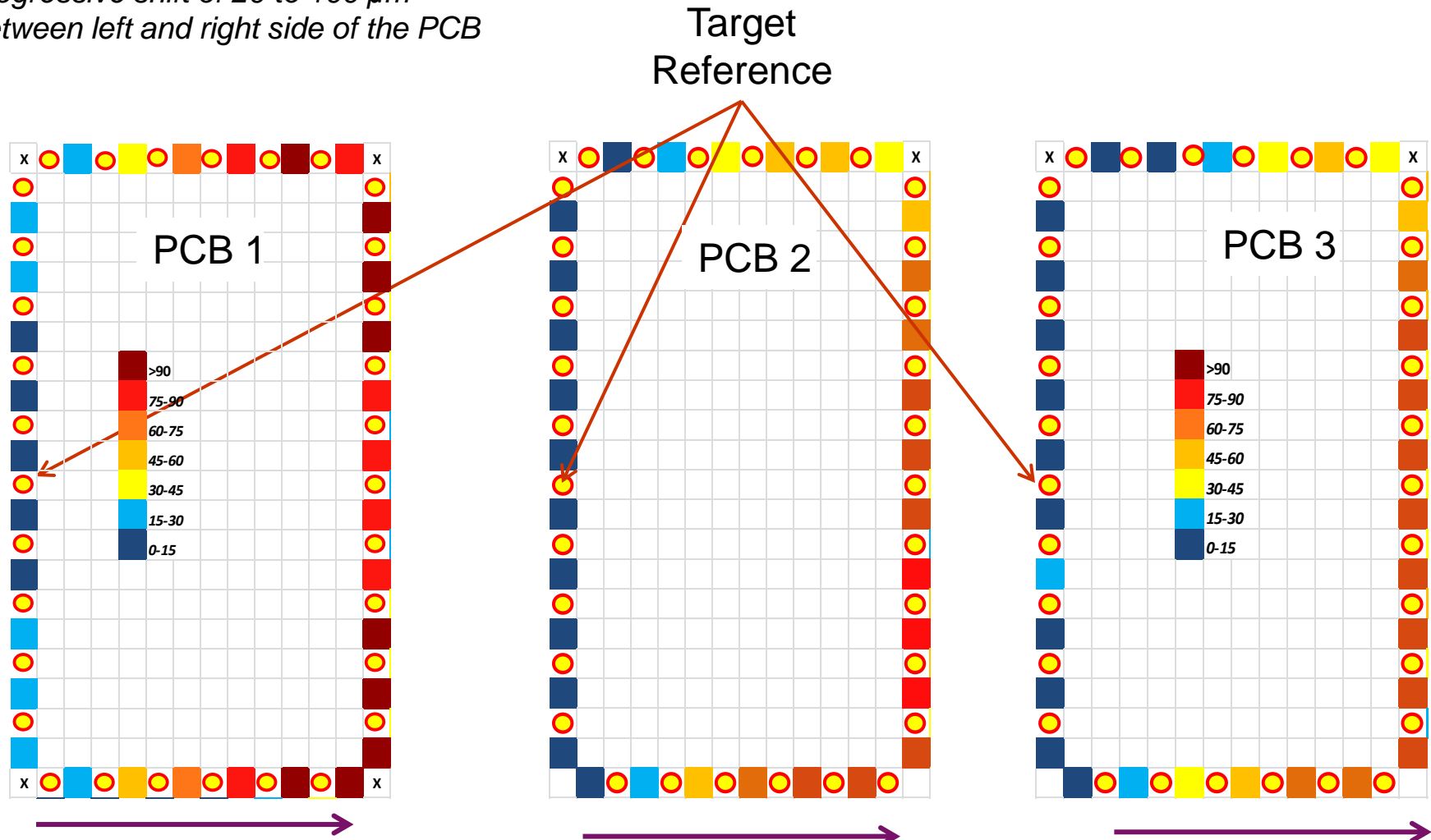
Expected:
270 μm

		1 meter			2 meter			
<u>gap strips</u>	PCB 1	PCB 2	PCB 3	PCB 1	PCB 2	PCB 3	Average	
<i>mimum</i>	121.00	132.00	116.00	116.00	127.00	129.00	123.50	
<i>maximum</i>	148.00	154.00	146.00	152.00	151.00	159.00	151.67	
<i>average</i>	135.00	142.00	133.00	133.00	140.00	143.00	137.67	
<i>standart deviation</i>	6.00	5.00	6.00	7.00	5.00	6.00	5.83	

Expected:
130 μm

Precision of the target position on PCB 1m:

*progressive shift of 20 to 100 μm
between left and right side of the PCB*



Error of target position on X axis from target reference in μm

STRIPS POSITIONING (2 M)

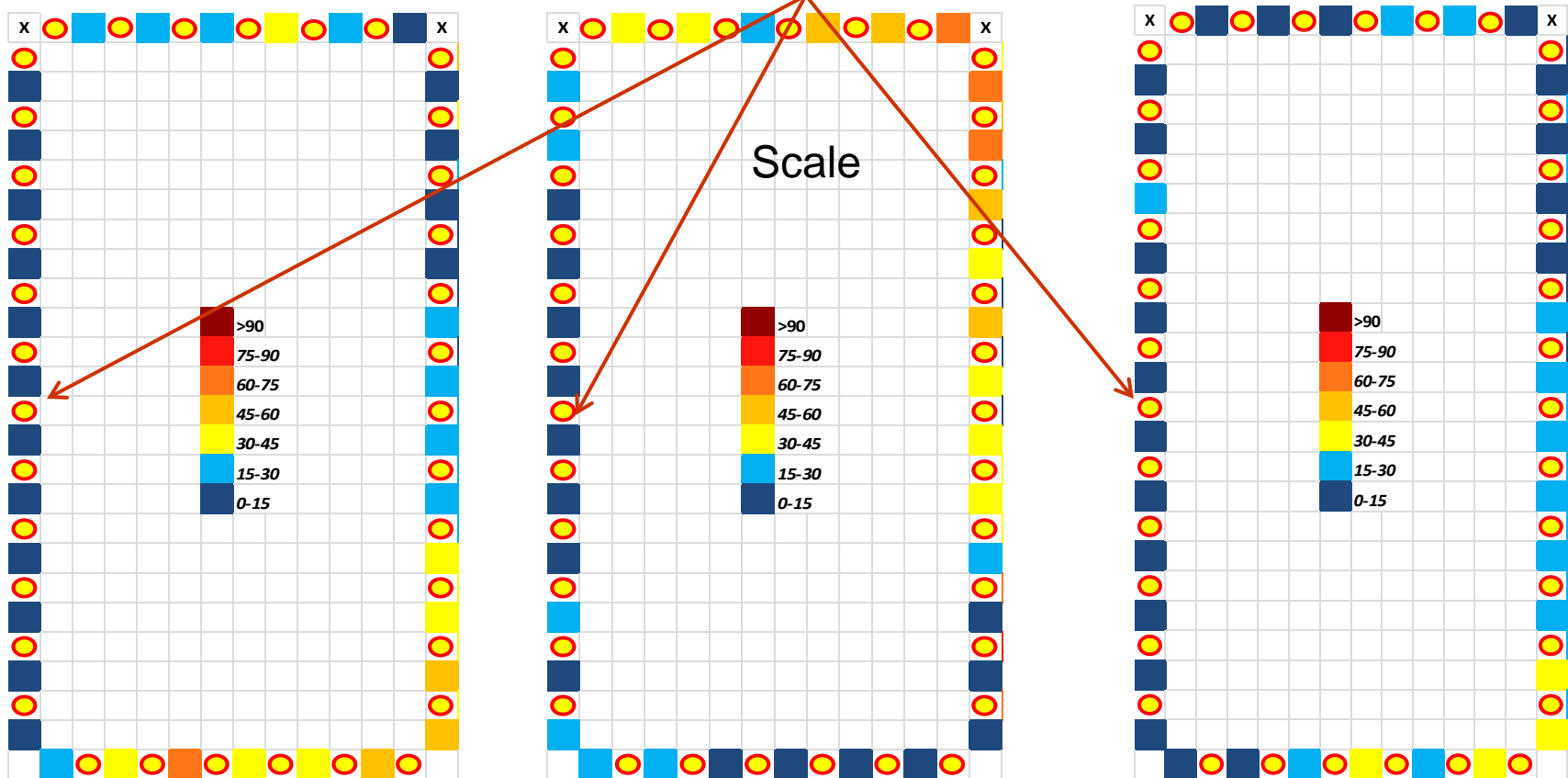
Precision of the target position on PCB 2m:

PCB 1 & 3: Error less than 45 μm

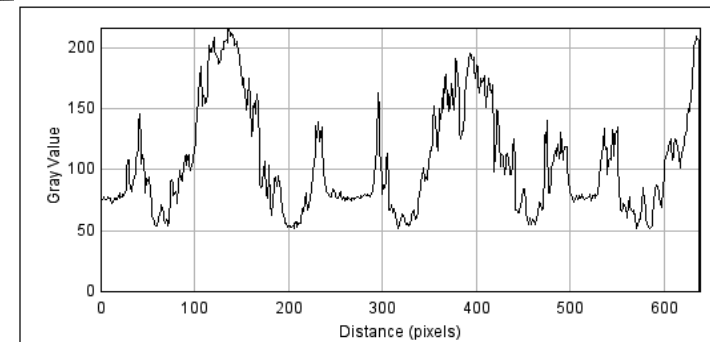
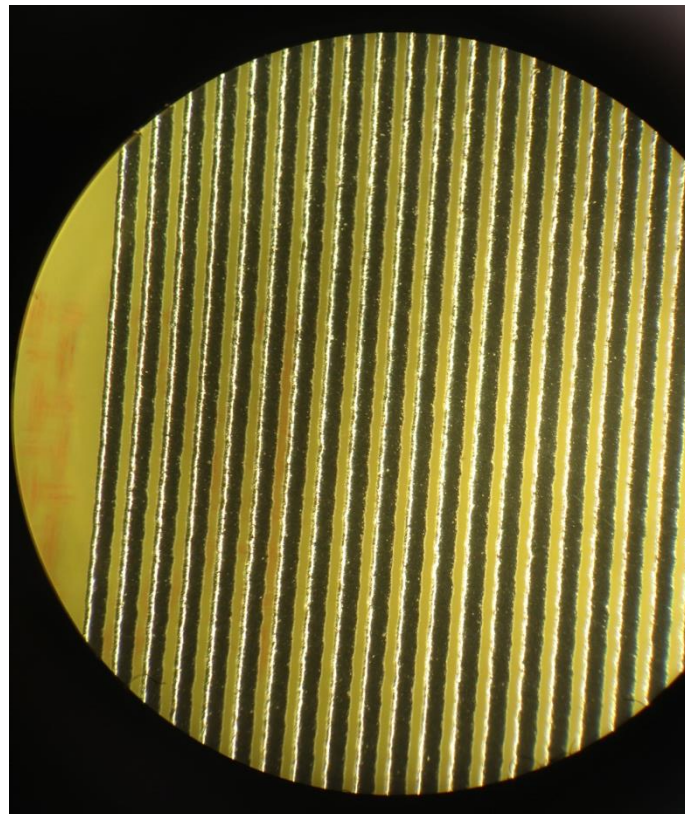
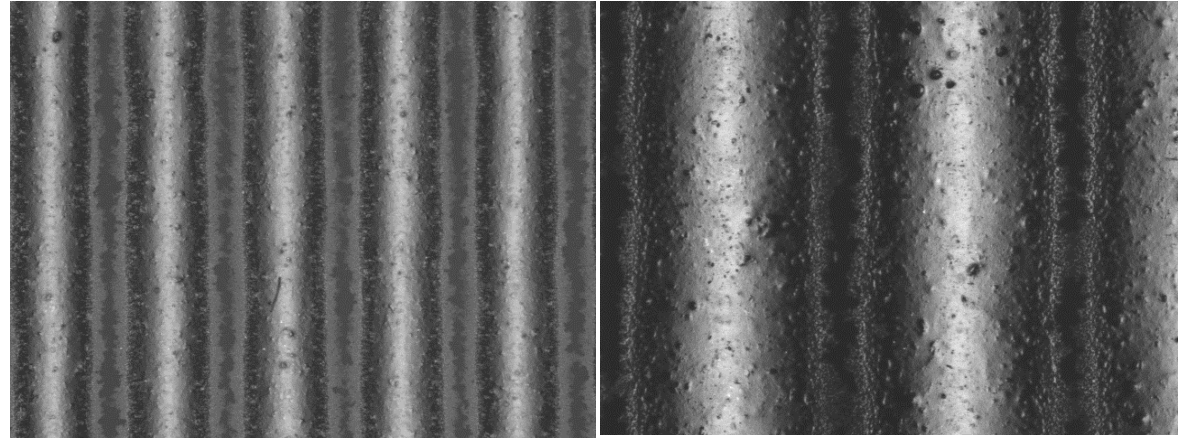
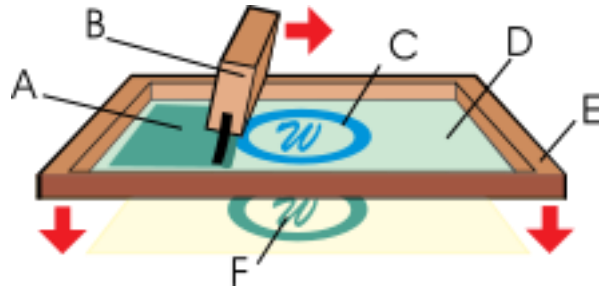
PCB 2: Error less than 75 μm

Target Reference

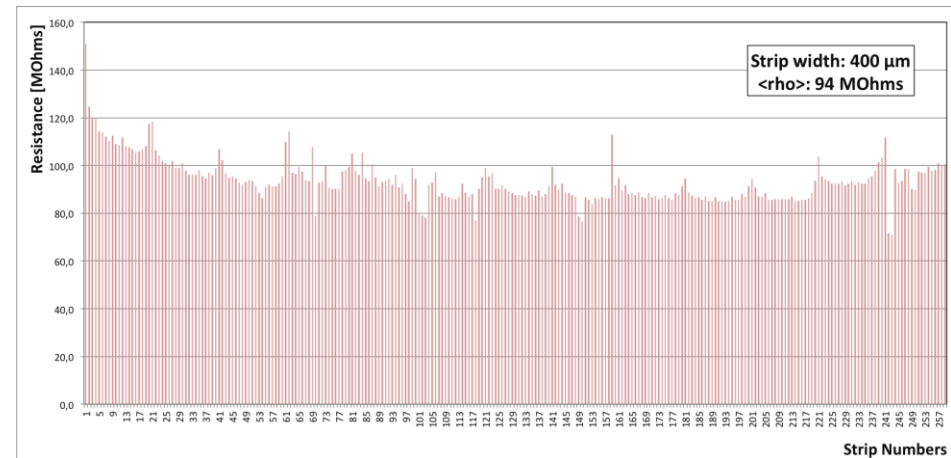
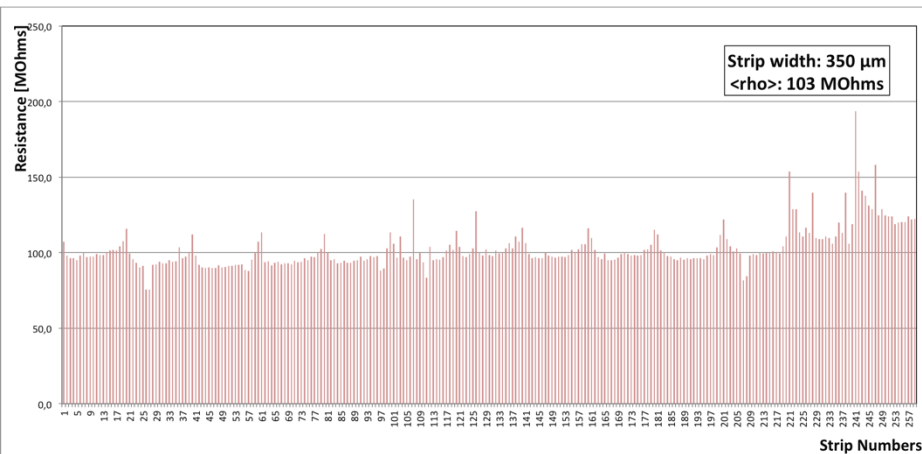
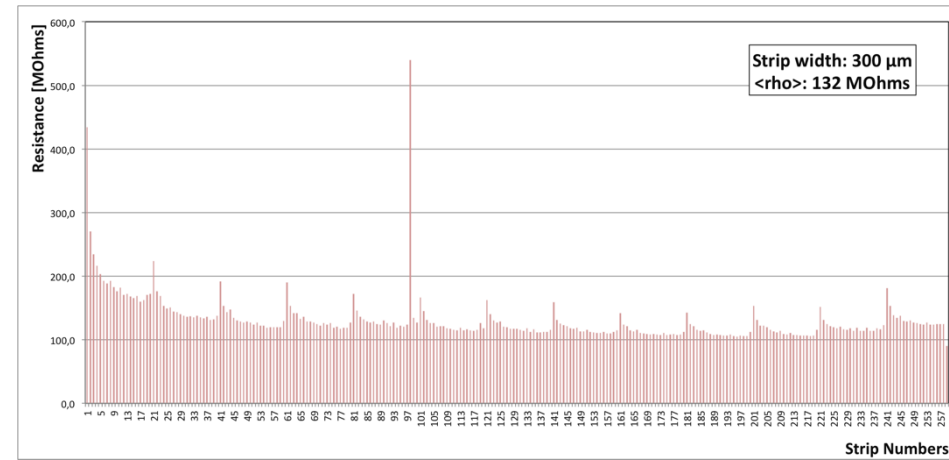
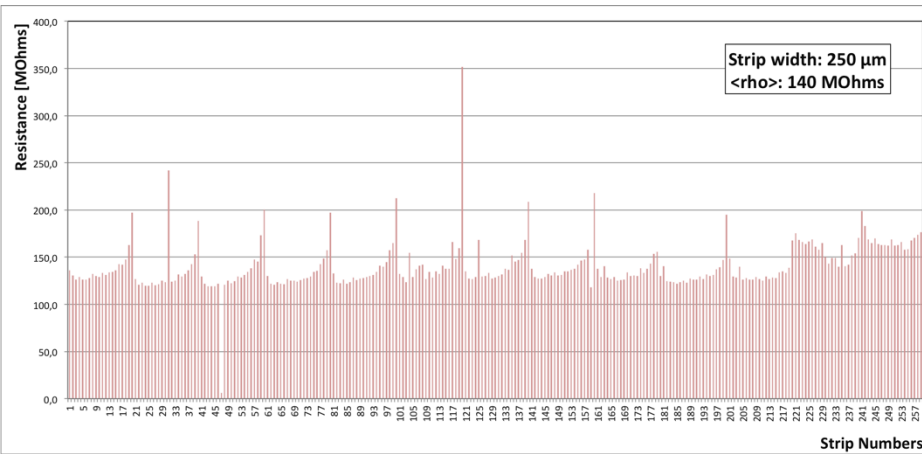
Scale



Error of target position on X axis from target reference in μm



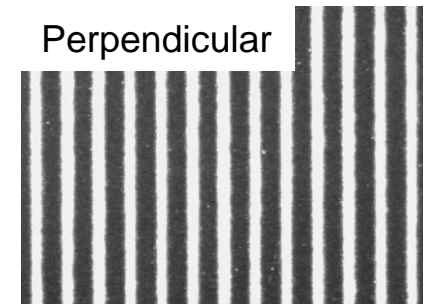
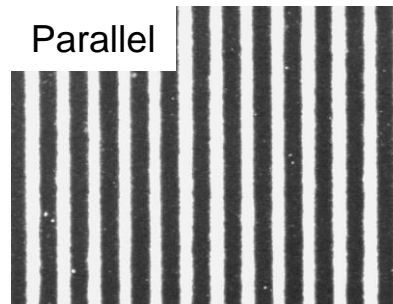
- Length: 30 cm
- 100 Ohms/sqr to 1 MOhms/sqr
- Cylindrical shape ~ 30 μ m
- Pitch 500 μ m (strip gap 100 to 250 μ m)



Strip length:

- Parallel → 30 cm
- Perpendicular → 10 cm

Pitch: 500 μm



p=500 μm	Strip width / Strip gap (μm)			
	Mask	250/250	300/200	350/150
1 pass, along the strips	350/150	380/120	C	C
1 pass, across the strips	350/150	380/120	C	C
2 passes, along the strips	380/120	400/100	C	C
2 passes, across the strips	400/100	430/70	C	C

Techno transfer to ELVIA:

- μM bulk up to areas of $50 \times 50 \text{ cm}^2$ → ok
- μM resistive bulk:
 - Small area ($10 \times 10 \text{ cm}^2$) → ok
 - Medium areas ($50 \times 50 \text{ cm}^2$) → ok

Still to do:

- μM resistive bulk up to $0.5 \times 1 \text{ m}^2$
- screen printing for long resistive strips

For the ATLAS/NSW

- Large precise PCBs → ok
- Screen printing → in progress
- Fund raising needed (ANR, regional funds, ...)