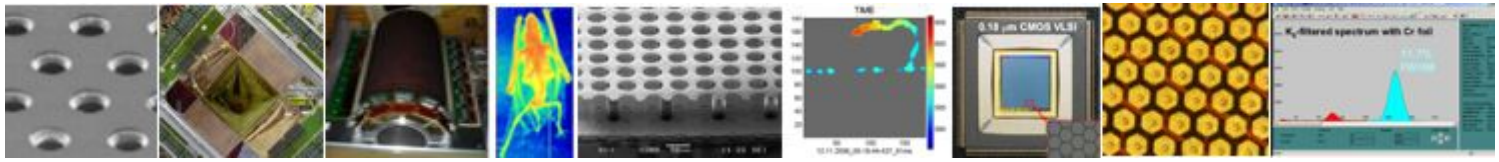
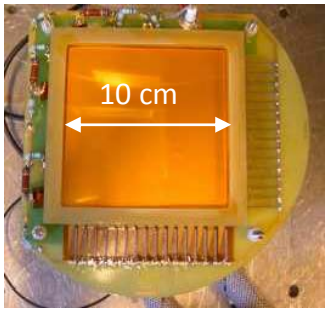
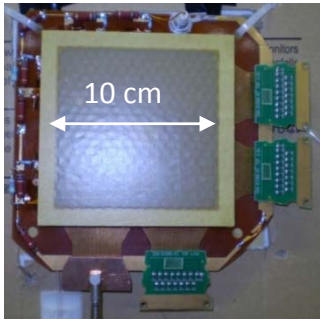
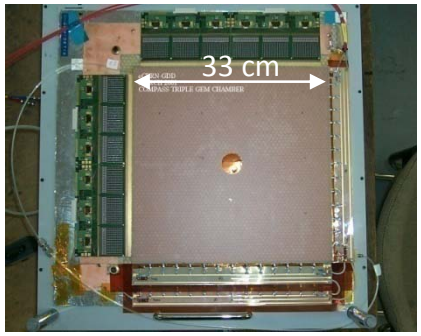


Introduction to GEM detectors assembly



Leszek Ropelewski CERN





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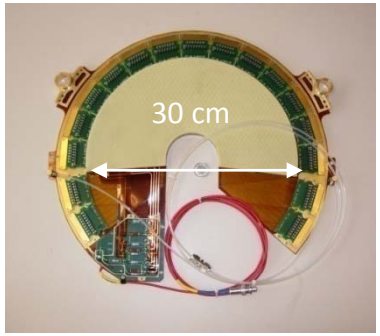
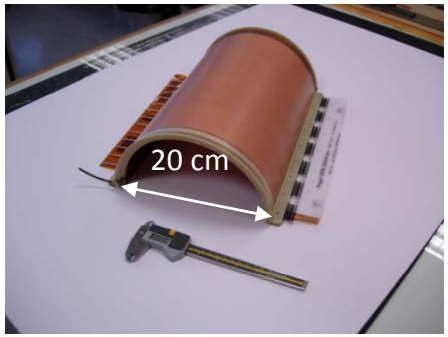


Totem



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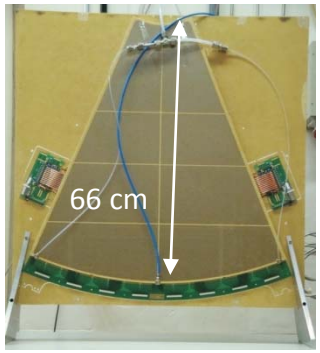


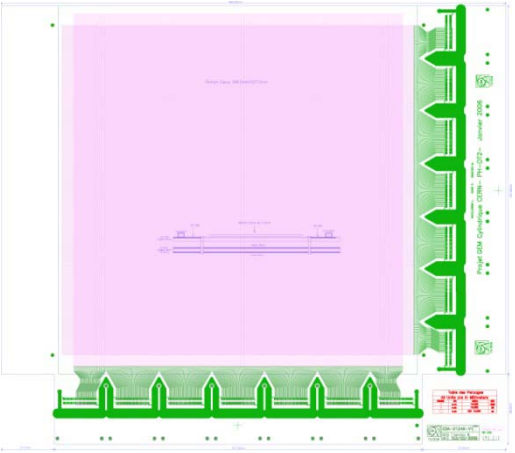
Totem Upgrade

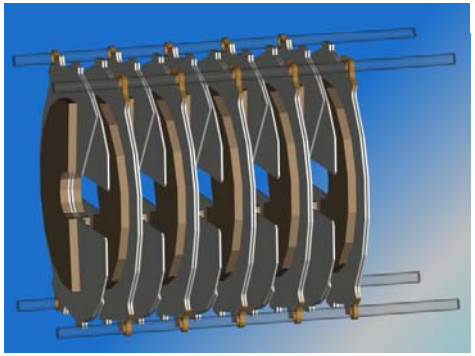
Outlook

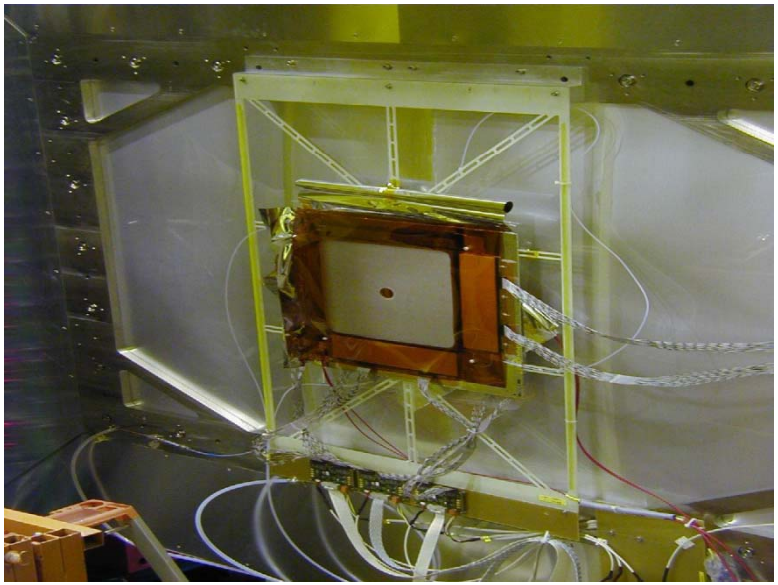
- Design phase:
  - GEM foils (HV sectors, HV connectivity, stretching method)
  - Readout boards (electronics connectivity, bonding, connectors)
  - HV divider
  - Frames and support structure (spacers, gas flow, protection grooves, choice of materials (electrical stability, outgassing properties, radiation hardness))
  - Infrastructure and tools
- Components quality control:
  - GEM foils (optical, electrical)
  - Readout boards (electrical)
  - Frames (mechanical, electrical)
- Construction:
  - Clean room (masks, gloves !)
  - Test after each step !
- Detector commissioning

COMPASS GEM detectors production guide

Design

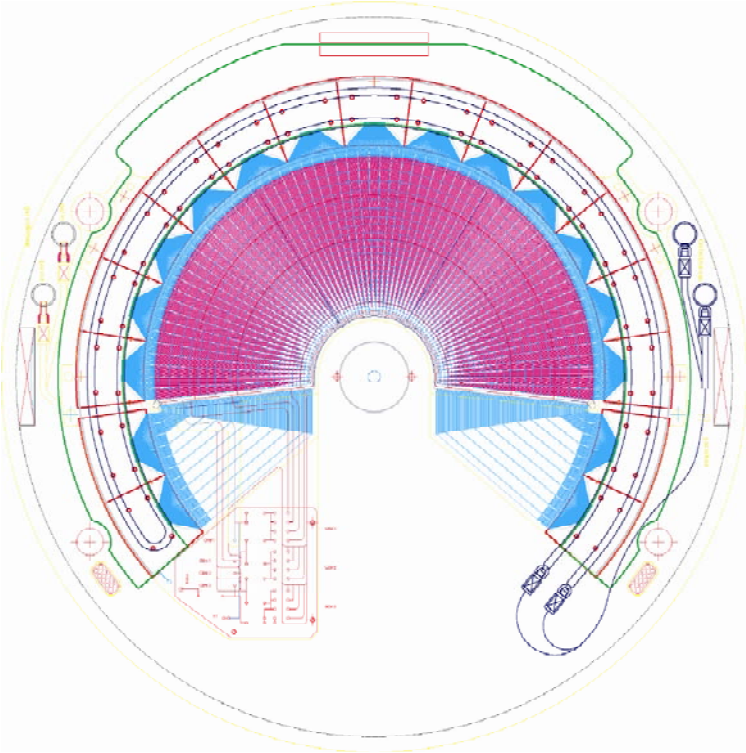


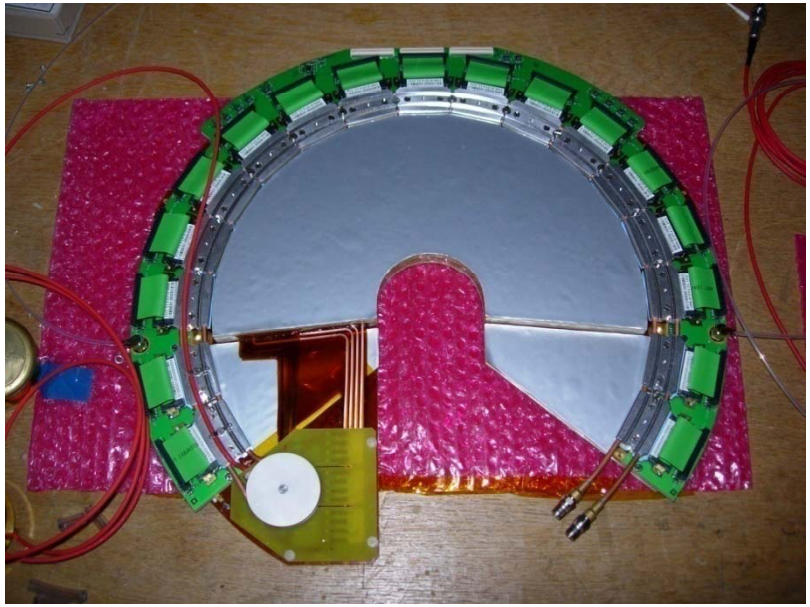




Services : HV, LV, gas, cooling

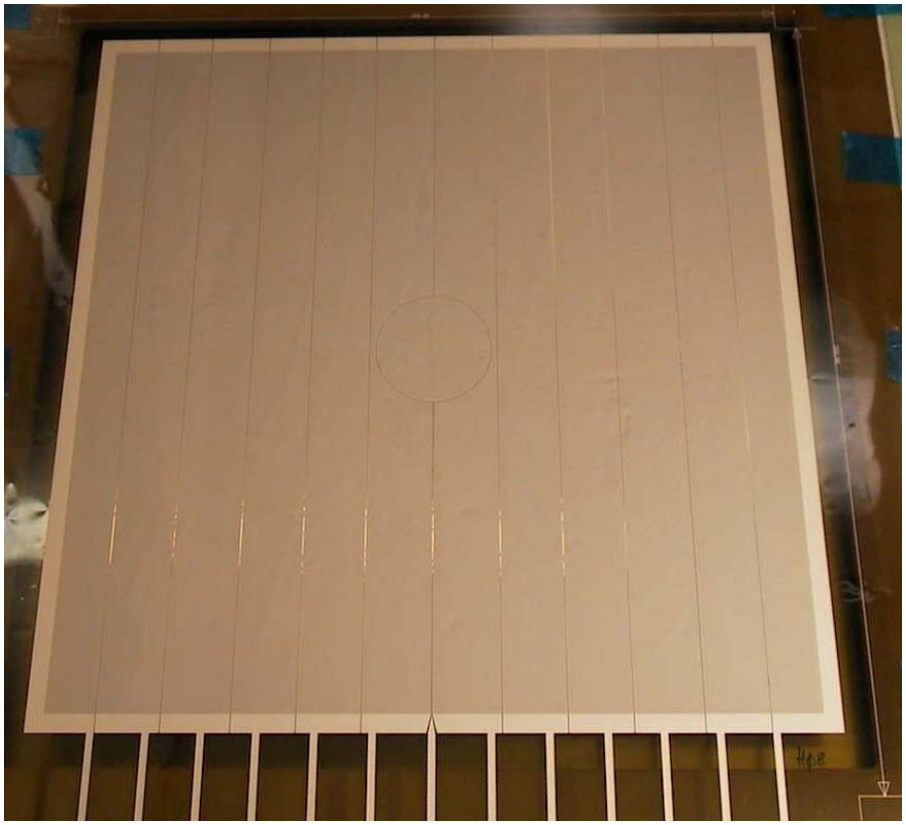
Design

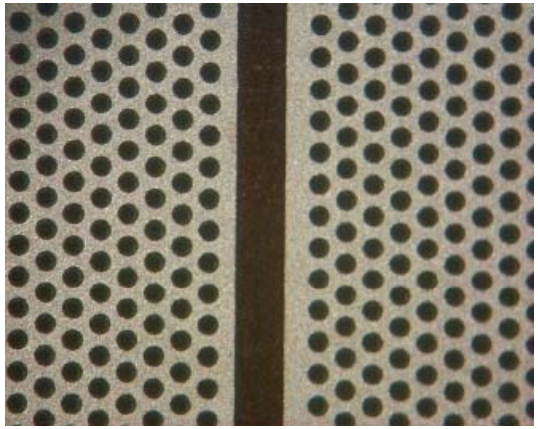


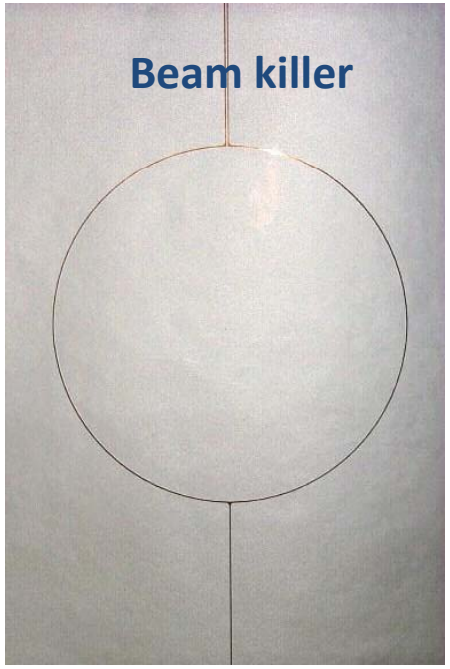


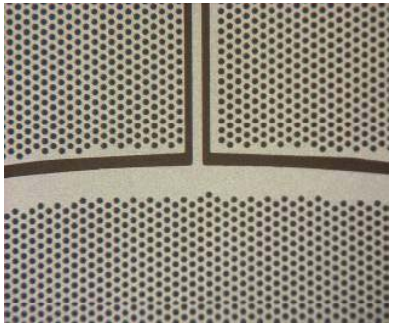
Shielding: RF noise

GEM foils



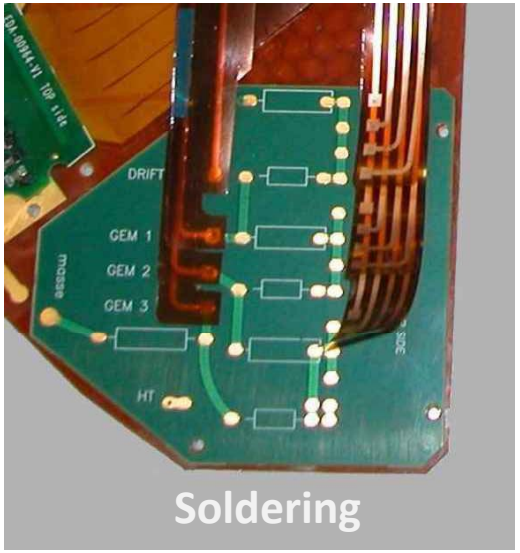




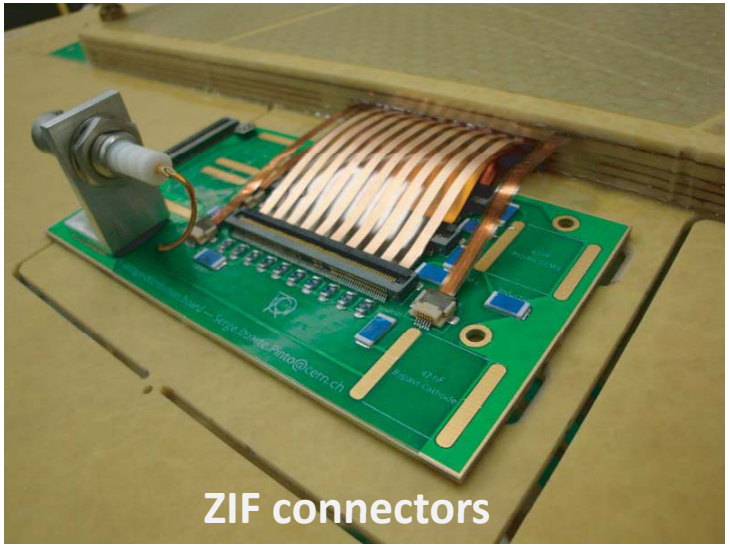


- HV sectors – max. 100 cm^2
- Holes shape preserved on the borders !

HV divider

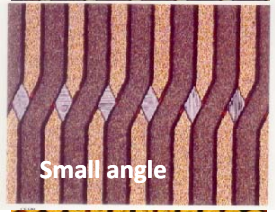


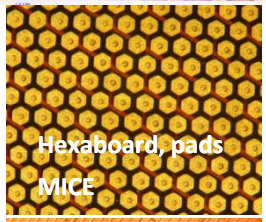
Soldering

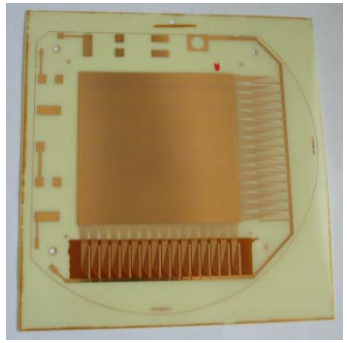

ZIF connectors

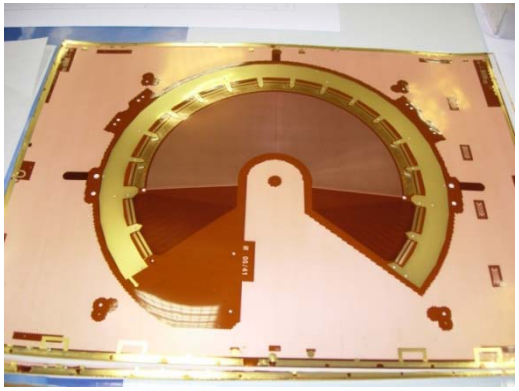
- Cleaning and testing after components mounting is very important !
- HV components
- HV values – working point
- Coated Kapton soldering
- Conformal coating

Readout boards

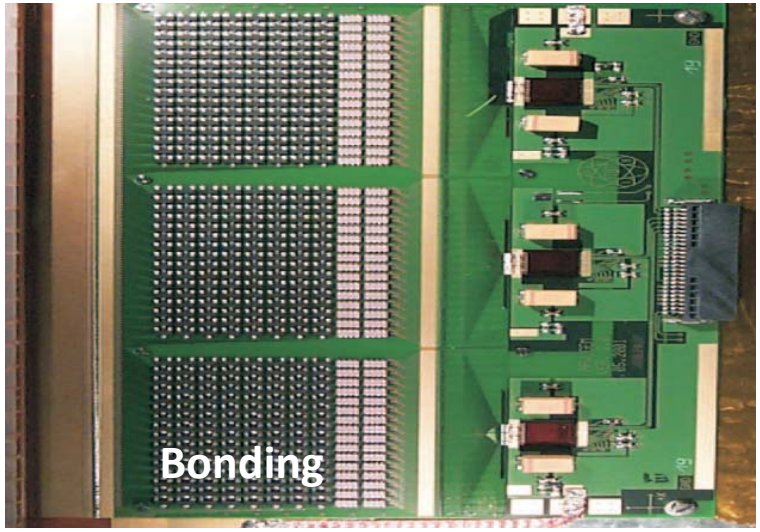


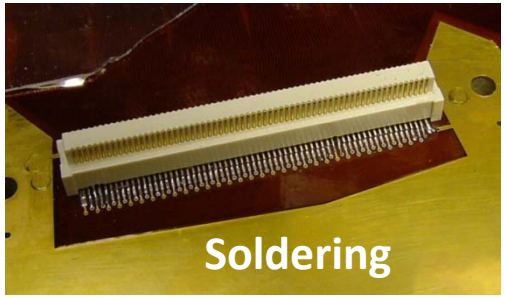


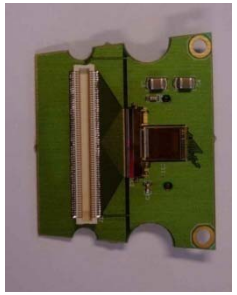




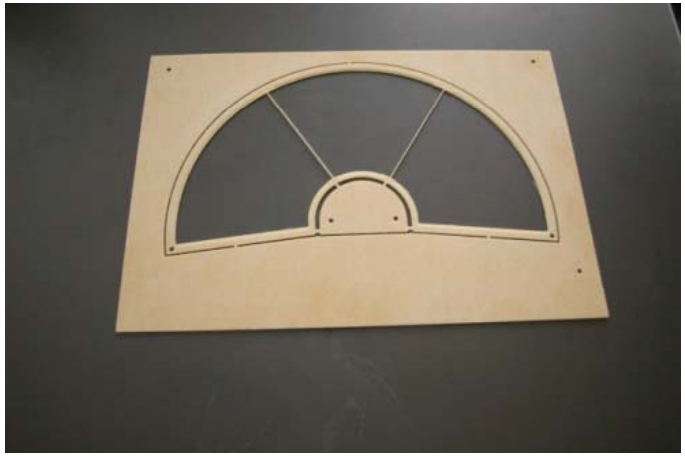
- Bonding is difficult
- Input capacitance
- Cross talk

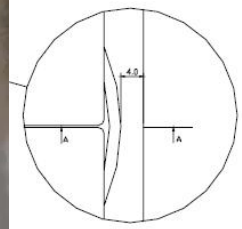


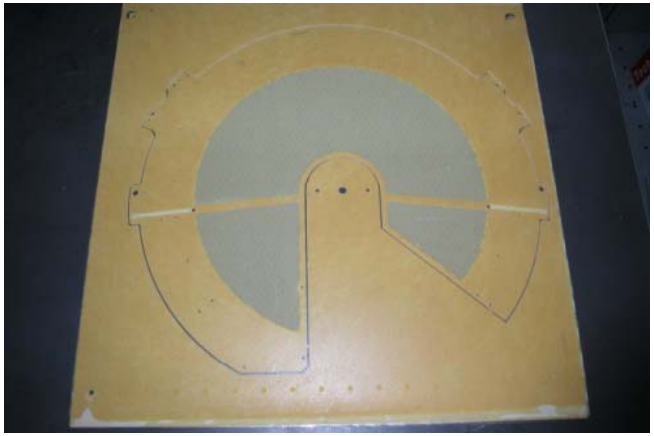


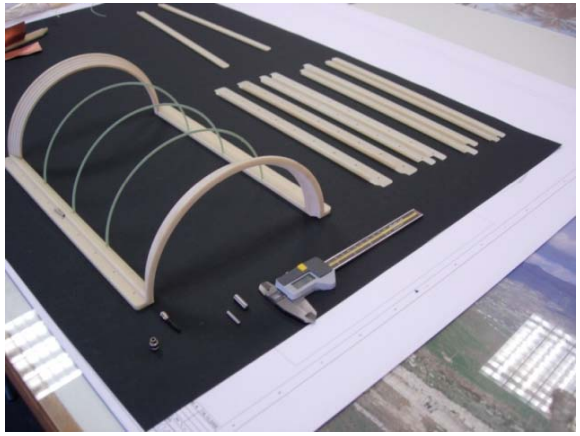


Frames and support

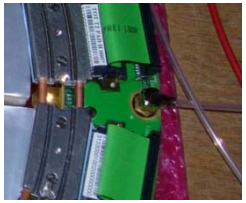








- Mechanical rigidity after foil stretching and gluing !
- Spacers
- Gas flow channels; gas connectors
- Glue flow preventing grooves



Choice of materials

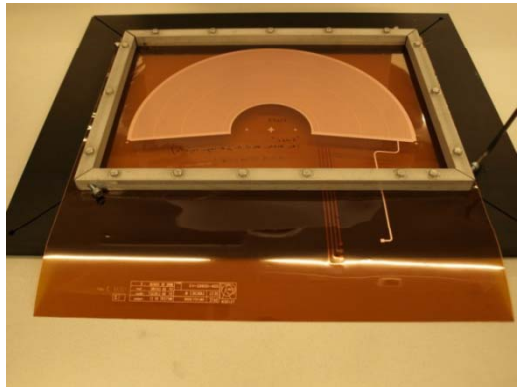
Materials:	Name	Reference	Supplier:
* glue	Araldite 103		
	Hardener HY991		
*frame coating	Nuvovern LW 3/1	no art. 564.8.0.0002-03	Socol
	Brillant Incolore		Rue du Lac 24
	Anti grafitti		1020 Renens
	Hardener	no art.857.0.0.0010-01	Suisse
*chamber coating	Conformal coating 1-2577	replacement for R4-3117 RTV	Omya AG
	Dow Corning		Baslerstrasse 42
			CH-4665 Oftringen
* fiberglass frames	Permaglas ME730		Resarm Engeneering plastics SA
			Zoning Industriel
			Rue Pres-champs 21
			B-4671 Barchon
			Belgium
*honeycomb structure	ECA-I Aramid fibre core	Type ECA-I 6.4 - 24 thickness 3mm	Euro-composites SA
		hexagonal cell	Zone industrielle
			6401 Echternach
			Luxembourg

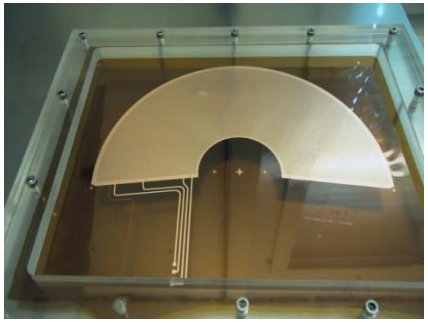
Only certified materials:

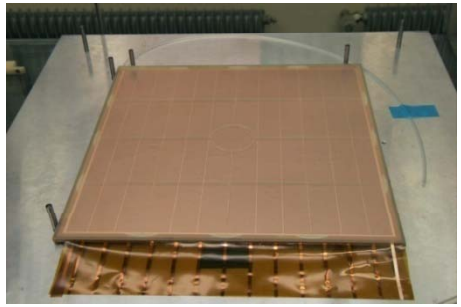
- **outgassing and ageing test !**
- **radiation hardness**
- **electrical properties**

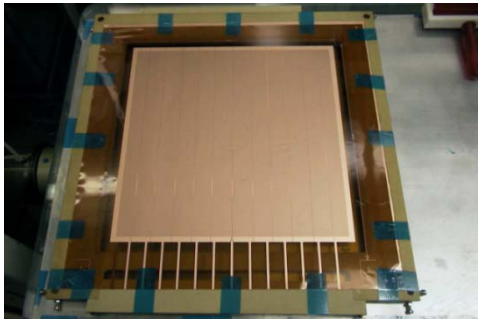
Tools and infrastructure

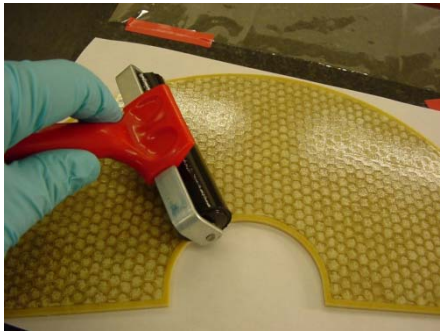
Tools and infrastructure

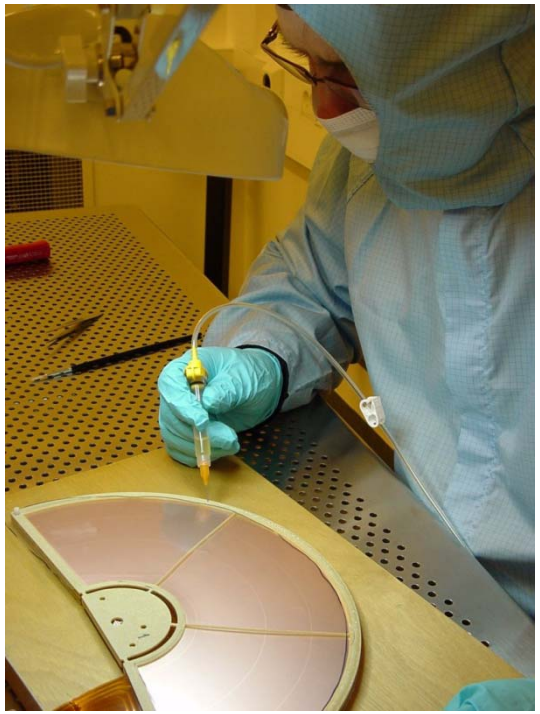


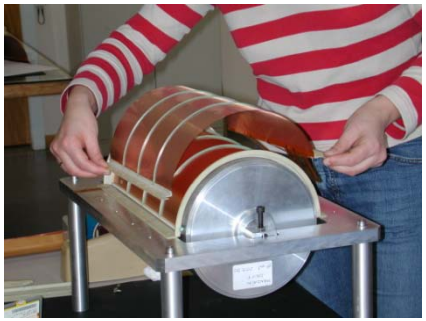


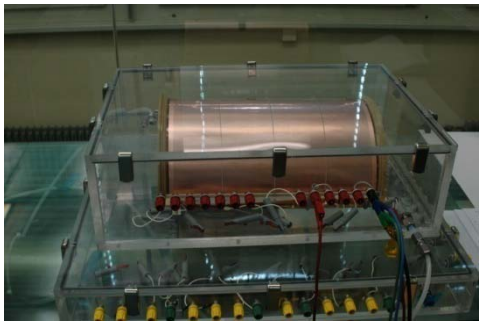




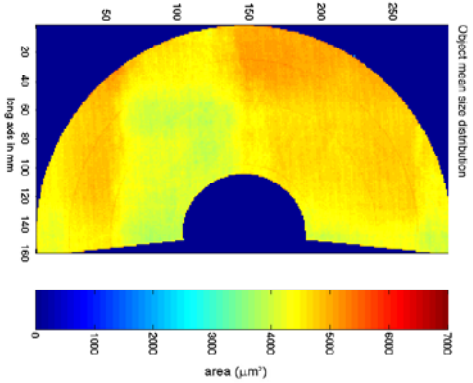


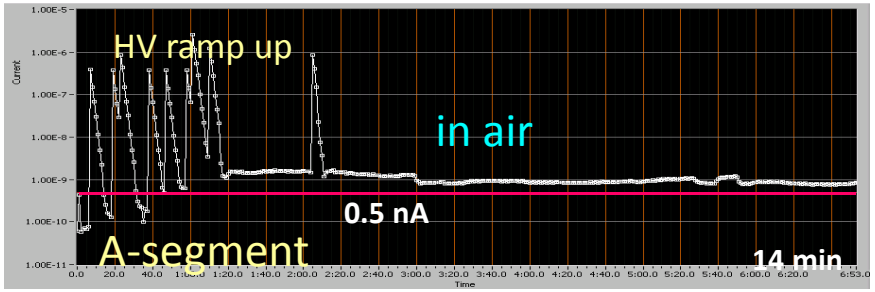


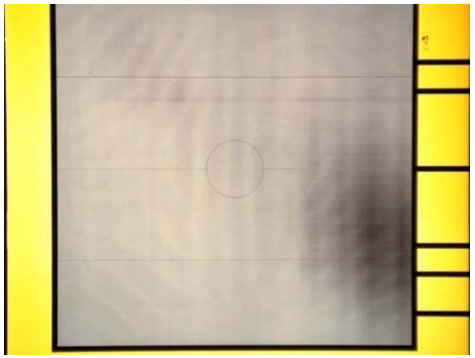


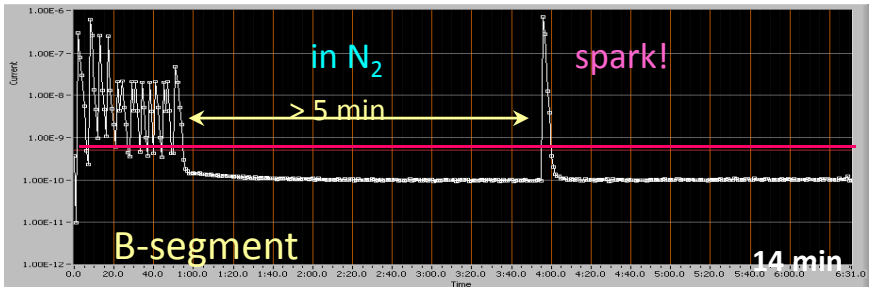


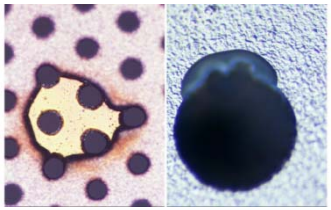
QC: GEM foils







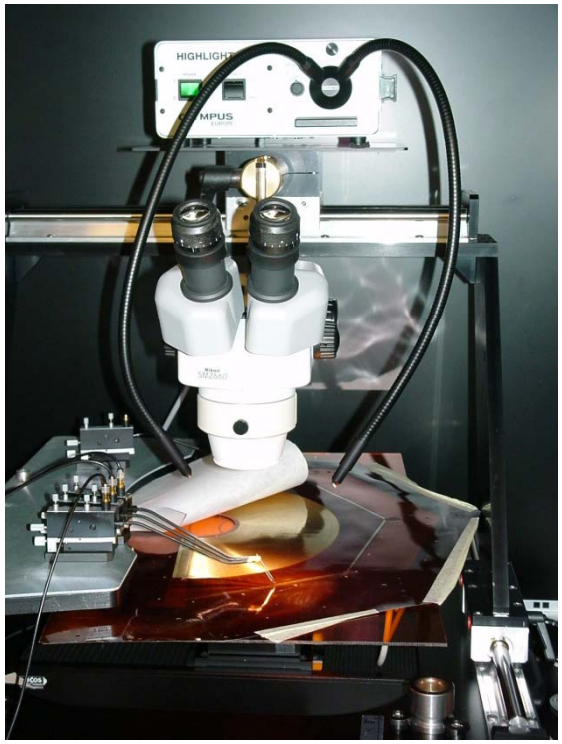


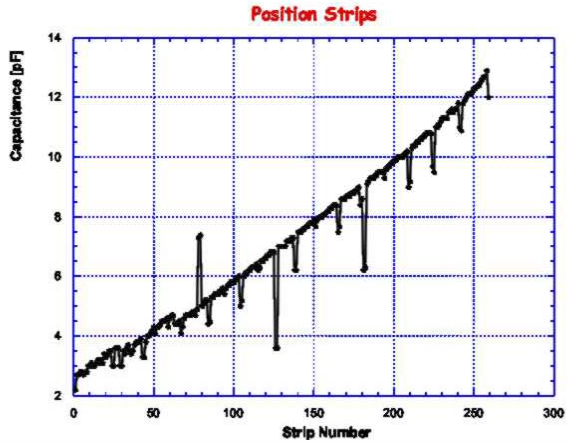


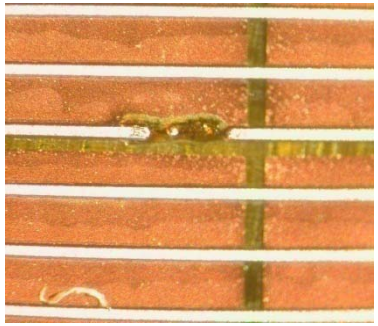
Current measurements under 600 V

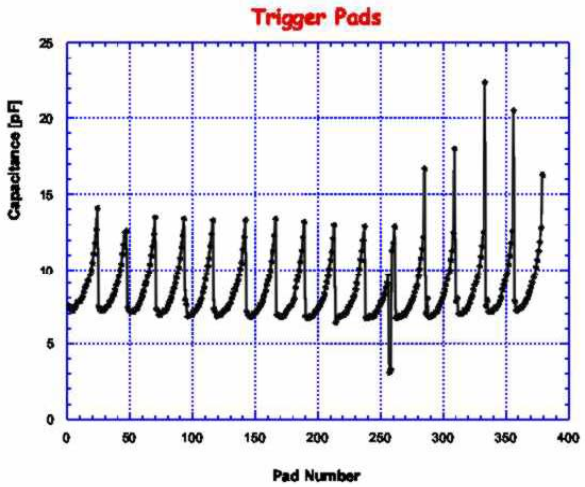
Optical inspection : hole diameter and defects

QC: Readout boards



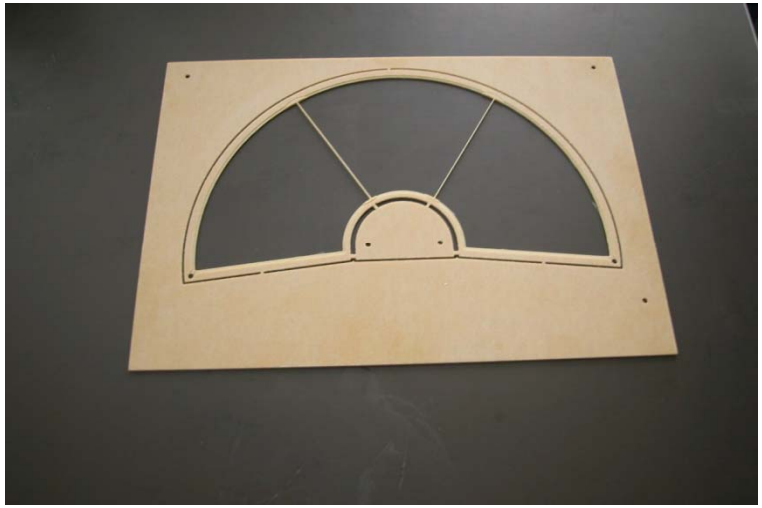


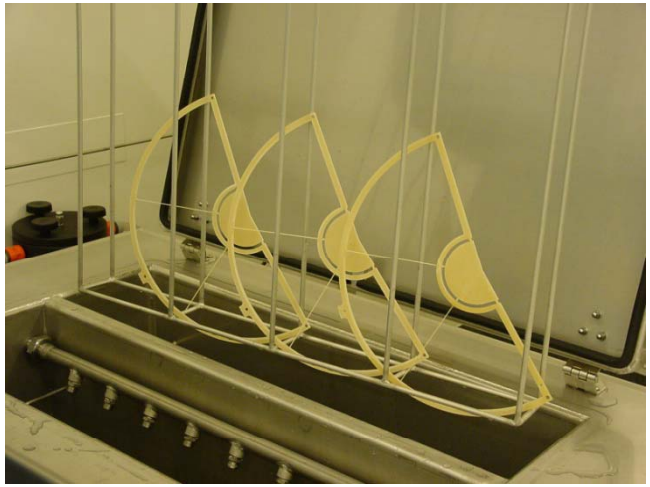




Interstrip capacitance measurement

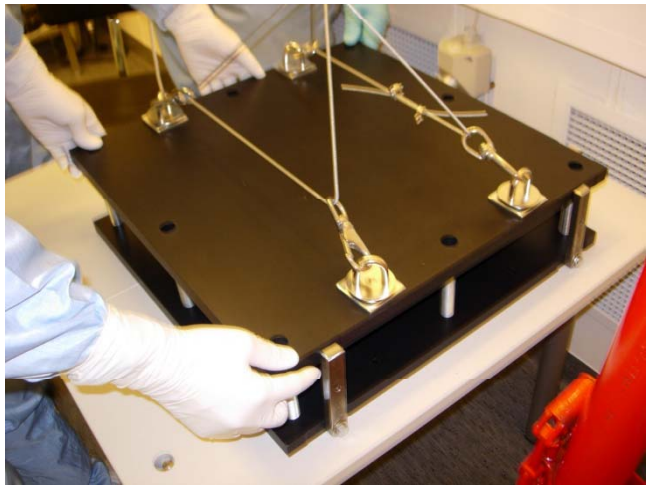
QC: Frames and support





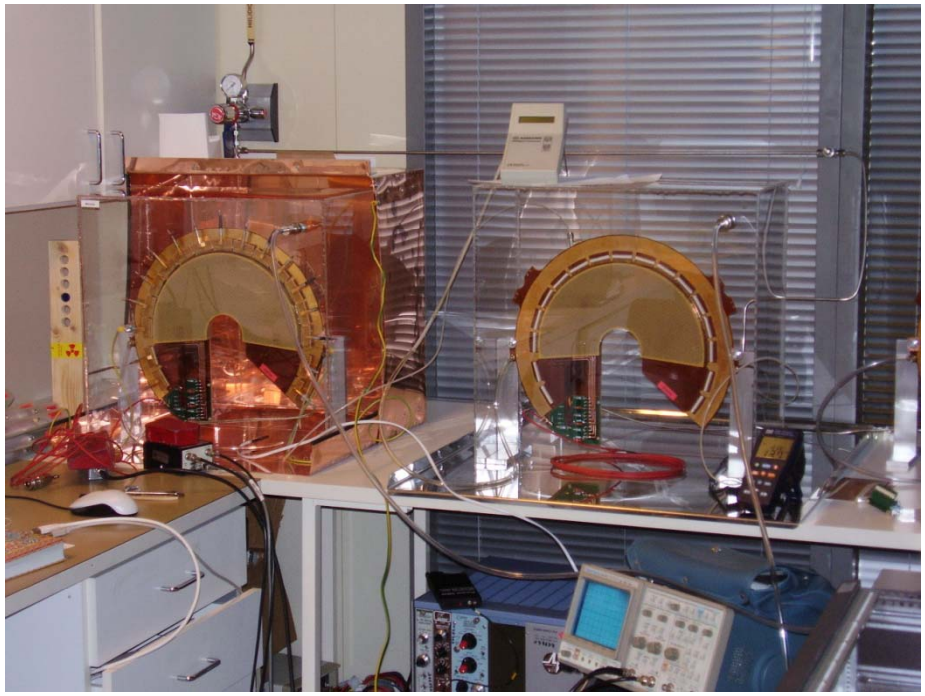
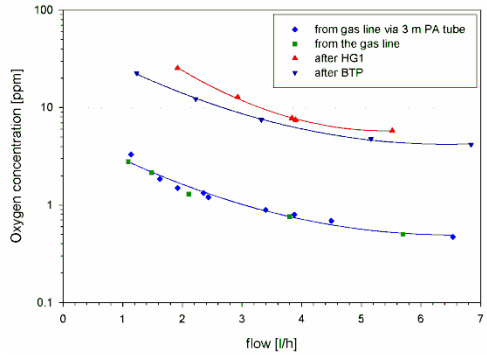
HV test – 5 kV

Detector assembly



- Clean room class 1000
- Temperature, humidity controlled
- Protective clothing
- Custom-made, simple tools
- Only certified materials used: No aging!
- HV test after each step
- Detailed documentation of each step

Detector commissioning



- gas tightness
- HV test with Nitrogen
- gas gain calibration, uniformity, temporal stability etc.