

<u>outline</u>

- AIDA project
- Largest GEM
 - NS2 description and projects
 - Industry status
- Largest Micromegas
 - •industry status
- conclusion

CERN workshop upgrade for MPGD

- CERN have invested in 9 machines for large MPGD production.
 - The 9 machines are at CERN
 - •5 machines are installed and commissioned
 - •4 are still not installed, the installation is postponed.
 - •The machines will be installed directly into the new building 107 (no space in existing premises)
 - This decision does not affect the running R&Ds
 - •The processes involved in these 4 machines are standard only the size of the machine have been increased. No commissioning is needed

Deliverables:

- redefine all the process parameter related to the new equipment's
- Build prototypes with these equipment

•Man power:

- •4 CERN staff during 4 years up to 15% of their time
- •1 technician during 2 years (AIDA contribution)
 - •Juliens Burnens 1/07/2011 → 31/12/2011
 - •Michal Zientec 1/01/2012 → 31/12/2012
 - •Kacper Kapusniak 1/04/2014 → 31/12/2014

Equipment status

•	GEM	installation	Commissioning
	 1/ continuous polyimide etcher 	06/2012	ОК
	 2/ Cu electro-etch line 	06/2012	ОК
•	Micromegas		
	3/ large laminator	06/2011	ОК
	 4/ large Cu etcher 	postponed	no need
	 5/ large UV exposure unit 	06/2011	ОК
	 6/ large resist developer 	postponed	no need
	 7/ large resist stripper 	postponed	no need
	8/ large oven	06/2011	ОК
	9/ large dryer	postponed	no need

Juliens Burnens 1/07/2011 → 31/12/2011 Machines: 3,8
 Michal Zientec 1/01/2012 → 31/12/2012 Machines: 2,5
 Kacper Kapusniak 1/04/2014 → 31/12/2014 Machine: 1



•UV exposure unit limited to 2m x 0.6m → 2.2m x 1.4m





•Resist developer limited to 0.6m width → 1.2m

Resist stripper

Copper etcher

Dryer



•GEM electro etch limited to 1m → 2m





•GEM polyimide etch limited to 1m → 2m





•Ovens limited to 1.5m x 0.6m \rightarrow 2.2m x 1.4m



•Laminator limited to 0.6m width → 1.2m



R&D Projects made with these equipment

SBS tracker
 ALICE TPC upgrade
 CMS muon
 ATLAS NSW muon
 GEM 600mm x 400mm
 GEM 1.2m x 450mm
 Micromegas 2m x 1m

• COMPASS pixel Micromegas GEM & Micromegas 500mm x 500mm

•BESIII GEM 600mm x 400mm
•KLOE GEM 700mm x 400mm
•SOLID GEM 1.1m x 400mm

•CLAS 12 Micromegas 500mm x 500mm

•LSBB (geoscience) Micromegas 1m x 500mm

• Prad GEM 1.5m x 55cm • CBM GEM 1m x 450mm

• ASACUSA Micromegas

• Most of them are still at the R&D phase but some are already in production:

ATLAS NSW
 SBS Tracker
 ALICE TPC upgrade
 1300 m2
 100 GEMs
 350 GEMs

• COMPASS pixel Micromegas 20 GEM + Micromegas

•BESIII 15 GEM

• CLAS 12 30 Micromegas

•CMS 450 GEM

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Largest GEM ever produced for Prad prototype



GEM

- -Size 1.5m x 0.55m
- -140um pitch
- -70um hole

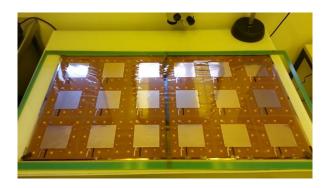
Read-out

- -2D
- -Compass type
- -400um pitch

Single mask introduces cost reduction 10cm x 10cm GEM example



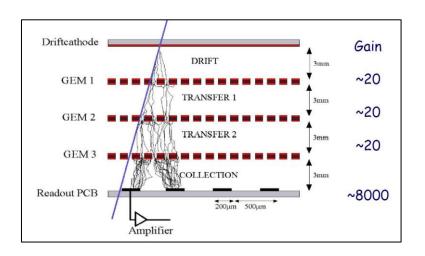




10cm x 10cm GEM low volume -300 CHF/piece

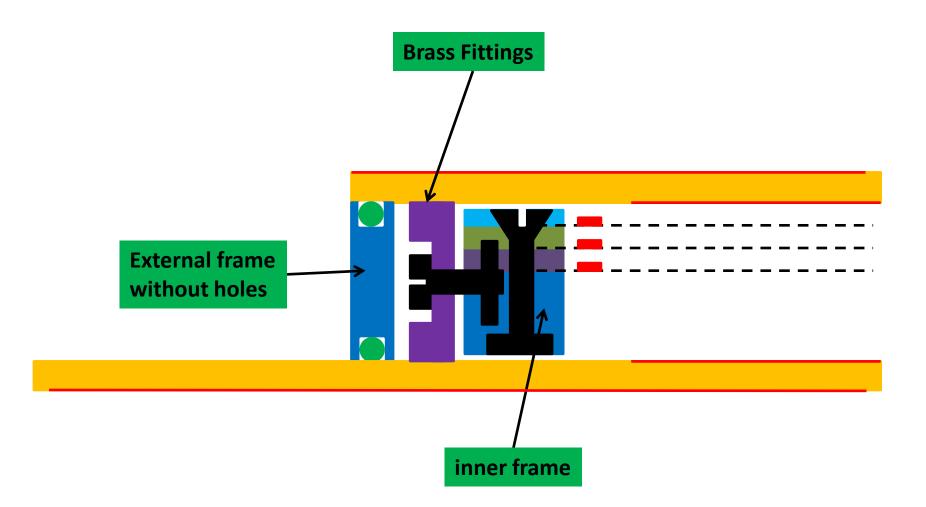
10cm x 10cm GEM high volume - 80 CHF/piece

NS2 assembly of 3 GEMs

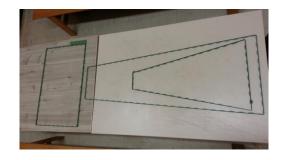


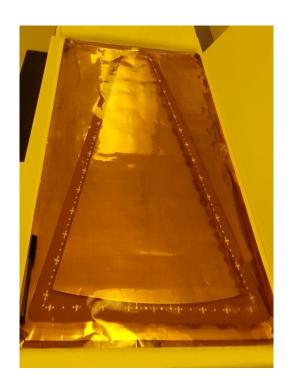


NS2 3.0



NS2 projects





CBM
Under characterization
2 detectors built



Dubna Prototype production

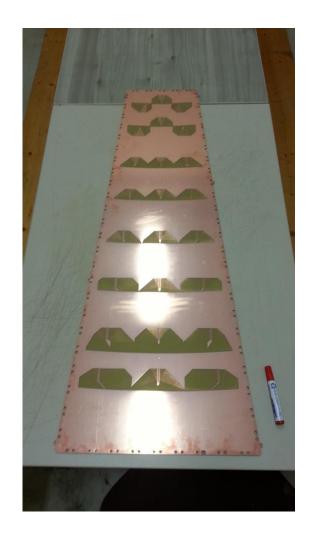


CMS
2 long version in production
5 STD KITS to be delivered

<u>Largest NS2 detector : CMS GE1/1 long</u> <u>First trial of PU-less detector</u>







1.3m x 0.5m GEM

1.3m x 0.5m

Double sided board

3.2mm thick

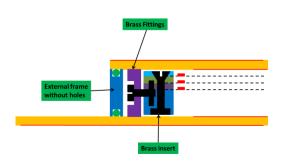
1.3m x 0.5m Double sided board 3.2mm thick

Brass fittings assembly



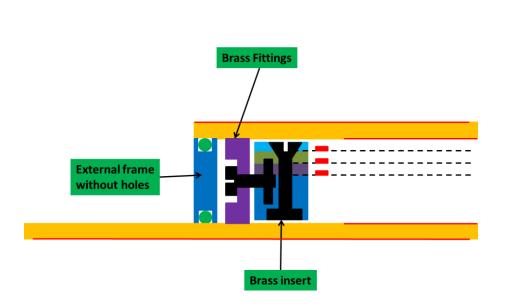


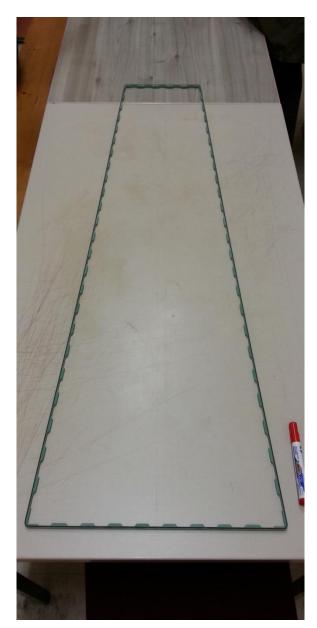


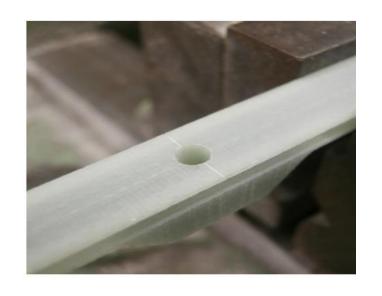




External frame

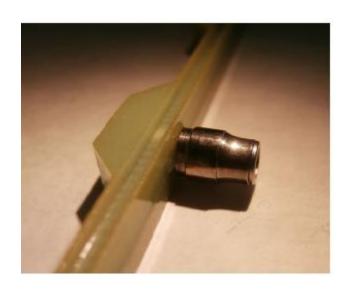


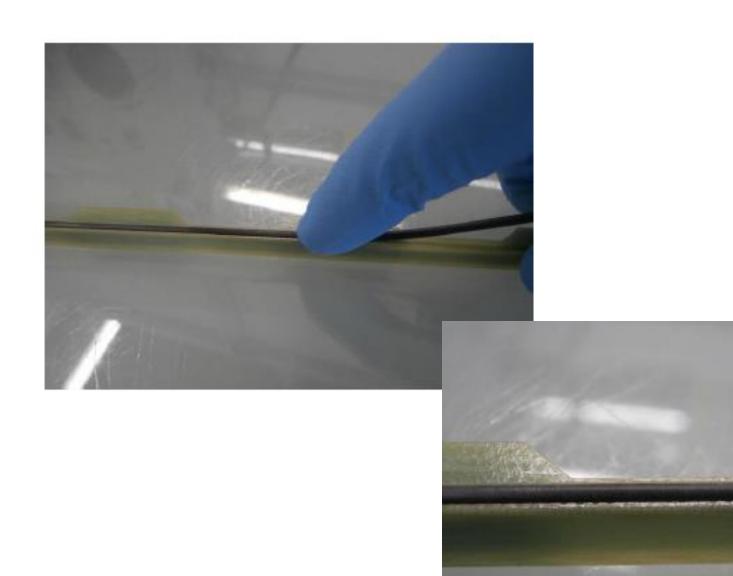


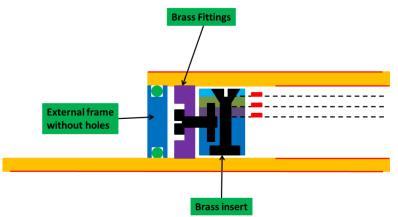




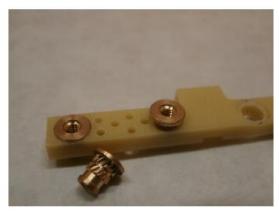


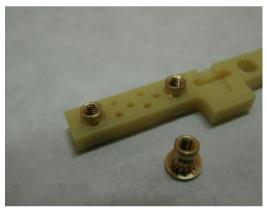


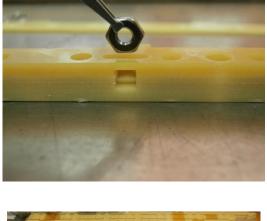




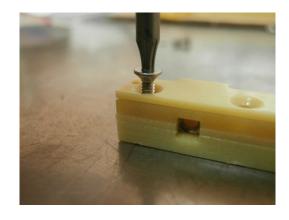
inner frame







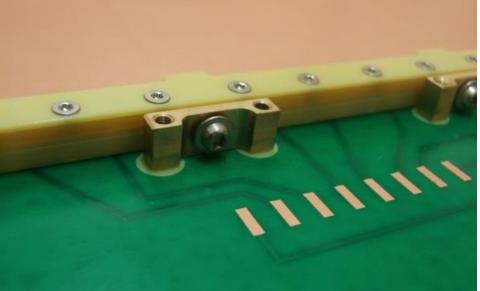


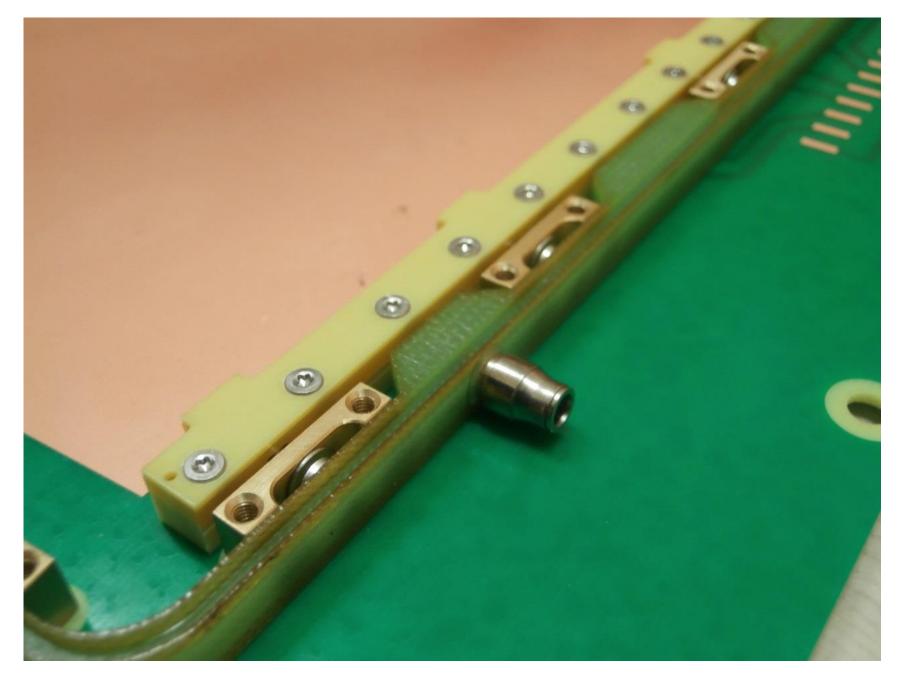


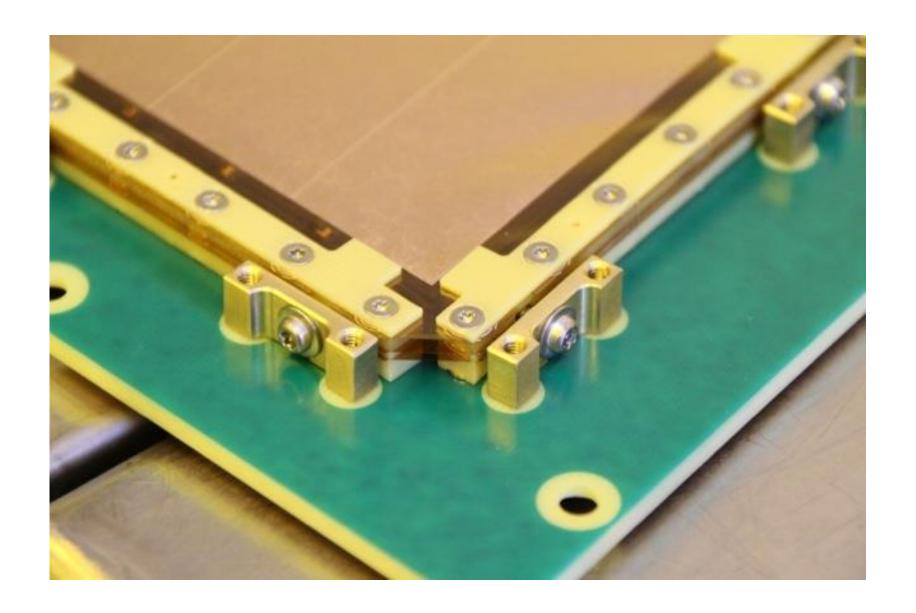




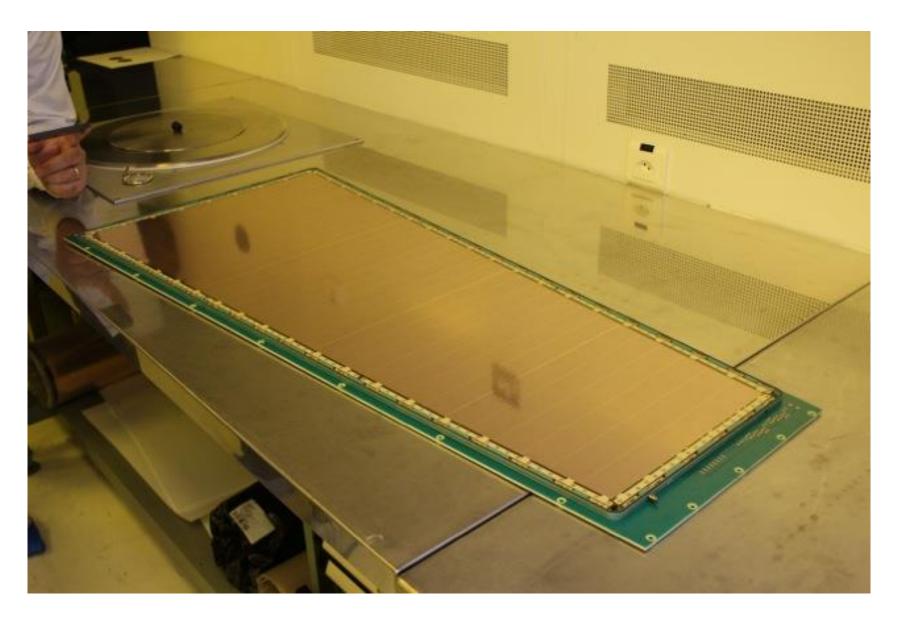
stretching principle







CMS GE1/1 NS2 detector assembled



Industry status

• **GEMs**

- •Tech-etch (US) → single mask 1m x 0.5m OK
- •Techtra (PL)→ single mask 30cm x 30cm OK
- •Mecharonics (KR) → single mask 1m x 0.5m in progress
- Micro Pack (India)→ single mask 10cm x 10cm in progress

Foil #	Current (A)	Voltage (V)	Etch Time (min)	Measured Back Side (μm)
1	2	~ 0.8	15	~ 25 μm
2	4.5	~0.9	12	~ 30 μm
3	2	~0.8	30	~ 40 μm
4	5	~1	34	~ 70 μm (over etched corners)
5	2	~ 0.7	50	~ 70 (slightly over etched corners)

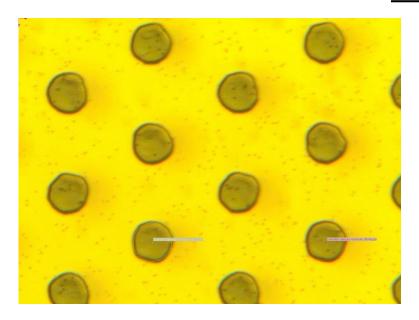


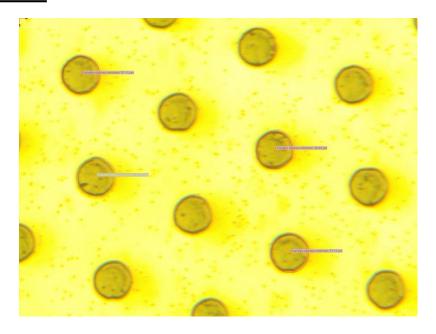
ALICE IROC

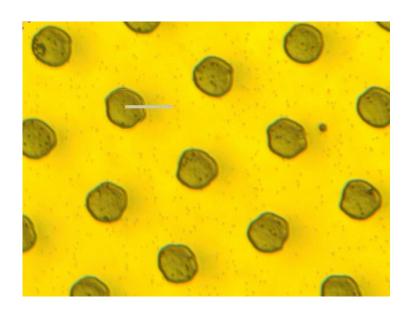
Made in Tech-etch

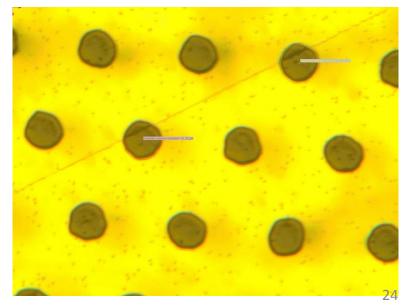
For detector smaller than 1m x 0.5m 100% of the GEM detectors parts are available in industry

Problems







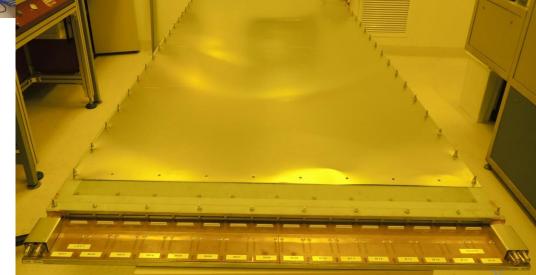


Largest Micromegas produced for NSW prototype



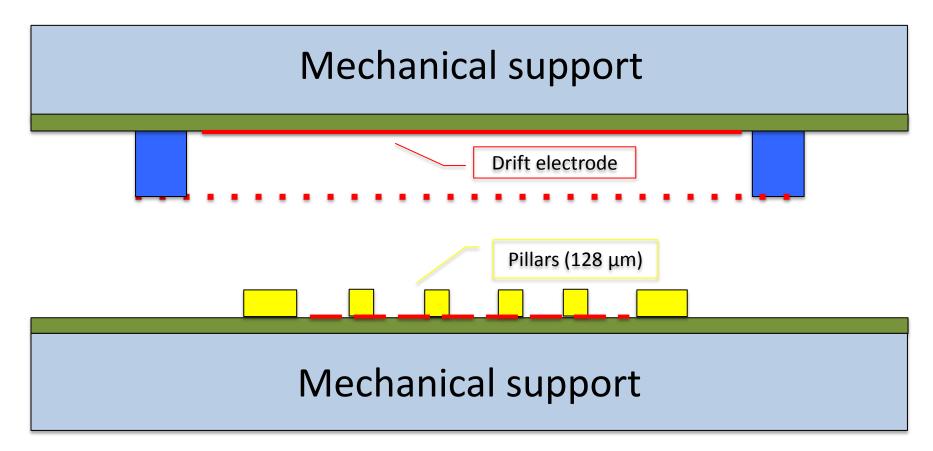
ATLAS NSW upgrade detector 2m x 1m opened

Detector closed



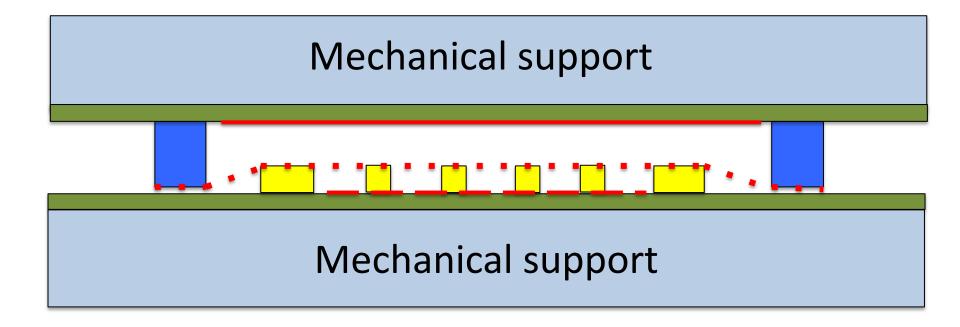
STD Micromegas structure

Open

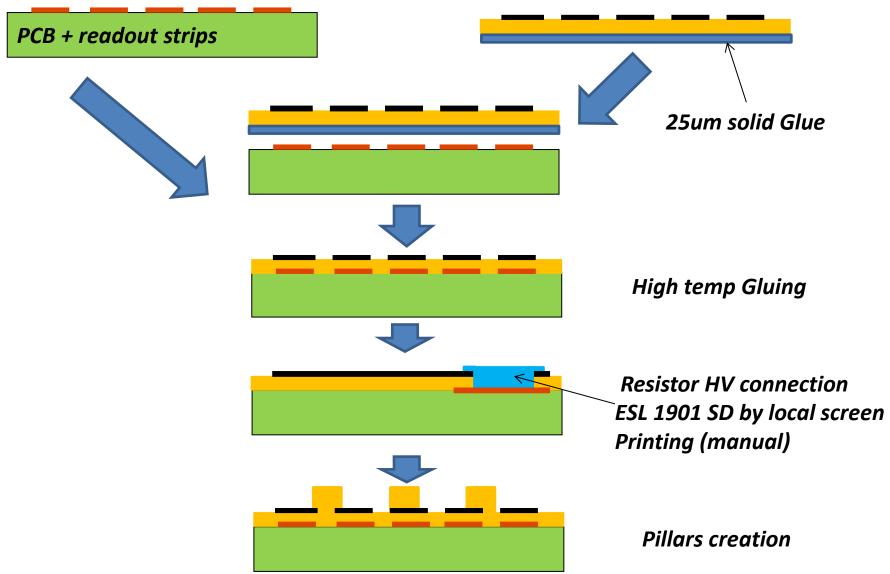


STD Micromegas structure

Closed



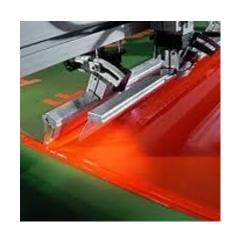
50um Kapton + resistive strips + glue + hole



Screen printed resistive layer:



Semi automatic machine Printing area 1.5m x 0.9m



Squeegee

Emulsion Ink

Mesh

Substrate

50um Kapton

50um Kapton + resistive strips

Industry status

- Micromegas
 - ELTOS , ELVIA , Triangle Labs:
 - •BULK ok up to 50cm x 50cm
 - •STD Micromegas up to 2.2m x 0.5m
 - Other companies showing interest:
 - Trackwise (UK)
 - PCB electronics (Israel)

Conclusion

- Out of the Building 107 the project is on time
- •We are ready for 2m x 0.5m GEM
- •Micromegas are already available in 2m x 0.5m