

# Large size GEM production

RD51 mini week 15/12/17

- Mecaronics
- Techtra
- Micropack
- CERN



European  
Funds  
Smart Growth

**TECHTRA**  
TECHNOLOGY TRANSFER AGENCY

EUROPEAN UNION  
EUROPEAN REGIONAL  
DEVELOPMENT FUND



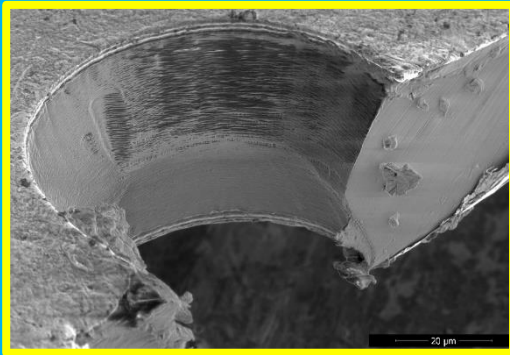
## Production of GEM foils



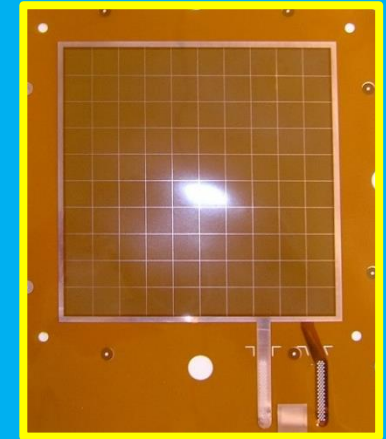
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Microscopic view of GEM hole,  
Techtra



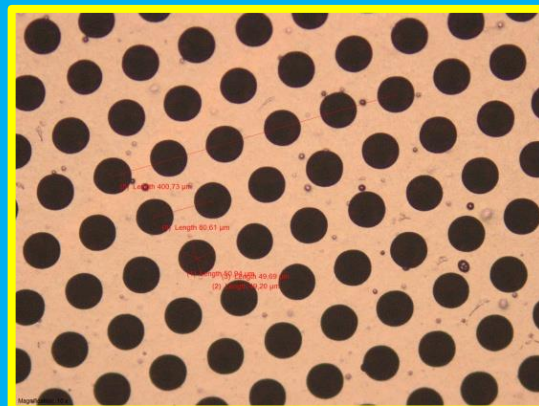
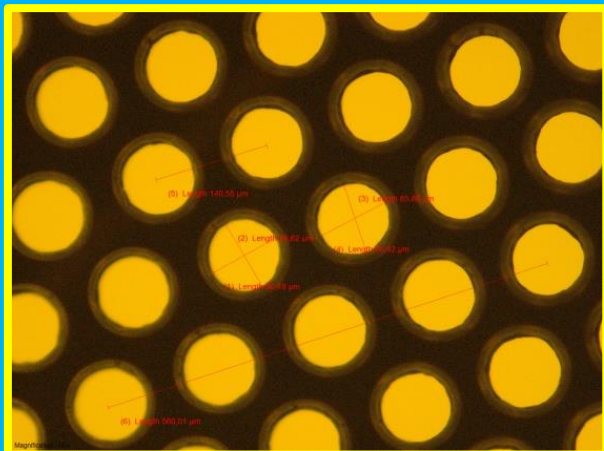
Chrome GEM, Techtra

## Production of small GEMs

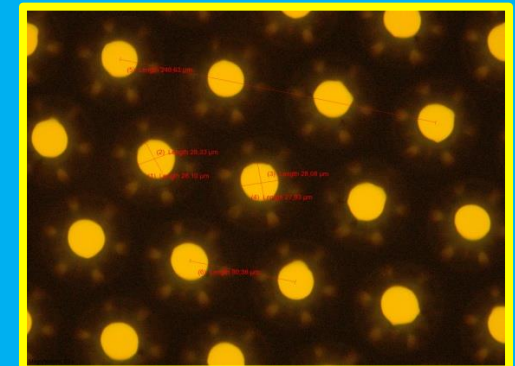
Since 2010 Techtra has produced over 1800 small GEM foils of different parameters: pitches, shapes, conical and cylindrical openings, ect

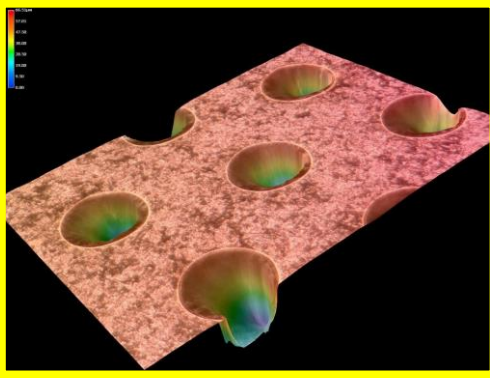
We make both large orders and individual foils.

We use CERN technology to get the same GEMs parameters.



GEM foils with different holes  
diameters, sizes ect, Techtra





Microscopic view of GEM hole, Techtra



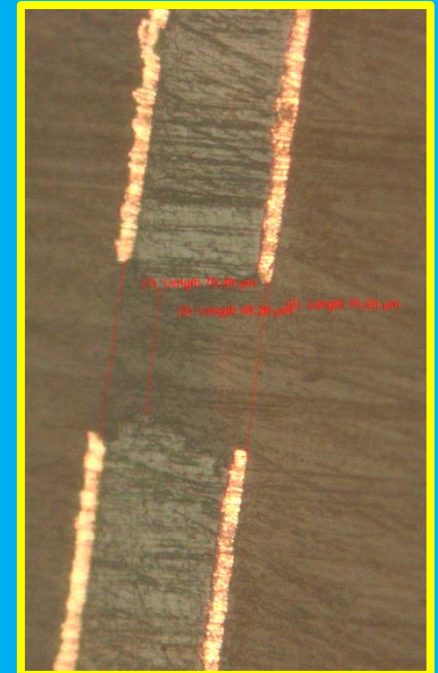
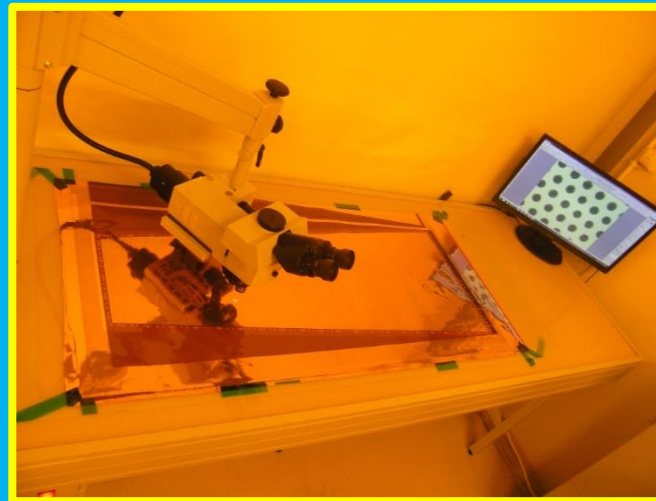
## Production of „big” GEMs

Techtra has produced many big foils with single-mask technique. The quality of the foils has reached an acceptable level.

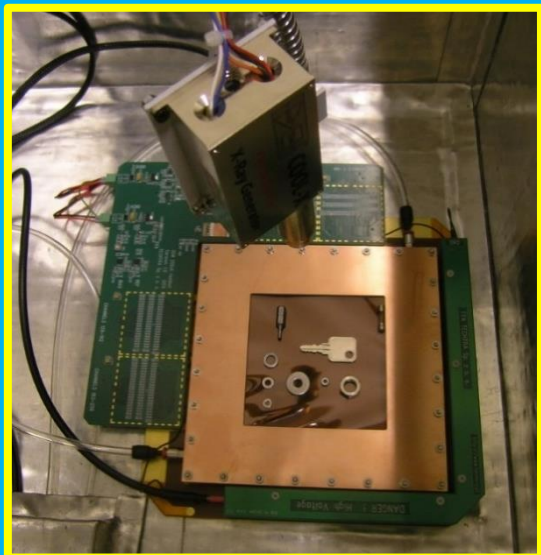
Production efficiency and yield must be significantly increased in order to obtain production profitability.

We use CERN technology to get the same GEMs parameters.

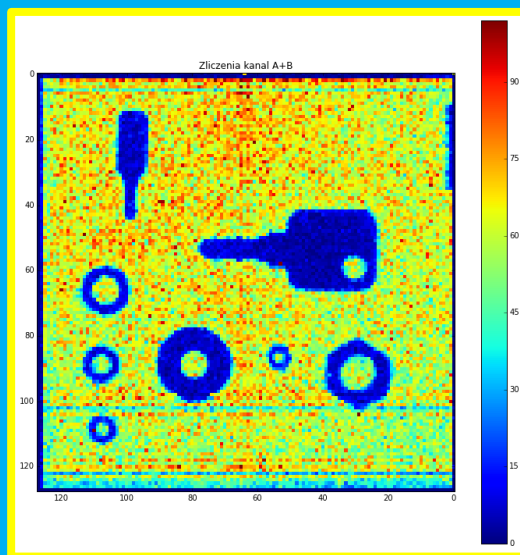
„Big” GEM production, Techtra



## Production of GEM detectors



Commercially offered GEM detectors, Techtra.



Radiograph made with miniature X-ray tube, Techtra



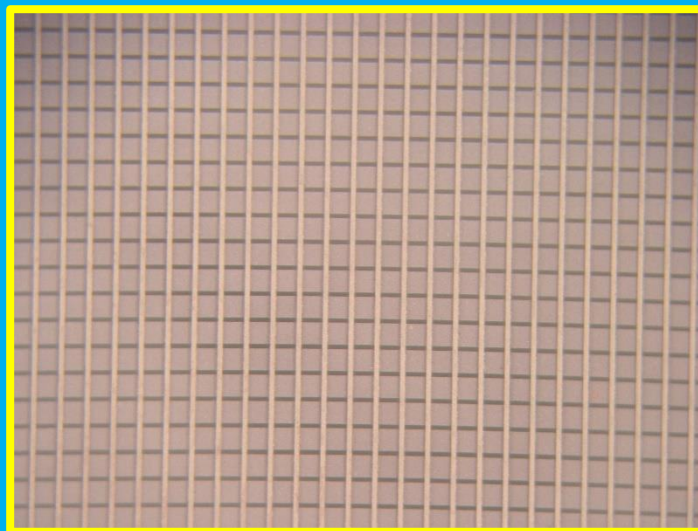
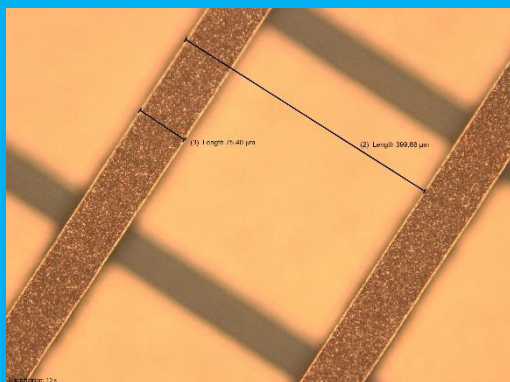
HV power supply for GEM detectors, Techtra

Techtra offers 10x10cm<sup>2</sup> GEM detectors fully compatible with CERN XY256 detector kit. The detectors are built with:

- 256 CH's readout system with USB/Ethernet communication module
- Dedicated electronic DAQ system
- High Voltage power supply controlled via Ethernet,
- PC software for data acquisition and visualisation
- GEMs, HV dividers, screws, gas box, gas system, cables, ect

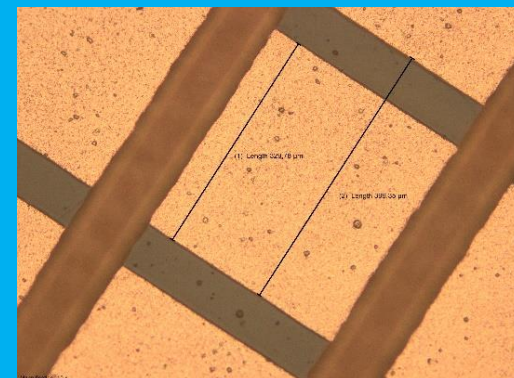
## A new project: Production of read-out boards

256 Y readout strips



First 10x10cm<sup>2</sup> readout board  
made by Techtra.

256 X readout strips



R&D work is ongoing. First fully operational boards will be ready in 6 months from now.  
Second phase of project is to build 30x30cm<sup>2</sup> readout boards.  
Third phase of the project is to build 30x30cm<sup>3</sup> GEM detector.

## **GE 1/1 PCB Status**

- **Received order for initial batch of Long Readout / Drift , Short Readout / Drift PCBs in June 2016**
- **Bare PCBs manufactured as per IPC 6012 Class 3 standards and the trial lot offered for inspection in August of 2016.**
- **Was inspected by CERN team and representatives from the Indian Institutes of BARC and Delhi University**
- **Cleared for pilot lot production.**





**CERN team & Indian institute representatives during the Sep 2016 visit**

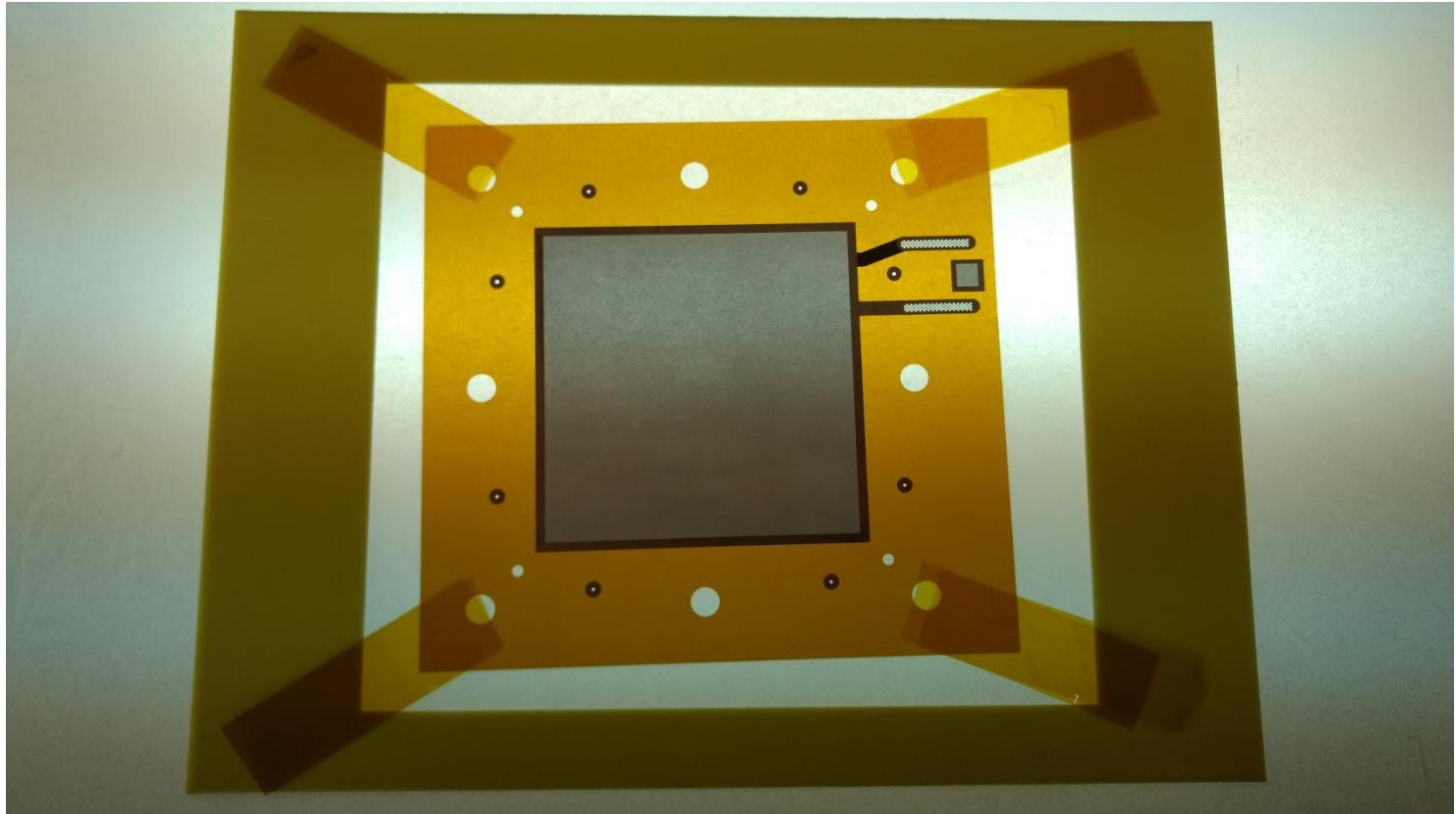
# GE 1/1 status

## Supplies made till date against orders received from CERN / Indian Institutes:

Short Drift PCBs	-	52 nos
Long Drift PCBs	-	52 nos
Short Readout PCBs with connector assembly-		48 nos
Long Readout PCBs with connector assembly -		34 nos
Bare Short Readout PCBs	-	4 nos
Bare Long Readout PCBs	-	4 nos
Total PCBs	-	194 nos

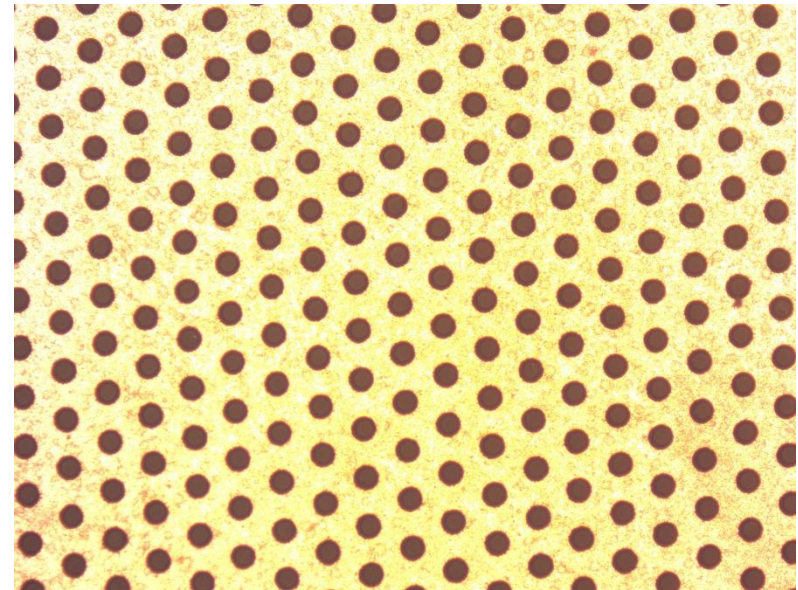
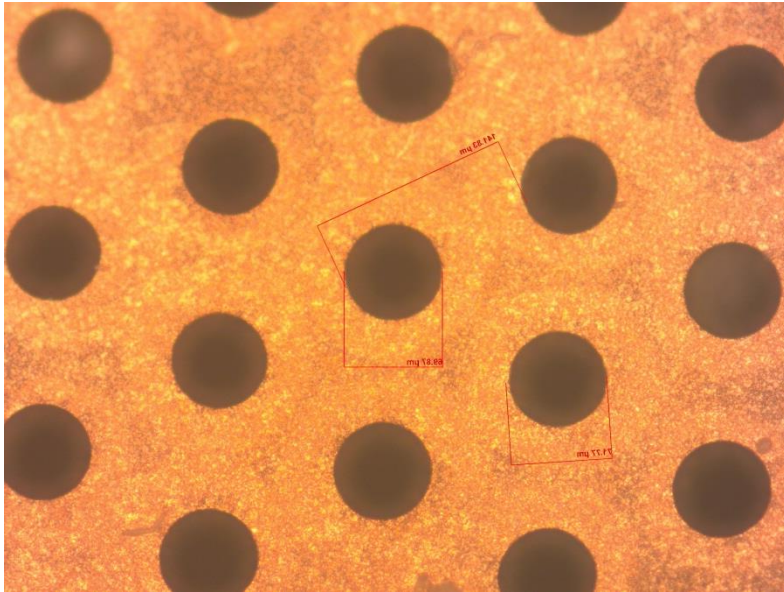
# Thin GEM Foils

- **Initial development of Thin GEM to be with 100mm x 100mm active area.**
- **Had issues with the availability of the special raw material (FCCL) initially.**
- **Since 2016 almost 20-25 100mmx100mm GEM foils were fabricated and submitted to different agencies for evaluation including CERN, BARC and Delhi University**
- **Has been able to achieve good uniformity as well as consistency across the 100x100mm foils**

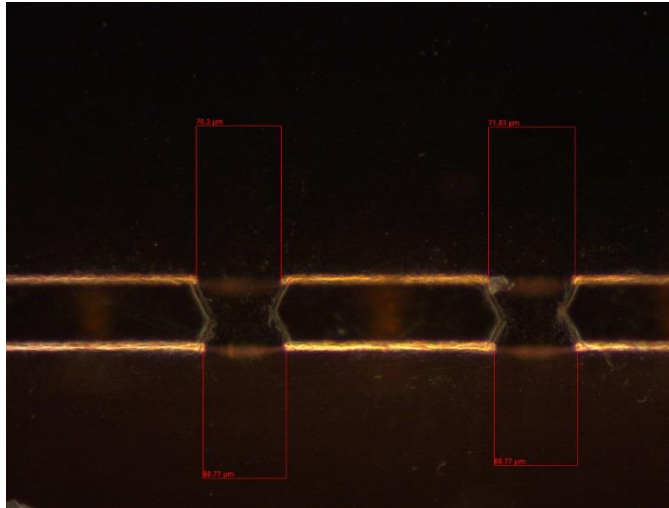


**100mm x100mm active area - 70 microns dia / 140 microns pitch**

# Images from the recent lot



**100mm x100mm active area - 70 microns dia / 140 microns pitch**



## Consistent Double cone profile

### Internal verification :

1. Optical Inspection – Outer copper Hole diameter / Inner Hole diameter / Uniformity
2. Insulation resistance – @ 600 V DC – Min 6 Giga Ohms for 60 seconds

## Status & Work ahead – Thin GEM foils

- **Has stabilized the process for 100x100 Thin GEM foils**
- **Also has started working on 300 x 300mm thin GEM foils.**
- **Process requirements for a bigger panel size, especially with regard to PI etching established.**
- **Further trials and process optimization in progress based on inputs from CERN & various agencies**

## CERN MPT workshop

### GEM main projects in production

<u>Production projects</u>			<u>Completion</u>
•ALICE TPC	GEM 1.6m x 400mm	772 GEM	80%
•CMS GE1/1	GEM 1.2m x 450mm	480 GEM	70%
•BESIII	detector 600mm x 400mm	10 detectors	80%
•CBM	GEM 1m x 450mm	100 GEMs	50%
•BM@N Dubna	GEM detectors 1.8m x 0.6m	7 detectors	95%
•BM@N Dubna	GEM detectors 1.8m x 0.5m	7 detectors	0%
•BM@N Dubna	GEM detectors 2m x 0.6m	7 detectors	0%

### Main GEM R&D project in progress

• <u>R&amp;D project</u>			
•Bonus 12			
•Gadolinium triple GEM detector			
•ESS			
•AL GEM			



# ALICE/CMS Status

5 FSU technicians + 2 CERN staff part time



Year	2016	2017	June/2018	
Expected	140	220	120	total 480
reality	140	233		

**CMS**  
Yield:

initial 10 GEM/tech/4w  
now 12 GEM/tech/4w



Year	2016	2017	April/2018	
Expected	174	378	220	total 772
reality	174	353		

**ALICE TPC**  
Yield:

initial 16 GEM/tech/5w  
now 20 GEM/tech/5w