

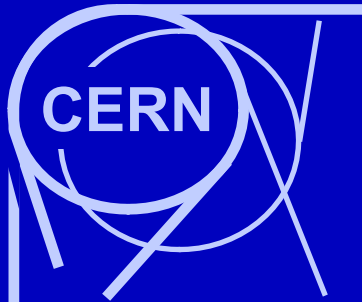
# Large size detectors

## CERN TS-DEM-PMT Capabilities

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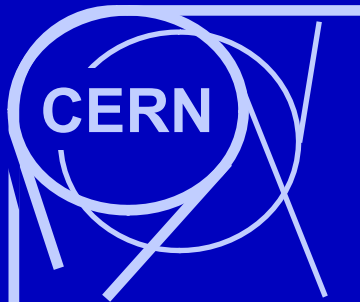
Rui de Oliveira  
TS-DEM

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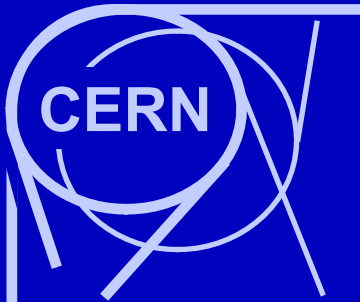
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  - Process and present limitations at CERN
  - Quality control
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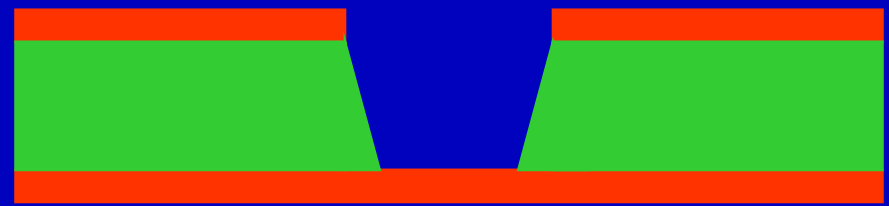
# Chemical conical single mask



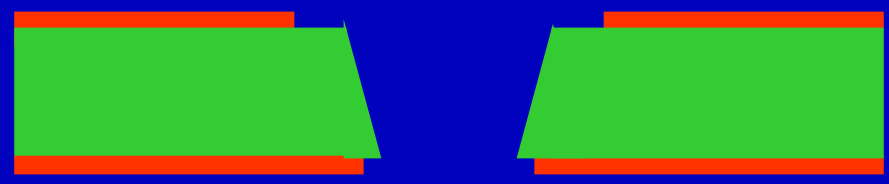
Raw material



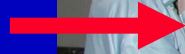
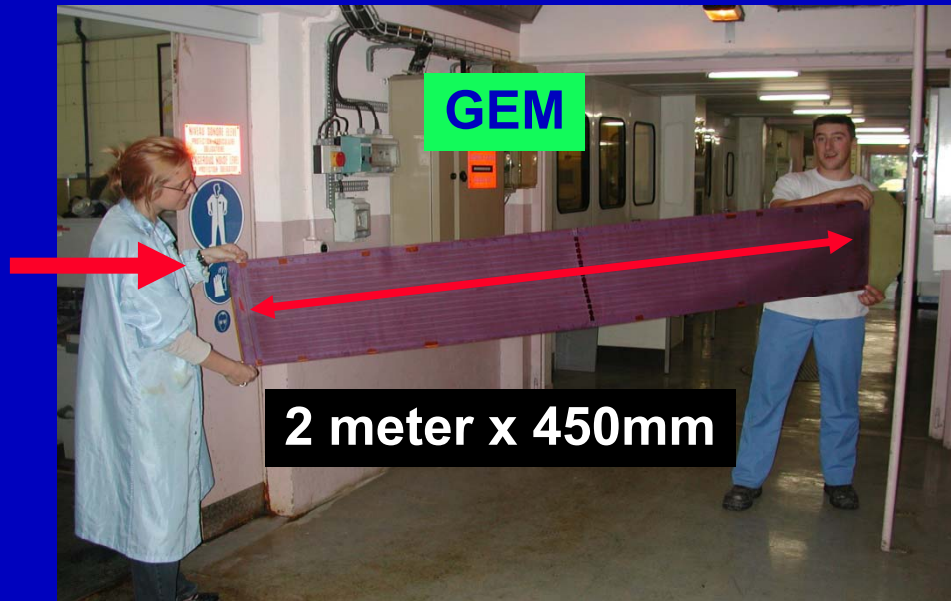
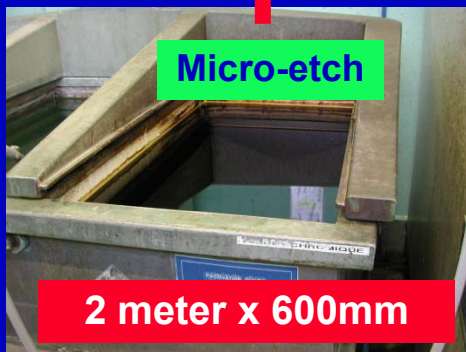
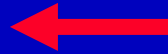
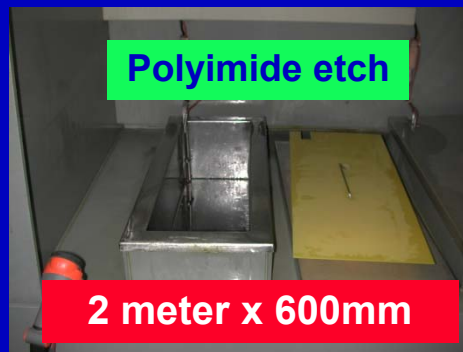
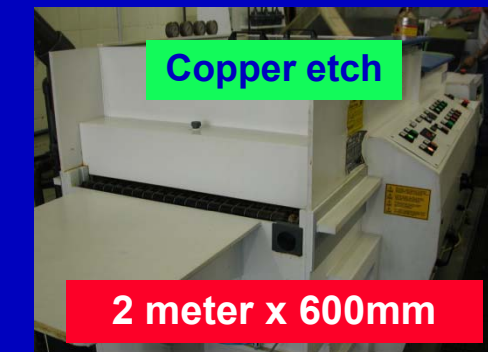
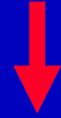
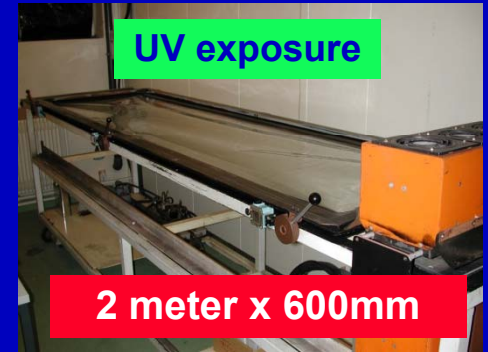
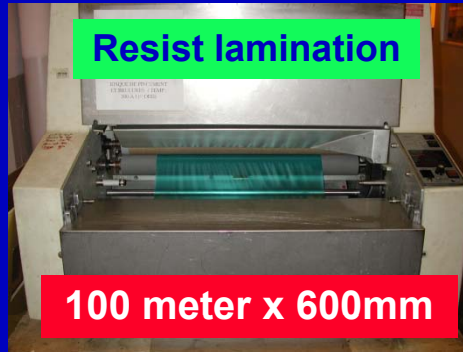
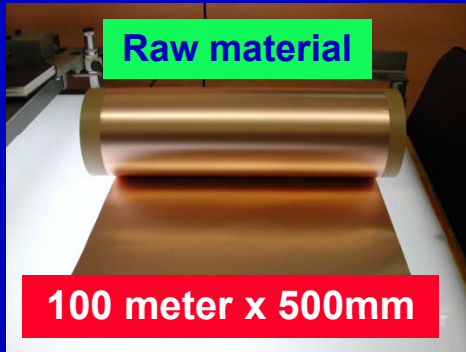
Single side Copper patterning

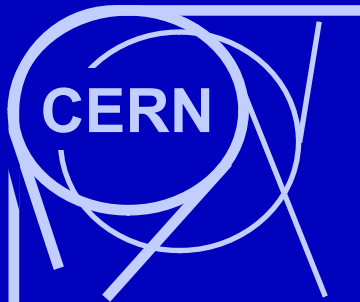


Chemical Polyimide etching

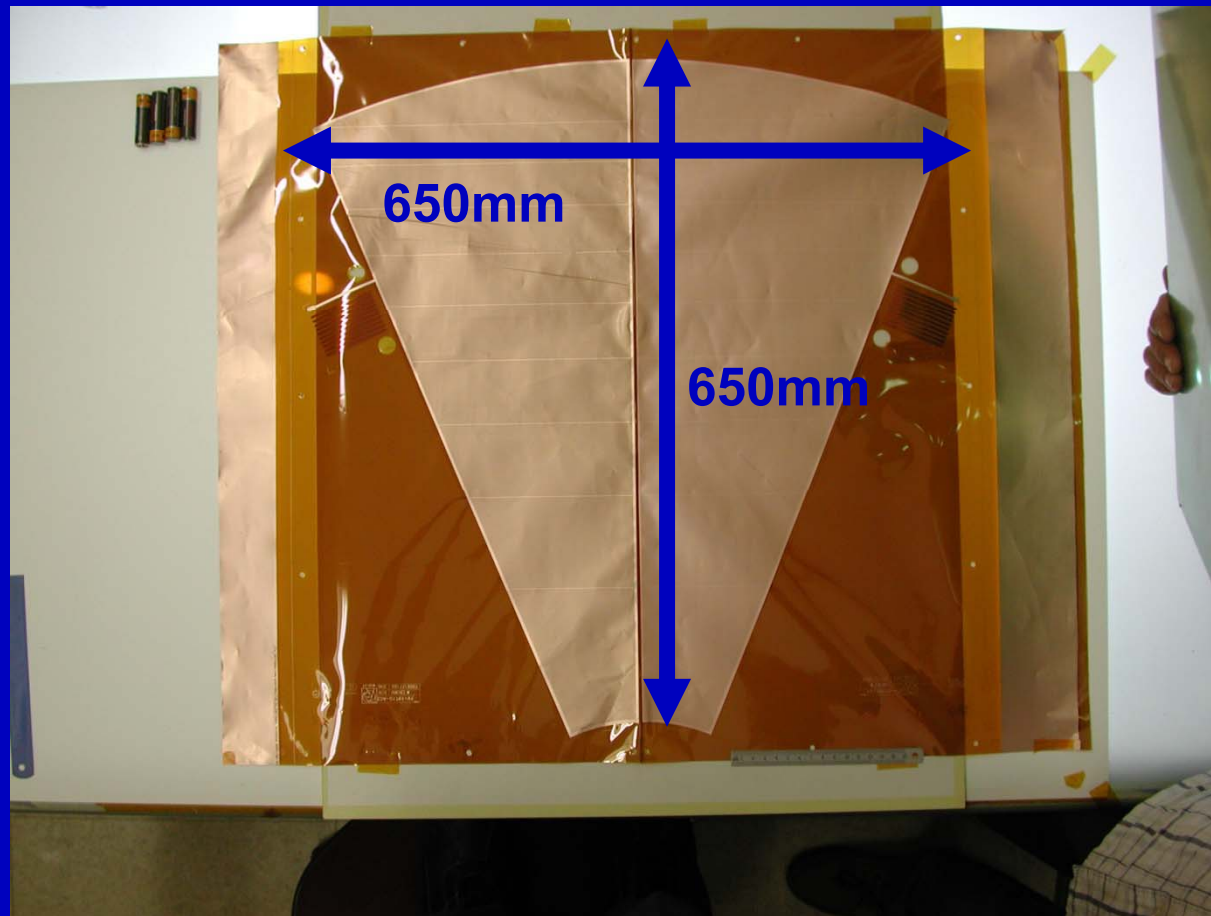


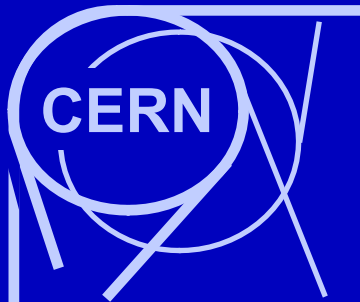
Chemical Copper reduction





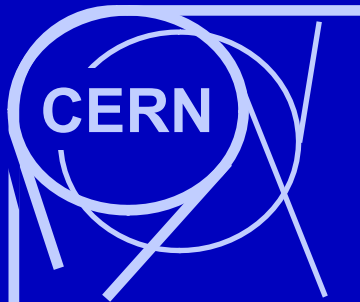
# Biggest GEM produced this year 2 GEMs glued together





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# Quality control

## Microscope optical measurement

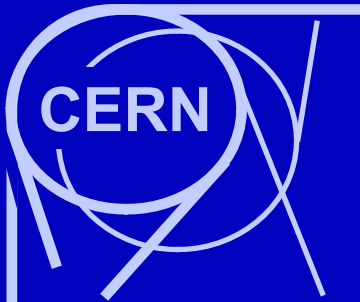
- on several points on the GEM
- Copper hole :  $70 \pm 2 \mu\text{m}$
- Polyimide hole :  $55 \pm 5 \mu\text{m}$

## High voltage test

- $< 10\text{nA}$  @ 600V for 100mm x 100mm
- @ 35%HR max

And... **\*new\*** Light Transmission measurement





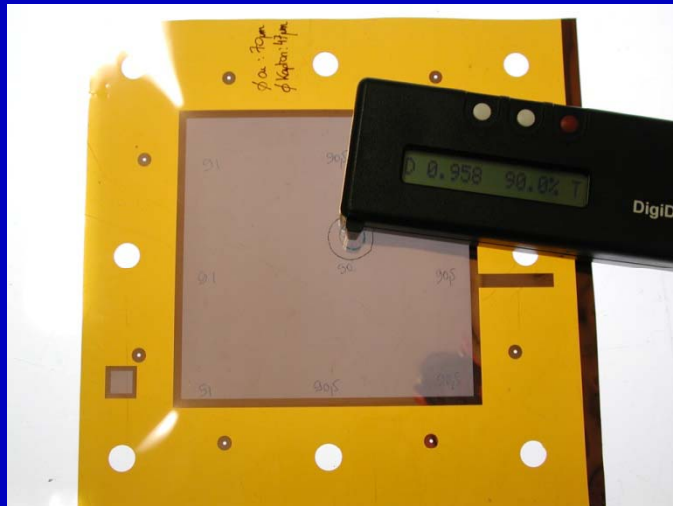
# Light transmission measurement

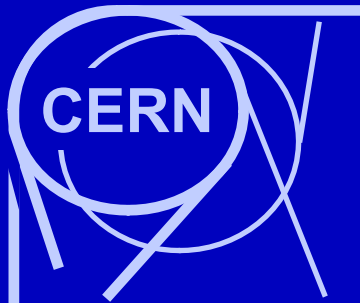
## Good quality

GEM A: 70  $\mu\text{m}$  copper hole, 47  $\mu\text{m}$  polyimide hole  
Transmission = 9.5%  $\pm$  0.5% max over all surface

## Bad quality

GEM B: 83  $\mu\text{m}$  copper hole, 55  $\mu\text{m}$  polyimide hole  
Transmission = 13.5%  $\pm$  4% max over the all surface



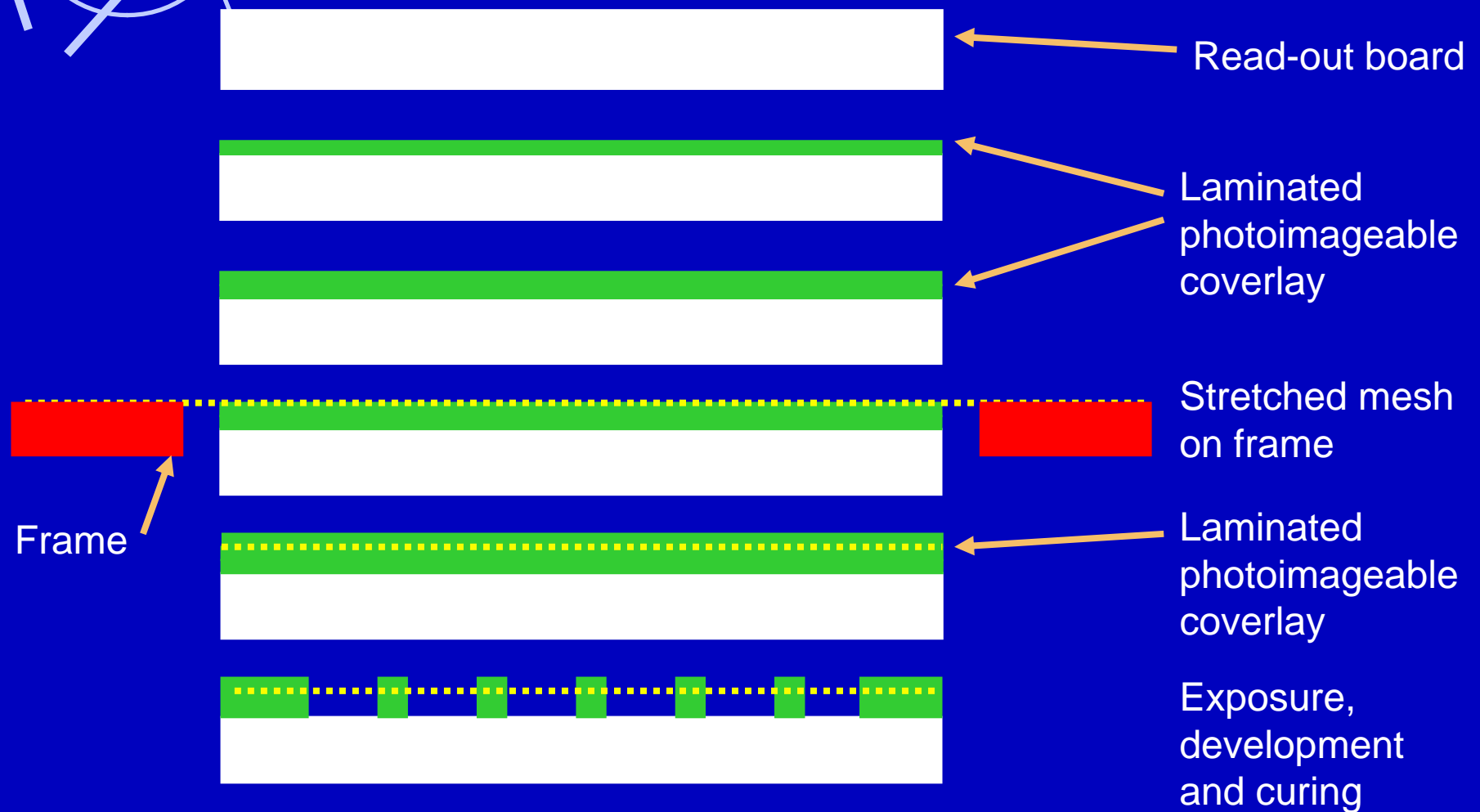


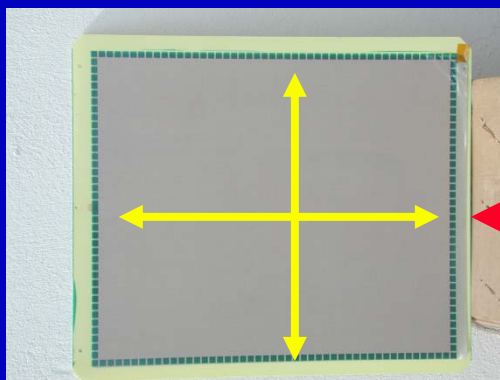
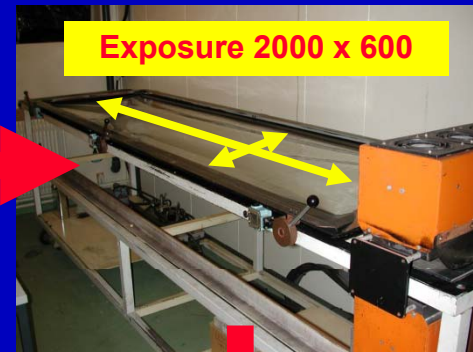
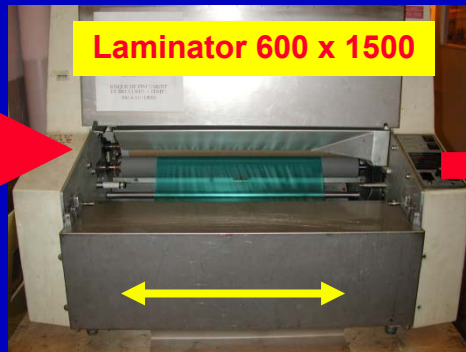
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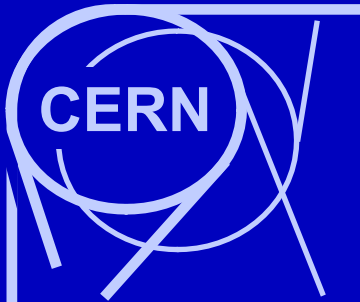
# Micromegas Bulk





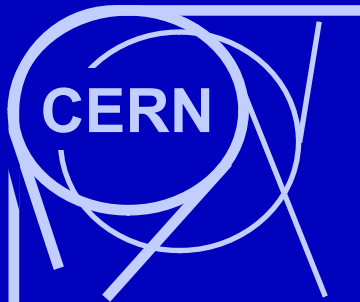
With present equipment

**Detector 1500 x 500**



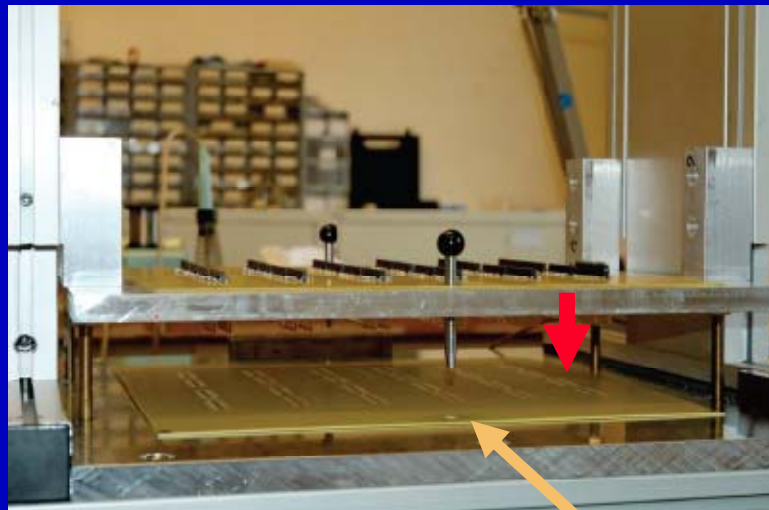
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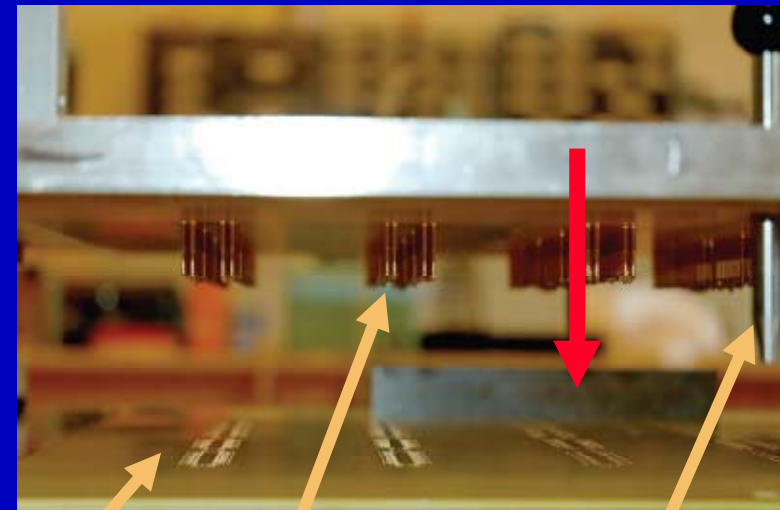


# QUALITY CONTROL

## Bed of nails



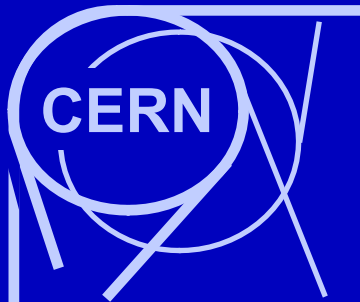
Detector



Probe needles

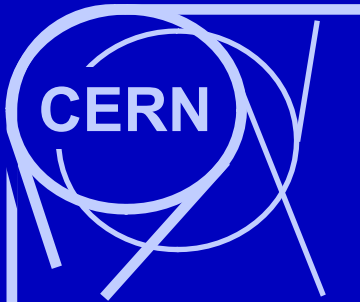
Locating pins

**Test: current < 20 nA @ 800V @ 35% HR max**  
**No standard tool for test!**

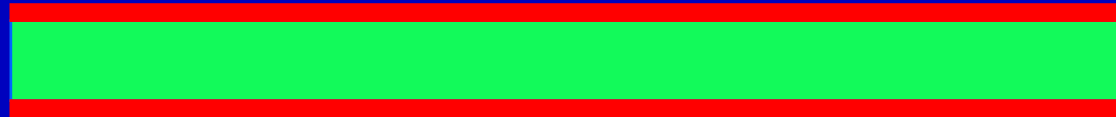


# Contents

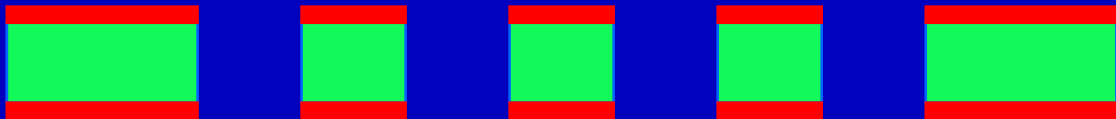
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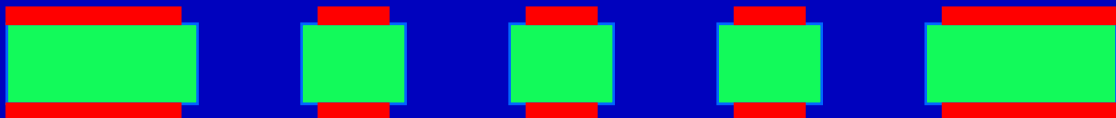
# Copper THGEM production description



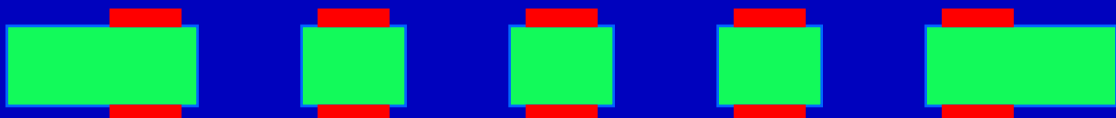
Raw material



CNC drilling

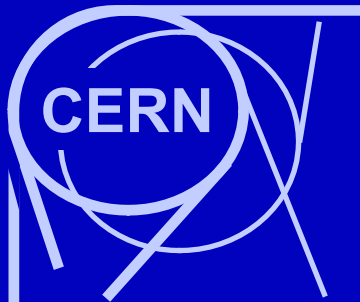


Small rim if needed



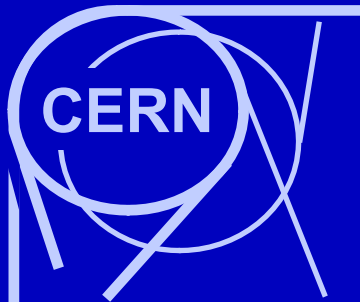
Electrodes etching





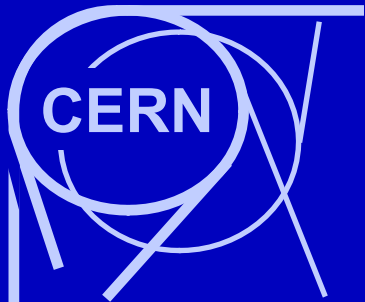
## Practical limits ThGEMs at CERN

- **Raw material** : 2000mm x 1000mm
- **Drilling area** : 700mm x 600mm
  - Drilling cadence : 1 hole per second
  - Tool life : 10000 holes with 2 sharpenings
- **Small rim etching** : 1500mm x 800mm
- **Electrode patterning** : 2000mm x 600mm
- **Possible Detector size : 700mm x 600mm**
  - 116 hour drilling time for 1mm pitch with 1 head drilling machine

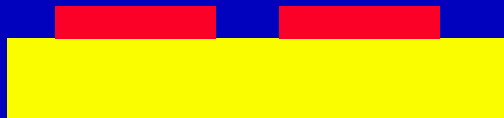


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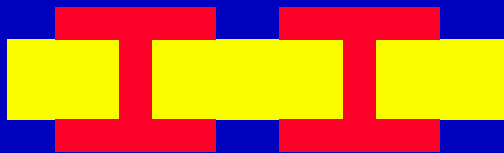
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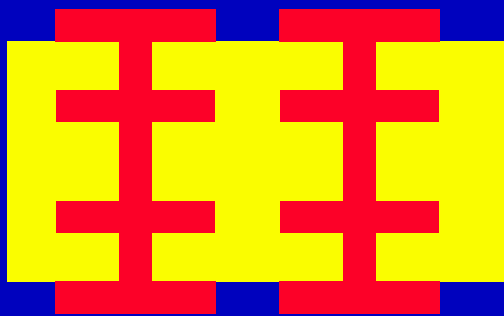
# Read-out board



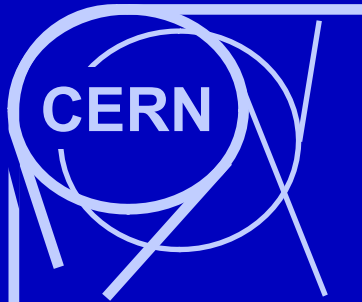
Single sided: 2000mm x 600mm



Double sided: 1500mm x 400mm



**Multi-layer: 600mm x 500mm!**



# Conclusion

## CERN capabilities (2008)

- **GEM** : 2.0 meter x 450 mm
- **Micromegas Bulk** : 1.5 meter x 500 mm
- **ThGEM** : 0.7 meter x 600 mm
- **Read-out board** : 0.6 meter x 500 mm  
for multi-layer!