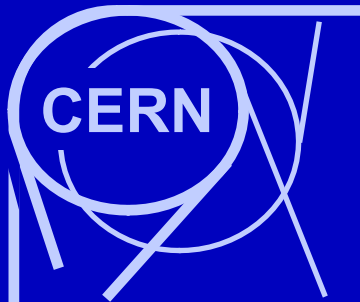


Large size detectors

practical limits
based on present knowledge

Rui de Oliveira
TS-DEM



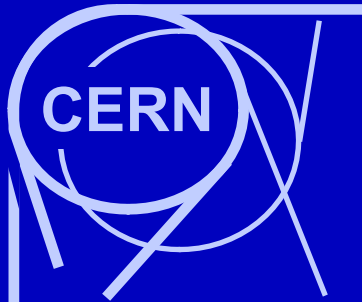
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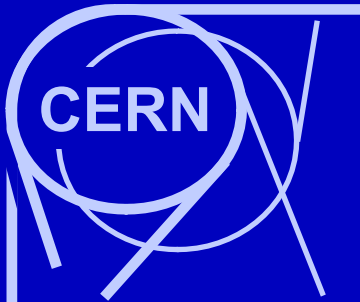
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Process status

- **Standard bi-conical LDI exposure**
 - Misregistration top to bottom
- **Standard bi-conical large glass mask**
 - Large mask bowing problem
- **Electrochemical single cone**
 - 10 micron level defects on the metals
- **Chemical single cone**
 - Best results up to now



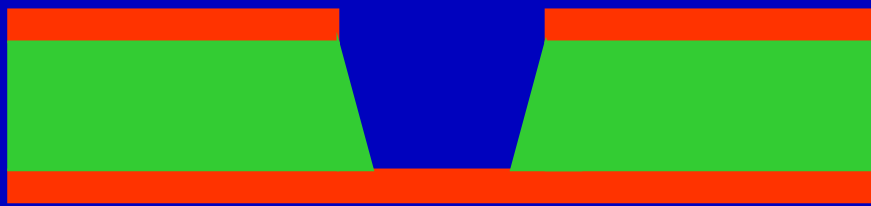
Chemical conical single mask



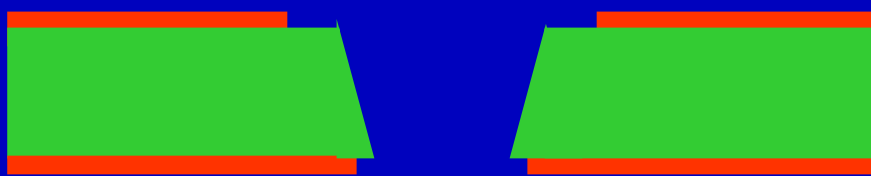
Raw material



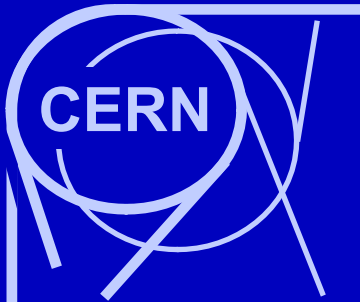
Single side copper patterning



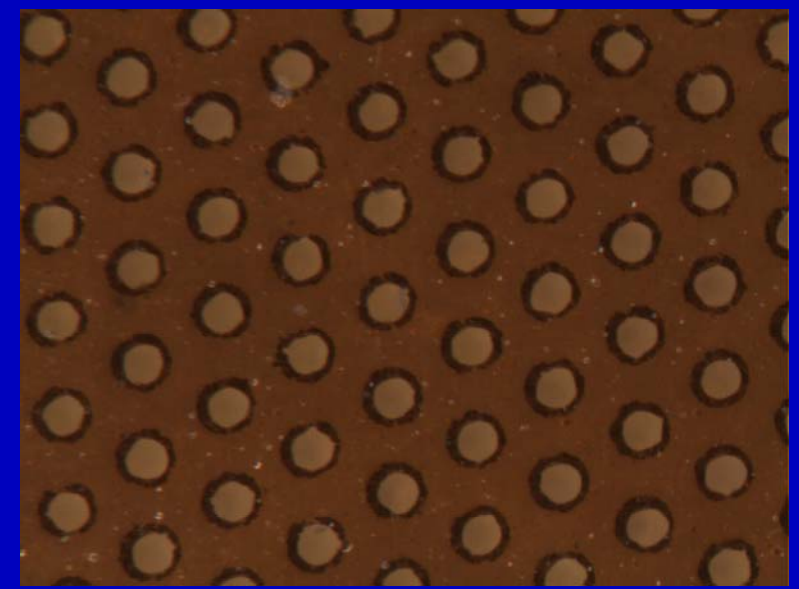
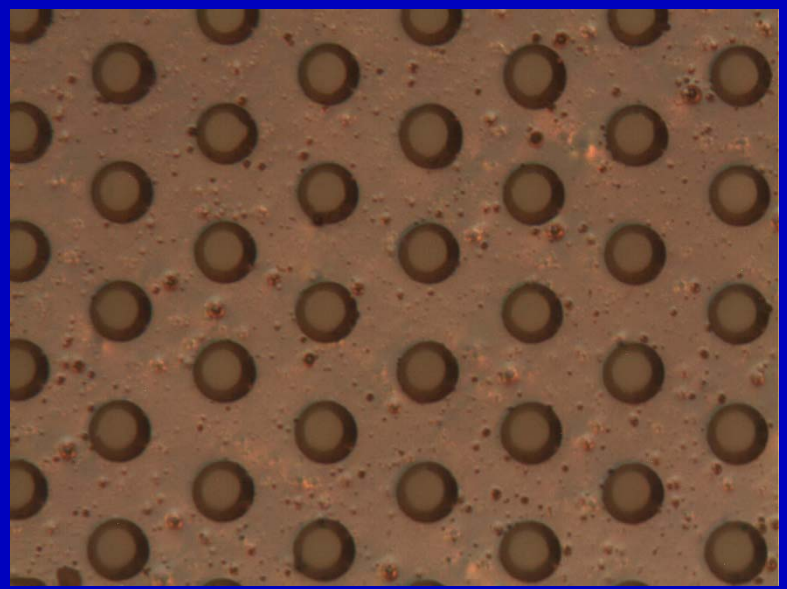
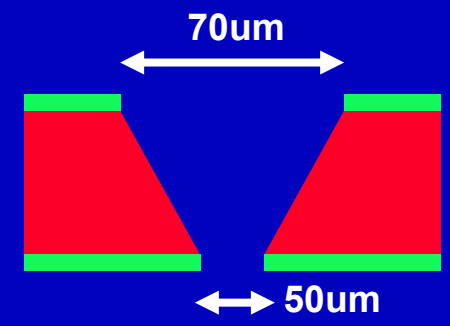
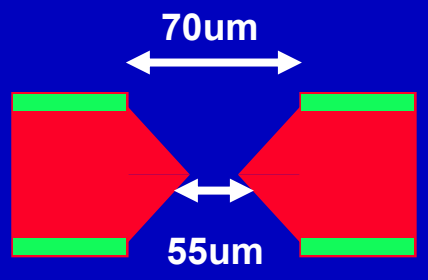
Chemical polyimide etching

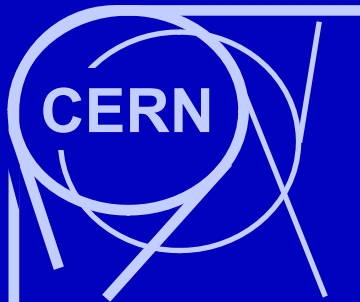


Chemical copper reduction



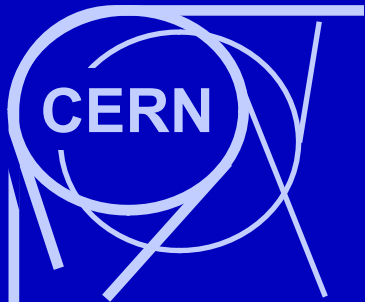
- Quality at the micron level is still better with standard GEM
- We are working hard to improve this parameter





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Base material

copper

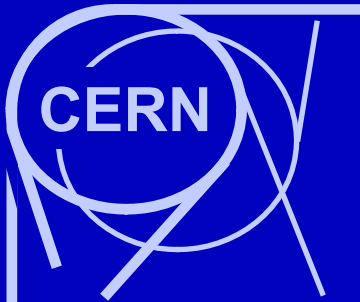


Raw material

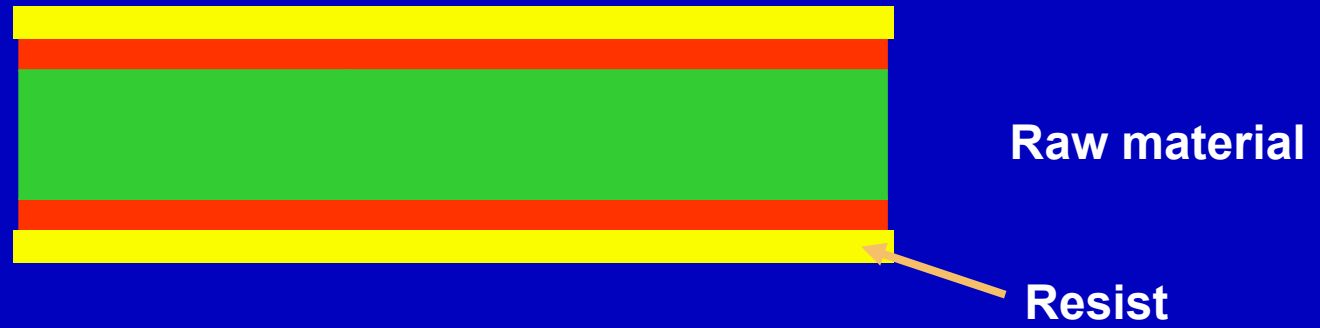


Roll size 500 mm x 100 meter

50 μm polyimide + 5 μm copper



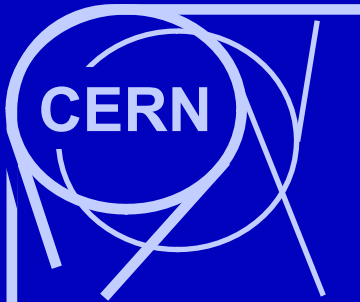
Resist lamination



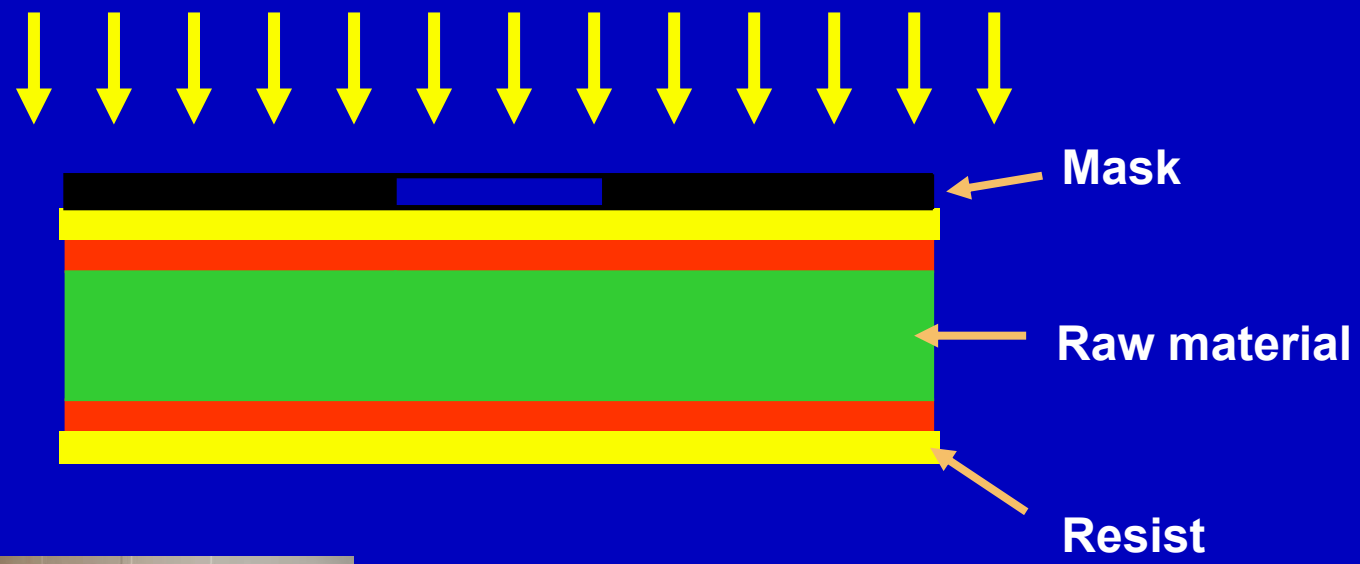
ATTENTION
EN CAS D'UTILISATION
SANS CAPOT DE
PROTECTION
FAIRE ATTENTION AUX
ROULEAUX DE
LAMINATION

RISQUE DE PINCEMENT
ET BRULURES (TEMP.
100 A 110 DEG)

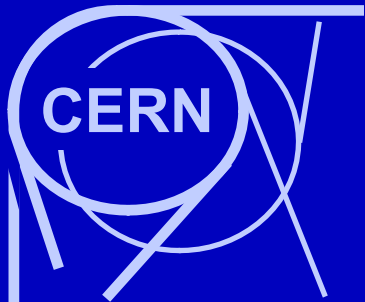
600 mm x 100 meter
Roll to roll process



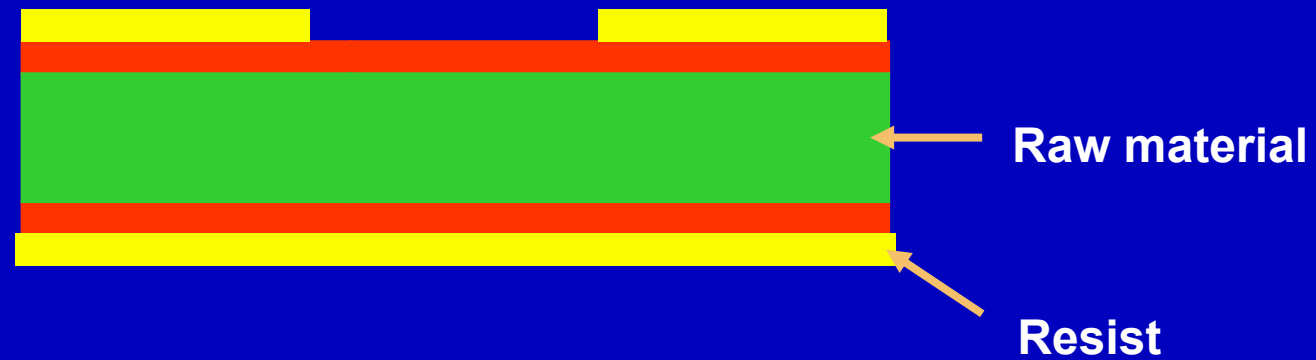
UV exposure



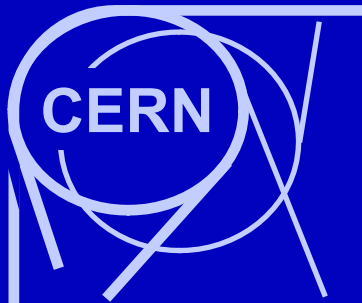
Film: up to 2m x 0.6m step by step exposure
Roll to roll possibility



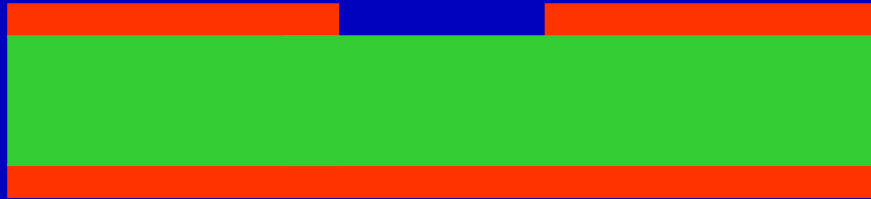
Development by spray



600 mm x 100 meter
Roll to roll process



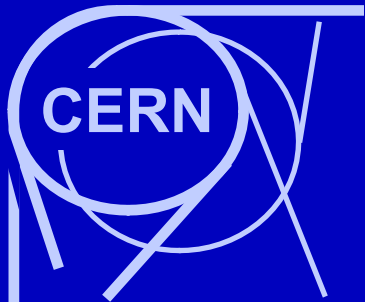
Copper etching



Single side copper patterning



Roll to roll process
600 mm x 100 meter



Polyimide etching

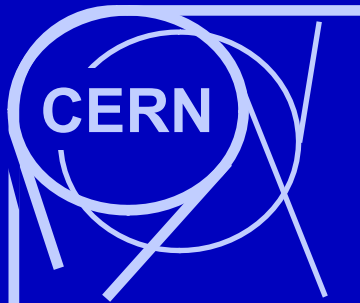


Chemical Polyimide etching



Roll to roll process

600 mm x 100 meter



Microetching

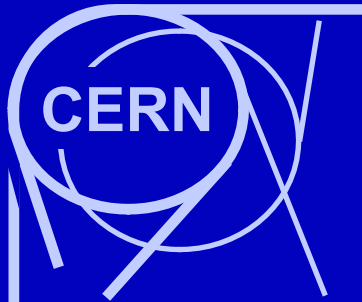


Chemical copper reduction



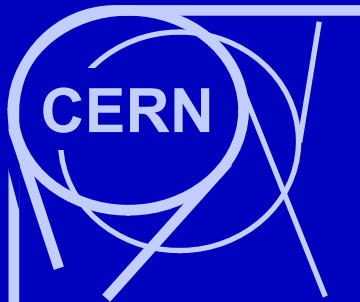
Roll to roll process

600 mm x 100 meter



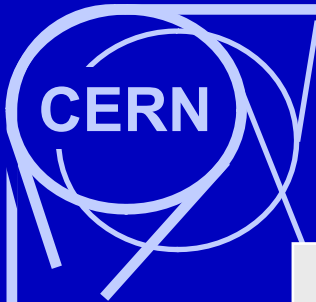
GEM Practical limitations

- 450 mm x 100 meter active area**
- 300 μm dead zone between sectors inside one film**
- 2 mm dead zone between two film exposures**

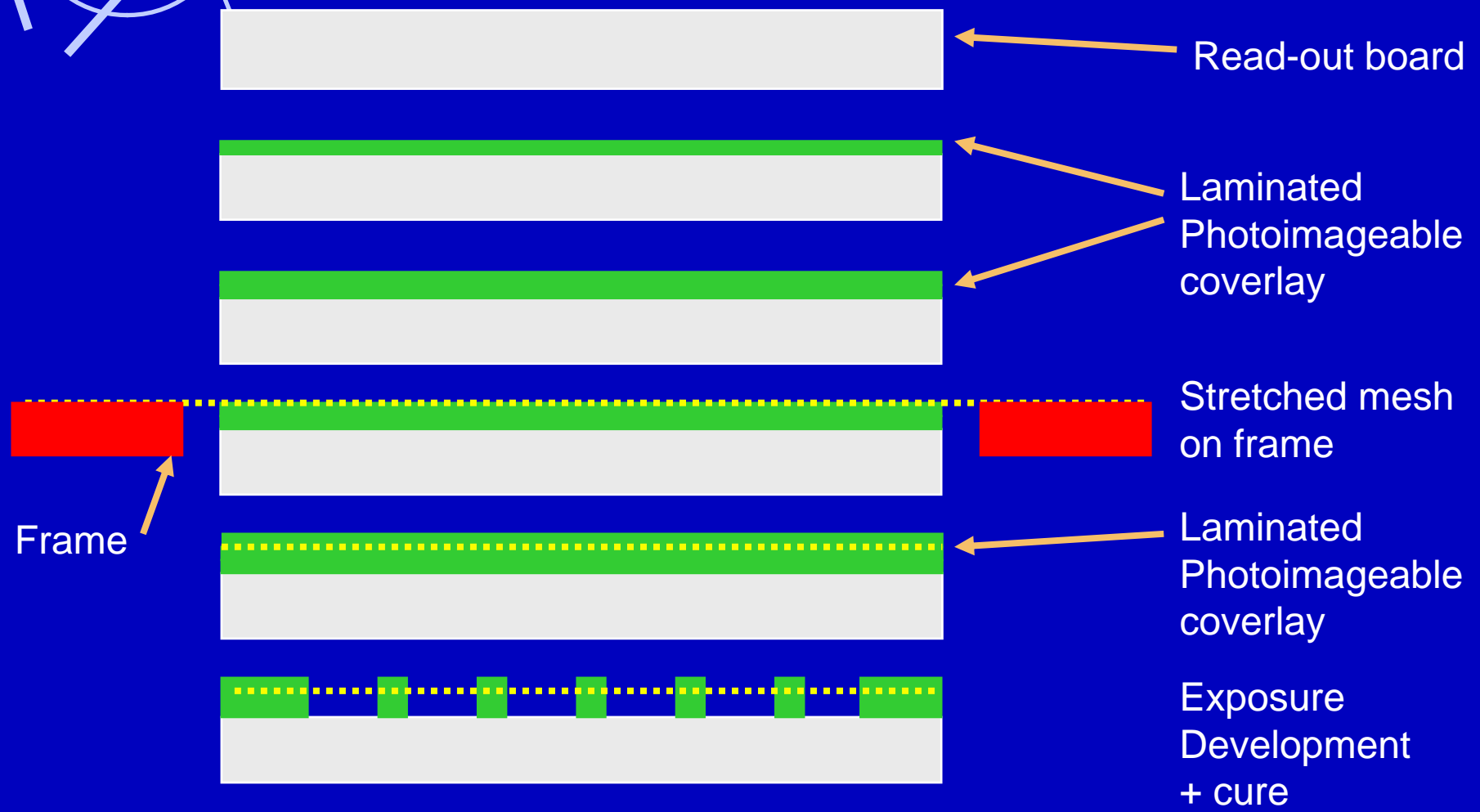


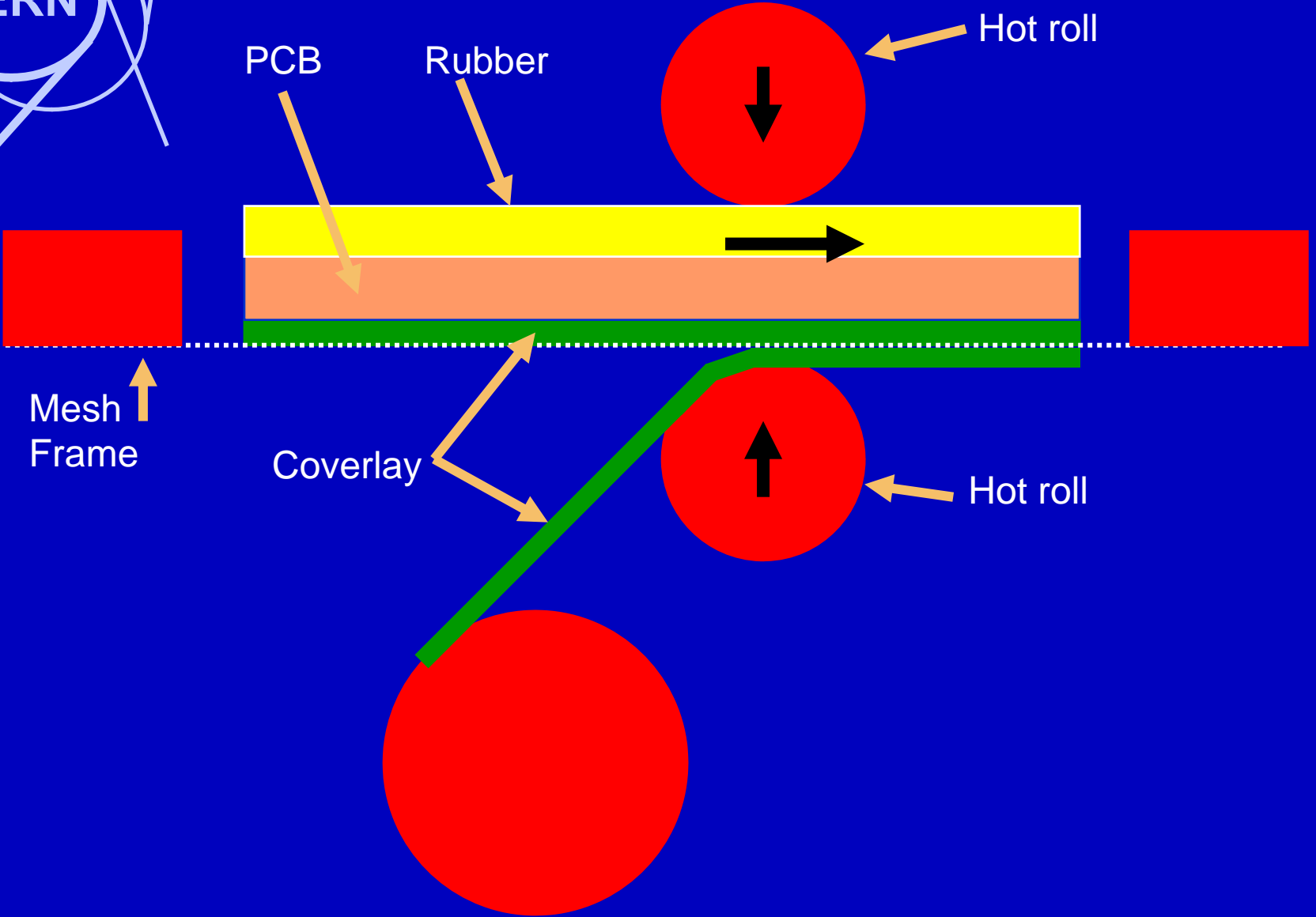
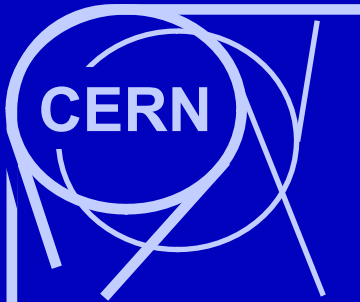
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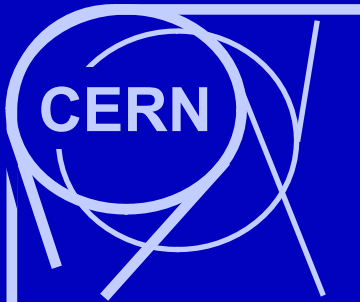
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Micromegas Bulk

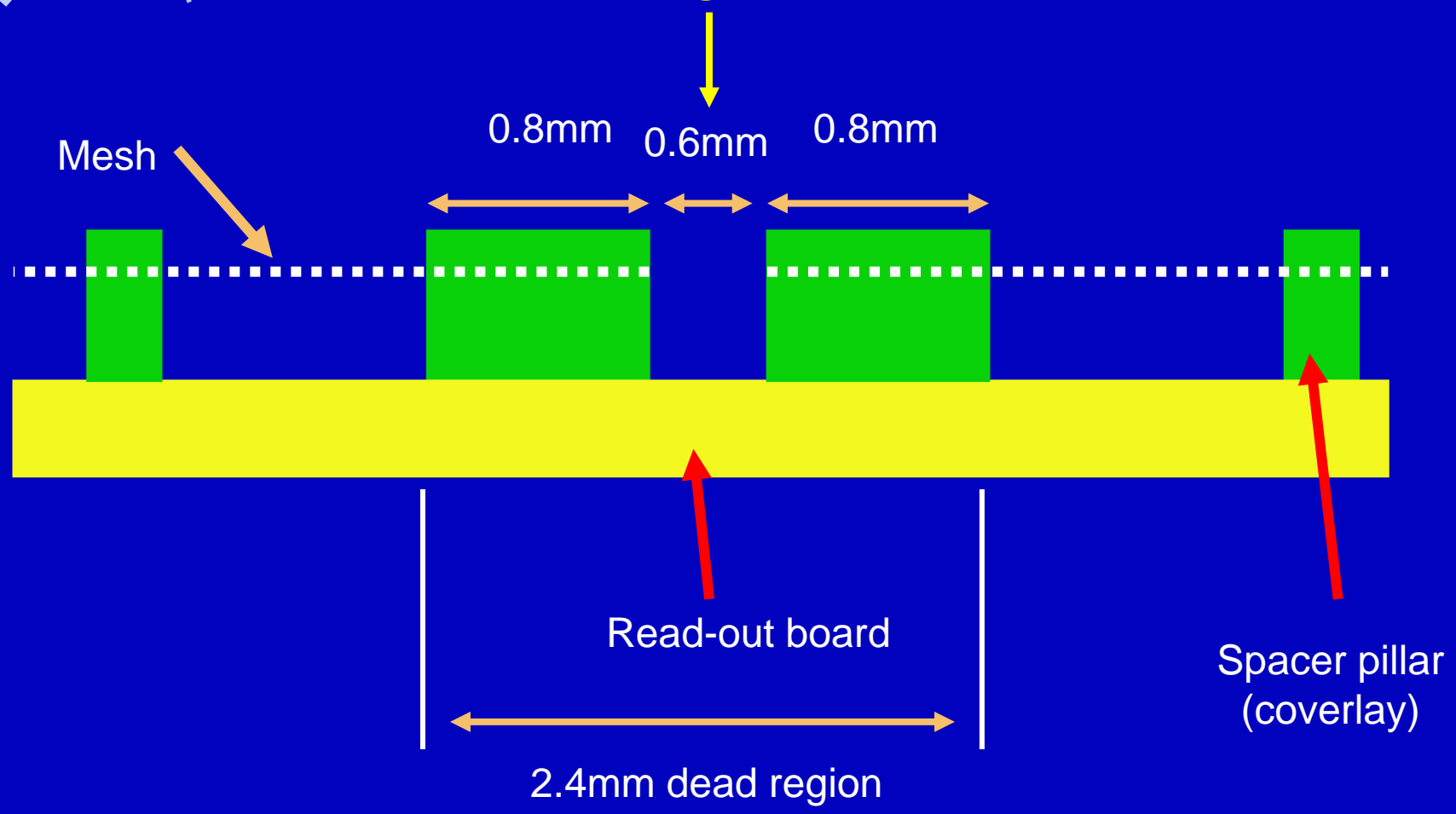


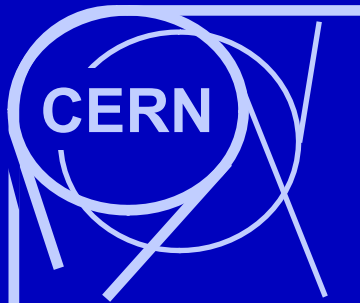




Detail on the sector partitioning

Mechanical milling 0.6 mm tool diameter





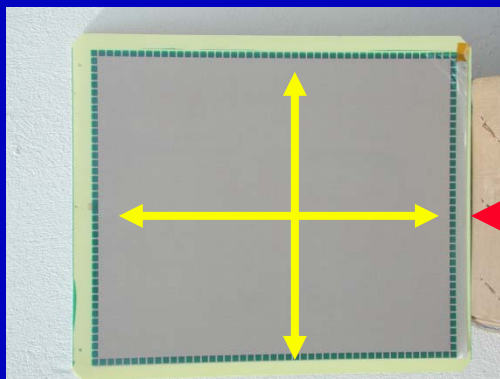
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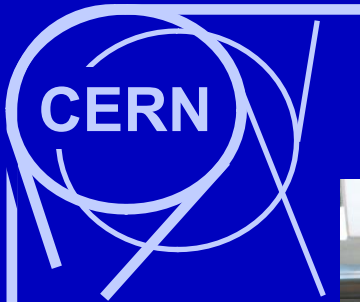
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Practical limitations Bulk Micromegas

Detector 2000 x 1000





Mesh stretching



Mesh 2000 x 1000



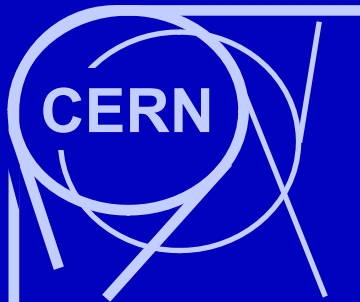
Tension: from 10Ncm to 15Ncm



Over mesh cutting



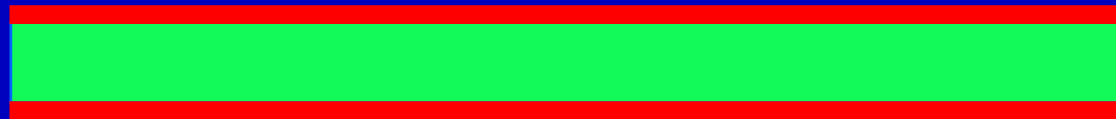
Glue deposit



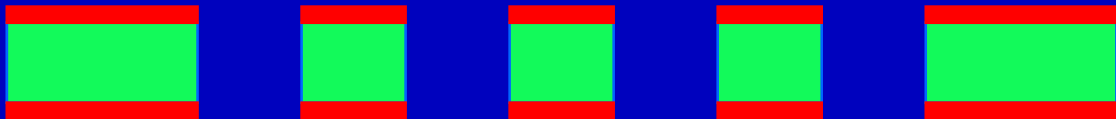
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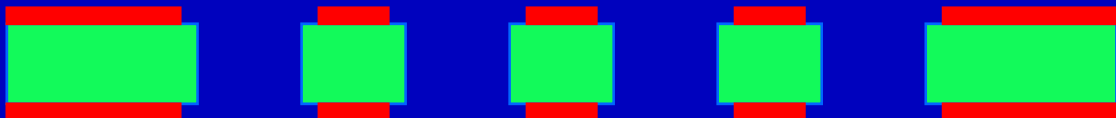
Copper THGEM production description



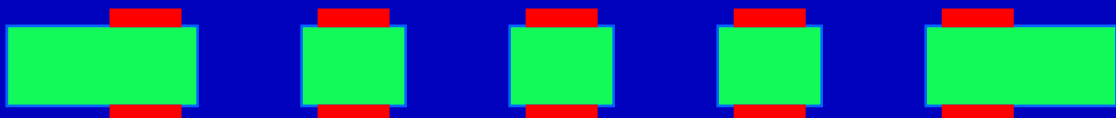
Raw material



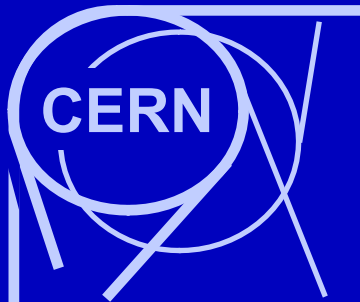
CNC drilling



Small rim if needed

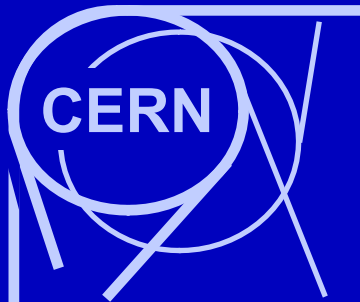


Electrodes etching



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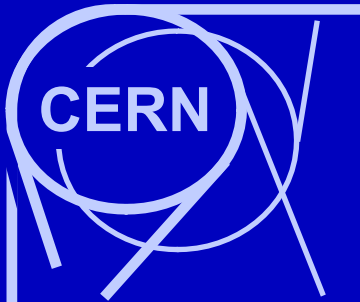
Practical limits ThGEMs

- Raw material : 2000mm x 1000mm
- Drilling area : 2000mm x 600mm (1000mm?)
 - Drilling speed : 3 to 4 holes per second
 - Tool life : 10000 drills with 2 sharpenings
- Small rim etching : 2000mm x 1000mm
- Electrode patterning : 2000mm x 600mm
- **Possible Detector size : 2000mm x 600mm**
 - 28 h drilling time for 1mm pitch with 4 heads drilling machine
 - 111h drilling time for 0.5mm pitch " " " " "

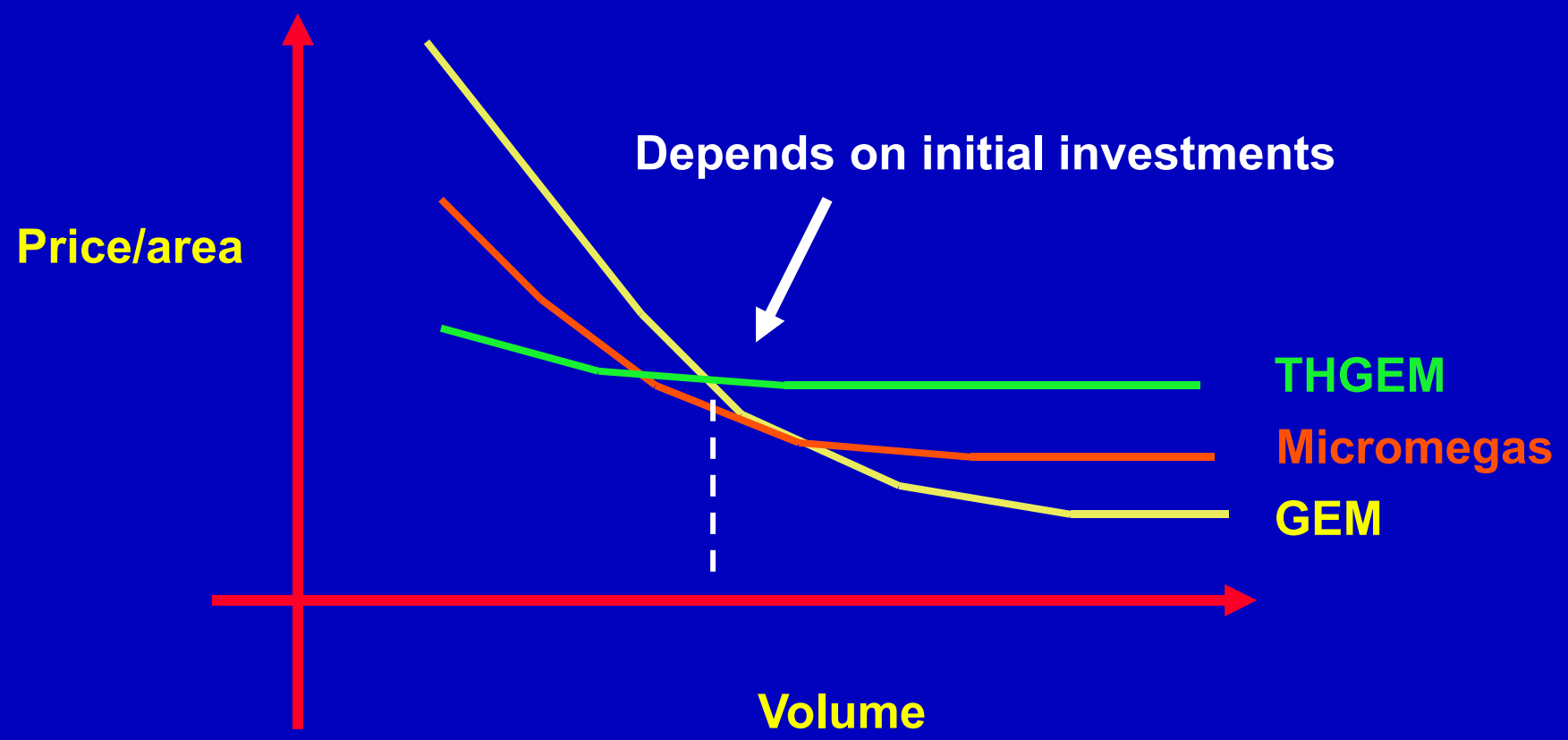


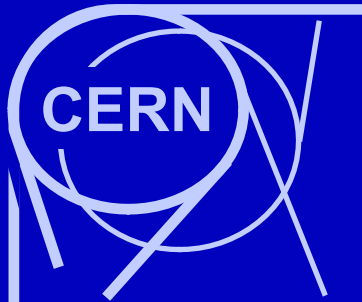
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Large volume effect





Conclusions

Practical limits with investment

- GEM : 100 meter x 450mm
- Bulk Micromegas : 2 meter x 1 meter
- ThGEM : 2 meter x 0.6 meter (1 meter?)