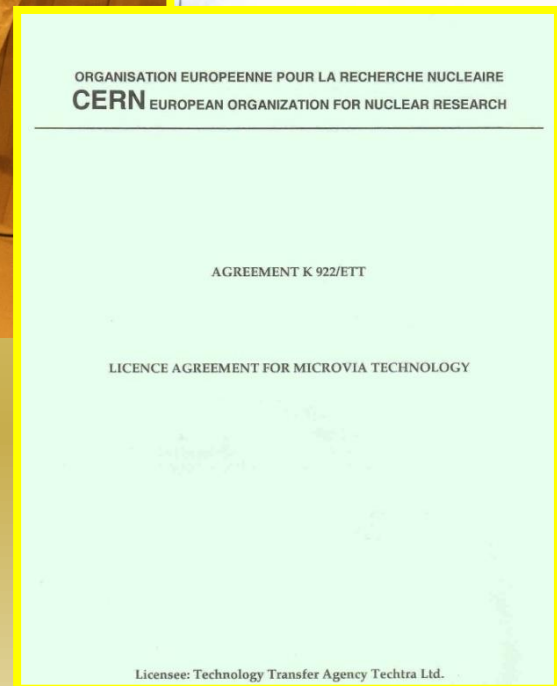
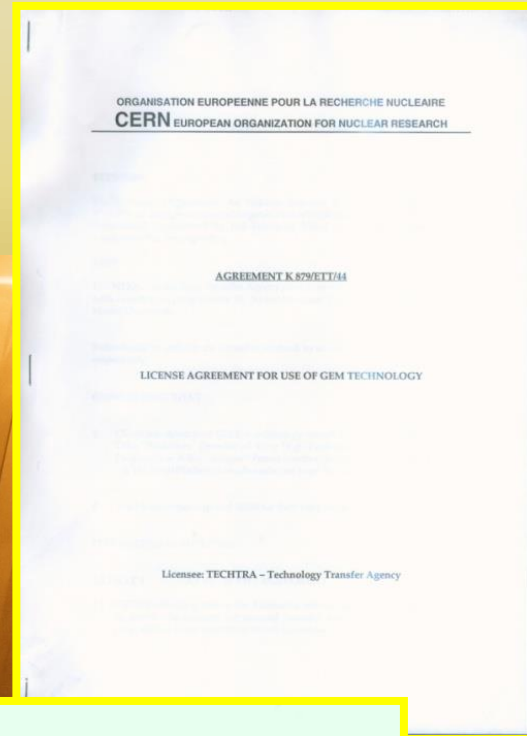
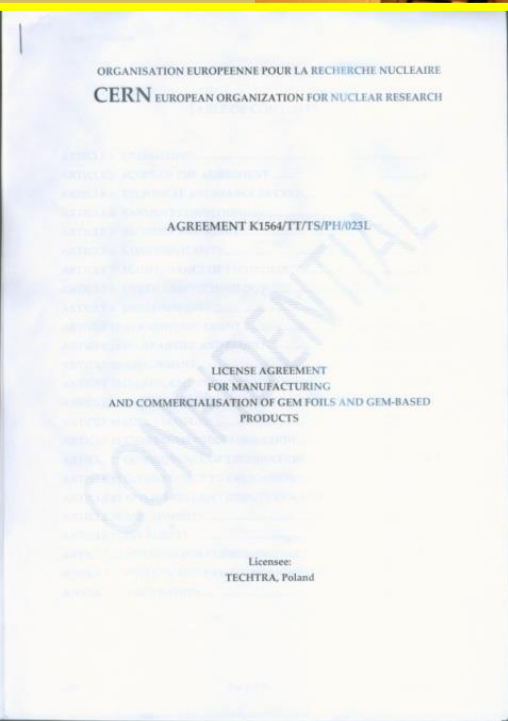


# GEM foils production status and plans @ Techtra



# The beginning: December 2002



**GEM manufacturing upon  
CERN licence**

# Machinery for „small“ GEM production.



A cleanroom



PCB laminator



Exposure Unit



PCB developer -etcher



Kapton etching machine -  
processing baths

# „Small” GEMs

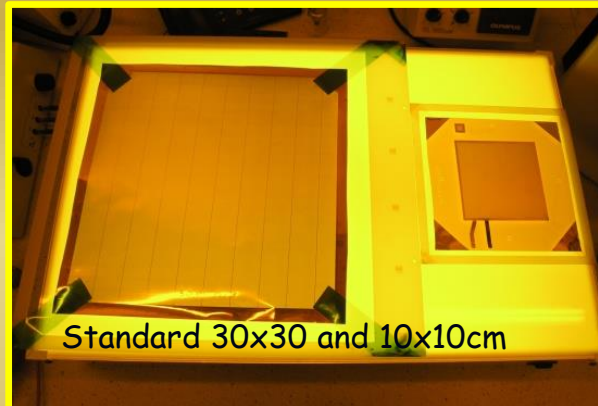
Since 2010 Techtra has produced over 1700 small GEM foils.

Different :

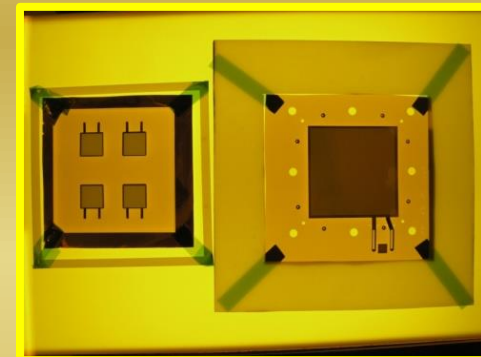
- sizes
- shapes
- pitch
- hole diameter



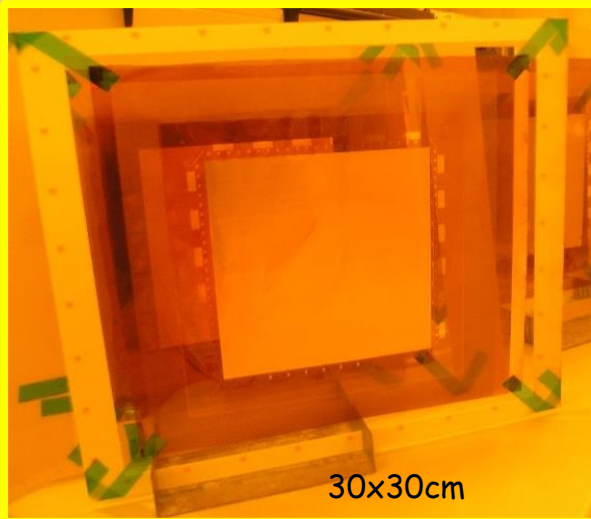
GEM cross section



Standard 30x30 and 10x10cm



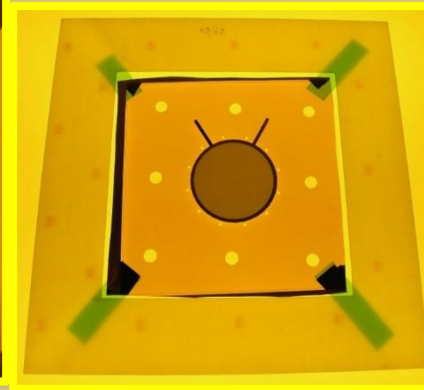
Multi-GEMs Different pitch



30x30cm



Round  $\varnothing$  12cm



Round  $\varnothing$  5cm

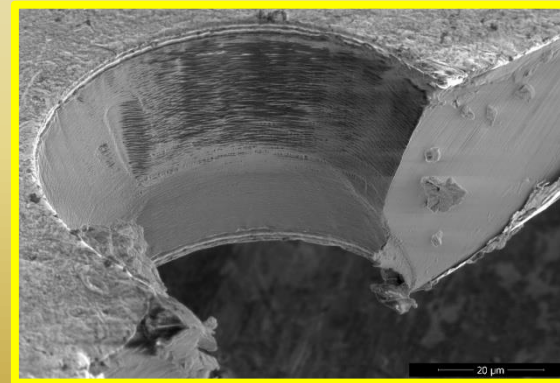


Multi-GEMs Different pitch



RD51, 5 Dec. 2018

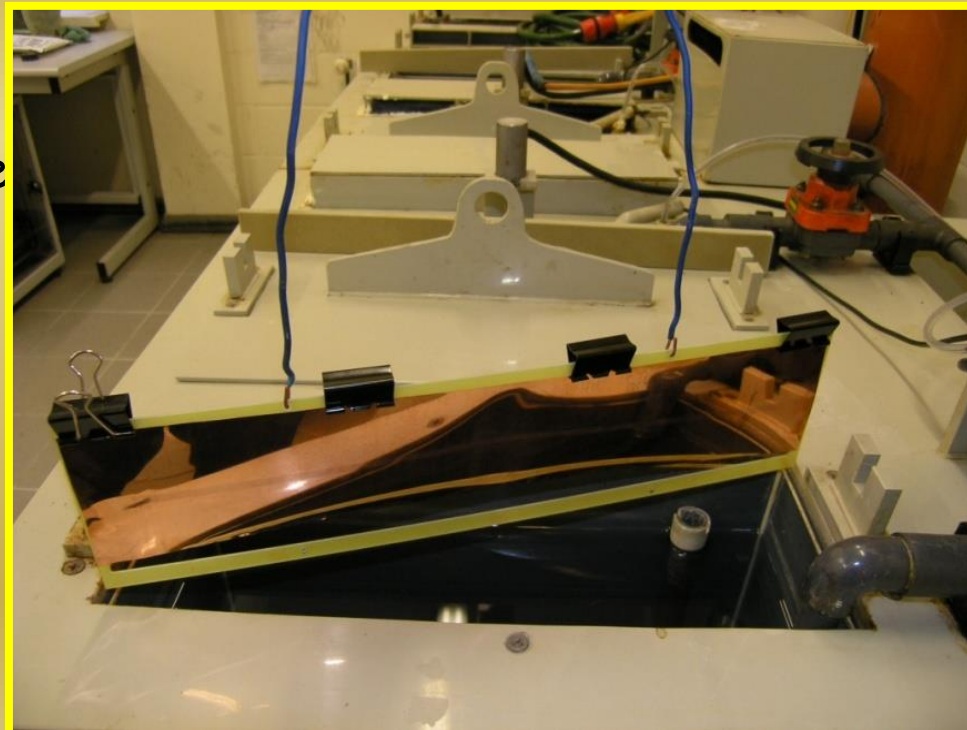
# „Small” GEMs technological limits:



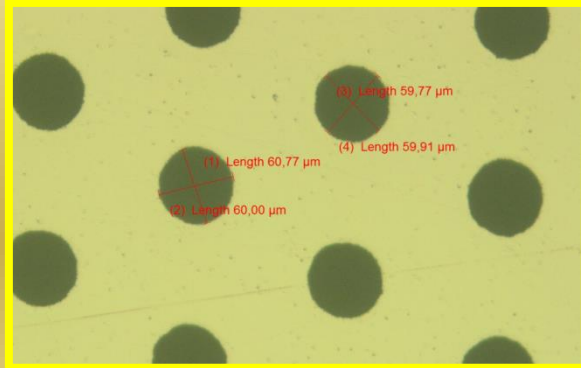
GEM cross section by SEM

- Total dimension: 40x55cm<sup>2</sup>
- Active area: 30x40cm<sup>2</sup>
- Foils can be produced with „double mask” or „single mask” technique

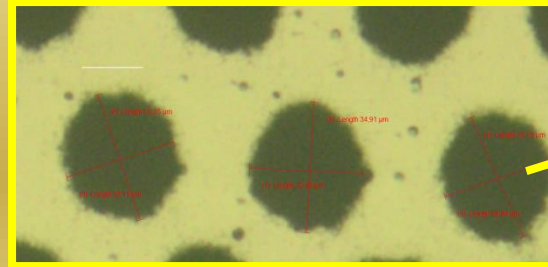
Production yield: **about 90%**



# Photomasks

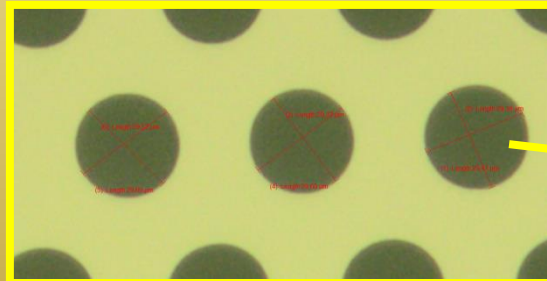
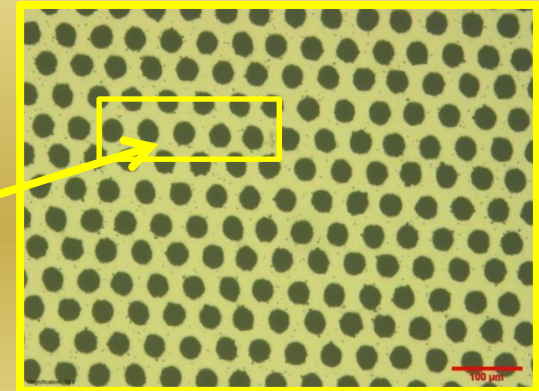


Pitch  $140\mu\text{m}$ , dot  $60\mu\text{m}$



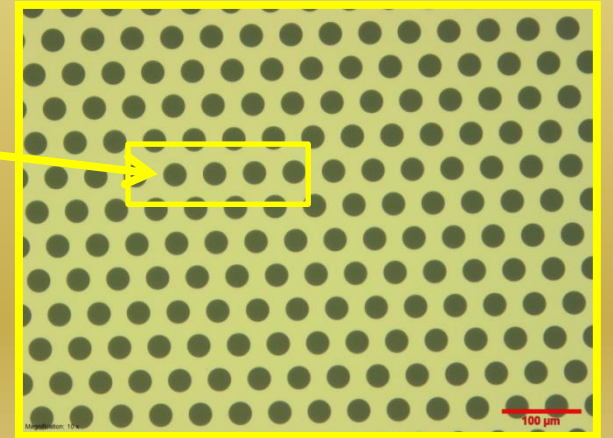
Pitch  $50\mu\text{m}$ , dot  $30\text{-}35\mu\text{m}$

**Foil** photomask



Pitch  $50\mu\text{m}$ , dot  $30\mu\text{m}$

**Glass** photomask



# Machinery for „BIG” GEM production



Exposure unit



PCB developer



Copper etcher



Kapton etching  
„industrial” PROTOTYPE



Machinery suitable for production of  
2 meters long GEMs

RD51, 5 Dec. 2018

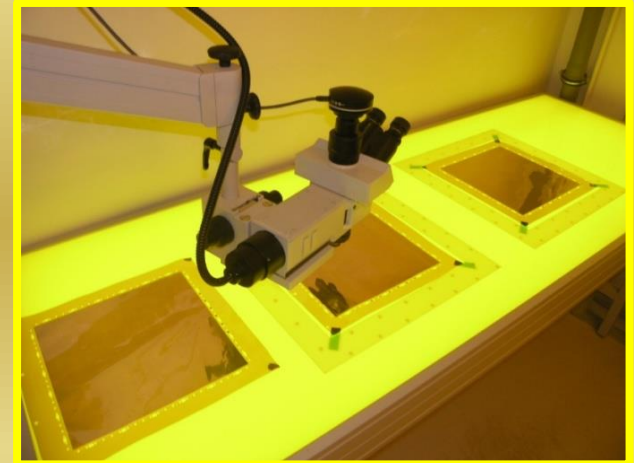
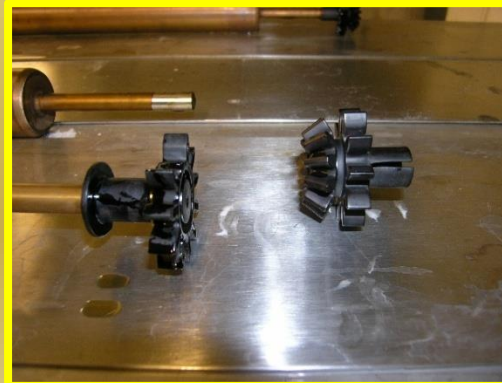
# Problems with Kapton etching PROTOTYPE

- non uniform spraying system
- foils blocks itself inside the machine.
- chemistry and fumes leakages from: pumps, pipes joints, ect
- non compatibility of used materials
- many more....

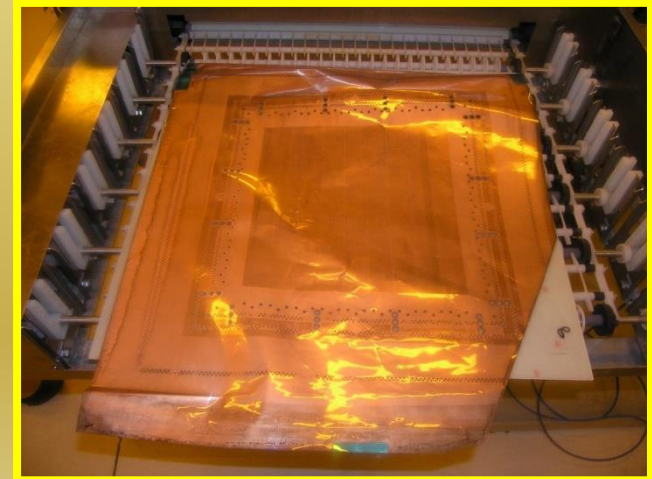
After 1 month work, the plastic parts were worn.



Worn conveyor rollers and endcaps leads to kapton foils destruction



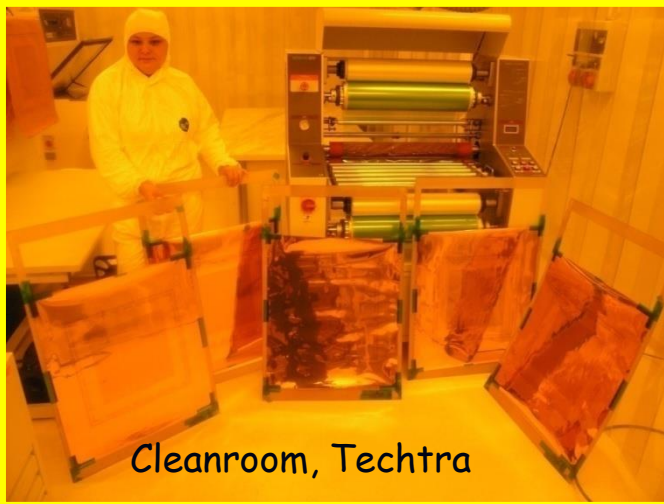
Openings uniformity test



Destructed Kapton foil

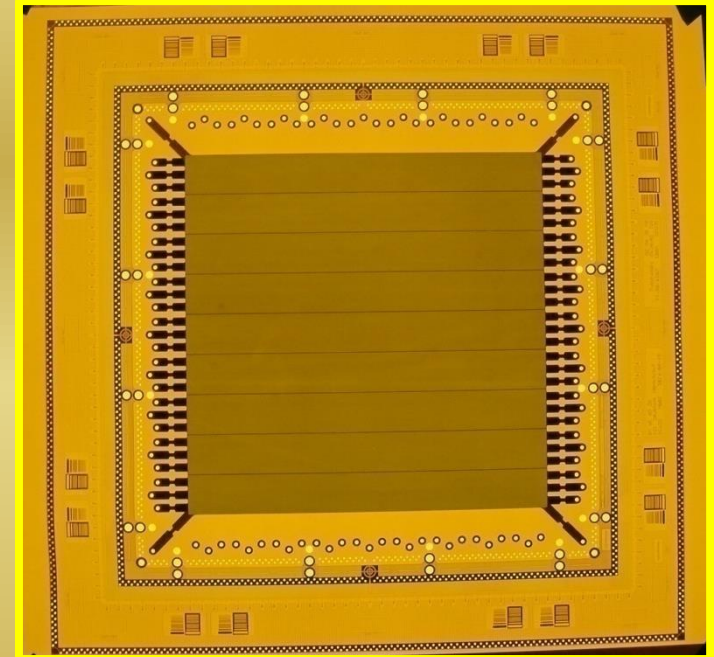


# BIG GEMs



Cleanroom, Techtra

Recent production at Techtra.  
Over 15 foils was done.



Leakage currents: 8-20 nA  
@600V@30%HR per foil

A prototype machine causes many problems:

- Very low production yield - about 30%
- Time and resource consuming
- Needs constant tuning, testing, repairing, ect

# BIG GEMs



- The only visible solution is to step back to processing baths technique

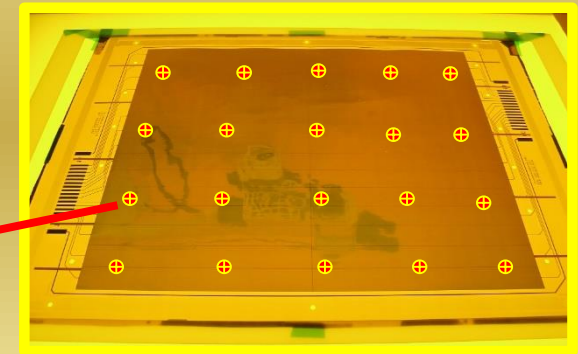
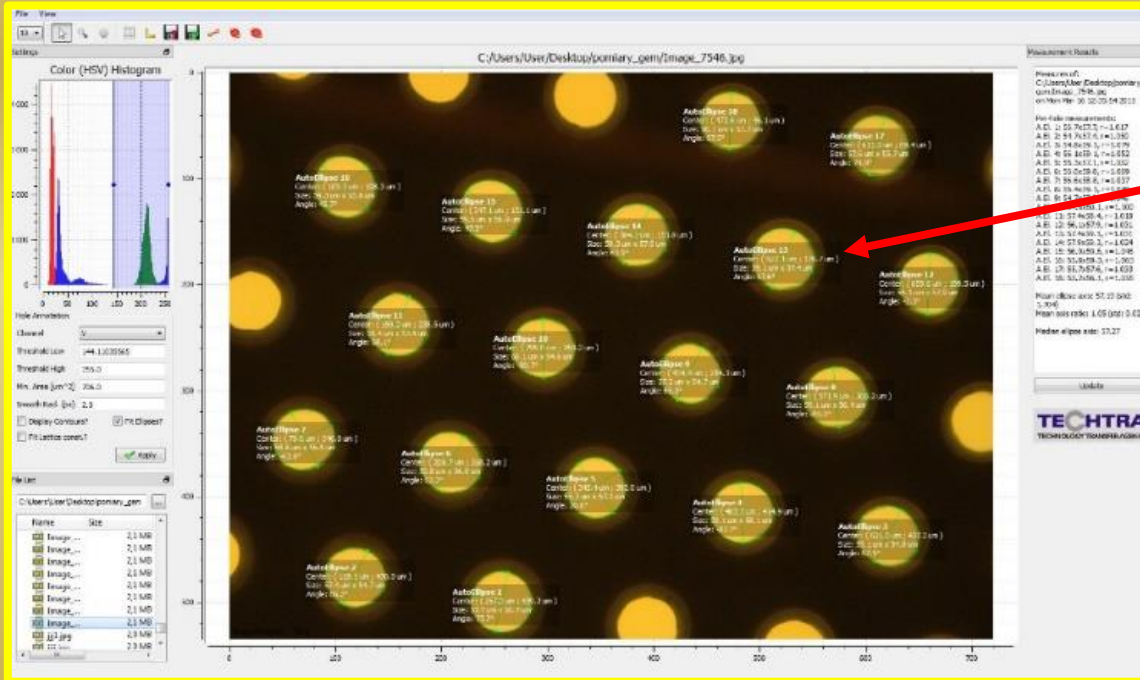
- Exchange of baths is necessary

Two companies are ready to dispose old baths set and to design, build and install a new set of Kapton etching bath, fumes extractors, wasted water treatment station, ect.

Techtra would like to established a collaboration dedicated to beam tests of our big GEMs. The validation should involve:

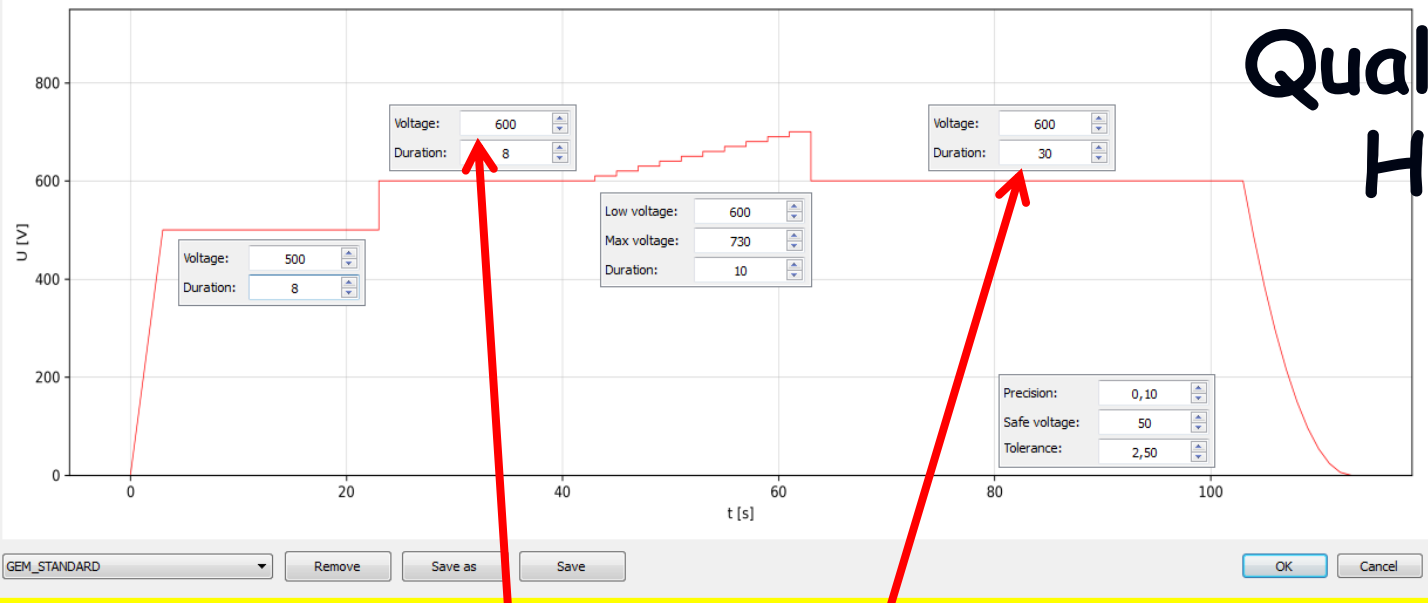
- Gain mapping
- Gas leakage testing
- Mechanical assembly tests, ect.

# Quality check: optical measurements

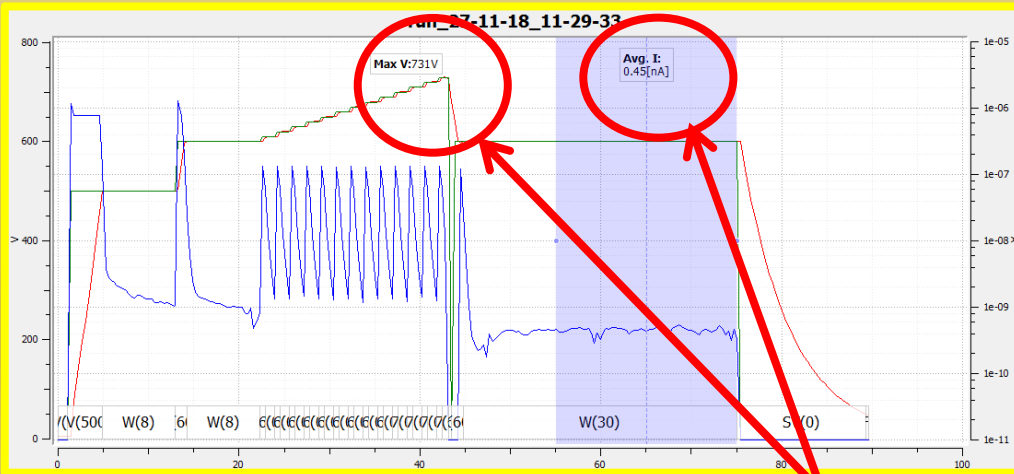


Local uniformity test

# Quality check: HV tests



All testing steps parameters (voltage value, time of each step, ect.) can be set independently.

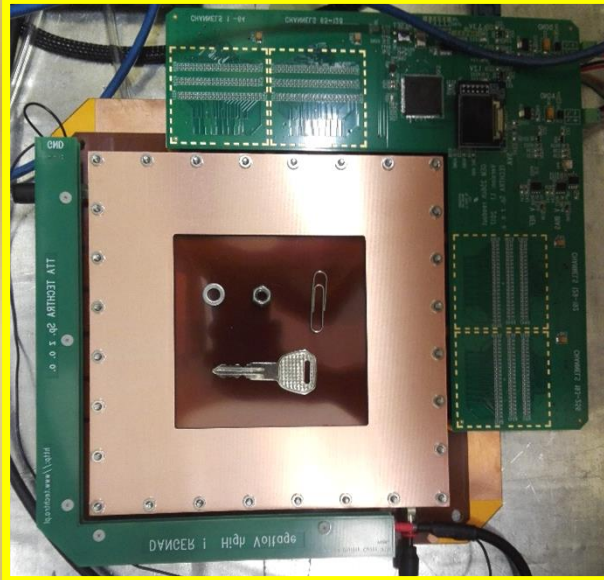


@30 %HR Leakage current  
below 1nA @100cm<sup>2</sup> @600V

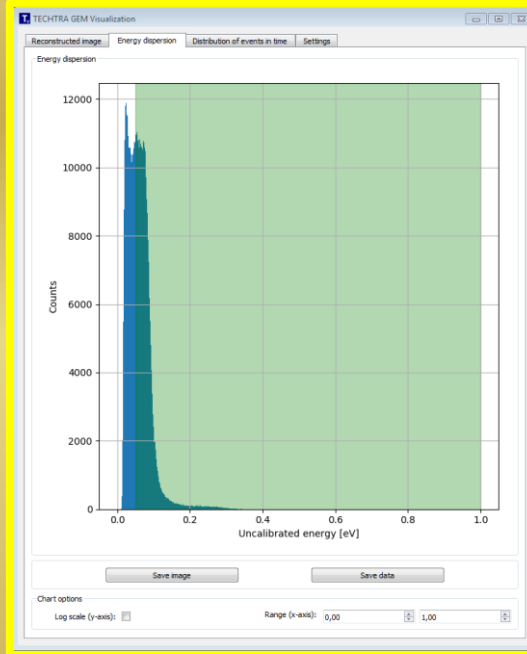
HV testing stand

RD51, 5 Dec. 2018

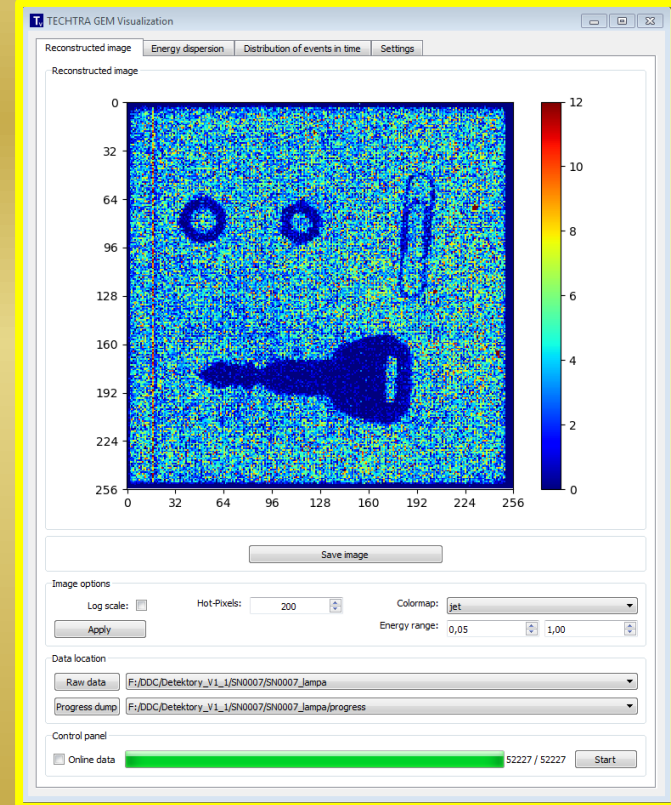
# GEM detectors sets @ Techtra



Commercially available detector.



Data visualization software - window with spectral graph



Data visualization software - main window

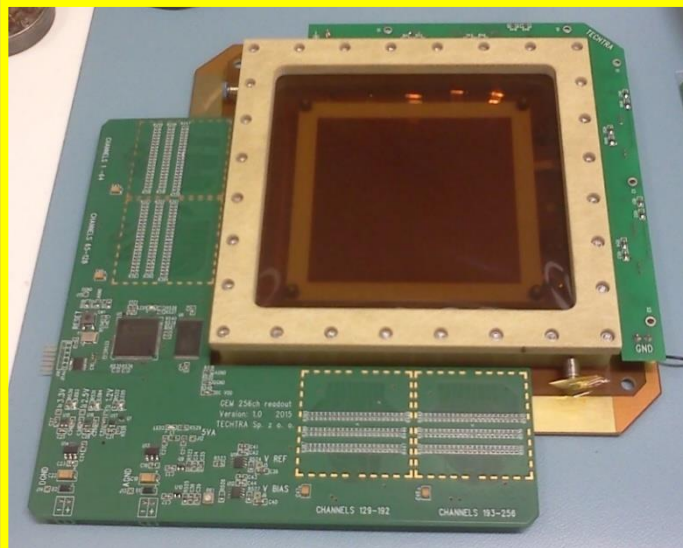
# Our Core GEM-team



EUROPEAN UNION  
EUROPEAN REGIONAL  
DEVELOPMENT FUND



## RD51 collaboration



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