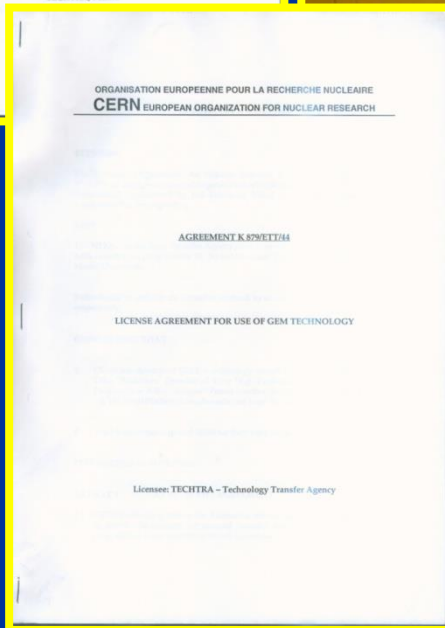
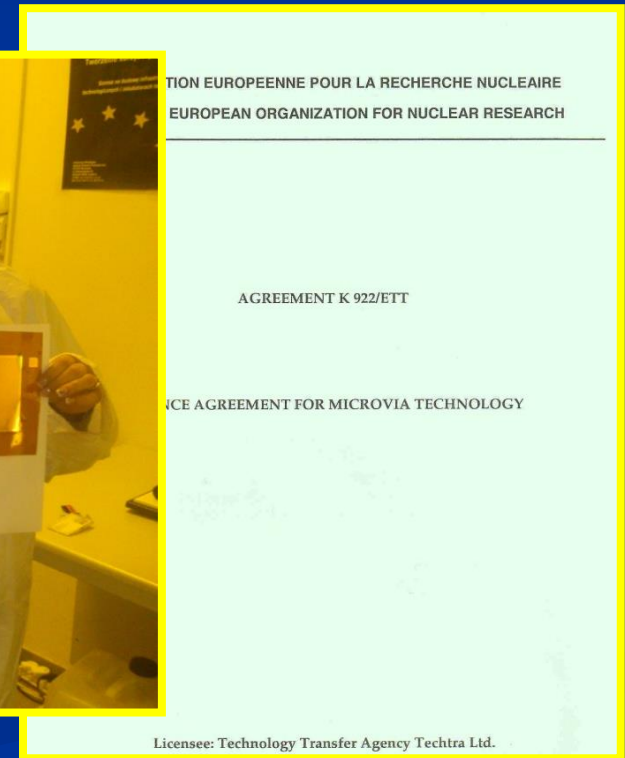
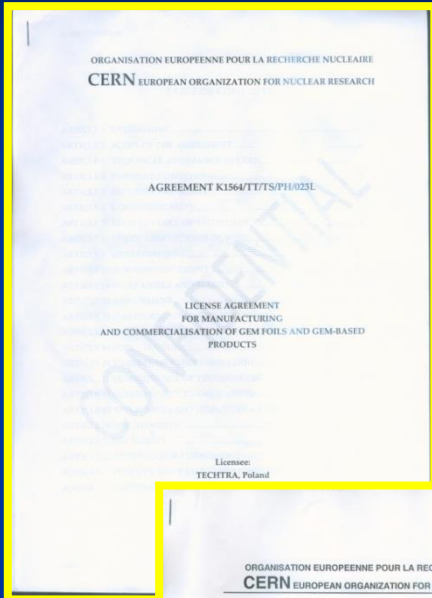




GEM foils production
&
Commercial GEM based detection system

Michał Babij & Piotr Bielówka

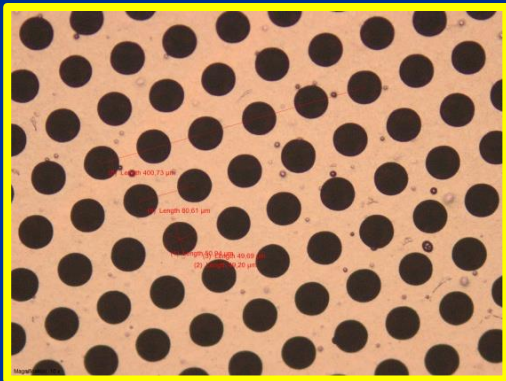
The beginning: December 2002



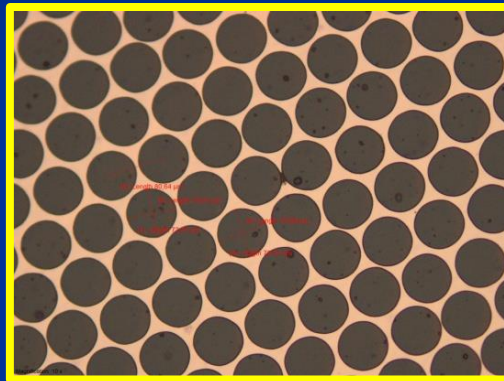
GEM manufacturing upon CERN licence

RD51, Trieste, Oct. 2015

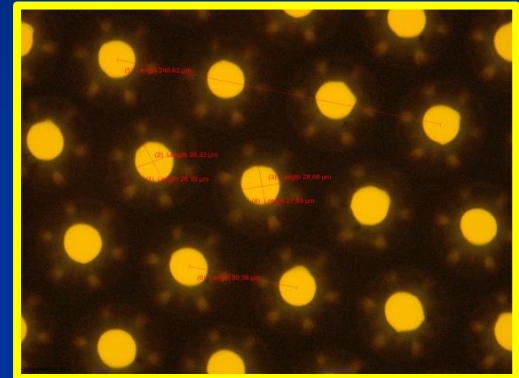
Customizing GEM layouts:



$\varnothing 50\mu\text{m}$, pitch: $80\mu\text{m}$



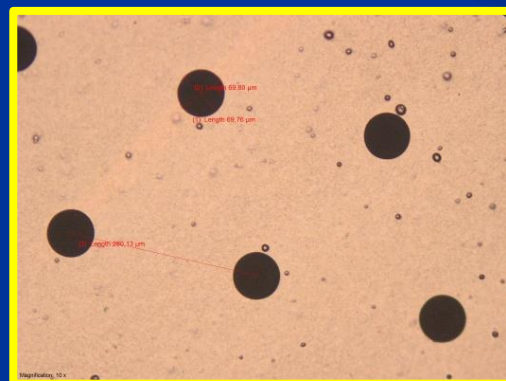
$\varnothing 70\mu\text{m}$, pitch: $80\mu\text{m}$



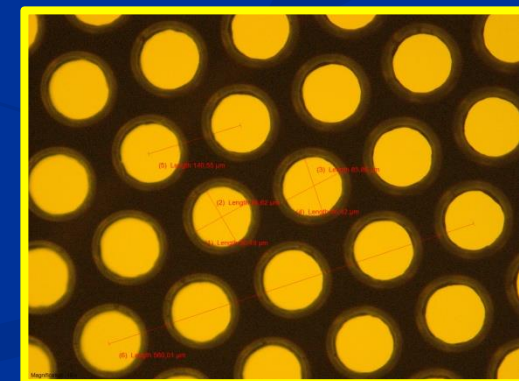
$\varnothing 30\mu\text{m}$, pitch: $80\mu\text{m}$



$\varnothing 50\mu\text{m}$, pitch: $280\mu\text{m}$



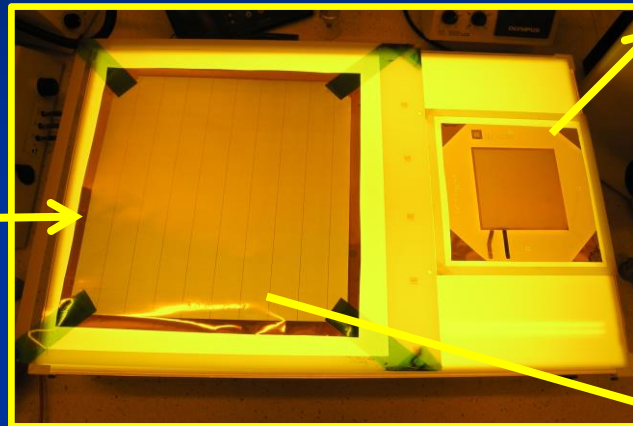
$\varnothing 70\mu\text{m}$, pitch: $280\mu\text{m}$



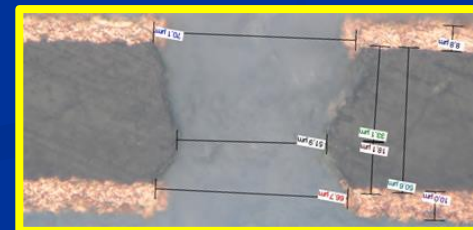
$\varnothing 90\mu\text{m}$, pitch: $140\mu\text{m}$



Prototype etching machine



10x10cm² Double Mask

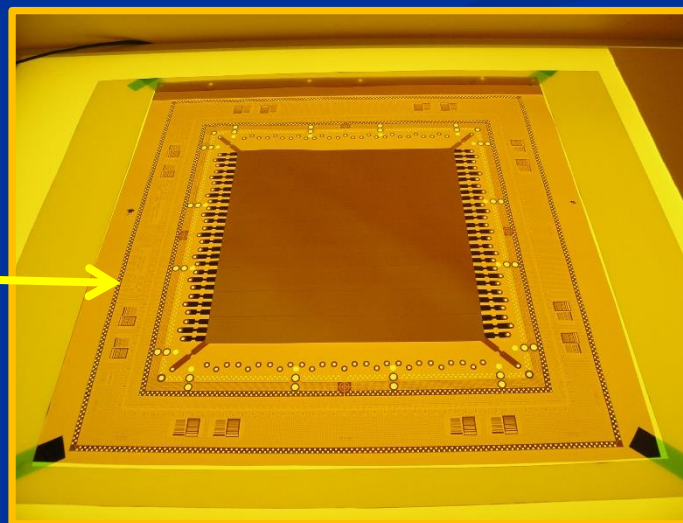


30x30cm² Single Mask

Manufactured:
16.10.2015 1.06 pm

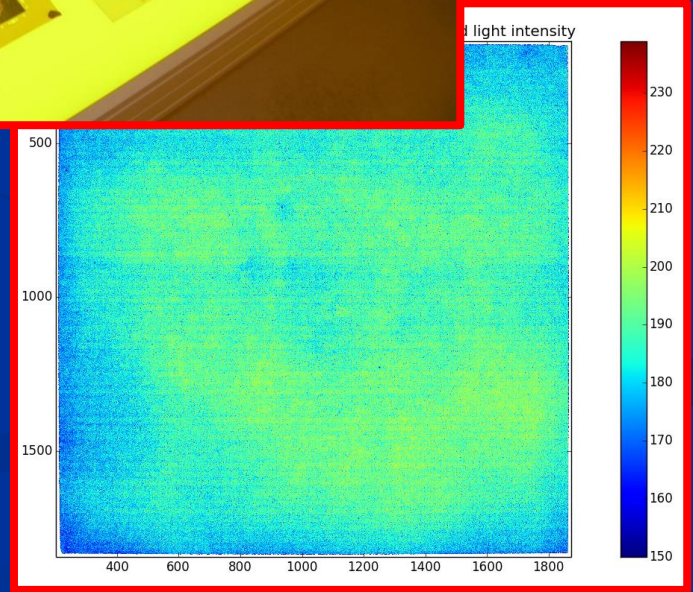
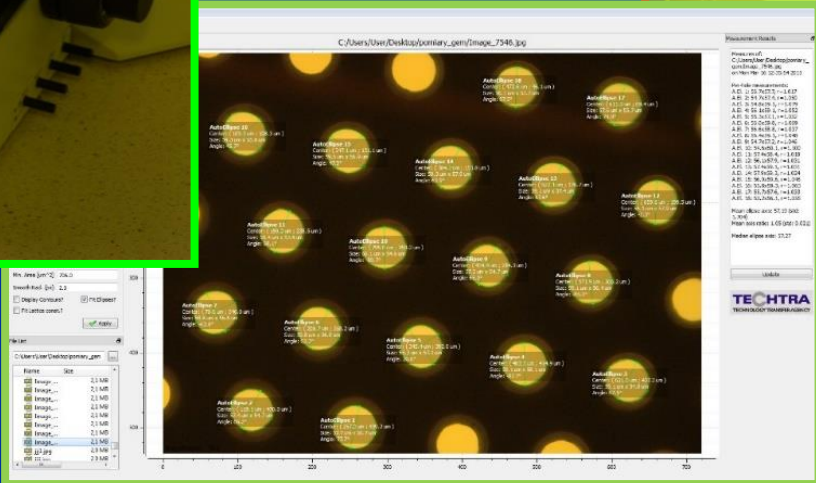
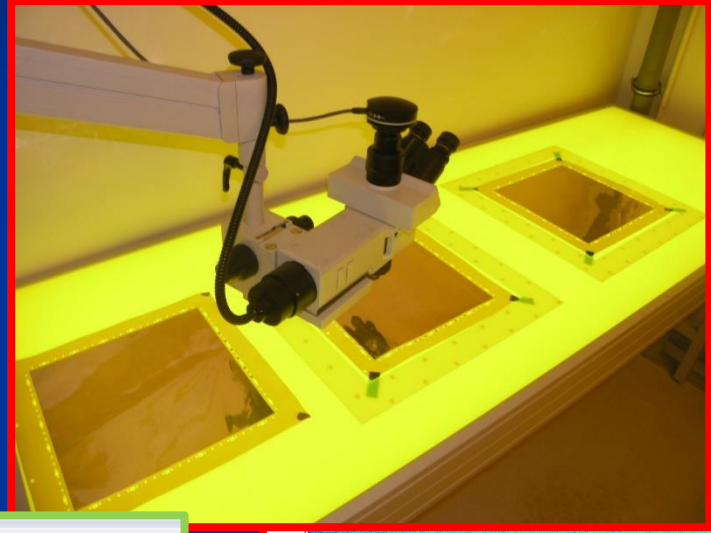
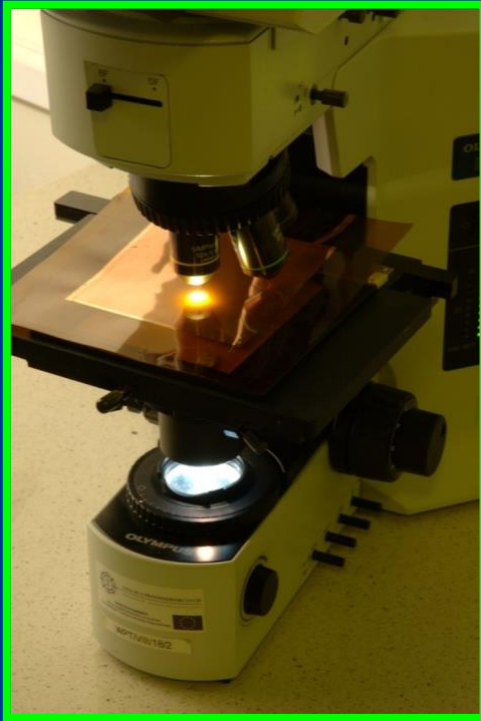


Industrial etching machine



Automated optical measurements

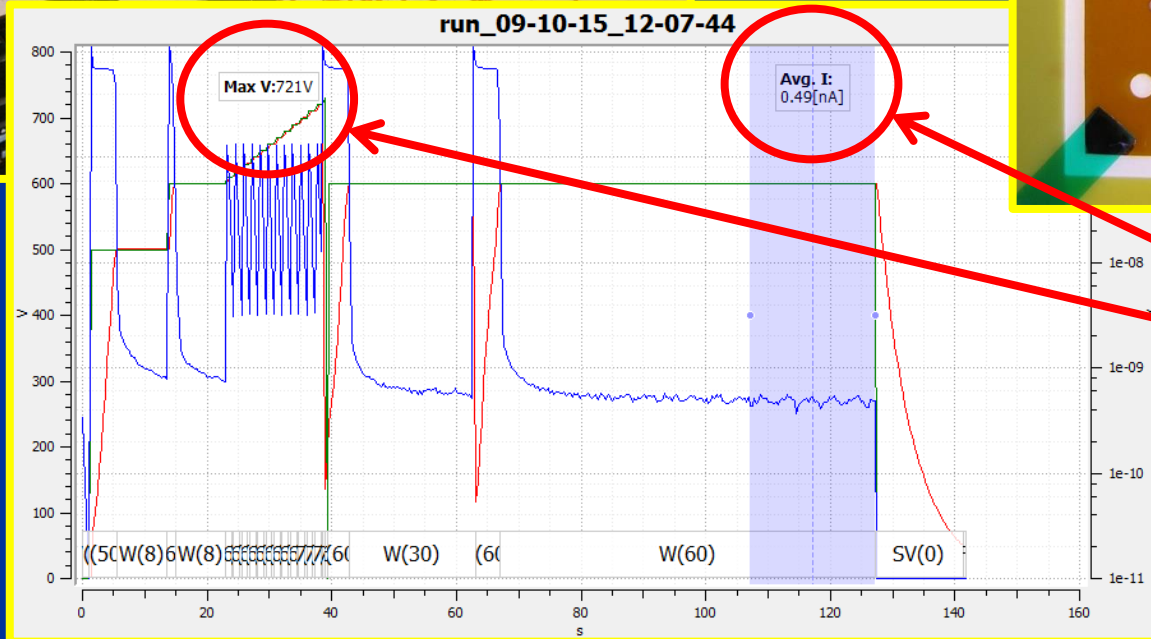
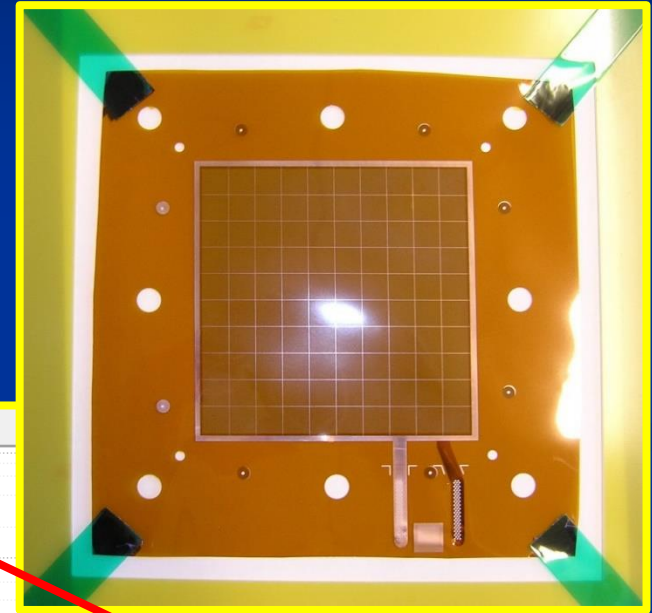
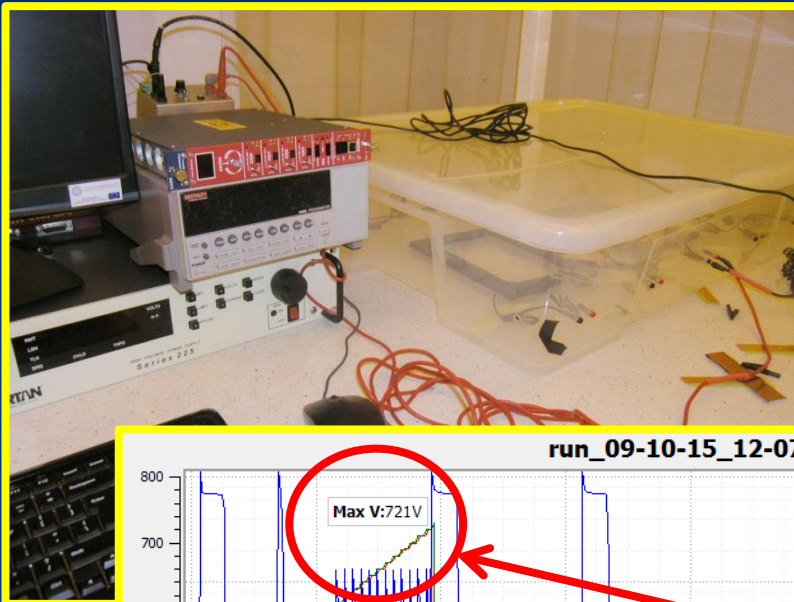
Global uniformity test



Local uniformity test

RD51, Trieste, Oct. 2015

Leakage current measurement stand.

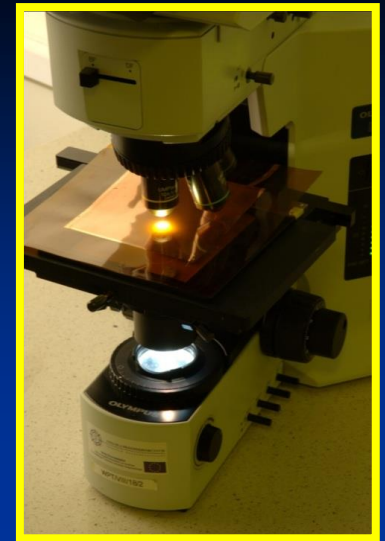


Leakage current below
1nA @100cm² @600V
@30 %HR

Offer:

Single and double mask GEMs upto :

- GEM boards size: up to: about 0,55x1,5m²
- Holes diameter in copper: 70 μ m +/-5 μ m
- Holes diameter in kapton: 50 μ m +/-5 μ m
- Leakage currents: below 2nA @ 600V @ 30% HR @ 10x10cm²



Possible changes:

- Different sizes, shapes,
- Different openings diameters
- Different layouts, pitches

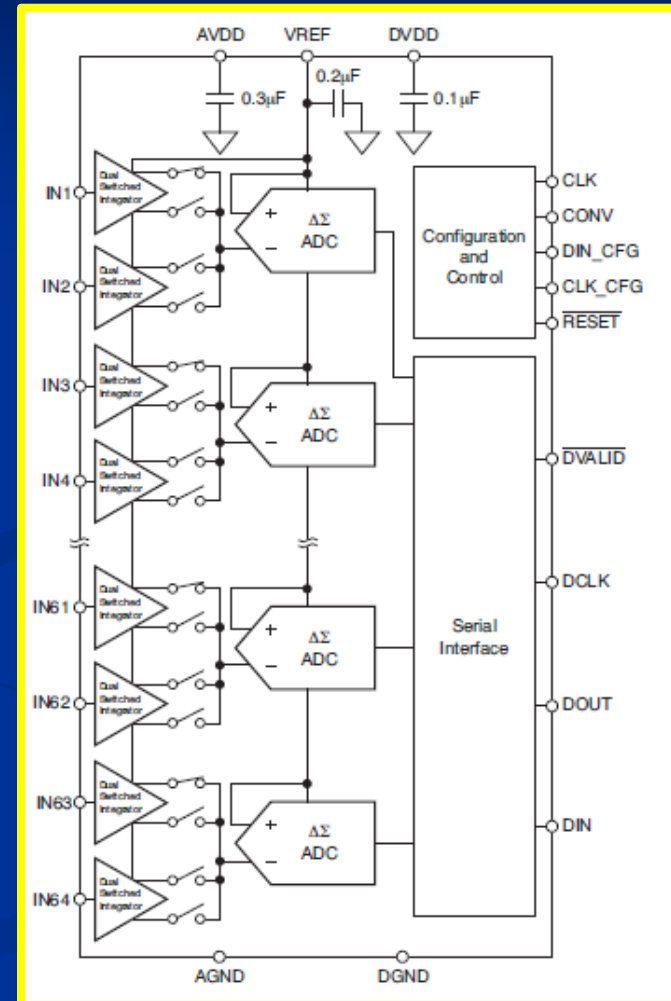
We have to gather more experience at big GEM boards production.



Commercial GEM based detection system

DDC264 IC's:

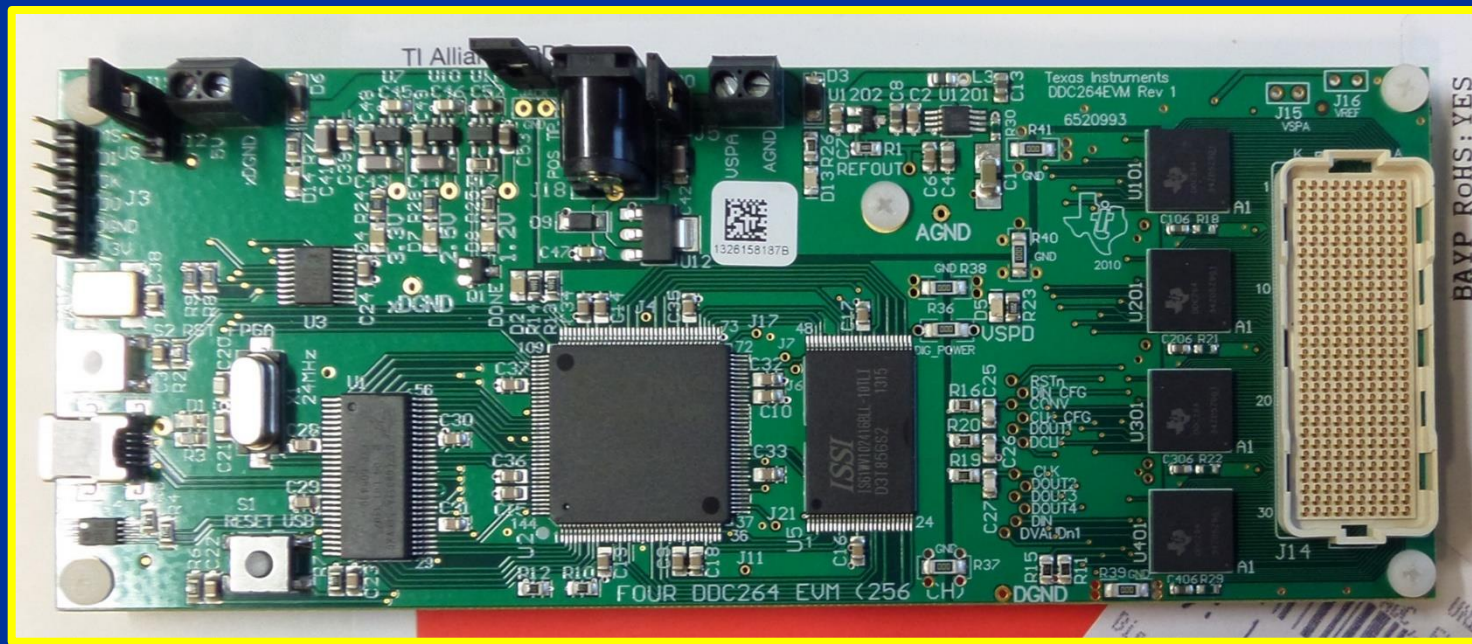
- 64 current channels simultaneously measured into single chip,
- Noise level : 6,3 ppm of FSR (0,2 fC in 12,5pC range),
- 20-bit Sigma-Delta converters
- Inlinearity: +/- 0,025% of reading, +/- 1% of FSR,
- Minimum integration time: 160 μ s (6,25 kHz)GEM,
- Every channel consist of two switched integrator front-end,
- SPI digital interface,
- Enables continuous measurement without triggering.



<http://www.ti.com>

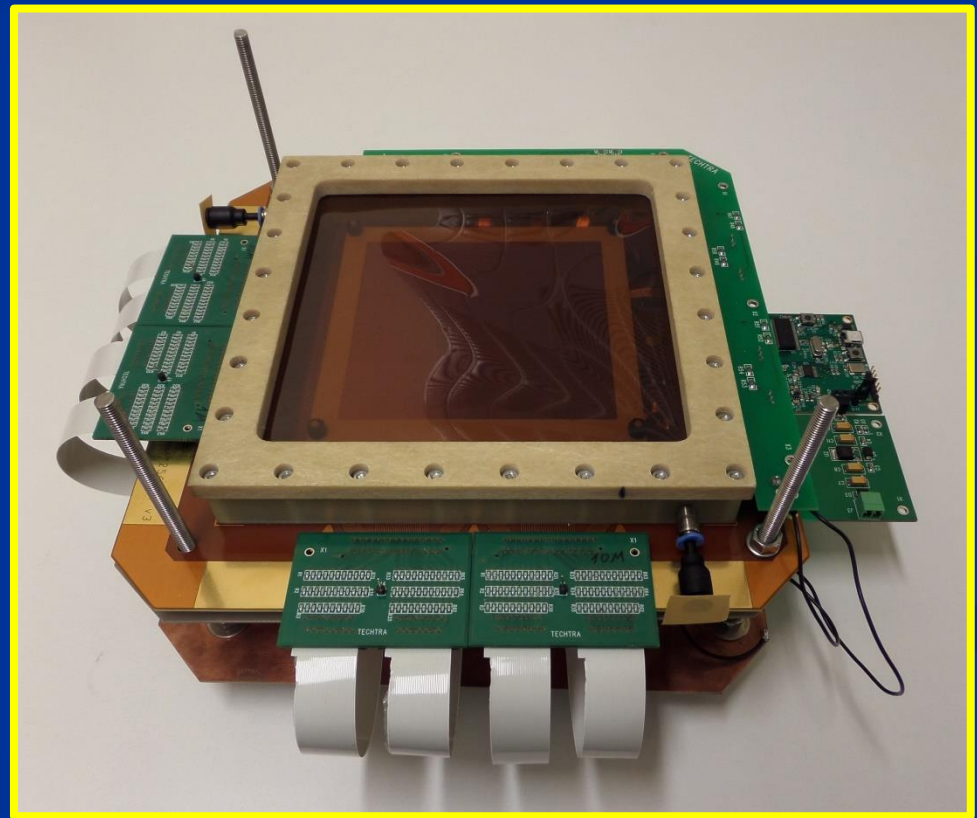
DDC264 Evaluation module:

- Consist of 4 DDC264 IC's, Spartan 3 FPGA controller and USB communication module,
- Allows to measure 256 channels and send data to PC computer.

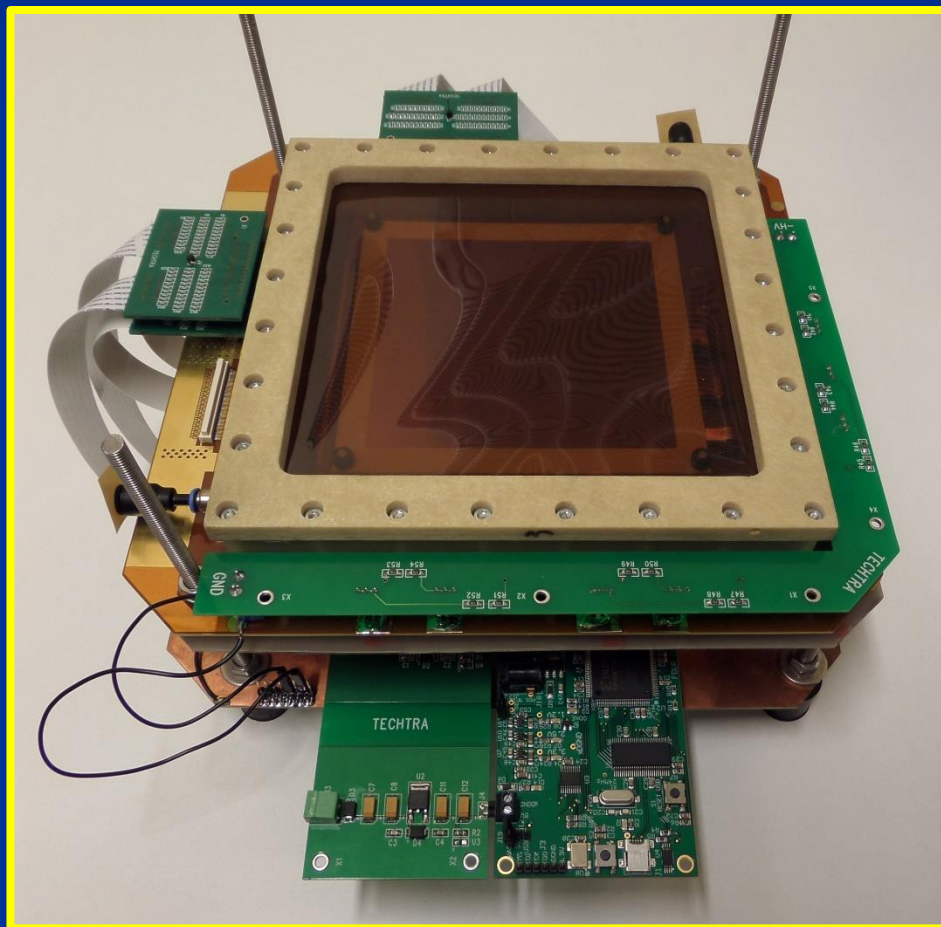


256 channels prototype GEM readout system:

- GEM detection system suitable for standard CERN 10x10 cm 256 CH's detector kit,
- Low noise amplitude: $\sim 2fC$,
- This version allows to measure of every second line on a readout system,
- Polarization resistors allows to charge injection to every measuring channel,
- The system contains its own voltage regulators - accepts supply voltages from 8V to 20V.

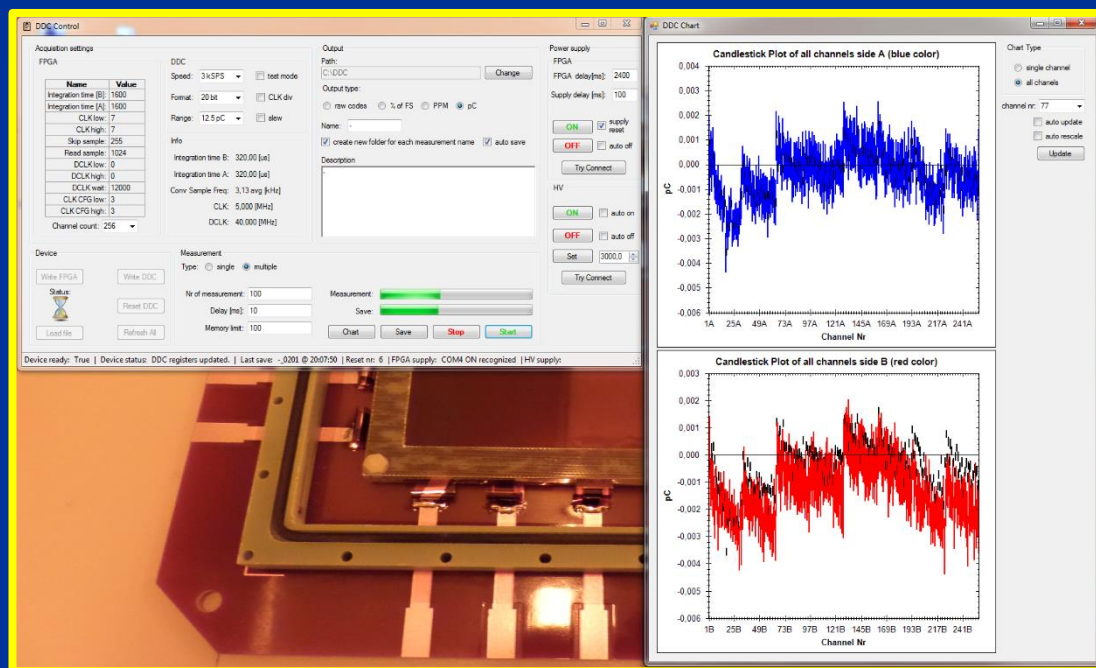


256 channels prototype GEM readout system:



PC application for prototype GEM readout system:

- PC application for controlling our GEM detection system,
- Allows to perform single or multiple measurements,
- Enables plotting signal in time for the selected channel, or box plot of signal parameters for every channel,
- All the measurement data is stored on HDD.



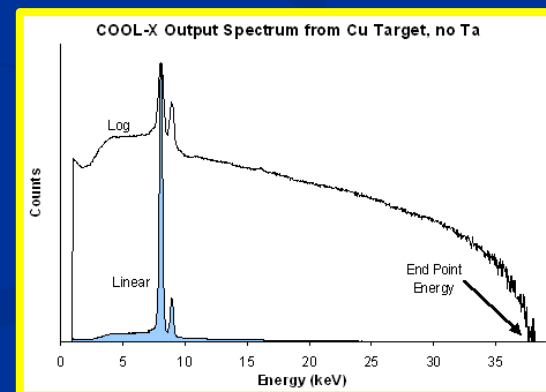
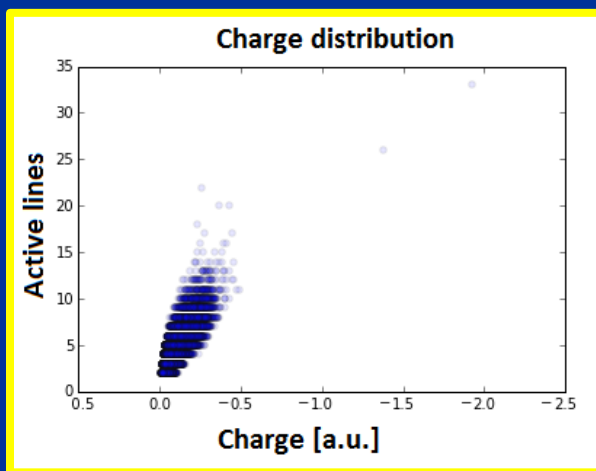
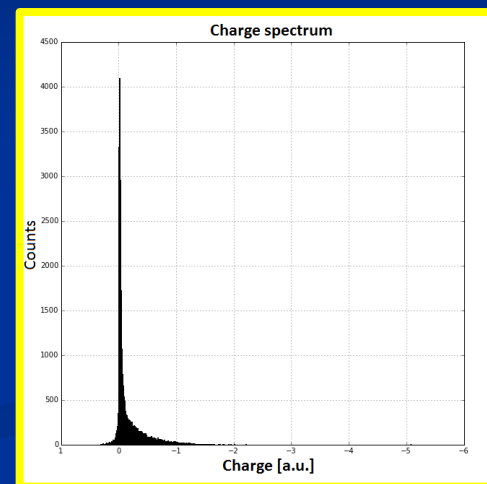
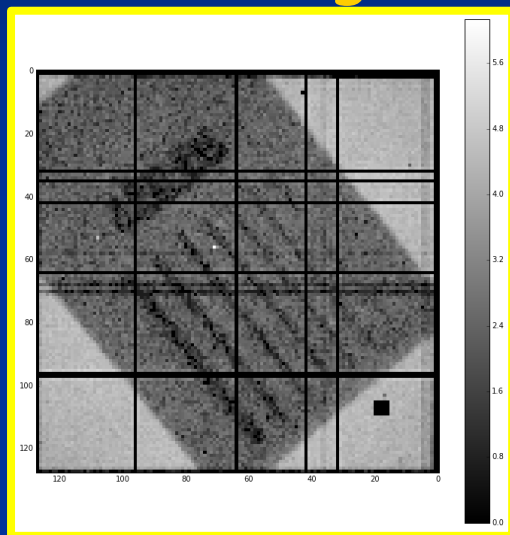
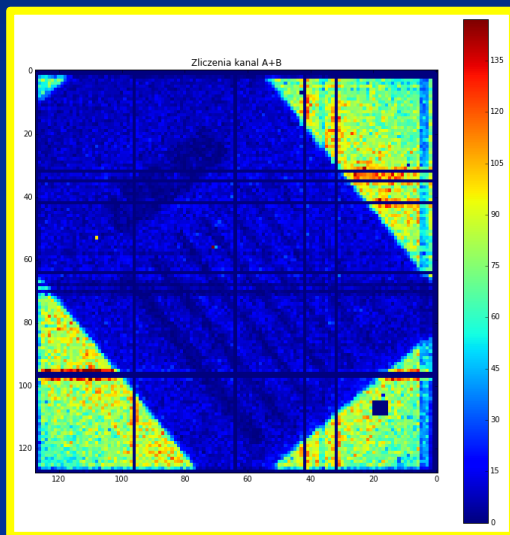
TECHTRA GEM readout board noise:

The screenshot displays the DDC Control software interface, which is used for configuring and monitoring the readout board. The interface is divided into several sections:

- Acquisition settings:** Includes FPGA parameters (Name, Value), DDC Speed (3 kSPS), Format (20 bit), Range (12.5 pC), and Info (Integration time B: 320.00 [us], Integration time A: 320.00 [us], Conv. Sample Freq.: 3.13 avg [kHz], CLK: 5,000 [MHz], DCLK: 40,000 [MHz]).
- Output:** Shows Path (C:\DDC), Output type (raw codes, % of FS, PPM, pC), Name, and Description.
- Power supply:** Includes FPGA delay (2400), Supply delay (100), and HV (ON/OFF) controls.
- Measurement:** Shows Type (single/multiple), Nr of measurement (100), Delay (10), and Memory limit (100).
- Device:** Includes Write FPGA, Write DDC, Load file, and Refresh All buttons.
- DDC Chart:** Displays two channel line plots: Channel Line Plot side A (blue color) and Channel Line Plot side B (red color). Both plots show noise levels (pC) over 600 samples, with values ranging from approximately -0.010 to 0.015 pC.

At the bottom of the software window, the status bar indicates: Device ready: True | Device status: DDC registers updated. | Last save: --:0161 @ 20:04:35 | Reset nr: 4 | FPGA supply: COM4 ON recognized | HV supply:

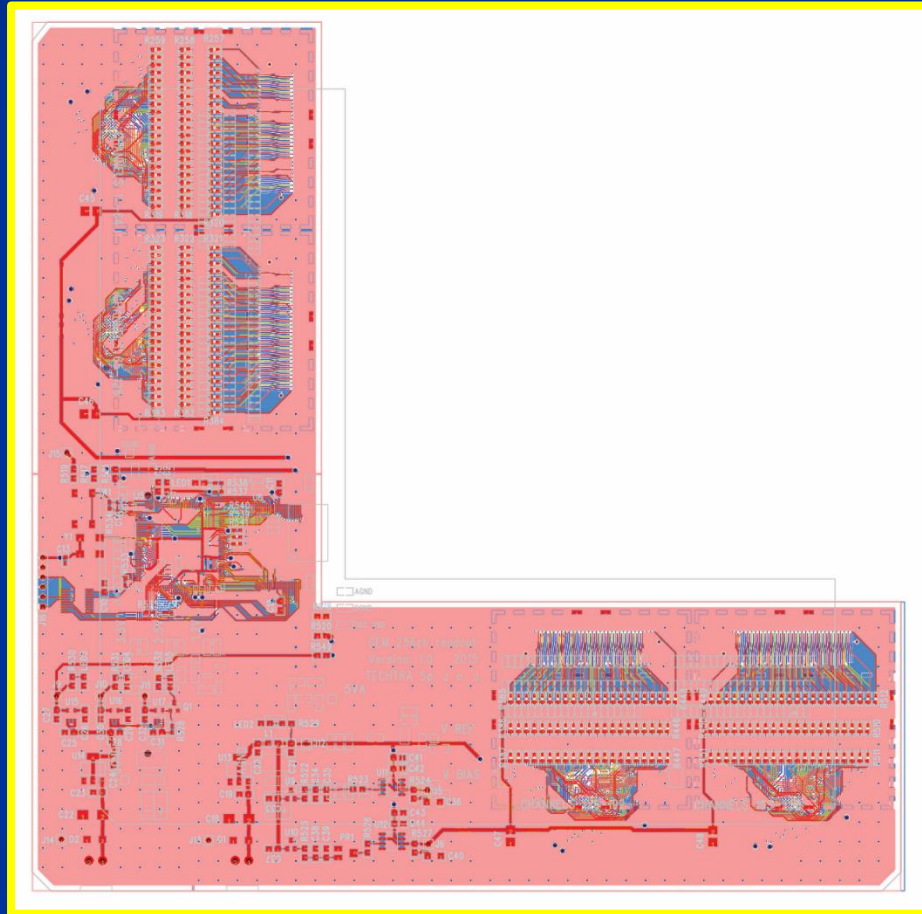
First results - images of wire indicator:



<http://www.amptek.com>

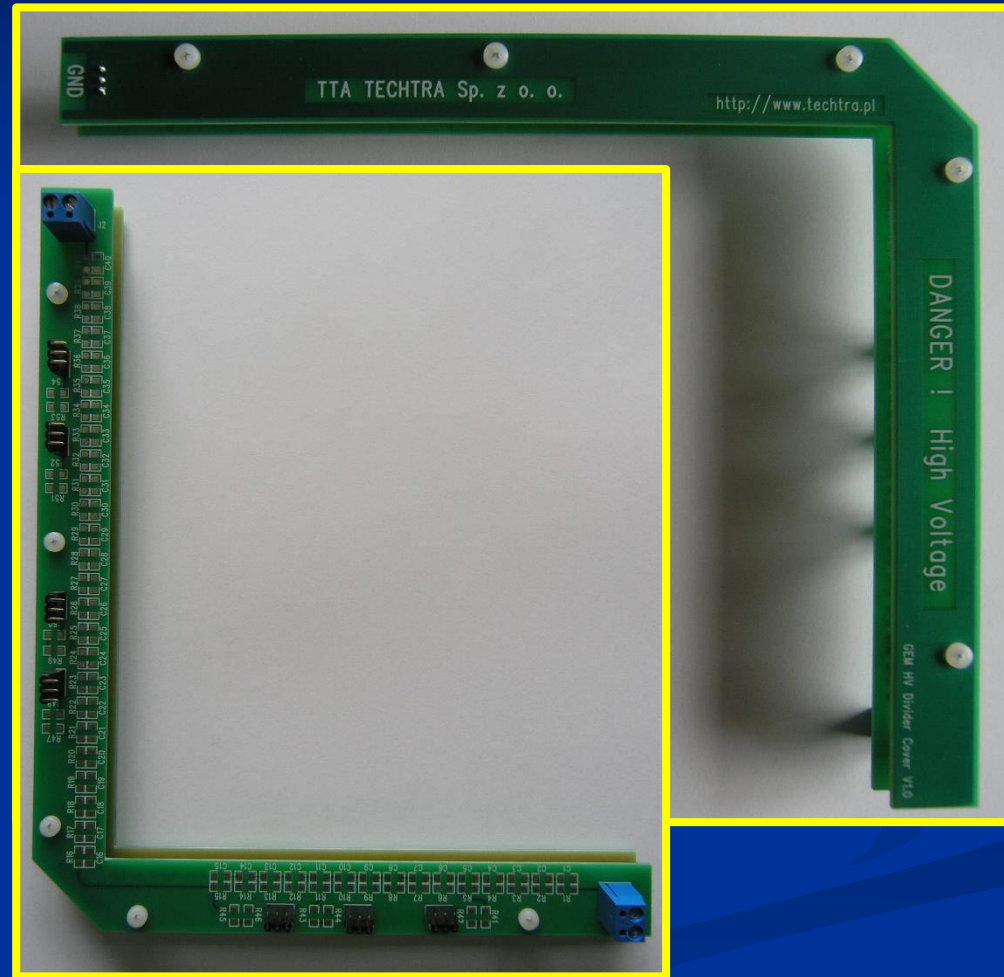
Our new readout project:

- Fully compatible with CERN 10x10 cm 256 CH's detector kit,
- Fully integrated: input circuits, DDC264 readout, FPGA, USB/Ethernet communication and power supply,
- Board is supply with two 8V positive DC voltages sources,
- Use 4 Panasonic connectors to get signals from detector board,
- Low noise, low power consumption, low size,
- Enables fast research startup,
- Plug & play.



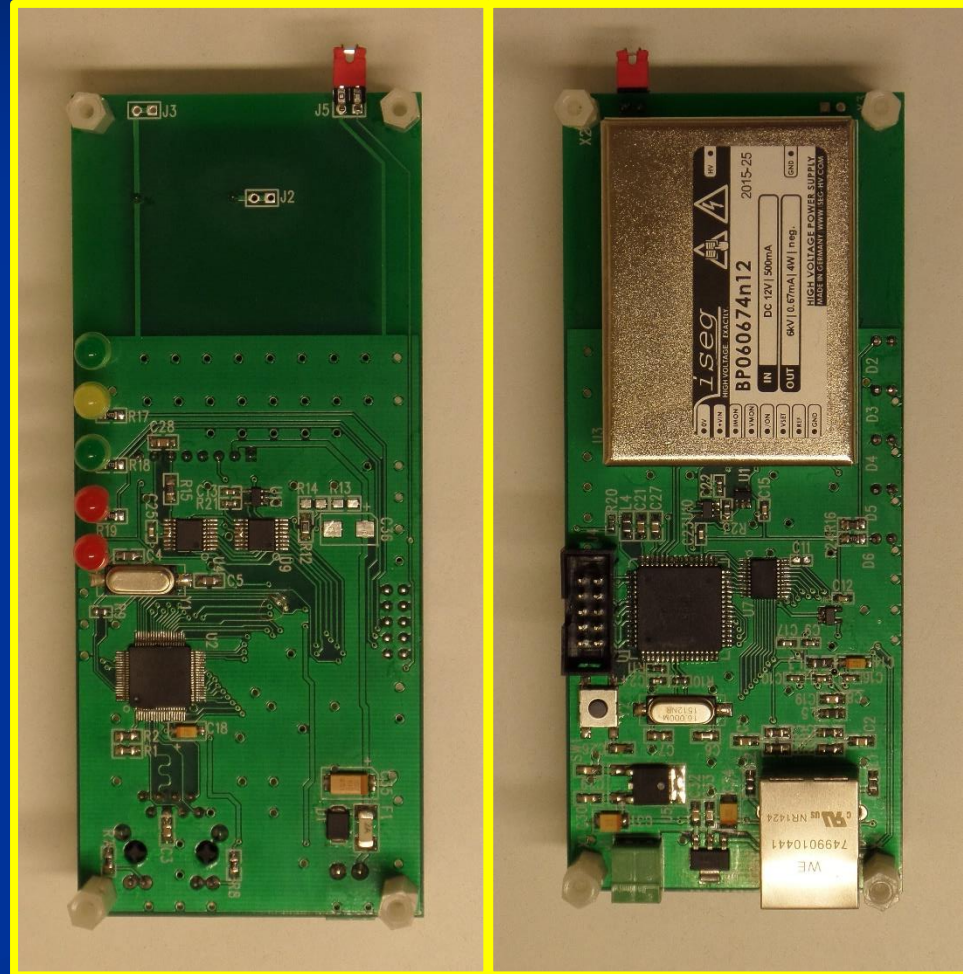
High voltage divider:

- Provide suitable polarization of GEM boards inside standard 10x10 cm GEM detector,
- Mounted directly on XY readout boards using goldpin connectors,
- Delivered with GEM voltages and polarization current specified by the customer.



High voltage power supply:

- Single 12V DC supply,
- Ethernet communication (PC computer controlled),
- Up to 6kV negative output voltage,
- Up to 0,65 mA output current
- Low noise level: typical <math><10\text{mVpp}</math>
- small external dimensions: 135x55x40 mm,
- Output overcurrent and short circuit protection,
- Low power consumption: below 15W.



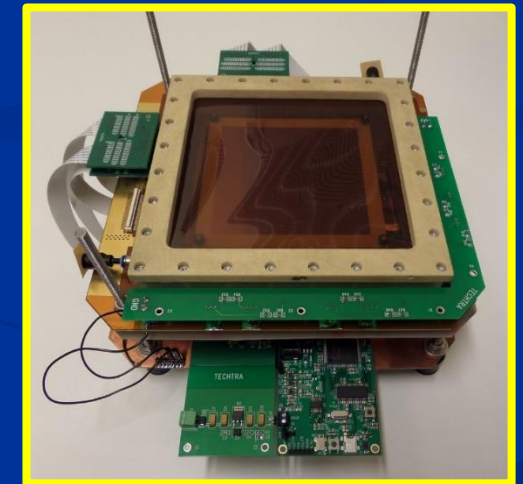
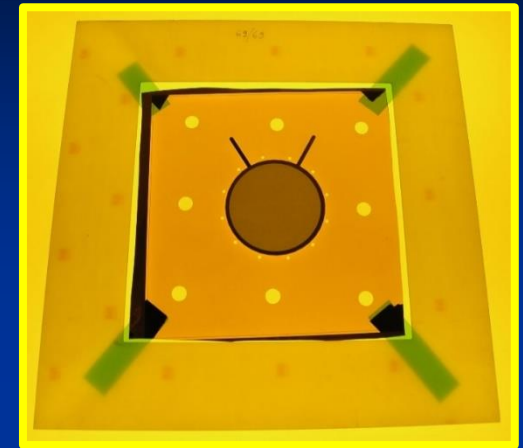
Offer:

- GEM detector fully compatible with CERN XY256 detector kit - in parts or assembled for the customer,
- High Voltage power supply controlled via Ethernet,
- High Voltage divider for GEM's polarization,
- 256 CH's readout system with USB/Ethernet communication module, allows to measure every second line,
- Steel case covered with lead for X-RAY investigations,
- Complete GEM detector system include GEM detector, HV power supply, HV divider, readout system ready to use (plug & play).

In the future:

- 512 CH's readout system allows to measure every single line on detector readout.
- Sealed system for gas circulation and purification.

Our Core GEM Team



TTA TECHTRA Sp. z o.o.
ul. Dunska 13,
54-427 Wrocław, Poland
Tel: +48 71 798 58 85
Fax: +48 71 798 58 86
www.techtra.pl
e-mail: techtra@techtra.pl

RD51

„Dotacje na innowacje”



**INNOVATIVE
ECONOMY**

NATIONAL COHESION STRATEGY

**EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND**

