The XIV-th International School-Conference *The Actual Problems of Microworld Physics*
In Memory of Professor Nikolai Shumeiko

MODULAR TESTING SYSTEM FOR DETECTORS AND FRONT-END ELECTRONICS

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THE AIM:
to create the modular testing system in Minsk

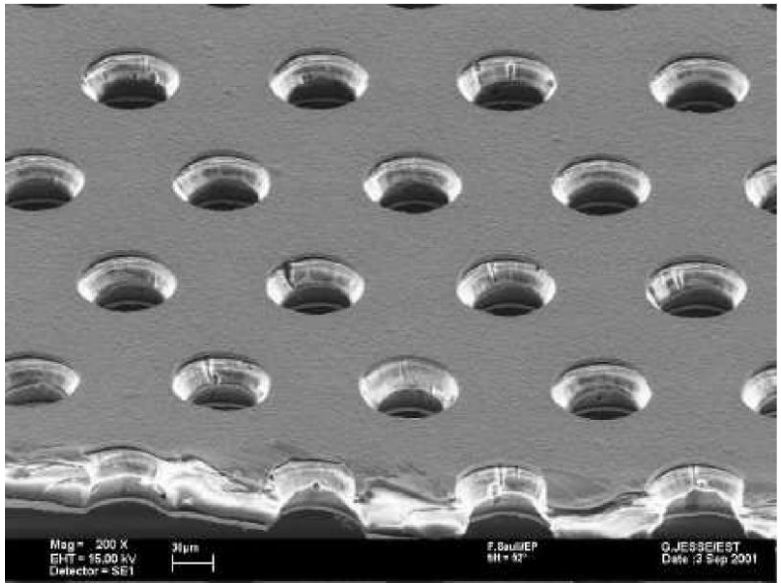
1. System for testing new type gas detectors (GEMs in particular) developed by JINR, INP BSU and Institute of Physics of the NAS of Belarus jointly.

2. System for testing front-end electronics developed by INP BSU for HEP experiments at JINR, CERN, DESY etc.

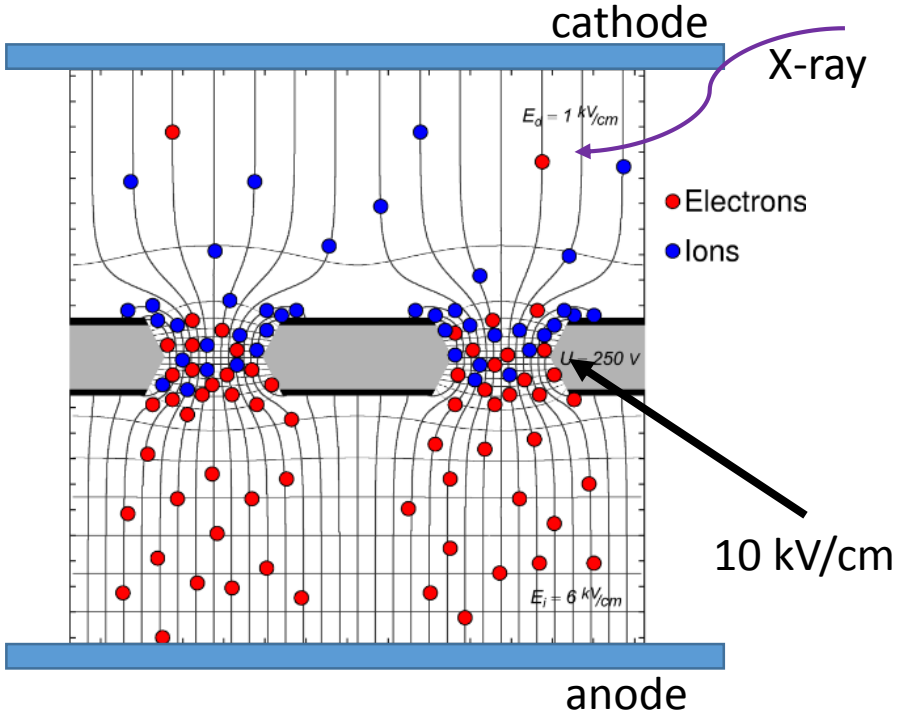
3. Verification of results obtained with testing facility in JINR.

Gas electron multiplier (GEM) detectors are one of the class of **Micropattern gas detectors** including such types as **MicroMegas, MicroStrip Gas Chamber, Micro Pattern Gas Detectors** and other

GEMs were invented in 1997 in the Gas Detector Development Group at CERN by physicist Fabio Sauli.

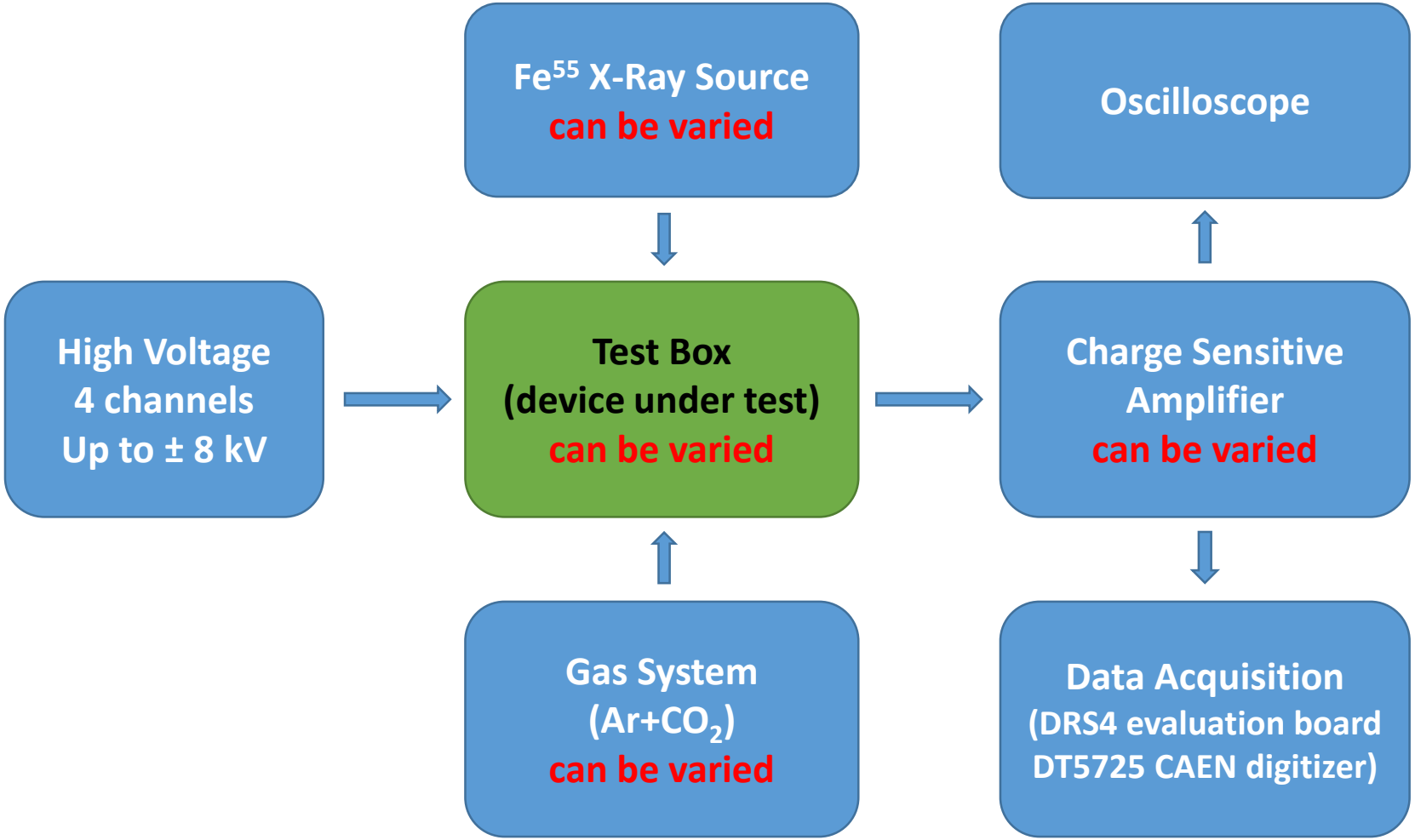


Electron microscope picture of a GEM surface (from CERN GDD group).



Sketch of the working principle of a GEM.

Scheme of modular testing system



Setup for gas detectors study

GEM

Gas tubes

Wire chamber

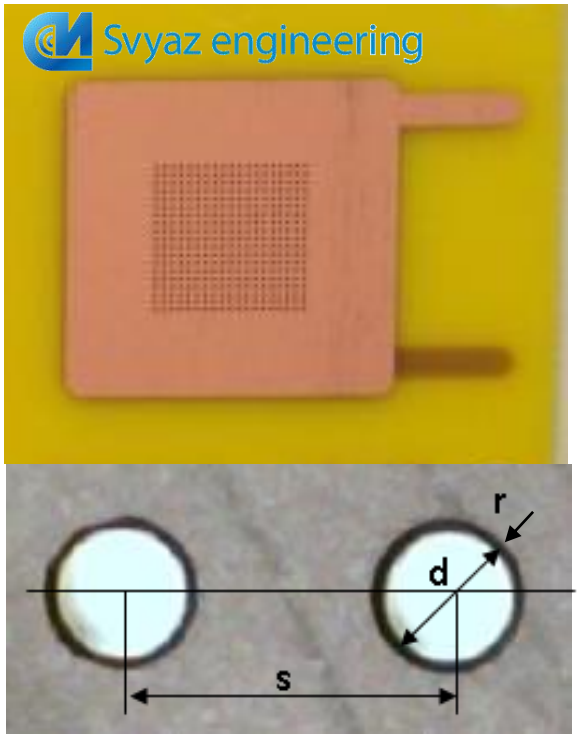
Straw tube

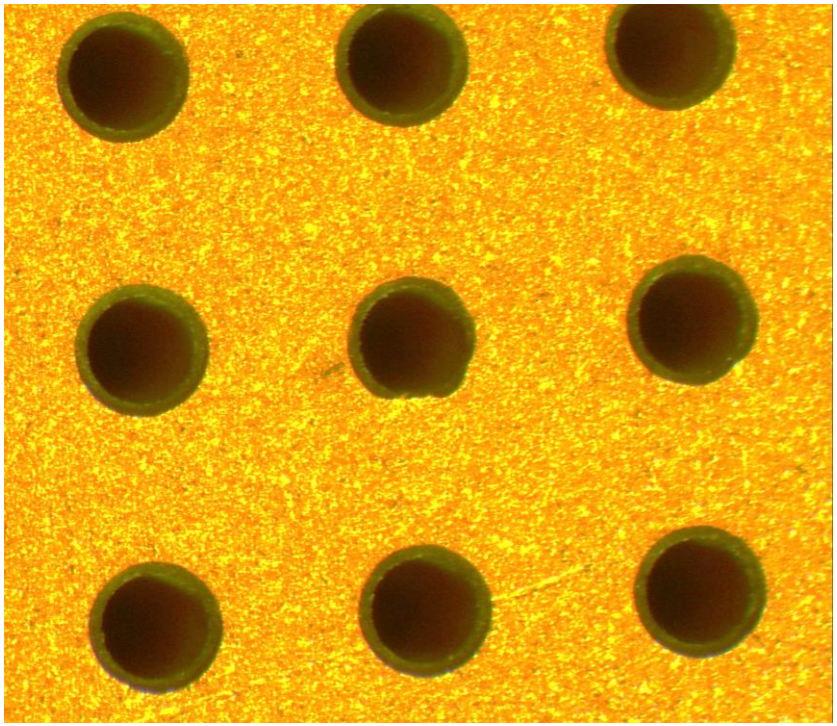
Charge sensitive amplifiers

2-ch MH1XAA010

8-ch MH2XAA020 (KT-N)

Thick Gas Electron Multiplier (THGEM)

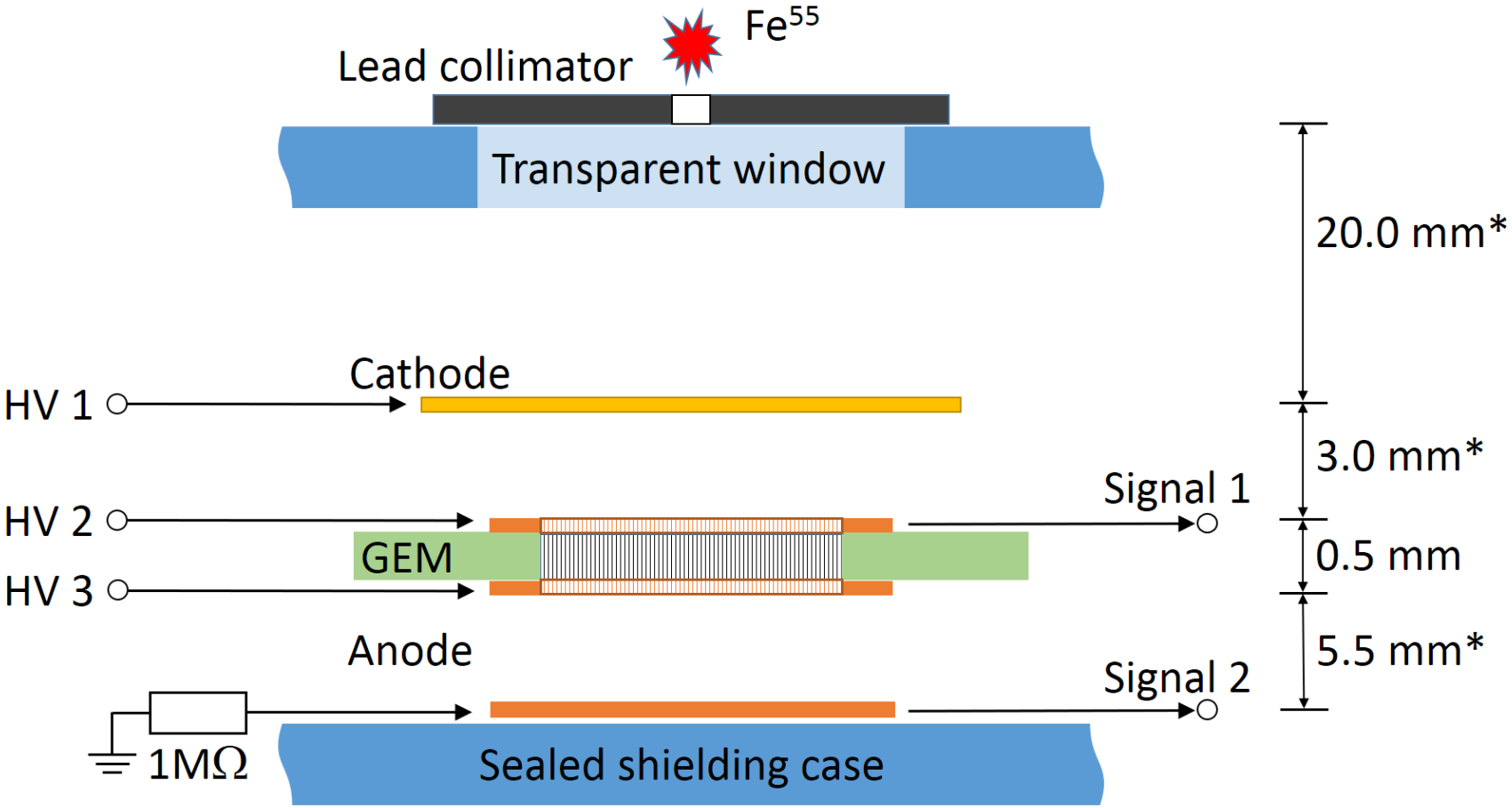




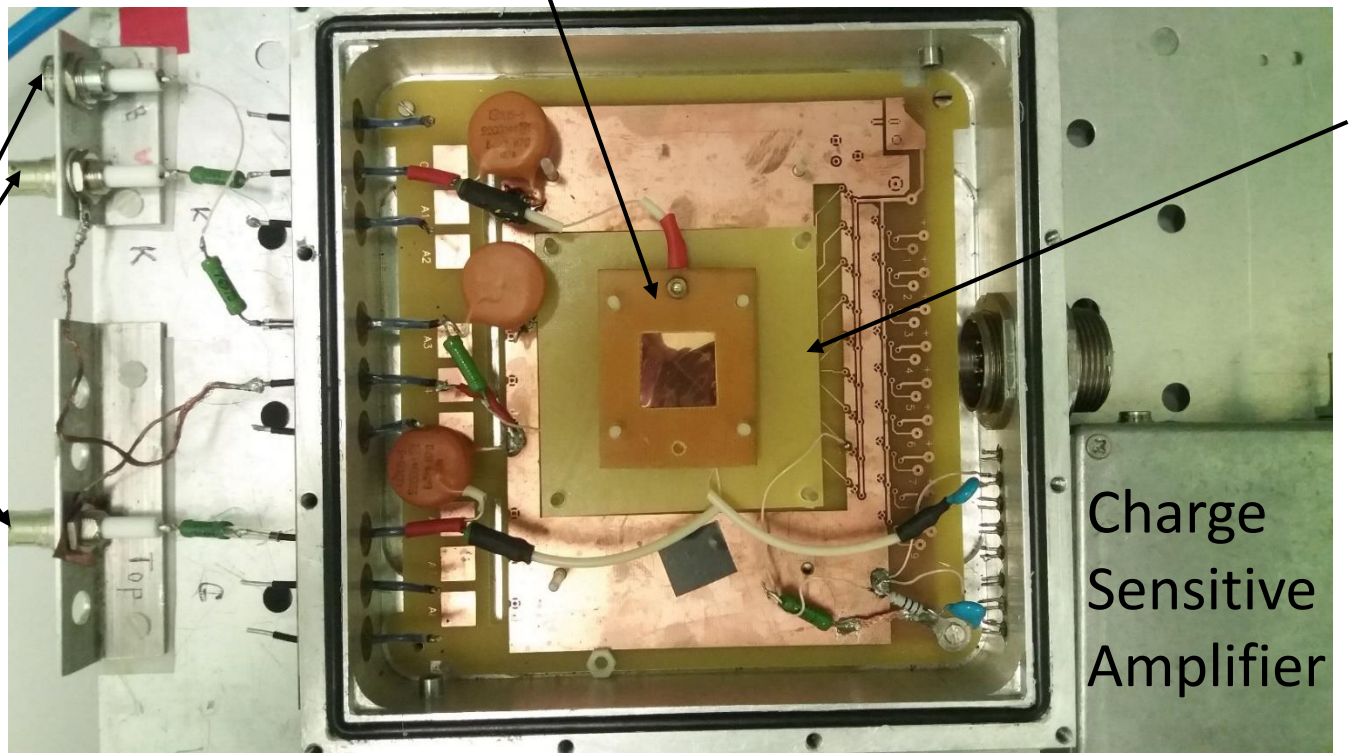
Produced by Svyaz Engineering (Dubna, Russia), 15 pcs tested
Thickness of fiberglass is 0.5 mm
Thickness of copper metallization after etching is 12 μm
Diameter of holes d = 0.2 mm
Distance between holes s= 0.5 mm
Width of rims is 15 μm
Area of THGEM is 10x10 mm^2

Breakdown Voltage Test:
for Ar 90% + CO_2 10% ~1450 V
for Ar 70% + CO_2 30% ~3100 V

THGEM detector scheme with anode readout

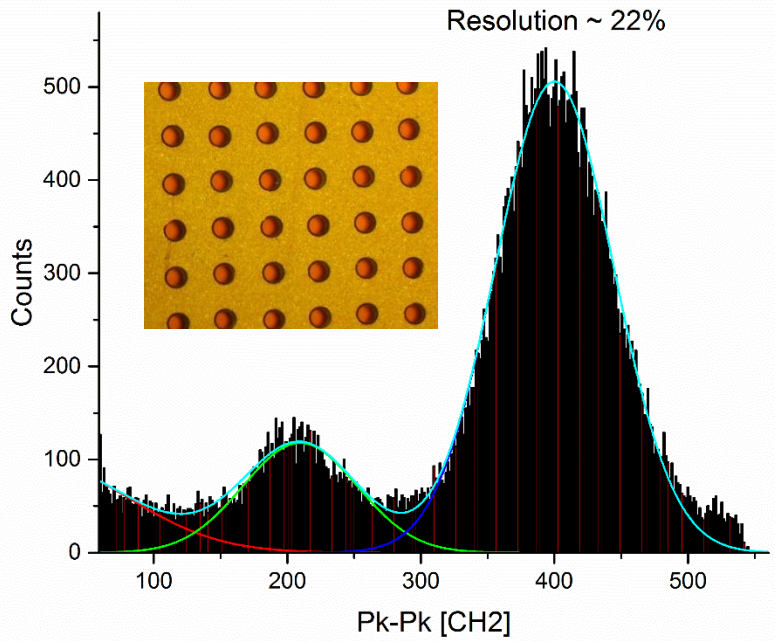


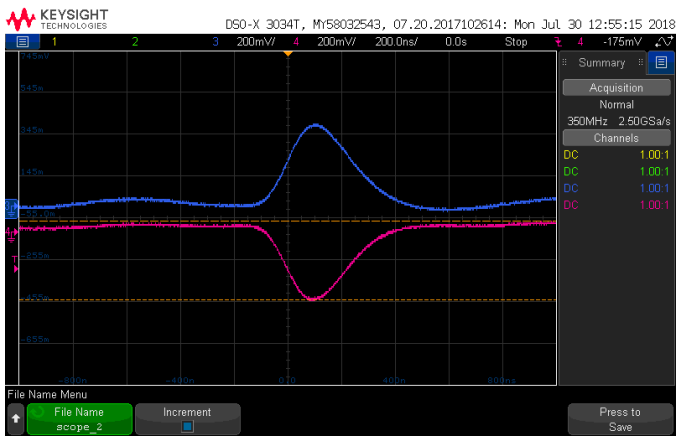
Test module for THGEM detector characterization with readout anode



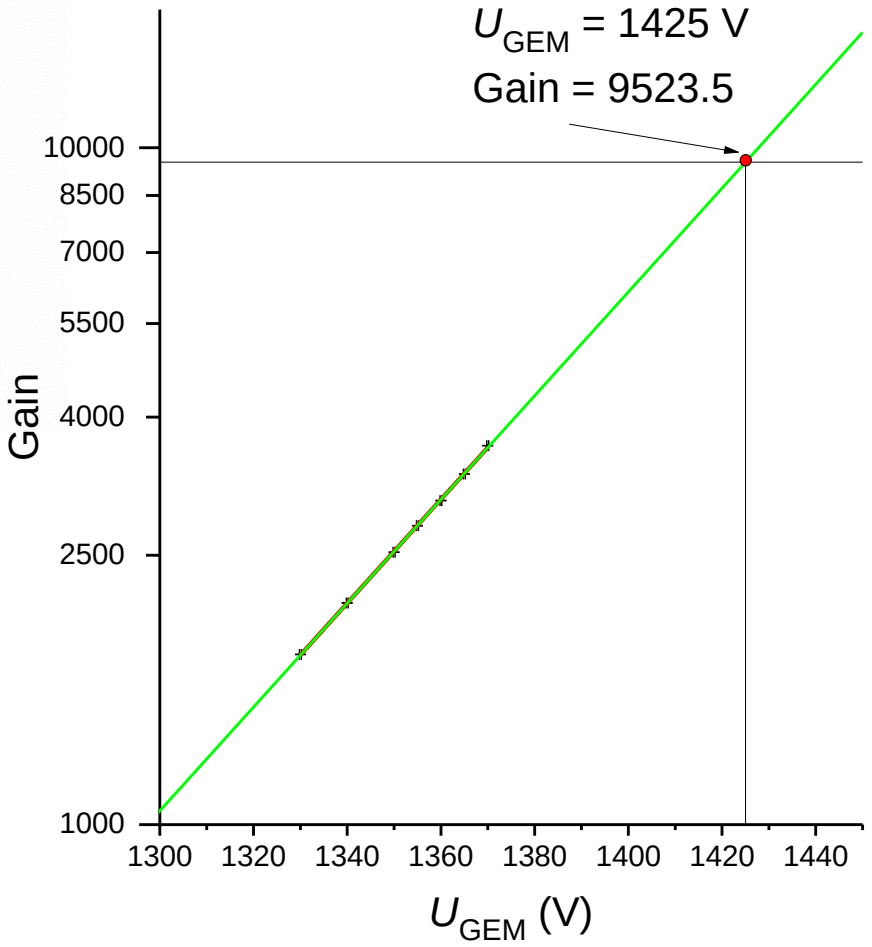
8-ch MH2XAA020 (KT-N)

Spectroscopy results (Fe^{55})

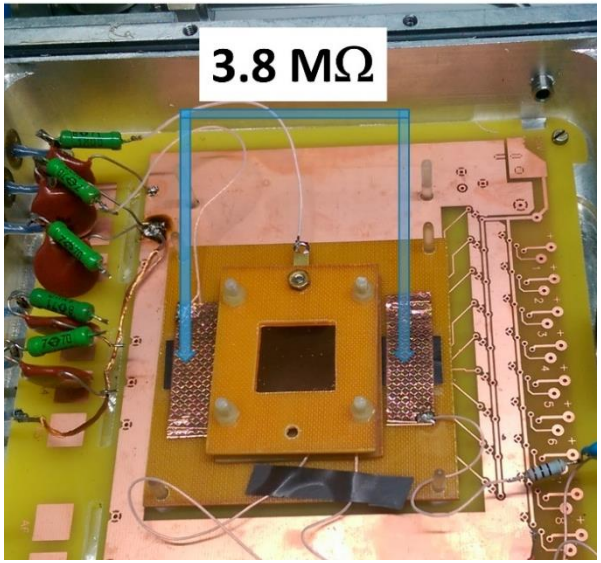


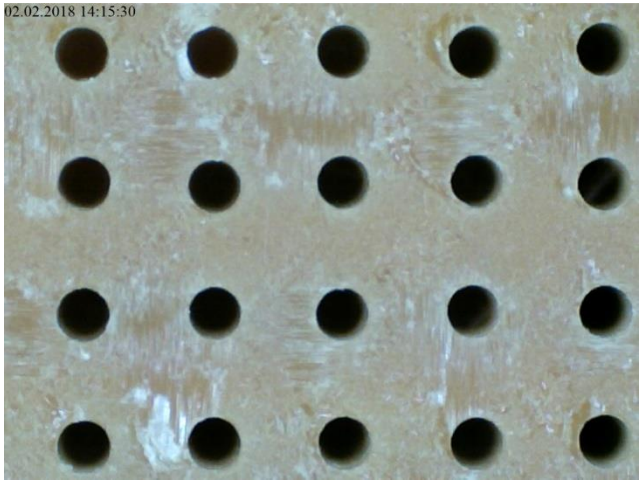


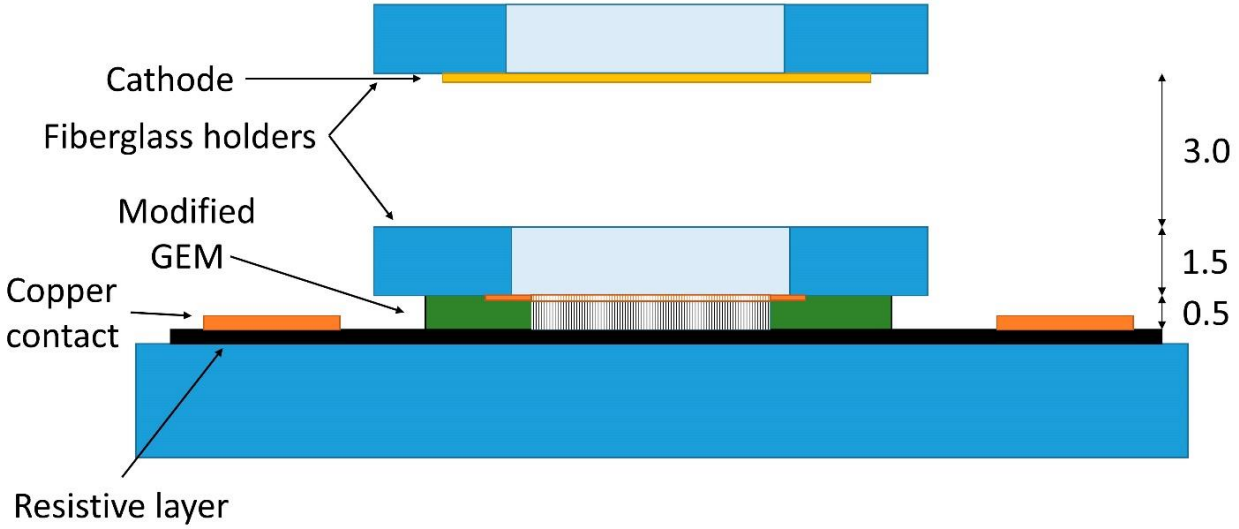
Fe^{55} X-ray source used for testing
5.9 keV main peak
2.9 keV escape peak in Ar



μRWELL dector



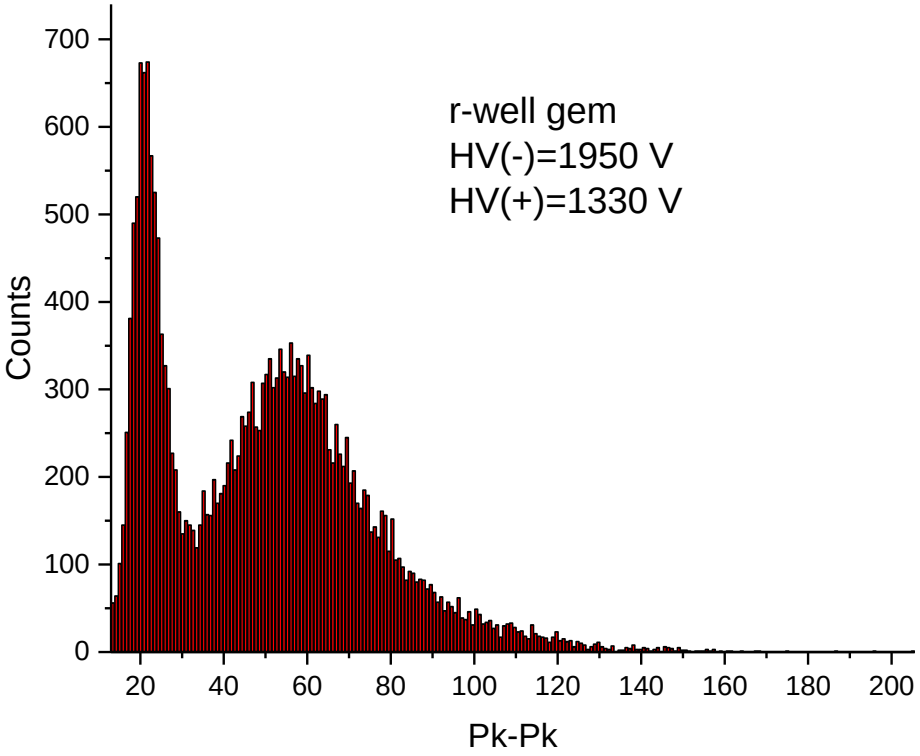




Bottom metallization removed

Resistive Kapton used for signal registration

Spectroscopy results (Fe^{55})



The signals from μRWELL detector example were obtained but the resolution and Gain were much worse than expected.

Also resistive Kapton was damaged after some time of detector operation.
We plan to use DLC coating instead of resistive Kapton.

Plans for the near future

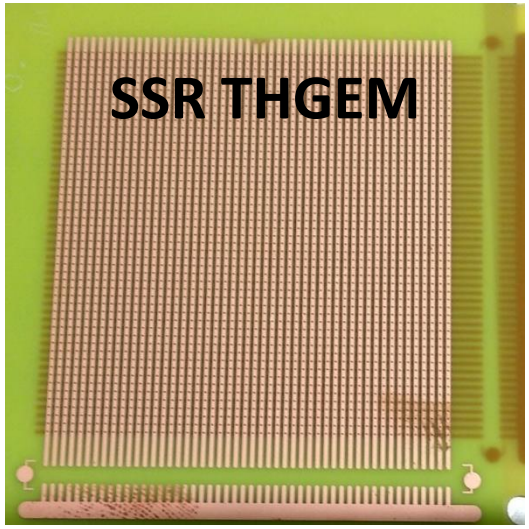
detector μRWELL with DLC coating

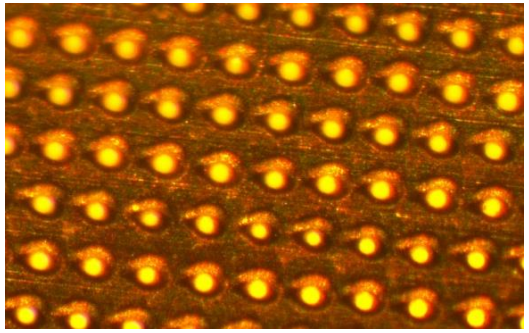
SSR THGEM (strip readout)

GEM and μRWELL with holes formed by laser beam in collaboration with Institute of Physics of the NAS of Belarus

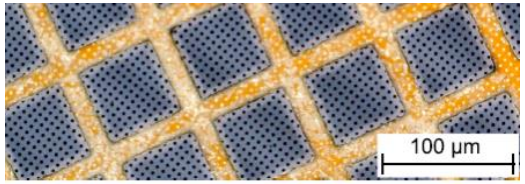
GEM with graphene coating to prevent ion back flow

Straw tubes with segmented cathode for Z-coordinate





Cu foil
d =20 μm
pitch 40 μm



Graphene
at Cu mesh
d = 50 μm

Conclusions

The modular system for detectors and front-end electronics testing was developed in INP BSU

The characterization of Thick Gas Electron Multiplier (produced by Svyaz Engineering in Dubna) was performed

It was shown that the developed modular testing system allows to measure the main characteristics of GEM detectors

Main characteristics of THGEM detectors measured in Minsk fully correlate with those obtained in Dubna