Measurement system for characterisation of new type GEM-detectors for MPD experiment at NICA

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Detectors

This work is done for application in the TPC of MPD detector at NICA collider in collaboration between

JINR (Dubna, Russia),

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Kuchinskiy N. A.
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Malyshev V. L.

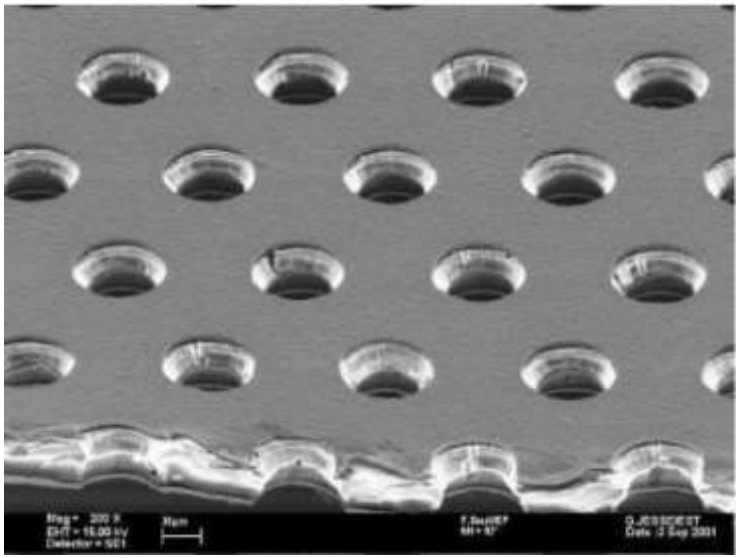
INP BSU (Minsk, Belarus)

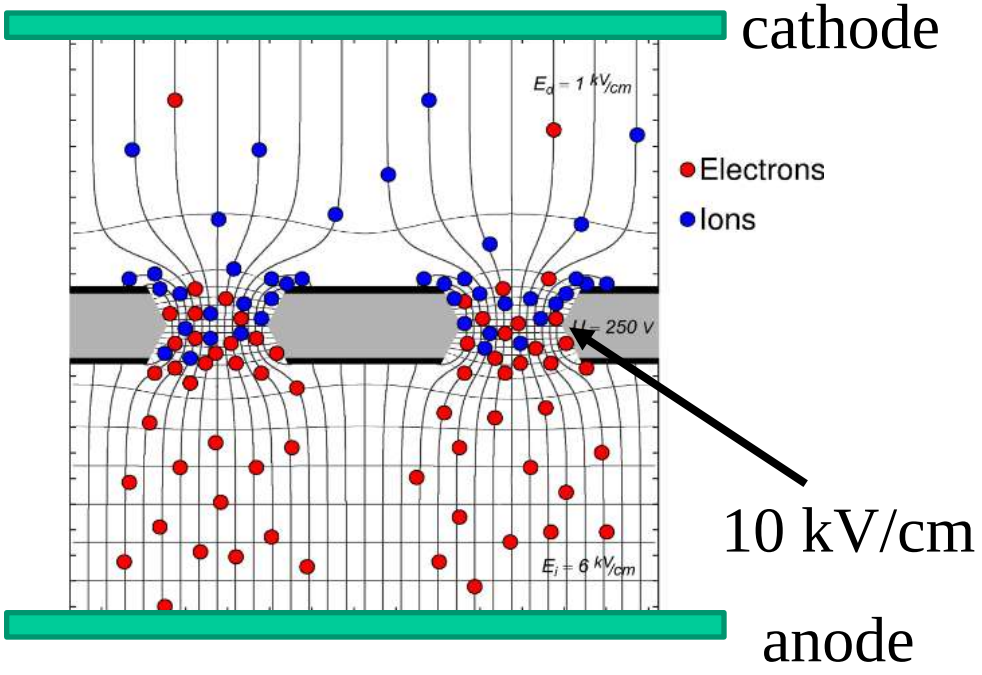
Fedotova Ju. A.
Bayev V. G.
Afanaciev K. G.

PNPI (Gatchina, Russia)

Kaschuk A. P.

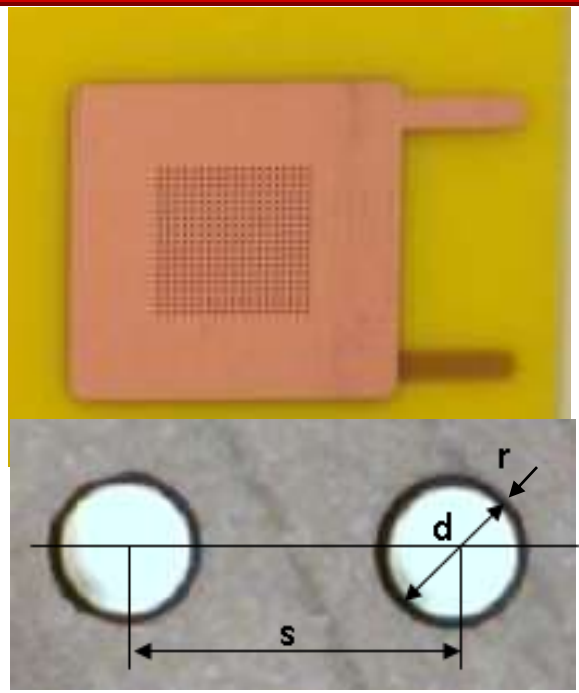
GEMs were invented in 1997 in the Gas Detector Development Group at CERN by Fabio Sauli.

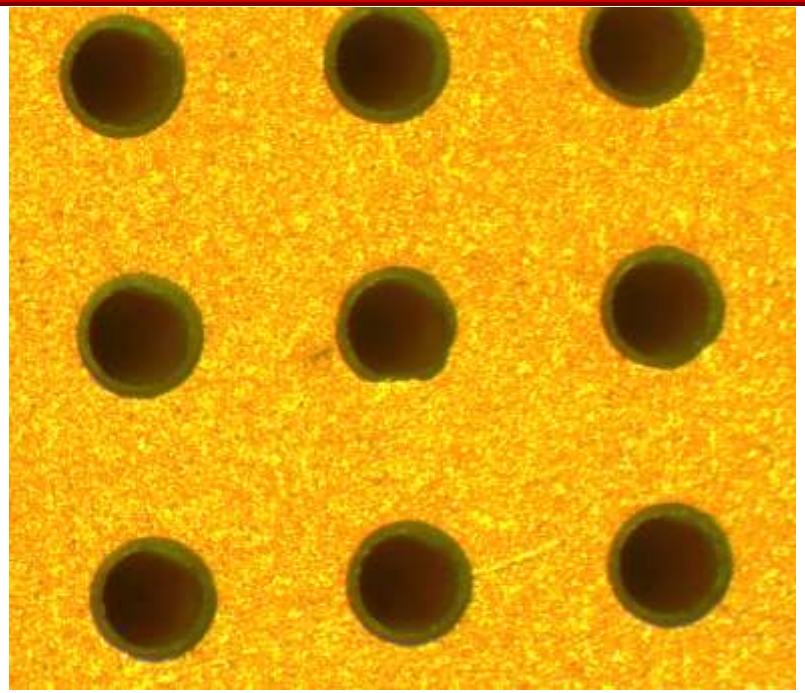




Typical thickness 50 μm, hole diameter 70 μm, pitch 150 μm
Typical gain ~1000.

Thick Gas Electron Multiplier (THGEM)

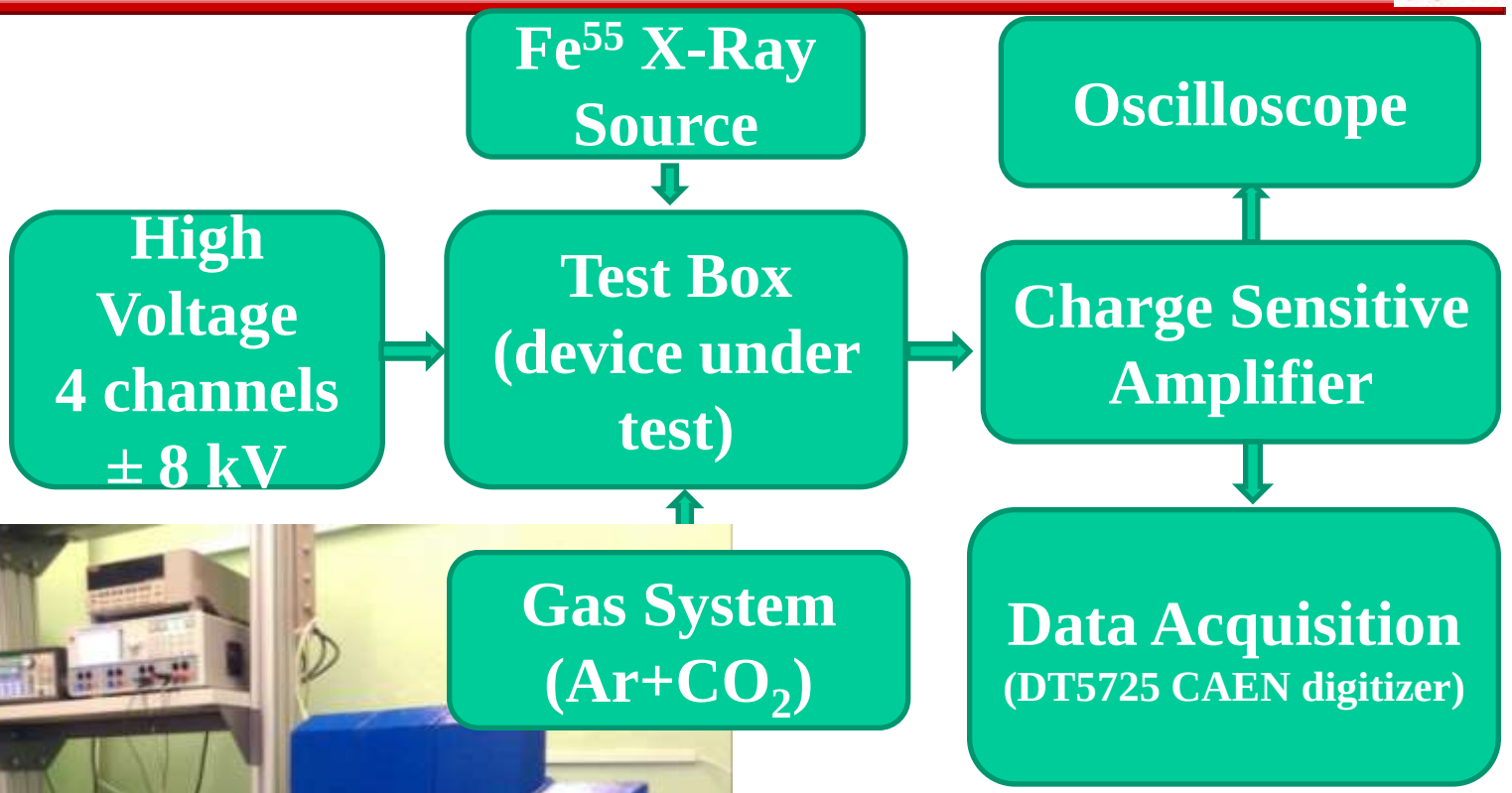




Produced by Svyaz Engineering (Dubna, Russia), 15 pcs tested
Thickness of fiberglass is 0.5 mm
Thickness of copper metallization after etching is 12 μm
Diameter of holes d = 0.2 mm
Distance between holes s= 0.5 mm
Width of rims is 15 μm
Area of test THGEMs is 10x10 mm^2

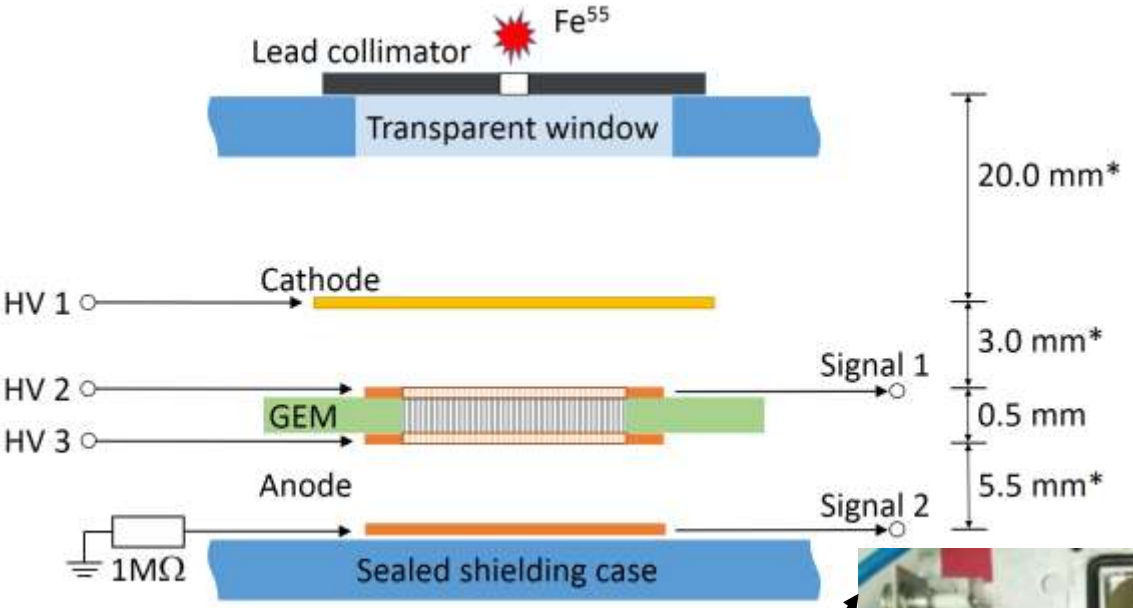
Gain of thin GEM ~1000
$\Rightarrow$ Multistage structures
Gain of THGEM ~ 10000

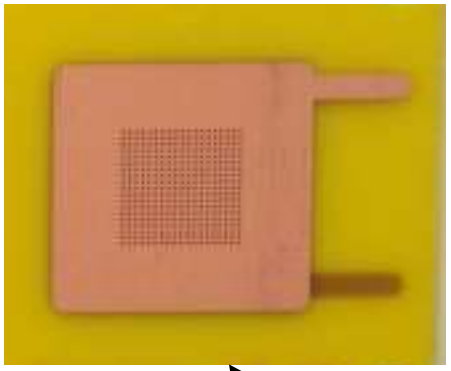
Test setup



Ar 90%, Co_2 10% premix was used

Test setup

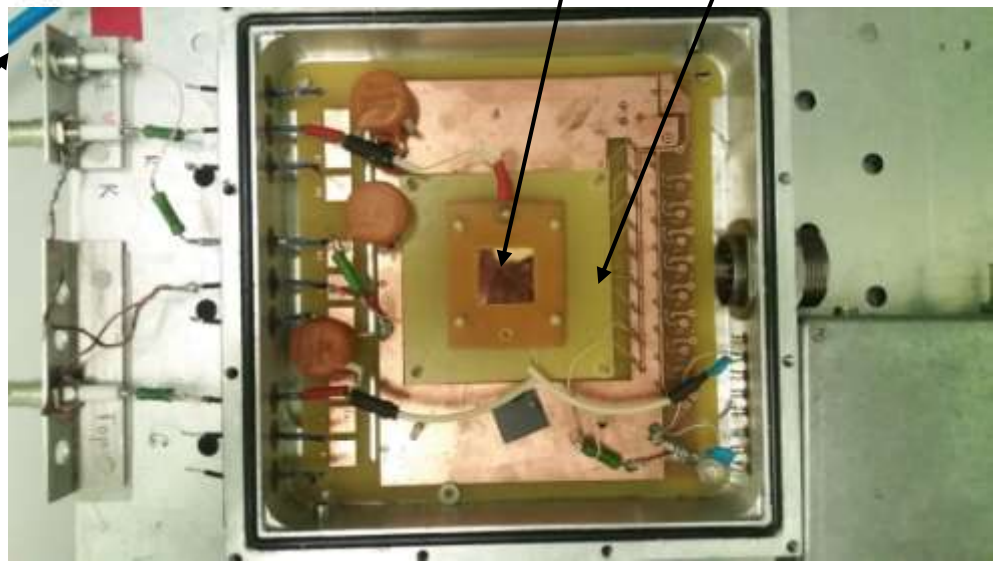




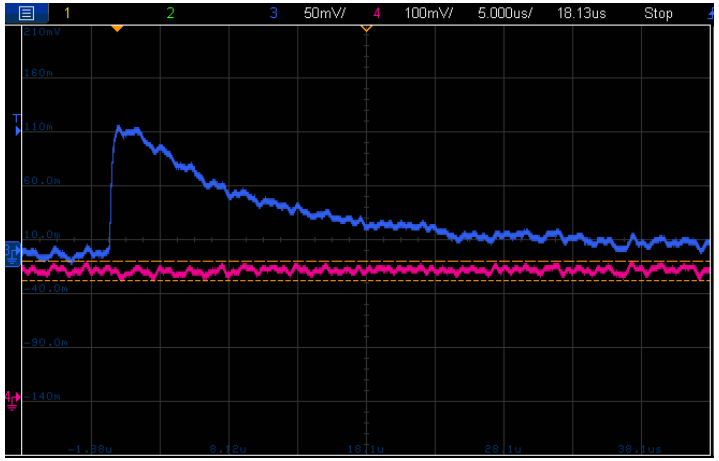
Cathode

THGEM

HV

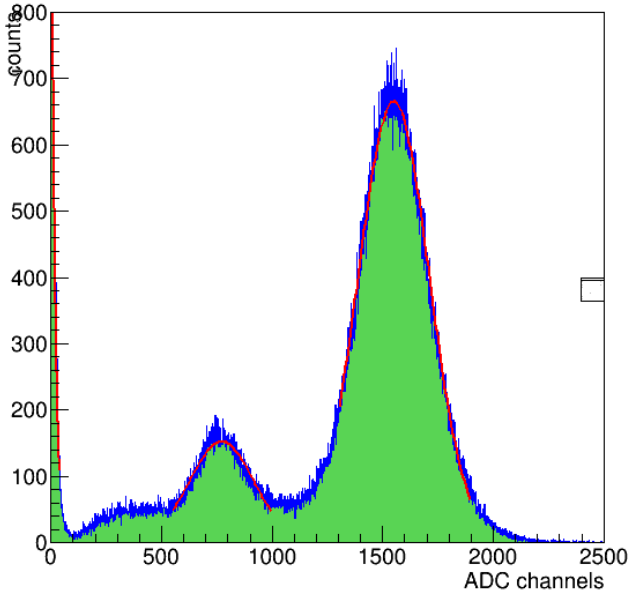


THGEM results

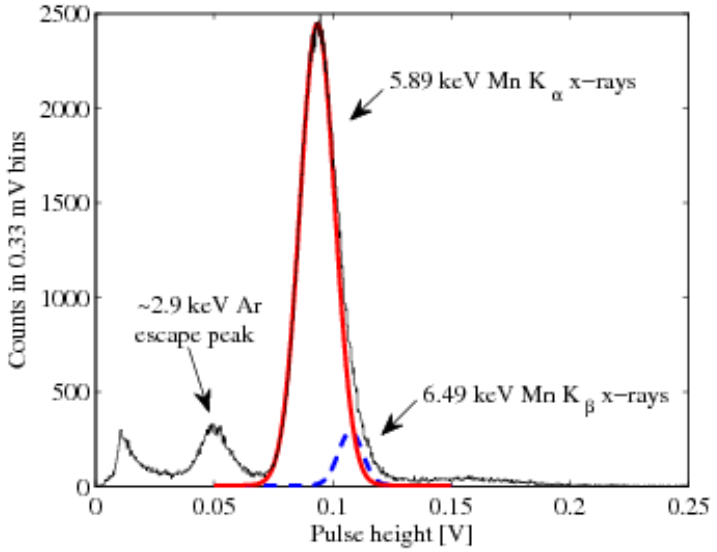


Fe 55 x-ray source used for testing
5,9 keV main peak,
2,9 keV escape peak in Ar

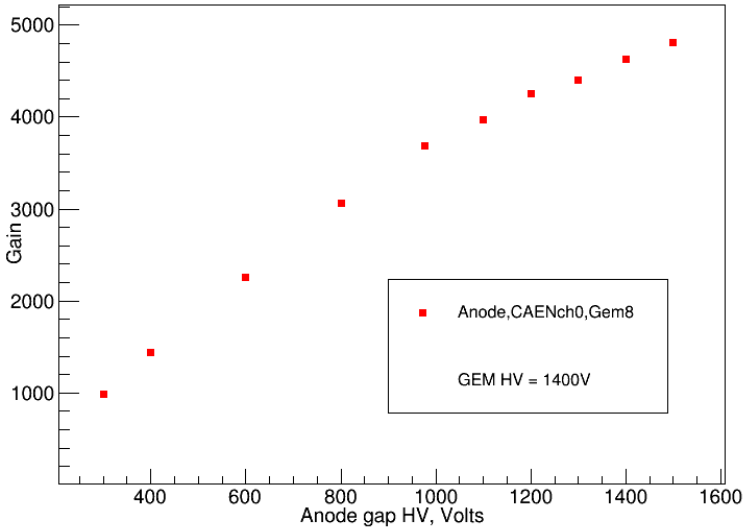
anode_1400_2820_3820.txt

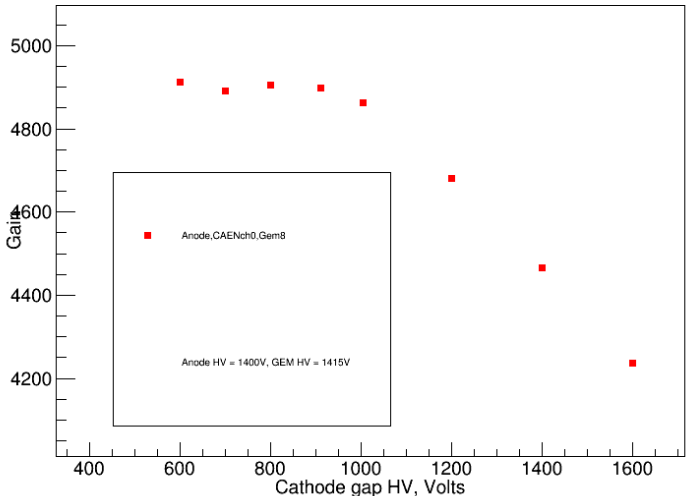


For comparison

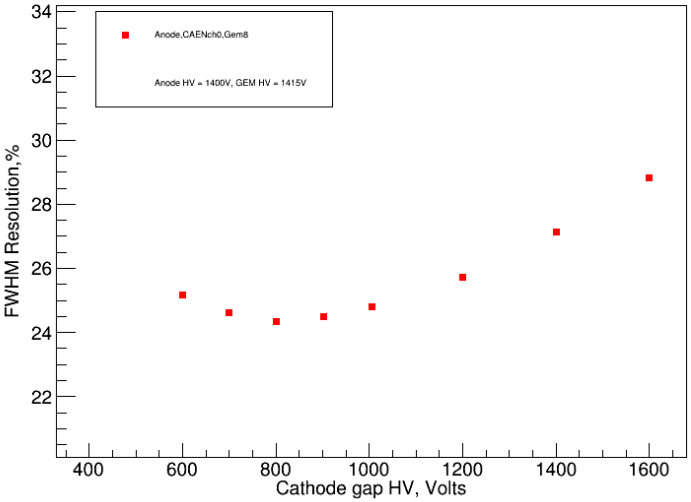


THGEM results



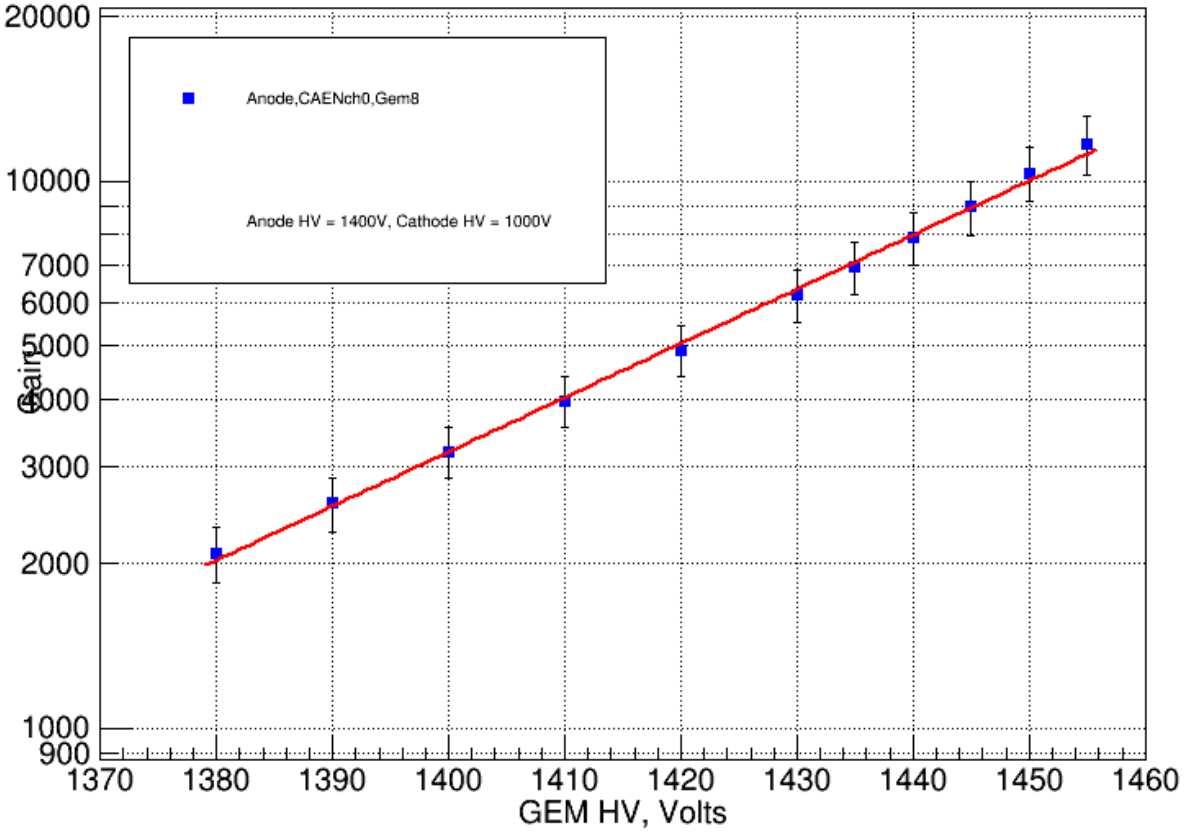


Gain vs anode gap voltage 1400 volts was chosen as a working point



Optimal cathode gap voltage 600 to 1000 volts

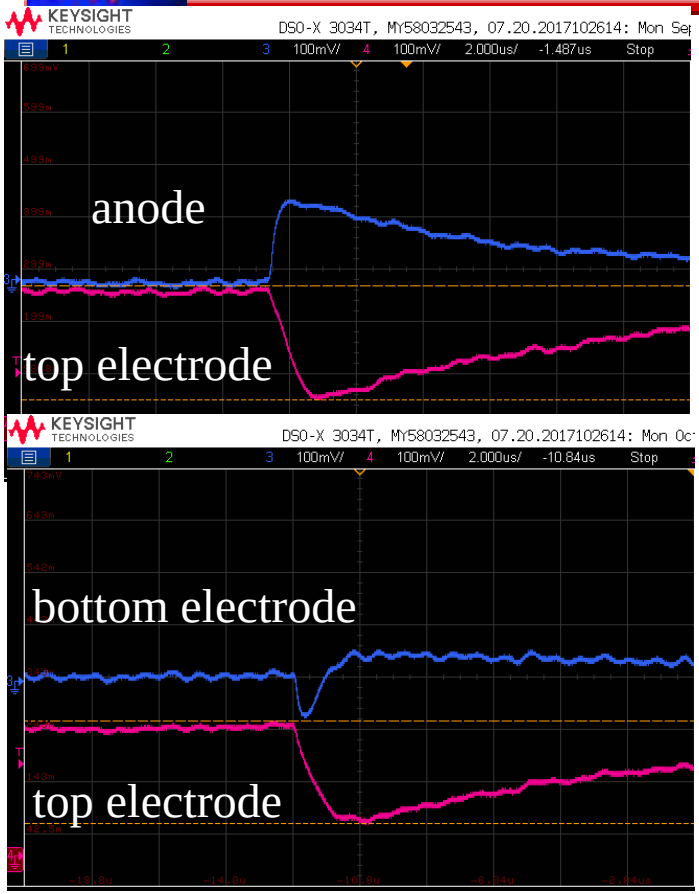
THGEM results



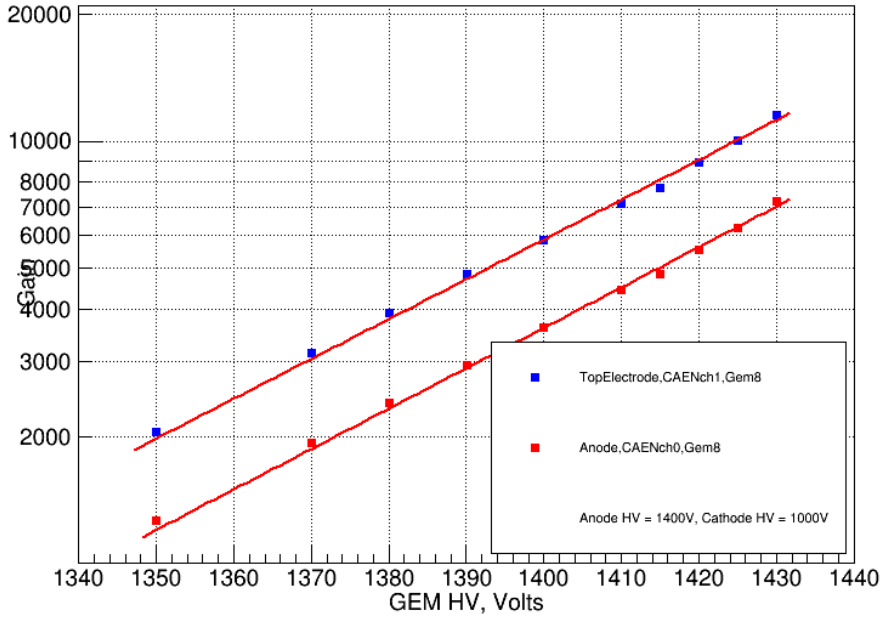
The gain of THGEM was ~11500 at 1455 volts

Energy resolution (FWHW) ~ 25%

THGEM electrodes readout



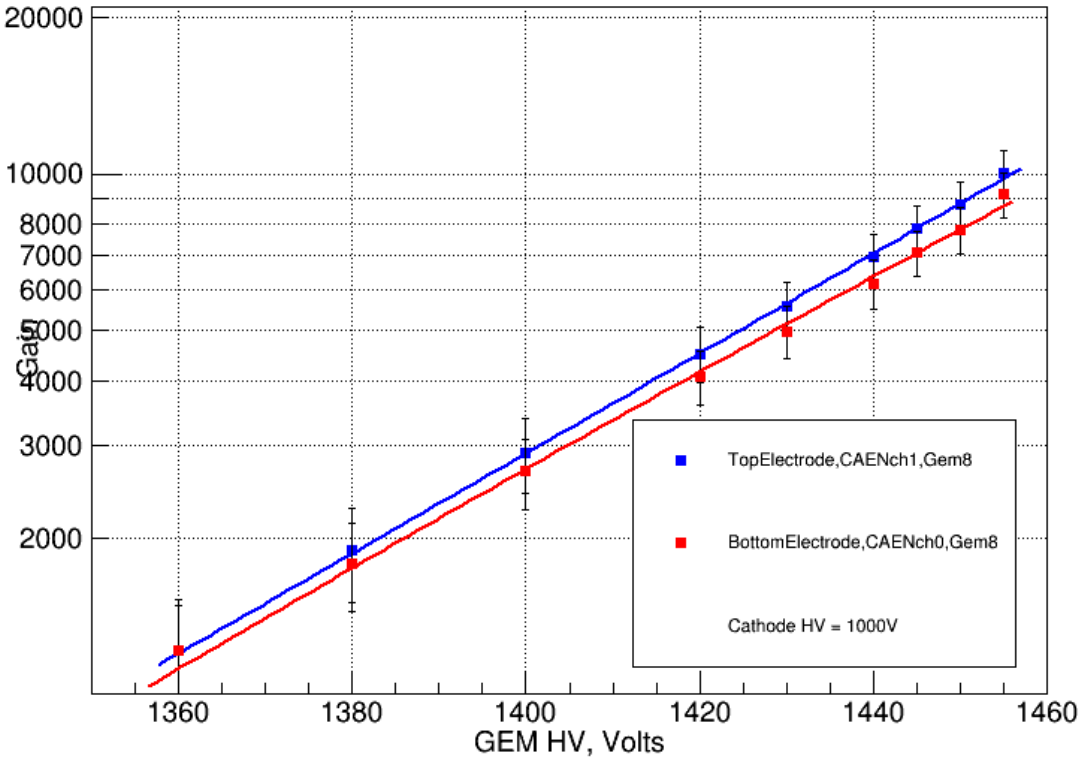
Both GEM electrodes were instrumented in addition to anode.
Anode fast front, due to only e drift
Top electrode e and ion drift, slower
Bottom electrode fast electron component and then slow ion component of opposite polarity



Gain on the top electrode is higher

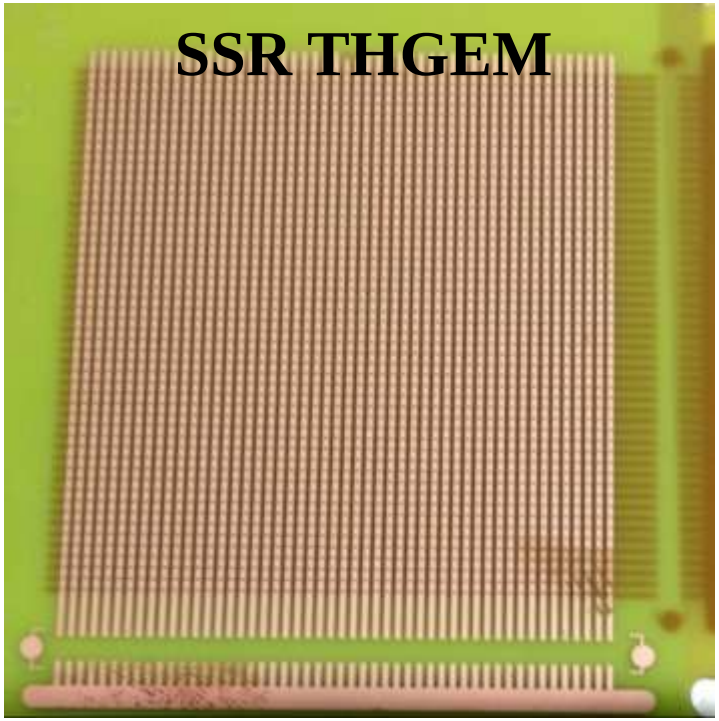
THGEM electrodes readout

It is also possible to read out signals from electrodes only.
In this case the signals are symmetric.
The gains are similar within the systematic error



Prototype THGEM with coordinate read-out

Electrode readout makes it possible to get position information from the electrodes as well as energy information from anode.
A prototype device was made to test this.



Prototype of the
strip-strip resistive THGEM

Conclusions

- A setup for testing GEM detectors was made in INP BSU
- We tested 15 THGEMs produced by Svyaz Engineering.
  All are working.
- We can reliably measure gain and energy resolution of GEM detectors
- It is possible to read out signals from GEM detector electrodes.

THANK YOU FOR ATTENTION