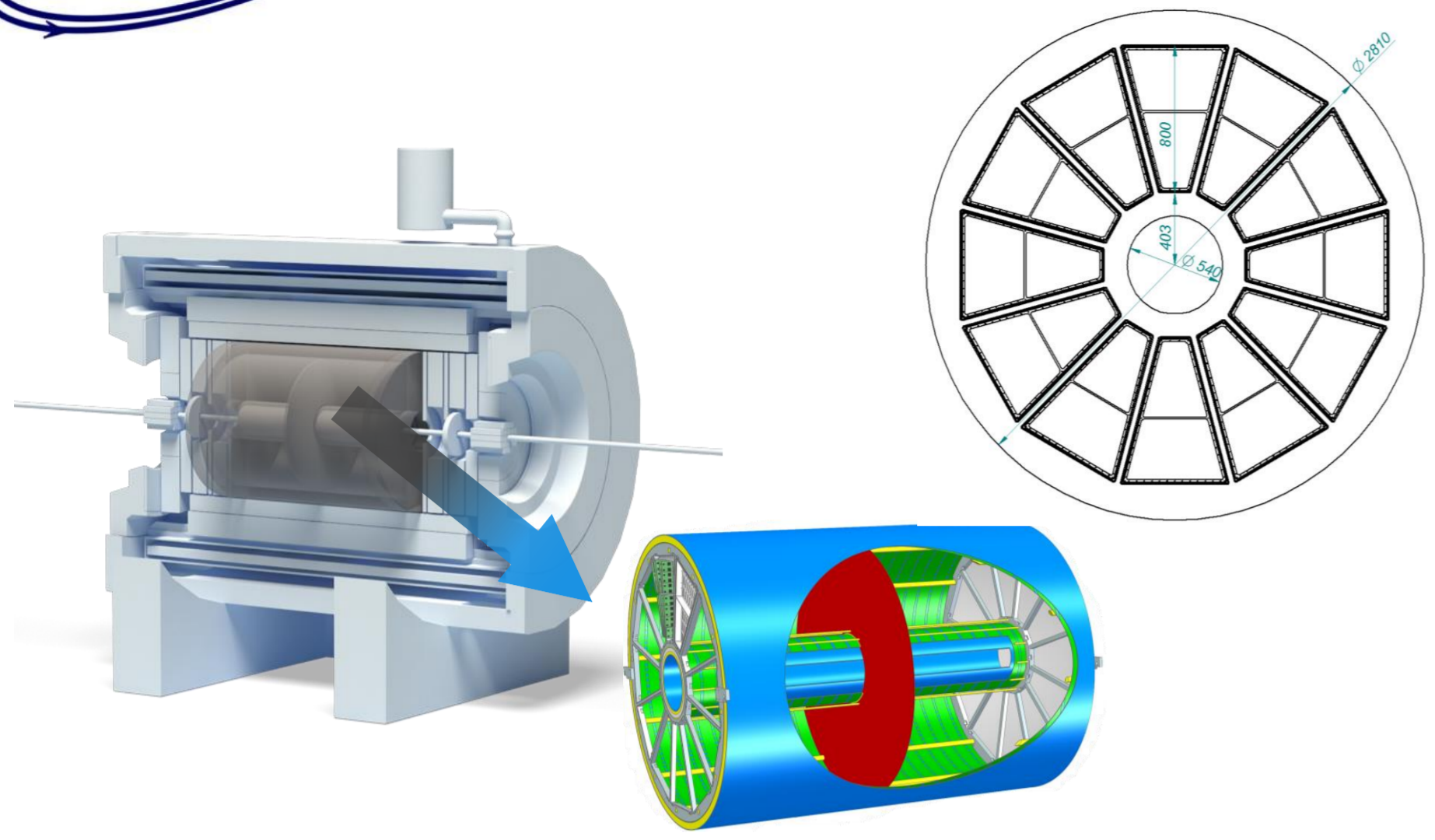




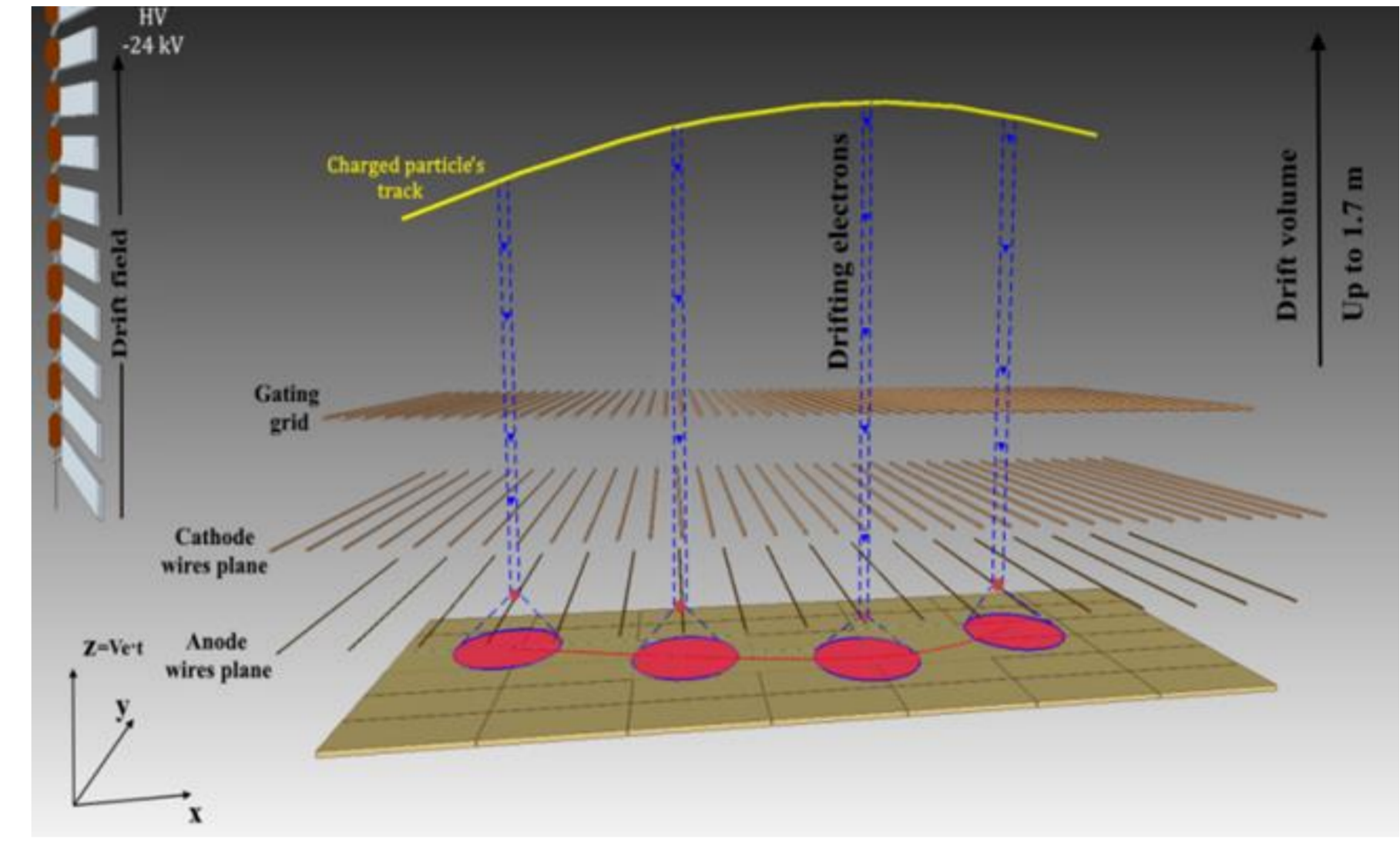
# Manufacturing serial readout chambers based on MWPC for the MPD TPC detector for NICA project

S.Movchan, O.Fateev, J.Lukstinsh, A.Rybakov, V.F.Chepurnov, V.V.Chepurnov, V.Samsonov,  
S.Vereschagin, S.Zaporozhets, V. Komarov, M. Zaytseva, Yu.Zanevsky

# Structure of the TPC readout system based on MWPC



Item	Dimension
Length of the TPC	340cm
Outer / Inner radius of vessel	140cm / 27 cm
Outer / Inner radius of the drift volume	133cm / 34cm
Length of the drift volume	163 cm (of each half)
Electric field strength	~ 140 V/cm
Drift gas	90% Ar+10% CH <sub>4</sub> / 80%Ar+20%CO <sub>2</sub>
Gas amplification factor	~ 10 <sup>4</sup>
Drift velocity	5.45 cm/μs;
Drift time	< 30 μs;
Temperature stability	< 0.5°C
Number of readout chambers	24 (12 on each side)
Number of pads	95232
Maximal event rate	< 7 kHz ( at Lum.= 10 <sup>27</sup> )
Electronics shaping time	~180 ns
Signal-to-noise ratio	30:1
Signal dynamical range	10 бит
Signal sampling	10 МГц
Two-track resolution	~1 cm



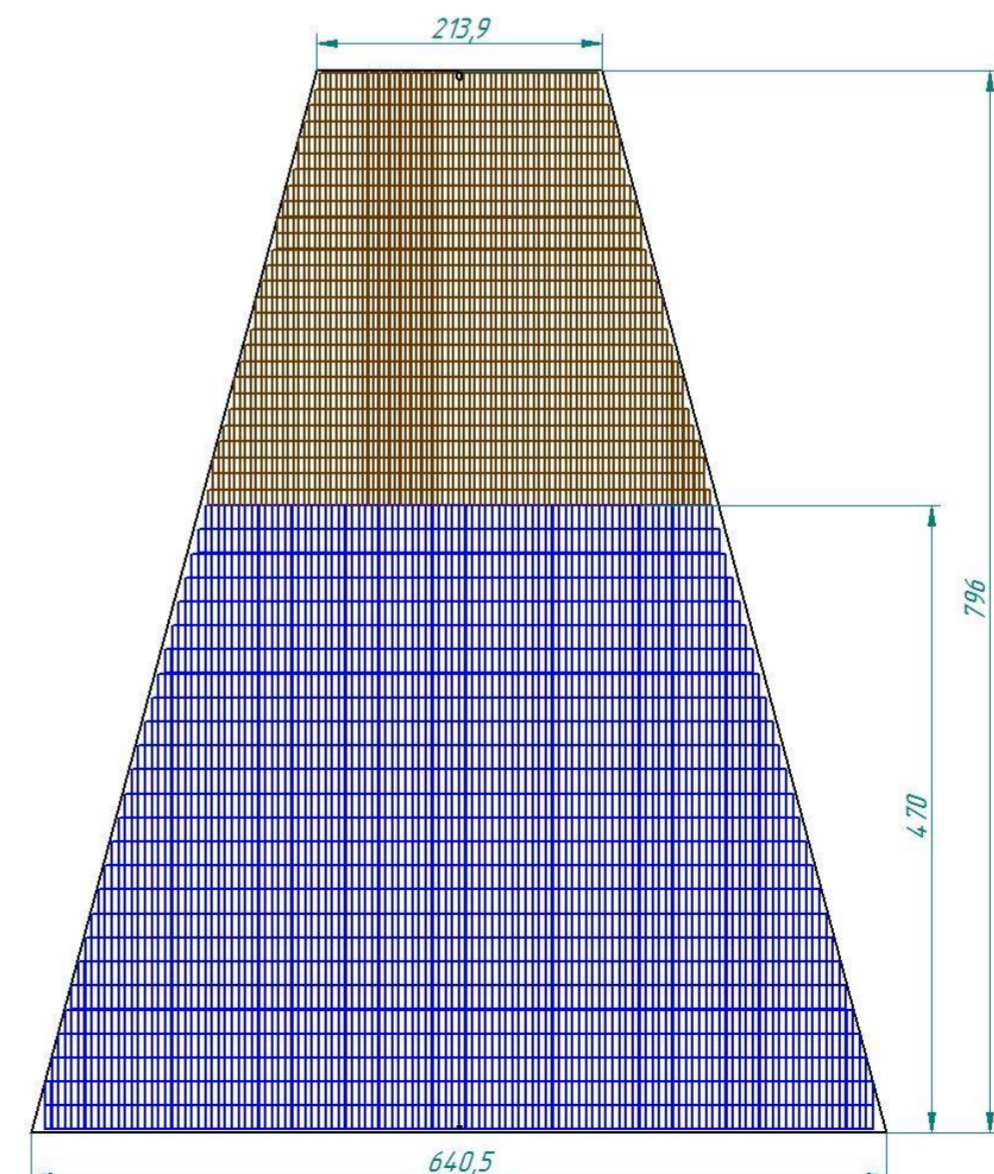
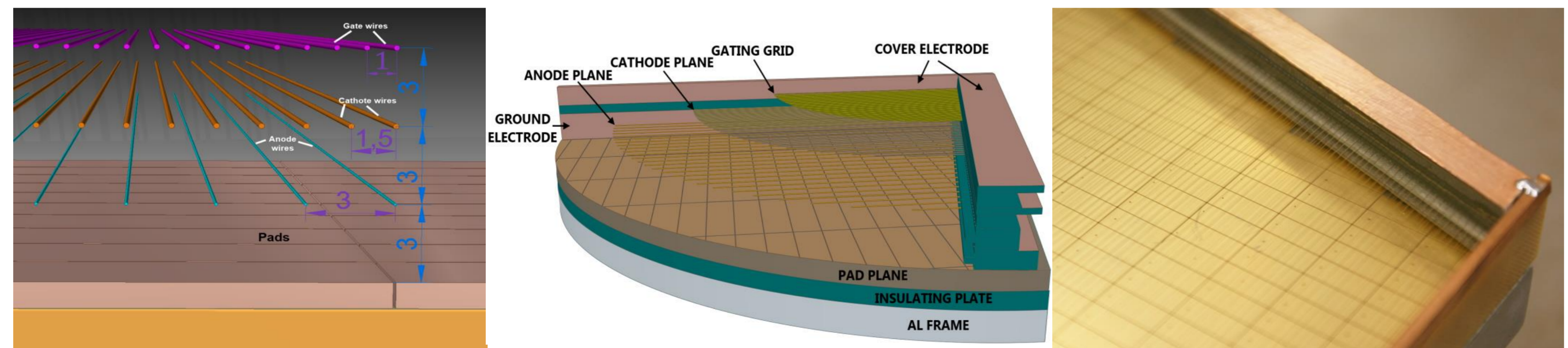
The Time-Projection Chamber (TPC) is the main tracking detector of the MPD detector. It is a well-known detector for the 3-dimensional tracking and particle identification for high multiplicity events.

The electron cluster from a particle track as a result of the gas mixture ionization by charge particle are drift to the TPC end cap readout chambers.

Each chamber measure two coordinates (X, Y) for each cluster and the third coordinate (Z) is determined from the drift time.

TPC readout system is based on the **Multi-Wire Proportional Chambers (MWPC)** with cathode pad readout. Image charges are induced on an array of pads and are recorded as a function of time.

The end-cap readout plane is covered by 12 x 30° trapezoidal sector in azimuth. The readout chamber size is bottom=214 mm, top=643 mm and the height - H= 800 mm.



Padplane: 27 rows of pads with the size of 5x12 mm at inner R and 26 rows of pads with size of 5x18 mm at outer R have been selected as a compromise of reasonable number of readout electronics channels.

The pads have a rectangular shape and the total number of pads in the TPC is 95232.

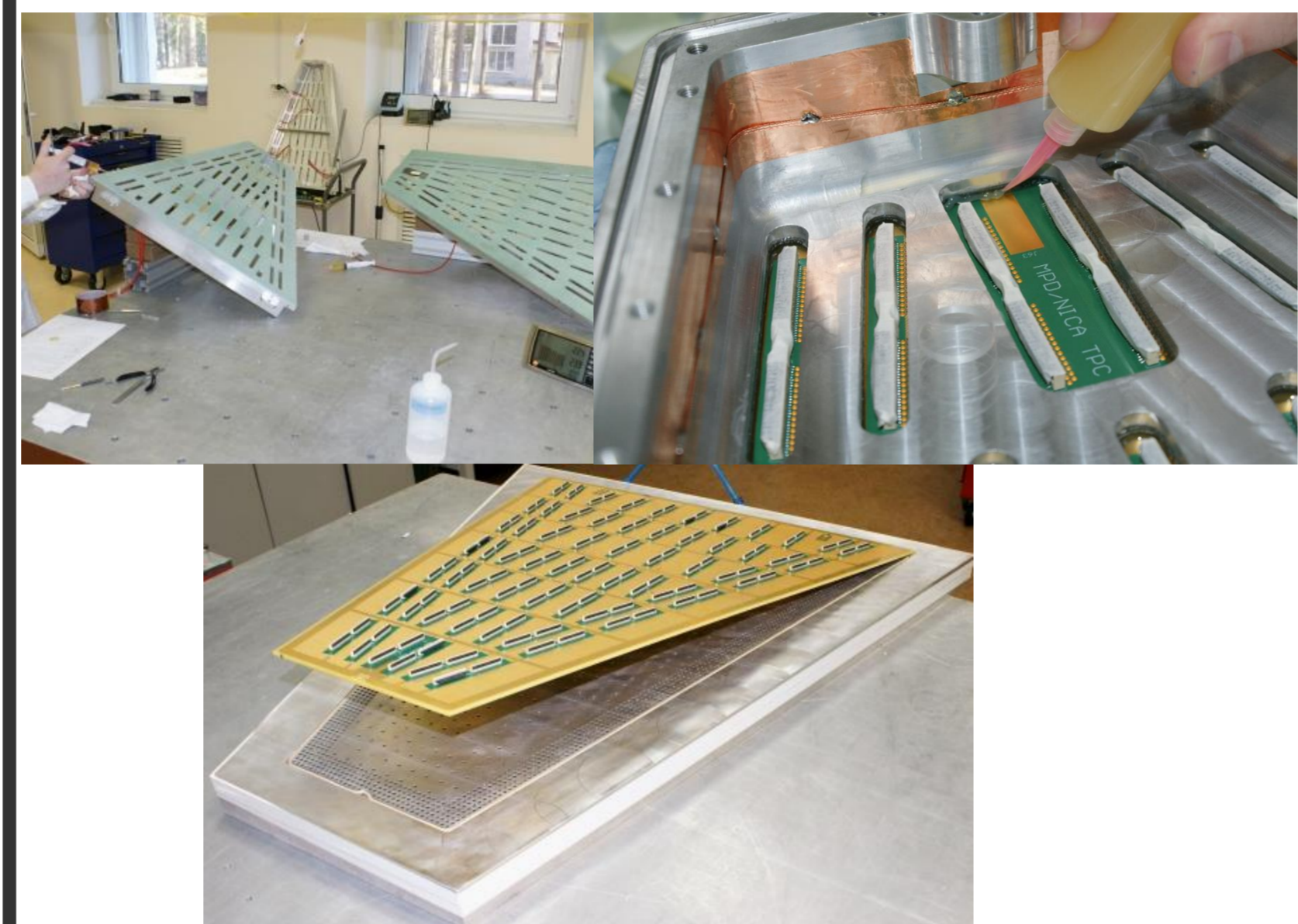
In the ROC chamber next wire planes is used: an anode plane, a cathode plane and a gating grid. The gap between the planes is 3mm. The flatness of the planks is better than ±0.03mm. In order for the detector to comply with the declared parameters, it is necessary to ensure the precise manufacturing accuracy and mutual positioning of the reading pad's plane and wire planes.

## Checks and connectivity test



To ensure the high quality of the reading chambers, all assemblies and parts of the cameras are checked and tested.

## Gluing and Sealing



The purity of the gas mixture is critical to the TPC detector. It is important to ensure the tightness of the housings of the read out chambers.  
The vacuum table used to glue the padplane to the aluminum frame of the ROC camera ensures good flatness of the reading surface.

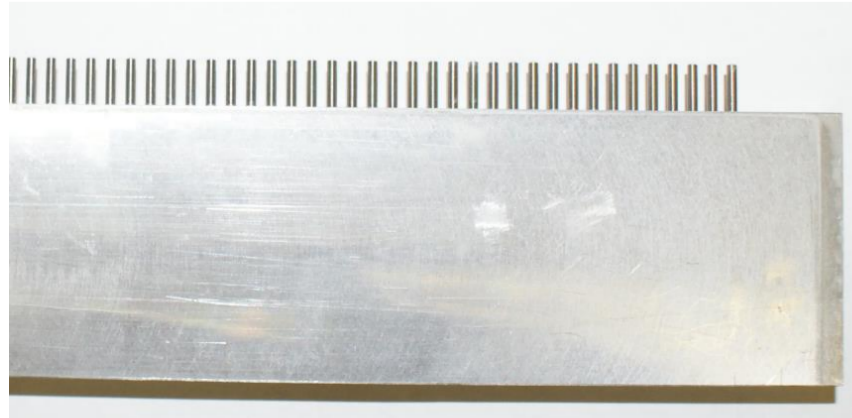
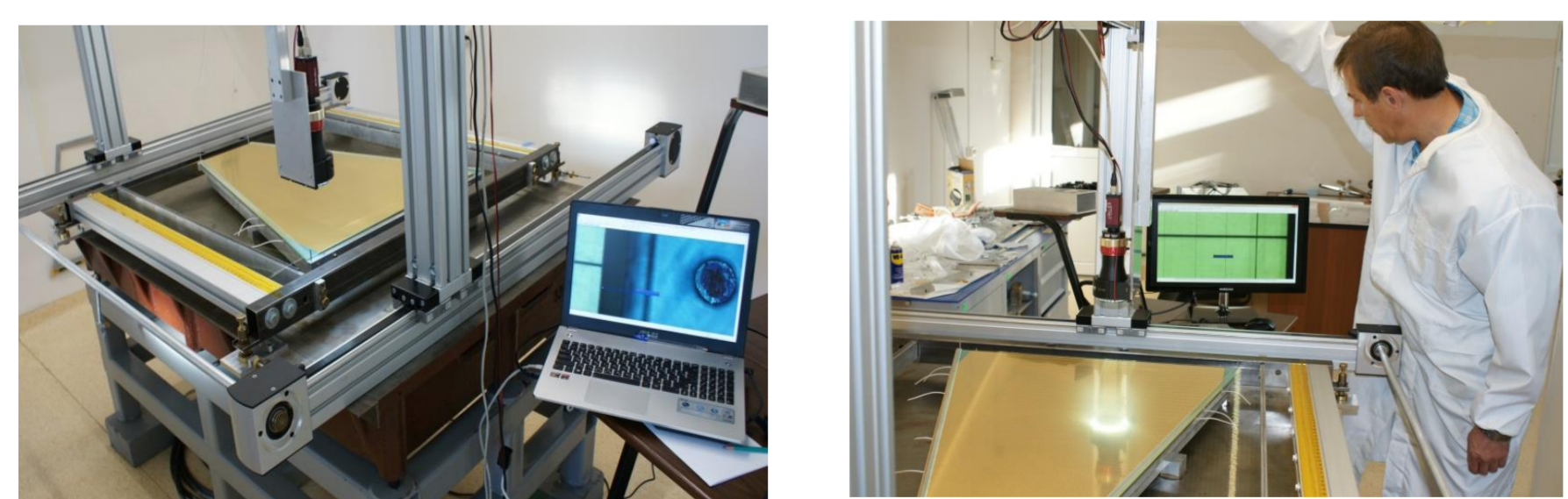
## Wiring



The wiring machine is used. Wires step is in the range (1÷3) mm, accuracy is better than 30 μm. Wire pretension is in the range (50÷100) Gramm, accuracy is +/- 2 Gramm. Wire transfer frame size is 900x900 mm.

The glue ARALDITE 2011 is selected. This glue ensures the detector gas tightness and it mechanical stability.

## Wire transfer and pitch control



The precision of the wire pitch in the planes allows to achieve good uniformity of the gas gain in the chamber.

## Connecting electrodes and earth.



## Storage



**Status:**  
24 serial chambers are assembled and tested.  
2 spare chambers are assembled, testing now.

# ROC chambers testing

Stand

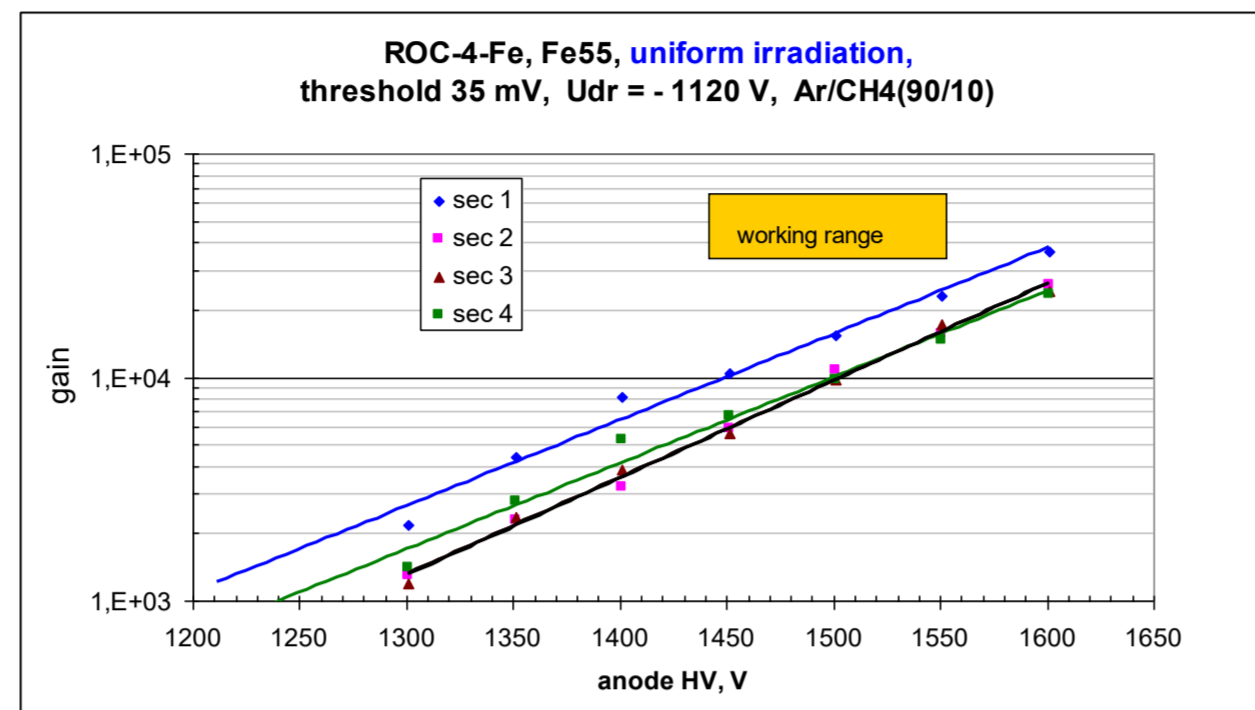


To simplify the testing procedure, software was specially developed for the test bench based on LabVIEW, which allows automating the testing process and processing the results in real time.

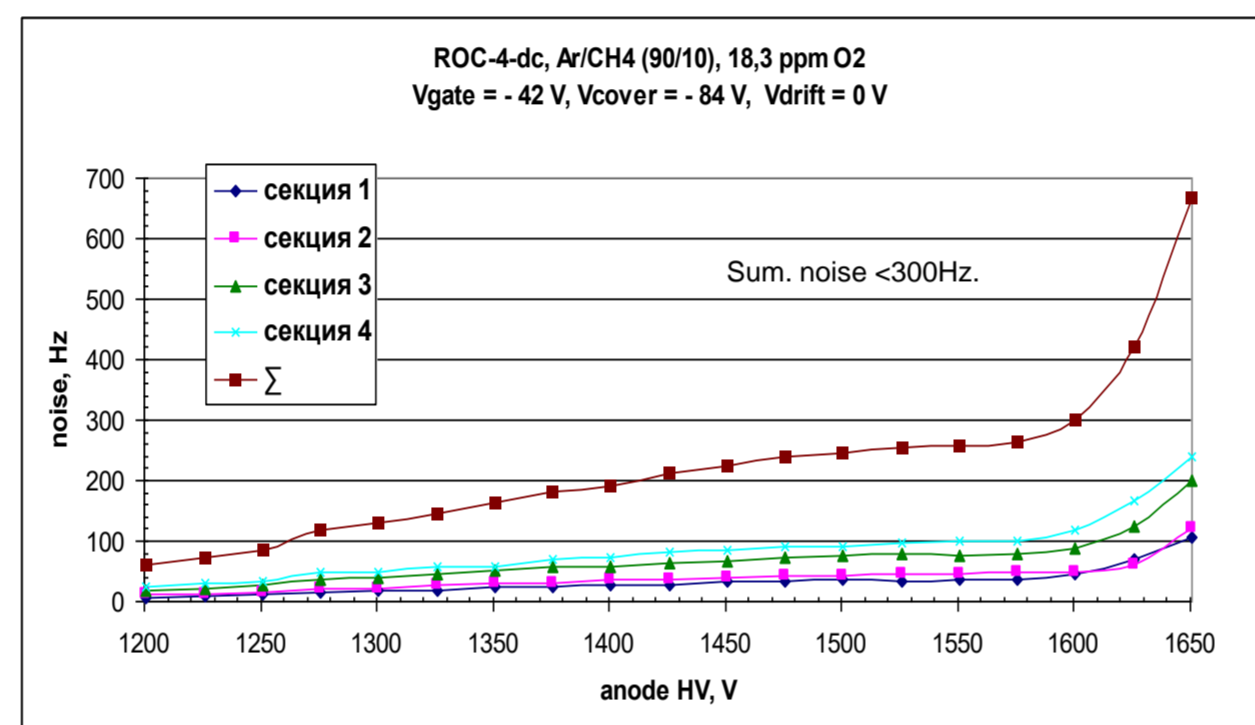
## Quality control:

- Dark current less than 100nA (noise rate  $\leq 300\text{Hz}$ )
- Gas gain uniformity  $\leq 25\%$
- Energy resolution  $\leq 20\%$
- Counting rate plateau (HV max)
- Gas gain vs HV
- Nominal chamber HV for gas gain  $G=10^4$
- High intensity x-ray scan (no current spikes)
- Long-term stability test
- Suppression of ion current to drift region ( $K \leq 10^{-4}$ )

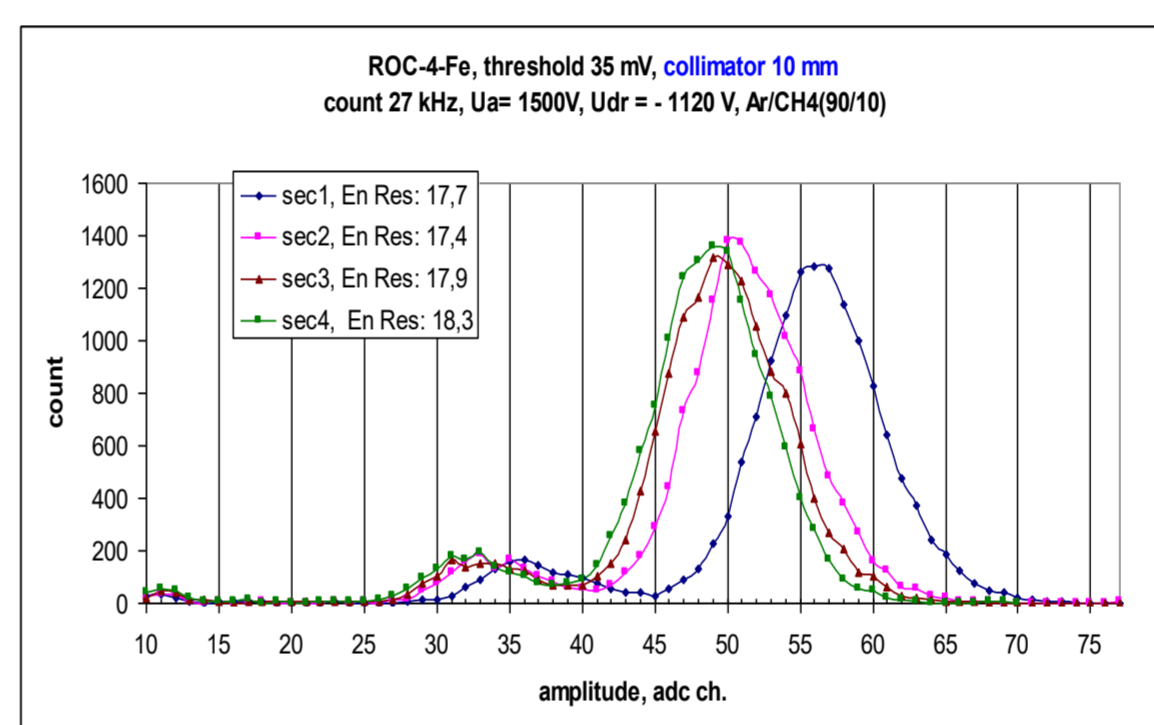
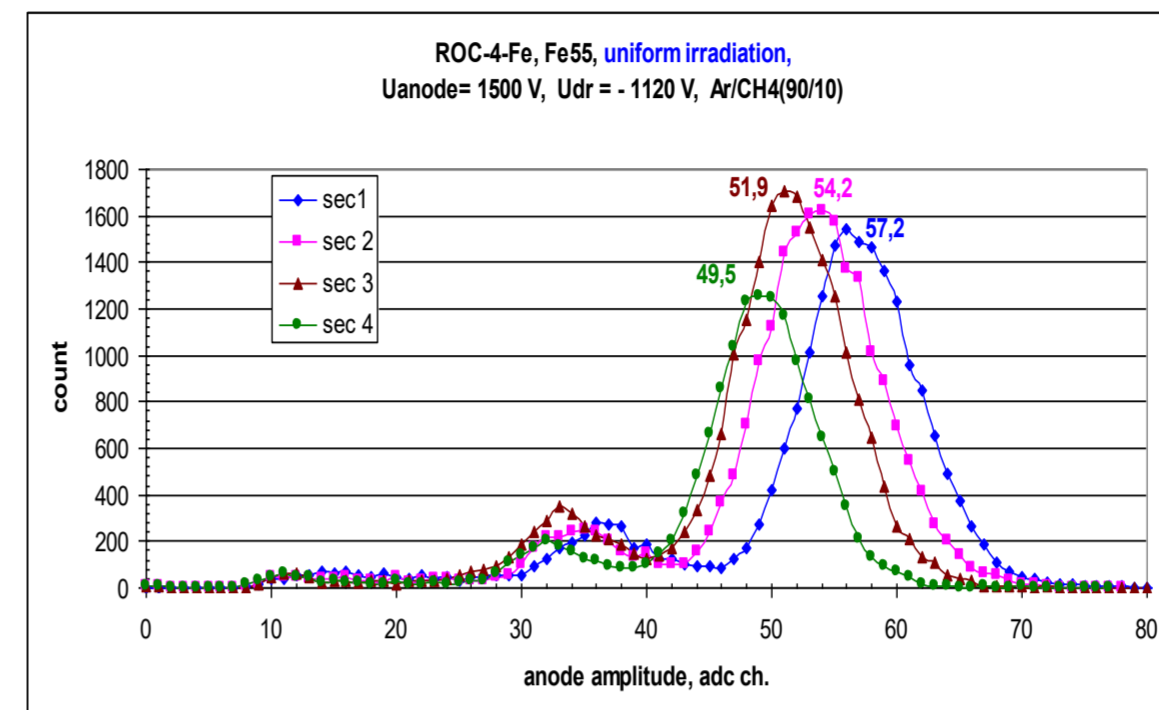
Gas amplification factor



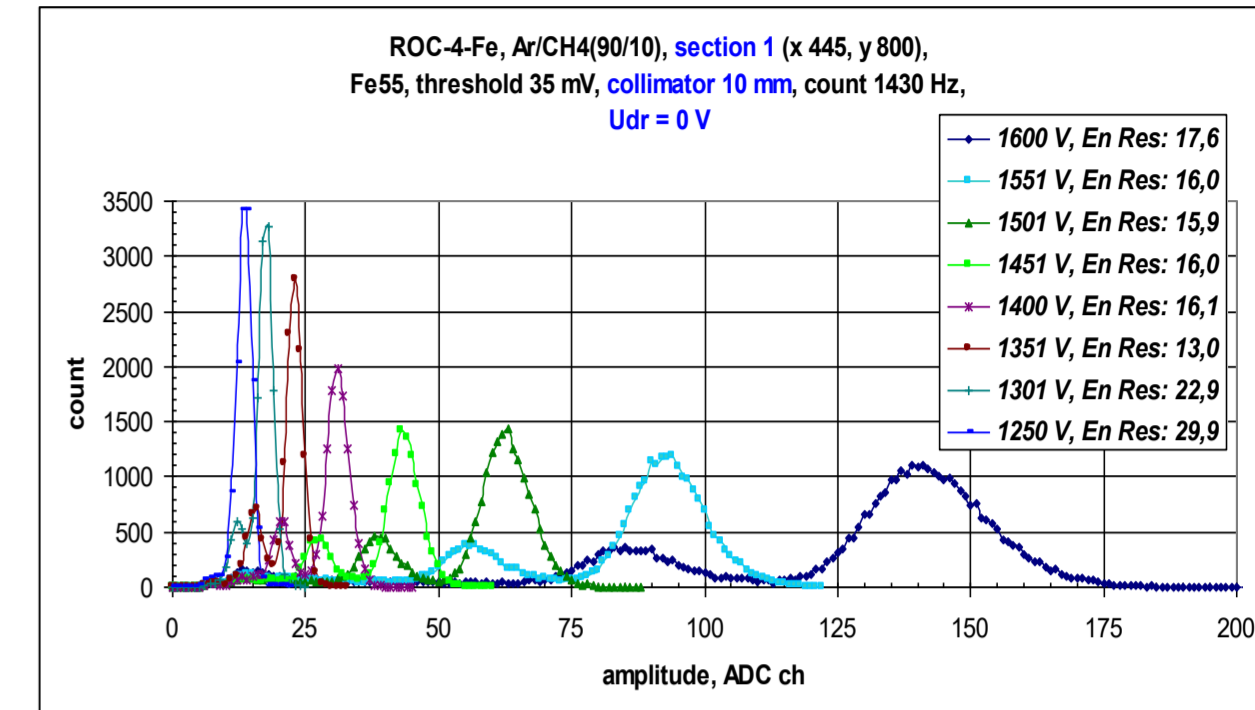
Noises



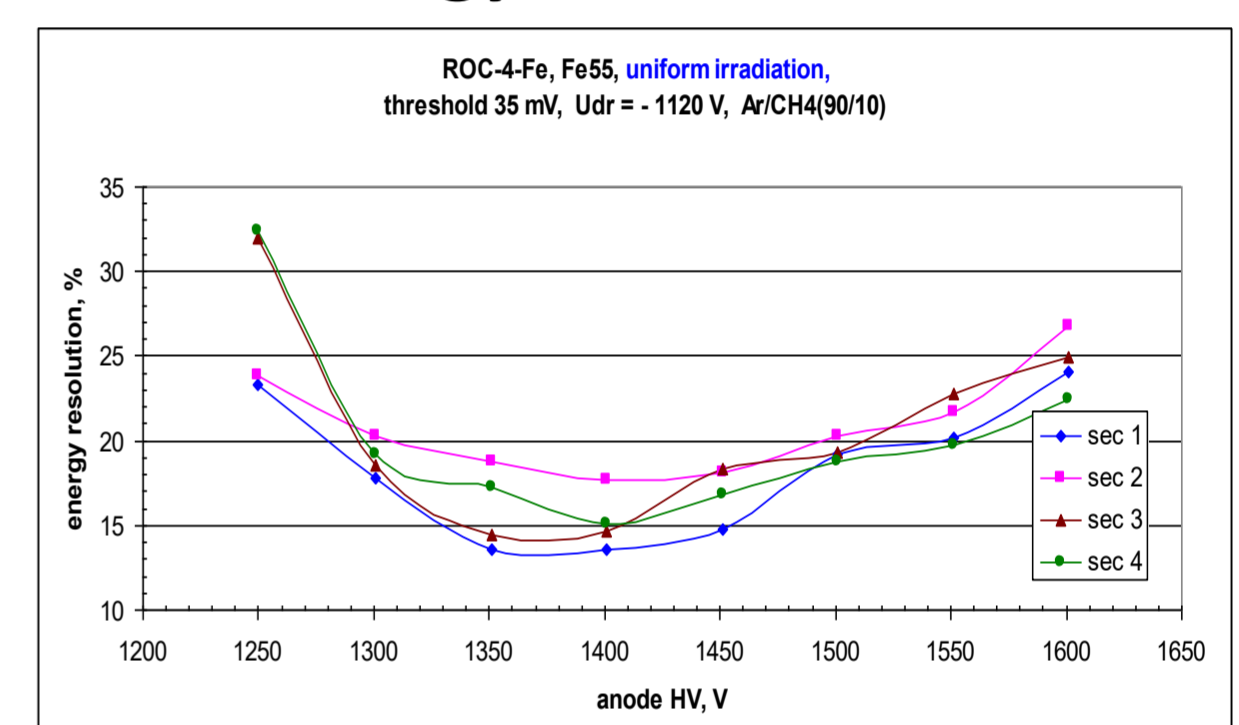
Signal spectrum



Amplitude spectra



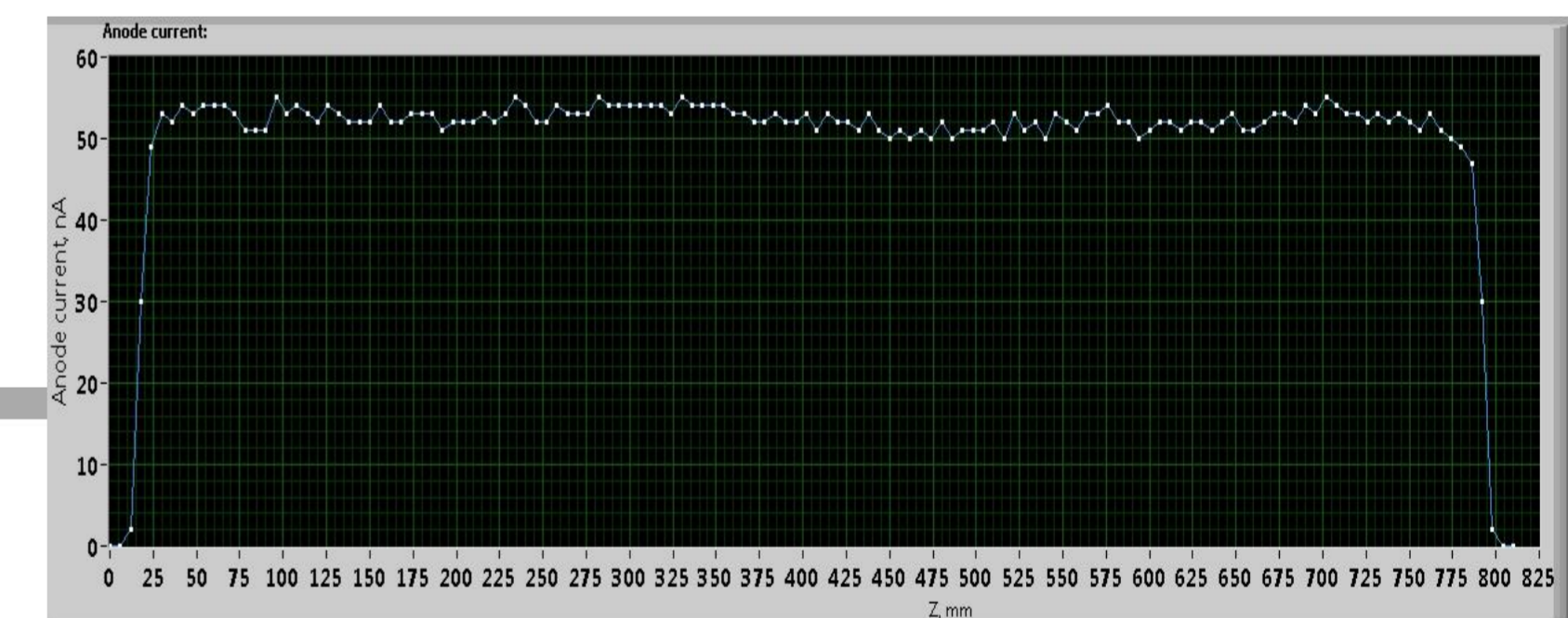
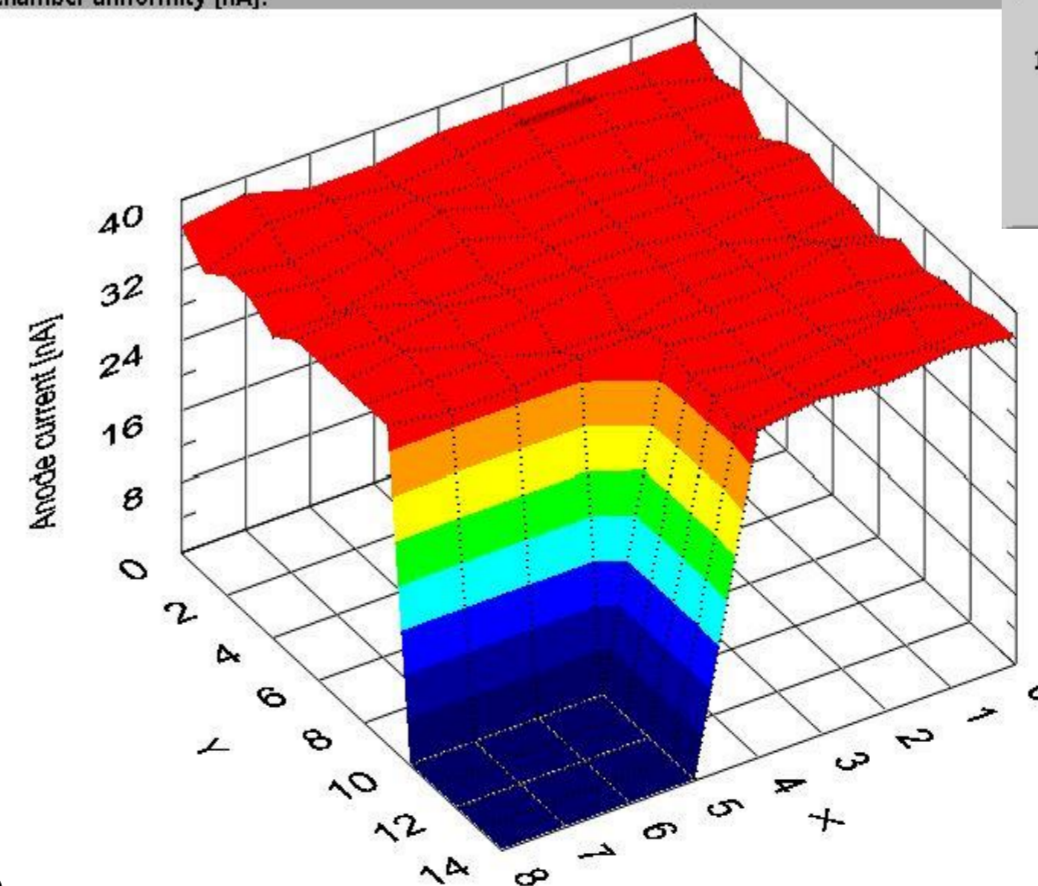
Energy Resolution



Counting rate uniformity

**Line scan:** In linear scanning, a stepper motor moves the X-ray tube vertically along the camera, in 3 mm increments, and a narrowly collimated X-ray beam allows each wire to be checked.

Chamber uniformity [nA]:



**2D scan:** Scanning the entire area of the chamber at selected points allows you to check the uniformity of the gas gain.

The characteristics of a complete set of 24 serial ROC chambers on an automated stand have been investigated. The chambers have been shown to provide the desired parameters. The average  $dE / E$  of the tested chambers is better than 20%.

**THANK YOU!**