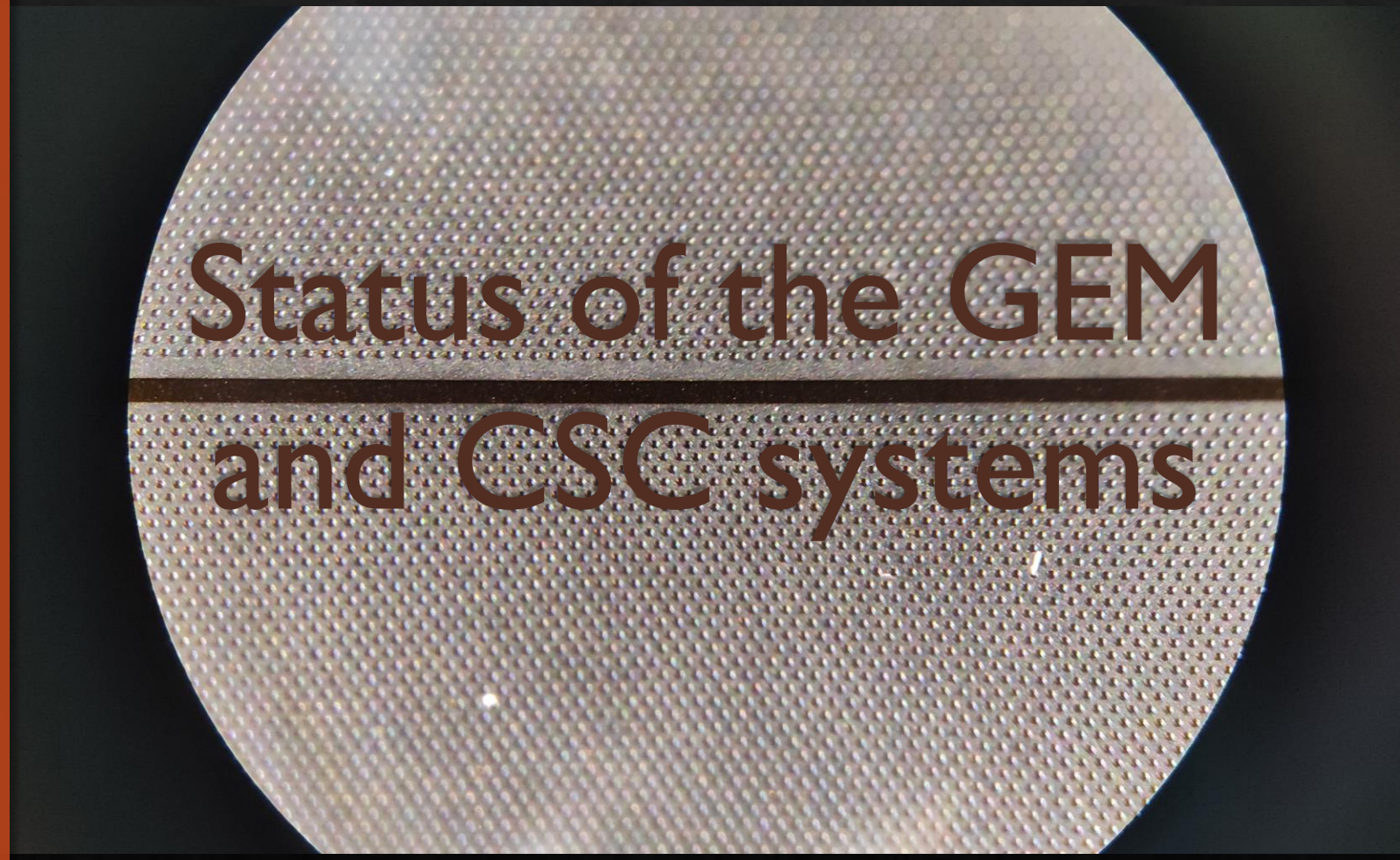
BM@N
Baryonic Matter at Nuclotron



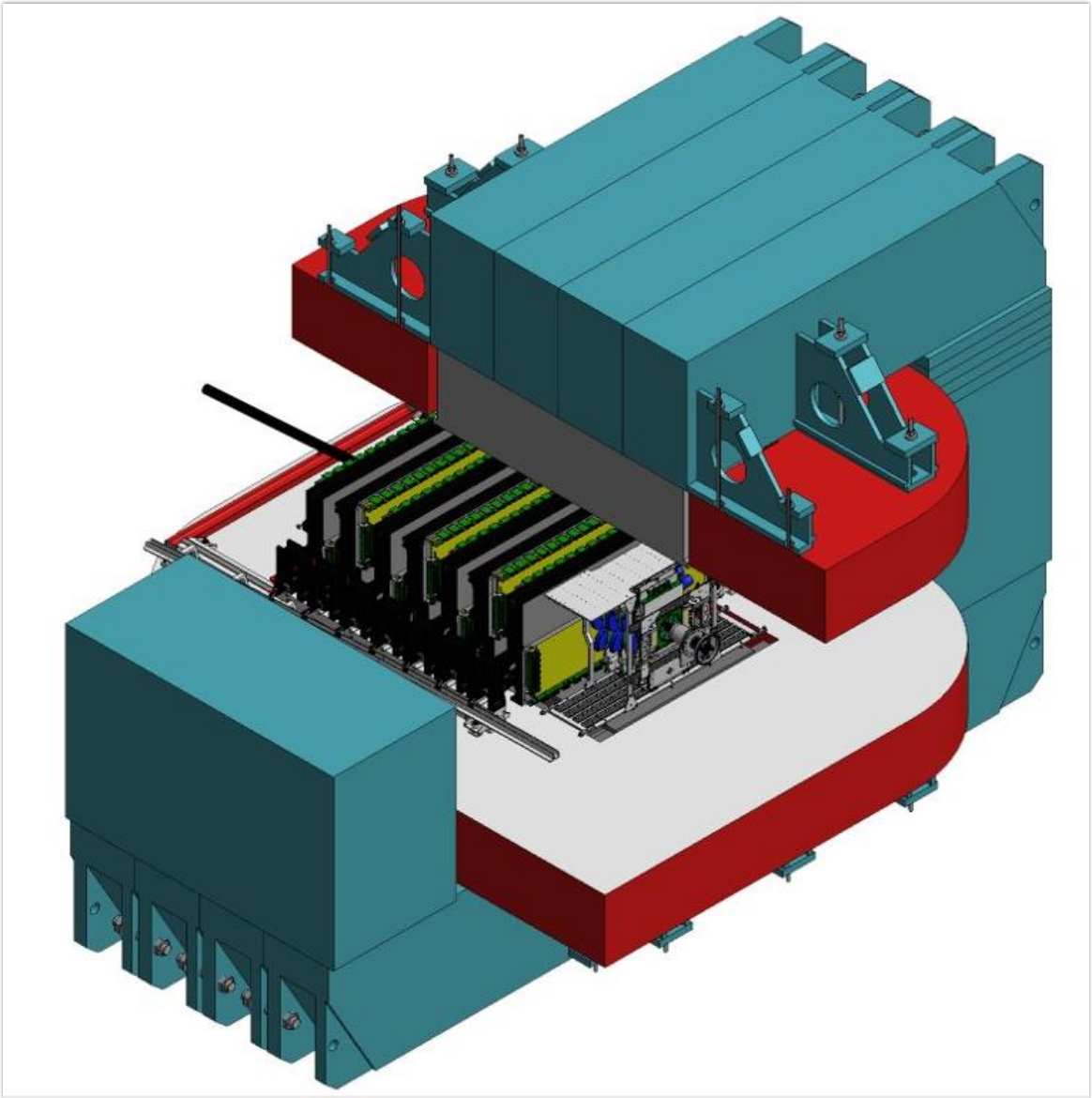
Status of the GEM and CSC systems

LHEP
ЛФВЭ

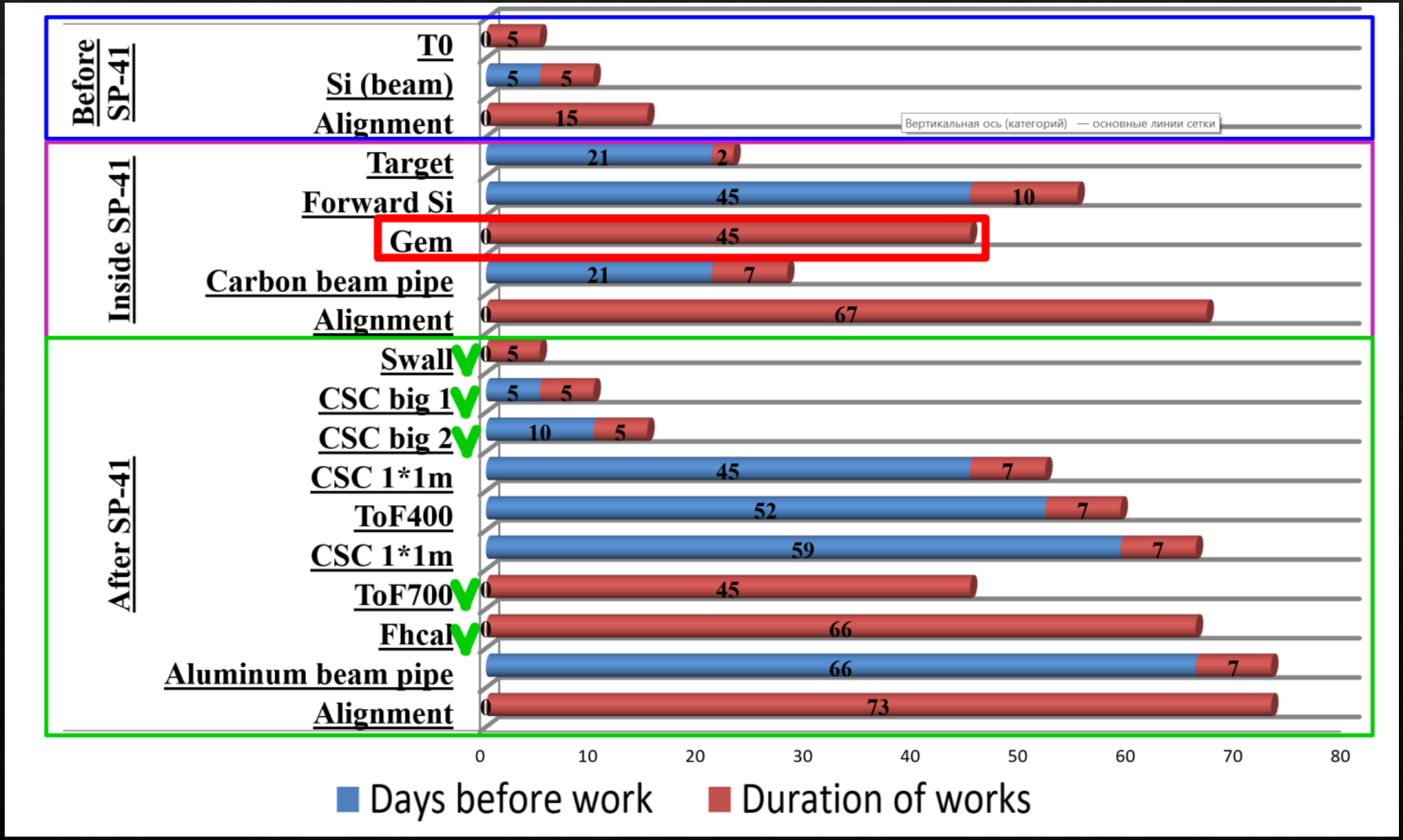
Elena Kulish on behalf of the CSC and GEM groups

GEM configuration

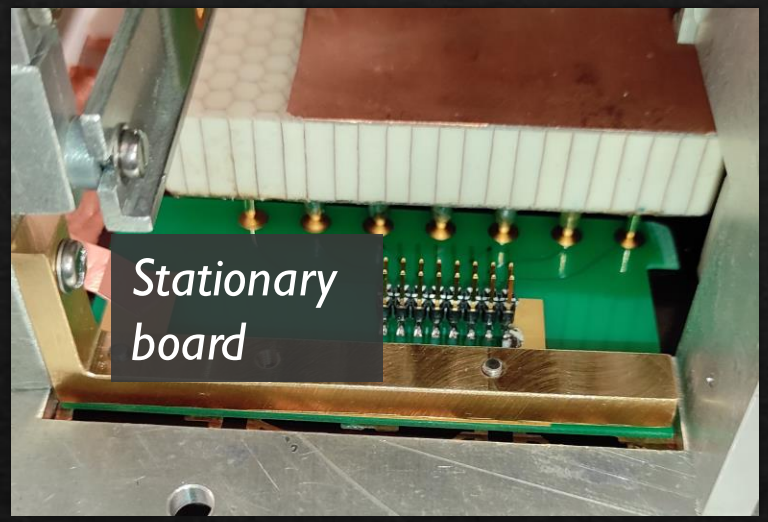
14 detectors forming 7 tracking planes:
7 top detectors (active area size 163 × 45 cm^2) above the vacuum beam pipe;
7 bottom detectors (active area size 163 × 39 cm^2) below the pipe.

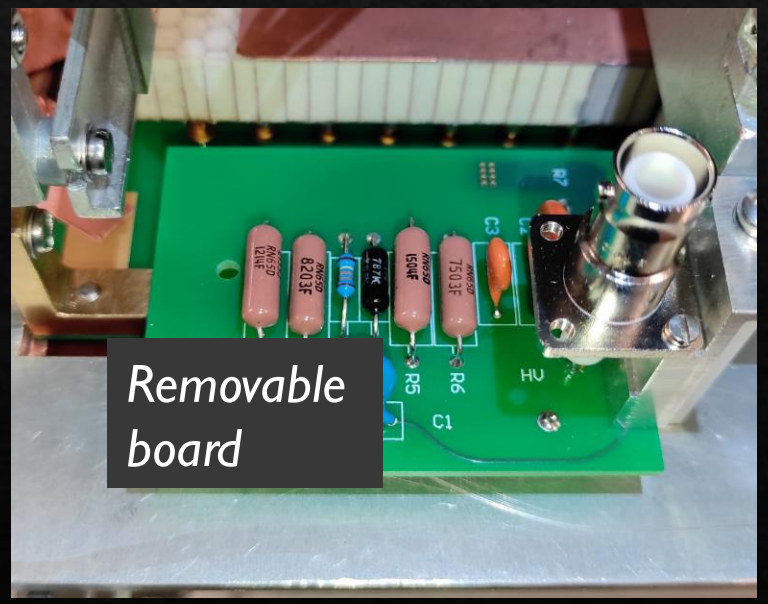


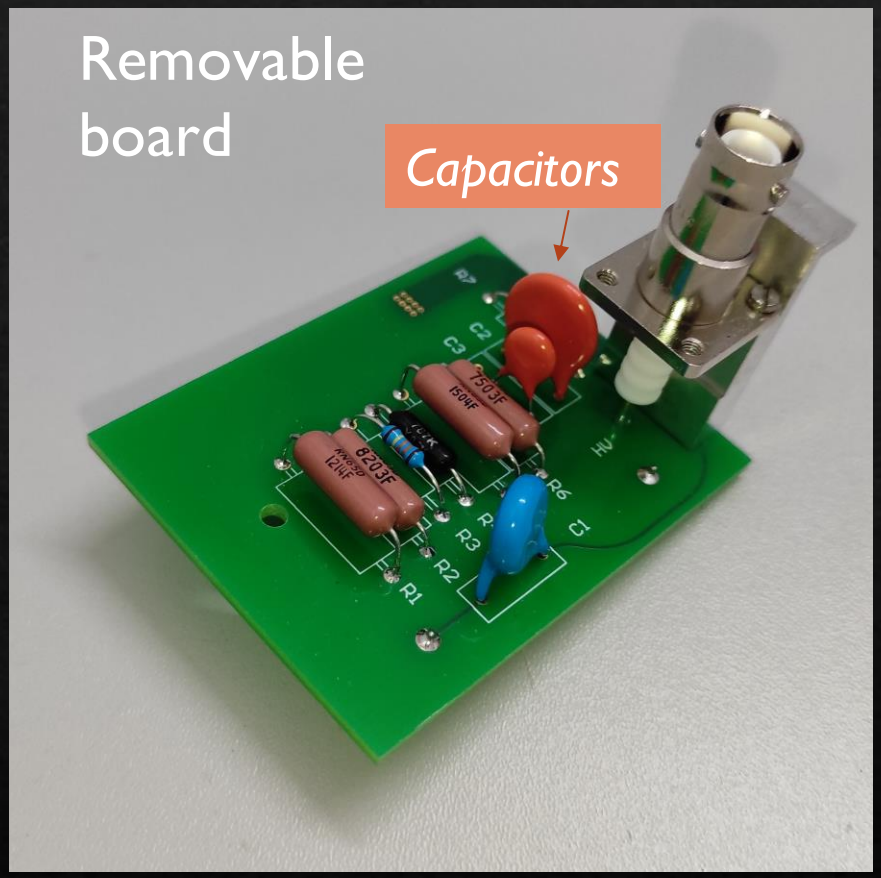
Detectors installation sequence



New type HV divider

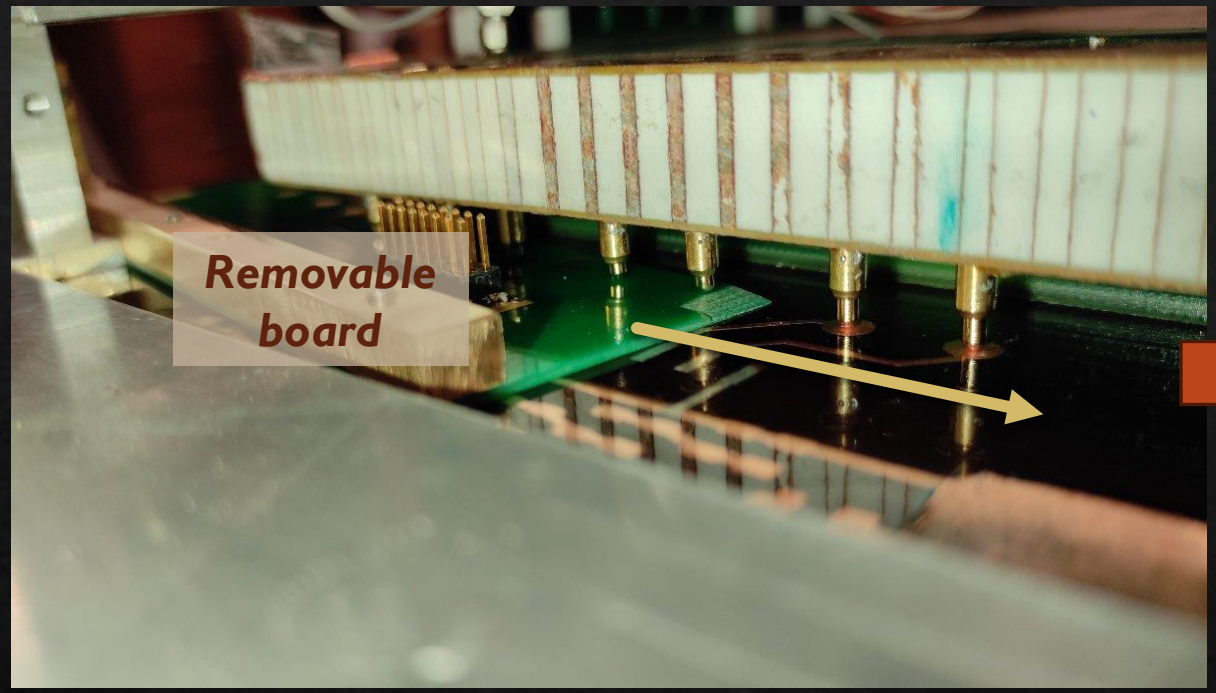


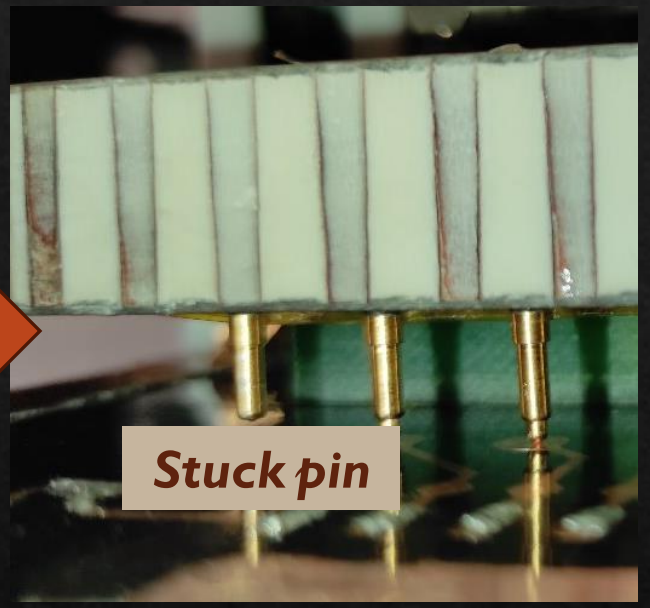




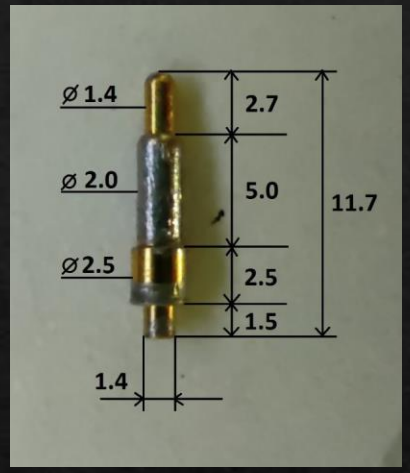
The second version of the removable board, in addition to resistors, contains capacitors, that act as voltage stabilizers. This idea was proposed to solve the problem of signal amplitude reduction due to high loads during a run.

Replacing pogo pins

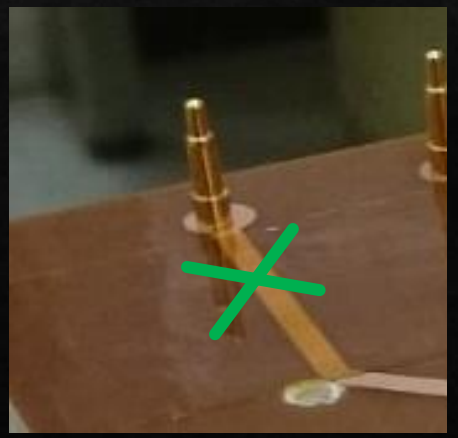




Parameters of old and new pins



Destruction of the line and pad during resoldering



Copper line torn off the cathode

M12

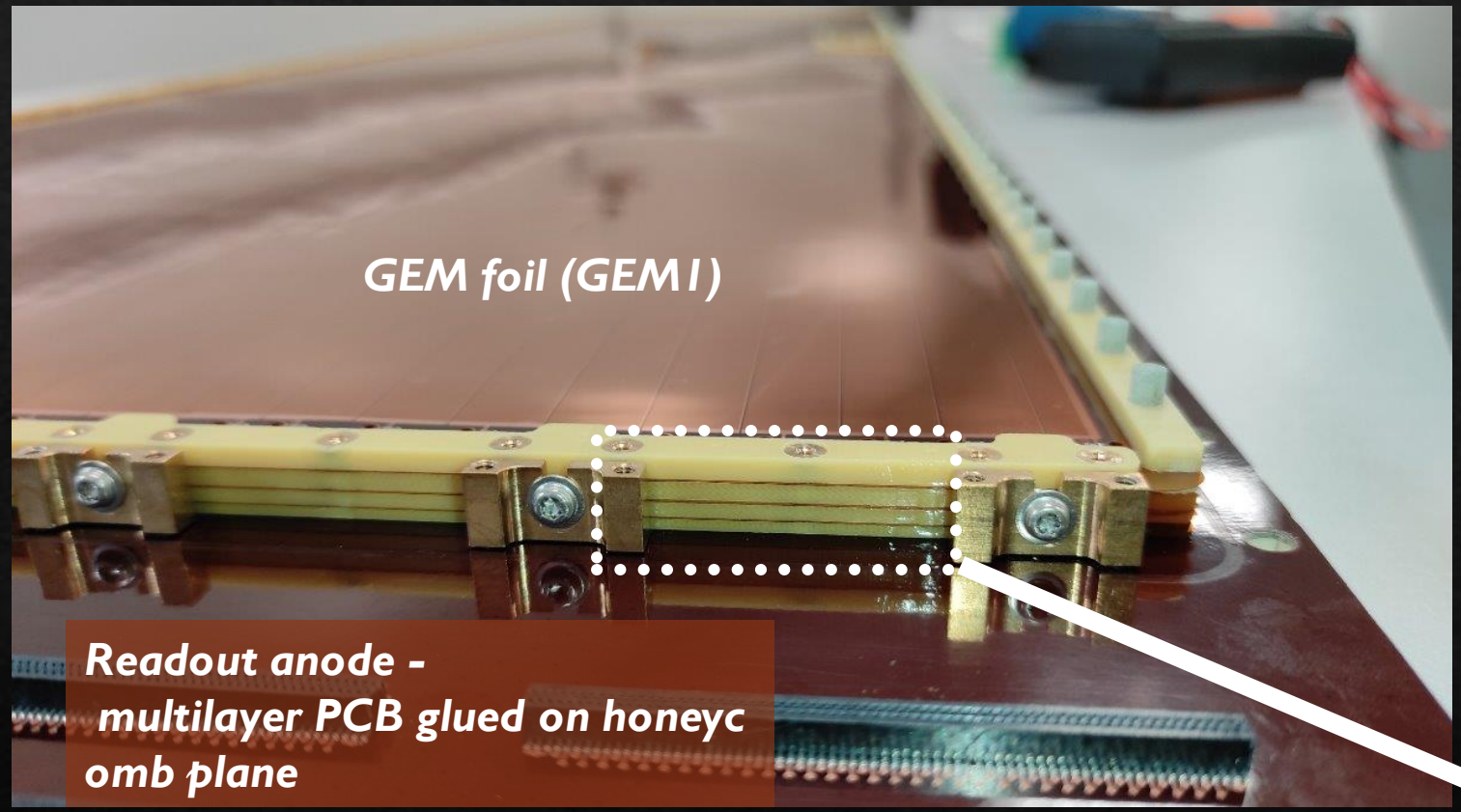
During testing with cosmic rays, the detector began to trip. It was decided to use a channel-by-channel high voltage supply to the detector electrodes. This means that we remove the divider and manually set the required voltage for each electrode. Using this scheme, we observed that the discharge occurs on the top foil and then on the cathode. We assumed that there was a dust in the detector.

To get rid of this, it is necessary to fill the detector with Nitrogen and try to burn the dust with an insulation tester. In case of M12, this procedure did not help.

We found a short in the top foil that could not be repaired while the detector was closed.

Therefore, it was decided to open this detector.

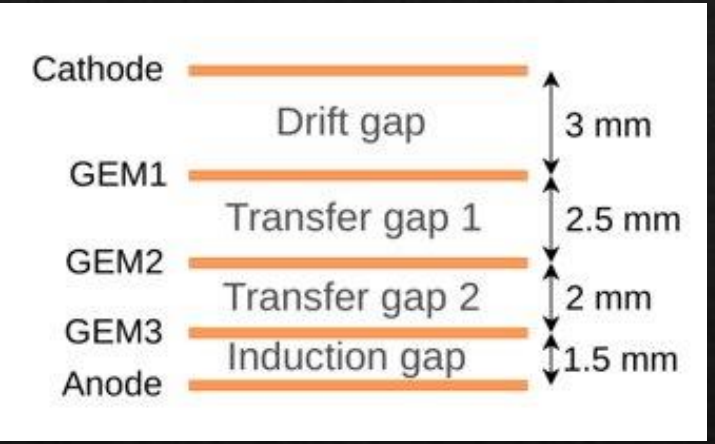
GEM detector construction



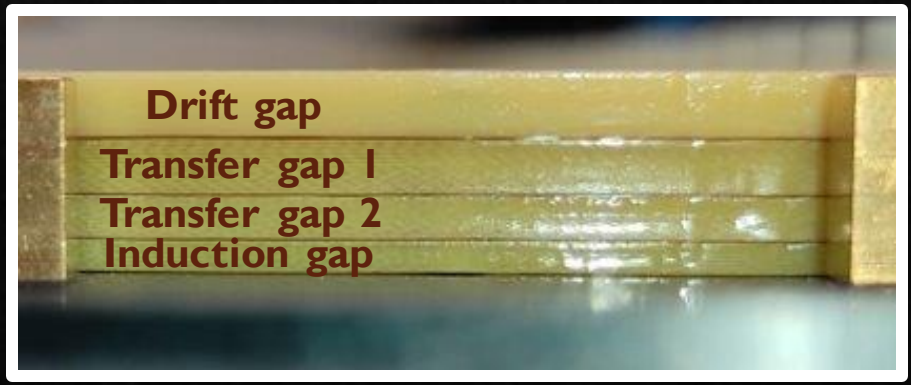
GEM detector without cathode plane

Cathode PCB made on Kapton and glued on honeycomb plane.

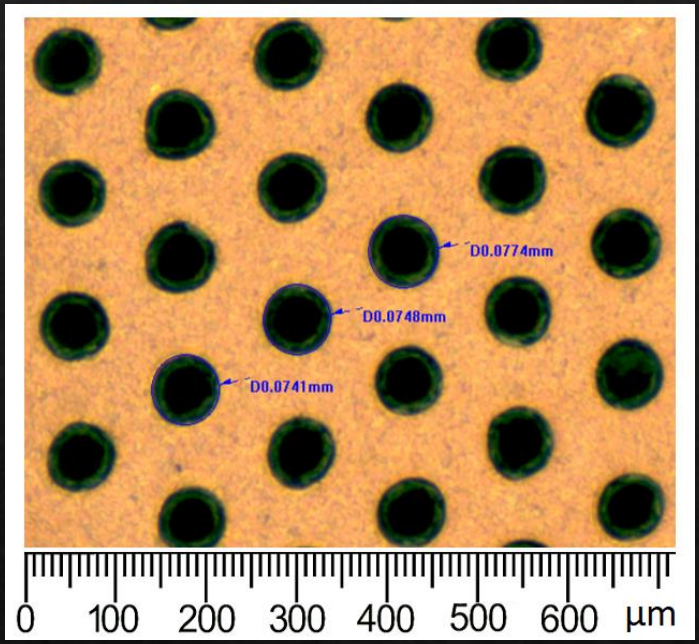
Schematic cross section of the GEM detector

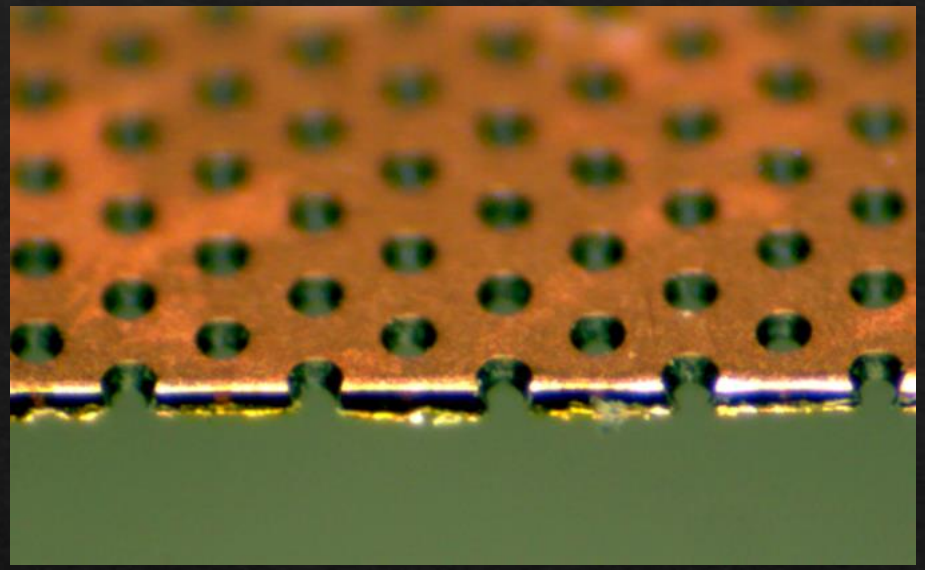


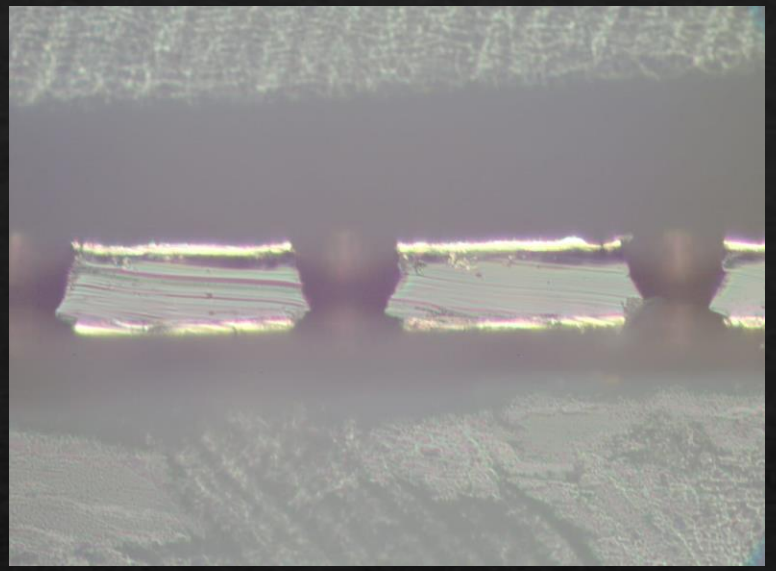
Frames defining distances between G EM foils



GEM foil structure



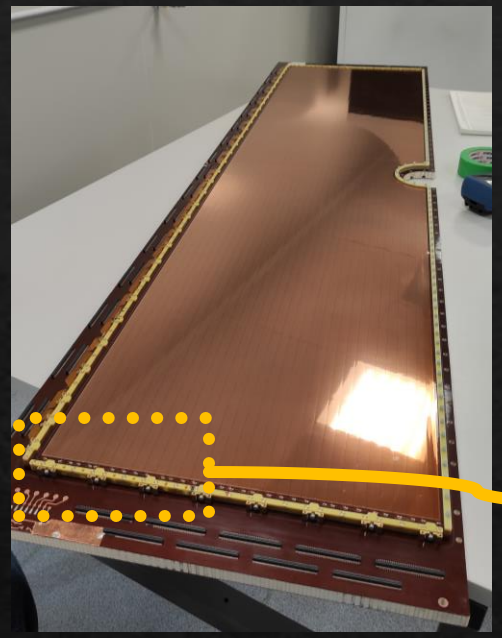


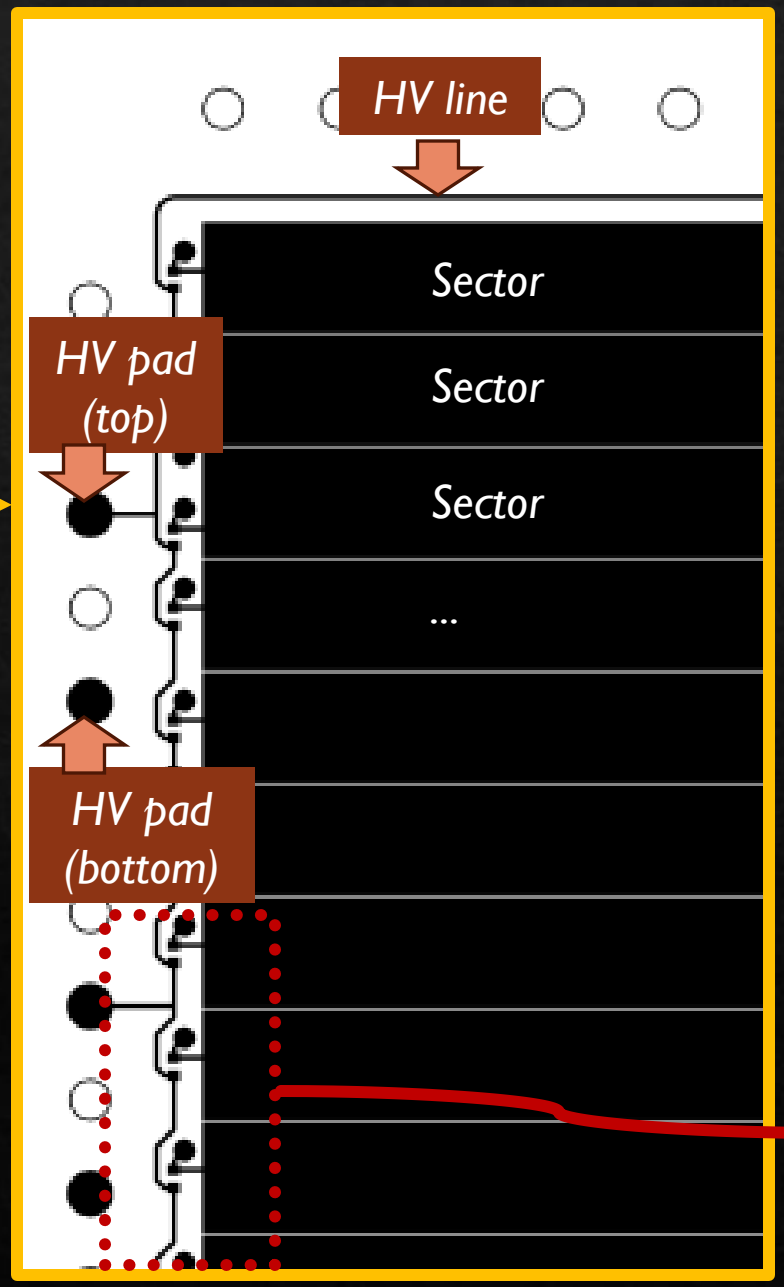


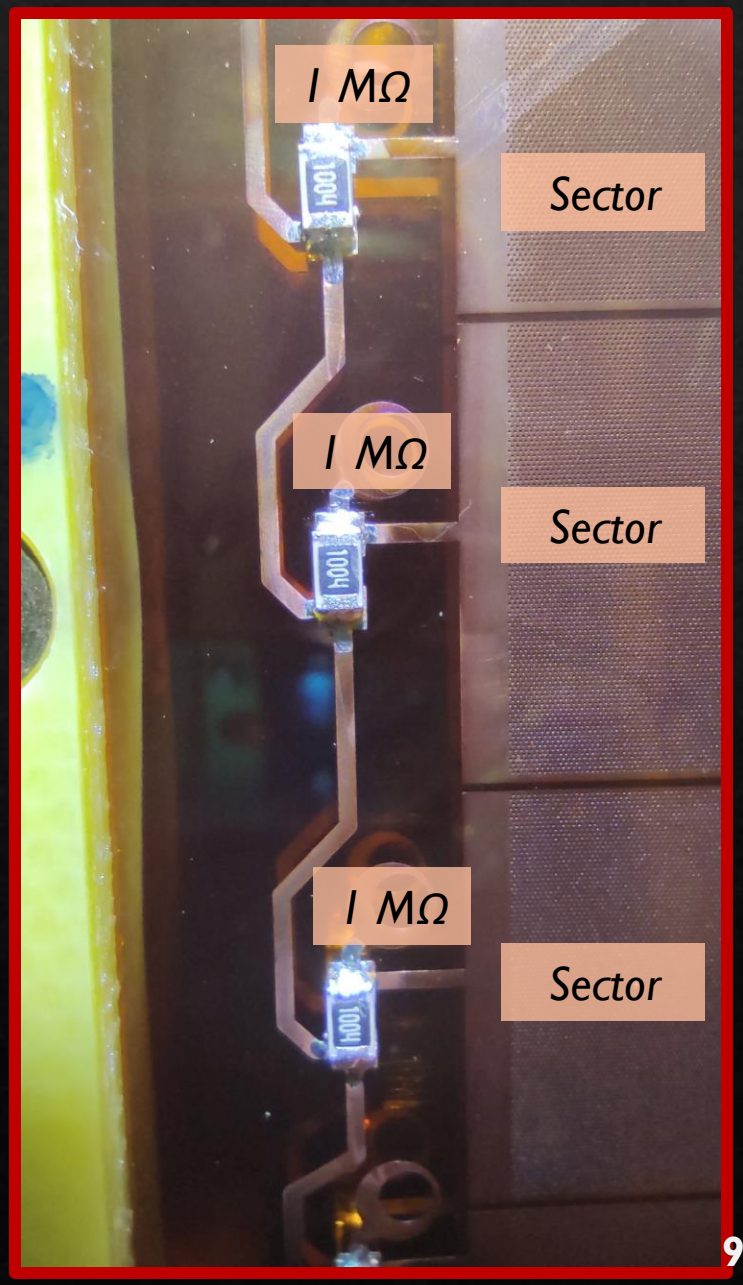
Microscopic pictures of the GEM foil

Schematic cross section of the GEM foil

GEM foil sectors







On the top surface of the foil there is a copper line from the pad. Each sector is connected to this line through a 1 MΩ resistor. The bottom surface is not divided into sectors.

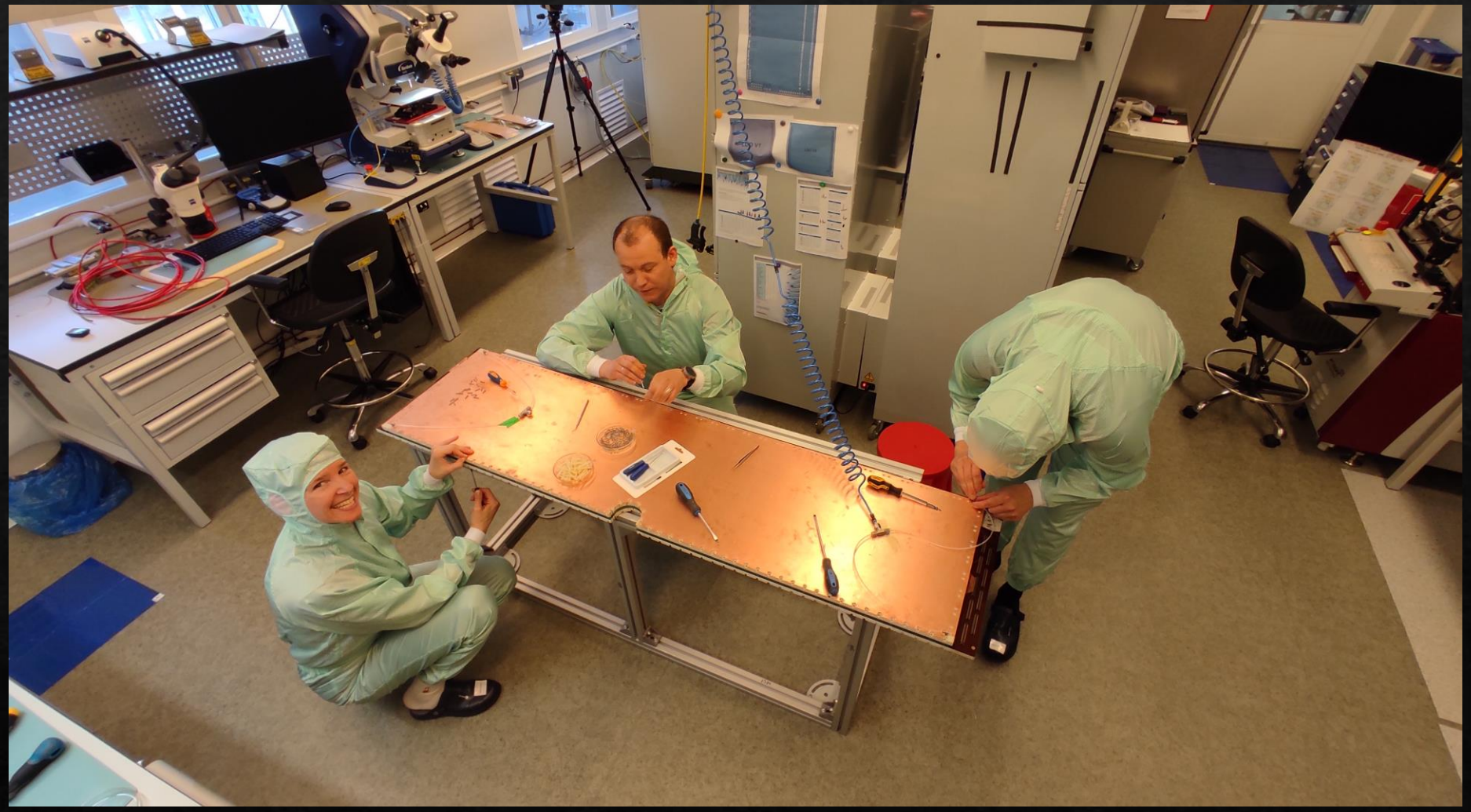
Short circuit between sector on the top and bottom surface

Opening of the GEM detector (M12)

Yuri Murin's clean room

Alexei Sheremetev
Dmitrii Dementev

To prevent dust from entering the detector when removing the cathode plane, a nitrogen gas line was connected to the detector.



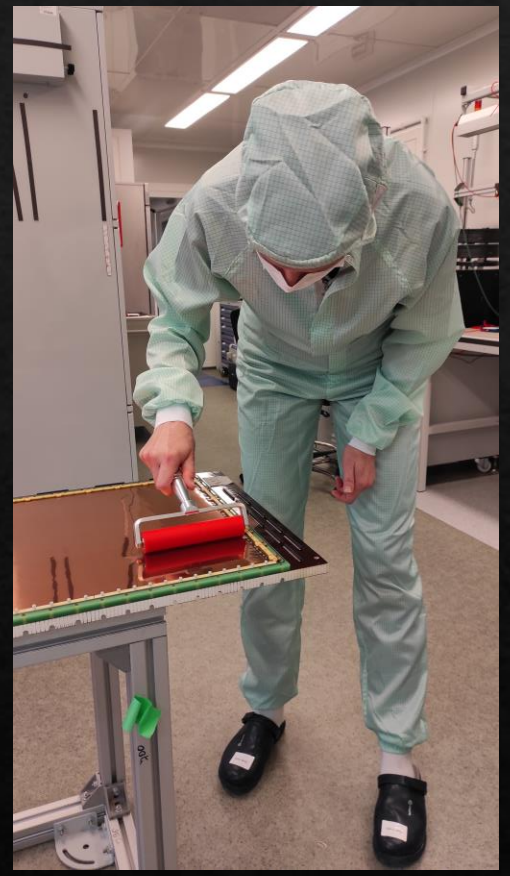
Why do we need to open the detector?

If one foil is shorted, the remaining two foils in the detector will not be sufficient to provide the required gain.

When the detector is opened, we can clean the foil using a roller (photo), and also try to burn through the dust again using an insulation tester.

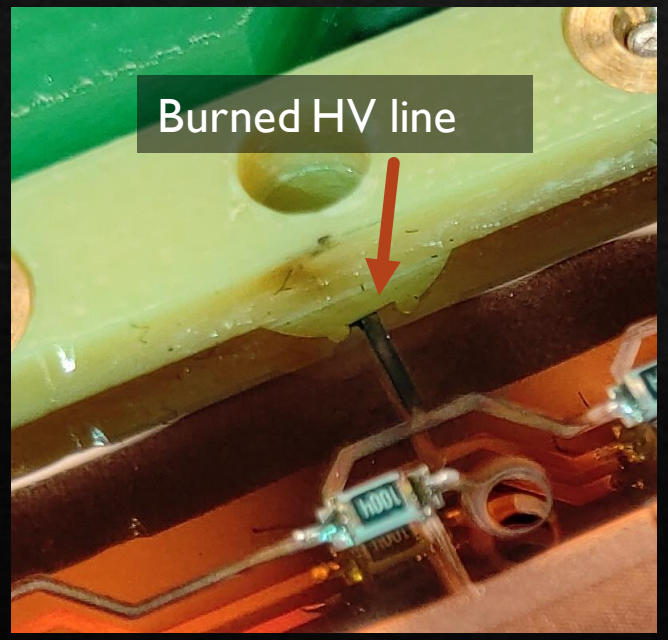
We may also see a defect that cannot be repaired.

If the problem cannot be solved, then in the worst case, we can remove the resistors on the non-working sectors. Thus, the foil will work except for these sectors.

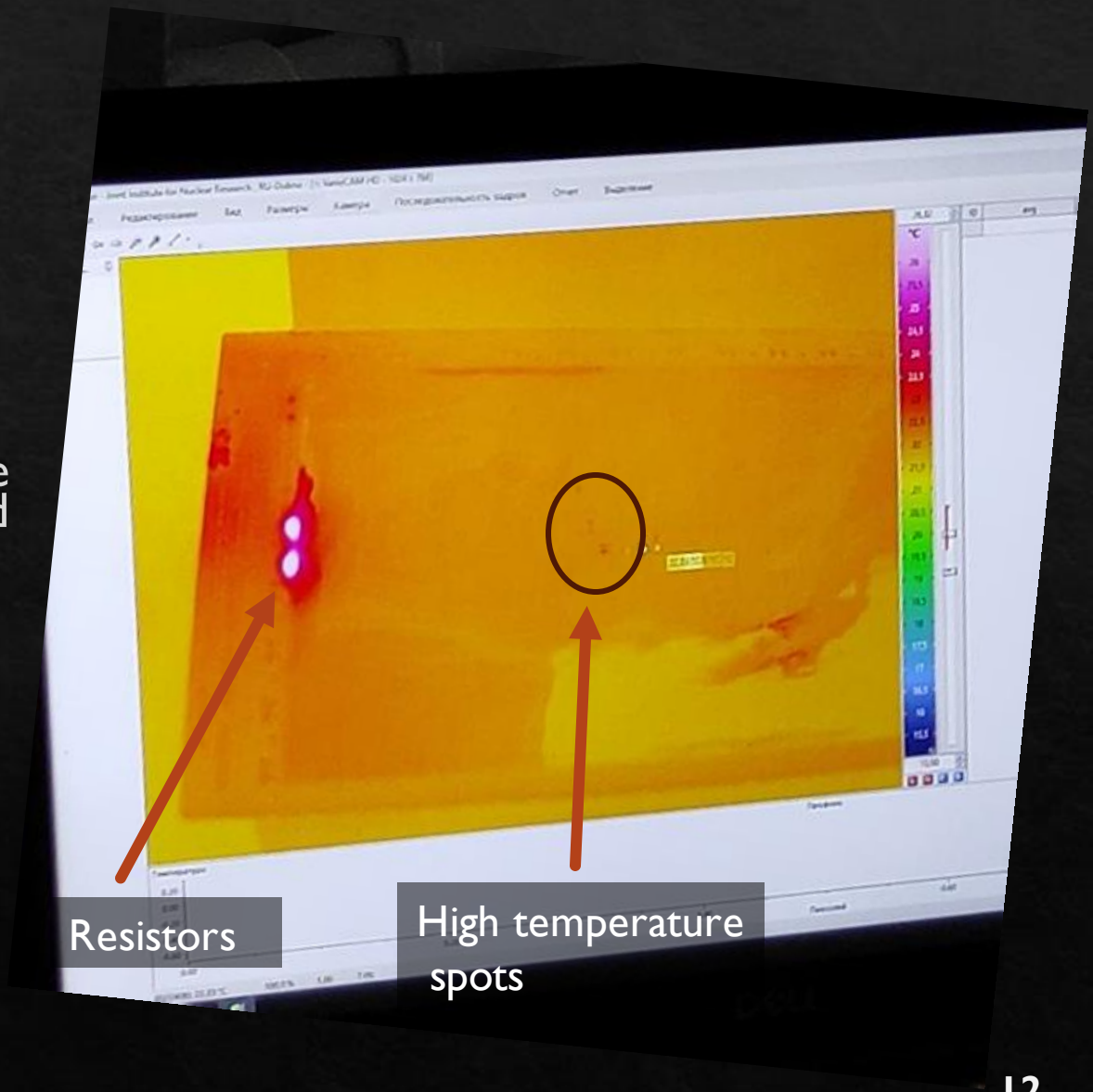


Investigating problems found inside the detector

- After opening of the detector, we first discovered two sectors with a short circuit, measuring all the resistances.
- It was also discovered where the discharge most likely occurred between the top surface of the foil and the cathode. The area was then taped with Kapton tape for insulation.



- Cleaning with a roller and compressed nitrogen, as well as applying high voltage with an insulation tester did not help get rid of these short circuits.
- Then it was decided to try to examine the foil using a thermal imager. Spots with higher temperatures were noticed in our sectors.
- Then the detector was moved to another clean room.

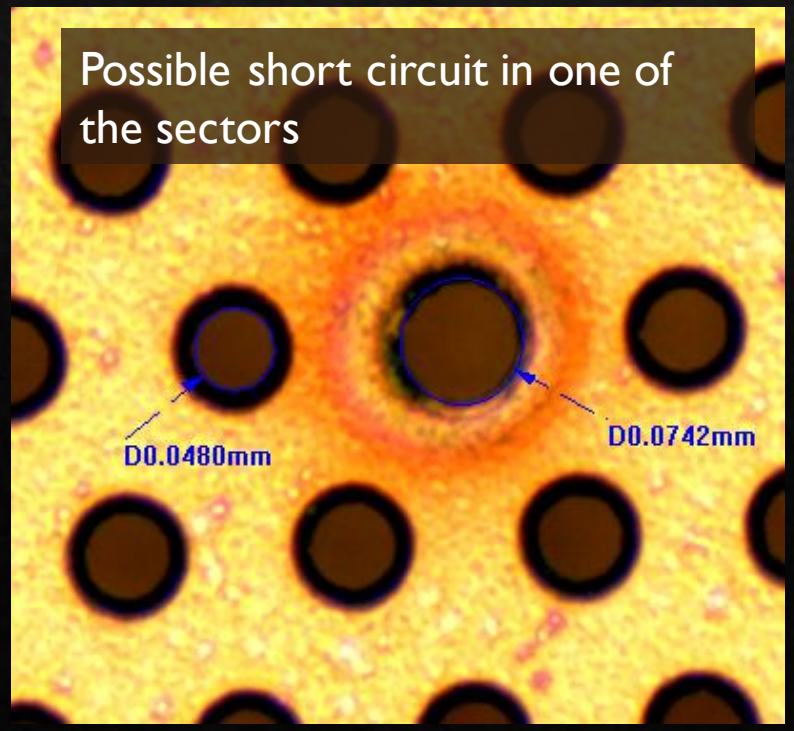


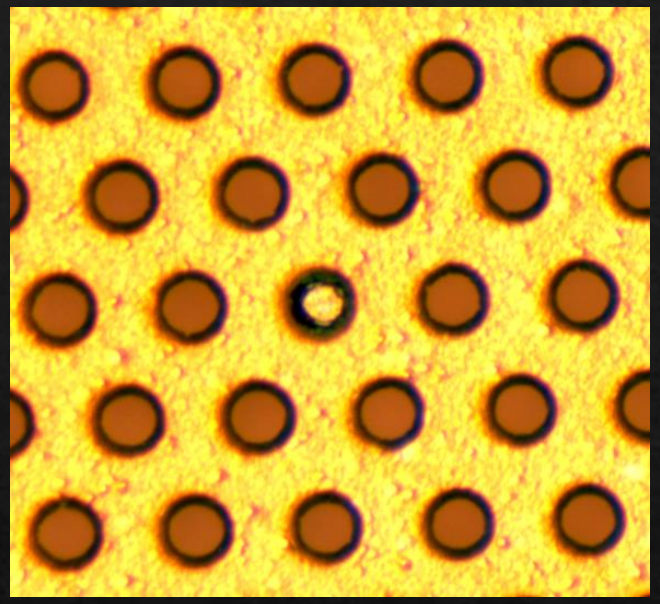
Defects on GEM foil

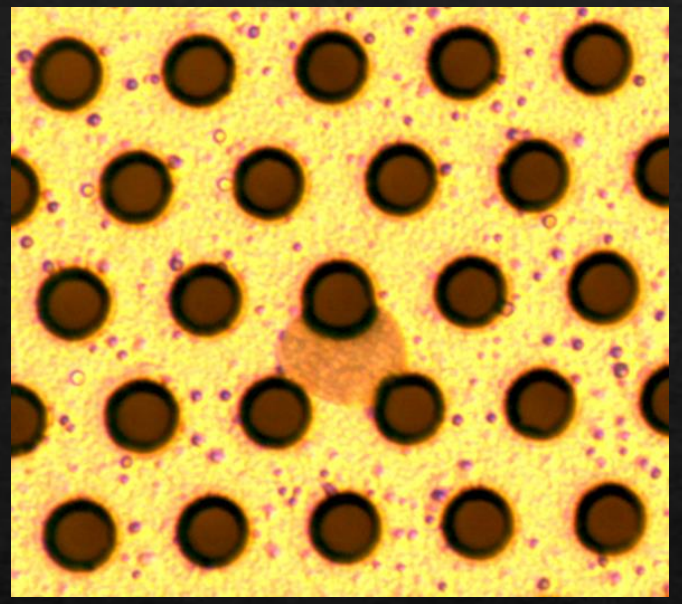
Nicolai Zamyatin's clean room

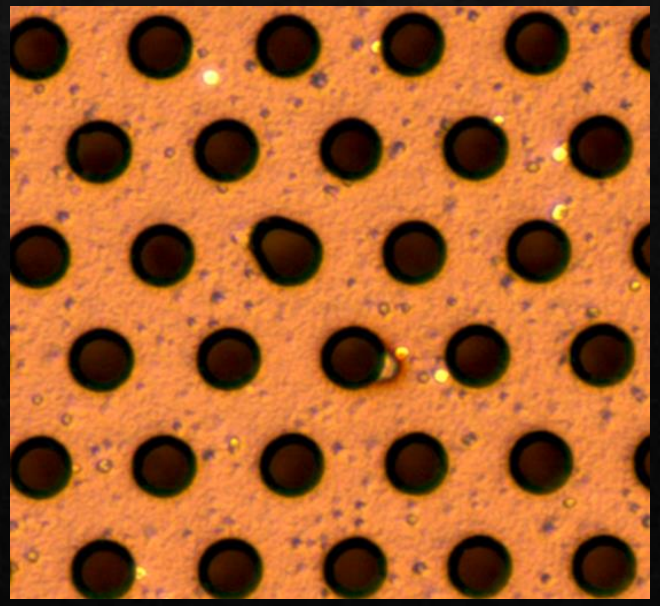
Oleg Tarasov

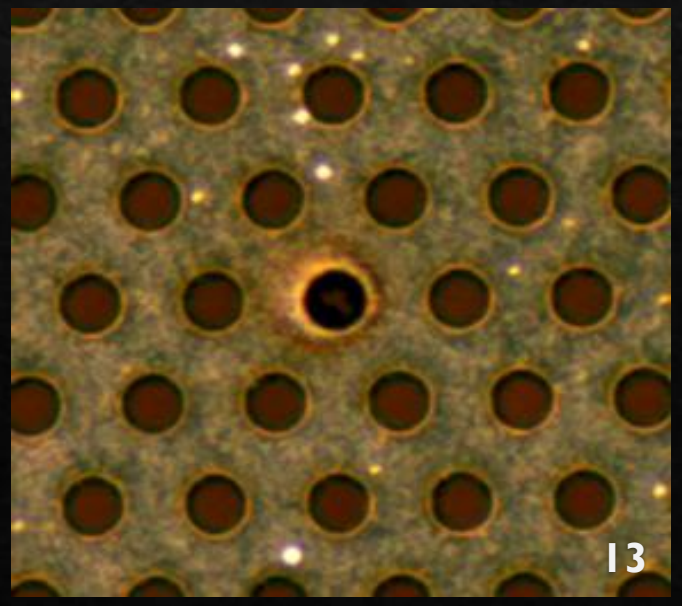
The detector was then moved to another clean room to examine the sectors using a microscope. Various defects were found across the entire surface of the foil. But no unique defects were found in the required sectors.









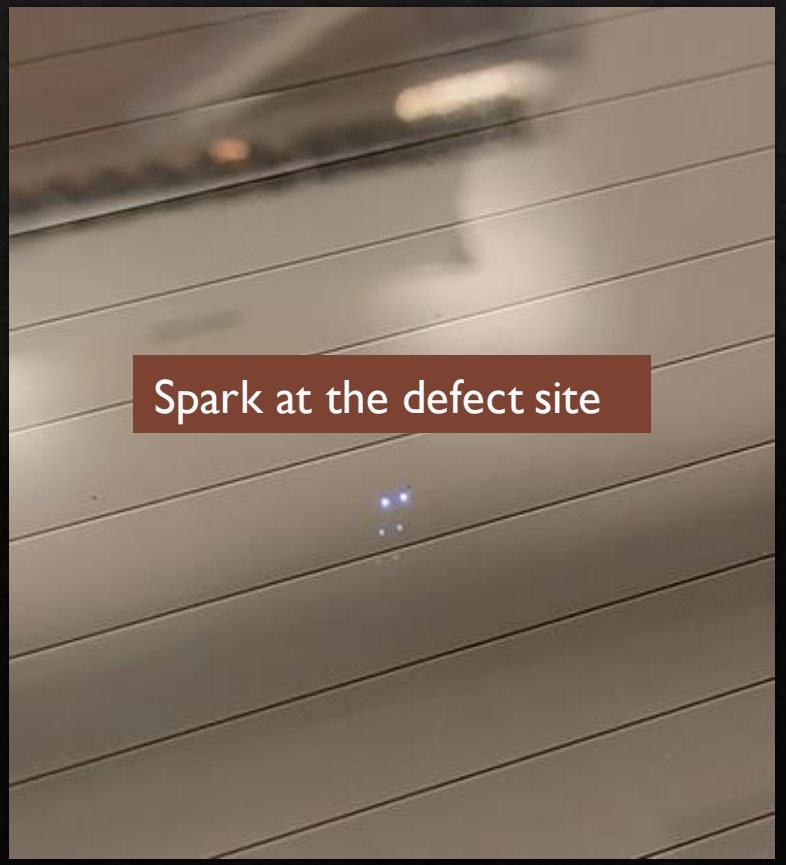


Burning out of the defects without resistors

Therefore, it was decided to unsolder the resistors and try to burn through the defects by applying high voltage directly to the sector.

Sergei Khabarov

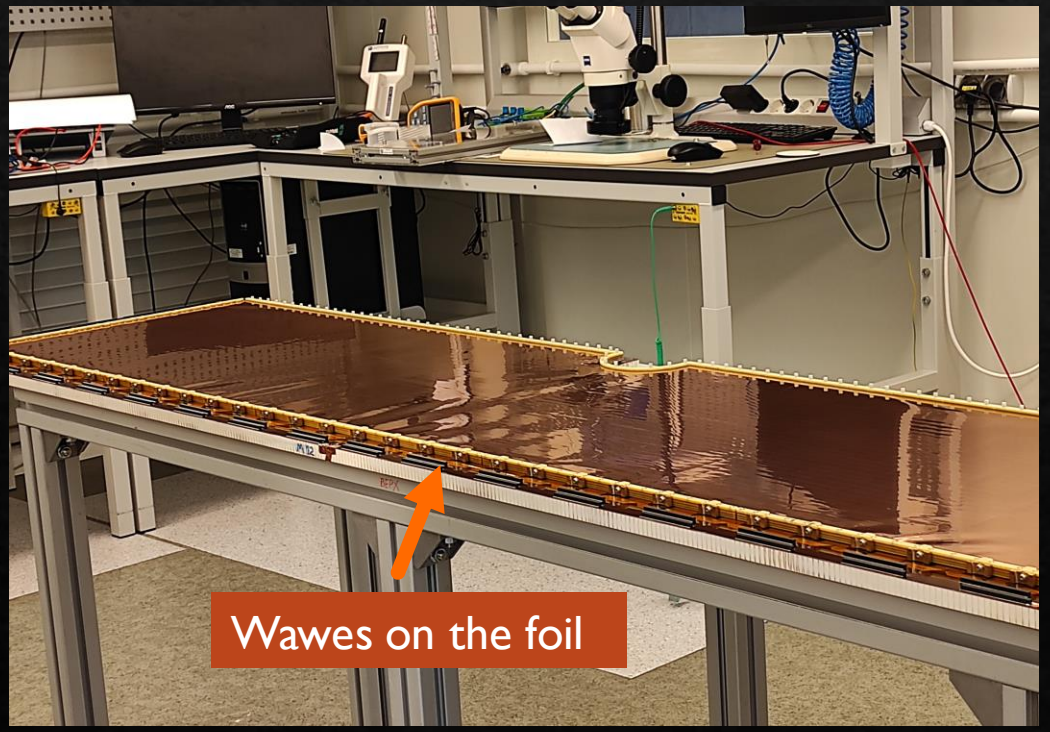
Normal use of an insulation tester did not help. Semen Piyadin suggested using it as a capacitor. This means charging the device when the probes are not into contact with the sectors, and discharging through the sector. This method led to a successful result. Short circuits were burned out.

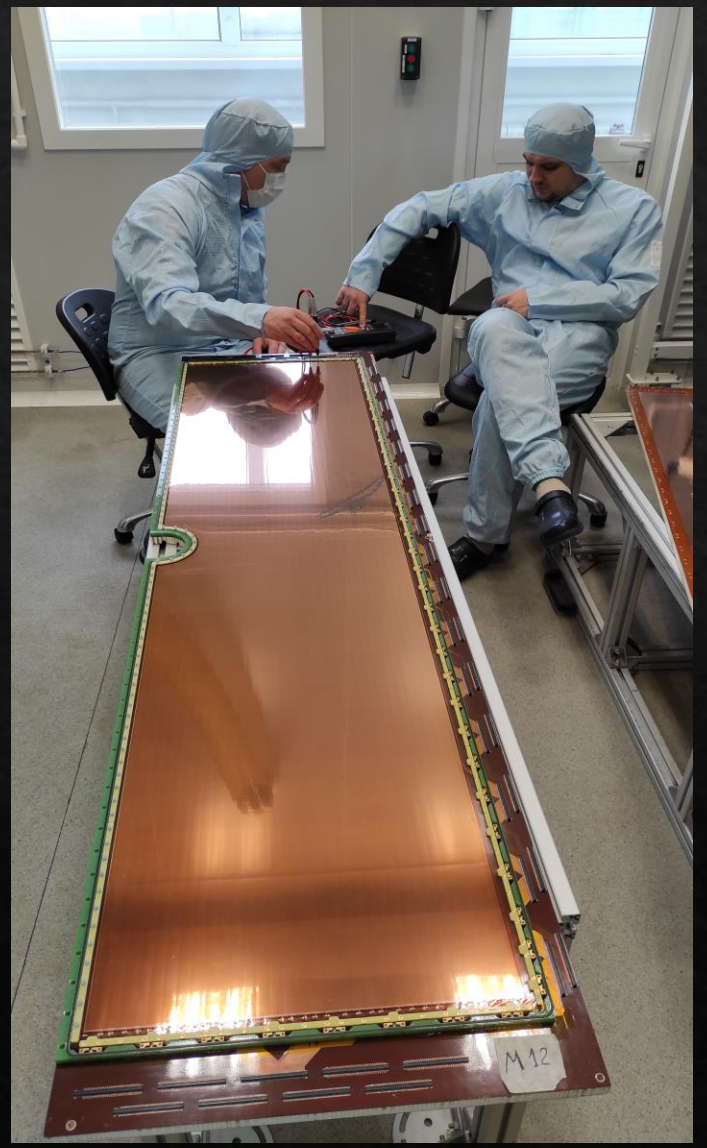


Humidity and the GEM

Yuri Murin's clean room

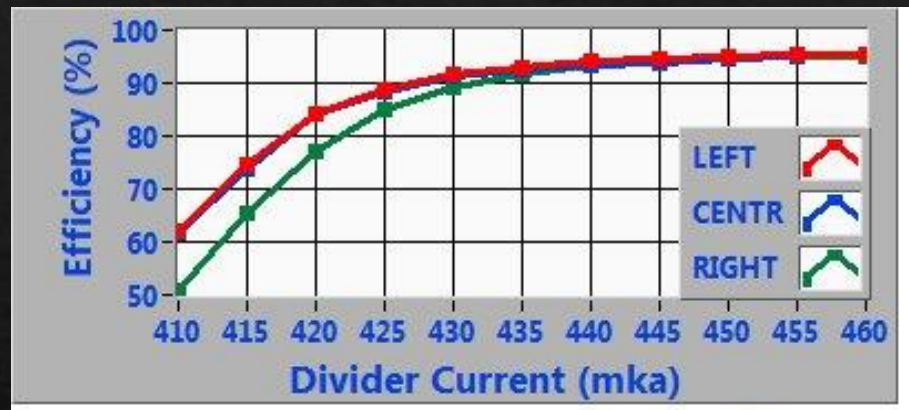
Changes in weather have increased the humidity in the cleanroom. We saw a decrease i n the resistance on the foil. App lying high voltage to the foil led to new short circuits. The foil became wavy.

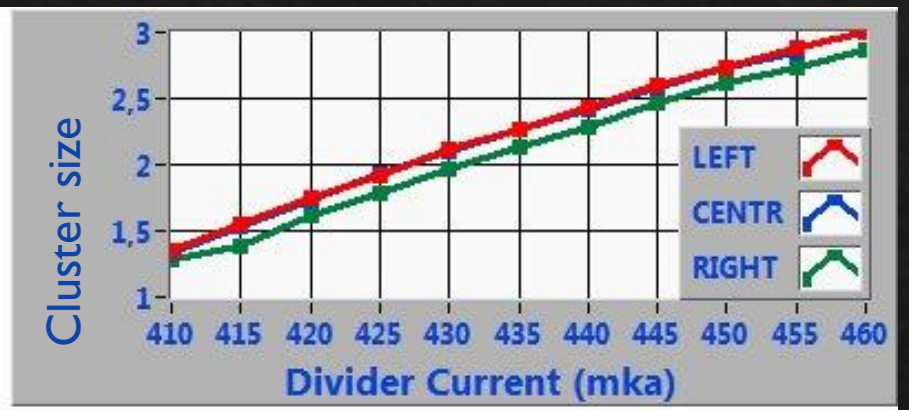


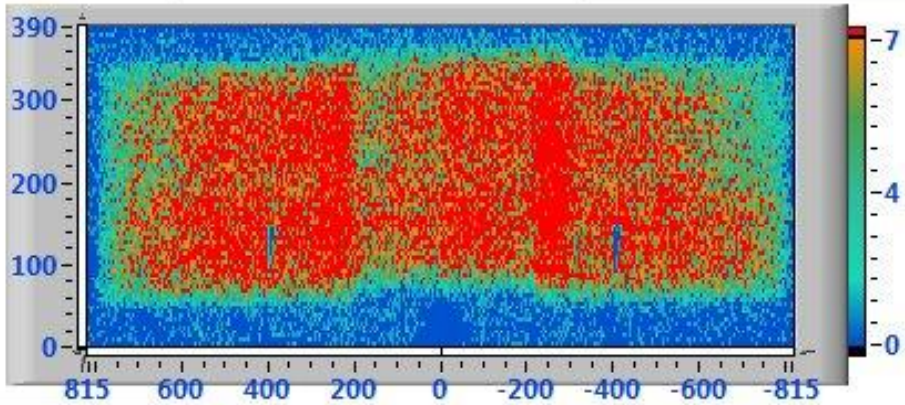


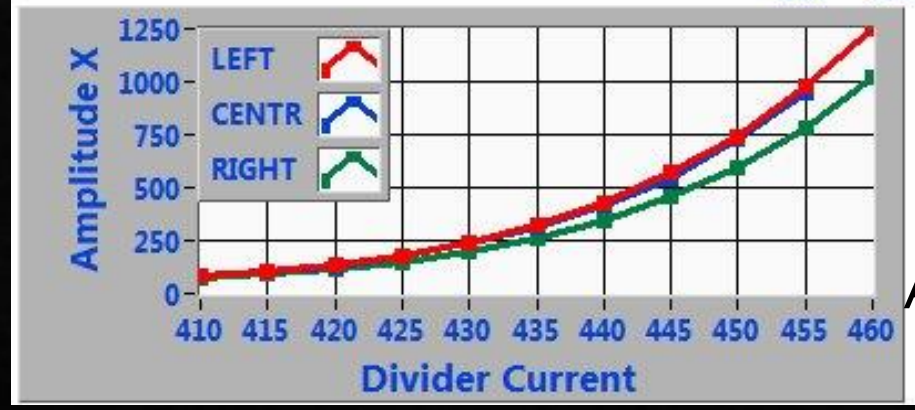
The detector was moved to another clean room with an air humidity of 7%. During the day, the detector dried out and some short circuits disappeared. The remaining short circuits were burned out.

M12 cosmic test: three areas - left, center, right

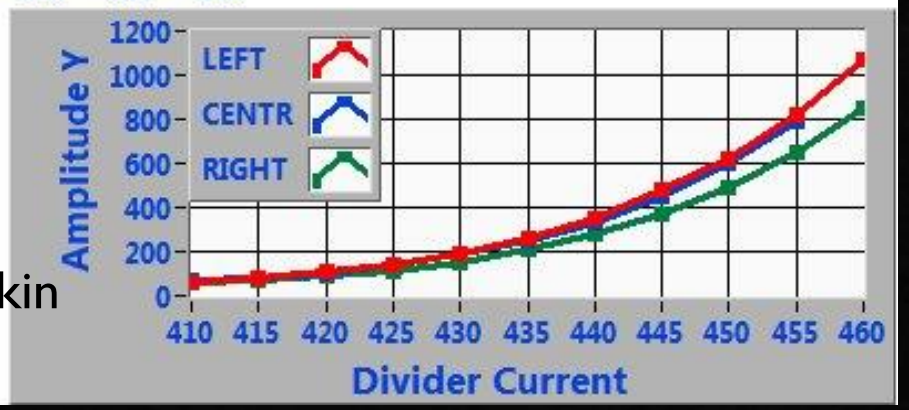






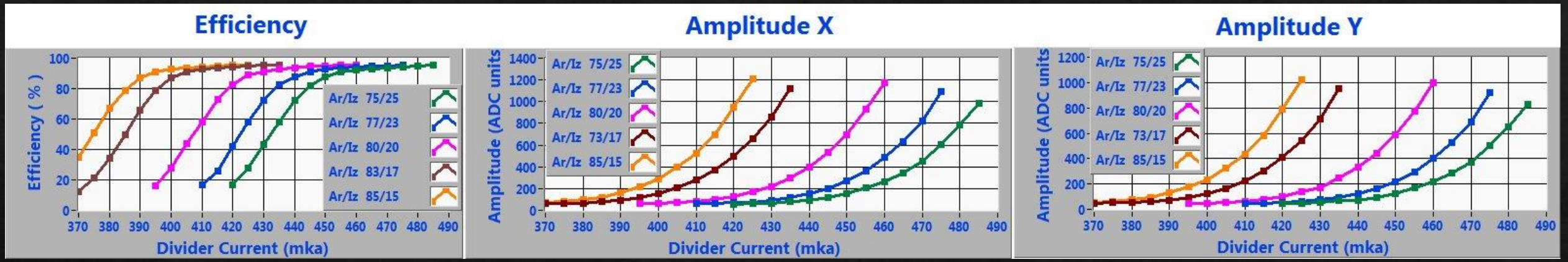


Alexander Makankin



M12 cosmic test

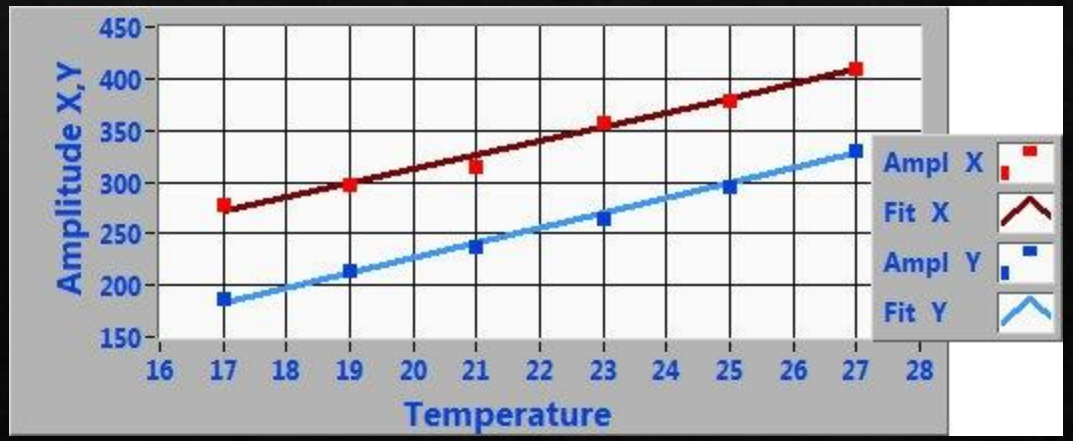
Efficiency and amplitudes of M12 left at various ratios of argon and isobutane in the gas mixture



Dependence of the divider current on the percentage of Ar in the mixture

± 1% Ar ⟶ ± 6,2 μA (± 50V)

Dependence of the signal amplitude on the temperature of the gas mixture. Divider current - 435 μA.



1 degree ⟶ 15 ADC units

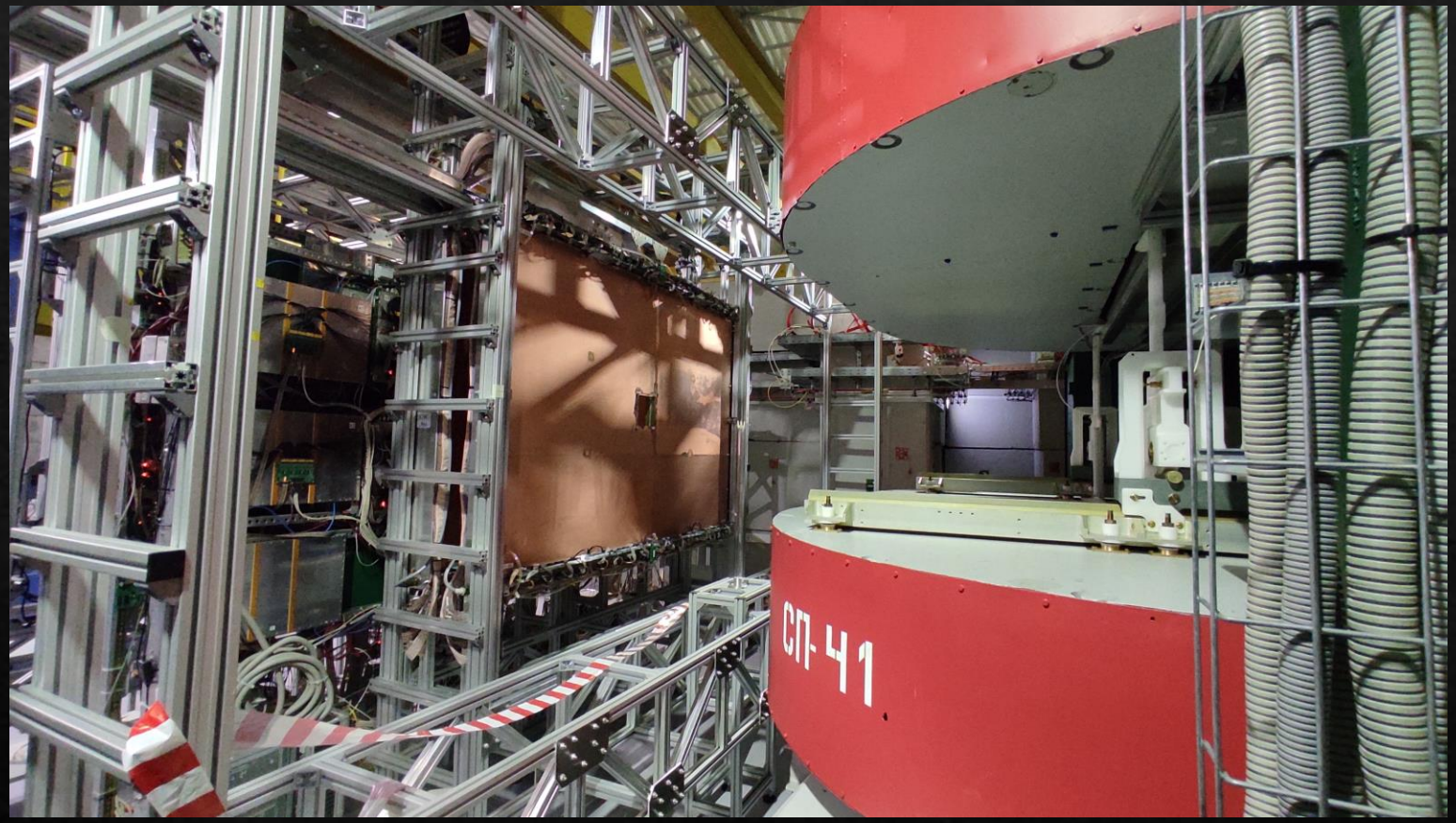
GEM detectors preparation

	Top GEM detectors							Bottom GEM detectors						
	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18
Remove the mechanics	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Remove old HV divider	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Cut off the protective Kapton	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Resolder pins	✓		✓❄	✓	✓			✓	✓	✓	✓	✓	✓	✓
Clean after soldering	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓
Check the pin plungers	✓			☹1	✓			✓	✓	✓	✓	✓	✓	✓
Check for short circuit	✓				✓			✓	✓	✓	✓	✓	✓	✓
Glue on new Kapton	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓
Prepare a stationary PCB	✓				✓			✓	✓	✓	✓	✓	✓	✓
Install the removable divider PCB	✓							✓	✓	✓	✓	✓	✓	✓
Install the mechanics					✓			✓	✓	✓	✓	✓	✓	✓
Test with cosmic rays (new pins)								✓	✓	✓	✓	✓	✓	✓

❄ A different type of pin was soldered here. These pins will need to be replaced with the latest type of pins.

1 The plunger of one pin is stuck. This pin must be replaced with a new one.

CSC status



2 Large CSC are installed.
Installation of 4 CSCs will be carried out after all GEM detectors will be installed. Installation sequence is following:
2 CSC, 2 new ToF-400, 2 CSC

Conclusion

- Bottom GEM detectors are ready for installation. Final tests will take place within a week after the meeting. Then it is planned to install them in the experimental hall.
- Top GEM detectors are in the process of preparation.
- Two Large CSC are installed, four Small CSC are waiting for the installation.

Thank you for your attention!