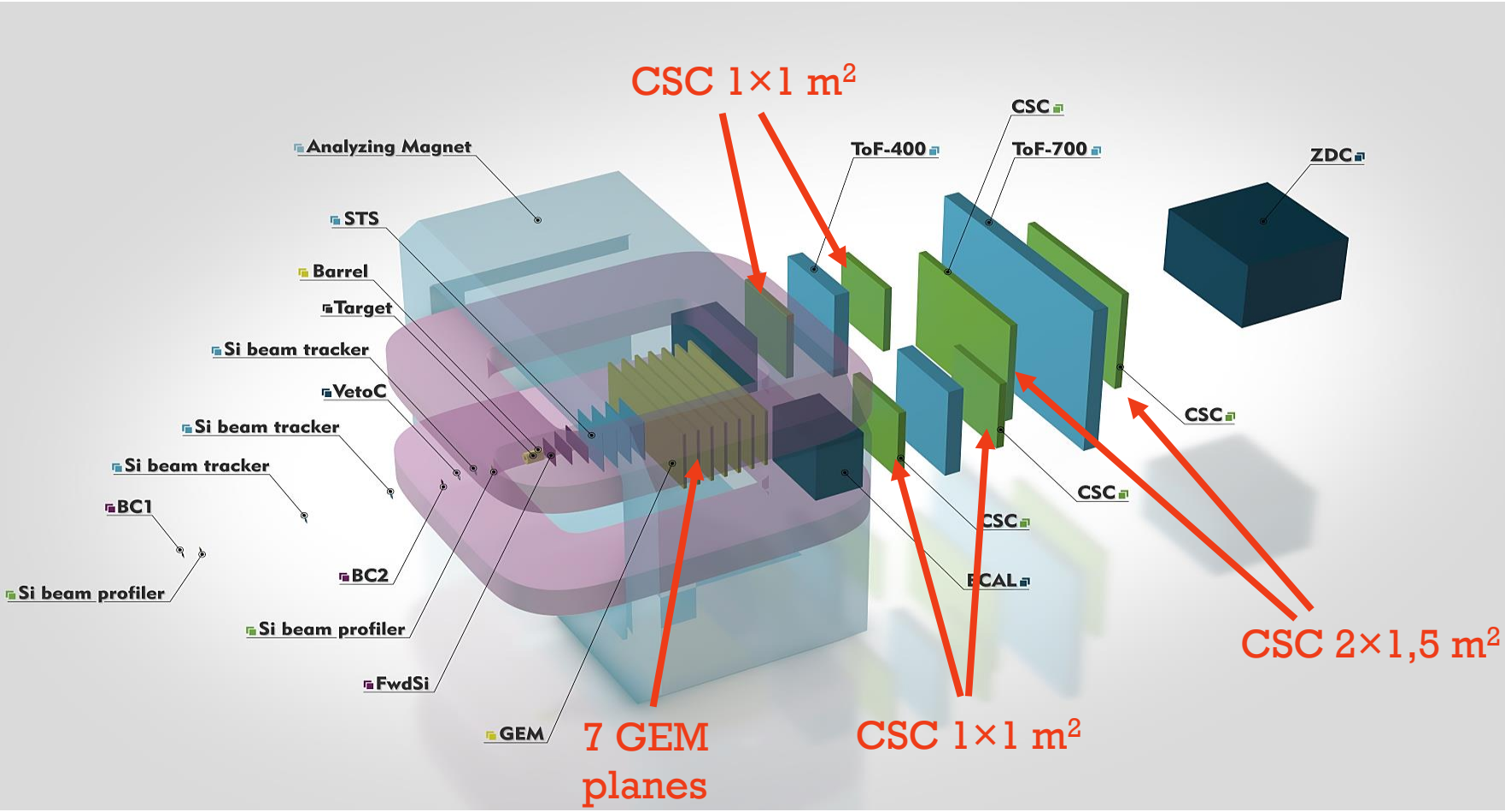
GEM/CSC tracking system status

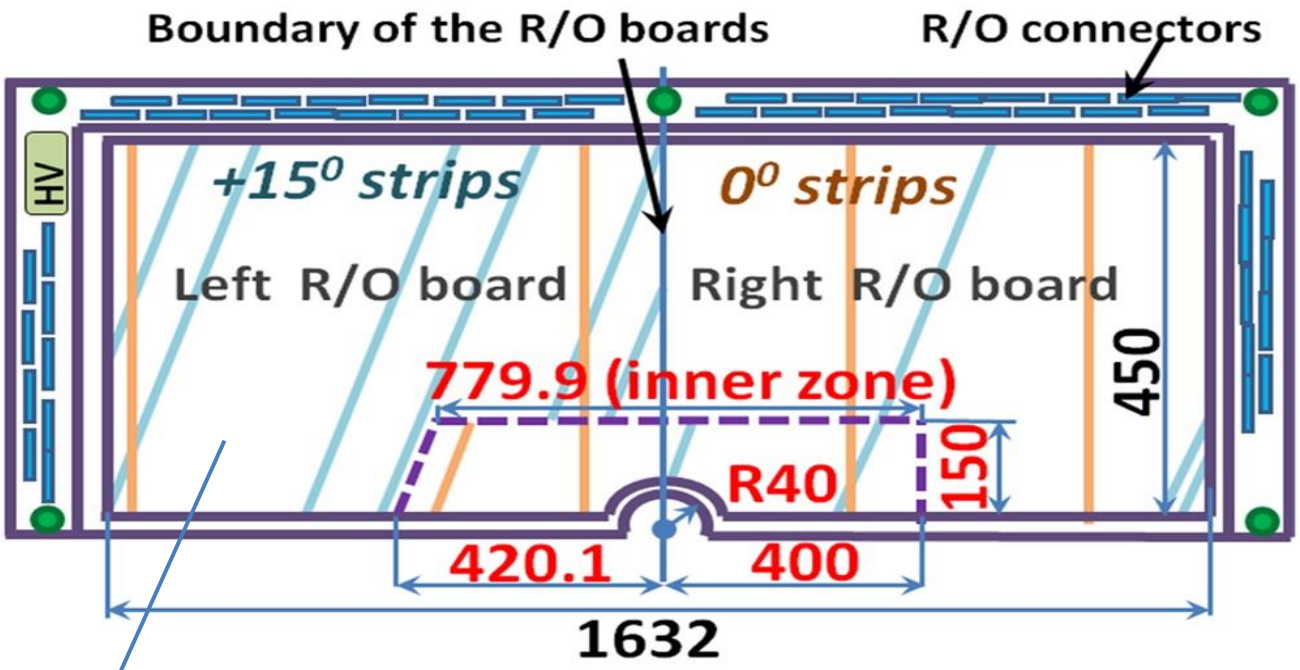
Andrei Galavanov on behalf of BM@N Collaboration

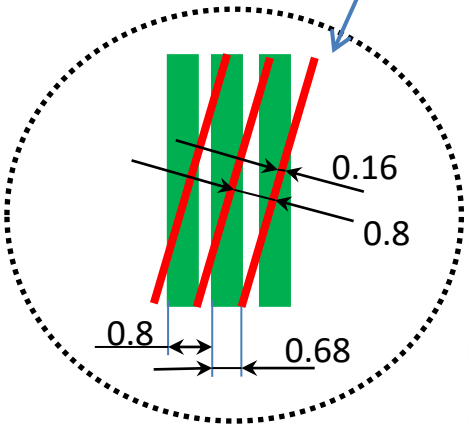
6th Collaboration Meeting of the BM@N Experiment at the NICA Facility, 26.10.2020

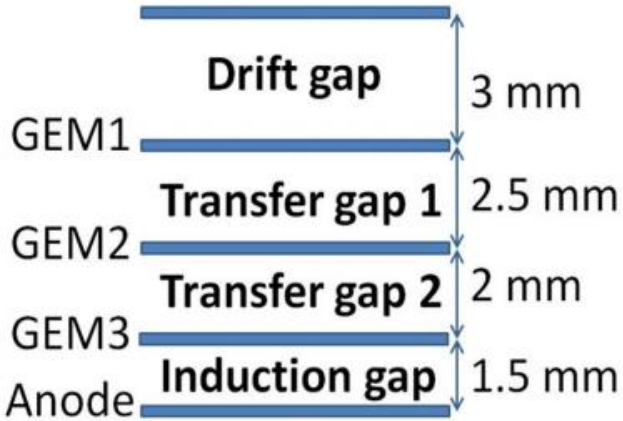
BM@N experiment



BM@N GEM detectors





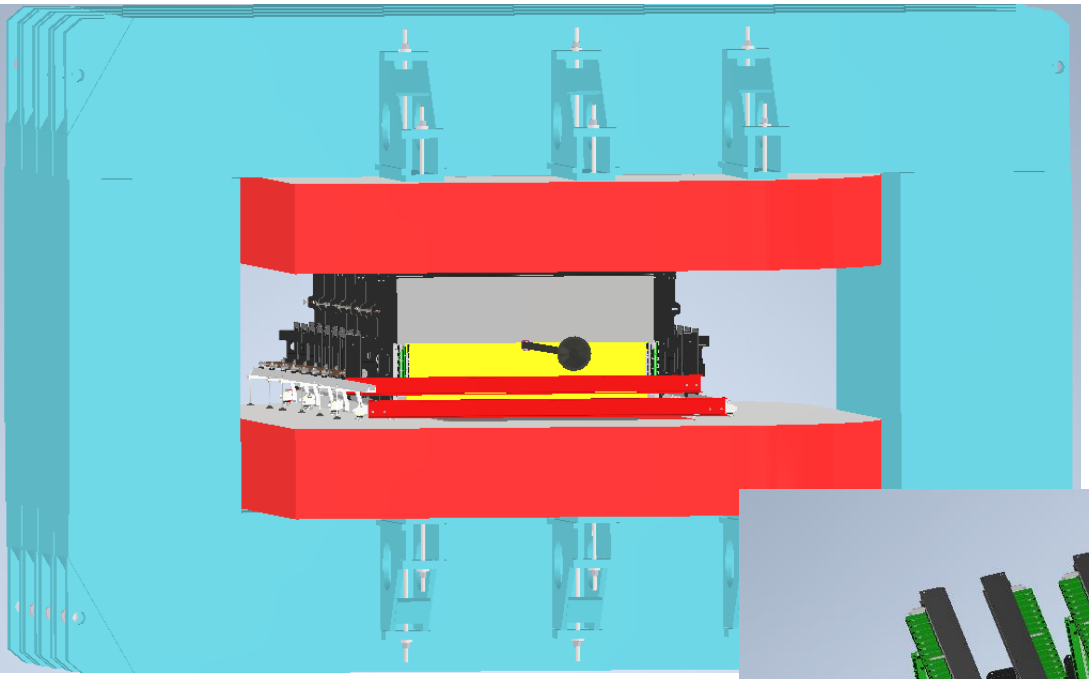


Now we have:
7 detectors 1632 × 450 mm^2
7 detectors 1632 × 390 mm^2

2 spare detectors will be produced in 2021

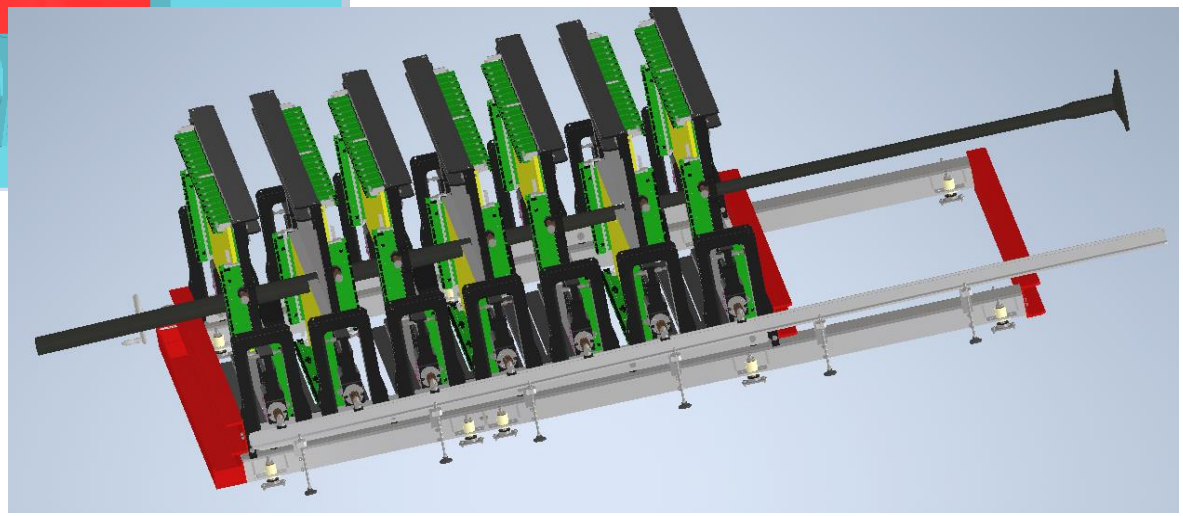
Schematic cross section of the BM@N triple GEM detector

Full planes configuration inside the SP-41 magnet



Active area of
the GEM tracking system ~ 9.5 m^2

Space for installation and alignment
is limited by the aperture of our magnet

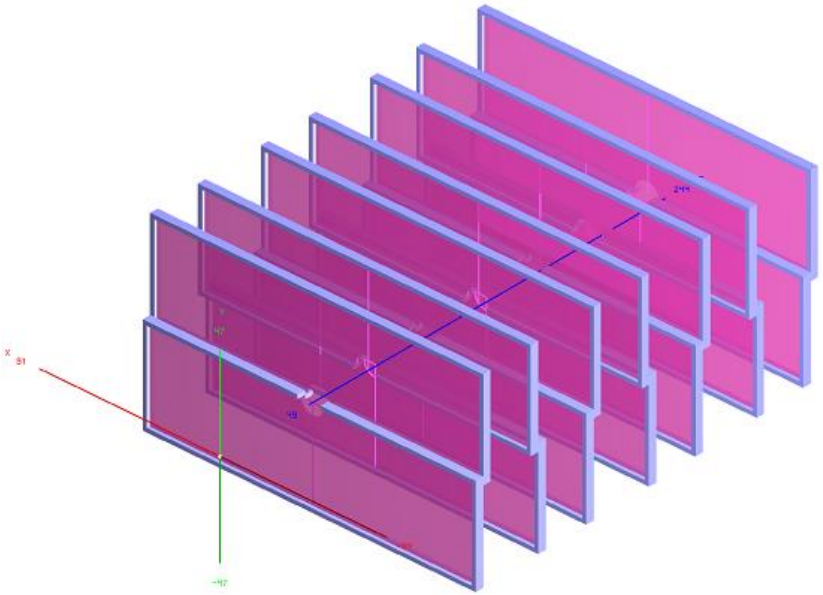


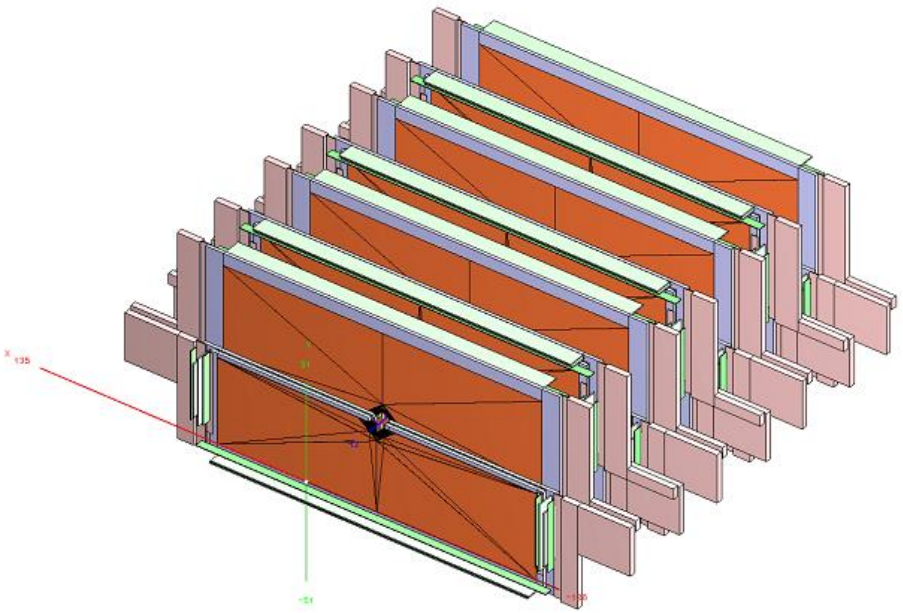
10.2020 – finish of development of the mechanics for GEM planes precise installation inside the magnet.
2021 – mechanics production, installation of the GEM planes.

Development of the mechanics design for GEM planes precise installation inside the magnet was done by "Pelcom" (Dubna). Final cross-checks of the design are performed by BM@N chief engineer and our group.

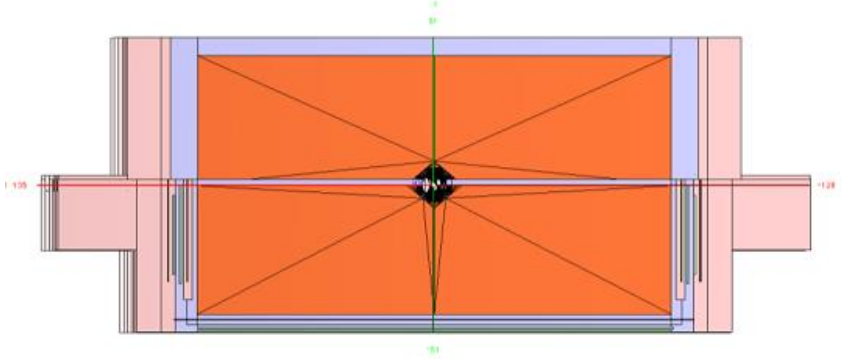
A tender procedure will be initiated to select a manufacturer of support mechanics.

Full configuration of the GEM central tracking system

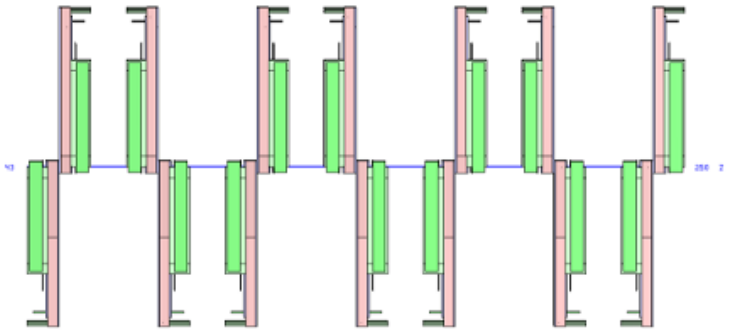




Detailed geometry of GEM planes for heavy ion beam runs (Left panel: GEM active areas, right panel: GEM planes with mechanical support frames and FEE electronics)

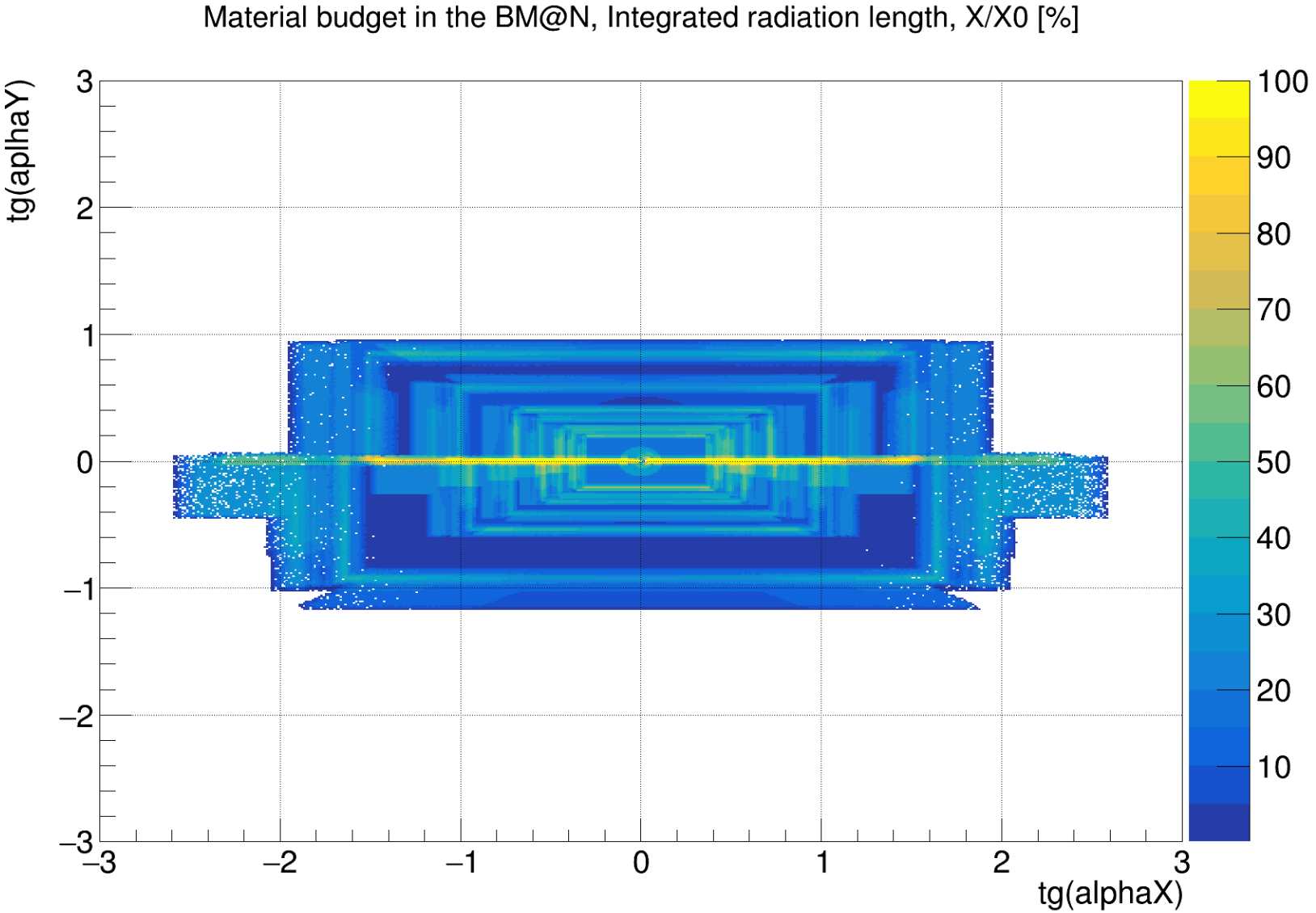


XY projection



ZY projection

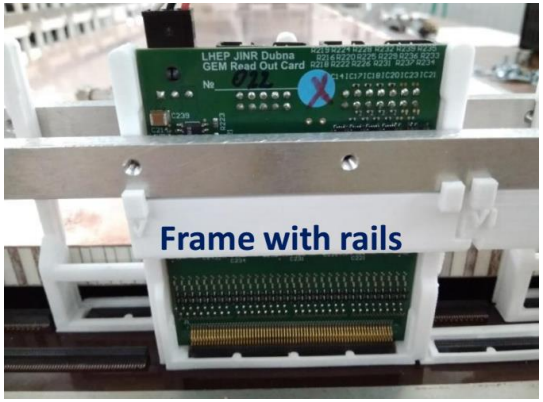
Material budget of the GEM central tracking system full configuration



Assembly of the stand for long-term GEM tests

First stage – tests of 1632*390 mm^2 detectors, right now
Second stage – tests of 1632*450 mm^2 detectors

Trigger system – ten 10*200 cm^2 scintillation detectors

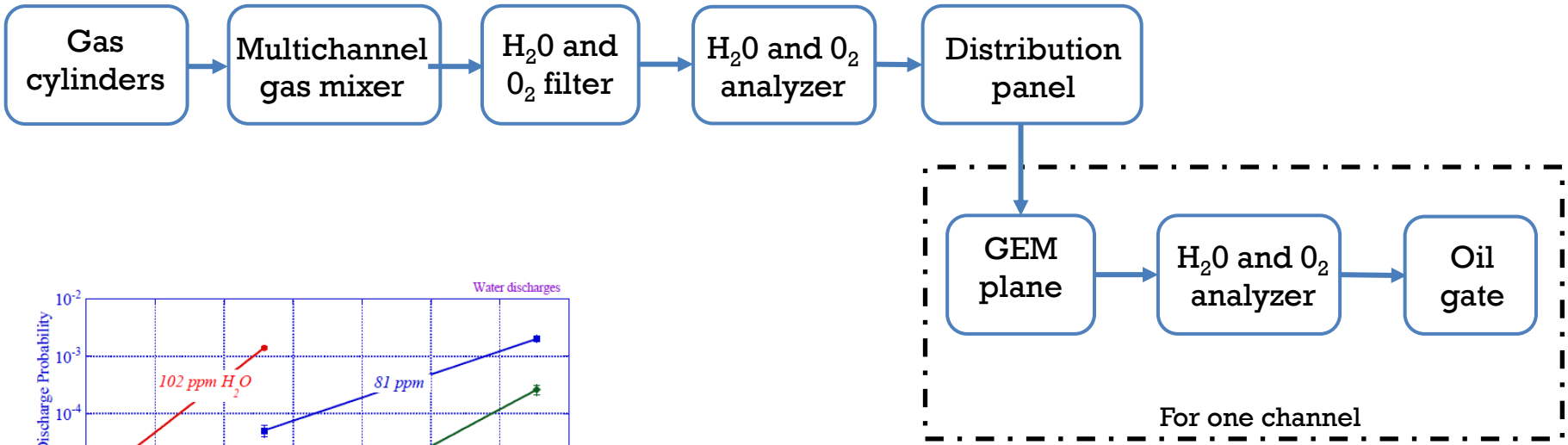


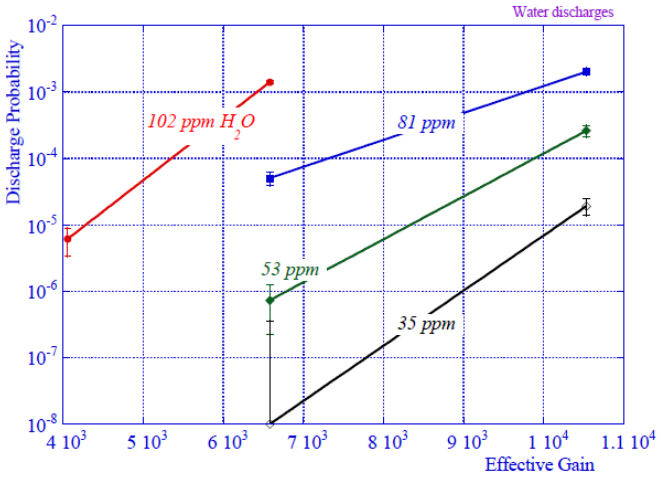
Frames for FEE electronics

Gas system

Gas system requirements :

- stable flow and mixture parameters;
- 7 independent channels to each GEM-plane;
- reducing and control oxygen and moisture impurities in gas mixture;





Discharge probability on alphas as a function of moisture level in the gas. COMPASS

We tested GE oxy.IQ for oxygen analyze and GE dew.IQ+ GE IQ.probe for moisture analyze.

Problem – moisture analyzers have no coincidences in measuring

Tests of the moisture analyzers

Tests of the oxygen analyzer have shown coincidence of the sensors readings on the level 1-5 ppm.

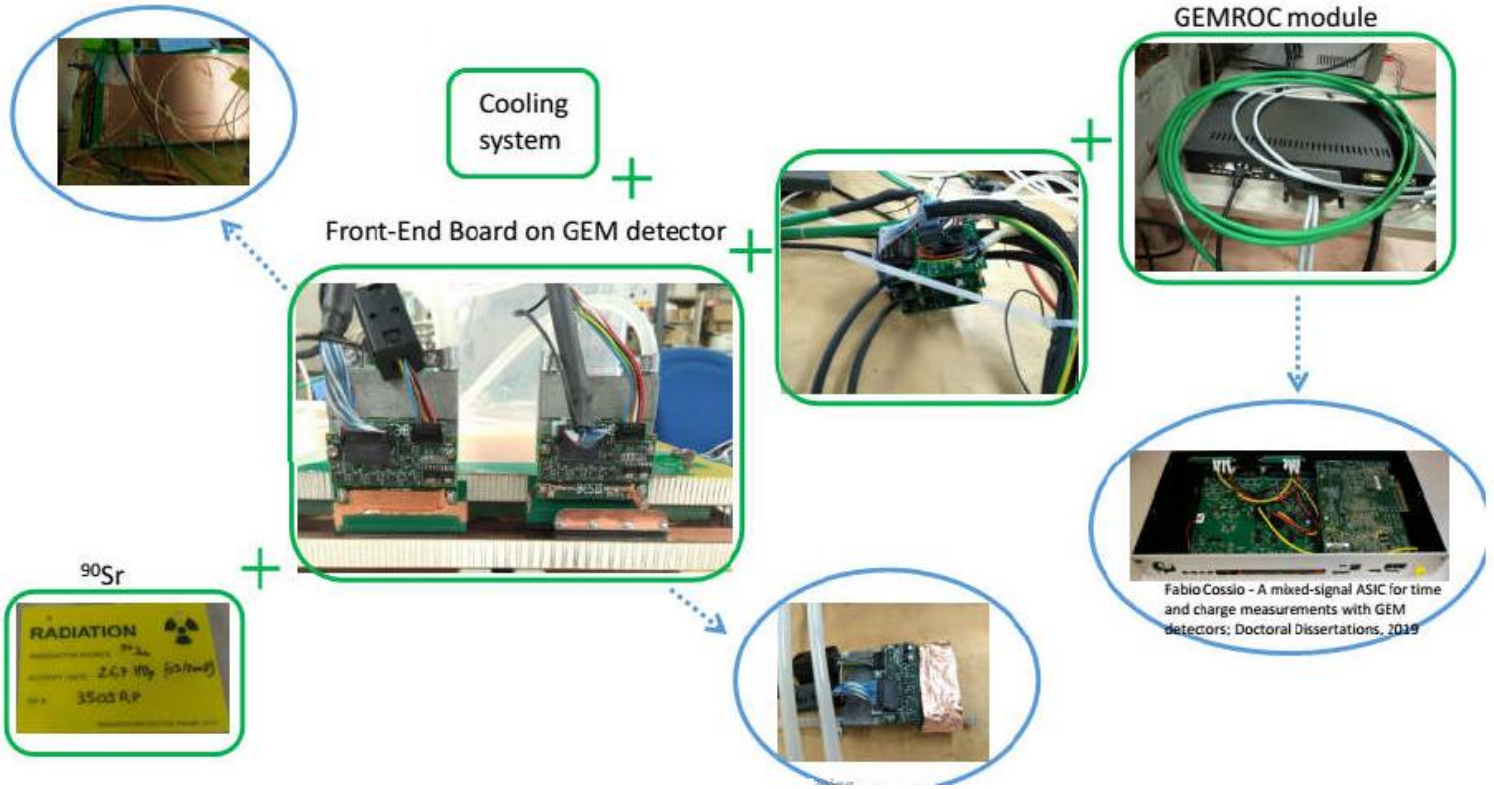
Tests of the moisture analyzer have shown coincidence of the sensors reading on the level 100-300 ppm.

Now we have a discussion with technical support of the official distributor about this situation.

Sensor 1 and 2 – old, last calibration in 2017;
sensor 3 and 4 – new, calibration in 2020.

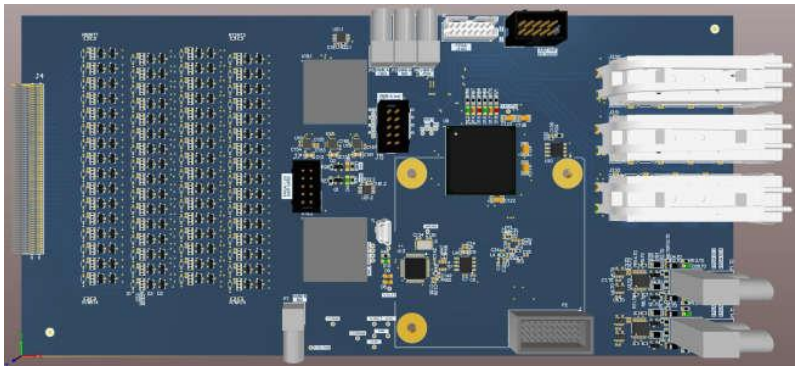
Development of new FEE for high intensity heavy ion beams

First run of TIGER FEE on the BM@N GEM detector was performed at CERN at the end of 2019. Next tests were planned on March 2020 at JINR, but were put forward.



Kintex7 based 128ch GEM evaluation board was designed for VMM3a tests.

Evaluation board is produced, the firmware is under development

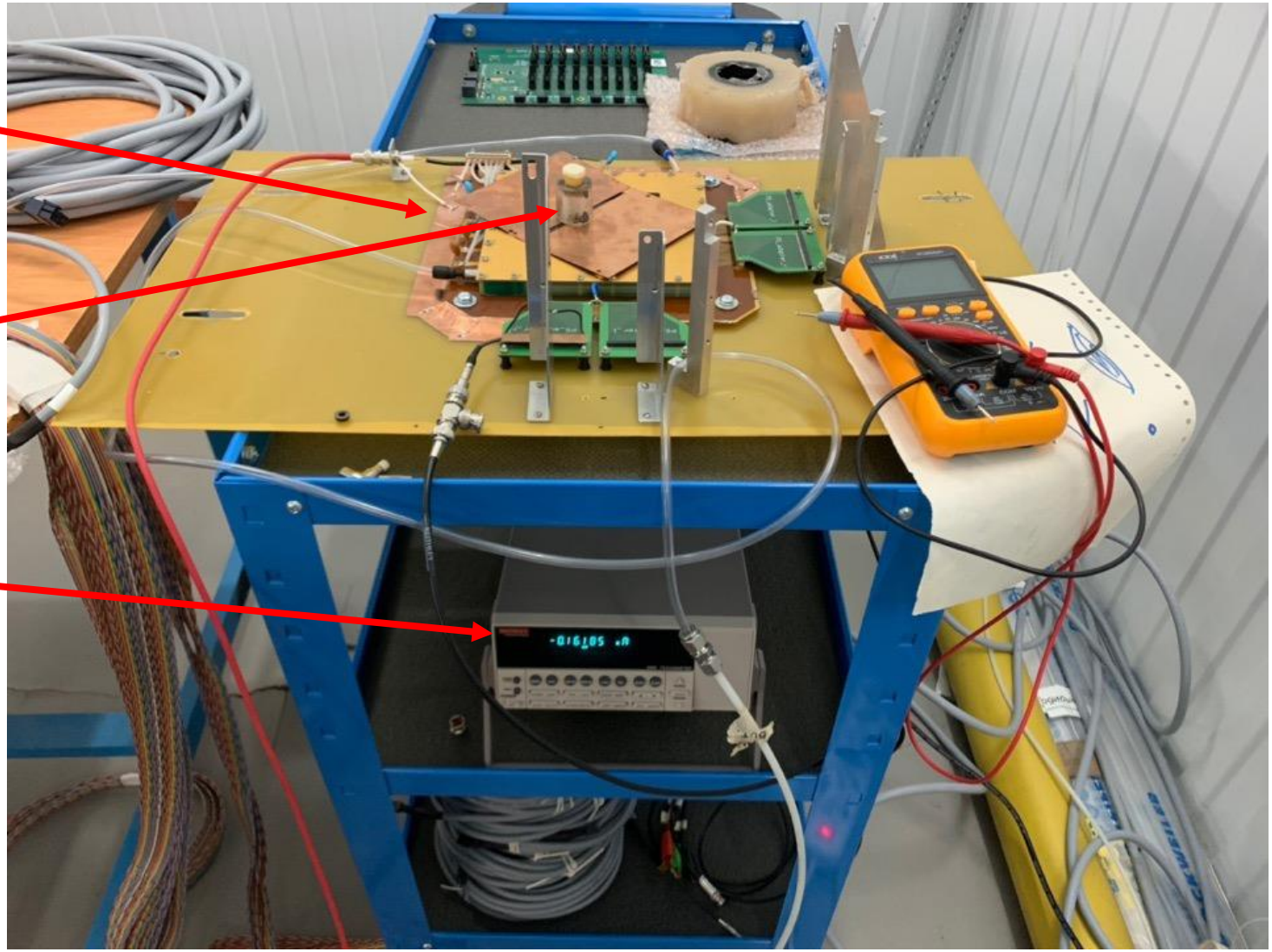


Small GEM for tests of the new FEE

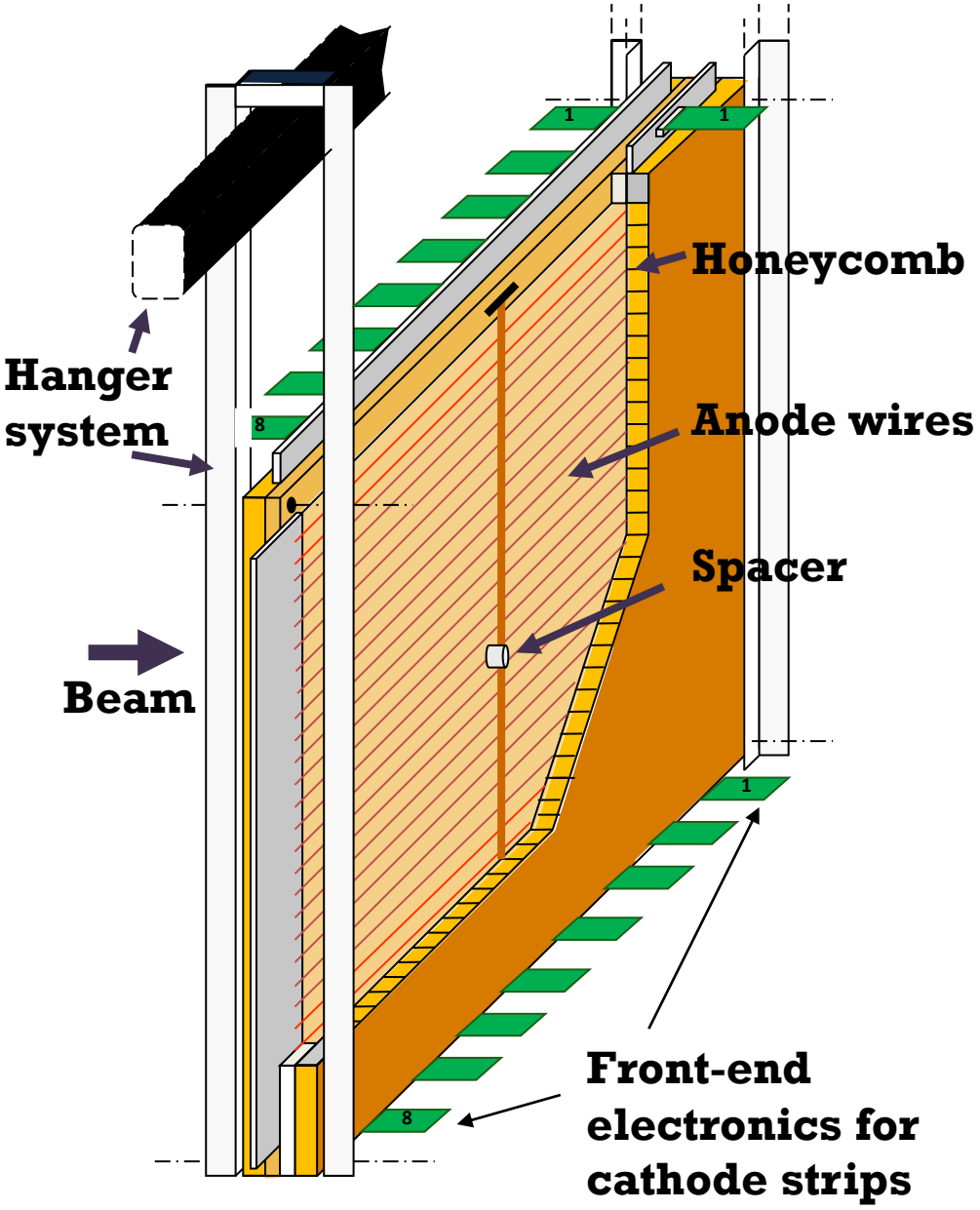
10×10 cm^2 GEM

Fe-55 ionization source

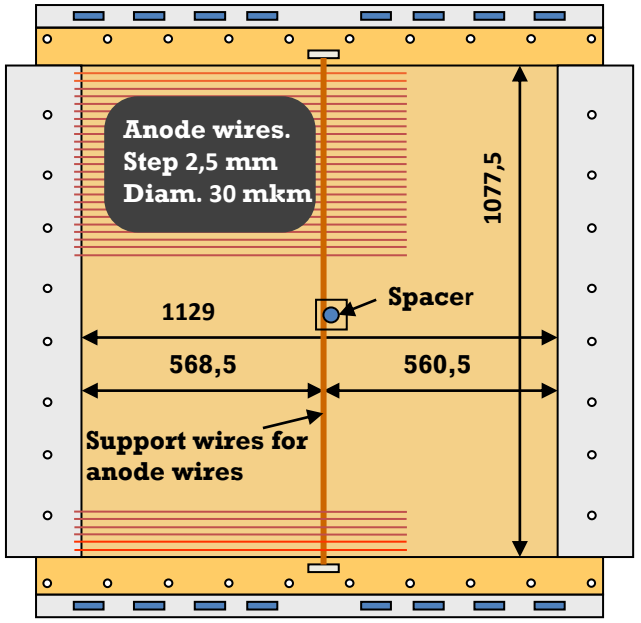
Picoampermeter Keithley 6485

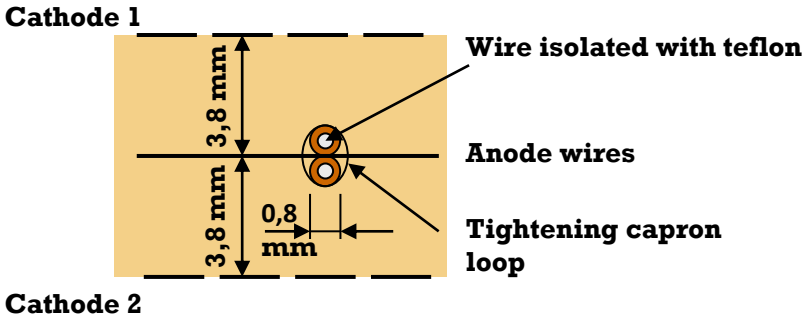


Schematic view of CSC



Anode wires geometry





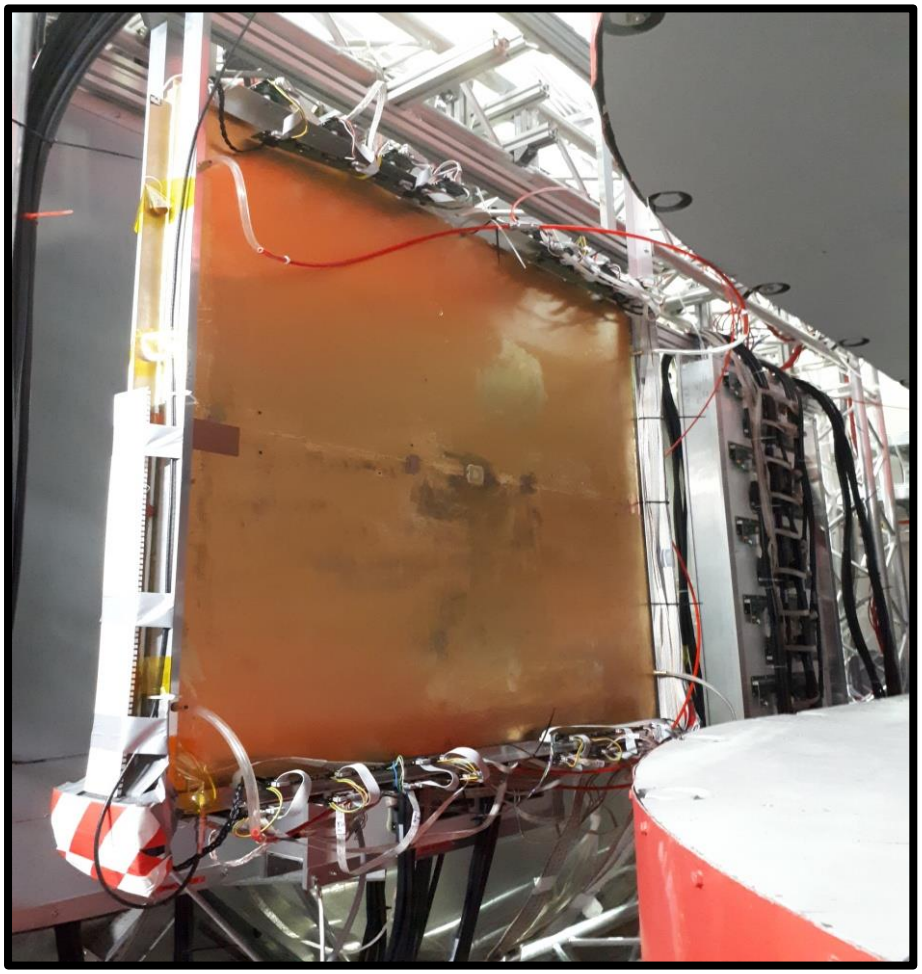
CSC 1 × 1 m^2

1 chamber was produced and integrated into the BM@N setup at 2018.

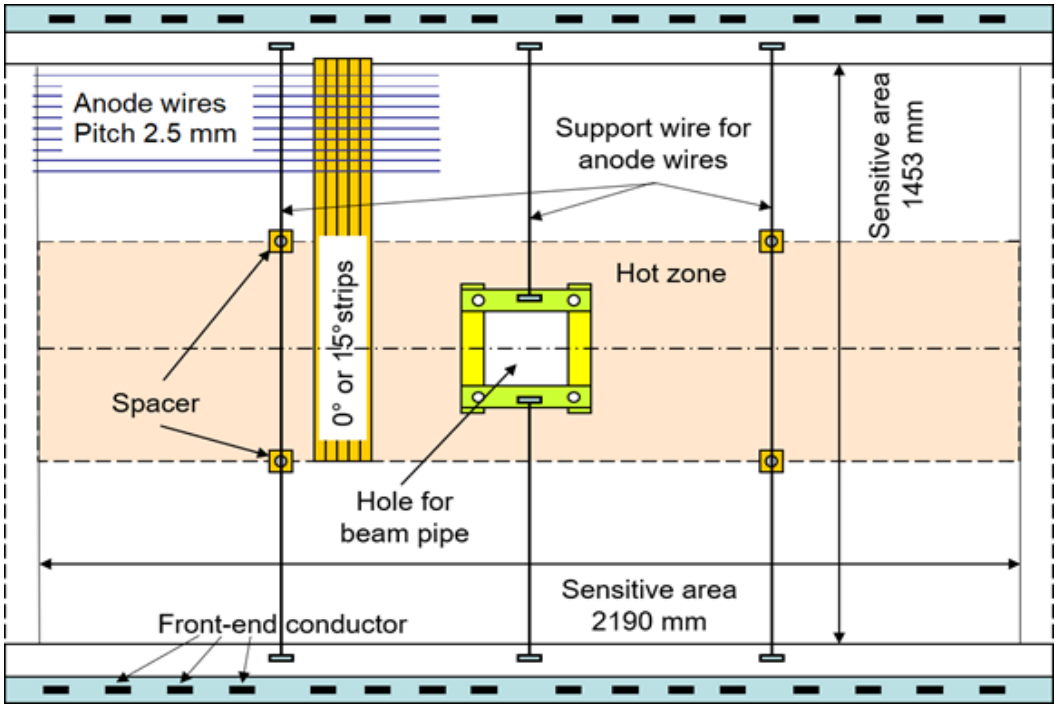
3 chambers are finished on 99%.
Remaining works:

- Sealing all chambers;
- Equip mount elements.

Necessary timing ~ 2 week.



CSC 2 × 1.5 m^2



- Design of the cathode planes is finished, producing of the cathode planes will be finished at the end of November;
- Production of the inner frames and another parts of detectors – end of November;
- Preparation of the assembly table – November 2020.

Problem – fume hood and ventilation system at the assembly building.

Conclusions

GEM:

- 7 detectors 1632×450 mm^2 and 7 detector 1632×390 mm^2 are produced;
- 2 spare detectors are waiting for the assembly at CERN;
- Mechanics for GEM-planes inside the magnet is developed;
- The tender procedure will be initiated to select a manufacturer of support mechanics by the end of the year;
- Assembling the stand for testing the GEM-detectors with cosmic rays is finished;
- Tests of 1632*390 mm^2 detectors with cosmic rays in progress.

CSC:

- 1 chamber of the size 1×1 m^2 is produced;
- 3 chamber of the size 1×1 m^2 will be produced in this two weeks;
- Preparatory work for 2×1.5 m^2 chambers is underway: cathode planes in production, another parts of detectors in production or already done.

Back up slide

Material budget of one Gem detector

layer	material	density [g/cm-3]	thickness (X) [cm]	X0 [cm]	X/X0 [%]
gas	ArCO2 (70/30)	0.0019	0.9	10960.2	0.0082
copper	copper	8.96	0.0131	1.435	0.9129
glue	acrylic glue	1.25	0.02	32.1603	0.0622
epoxide	polyurethane (high dens.)	1.8	0.21	22.5351	0.9319
	Polyurethane (medium dens.)	0.59	0.21	68.7512	0.3055
	Polyurethane (low dens.)	0.25	0.1	162.253	0.1295
honeycomb	nomex aramid honeycomb (kevlal chemical structure)	0.048	3.0	755.397	0.3971
polyamide	polyamide	1.14	0.025	36.4052	0.0687