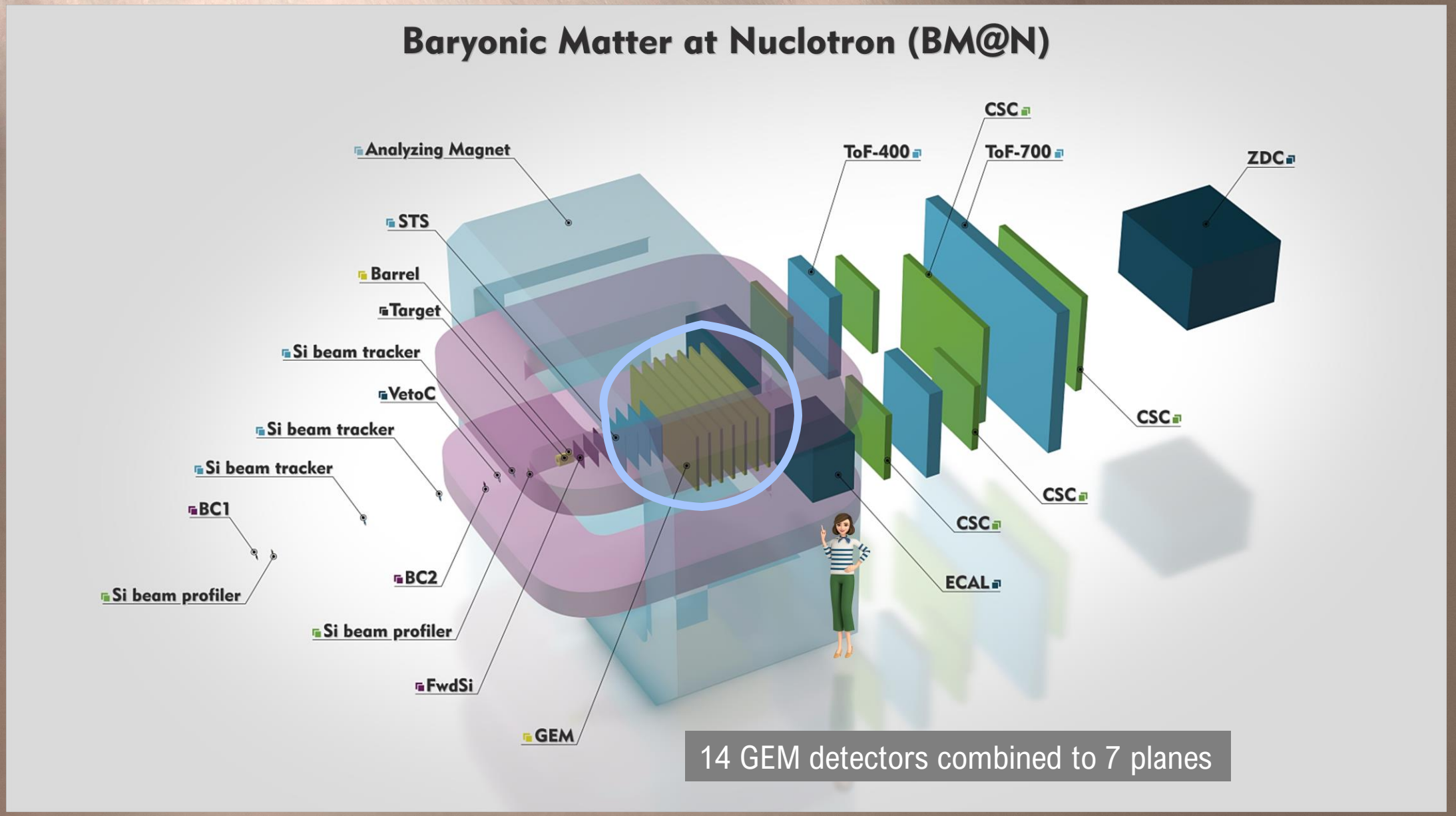
STATUS OF THE GEM/CSC TRACKING SYSTEM OF THE BM@N EXPERIMENT

Elena Kulish on behalf of the BM@N Collaboration

7th Collaboration Meeting of the BM@N Experiment at the NICA Facility, 19-20 April, 2021

GEM detectors in BM@N

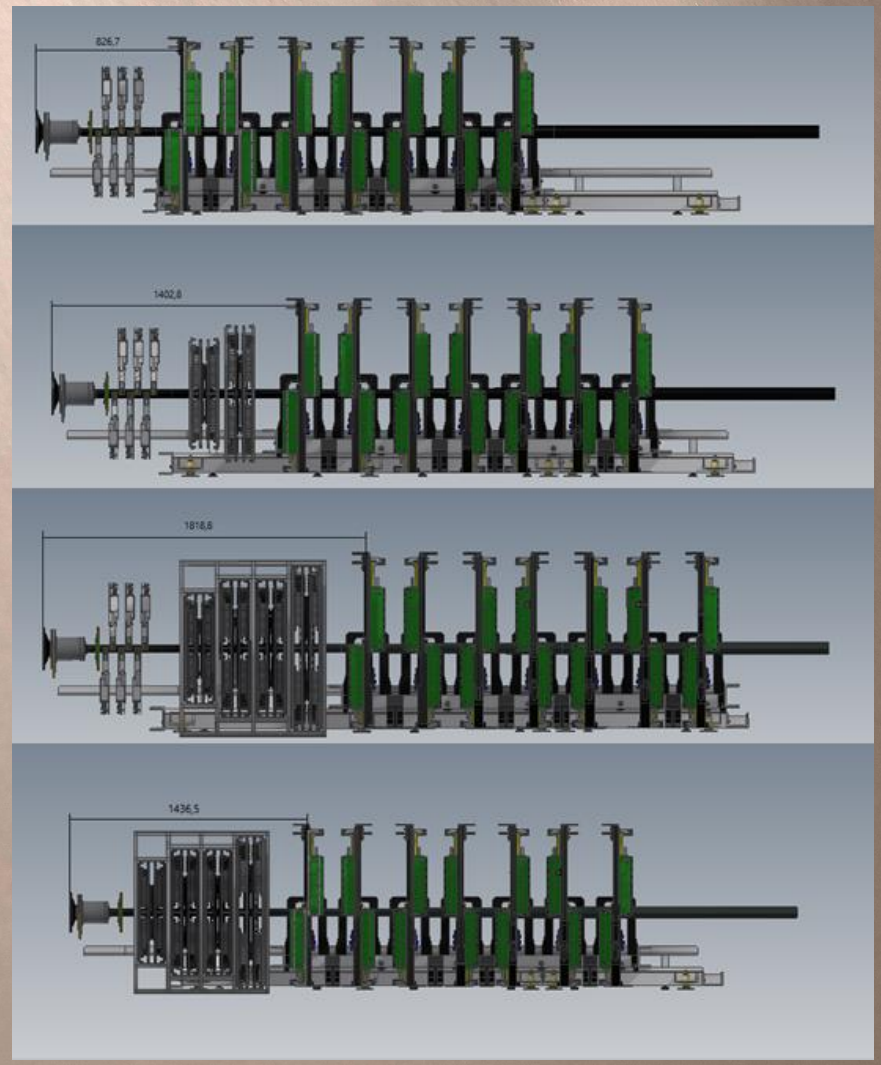


Configuration of GEM planes

Stages of changing the mechanical support for GEM detectors, taking into account the future stages of modernization of the central tracking system of the BM@N setup

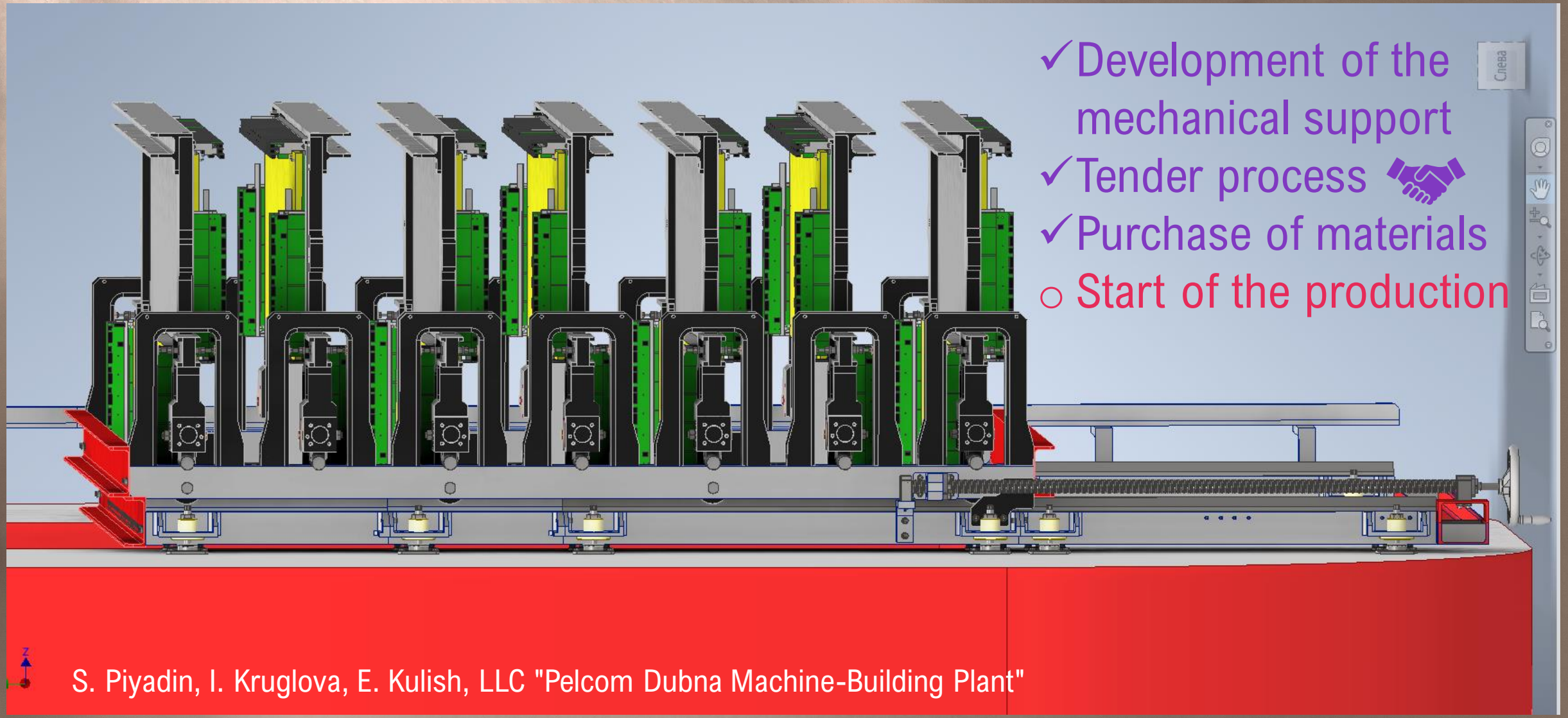
Requirements for the mechanical support:

- it is nessesary to use non-magnetic materials
- carbon beam pipe goes through detectors
- the whole assembly should move along the beam pipe



S. Piyadin, I. Kruglova

Mechanical support for GEM detectors



S. Piyadin, I. Kruglova, E. Kulish, LLC "Pelcom Dubna Machine-Building Plant"

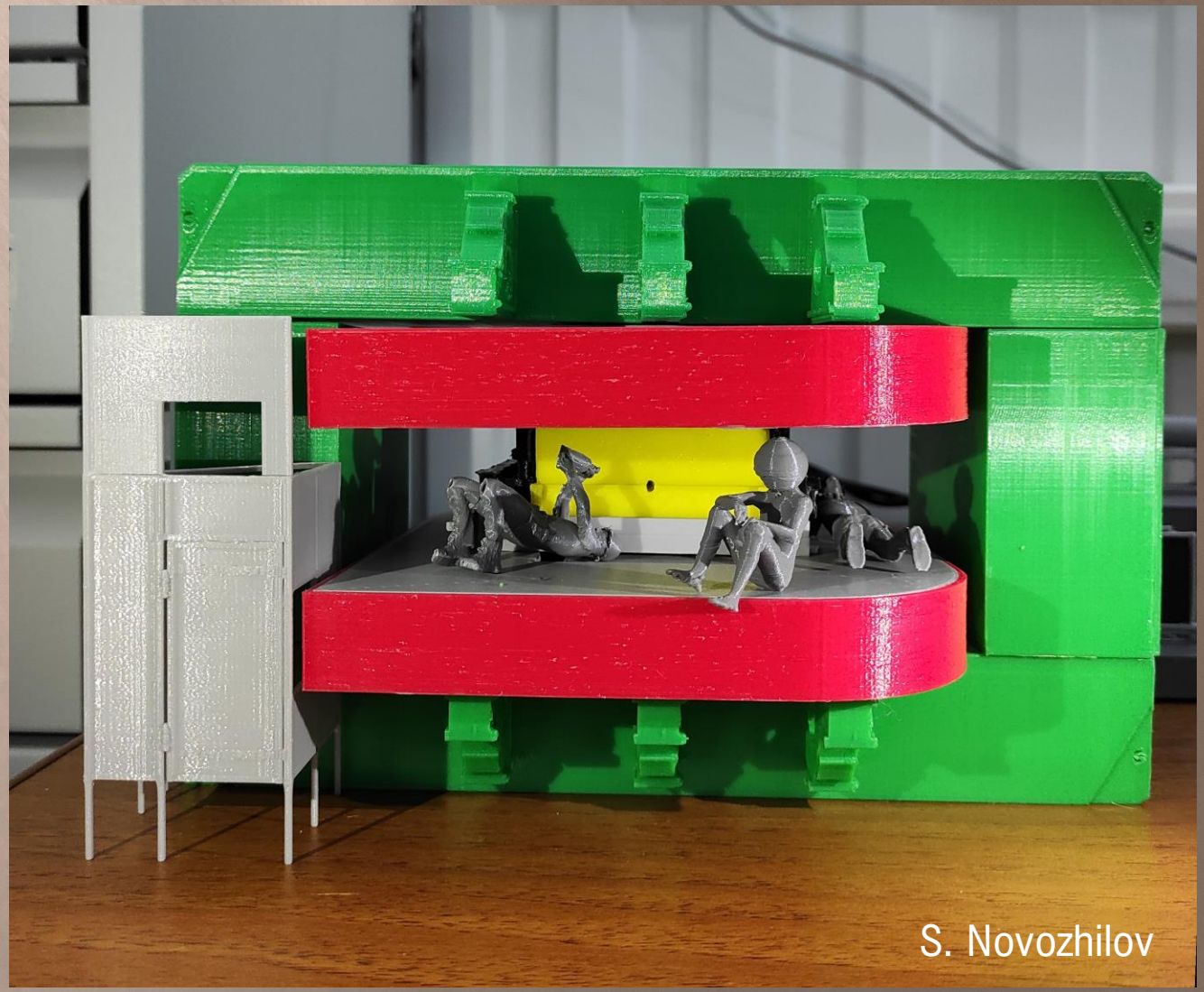
Installation to the magnet SP-41

Installation sequence:
rails, trolley, bottom
detectors (starting from the front detector), carbon beam pipe, top detectors (starting from the front detector).

Tests of 14 GEM detectors should be performed during installation.

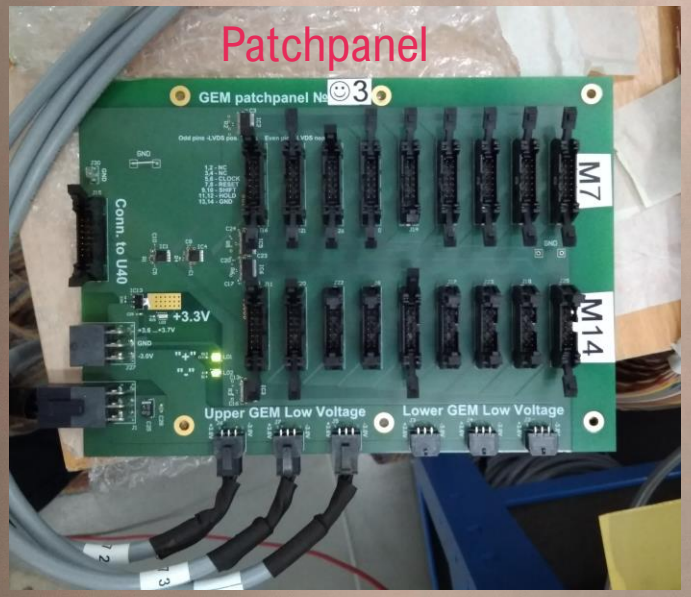
This work will take 2 monthes.

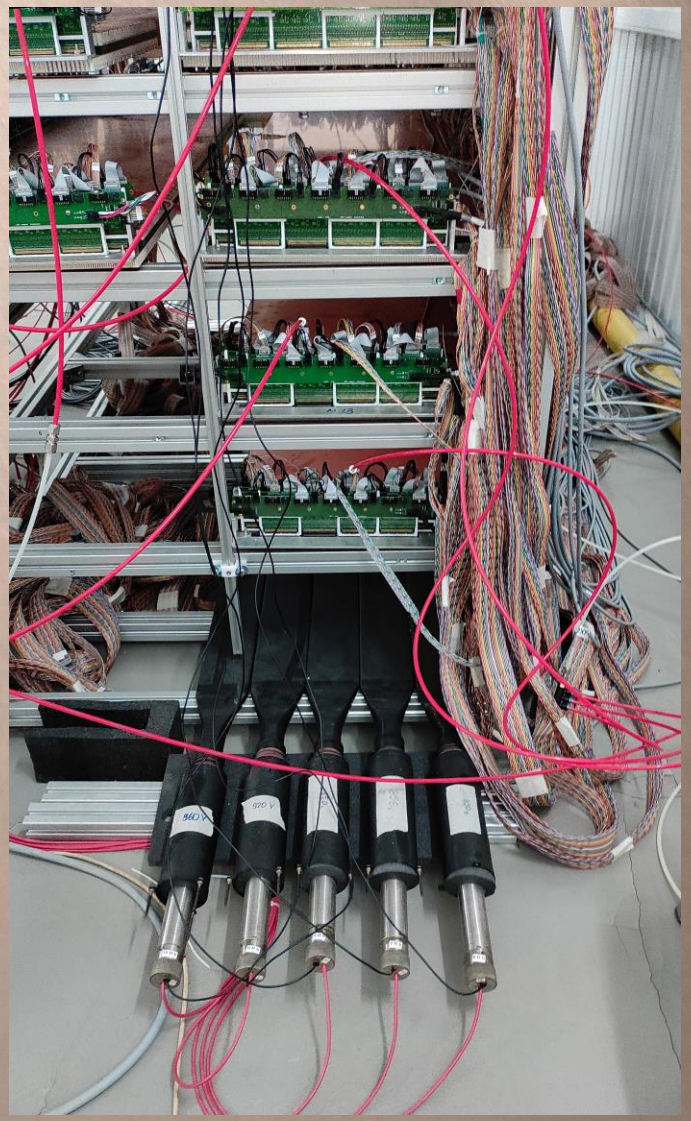
Installation will be performed from the opposite side of the magnet SP-41, therefore work should
be done separetely from ToF-400 and CSC groups.



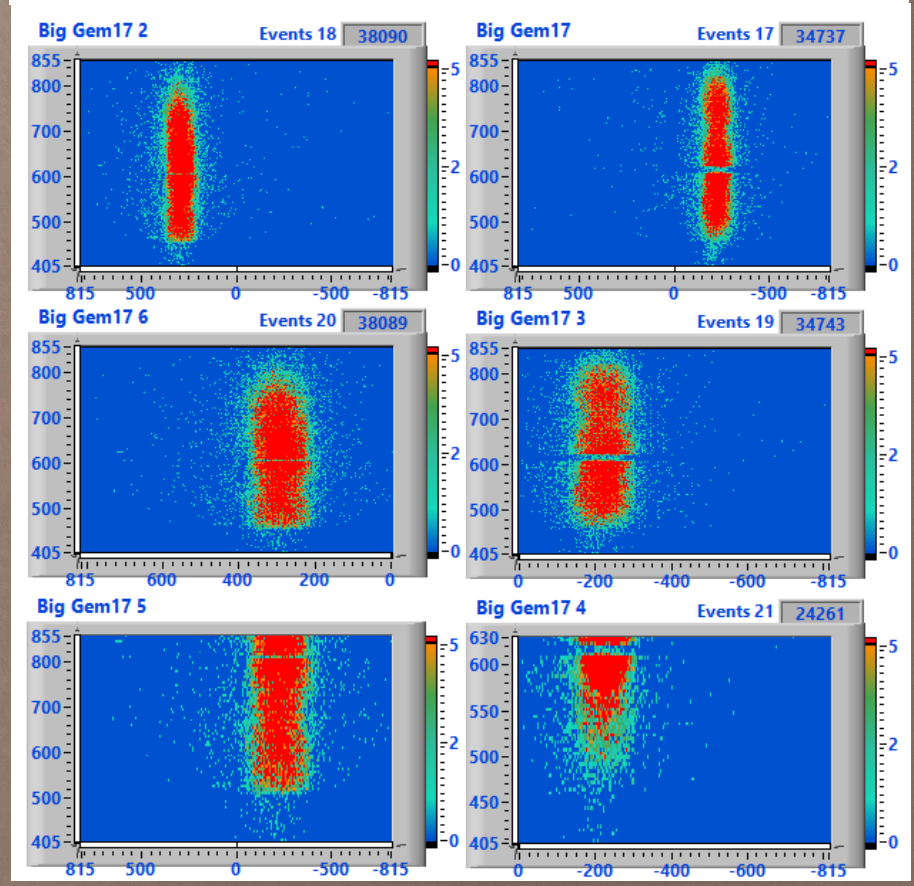
Cosmic ray tests

- 7 163×39 cm^2 GEM detectors
- 1 sector is broken in 1 detector
- Detector is delivered to CERN for repair
- Tests of FEE, cabling and patchpanels





Broken sector in 163×39 cm^2 GEM detector



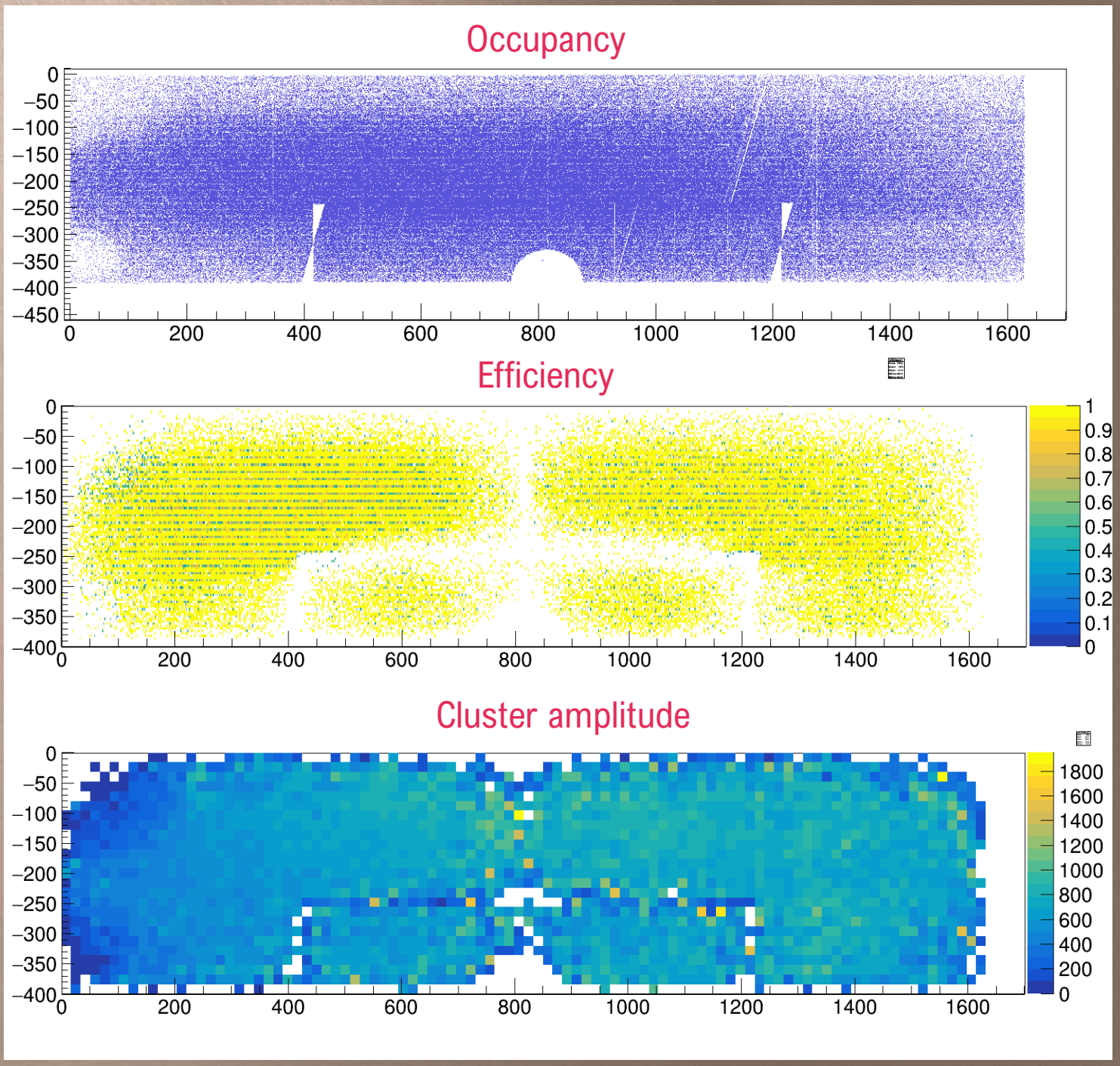
Cosmic ray tests

163×39 cm^2 GEM detectors

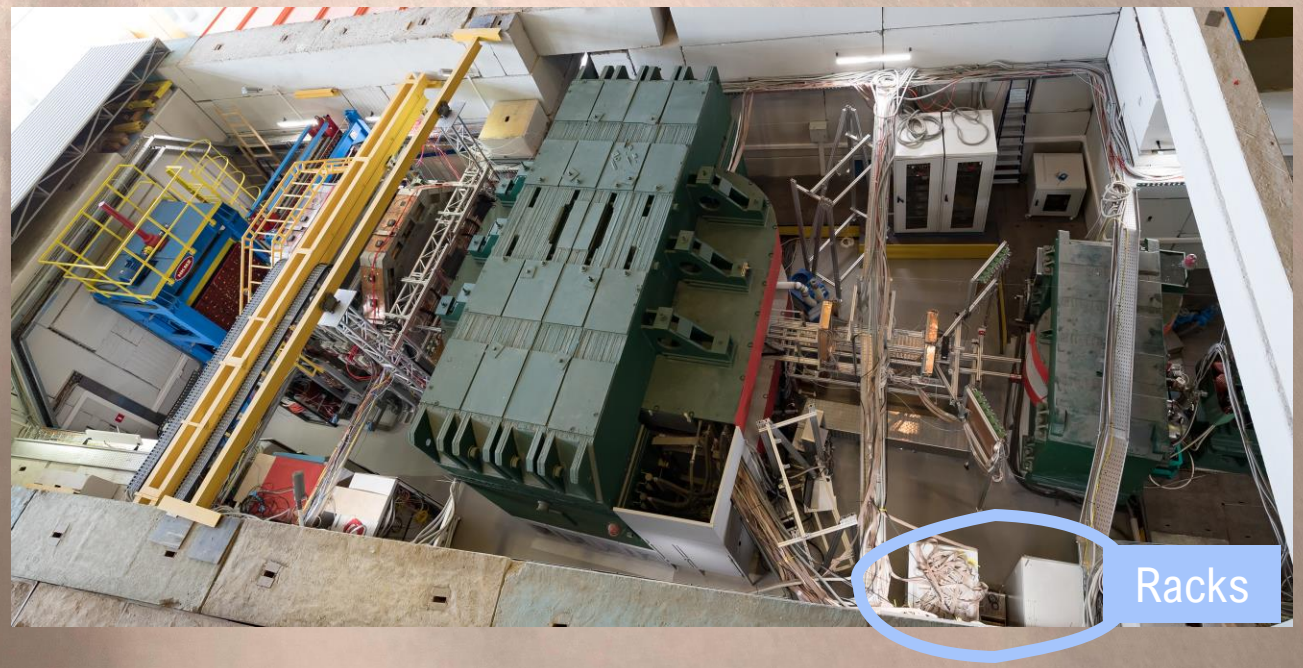
Horizontal sector design

Losses of efficiency are caused by boundaries between sectors. Inside sectors the efficiency is about 100%.

Position of each detector in the assembly will be chosen based on comparison of the location of dead channels and areas of low efficiency with simulations (S. Merts).



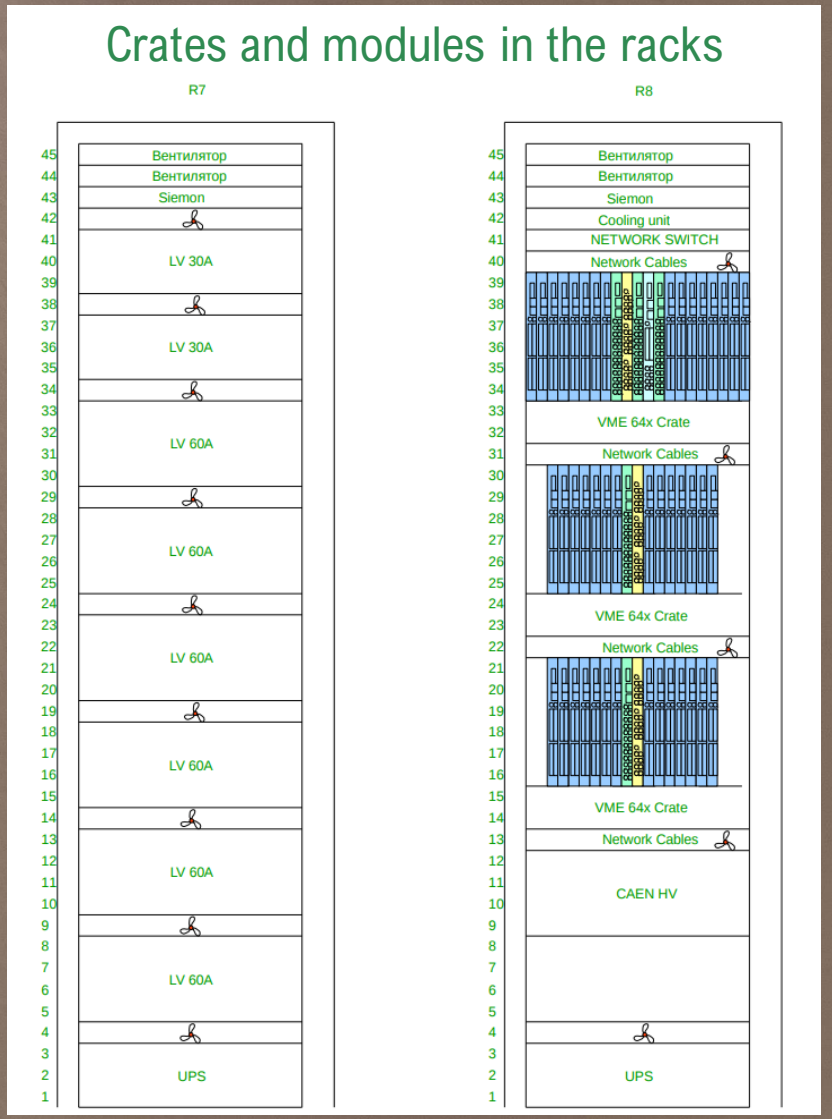
Racks and cables



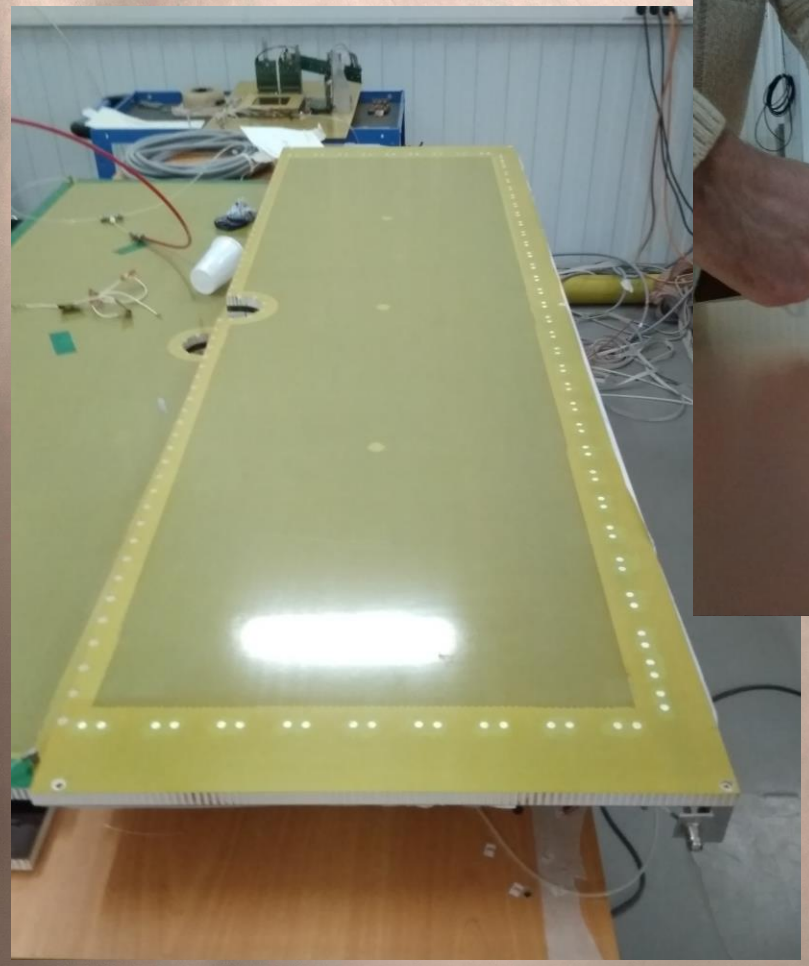
- Cables are ready for all detectors.
- Cable marking is 80% ready.
- Number and position of the racks in the experimental hall is fixed.
- Crates and modules in the racks are distributed (A. Terletsky, A. Fediunin).

Cable marking

Crates and modules in the racks

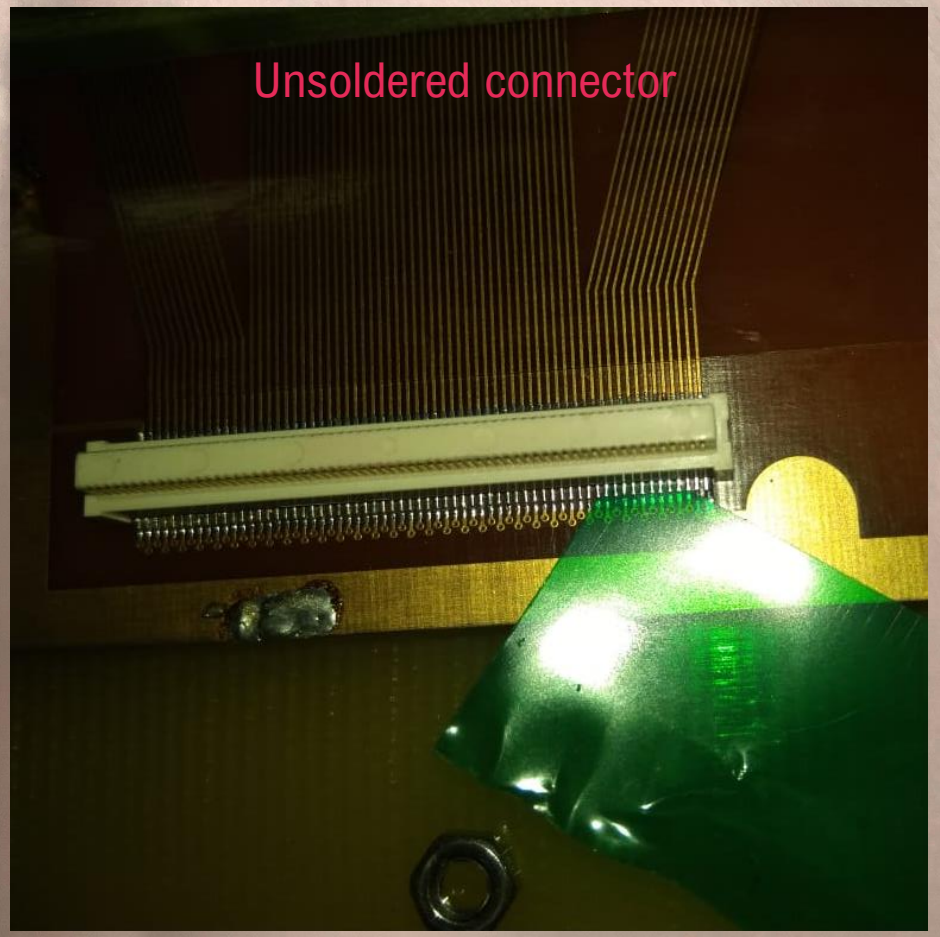


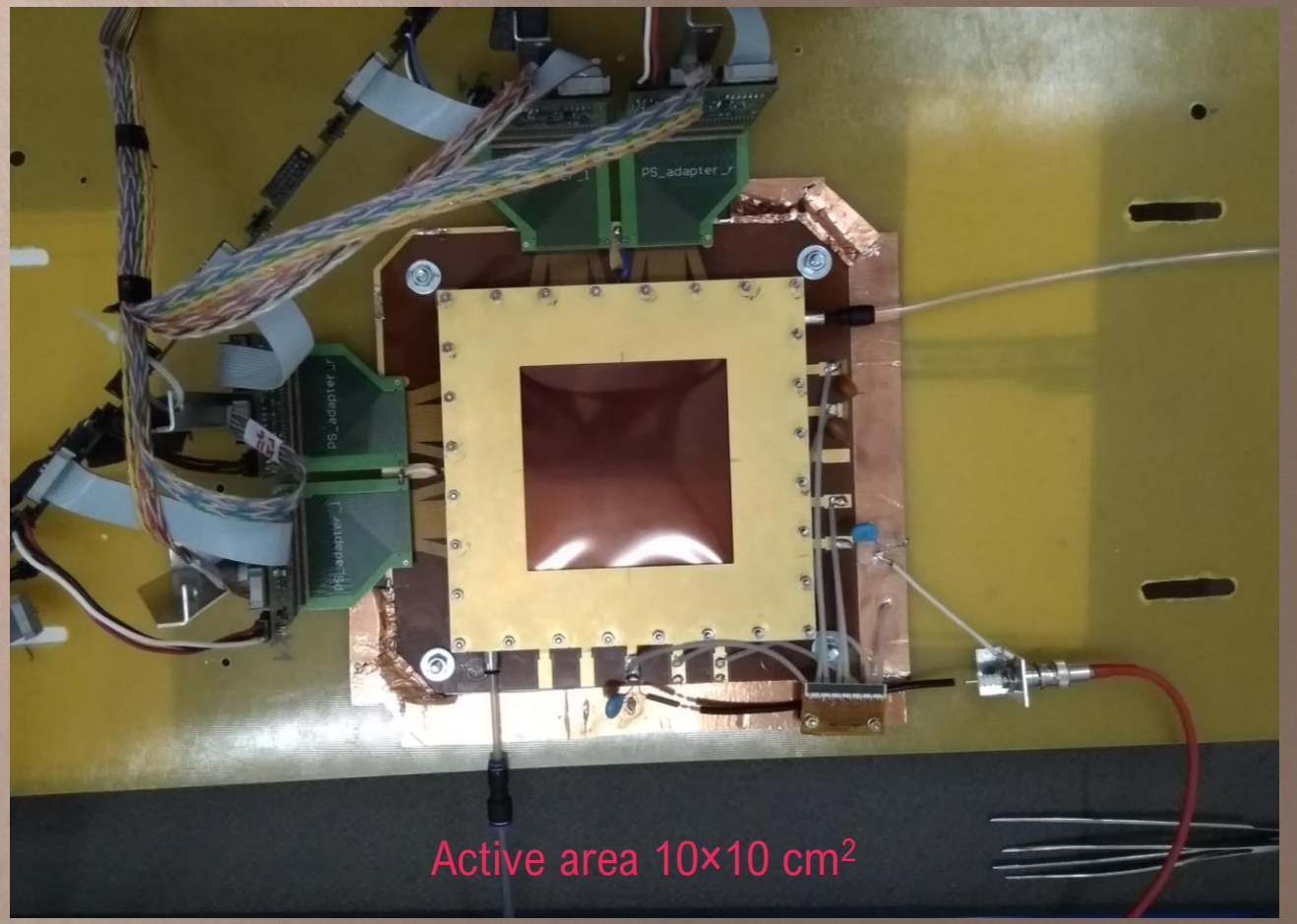
Copper foil gluing



2 163×45 cm^2 GEM detectors

Repair of small GEM detector





FEE for heavy ion beam runs

Two types of ASICs - TIGER (INFN) and VMM3 (BNL) are considered for upgrade of FEE for GEM detectors

An evaluation board was designed and produced by DAQ group for VMM3a tests.

Currently the tests are performed with generator only. Tests with the GEM detector are not performed yet.

The possibility of buying VMM3a is still in question. Work is underway to find this opportunity.

Currently the development of the TIGER is suspended for several reasons.

As an alternative to TIGER the other ASIC ToASt is suggested by INFN.

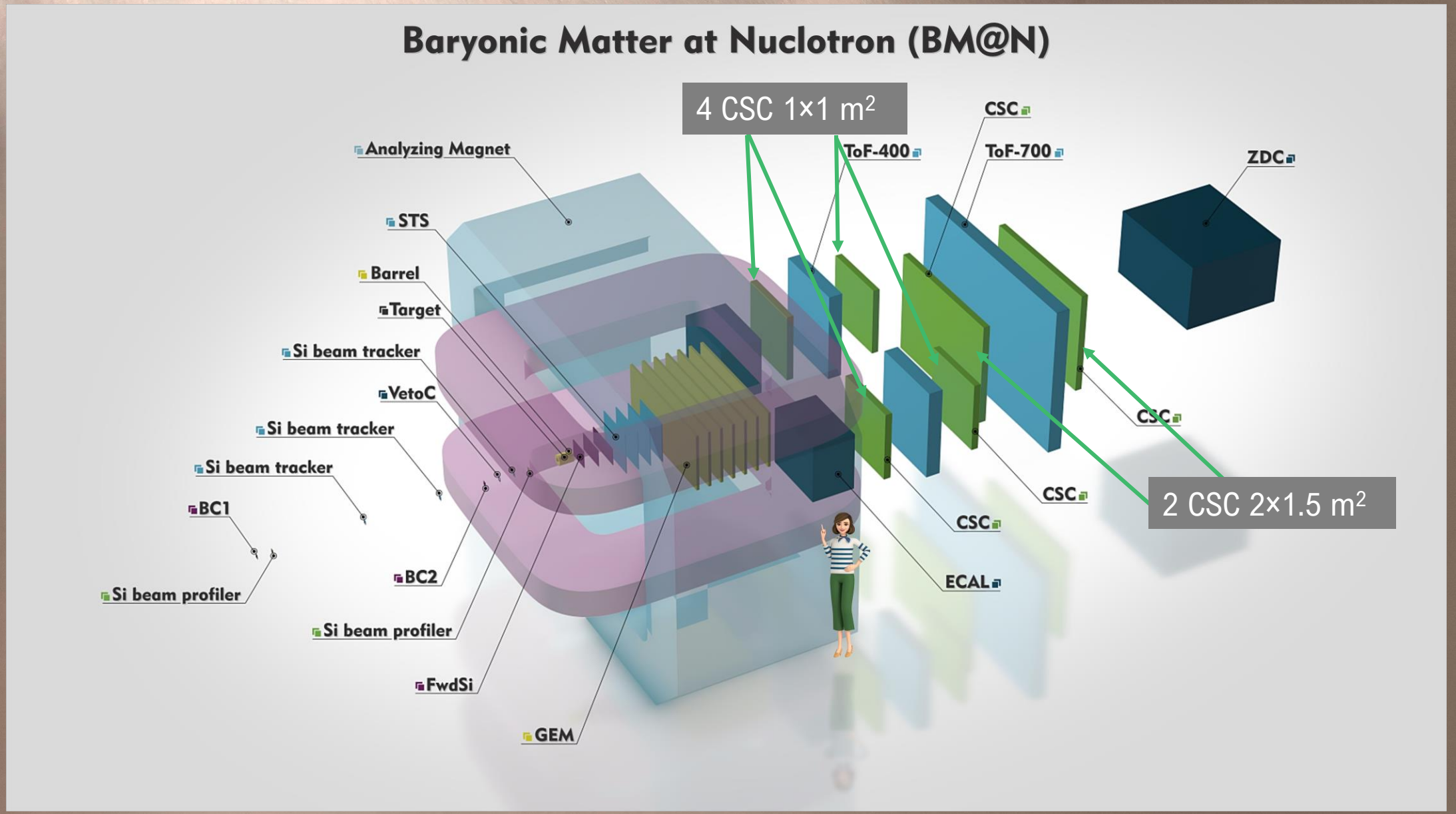
ToASt is now considered for the future FEE for FwdSi. It is planning to test it with GEM detectors also.

ToASt main characteristics

- 64 input channels
- Time of Arrival (ToA) and Time over Threshold (ToT) measurements
- Master clock frequency : 160 MHz
- Region : groups of 8 channels with local FIFO
- Second level FIFO buffering for the 8 regions
- Two output serial links at 160 Mb/s
- Serial configuration protocol at 80 Mb/s
- SEU protection for registers and FSM
- CMOS 0.11 μm technology

Specification	Min	Max	Unit
Input capacitance	2	17	pF
Max rate per strip		40	kHz
Input charge	1	40	fC
Noise		1500	e^-
Preamp peaking time	50	$\geq$ 100	ns
Channels per chip	64		
Reference clock		160	MHz
Charge resolution	8		bits
Time resolution (pk-pk)		6.25	ns
Time resolution (r.m.s.)		1.8	ns
Power consumption		256	mW
Chip dimensions	4.2 $\times$ 3.5		mm^2
Pads position	On two sides only		

CSC in BM@N


Baryonic Matter at Nuclotron (BM@N)
4 CSC 1×1 m²
2 CSC 2×1.5 m²
Analyzing Magnet
STS
Barrel
Target
Si beam tracker
VetoC
Si beam tracker
Si beam tracker
BC1
Si beam profiler
BC2
Si beam profiler
FwdSi
GEM
ToF-400
CSC
ToF-700
ZDC
CSC
CSC
CSC
ECAL

CSC in BM@N

4 CSC 1×1 m^2 are produced, 3 are equiped with FEE and cables.

Main 2×1.5 m^2 components (honeycomb, cathode readout plates) are received.

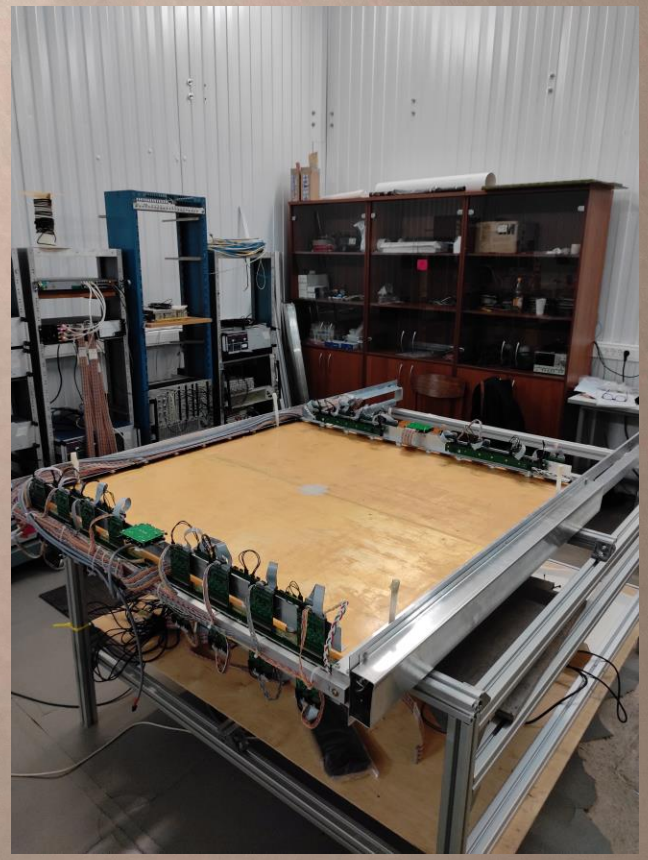
Expansion of the metal table for the chamber assembly is completed.

Making precise holes for pins in the table for positioning parts during gluing is planned on May.

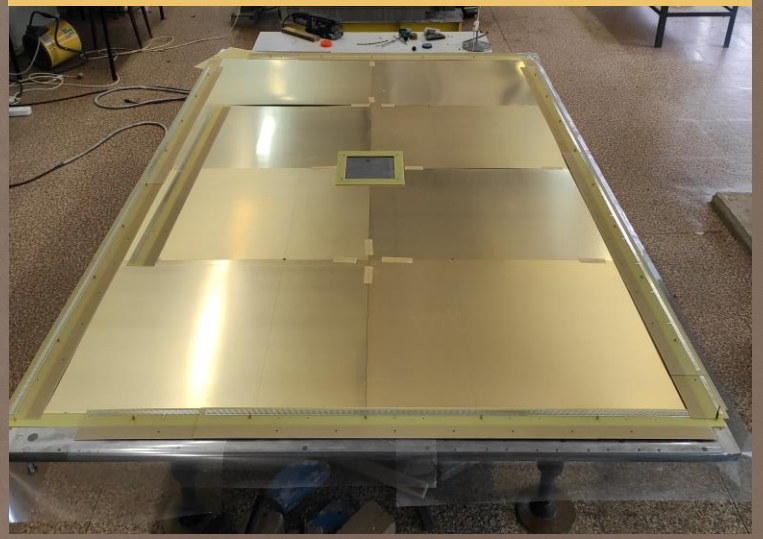
Production of fiberglass frame elements is scheduled for May - September.

Ordering and receiving thin one-side foiled fiberglass for the outer surface of the chambers – May – September.

Start of chamber assembly – October.



2×1.5 m^2 readout preparation



R. Kattabekov, A. Vishnevsky, A. Morozov

CSC 1×1 m² problem

The problem that needs to be solved at the present time is the disappearance of contact between individual pins on front-end board and connector on the chamber.

Priority version - contamination when washing chambers.

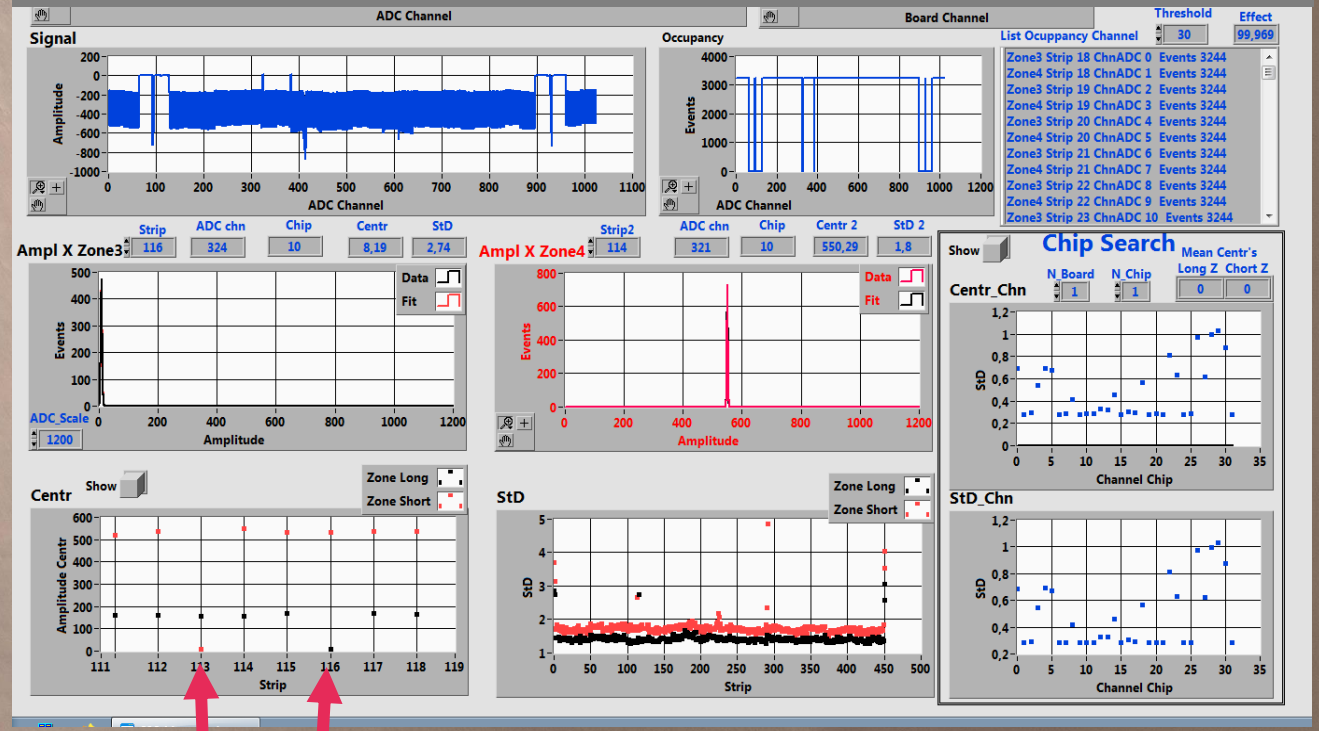
Missing contact leads to the situation that the charge accumulates at the cathode strip till the discharge occur.

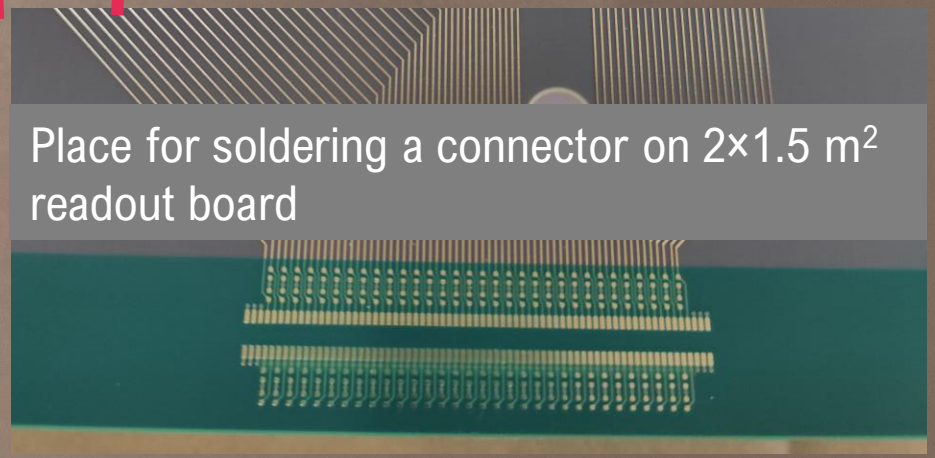
Options for solving the problem:
- washing of the connector with propanol
- soldering resistor from the strip to ground (outside)
- connect additional board to the connector (development)
- open the chamber and solder 100kΩ SMD components between strips (extreme case)

A possibility of soldering resistors on 2×1.5 m2 readout board is foreseen.

There is a system on each chamber, which allows to send a test signal to all channels. Channels without contact could be seen in the program.

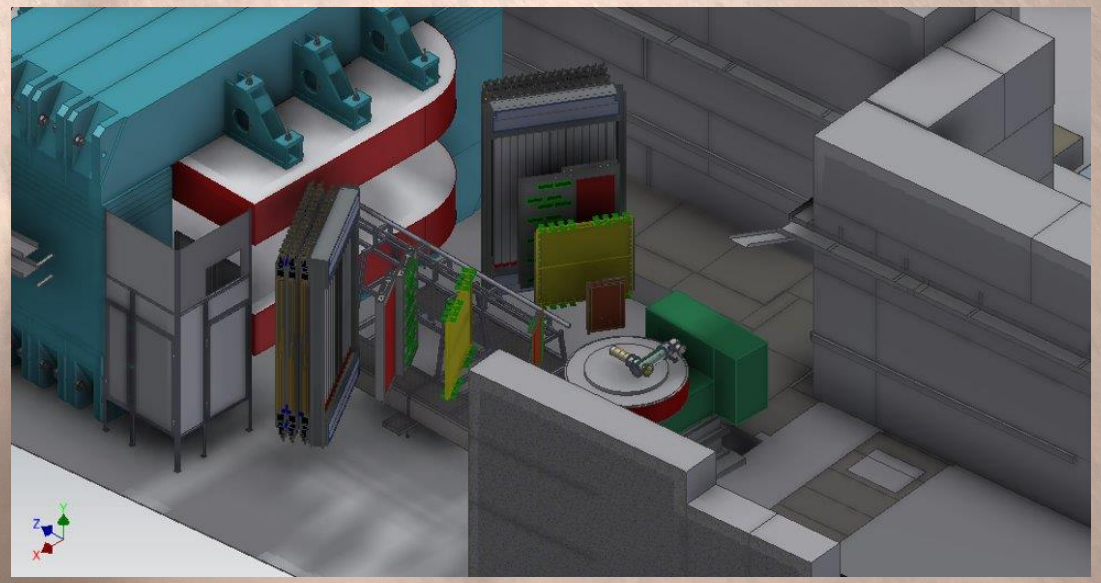
A. Makankin

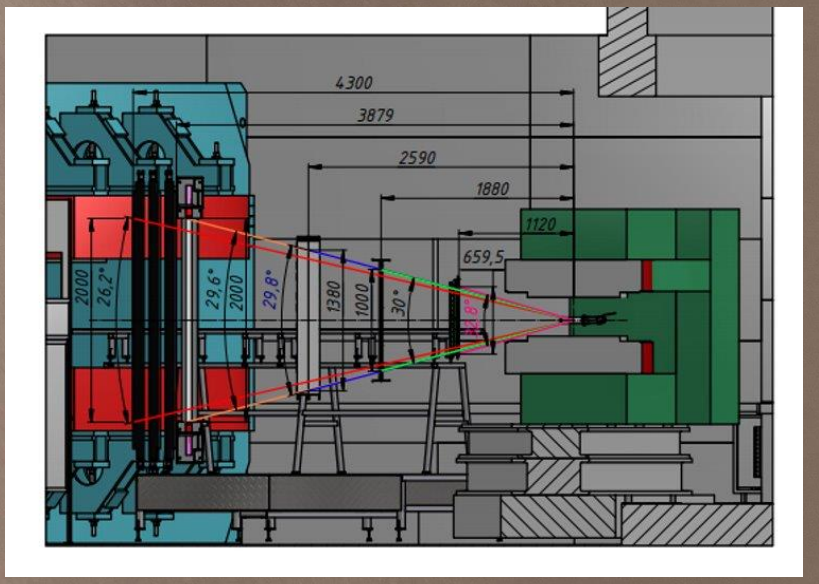


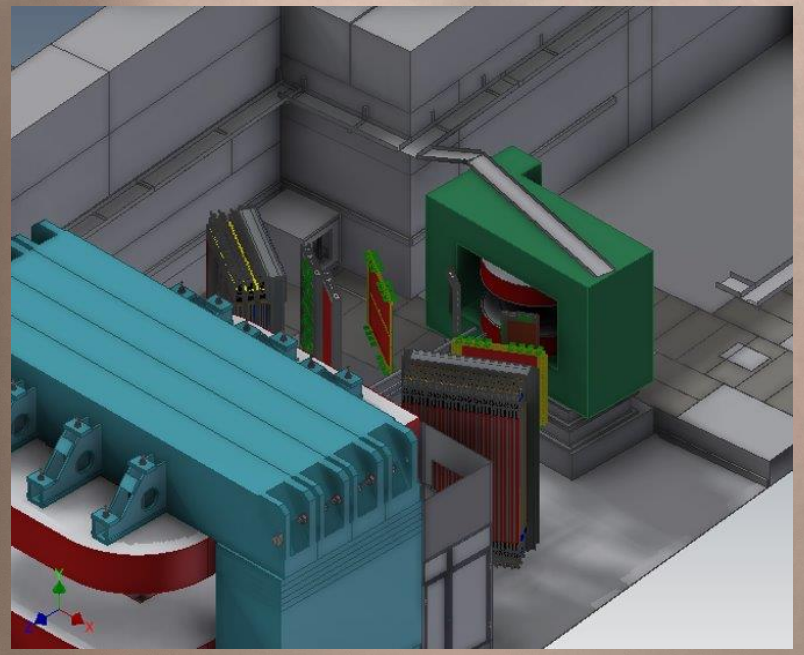


Place for soldering a connector on 2×1.5 m² readout board

CSC and GEM detectors in SRC





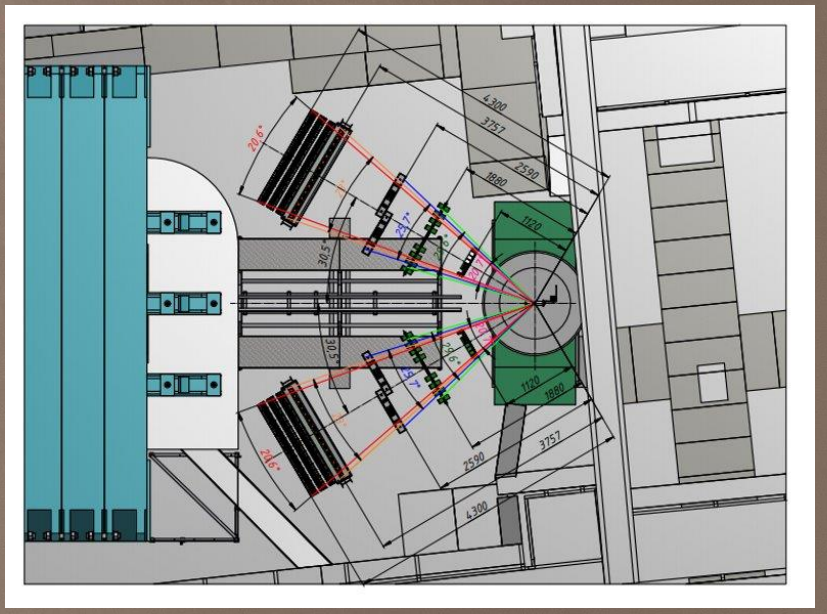


2 1×1 m^2 CSC
2 66×41 cm^2 GEM detectors

The position of CSC and GEM detectors is now fixed.

Development of the mechanical support can be started.

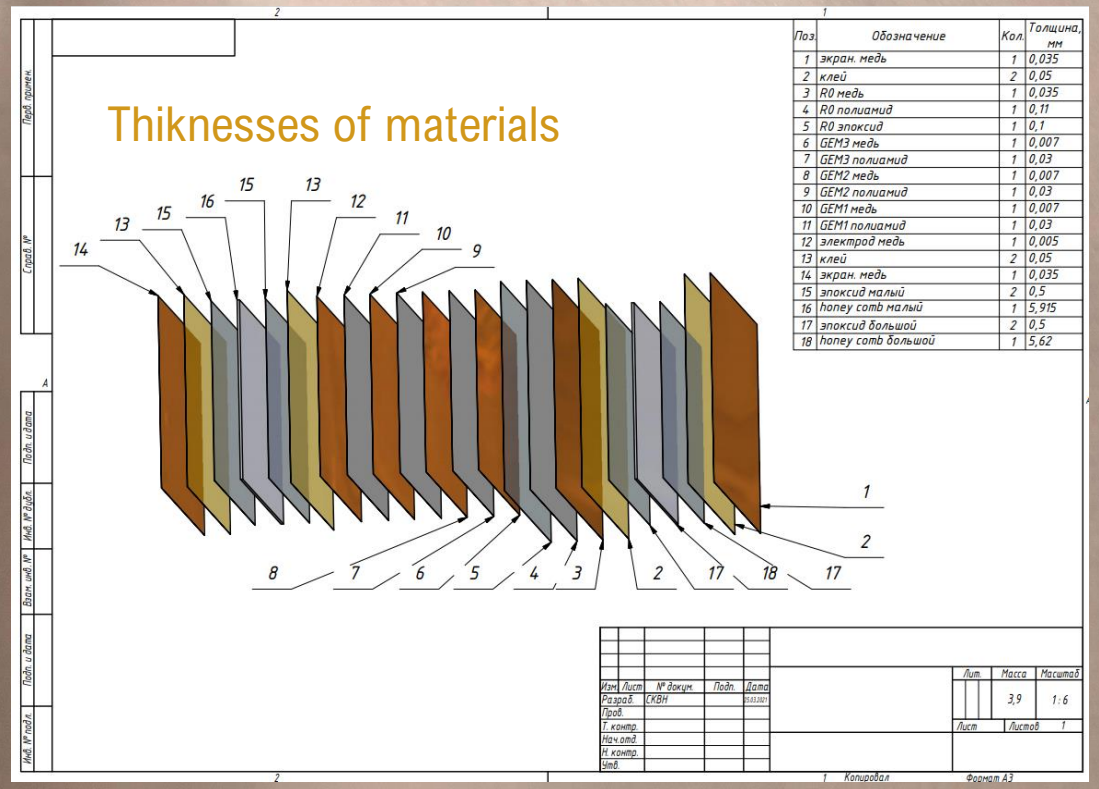
Cable production can be started.



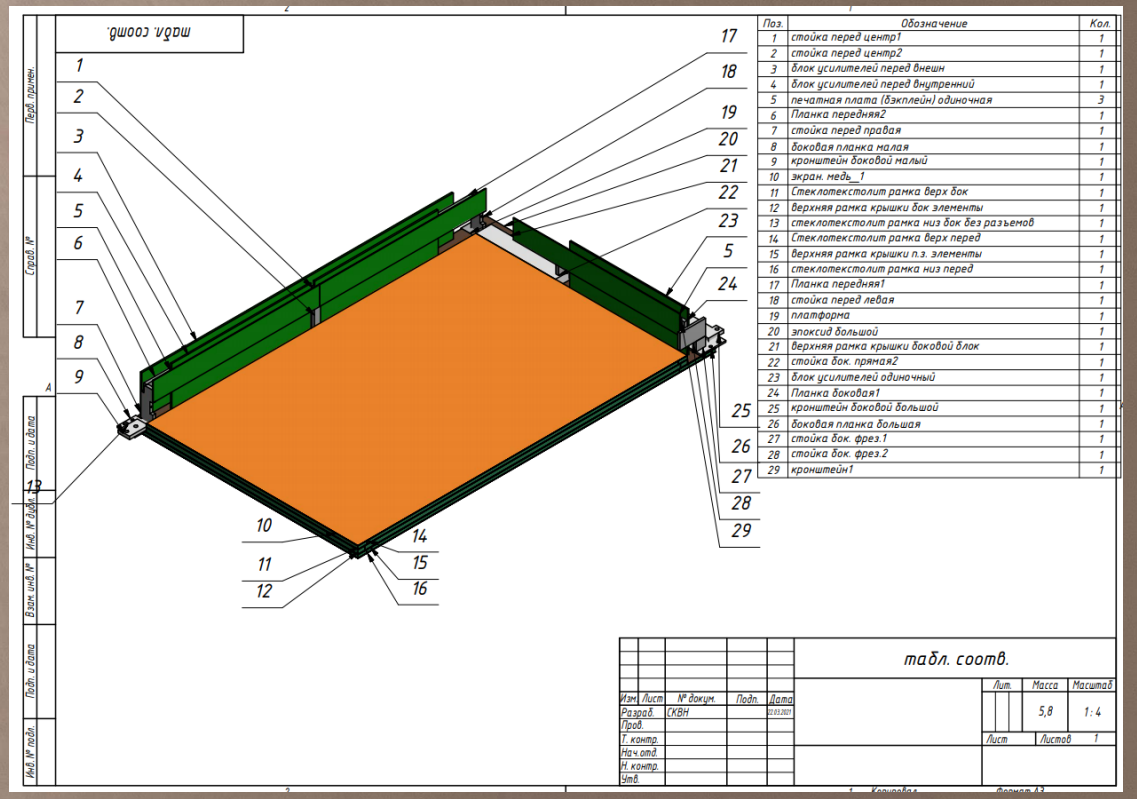
Materials and model for 66×41 cm² GEM detector

The contribution of materials for middle GEM detector was estimated.

Drawings contain an information about materials, densities and thiknesses.



Поз.	Обозначение	Кол.	Толщина, мм
1	экран. медь	1	0,035
2	клей	2	0,05
3	R0 медь	1	0,035
4	R0 полиамид	1	0,11
5	R0 эпоксид	1	0,1
6	GEM3 медь	1	0,007
7	GEM3 полиамид	1	0,03
8	GEM2 медь	1	0,007
9	GEM2 полиамид	1	0,03
10	GEM1 медь	1	0,007
11	GEM1 полиамид	1	0,03
12	электрод медь	1	0,005
13	клей	2	0,05
14	экран. медь	1	0,035
15	эпоксид малый	2	0,5
16	honey comb малый	1	5,915
17	эпоксид большой	2	0,5
18	honey comb большой	1	5,62



Поз.	Обозначение	Кол.
1	стойка перед центр1	1
2	стойка перед центр2	1
3	блок усилителей перед внешн	1
4	блок усилителей перед внутренний	1
5	печатная плата (дэкплейн) одиночная	3
6	Планка передняя2	1
7	стойка перед правая	1
8	боковая планка малая	1
9	кронштейн боковой малый	1
10	экран. медь_1	1
11	Стеклотекстолит рамка верх бок	1
12	верхняя рамка крышки бок элементы	1
13	стеклотекстолит рамка низ бок без разъемов	1
14	Стеклотекстолит рамка верх перед	1
15	верхняя рамка крышки п.э. элементы	1
16	стеклотекстолит рамка низ перед	1
17	Планка передняя1	1
18	стойка перед левая	1
19	платформа	1
20	эпоксид большой	1
21	верхняя рамка крышки боковой блок	1
22	стойка бок. прямая2	1
23	блок усилителей одиночный	1
24	Планка боковая1	1
25	кронштейн боковой большой	1
26	боковая планка большая	1
27	стойка бок. фрез.1	1
28	стойка бок. фрез.2	1
29	кронштейн1	1

S. Novozhilov

Summary

- 13 large area GEM detectors are in JINR.
- 7 163×39 cm^2 GEM detectors are tested with cosmic rays, 1 of them was broken and sent to CERN for repair.
- 2 spare detectors have to be assembled at CERN (parts are ready).
- tests with cosmic rays of 7 163×45 cm^2 GEM detectors will start in the nearest future.
- 2 66×41 cm^2 GEM detectors for the SRC are now testing with HV.

- 4 1×1 m^2 CSC are produced.
- 2×1.5 m^2 CSC readout is prepared on the table.
- A problem of disappearance of contact between pins and connector is being investigated.
- Planned dates for production of 2×1.5 m^2 CSC: February-March of 2022 – first chamber, July of 2022 – second chamber.

Thank you for your attention!