

Detector installation, experimental zone

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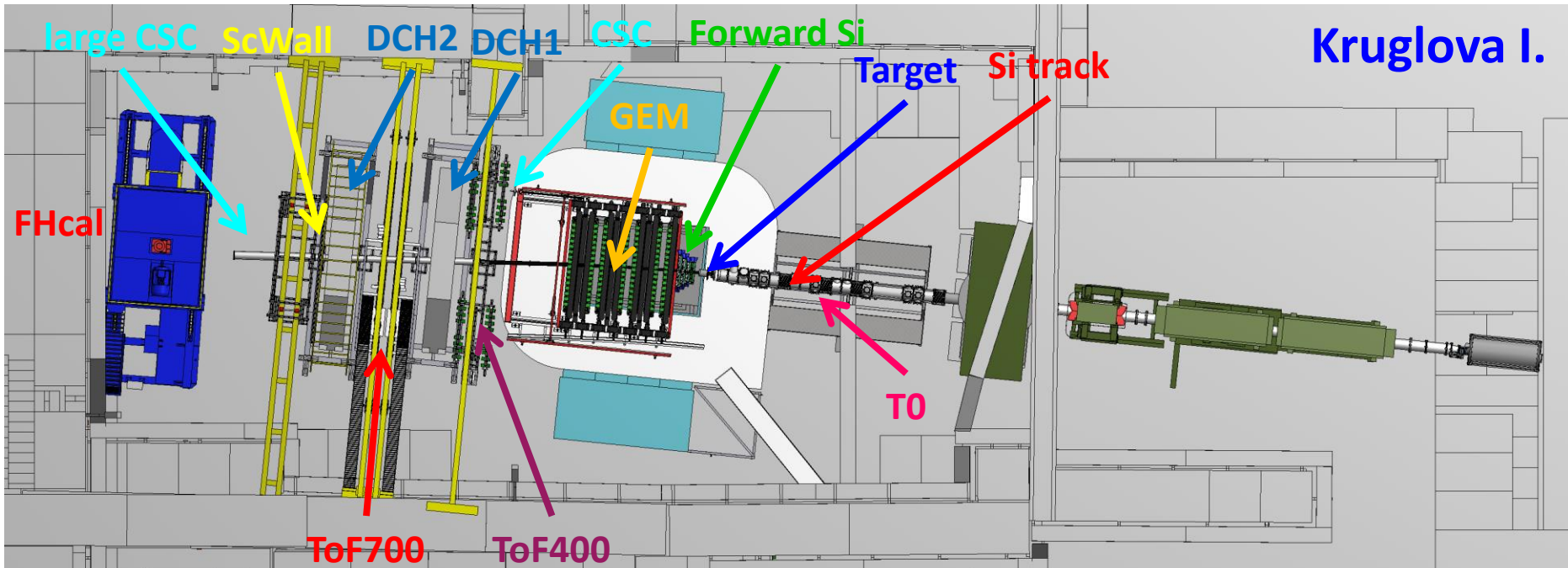
28.11.2023



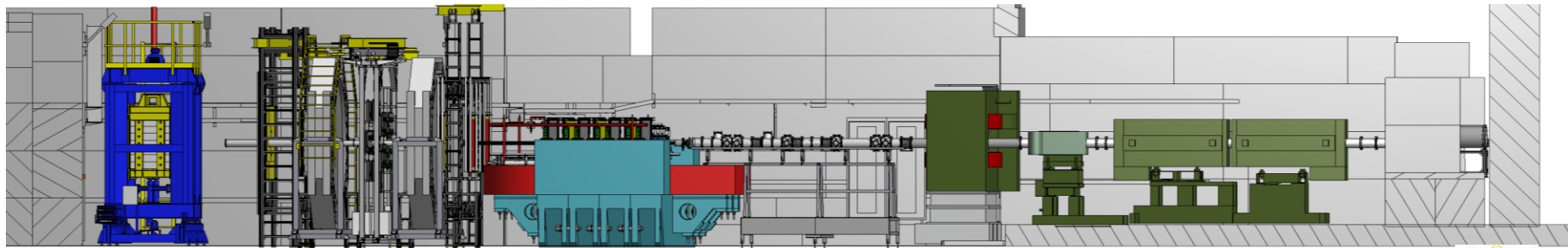
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Detector installation in BM@N experimental hall (Run 8)

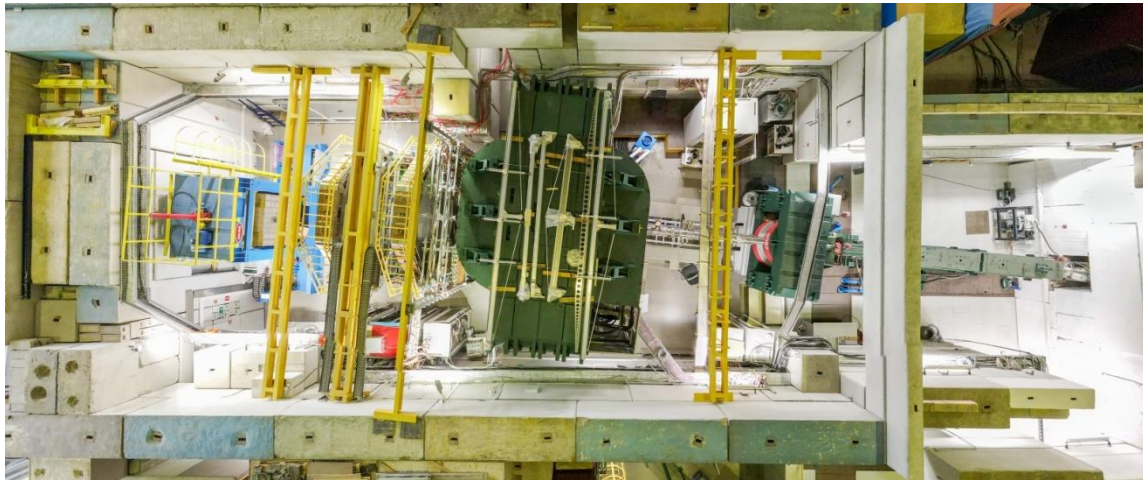
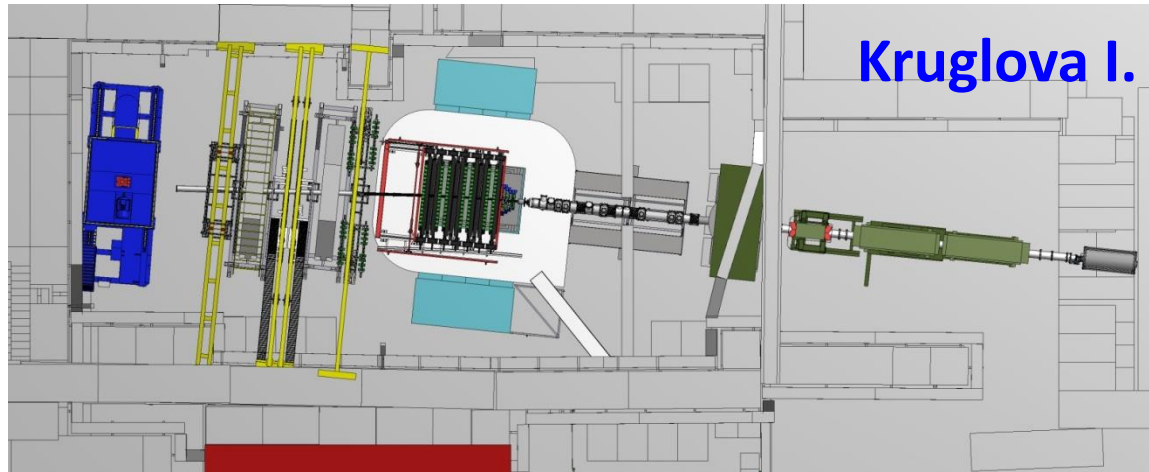


3D model of the entire experimental hall of BM@N



The density of the detector elements of both the central tracking system inside the SP-41 magnet and the external tracking system

Detector installation in BM@N experimental hall (Run 8)



The 3D model coincides with the actual position of the main elements of the BM@N installation very well.

3D model is necessary to create drawings of mechanical supports and the location of the detecting elements themselves.

The article about configuration BM@N setup in Run 8



The BM@N facility at the NICA accelerator complex

BMN collaboration

February 2023

1 Introduction

BM@N (baryonic matter at Nuclotron) is the first experiment operational at the ion-accelerating complex Nuclotron/NICA, studying interactions of relativistic ion beams of heavy ions with fixed targets [1] in the energy range of high densities of baryonic matter [2]. At the Nuclotron energies, the density of nucleons in a fireball created by two colliding heavy nuclei is 3-4 times higher than the nuclear saturation density[3]. In addition, these energies are high enough to study strange mesons and (multi)-strange hyperons produced in nucleus-nucleus collisions close to the kinematical threshold [4, 5]. The primary goal of the experiment is to constrain parameters of the equation of state (EoS) of high-density nuclear matter. Studies of the excitation function of strange particle production below and near to the kinematical threshold make it possible to distinguish hard behaviour of the EoS from the soft one [6].

The Nuclotron will provide the experiment with beams of a variety of particles, from protons to gold ions, with kinetic energy in the range from 1 to 6 GeV/nucleon for light ions with Z/A ratio of ~ 0.5 and up to 4.5 GeV/nucleon for heavy ions with Z/A ratio of ~ 0.4.

The BM@N detector is a forward spectrometer covering the pseudorapidity range $1.6 \leq \eta \leq 4.4$. Schematic view of the BM@N setup is shown in Fig. 1. The description of the spectrometer subsystems is organised in a "downstream beam" order. The details for all subsystems are given in a corresponding sections below.

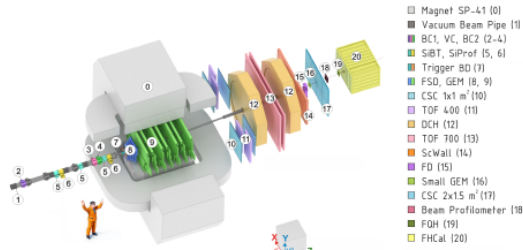
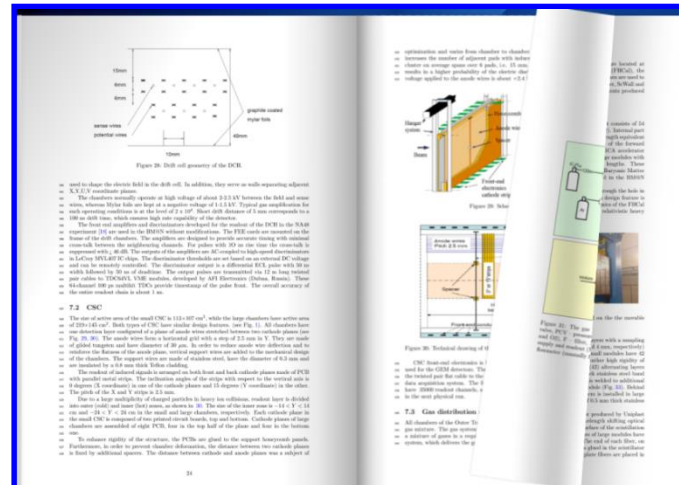
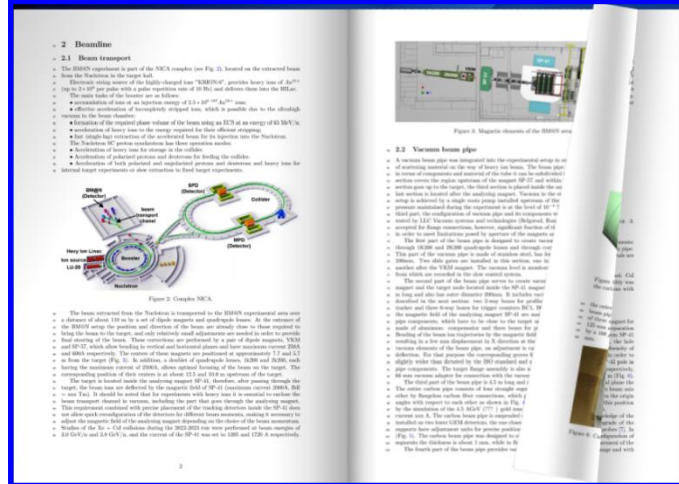


Figure 1: Schematic view of BM@N setup in RUN8.

- Magnet SP-L41 (0)
- Vacuum Beam Pipe (1)
- BC1, VC, BC2 (2-4)
- SBT, SiPProf (5, 6)
- Trigger BD (7)
- FSD, GEM (8, 9)
- CSC 1x1 m² (10)
- TOF 400 (11)
- DCH (12)
- TOF 700 (13)
- ScWall (14)
- FD (15)
- Small GEM (16)
- CSC 2x15 m² (17)
- Beam Profliometer (18)
- FOM (19)
- FHCal (20)



Our group of editors has finished editing the style of the article about the entire installation configuration in Run 8.

Content:

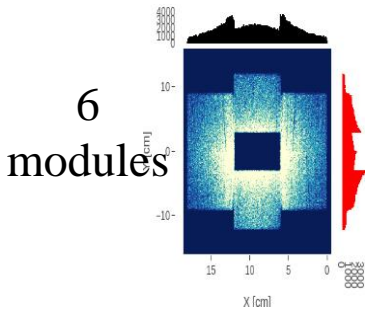
1. Introduction
2. Beamline
3. Beam and trigger detectors
4. Silicon Beam Tracker
5. Central Tracking System
6. TOF
7. Outer Tracker
8. Forward Spectator Detectors
9. Trigger and data acquisition
10. Slow Control System
11. Summary



We will send this version of the article to all those responsible for the subsystems. Those responsible for the subsystems will have only 1 week to review the final version of the article. If none of them have any comments, we will send the article to the journal.

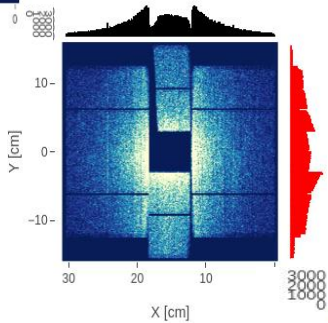
Forward Si modernization

The correlation plots for Forward Si detectors obtained during Run 8



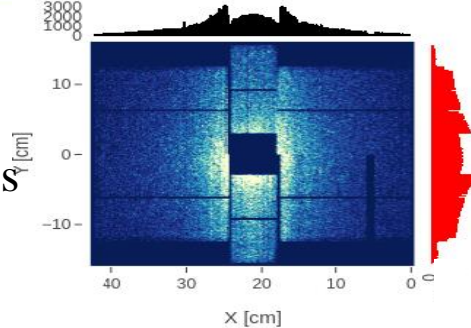
PI#1:
Id=8.9 μ A / 8.2 μ A
(100% chips work, there were no problems)

10 modules



PI#2:
Id=27.6 μ A / 28.5 μ A
(1% chips didn't work = 1 chip of 100 pcs., as of 09/26/23 everything is 100% working)

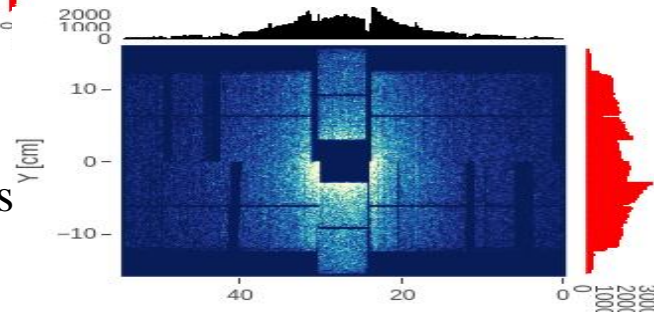
14 modules



PI#3:
Id=40 μ A / 48 μ A
(2 chips out of 140 do not work)

Experts are studying non-performing sectors now.

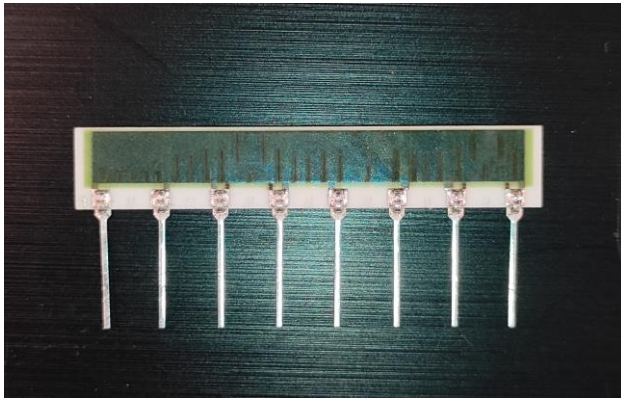
18 modules



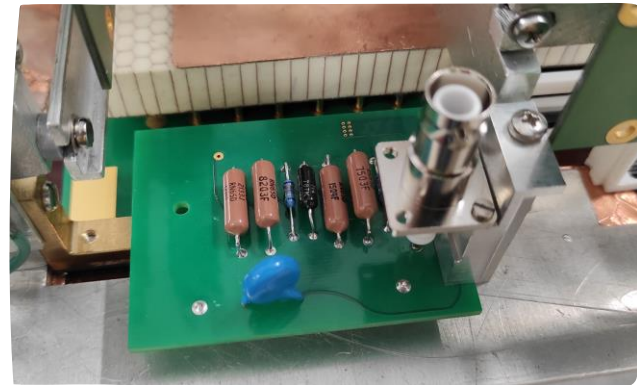
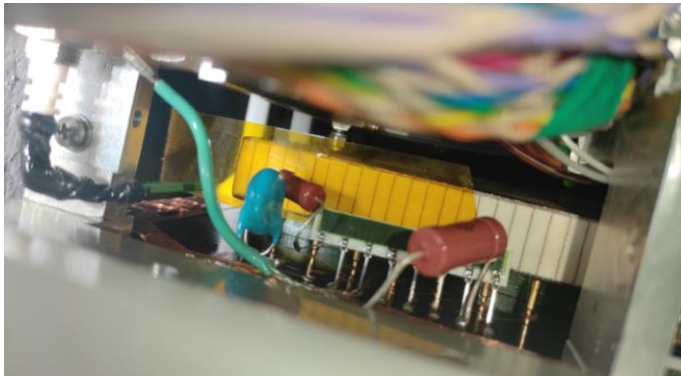
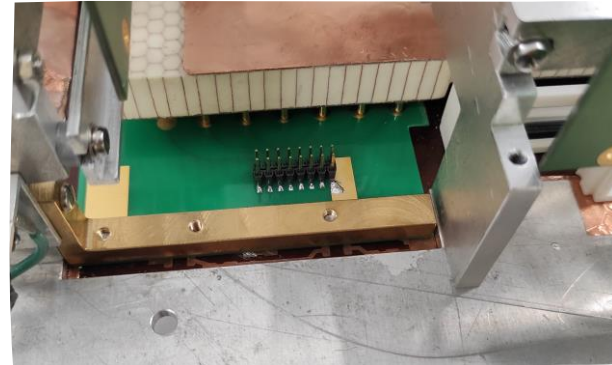
N. Zamyatin will talk in more detail about the operation of Si detectors

GEM modernization

Divider old configuration



The board on the detector



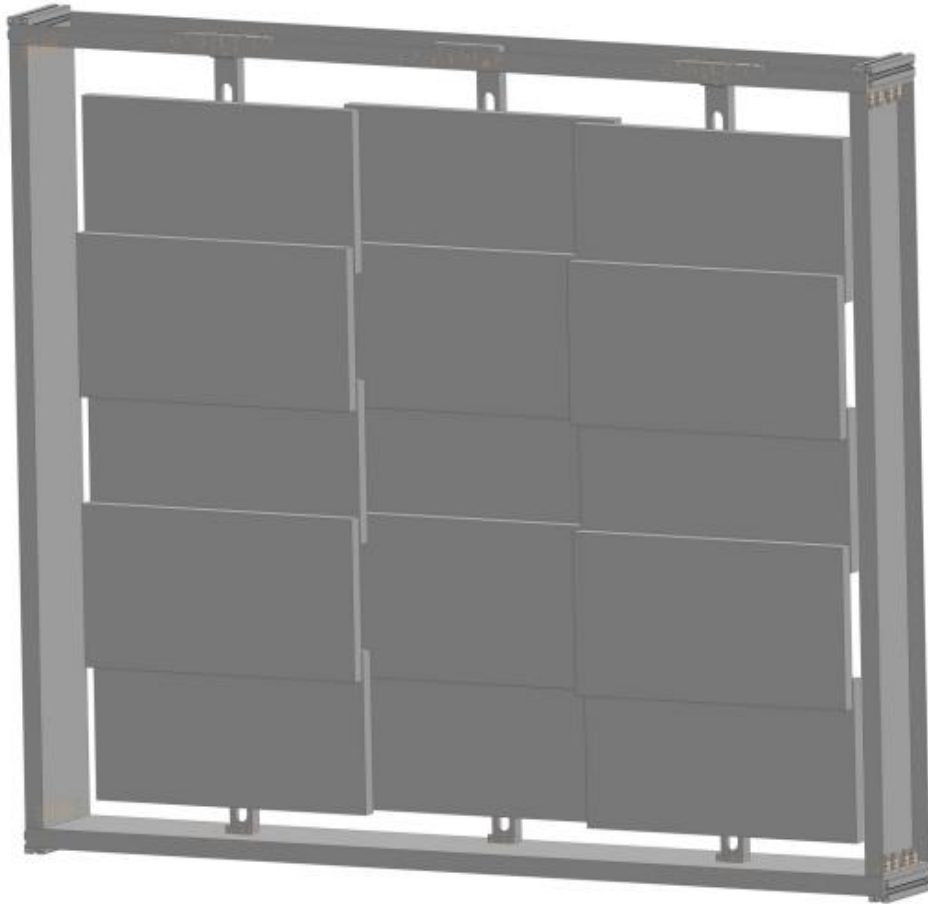
Divider new configuration

Location of the old divider on the [Gem](#) detector

[E. Kulish](#) will talk in more detail about the operation of [Gem](#) detectors

ToF400 modernization

It was decided to expand the acceptance of Tof400.
To do this, you will have to change the detector boxes.



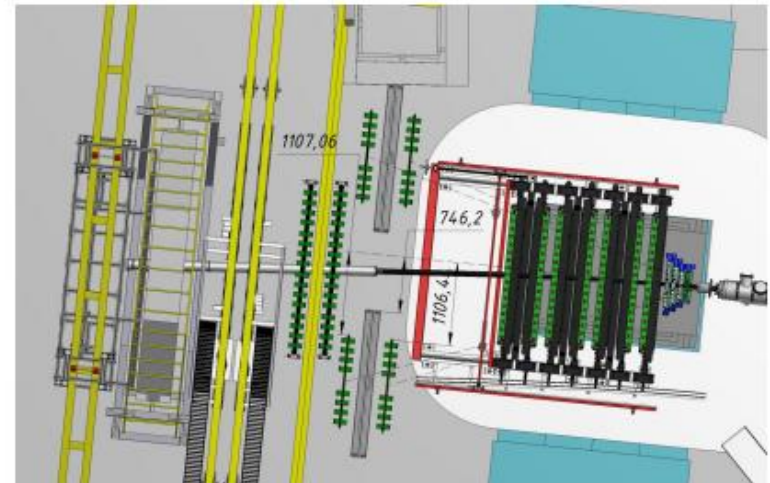
Box size - $\sim 1,5 \times 1,8 \text{ m}^2$

Material — aluminium

Minimizing material budget near to beam axis

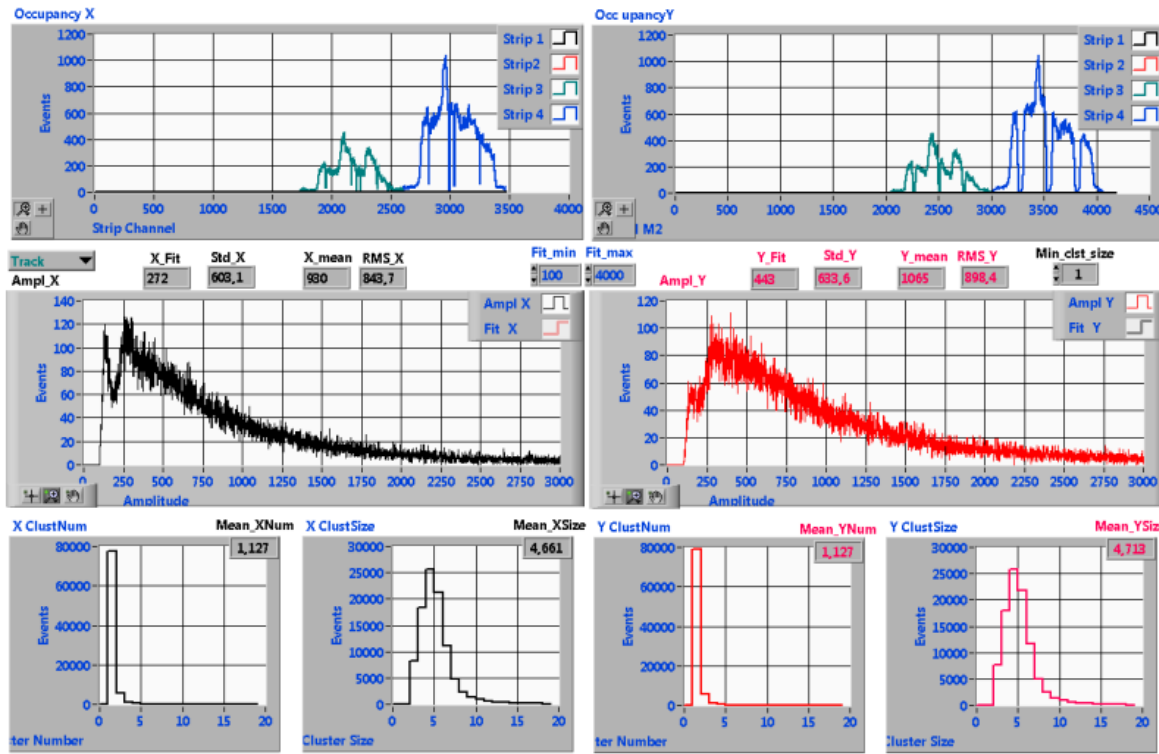
We are looking for a factory for production

- NPO «ATOM» - production is busy
- OOO «Pelkom» - Difficult situation at the factory

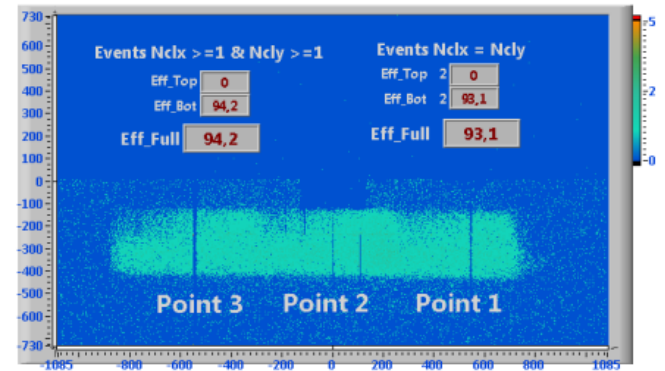


CSC big testing

We received confirmation that the new detector is working.
 Once we received confirmation that the detector was working well, we removed DCH2 from the installation.
 Then we began to work out the location of two CSCs big on the installation.



Cosmic test of CSC big detector.

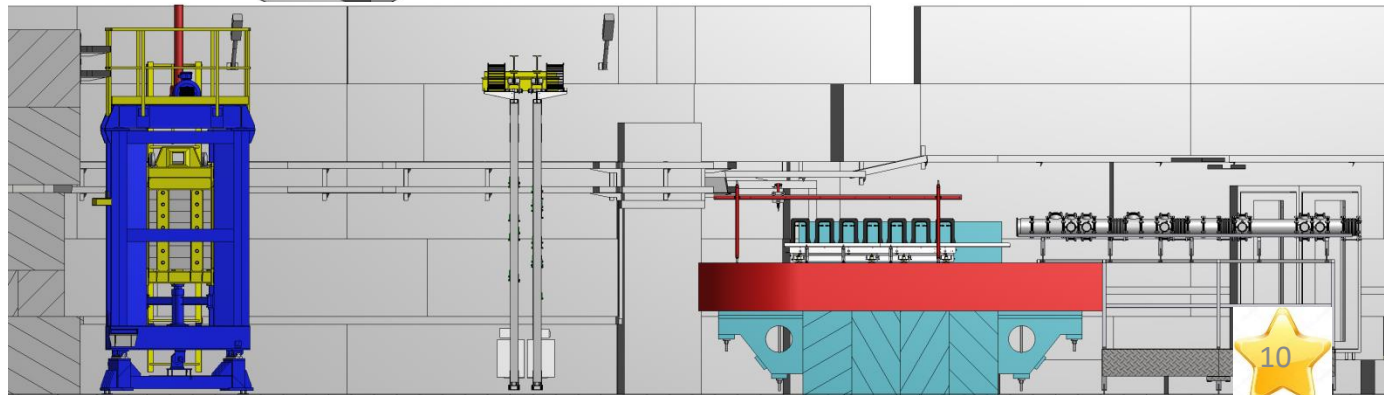
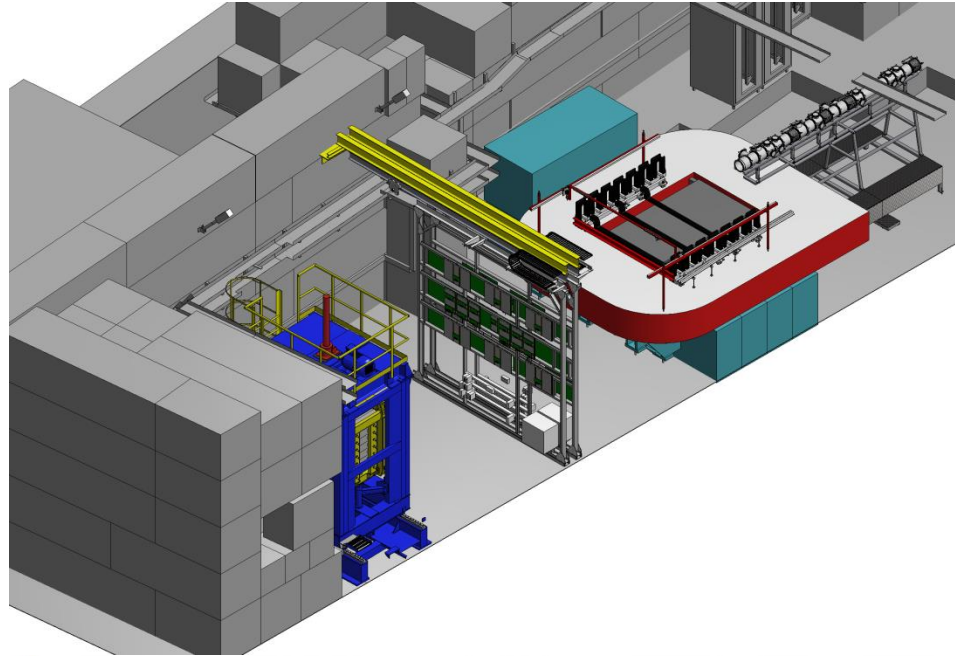


E. Kulish will talk in more detail about the operation of CSC detectors.

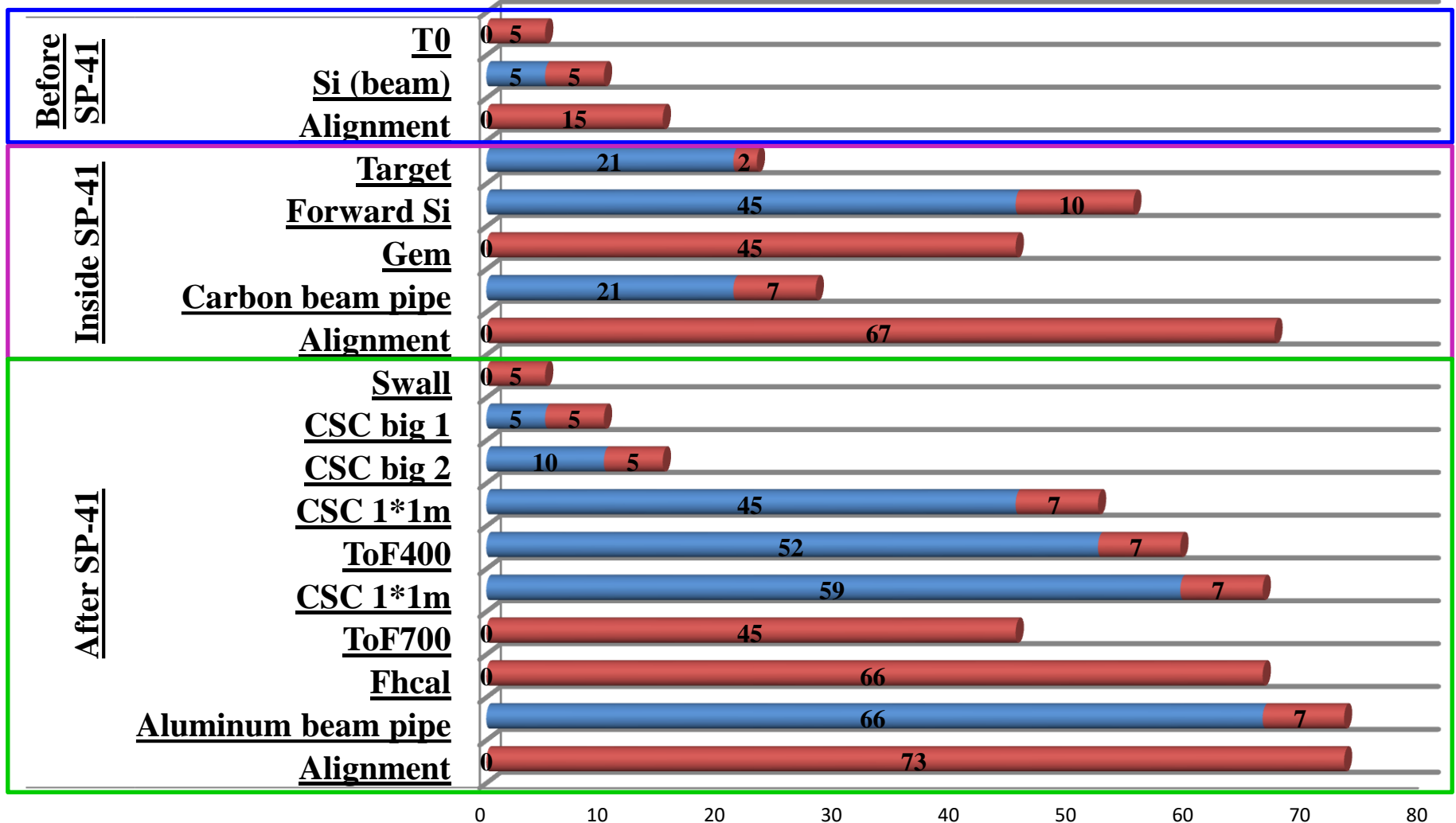
BM@N experimental hall now

The following elements of the **BM@N** installation were removed after **Run 8**:

1. 4 detectors **ToF400**;
2. 4 detectors **CSC 1x1m**;
3. **CSC 1,5x2m**;
4. **FD**;
5. small **Gem**;
6. Aluminum beam pipe;
7. **SiMD**;
8. 8 planes **forward Si**;
9. 14 **Gem**;
10. Carbon beam pipe;
11. **DCH1**;
12. **DCH2**;
13. **ScWall**;
14. **Target Station**.

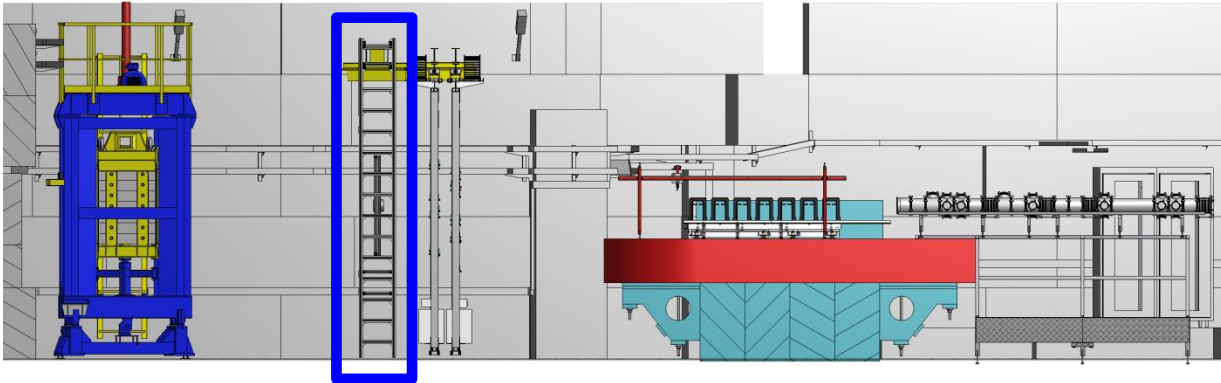


Installation timetable

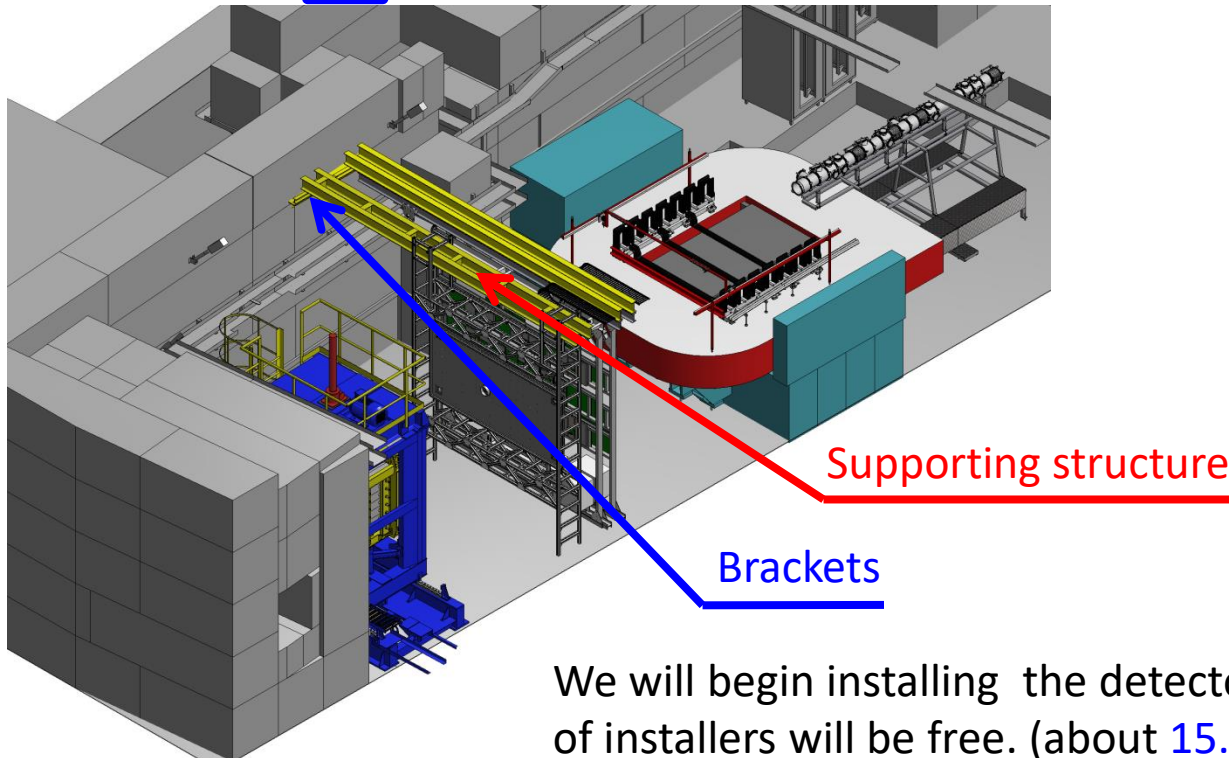


■ Days before work ■ Duration of works

Installation of ScWall detector

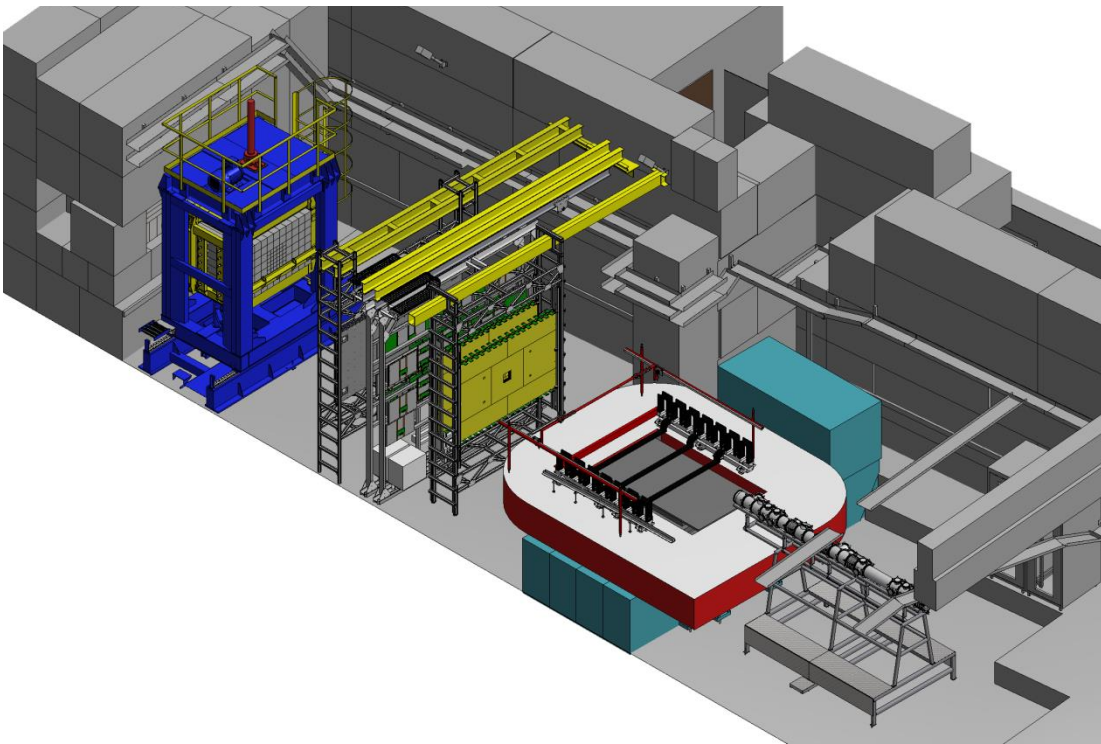
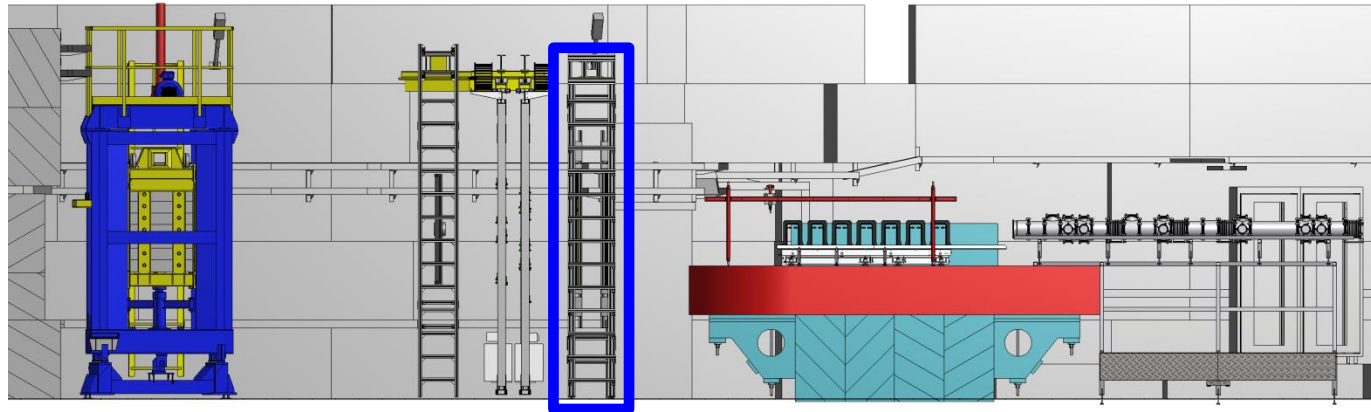


1. Mechanical support materials: **Yes**
2. Supporting structure for mechanical support : **Yes**
3. Brackets for fastening the supporting structure : **No**
4. Mechanical Support Project: **Yes**
5. The detector is ready for installation: **Yes**



We will begin installing the detector when the group of installers will be free. (about **15.12.2023**)

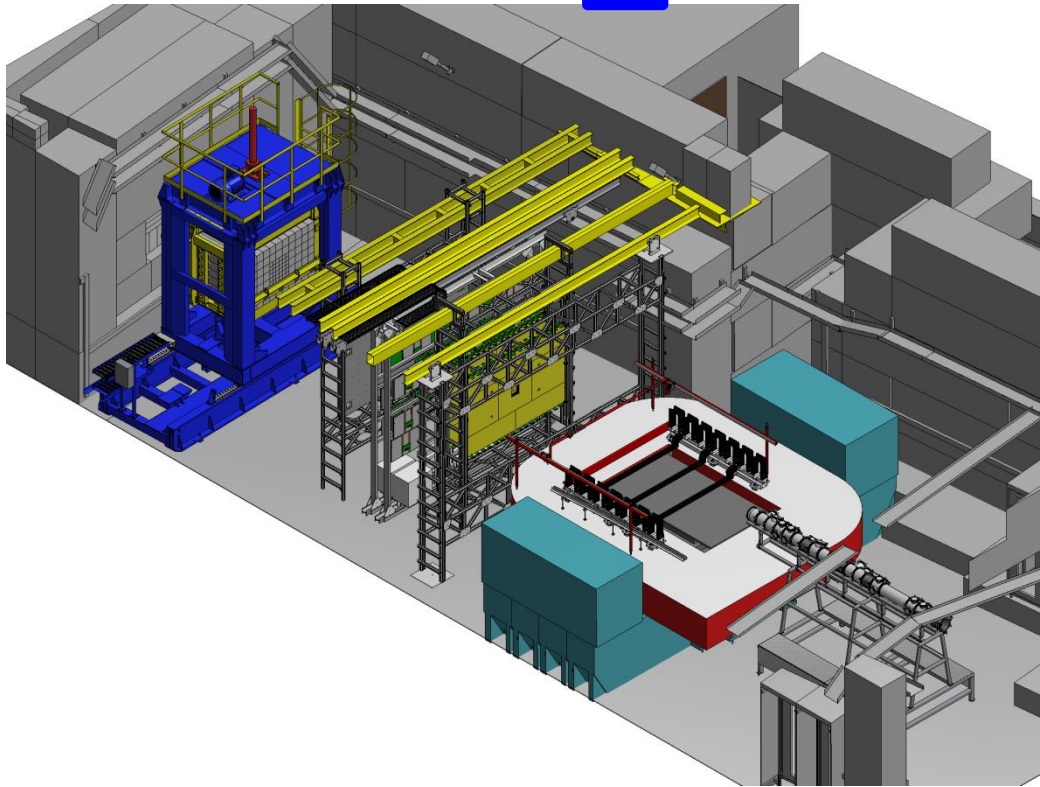
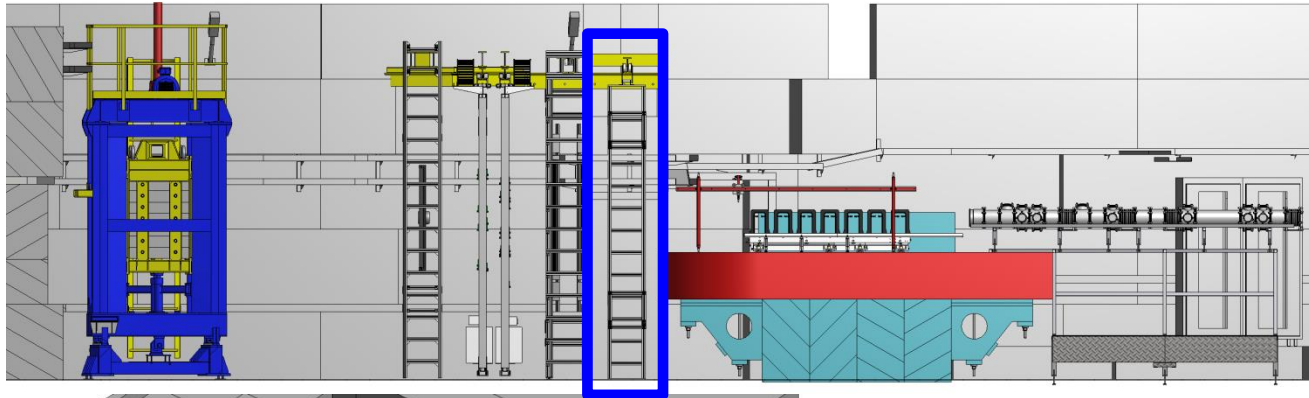
Installation of 2 CSC big detectors



1. Mechanical support materials: **Yes**
2. Supporting structure for mechanical support : **Yes**
3. Brackets for fastening the supporting structure : **Yes**
4. Mechanical Support Project: **Yes**
5. The detector is ready for installation: **Yes**

We will begin installing the mechanical support when the group of installers will be free (about **15.12.2023**)

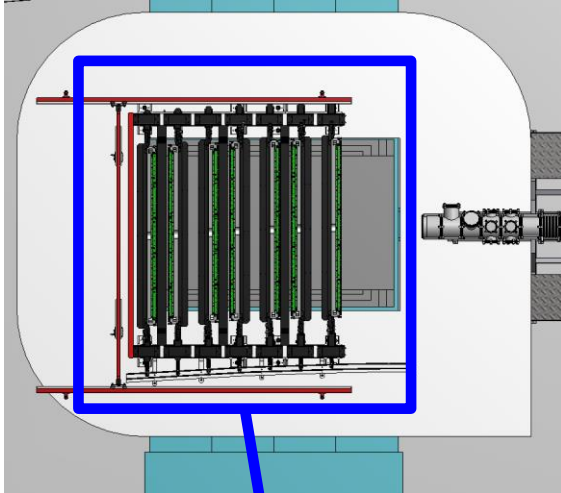
Installation of 2 new ToF400



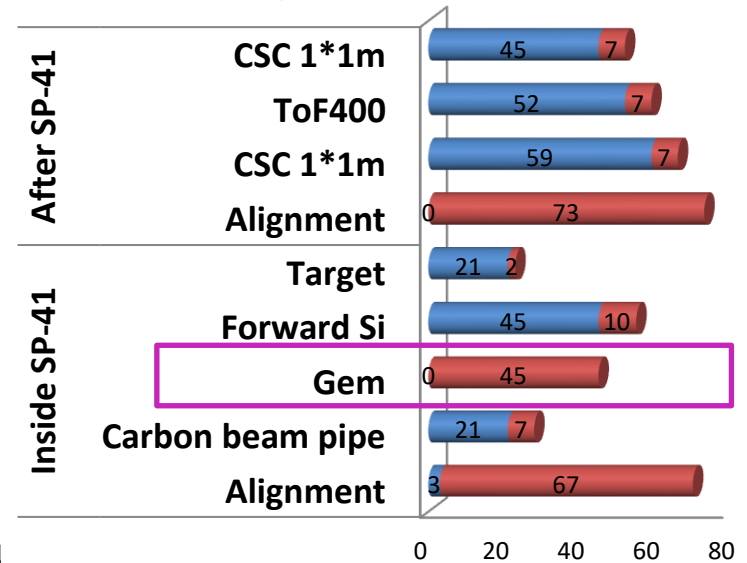
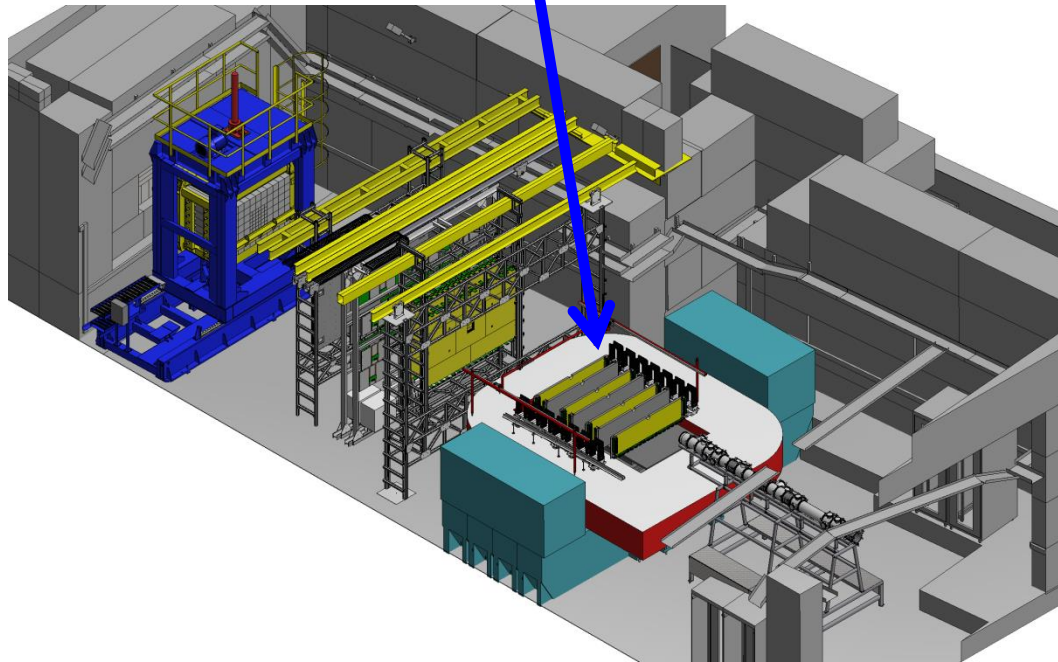
1. Mechanical support materials: **Yes**
2. Supporting structure for mechanical support : **Yes**
3. Brackets for fastening the supporting structure : **Yes**
4. Mechanical Support Project: **Yes**
5. The detector is ready for installation: **No (Modernization now)**

We will begin installing the mechanical support when the group of installers will be free.
(about [15.12.2023](#))

Installation of 7 GEM detectors



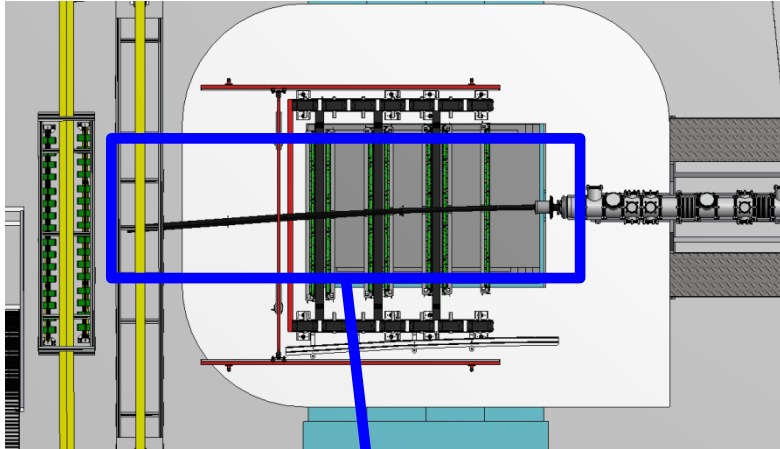
1. Mechanical support : **Yes**
2. The detector is ready for installation: **No**
(Modernization now)



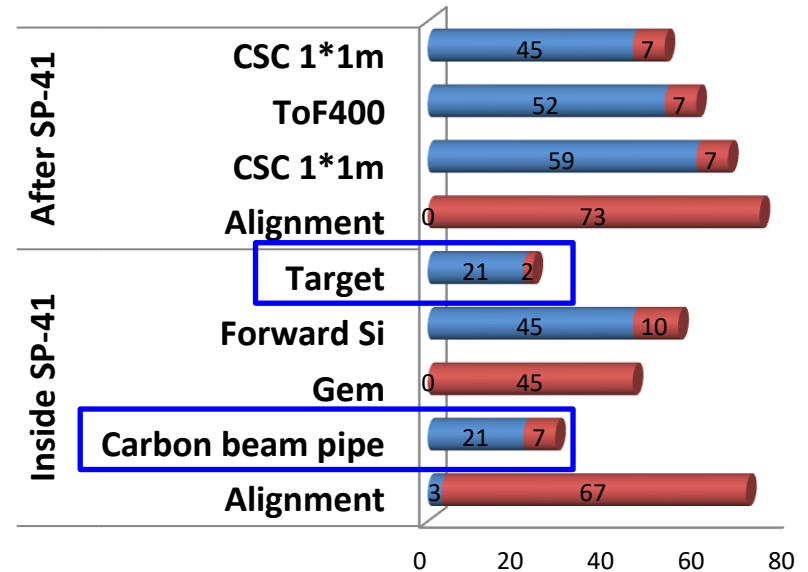
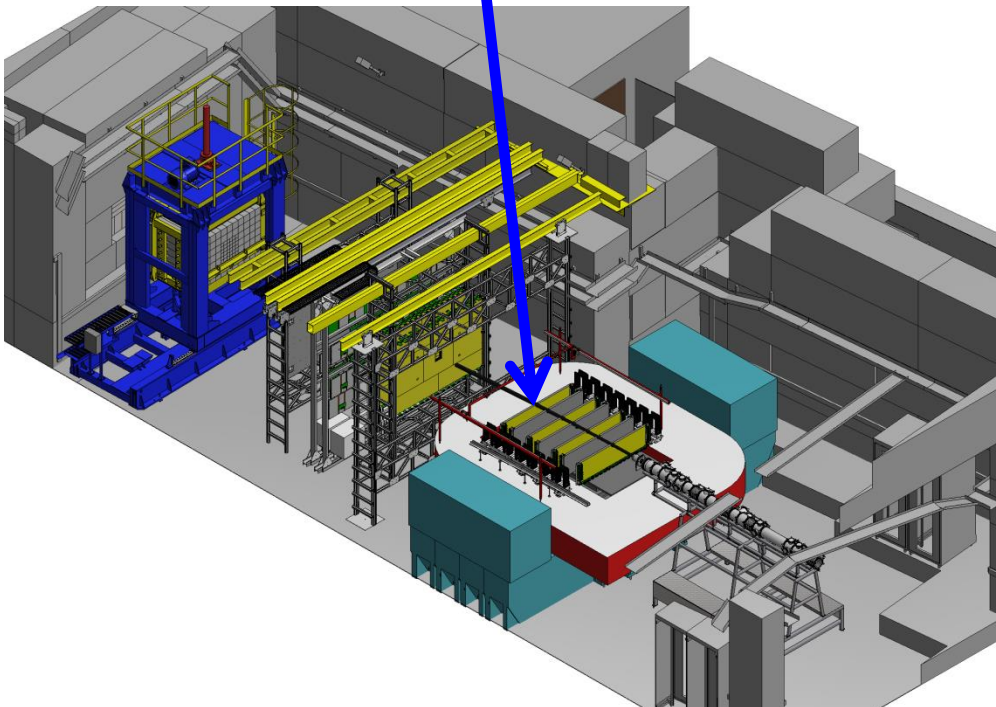
Only after installing all **GEM** we will be able to complete the installation of **CSC** and **TOF400**

We will begin installing detectors after the high power system is fully upgraded. (about **15.01.2024**)

Installation of carbon beam pipe & target station

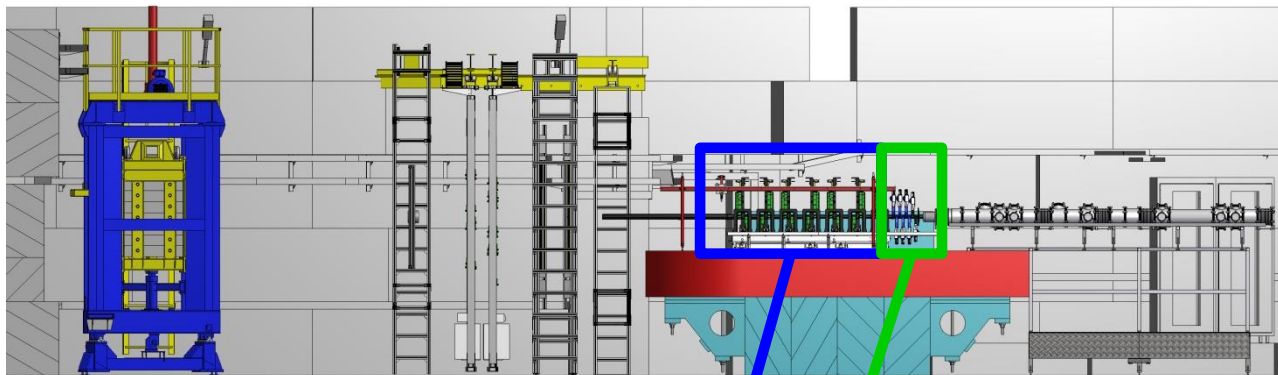


1. Carbon beam pipe is ready for installation: **Yes**
2. Target station is ready for installation : **Yes**

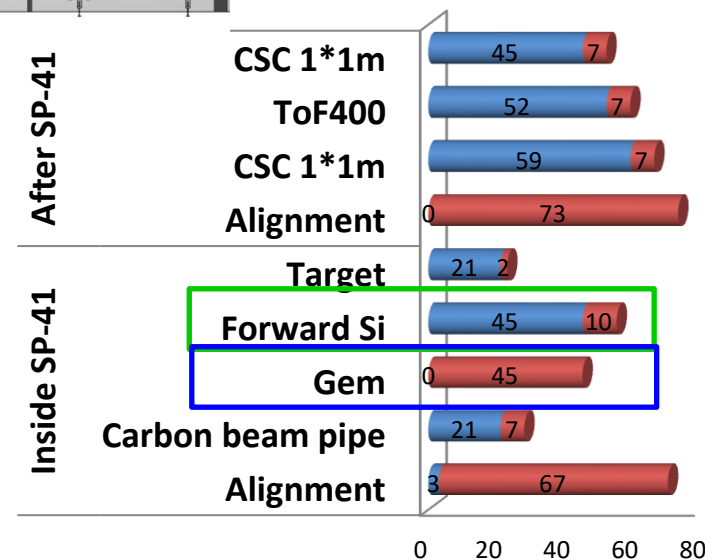
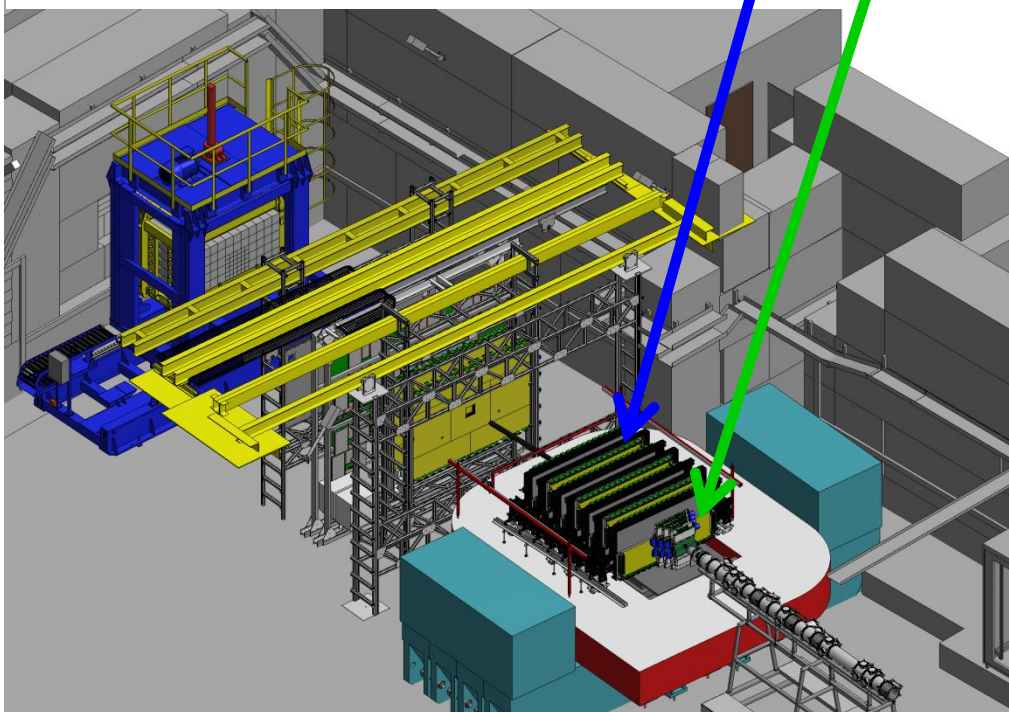


We will start installing the target station and carbon tube after installing the 7 bottom GEM detectors.

Installation of 7 GEM detectors & Forward Si

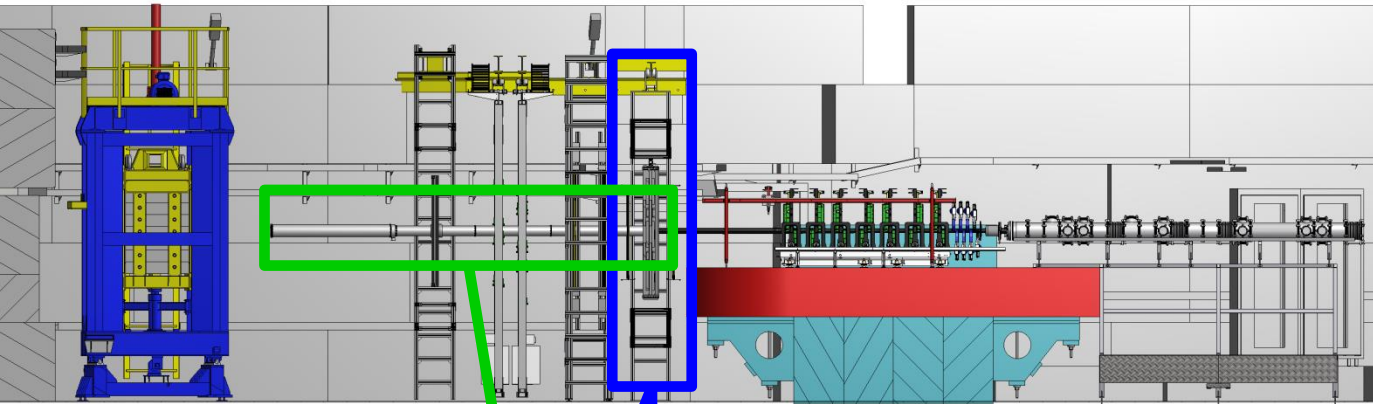


We will start installing the 7 top GEM detectors after installing the carbon beam pipe and target station.

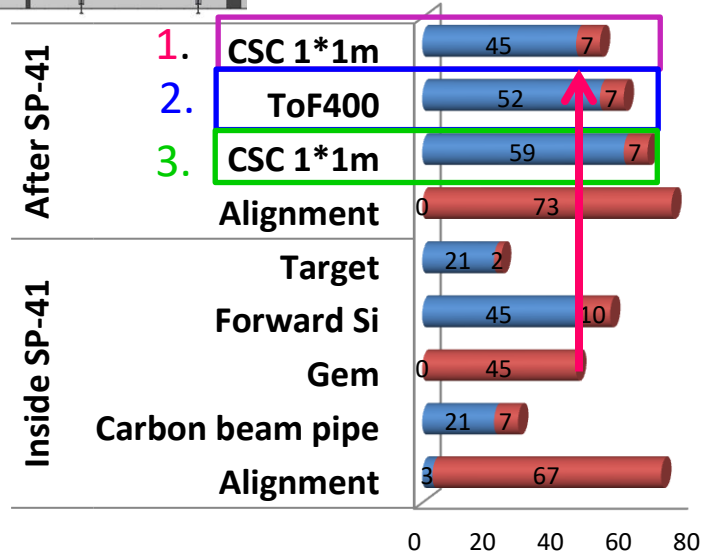
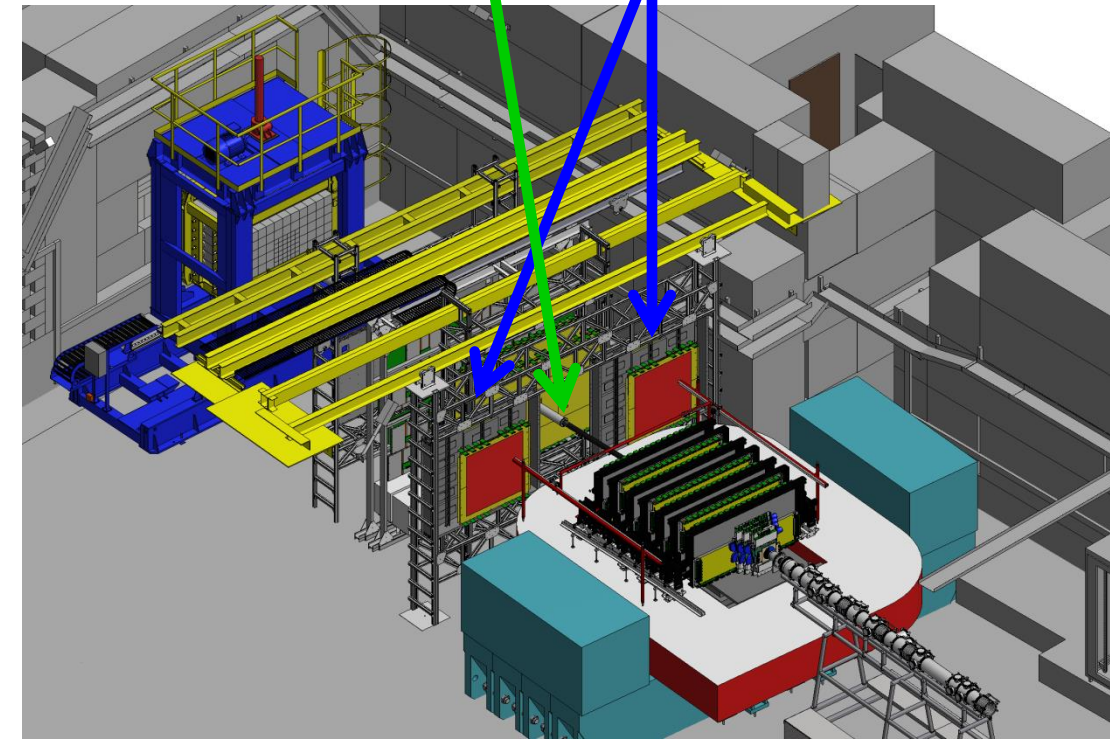


After installing all GEM detectors, Forward Si will be installed.

Installation of 2 ToF400 & 4 CSC & aluminum beam pipe



1. After installing all GEM detectors, 2 CSC 1x1 m will be installed.
2. The next stage will be the installation of 2 new ToF400 detectors.



3. We will be able to install the last 2 CSC only after the 2 ToF400 detectors are fully installed.

Conclusion



1. All work on the design and creation of mechanical supports was completed, taking into account the modernization of the external track system of the **BM@N** installation.
2. To begin work on installing mechanical supports on the **BM@N** installation, a group of installers is required.
3. The installation of a central tracking system inside the **SP-41** magnet will begin after the completion of the modernization process of the detectors themselves.



**THANK YOU
FOR YOUR
ATTENTION**

