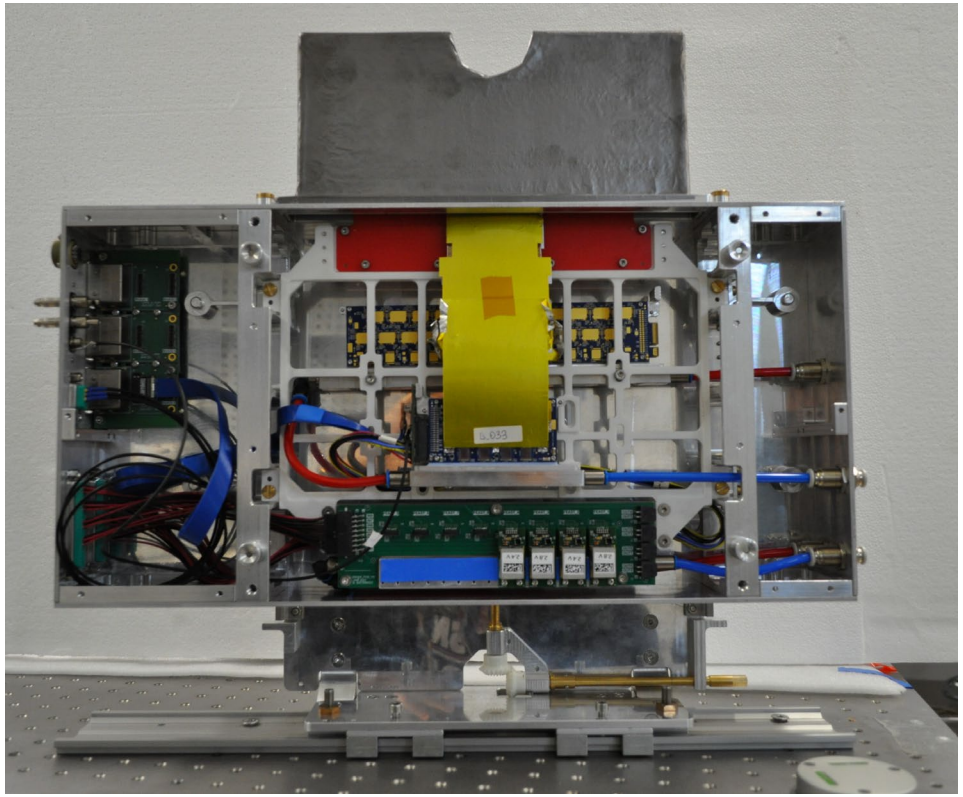
Status of the first Si-plane based on STS modules

Sheremetev Aleksei for STS team

JINR LHEP



13th Collaboration Meeting of the BM@N Experiment at NICA
08 – 10 October 2024

Outline

- Mechanics

  D. Andreev, I. Gorelicov, A.Voronin, A.Panfilov, A. Sheremetev

- In-beam tests of the DSSD-modules

  D. Dementev, M. Shitenkov, R. A. Díaz, A. Kolozhvari, V. Leontyev, A. R. Alvarez

- DAQ integration

  D. Dementev, M. Shitenkov, R. A. Díaz, A. Kolozhvari, I.Filipov

- DCS system

  A. R. Alvarez, I. Osokin

- Timelines

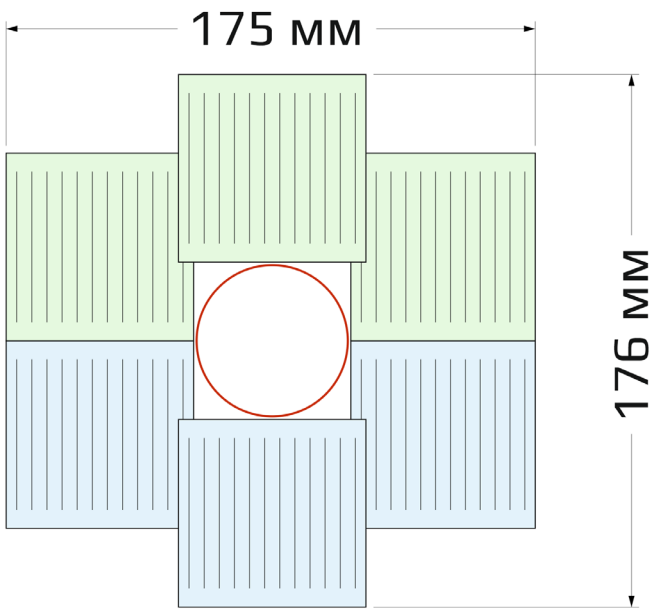
STS station based on STS modules

Size of the sensor: 62×62 mm^2;

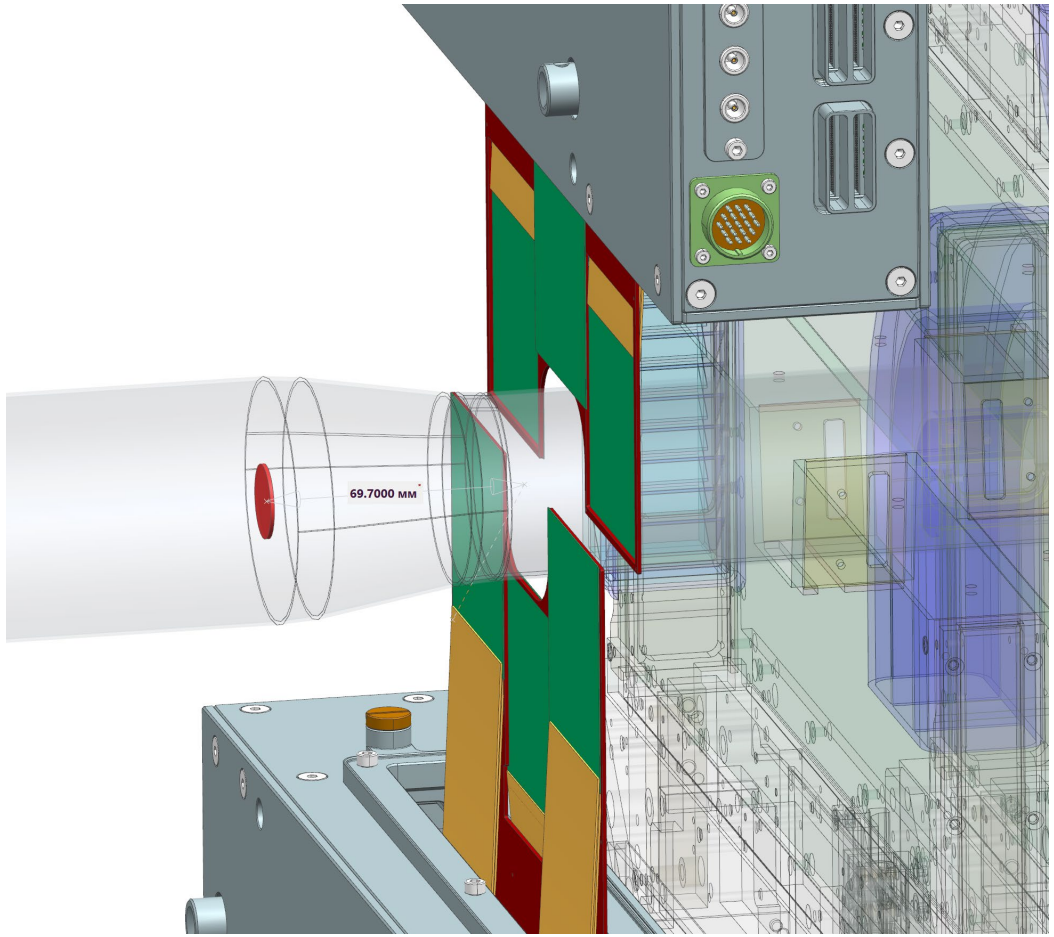
Pitch: 58 μm, 7.5° stereo-angle;

Thickness of the sensor: 320 μm ±15 μm;

Total number of channels: 12.288 channels;



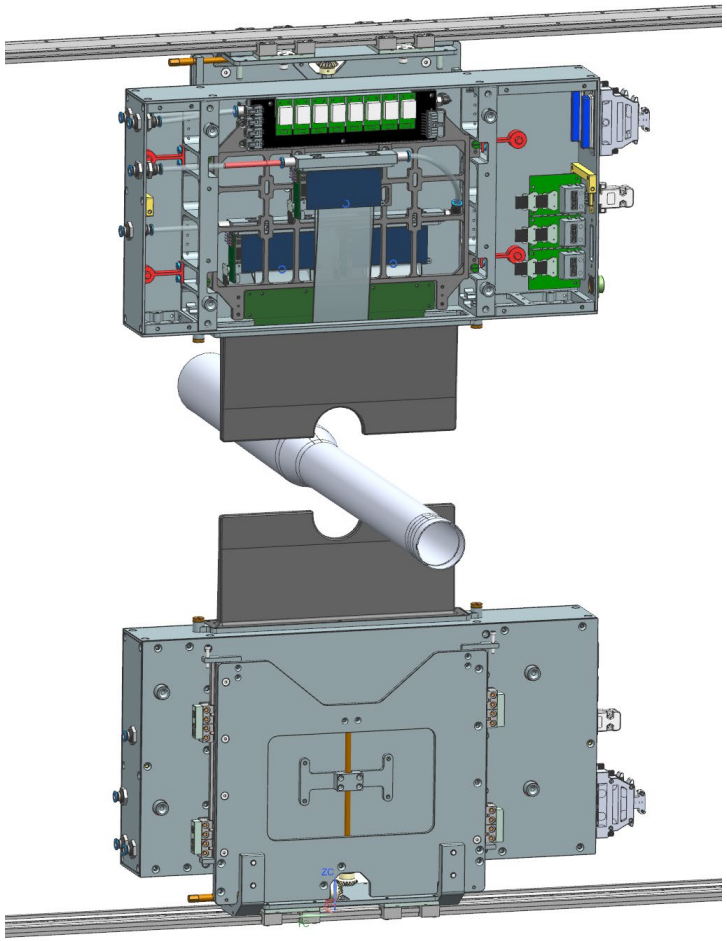
Si-station consist of 6 STS modules



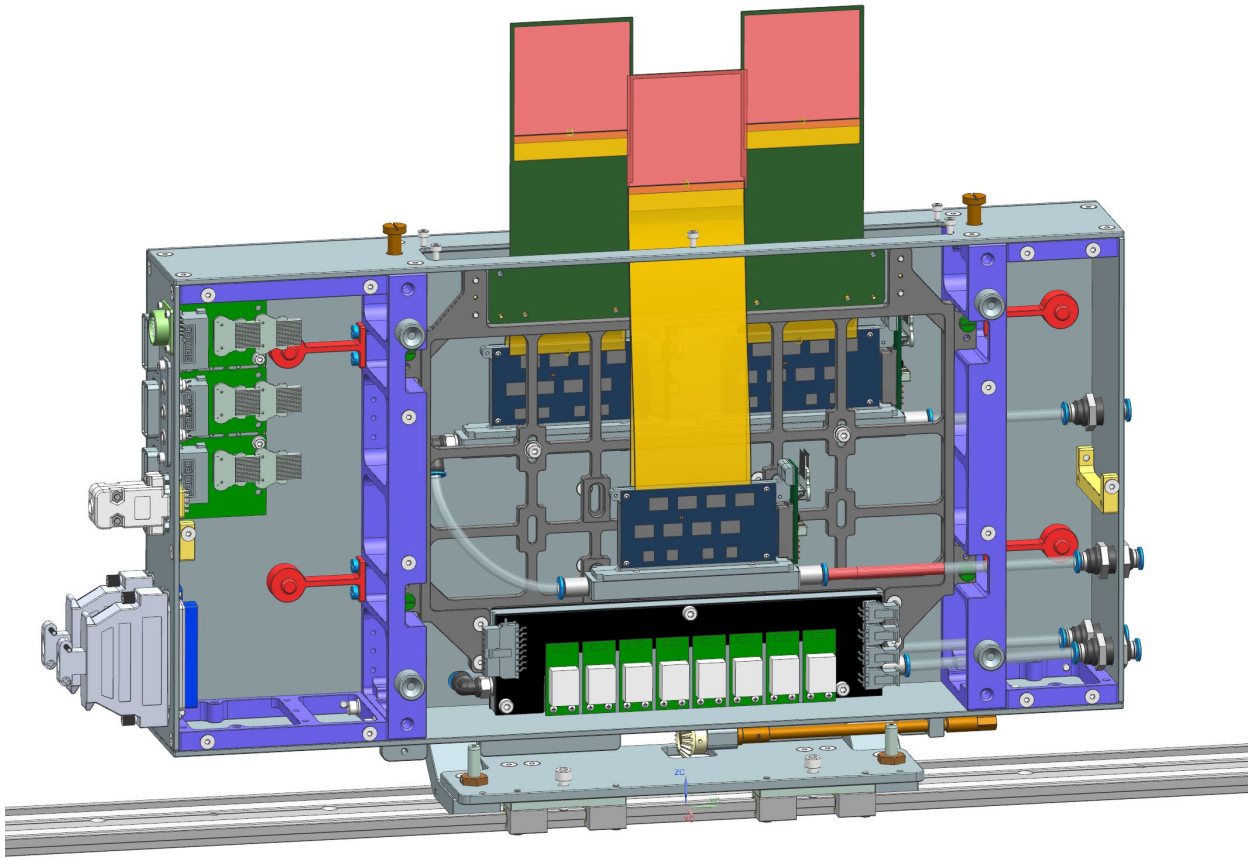
Distance from the Target ~ 70 mm

STS station based on STS modules

The STS station in open position

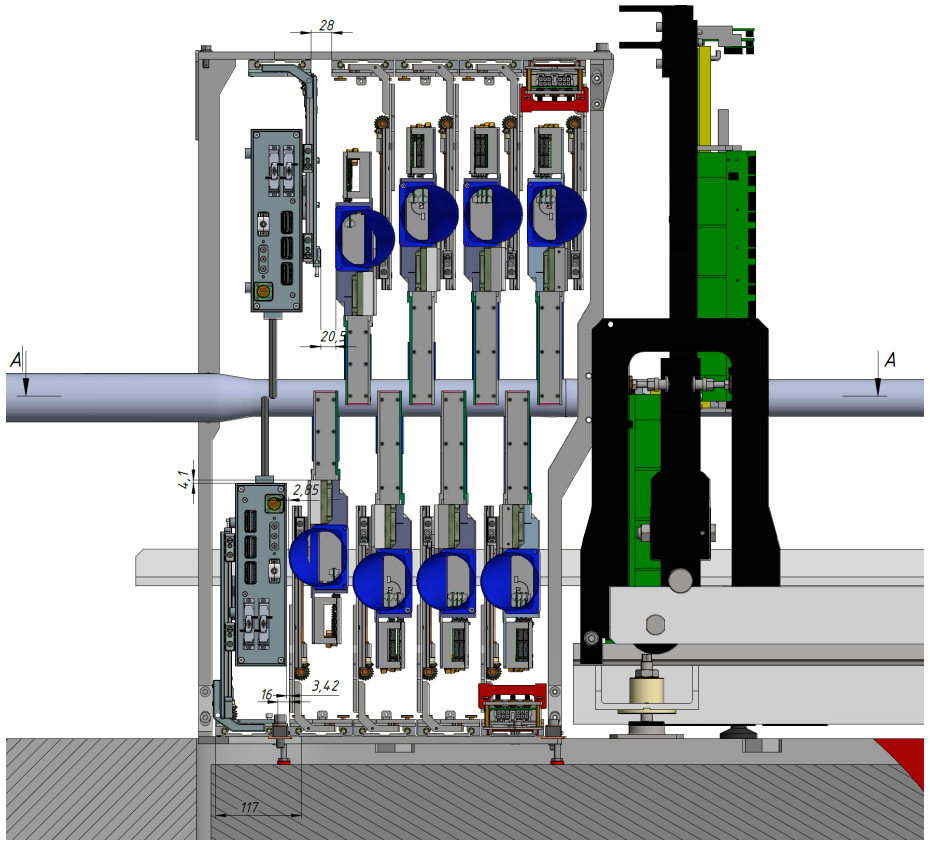


Half part of the STS station

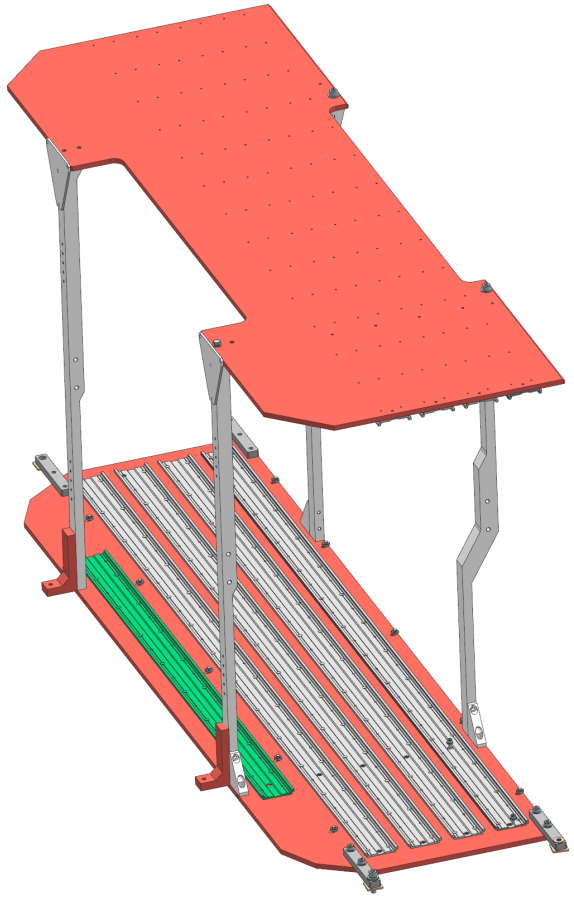


Mechanical integration of STS and FSD station

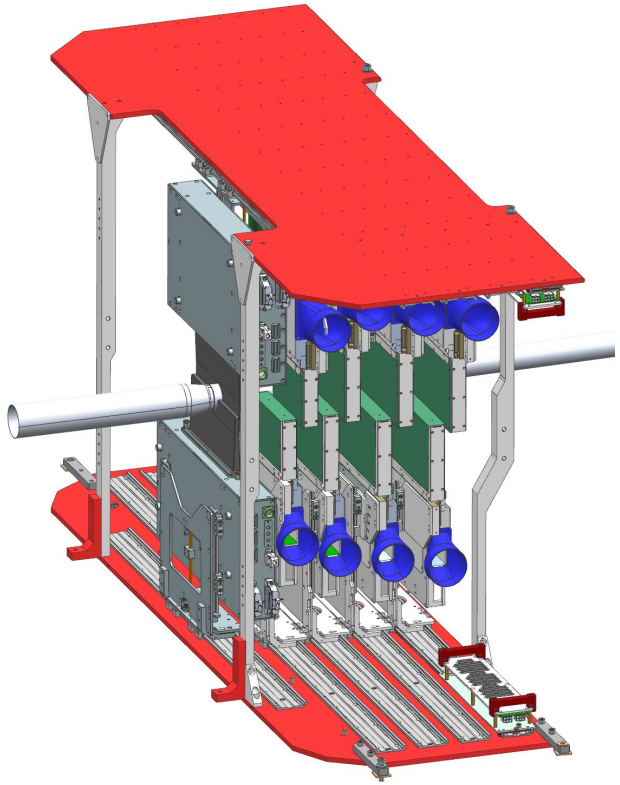
Top and Bottom parts of the **carrier plate** have to be redesigned to carry FSD and STS;



Cross section of STS + FSD stations inside magnet



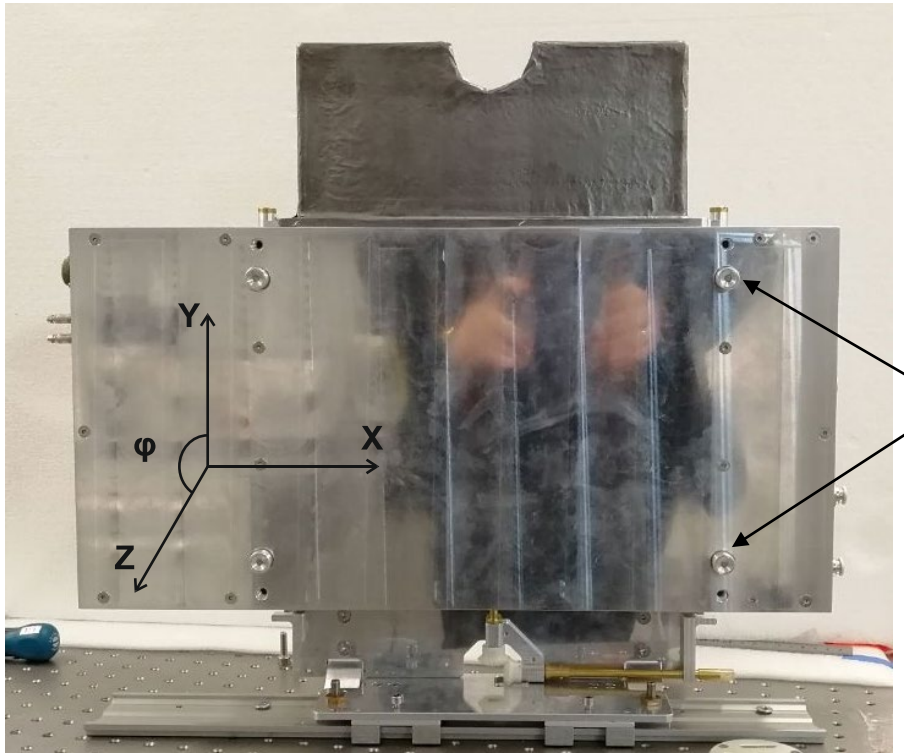
The work is carried out together with FSD grope



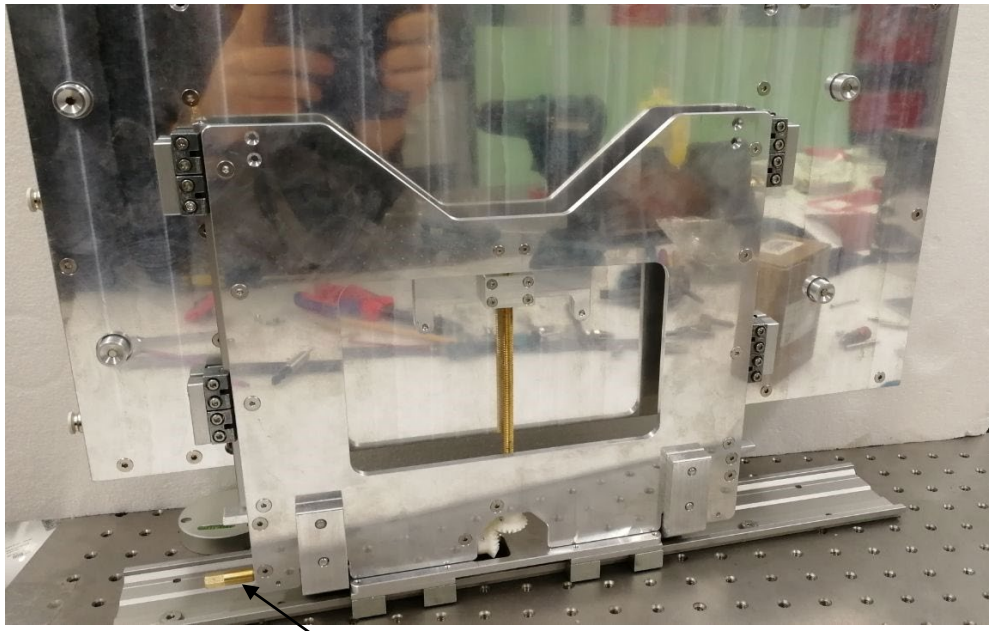
Alignments of half STS station

Each Half-Station:

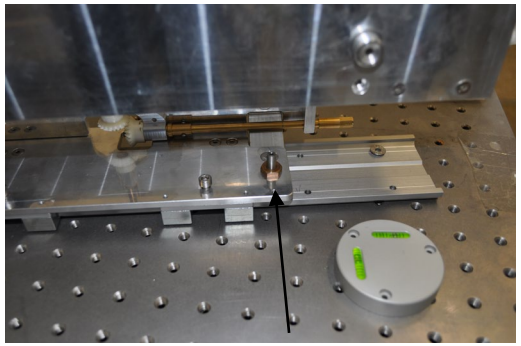
- Has 8 alignment marks;
- 3 DoF (x, y, φ) can be adjusted;



Alignment marks

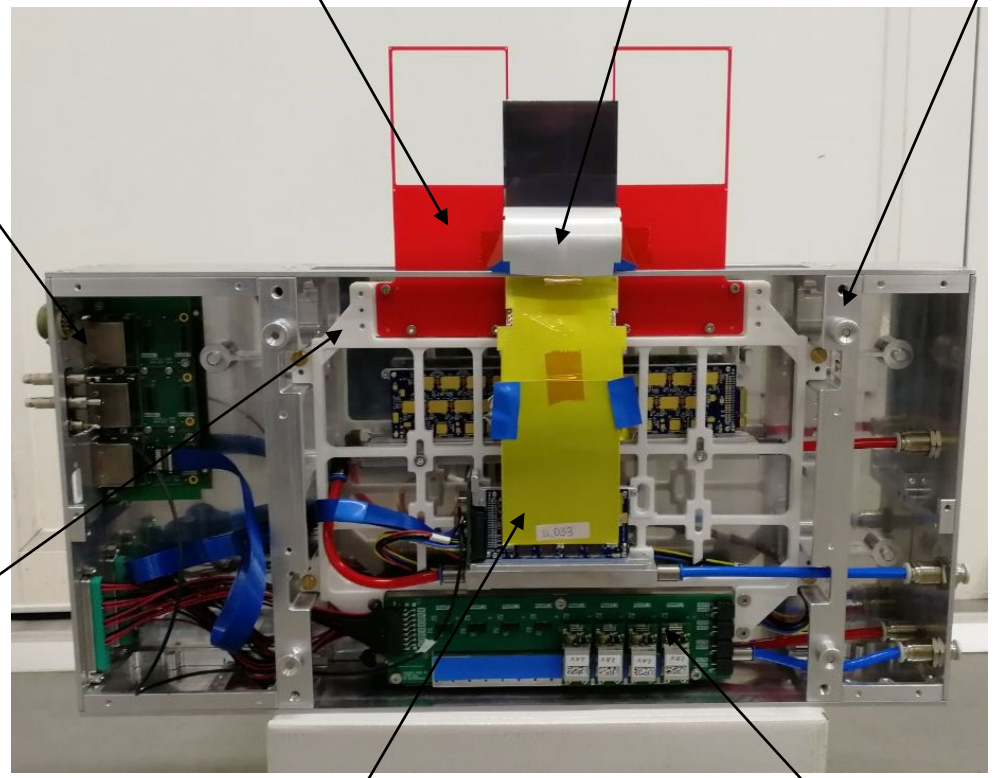


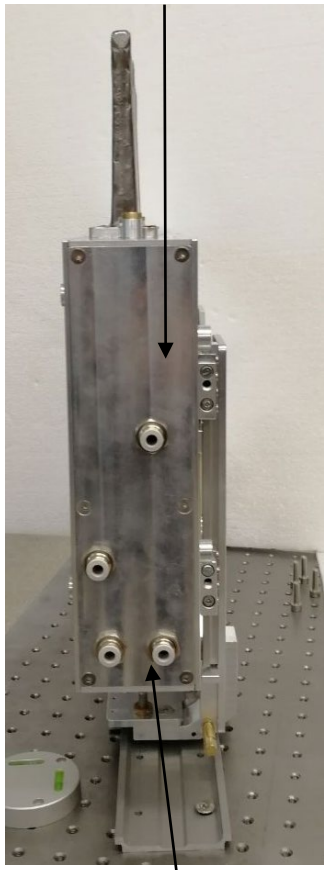
y - position alignment screw



φ - position alignment screw

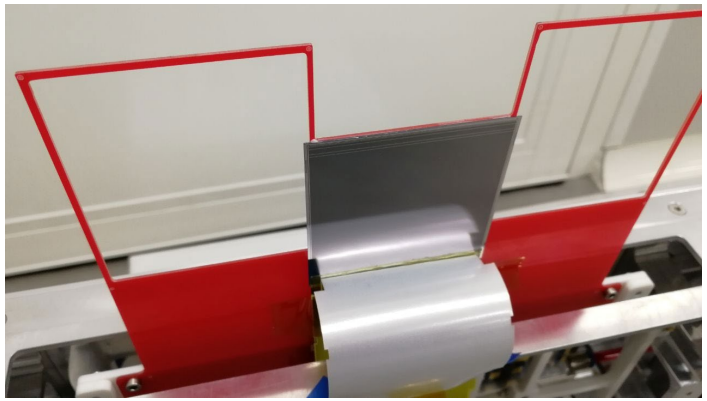
Construction of the STS station





Light part of STS station

FR4 frame of DSSD-detectors

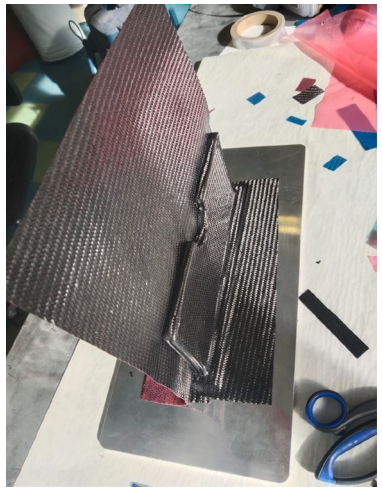


Carbon-Fiber cage: 600 μm prepreg + 20 μm graphite paper

Alignment holes

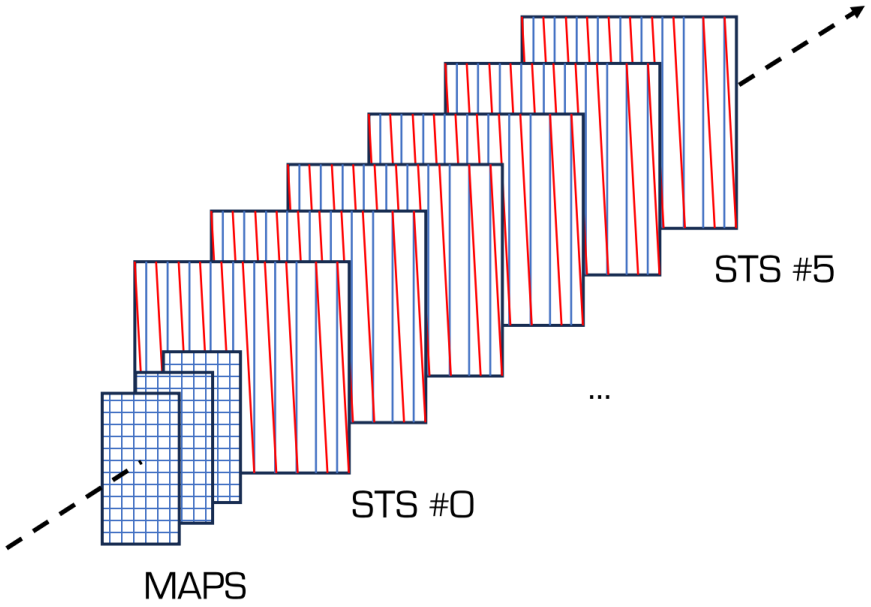
Aluminum frame of cover shielding part for Si-sensors

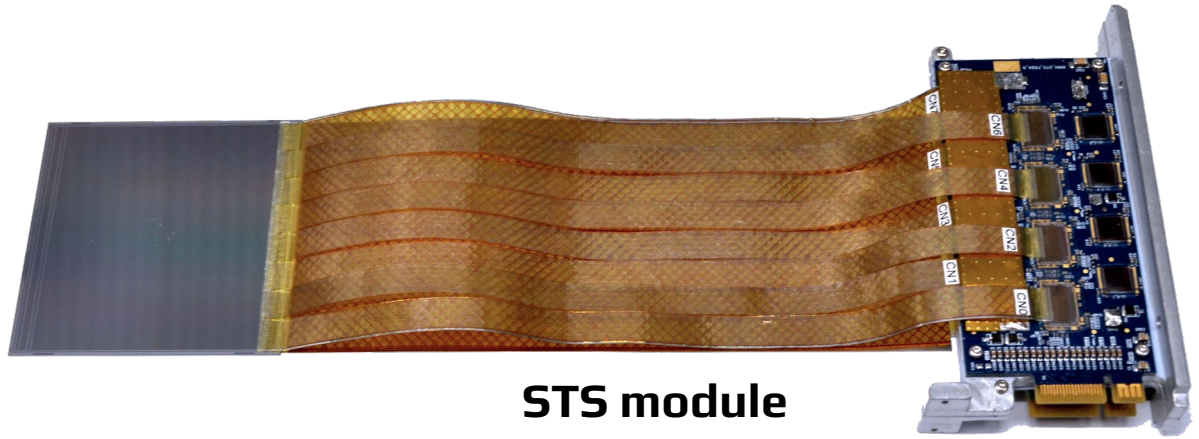
Production of light Carbon-Fiber cage for the DSSD-detectors



3 layers of prepreg (600 μm)

Results of the in-beam tests of the DSSD-modules at PNPI





STS module

Beam telescope:

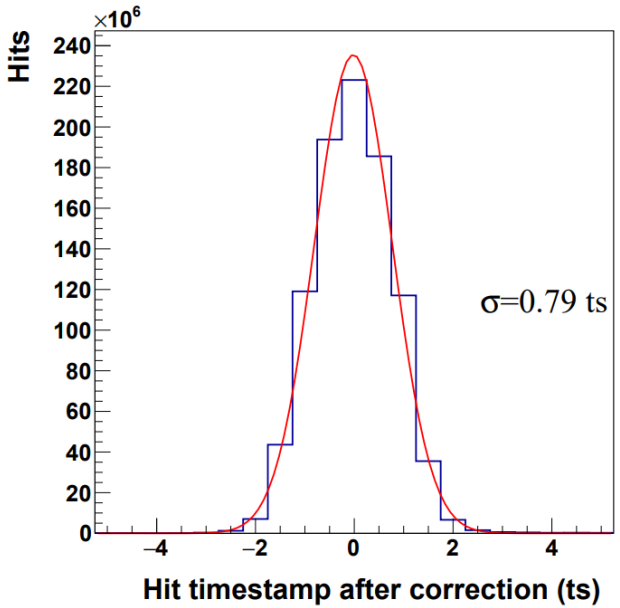
- 3 layers of MAPS;
- 6 STS modules;
- 2 scintillators (trigger)

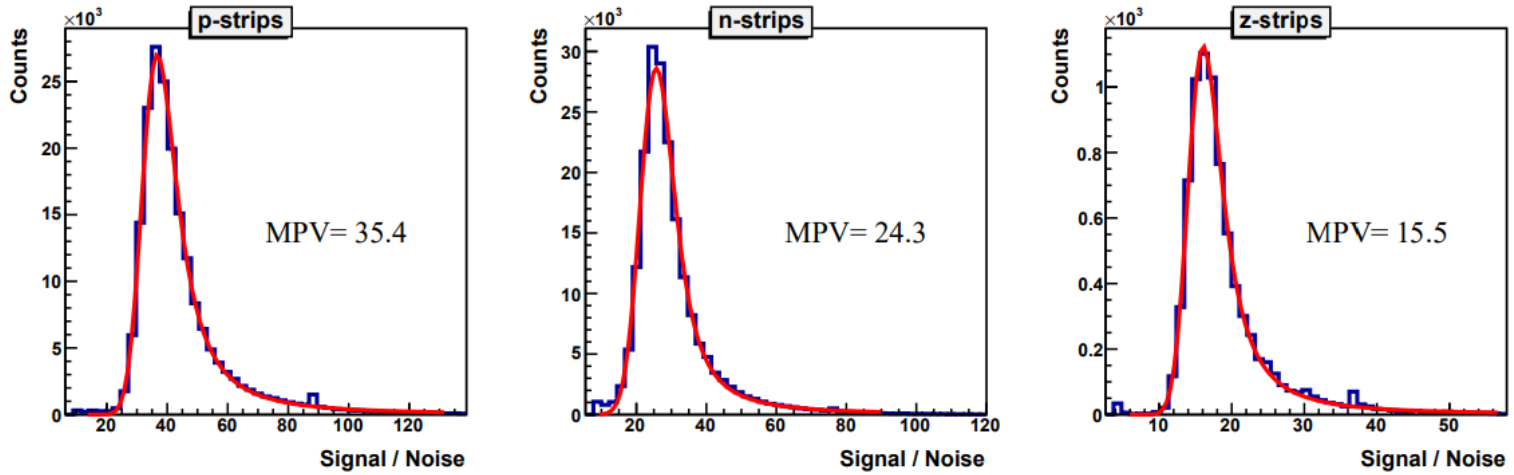
Was tested with **1 GeV proton** beams

Results of the in-beam tests:

1. Data streams from two subsystems (MAPS & DSSD) were successfully merged into events based on the trigger signal.
2. **Concept of the integration of the free-streaming STS readout into the trigger-based DAQ was proven**.
3. The following parameters of DSSD modules were measured:
   - *Signal- to- Noise ratio: >21;*
   - *Av. spatial resolution: 15.4 μm;*
   - *Time resolution: 9.9 ns;*
   - *Efficiency: >99%*
4. Dependency of the module parameters on the detector bias voltage and ADC threshold was studied

Results of the in-beam tests of the DSSD-modules at PNPI





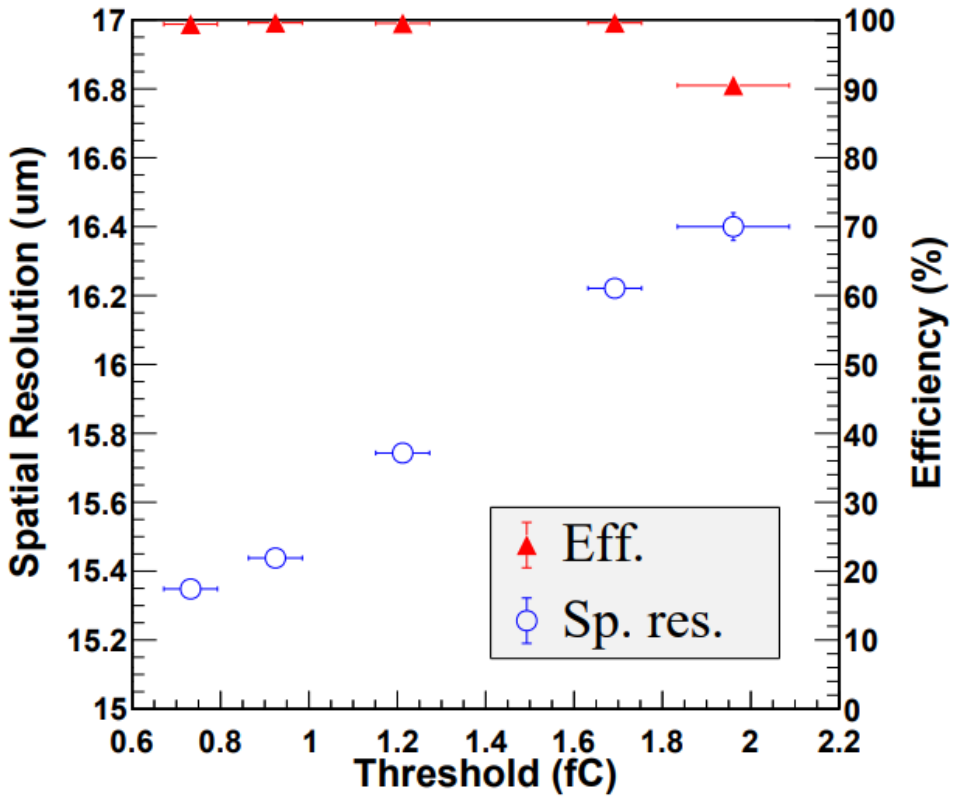
Hit timestamps with respect to the trigger timestamp (after corrections)

Time resolution of the system is 0.79 ts (9.9 ns)

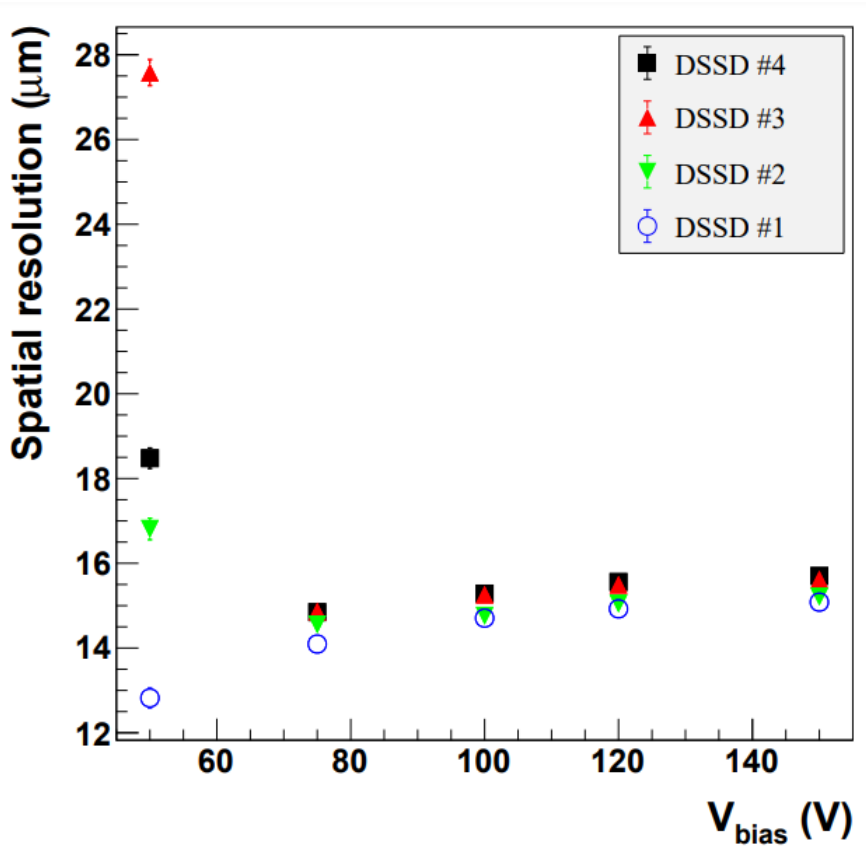
Signal-to-Noise distributions for the p-,n- and z-(with second metallization layer) strips for the 1 GeV protons

D. Dementev, M. Shitenkov

Results of the in-beam tests of the DSSD-modules at PNPI



Spatial resolution and Efficiency vs ADC Threshold



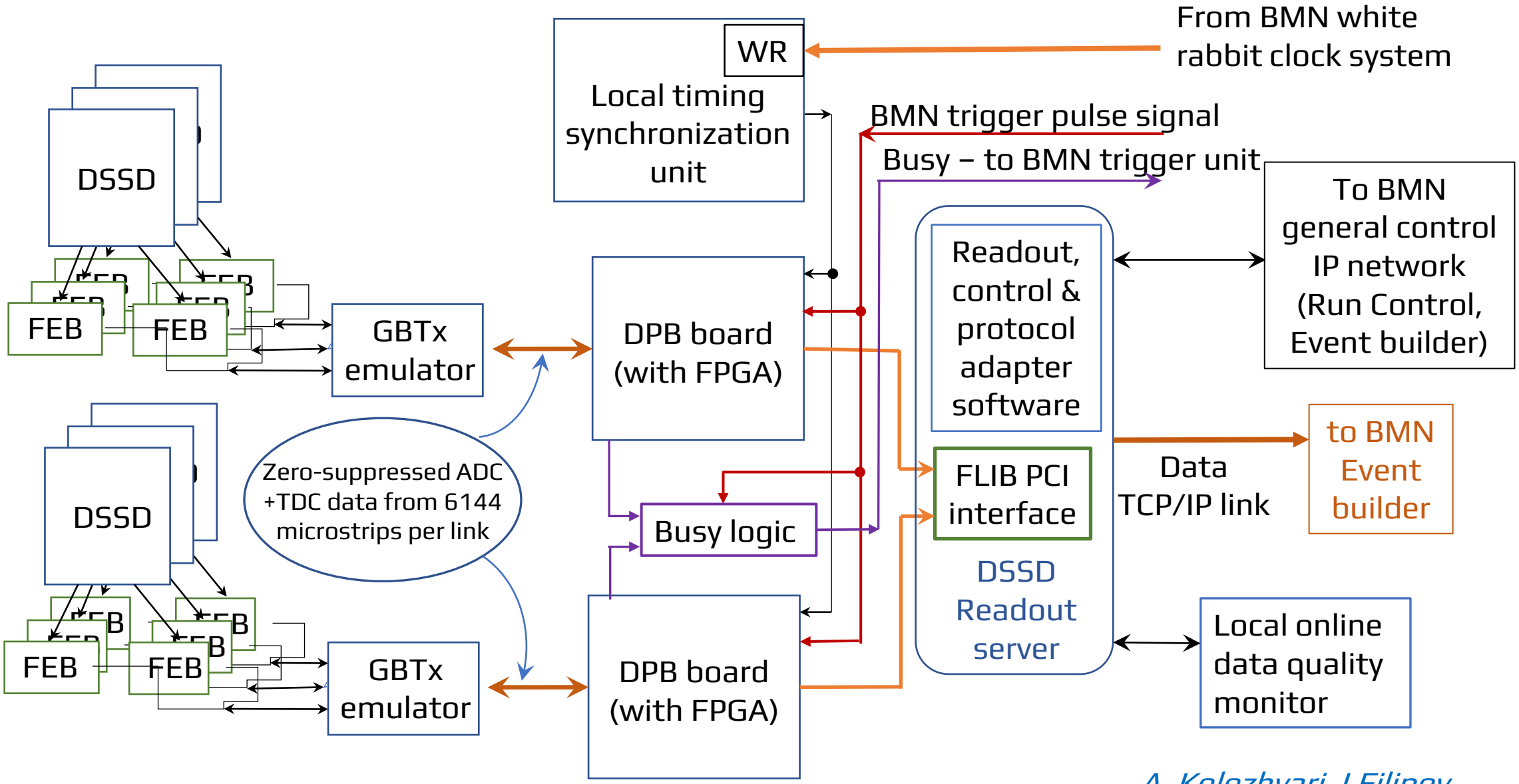
Spatial resolution vs bias voltage

Selected operation values:

- Detector bias voltage: 80-100 V
- ADC Threshold: ~ 1 fC

D. Dementev, M. Shitenkov

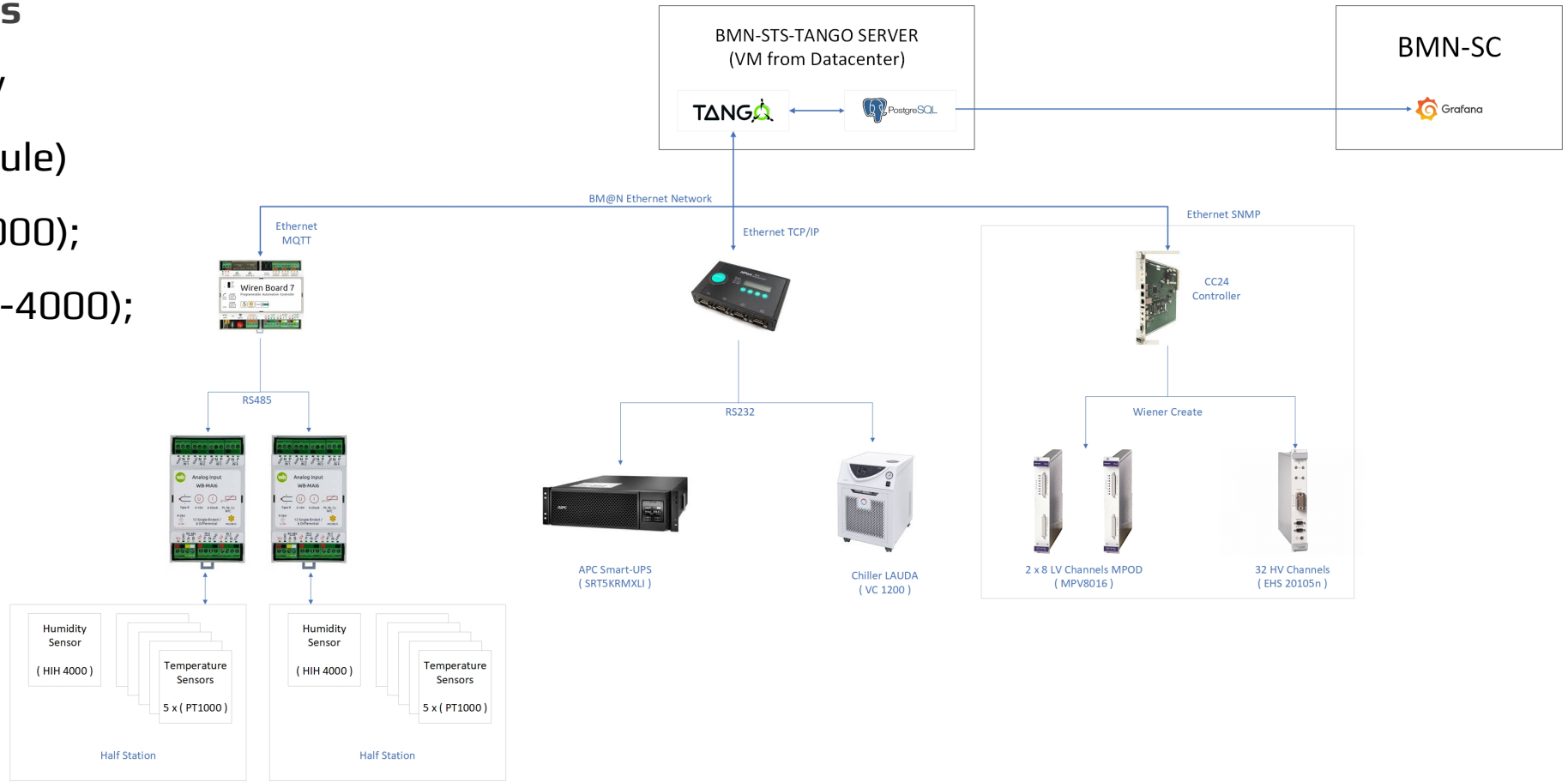
DAQ of the STS subsystem of BMN experiment



Detector Control System of STS station

Control parameters

- LV and HV power supply (individual for each module)
- 6 thermal sensors (PT1000);
- 2 humidity sensors (HIH-4000);
- UPS status
- Chiller status
- Water flow



Thanks to E. Martovitsky, S.Novogilov & S. Piyadin for the installation of the STS rack

A. R. Alvarez, I. Osokin

Conclusion & Timelines

- The DSSD modules for the STS station were tested with the proton beams in Gatchina;
- Mechanics for the STS station was produced and tested;
- CF cage for the light part of the station has to be finalized;
- The design of the carrier plate for FSD and STS is in progress;
- DAQ integration is almost finished and was tested in local network;
- Power system (crate, cables, PoB) have been tested and ready for assembly to station.

Project timelines:

October 2024: In lab test ongoing

October 2024: Production of carrier plate for FSD and STS.

End of November 2024: Installation, tuning and commissioning of STS station

DSSD Module

Module ID	Size of sensor	Cable length	Nb. of not-operable ch.
B033	62	155	26
B011	62	117	14
B008	62	117	10
B009	62	117	7
B032	62	155	56
B034	62	155	23