

Implementation of the SPD project

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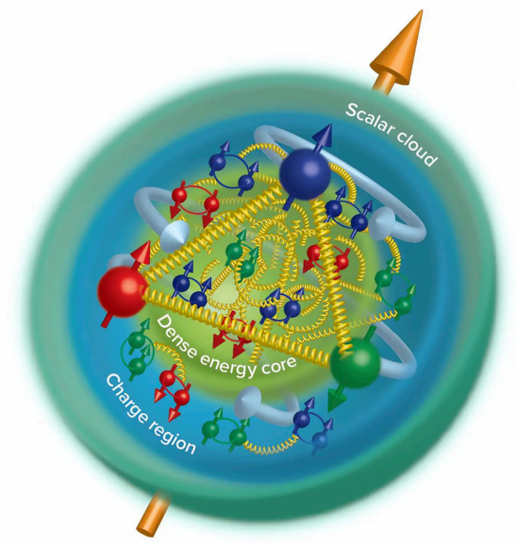
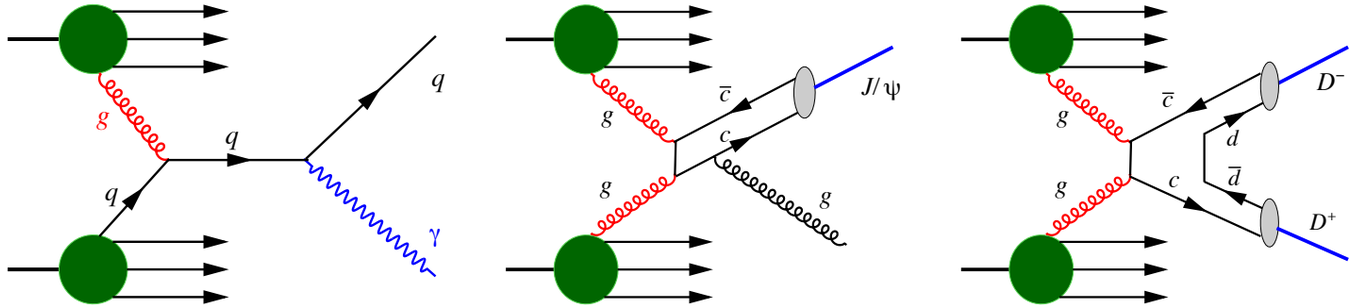
26.1.2026

SPD project



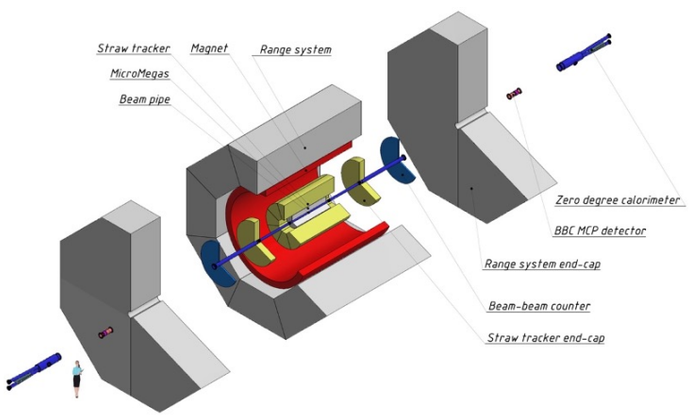
The purpose of the SPD experiment is the study of the nucleon spin structure in collisions of polarized protons and deuterons and other spin-related as well as unpolarized phenomena at $\sqrt{s}$ up to 27 GeV and luminosity up to $10^{32} cm^{-2} s^{-1}$

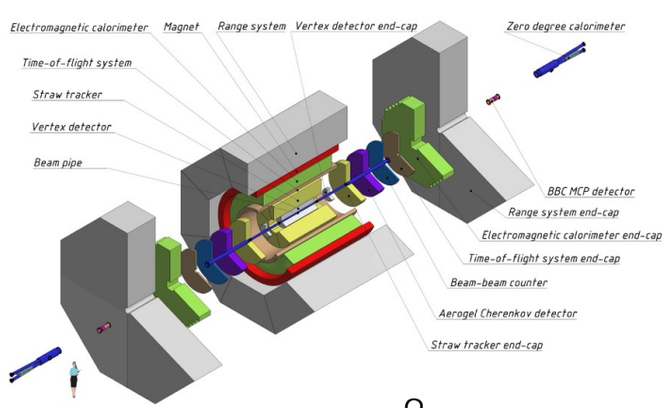


Gluon TMD PDFs will be accessed via 3 complementary processes.

$\sqrt{s}$

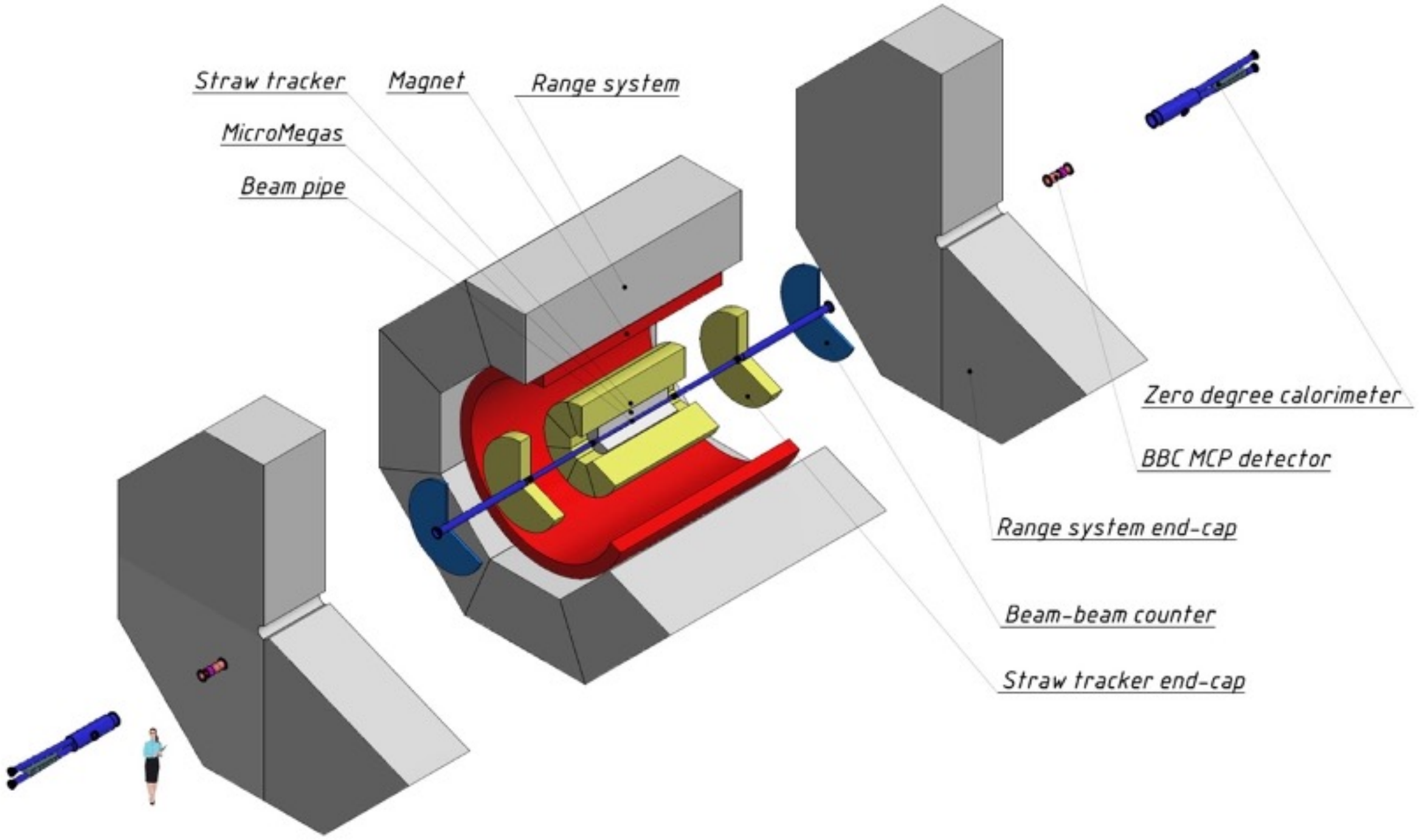
Non-perturbative QCD *Perturbative QCD*





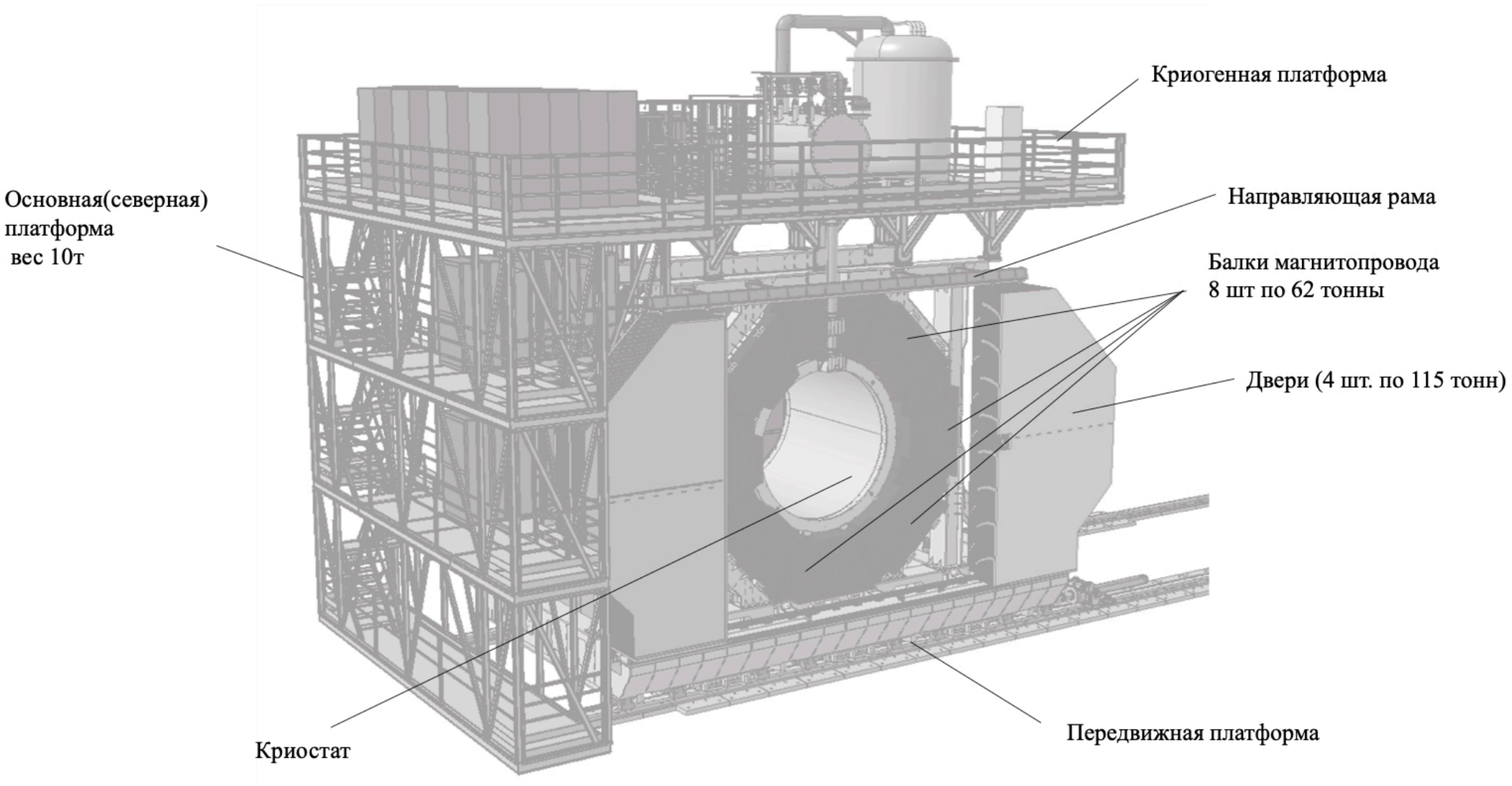
The project is planned to be implemented in two phases

SPD setup, stage I



General construction

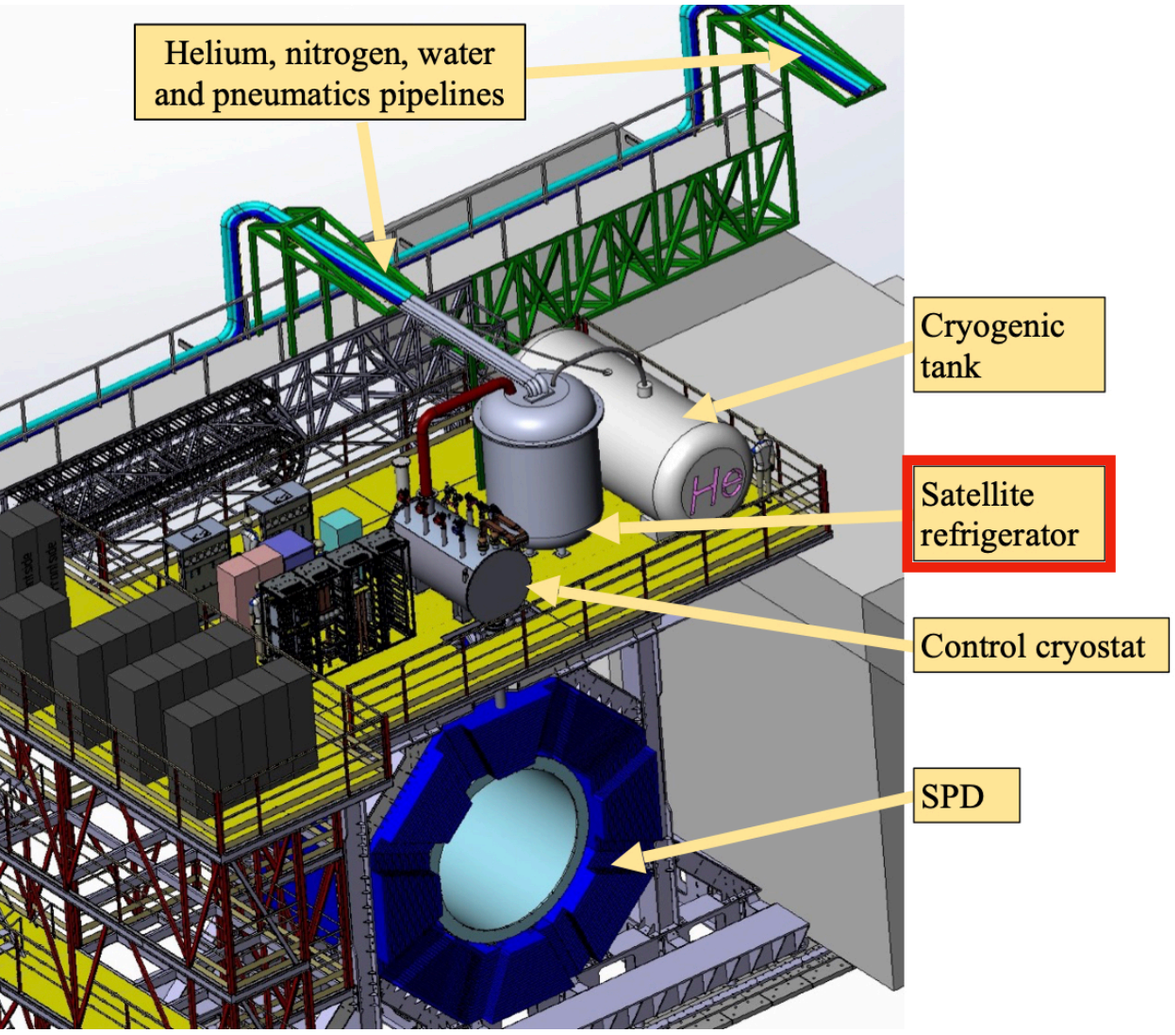
The creation of the full 3D model of the SPD setup's load-bearing system (yoke/absorber, support structure, and movement system is completed. Strength calculations have been performed, taking into account both the total weight of the setup and the effects of magnetic forces.



Магнитопровод SPD

Cryogenic system

The concept for the cryogenic system has been updated. A new version of the cryogenic scheme, based on the use of a satellite-type helium refrigerator, has been approved. Accordingly, the new technical parameters for the SPD magnet have been reviewed and approved. The route for laying cryogenic pipelines from the cryogenic tanks to the SPD service platform has been preliminarily agreed upon.



Steps of creation																
SPD	2025				2026				2027				2028			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Cryogenic plant																
Helium system																
Nitrogen system																
Vacuum system																
Pneumatic system																
Cryogenic system control																
Cryogenic tests																

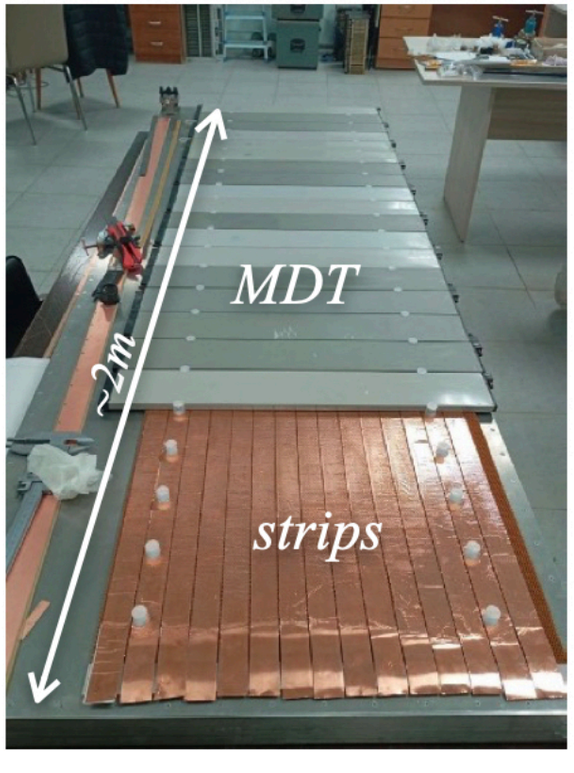
Technical design | Technical task | Contract execution | Assembly & Test | Commissioning

Muon system (based on MDT chambers)

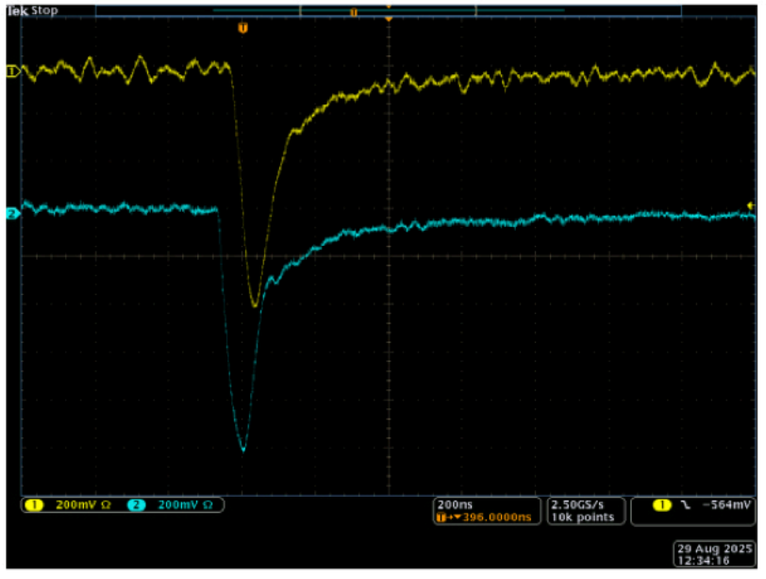
- Preparation of the site for the mass production of MDT detectors is ongoing.

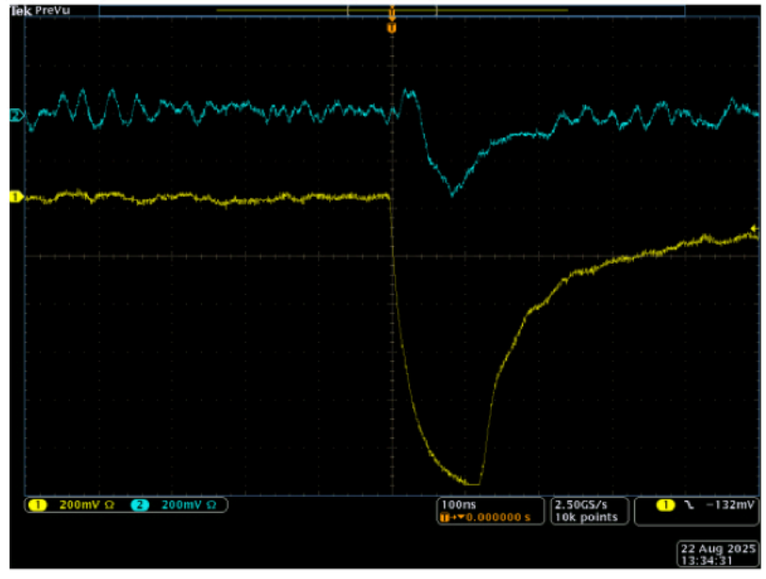






- Stable strip signals have been obtained for the first time from a full-scale prototype of the muon system detection plane.



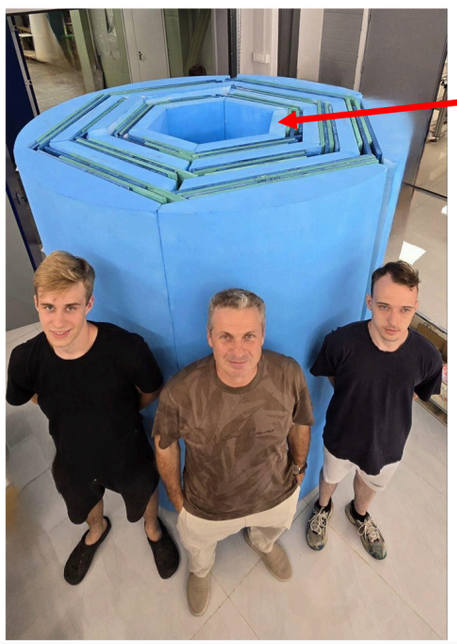


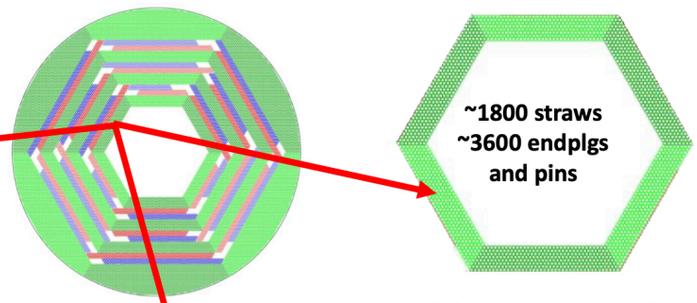
Straw tracker

- Two production lines for manufacturing 12-meter and 5-meter-long tubes have been assembled.
- Four small-scale prototypes have been produced and tested.
- The design for the detector's high-voltage and low-voltage systems has been developed.
- A series of methodological tests has been carried out at CERN and PNPI (Gatchina).
- A one-meter prototype of the end-cap straw detectors has been created and tested.

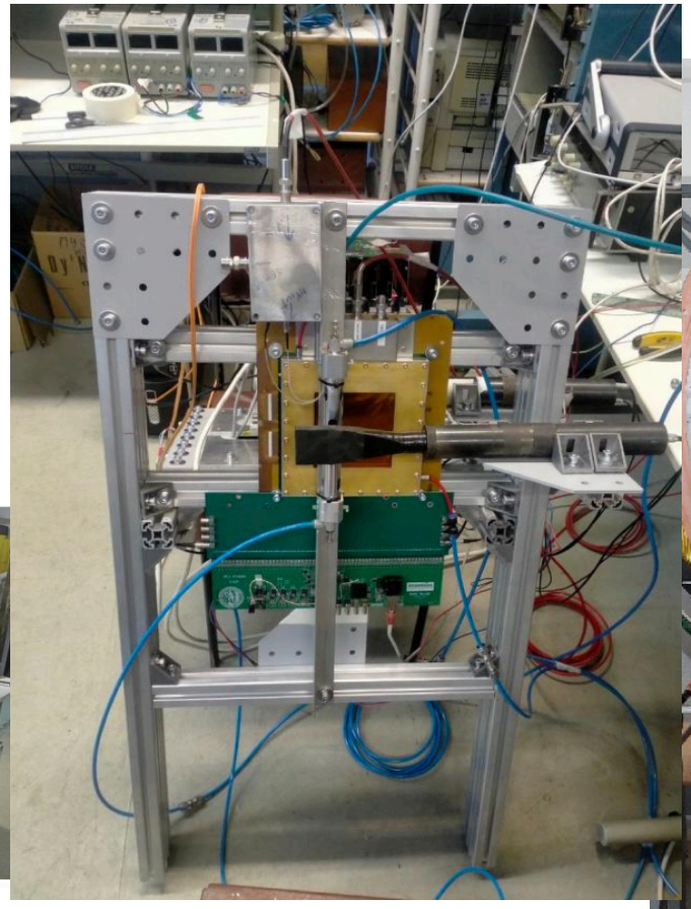
The support structure for the full-scale prototype has been manufactured and tested.

Prototyping





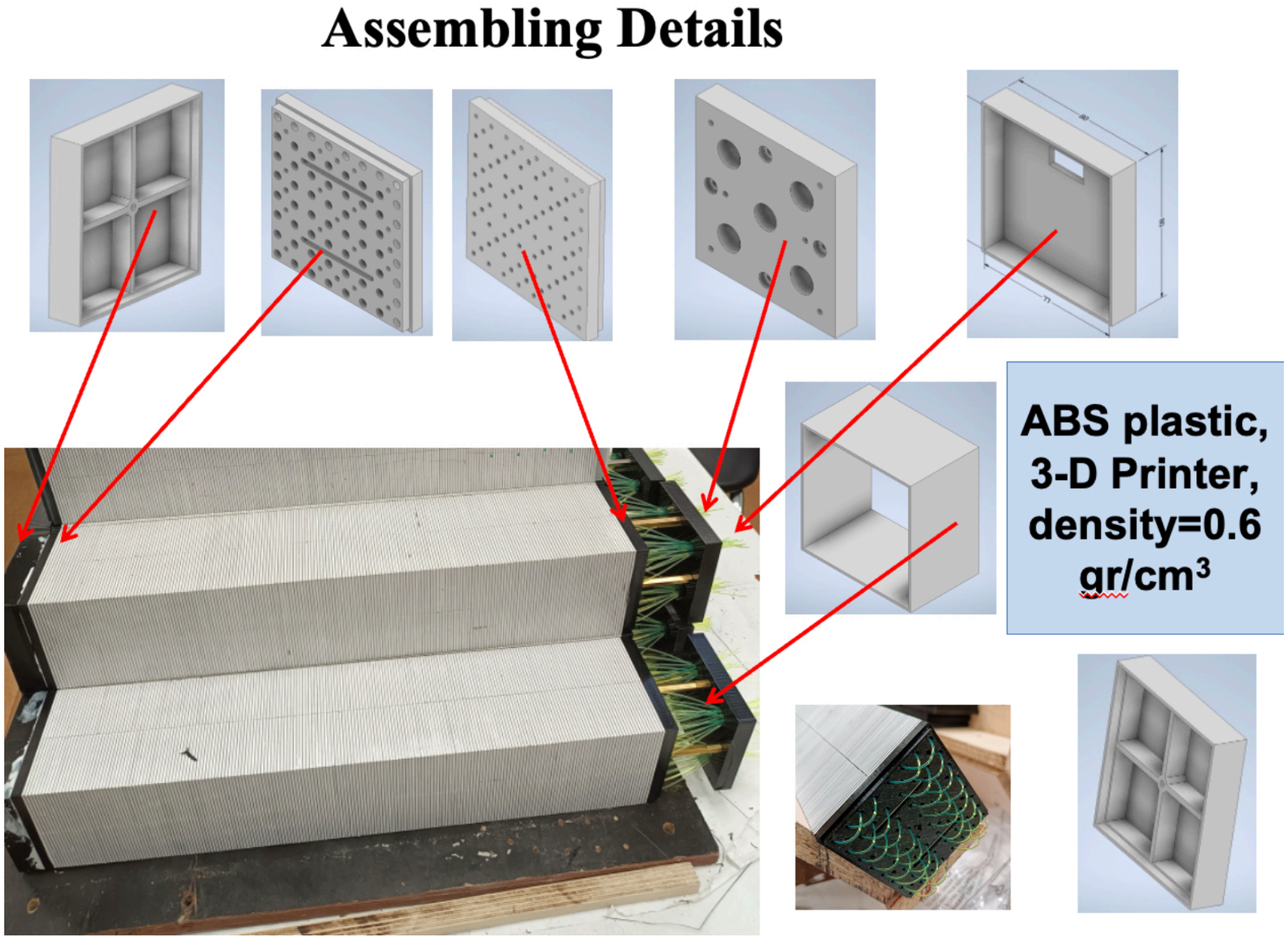






Electromagnetic calorimeter

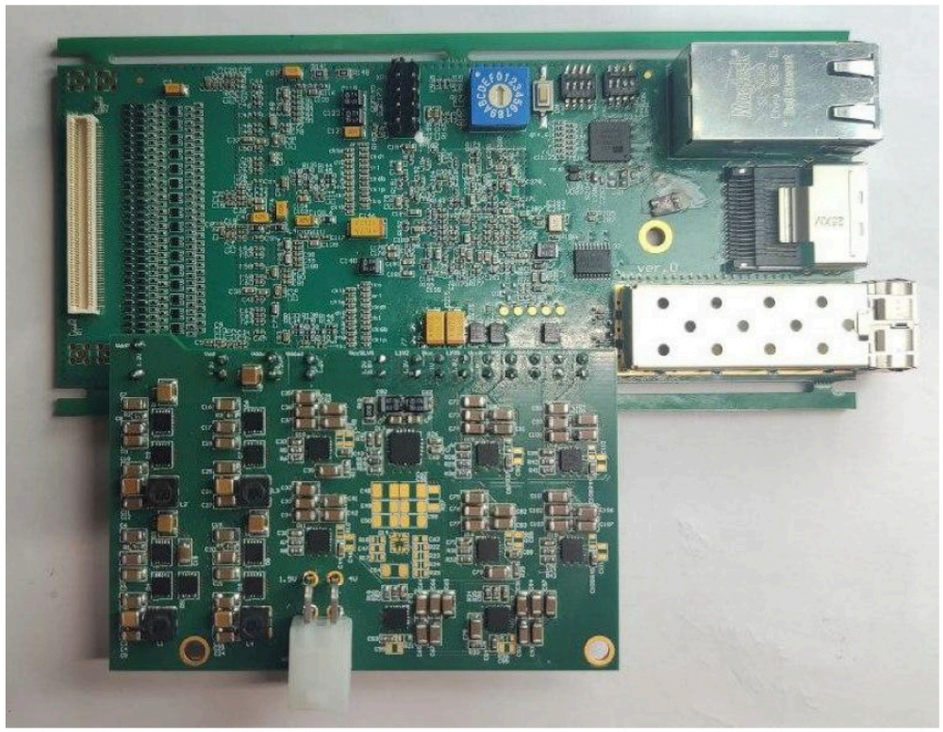
- The technology for the mass assembly of electromagnetic calorimeter modules has been tested
- More than 400 modules for the end-cap part of the detector, planned for use in the first phase of the experiment, have been assembled
- Cooperation with the Shandong University is under discussion

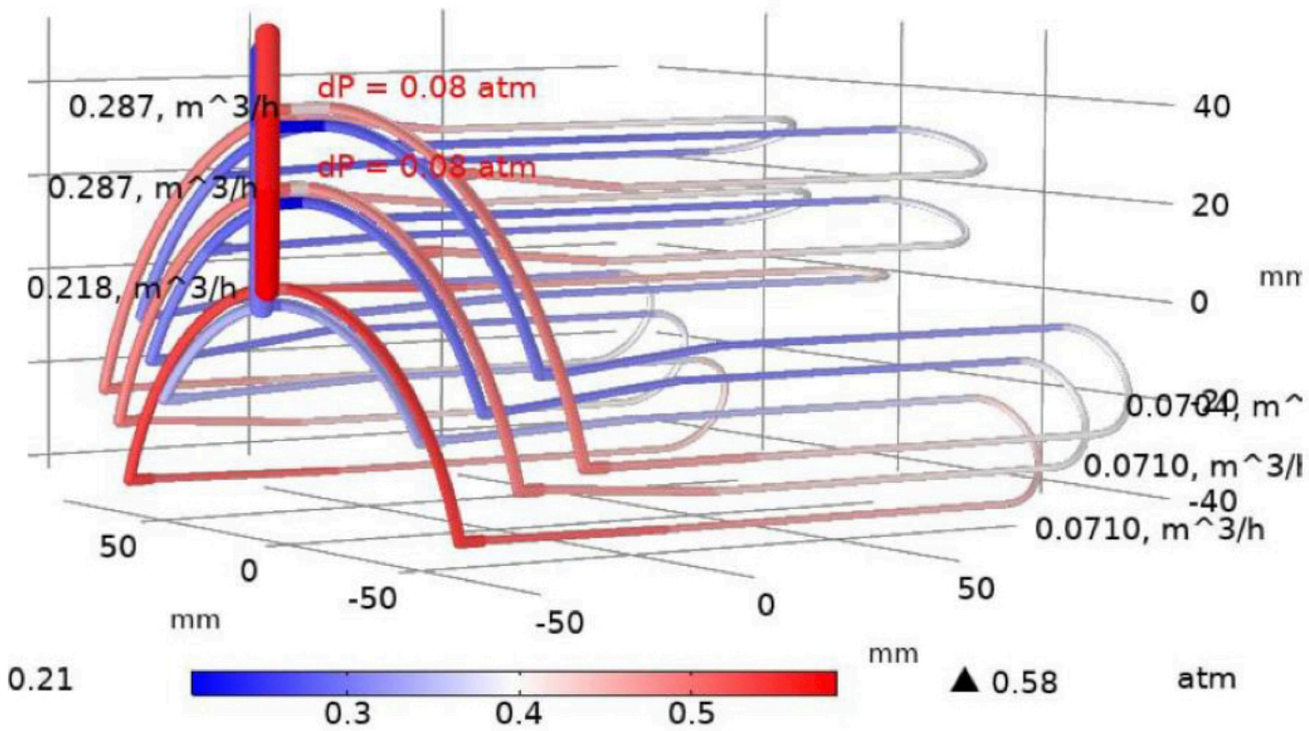


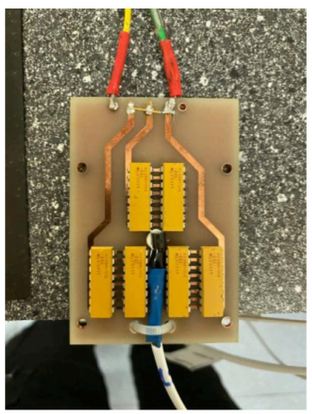


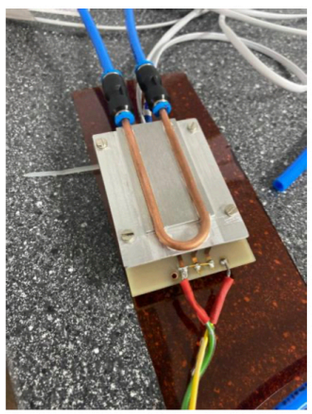
Micromegas

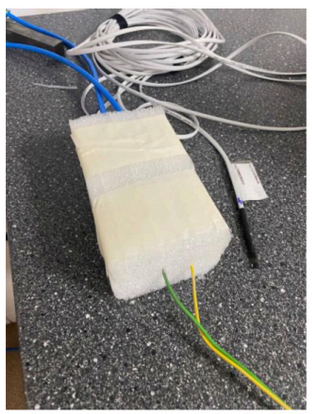
- First prototype of the readout system (FEE) based on the WMM3a chip has been developed at JINR and being tested
- First tests of the cooling system based of the thermal calculations performed by INP BSU







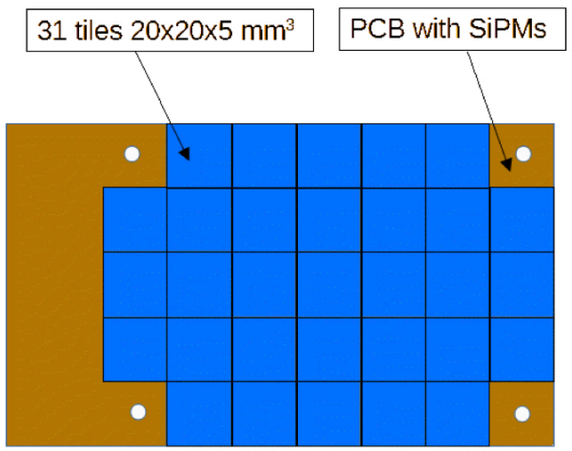


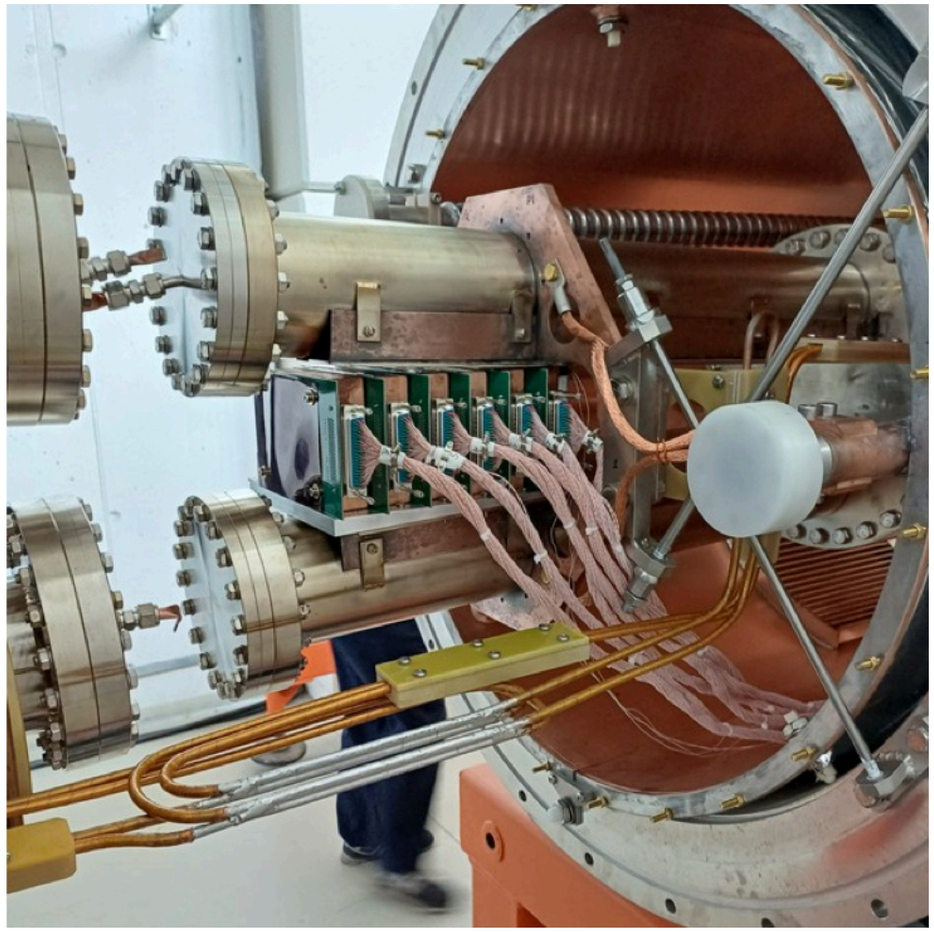


ZDC & BBC

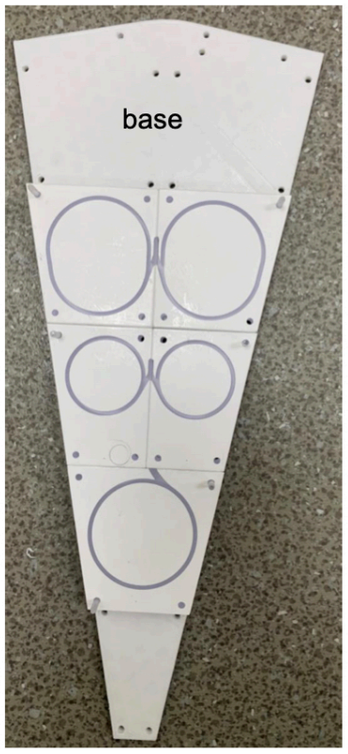
Both ZDC prototypes are installed in the SPD IP. In the west arc the flange is installed and cabled.







made by Kurchatov Institute





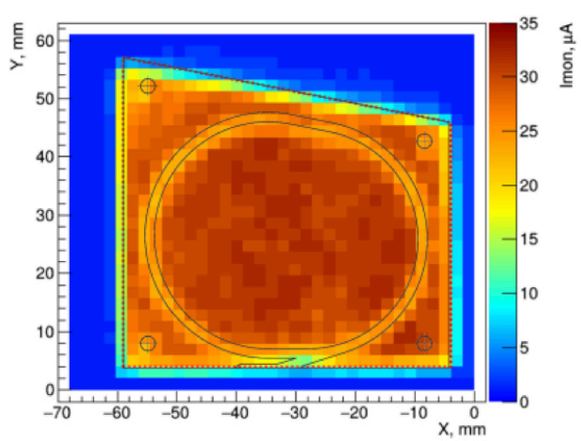
template

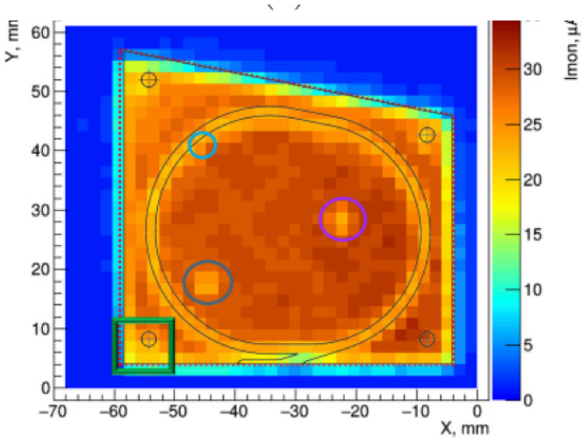


assembled sector

in collaboration with MEPHI

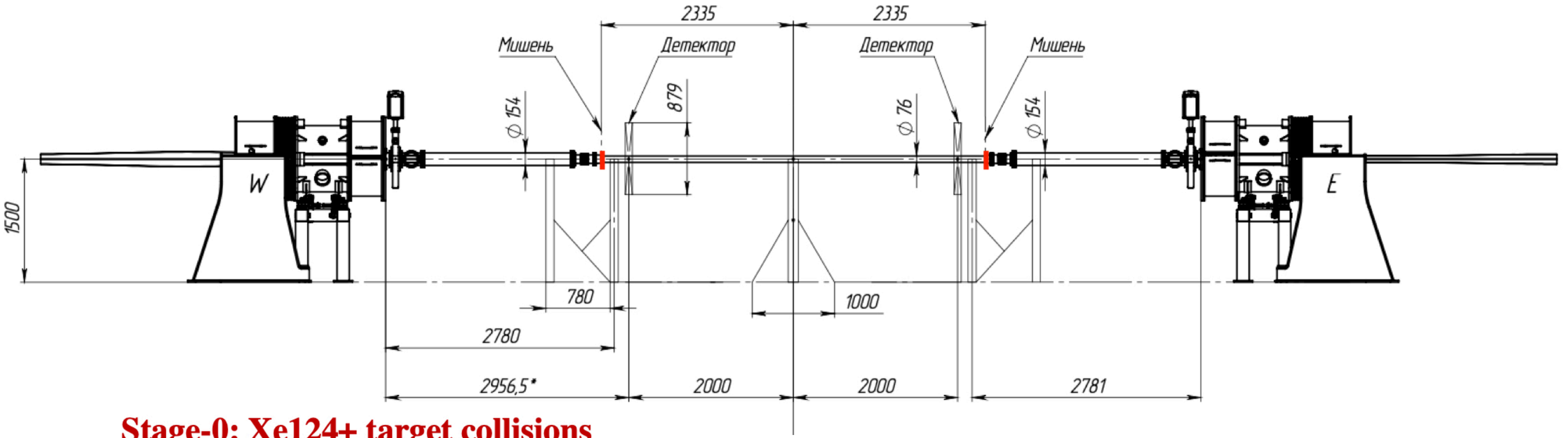
The BBC sectors manufacturing technology has been fine-tuned on prototypes (laying tiles and WLS, optical connectors, 8-fiber optical cables, etc. Eight and twelve-channel boards with SiPM FC-10035 have been manufactured, and their testing has started. The DAQ system based on FERS5200 modules and the DT5215 concentrator has been tested.



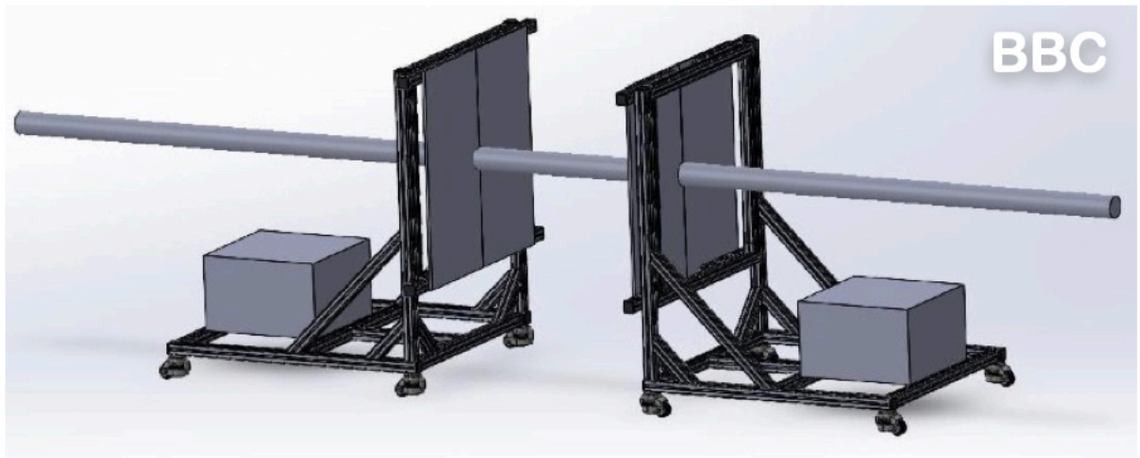


Phase-0

The prototypes of SPD subsystems will be installed in the SPD IP for tests and understanding of experimental conditions. A BBC prototype will be the first experience for us.



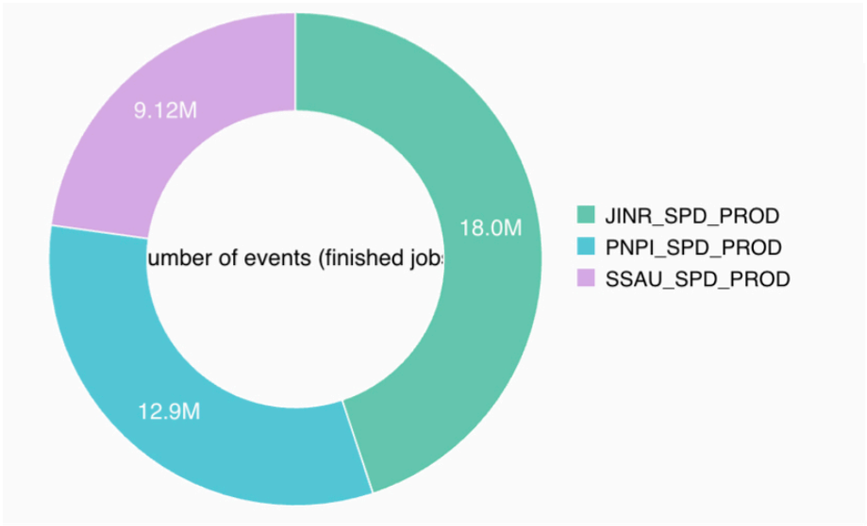
Stage-0: Xe124+ target collisions

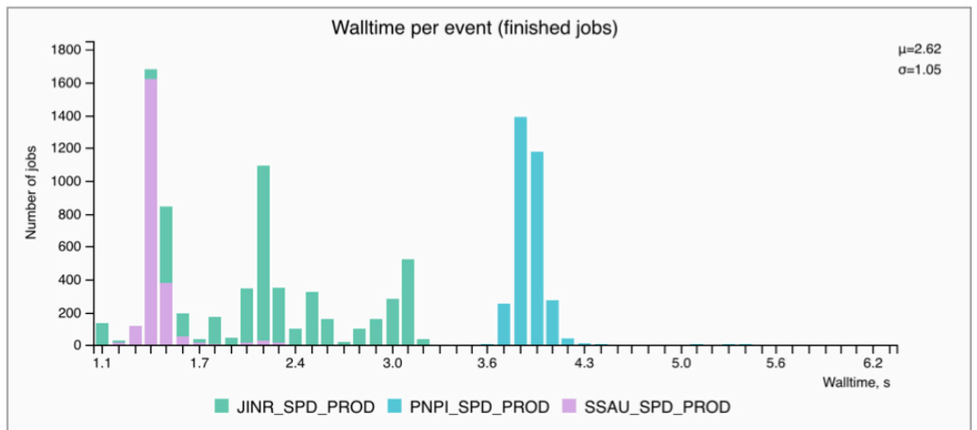


- A steel pipe with a central section 2 × 2.3m = 4.6m long, ∅=76 mm and a thickness of 1.5 mm
- An aluminum support in the middle
- The internal targets are represented by ∅=40 μm Au and ∅=50 μm Cu wires, located symmetrically ~1.5 cm above and below the beam line at a distance 2.3 m from center
- A titanium pipe of the same dimensions as in MPD was requested

IT infrastructure & software

- The distributed data processing system for the SPD experiment has been commissioned.
- Event simulation is performed on the resources of four participating organizations: JINR, PNPI, Samara University, and SPbSU.
- Significant progress has been made in the development of the new SAMPO platform for simulation and data analysis of the experiment.
- Equipment for the initial prototype of the SPD Online filter has been purchased and is being put into operation.





SAMPO components

Detector	SPD Geomodel description responsible	MC Hit production responsible
Micromegas-based Central Tracker	Wanted	✔
Double-Sided Silicon Vertex Detector	Wanted	Wanted
MAPS-based vertex detector	Wanted	Wanted
Straw-based Tracking system	✔	✔
Outer Beam-Beam Counter	Wanted	Wanted
Inner Beam-Beam Counter	✔	✔
Range System	✔	✔
Zero Degree Calorimeters	✔	✔
Electromagnetic Calorimeter	✔	✔
Time-of-Flight system	Wanted	Wanted
Aerogel Cherenkov detector	✔	✔

Priorities for 2026

First-priority activities:

- **Contracting of the SPD yoke**
- **Cryogenic infrastructure**
- **SC-cable for the SPD magnet**

Other activities will be continued within the limits of our financial capabilities.

Joint JINR-China projects:

Joint Proposal for the Development of a High-Performance Readout Electronics System for ToF and other timing Detectors: Period of realization: *2026-2028*

Contact person from JINR:

DLNP, CHMILL Valery, chmill@jinr.ru

Institutes and contact persons from PRC:

USTC, JIAJUN Qin, jjqin@ustc.edu.cn

Year	Visits/personal/ conferences	Materials/ Equipment/other	Total kUSD
2026	30	170	200
2027	30	170	200
2028	30	170	200
Total	90	510	600

This project aims to jointly develop a state-of-the-art, multi-channel readout electronics system optimized for Multigap Resistive Plate Chamber (MRPC) detectors and other ultra-fast gaseous detectors. The system will be based on the DISA (Differential Current (I) Saturation Amplifier) ASIC front-end amplifier/discriminator, coupled with a high-resolution FPGA-based Time-to-Digital Converter (TDC) or TDC ASIC backend. The DISA ASIC is specifically designed to process the very fast, low-amplitude signals (typically 20 mV to 200 mV with a rise time of ~1 ns) generated by MRPCs.

Year	Work	Place
2026	**Schematic design of the mixed-signal PCB, integrating the DISA ASICs**	**China**
	Joint specification of requirements based on MRPC signal parameters	**JINR**
2027	***Collaborative development of FPGA firmware***	**China**
	Development of data processing logic for time-over-threshold (ToT)	**JINR**
2028	***Integration of hardware, firmware, and software into a fully functional system.***	**China**
	Comprehensive laboratory testing using pulse generators to characterize time resolution etc.	**JINR, China**

SPD collaboration

New groups in 2025:

Shandong University (China)

USTC (China)

Under discussion:

Gomel State Technical University (Belarus)

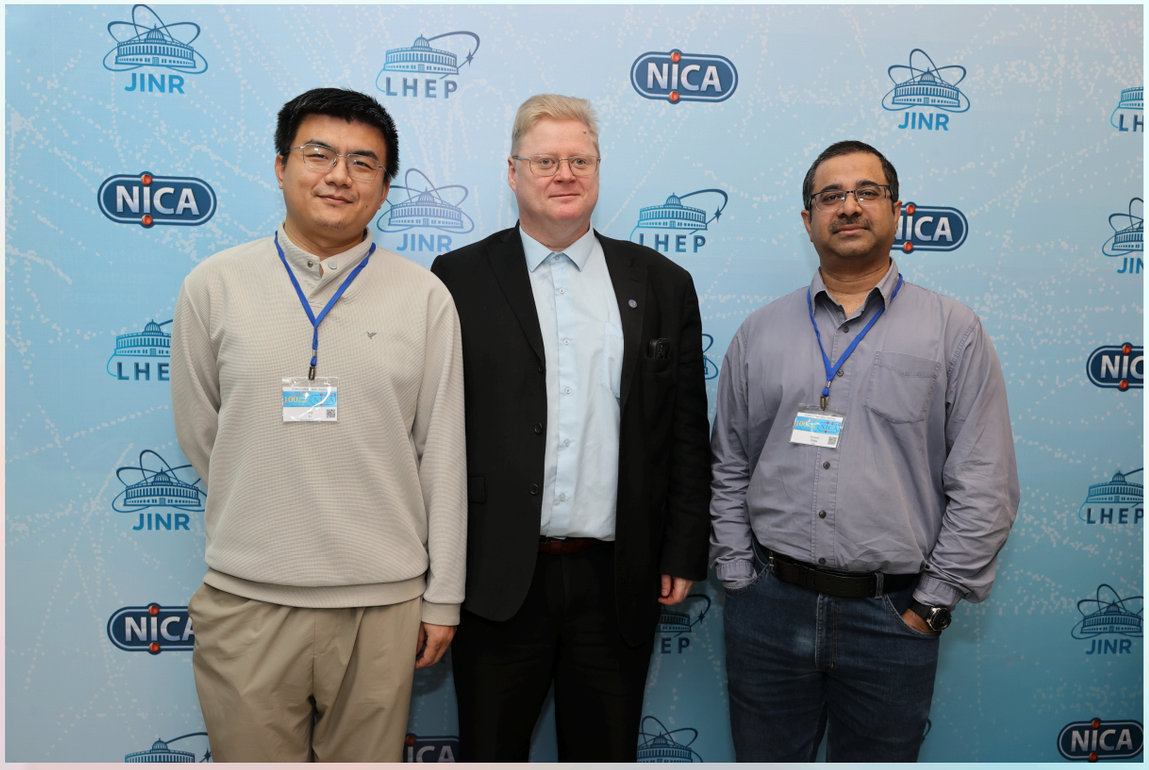
New MoU signed:

B.I. Stepanov Institute of Physics NAS (Belarus)

HSE University (Russia)

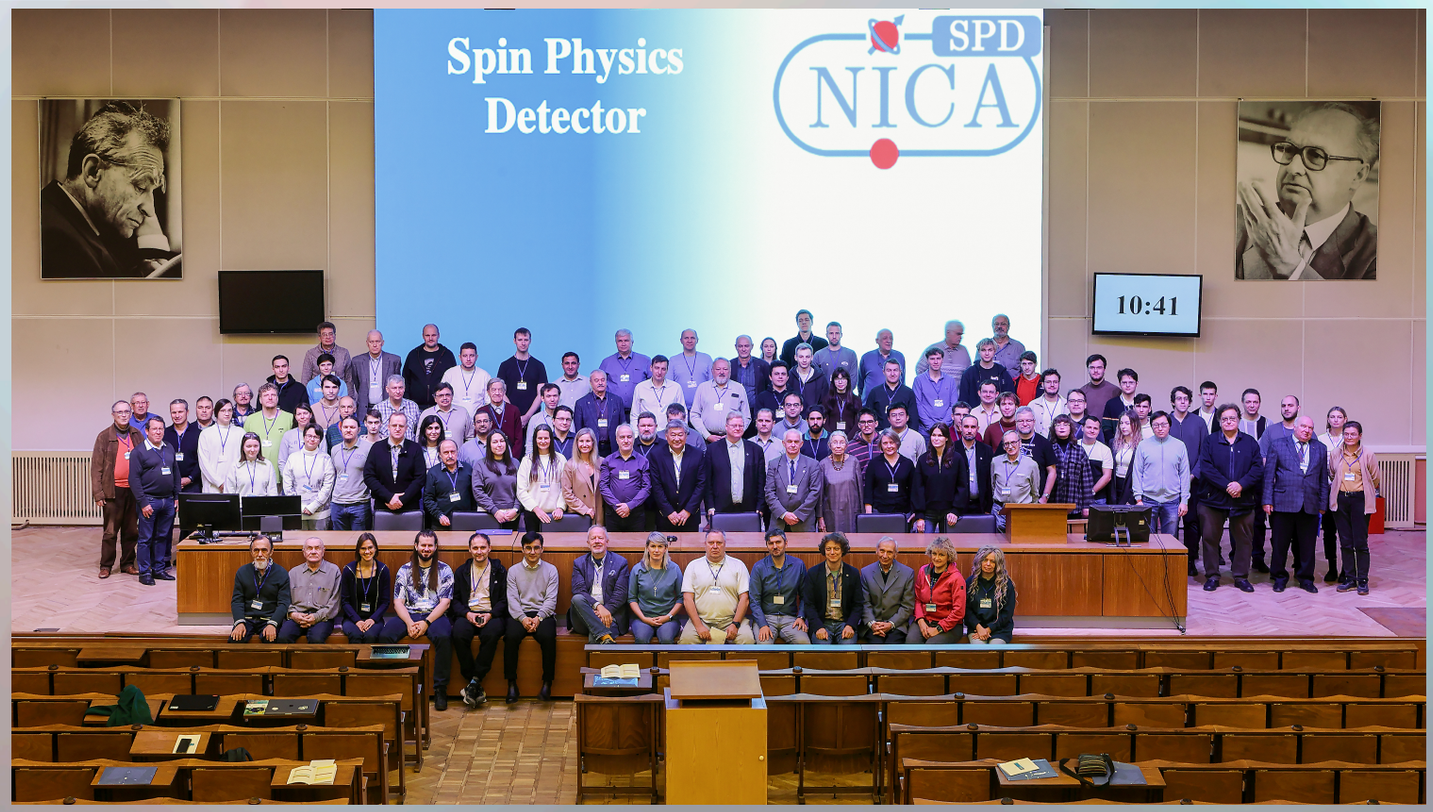
X collaboration meeting at JINR





October, 20-23





Conference activity

26th International Symposium on Spin Physics
A Century of Spin

Qingdao, China
Sep, 21-26

IWHSS QCD-N 2025

San Sebastian, Spain
Sep. 1-5

DIS 2025

Cape Town, RSA
Mar. 24-28

Baldin Seminar 2025 (Sep. 15-20, Dubna, Russia)

The Actual Problems of Microworld Physics (Aug. 25-31, Minsk, Belarus)

Joint Workshop on Physics of Strong Interacting Systems (Aug. 17-22, Almaty, Kazakhstan)

GRID 2025 (July, 7-11, Dubna, Russia)

NUCLEUS 2025 (July 1-6, St. Petersburg, Russia)

Alushta 2025 (June, 8-15, Alushta, Russia)

AST 2025 (Apr. 16-18, Almaty, Kazakhstan)

MSIT 2025 (Apr. 15-17, Tomsk, Russia)

Dubna 2025 (Apr. 7-10, Dubna, Russia)

SEDM 2025 (Feb. 27-28, St. Petersburg, Russia)

VCI 2025 (Feb. 17-21, Vienna, Austria)

RAS 2025 (Feb. 17-21, Moscow, Ruaais)

38 talks

SPD & young scientists

18 master and bachelor diploma theses were defended on the SPD project in 2025

Summary

- We are focused on the construction of the detector and the corresponding infrastructure for the first phase of the experiment;

- The main priorities for us are: contracting of the SPD yoke, cryogenic infrastructure of the experiment and arranging production of the SC-cable for the SPD magnet;

- We have plans to place prototypes of our detectors in the SPD ID (phase-0)

- The SPD collaboration is in a good shape and developing dynamically.