Report of the technical coordinator

Alexander Korzenev, JINR LHEP

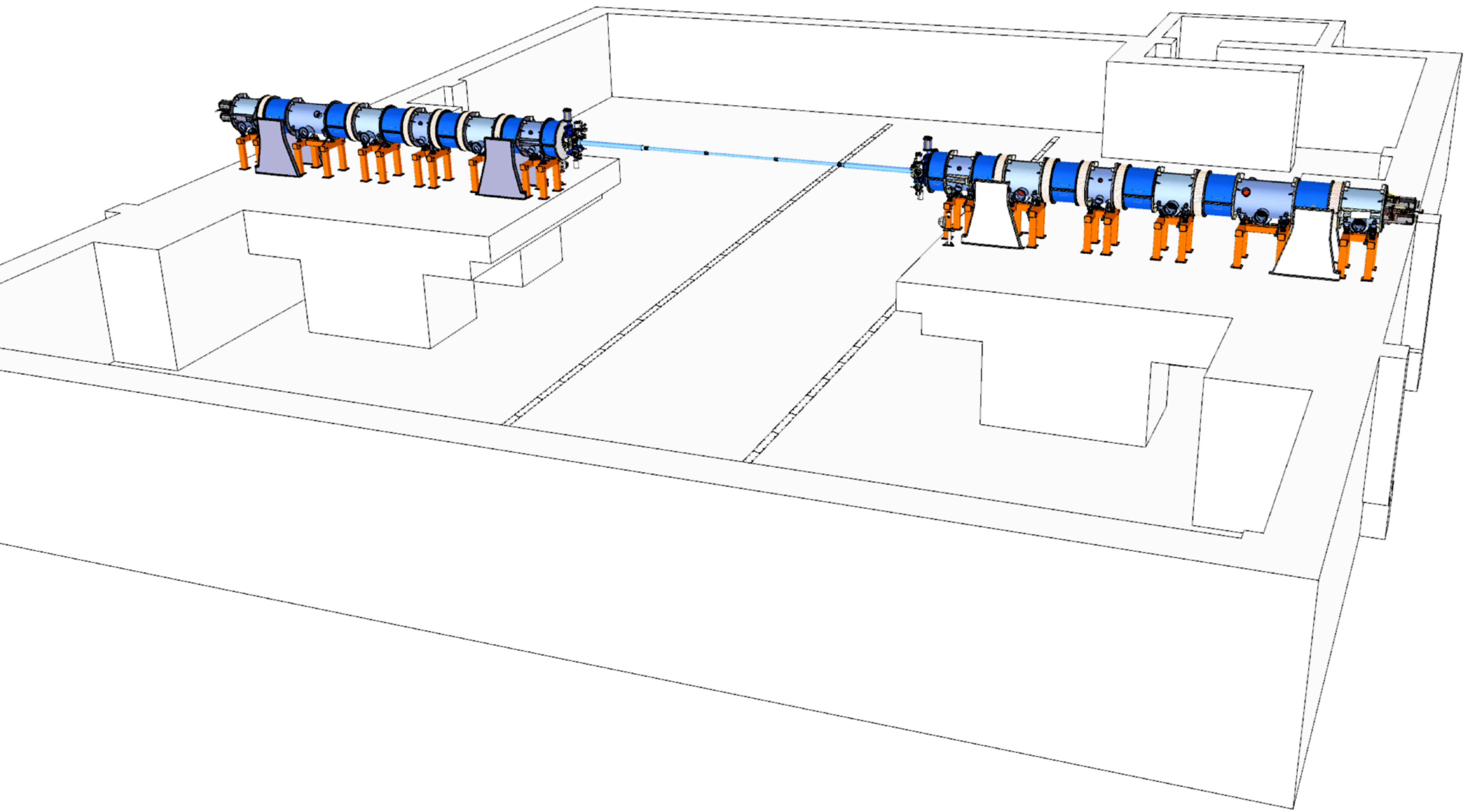
SPD Collaboration Meeting
Almaty, May 20, 2024

Outline

- Infrastructure
  - Construction work in the SPD hall
  - Installation of bio protection walls
  - Plans for installation of rails
- Progress on
  - Range System (RS)
  - SC solenoid magnet
  - EM calorimeter (ECal)
  - Time-of-Flight (TOF)
  - Straw Tracker (ST)
  - Focusing Aerogel RICH (FARICH)
  - MicroMegas (MM)
  - Beam-beam-counter (BBC)
  - Zero Degree Calorimeter (ZDC)
- Conclusion

SPD experimental hall in May 2024

It will be a 9m long section that can be used to test prototypes of our detectors until 2030

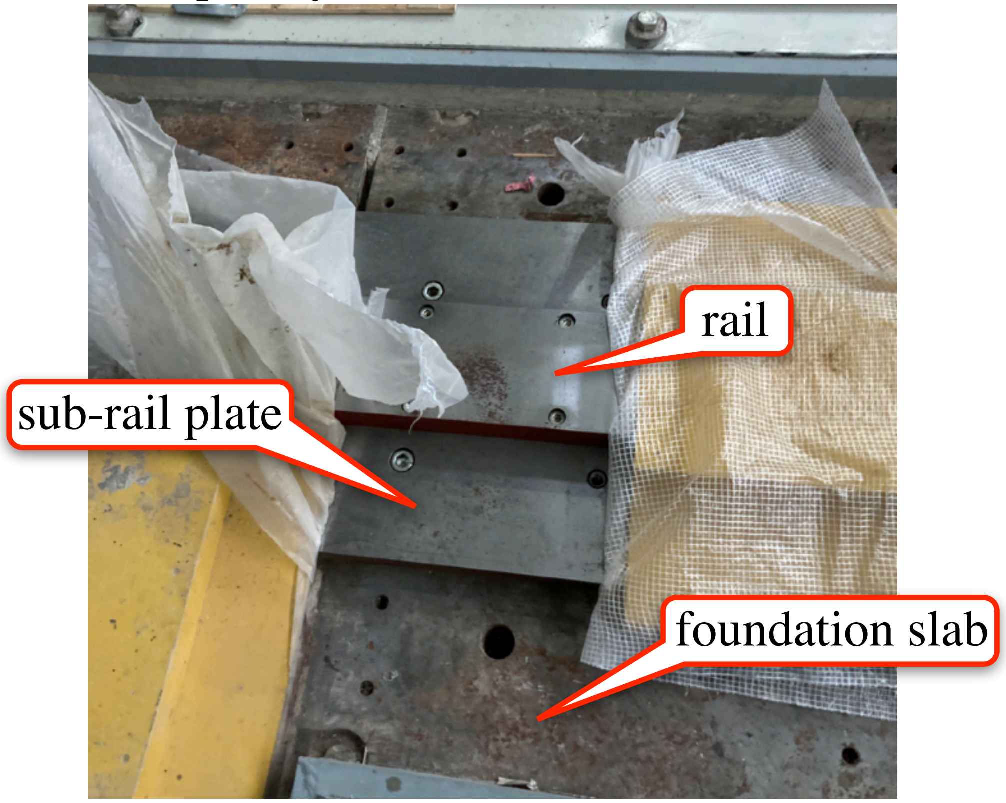


Straight section of SPD in spring 2024

Installation of sub-rail plates and rails

- After two years of struggle, rails and roller skates were delivered to Dubna in May
- Mounting sub-rails and rails will require deinstallation of bioprotection blocks
- (Sub-)Rail mounting procedure will take ~1 month and presumably can be done by “Pelkom”

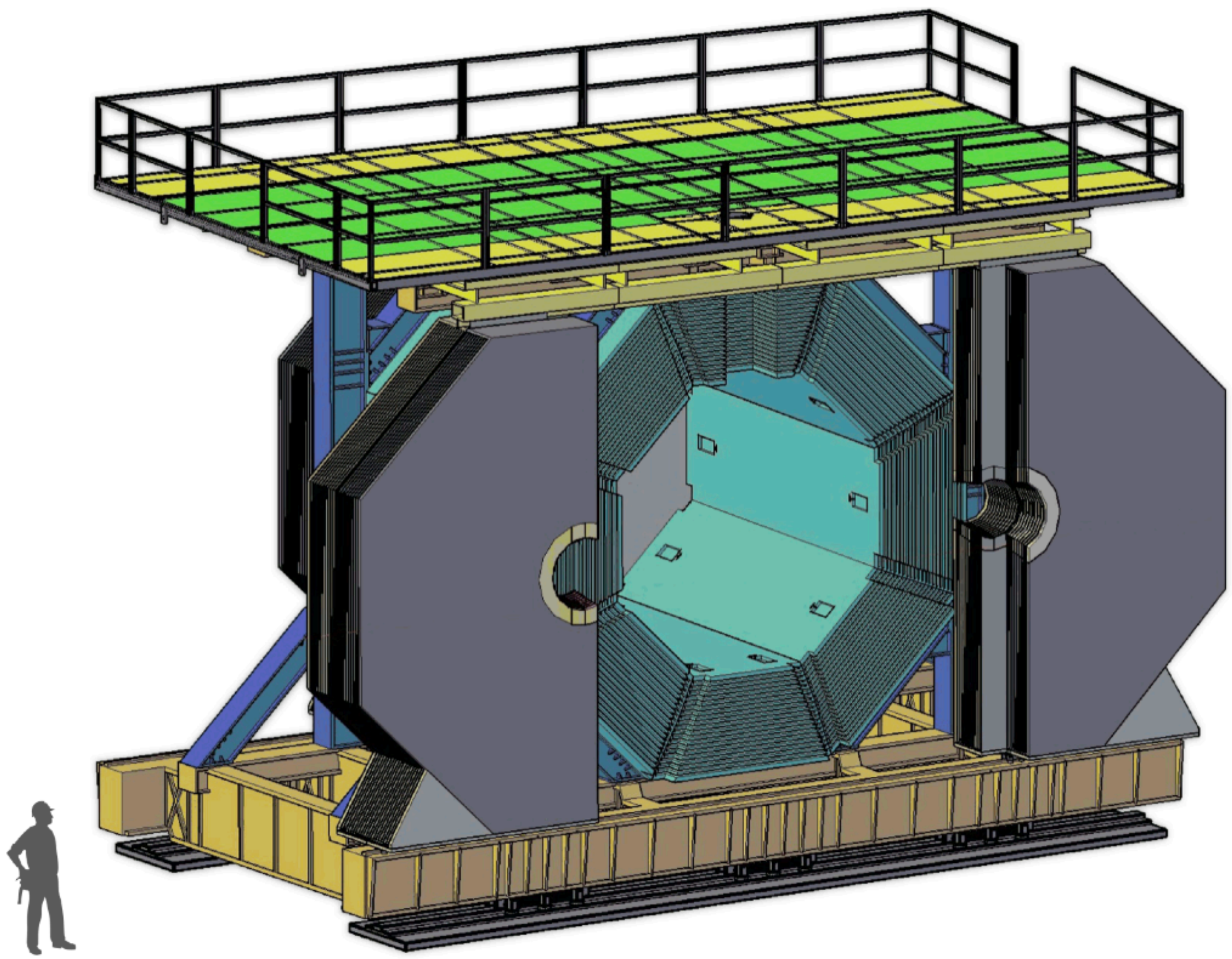
photo from MPD hall



Sub-rail plates were delivered in 2022

Rails and roller skates have been delivered to JINR

Power frame of RS (magnet yoke)



№	Наименование
1	АО «ТЯЖМАШ» г. Сызрань
2	Северсталь г. Череповец
3	АО «АЭМ-технологии» г. Санкт-Петербург / г. Петрозаводск / г. Колпино / г. Волгодонск
4	Воткинский Завод г. Воткинск
5	ПАО «Магнитогорский металлургический комбинат»
6	СЭЗ им. Серго Орджоникидзе, ПАО
7	Балашихинский Литейно-Механический Завод, ОАО г. Балашиха
8	СМК, АО
9	ЭЗТМ, ОАО
10	Взм, ООО
11	Булат, ООО г. Борок
12	ЛМЗ «Старт» г. Арзамас, ООО
13	Метмаш, ООО
14	НЛТ, ООО
15	ООО «ПСВ»
16	ООО НПП «ТоМаСт» г. Пенза

- First (semi-official) survey of potential manufacturers was conducted earlier this year
- Only two companies in Russia meet our requirements: “ТЯЖМАШ” and “АЭМ-технологии”
- First discussion with “ТЯЖМАШ” engineers was in February. Their consent and quotation have been received
- The start of the tender procedure is mid-summer 2025

ТЯЖМАШ TYAZHMASH

АКЦИОНЕРНОЕ ОБЩЕСТВО «ТЯЖМАШ»
ул. Гидротурбинная, 13, г. Сызрань, Самарская обл., 446010, Россия
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www.tyazhmash.com

№ 154 - 2013 от 04.04.2024
(исходящий номер) (дата, месяц, год)
на № ______ от ______
(входящий номер) (дата, месяц, год)

Главному техническому специалисту
ЛФВЭ ОИЯИ
С.И. Какурину
e-mail: kakurin@jinr.ru

Ценовое предложение на изготовление и поставку ярма сверхпроводящего магнита детектора SPD коллайдера NICA

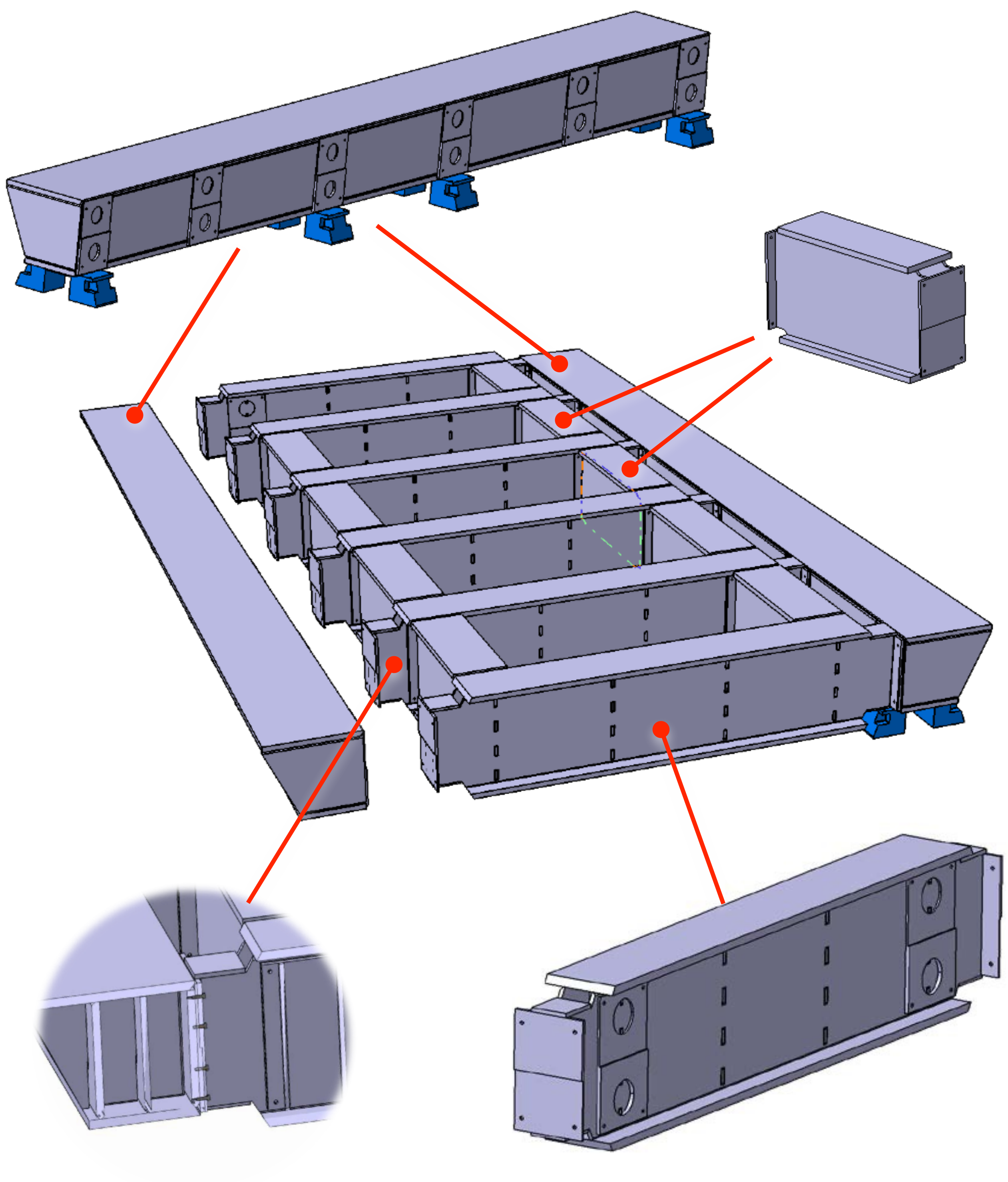
Уважаемый Сергей Иванович!

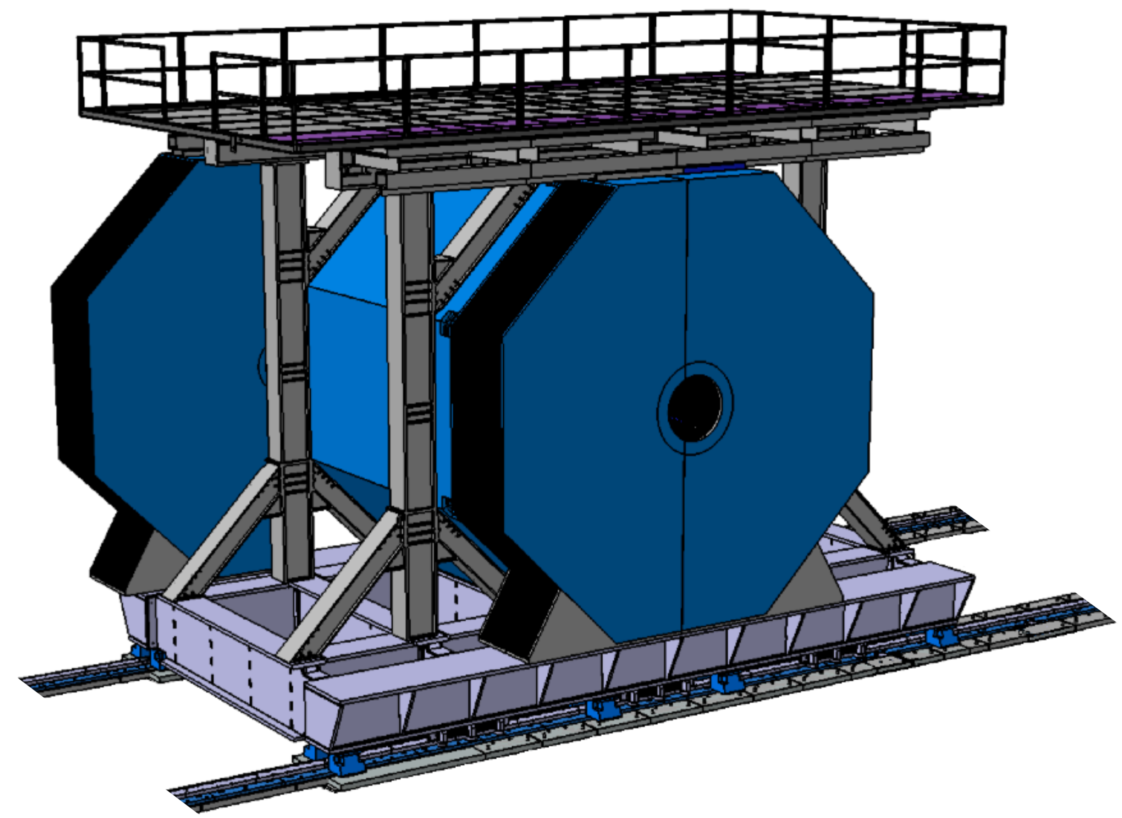
В ответ на Ваш запрос о возможности изготовления и поставки Ярма сверхпроводящего магнита детектора SPD коллайдера (далее – Оборудование), сообщаем, что АО «ТЯЖМАШ» заинтересован в работе над этим проектом, а также обладает соответствующими компетенциями и имеет возможность изготовить, провести испытания и поставить Оборудование, согласно представленной документации.

Специалисты предприятия рассмотрели техническую возможность изготовления и поставки данного Оборудования, а также произвели предварительную оценку его стоимости.

Учитывая опыт производства референтного оборудования, фактические значения цен на основные материалы и комплектующие, ориентировочная стоимость изготовления в условиях 2024 года составляет: **1 500 000 000,00 руб. без НДС (Один миллиард пятьсот миллионов рублей, 00 коп. без НДС).**

Activity on assembling schemes of RS+STS

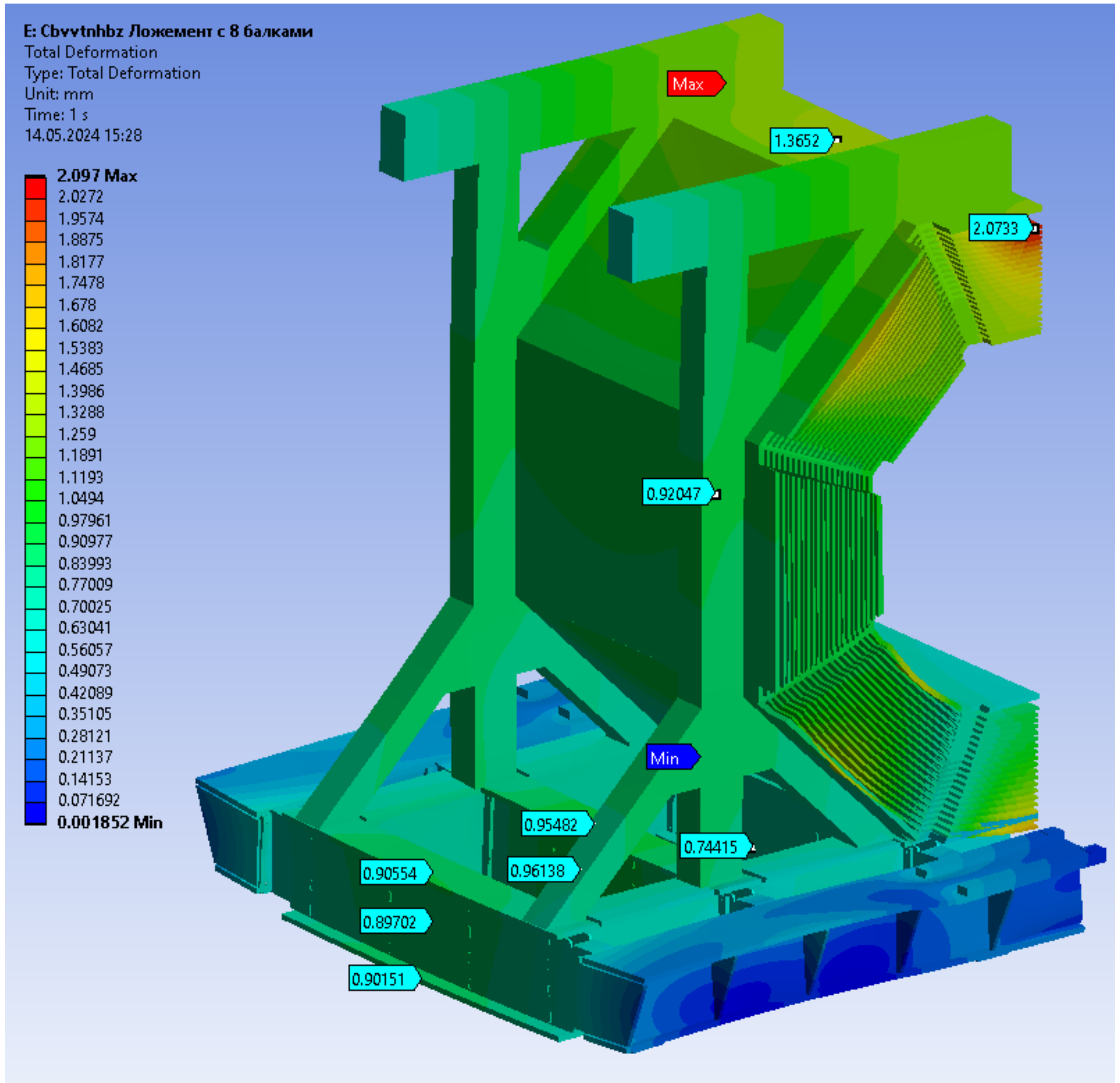




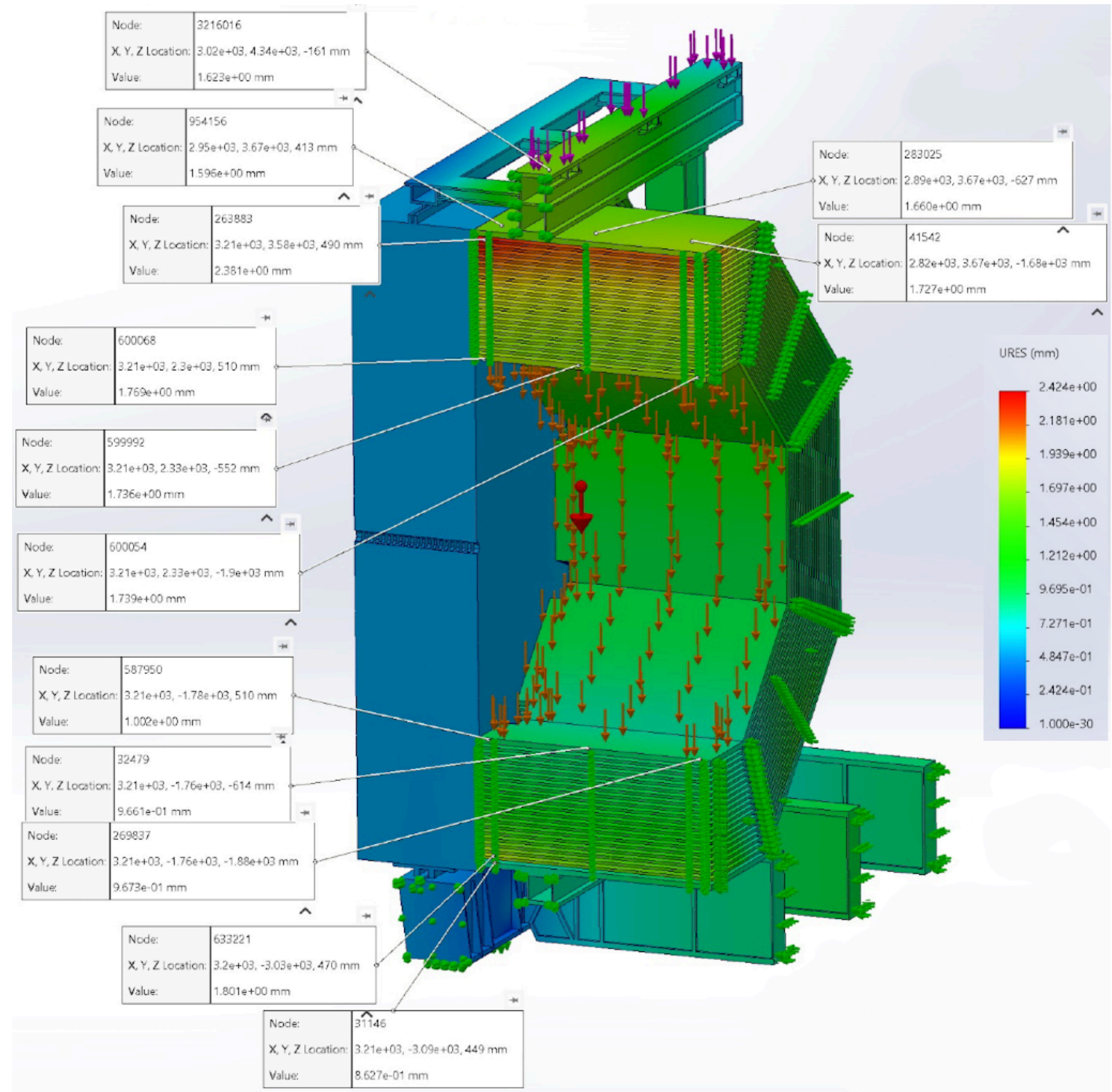
- Since March, a special assigned engineer (S.Gerasimov) from desing-department N2 of LHEP has been working on this topic
- A complete 3D model of the RS power frame (magneti yoke), including the support and transportation system, is expected by November
- The production of drawings will take another 6 months

Deflections due to own weight (FEA)

S.Gerasimov (May 2024)



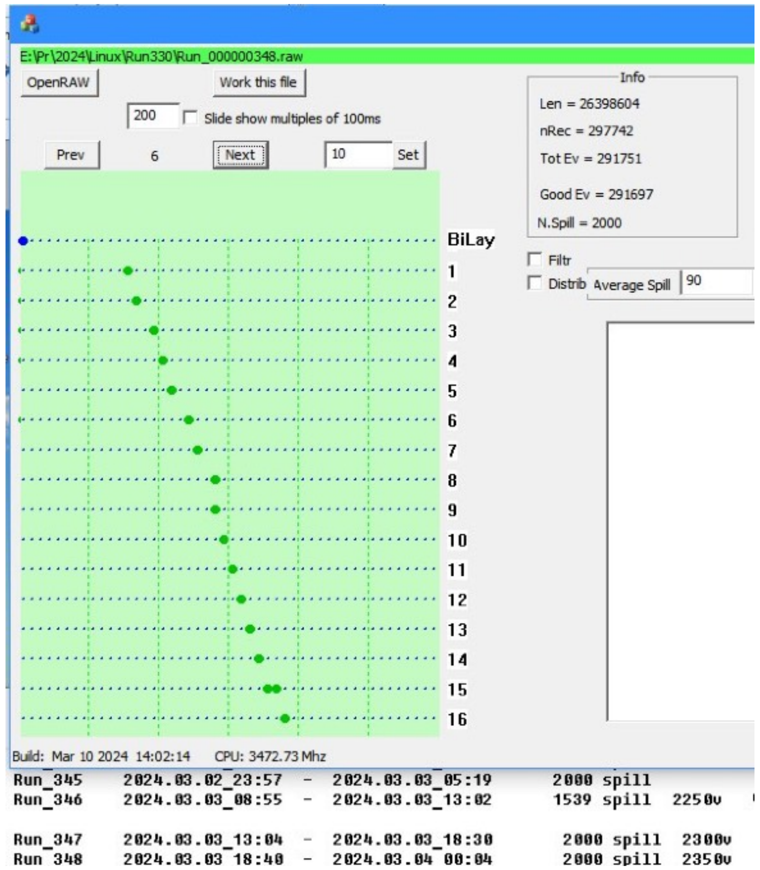
A.Samartsev (April 2023)



- Maximum deflection is ~2 mm for the 3 cm thick steel sheet of the top barrel module
- Good agreement between the results of two independent analyses
- Once the full design is completed, another cross-check will be carried out with an external company

G.Alexeev
A.Samartsev

Range (muon) System Status



- Cosmic muon track in RS is shown crossing all 16 layers of absorber (62 cm of Fe)
- Total number of R/O channels is 768
- COMPASS/CERN-like DAQ system
- Two scintillators (2x50x50 cm3) as trigger
- Total number of accumulated tracks ~ 10**6

Main results:

- Conclusion of the Agreement between JINR and (Institute of Physics + Integral, Minsk) on production of the first portion of Ampl-8.53 amplifiers
- Full commissioning of the RS prototype (MDT detectors, analog and digital front-end electronics, DAQ) at Nuclotron test beam area, and initial data collection with cosmic

Current activities:

* **Monitoring of the implementation of the contract with Minsk by JINR**

* **Analysis of RS prototype data collected at first cosmic run**

* **Calculation of magnetic forces influence on the Range System (magnet yoke)**

* **Preparation for testing the “final” digital FEE unit with DAQ L1 concentrator**

* **First test of Cherenkov counter with modified optical system on cosmic**

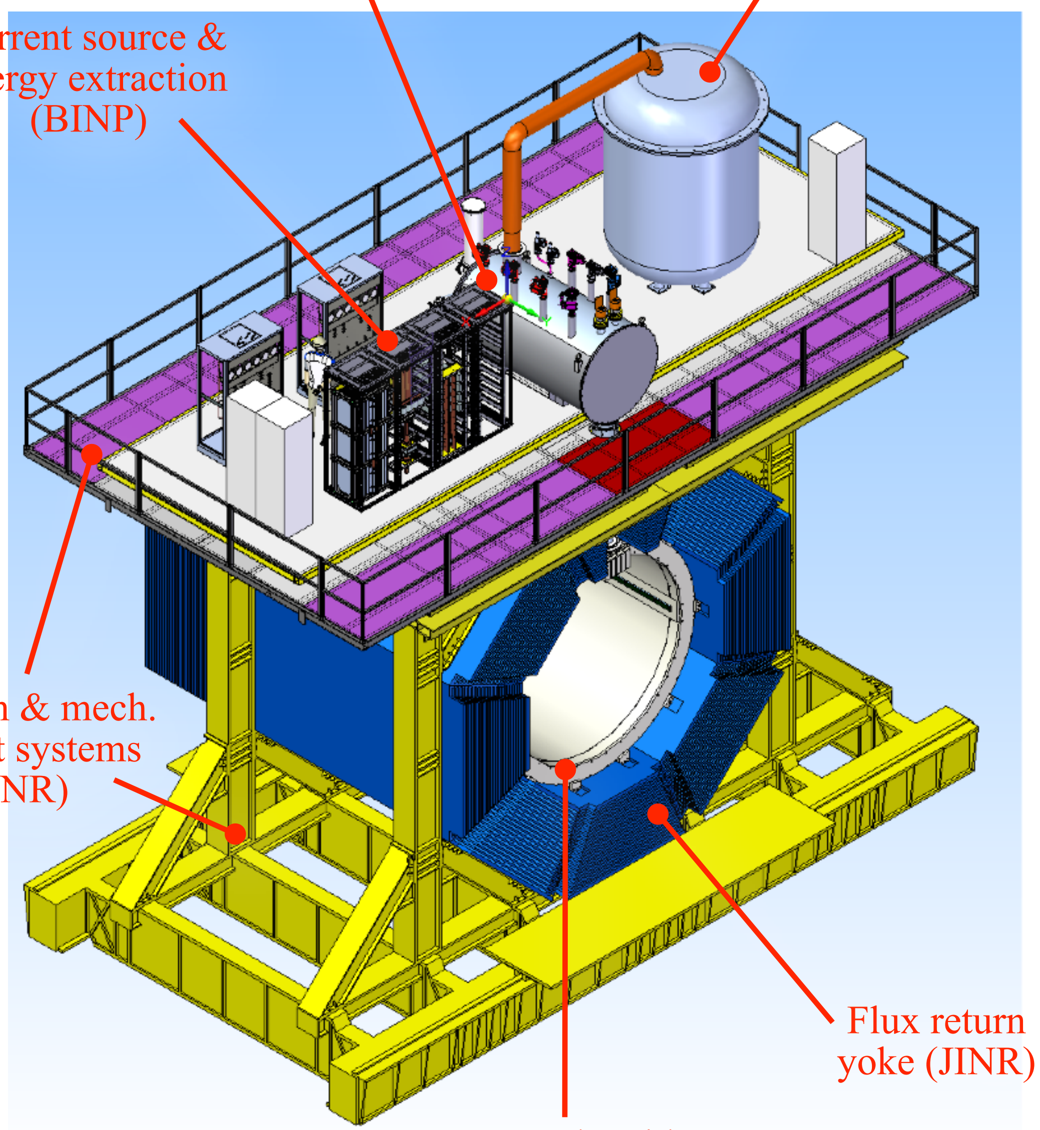
* **Preparations for deployment of equipment for MDTs mass production**

* **Participation in development of PID algorithms for pion-to-muon separation**

Budker Institute
of Nuclear Physics
Novosibirsk

SPD solenoid design progress

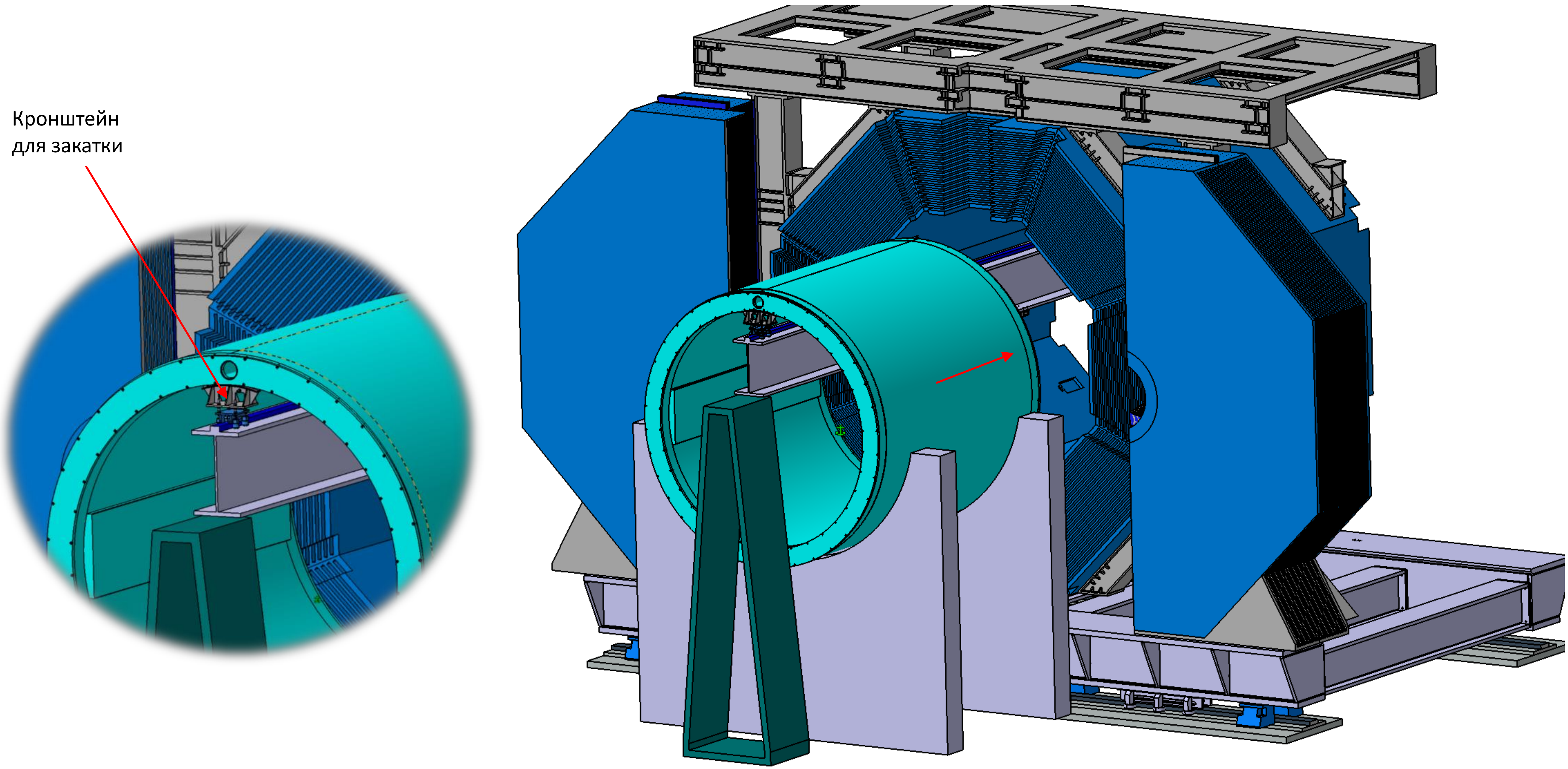
Pyata E., Antokhin E., Bedareva T., Erikhin A., Pivovarov S.



- Magnetic analysis of the magnet including of calculations of the magnetic forces is done.
- Engineering design of the magnet including of calculations of all loads and forces is in progress.
- Design of the superconductive conductors, coils and cold mass in progress. SPD Rutherford Cable parameters were selected and a 100 meter long sample was produced for further development. Cryogenic tests were performed on individual strands after cable fabrication.
- Design of the proximity cryogenics with flow scheme and all instrumentation for cryogenics and insulation vacuum for the cryostat and control Dewar, current leads is in progress.
- Design of the power supply system and energy extraction system is in progress.
- Development of the procedures for assembly of the magnet and the preparation of installation solenoid into the yoke
- Development of the worked conditions of the cryogenic system are carried out.

S.Pivovarov (PANDA)
S.Gerasimov (SPD)

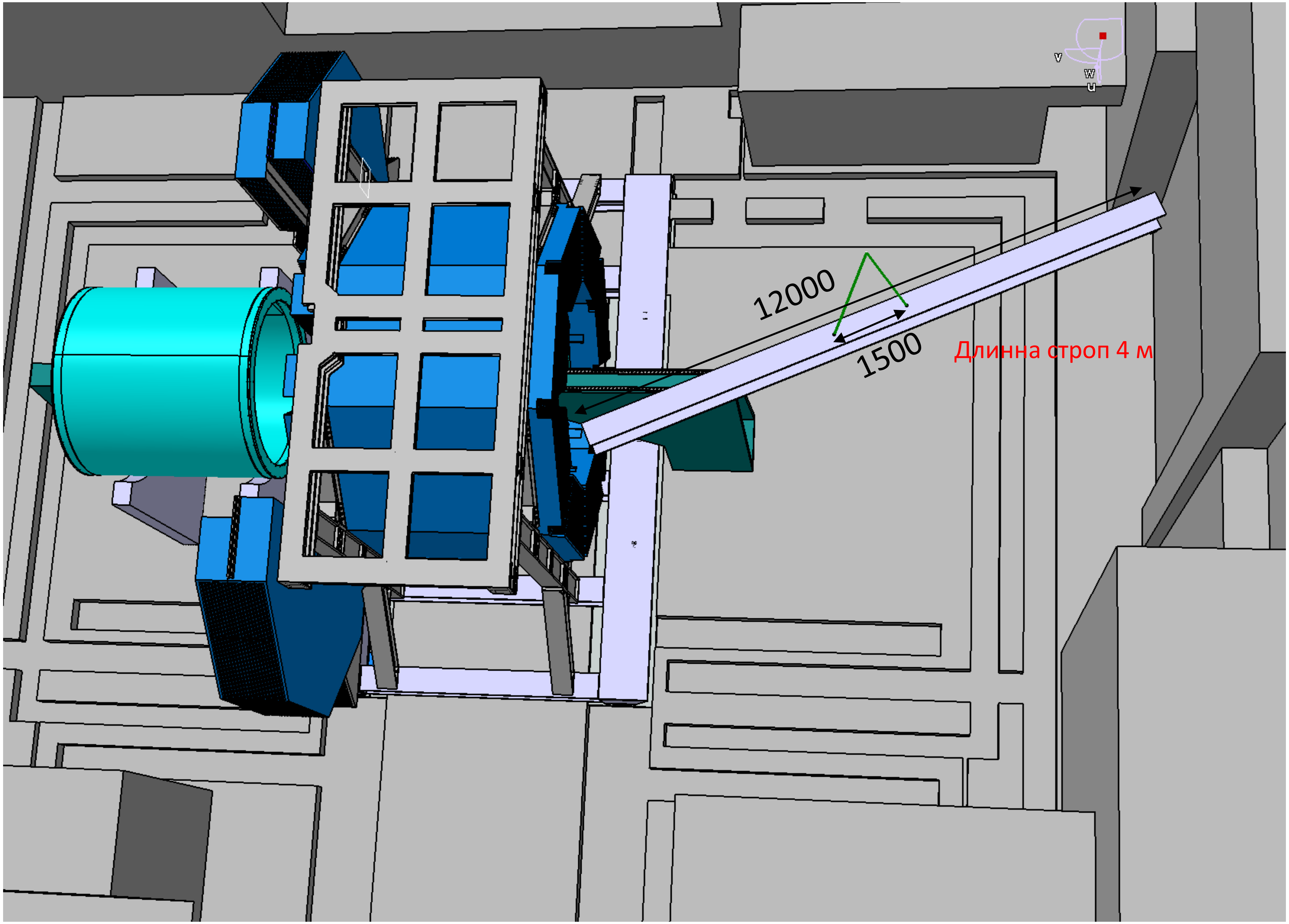
Installation of a cryostat in the yoke



- Two roller skates for moving the cryostat are installed and the cryostat is transported inside the yoke
- After fixing the cryostat, the beam is dismantled in the reverse order

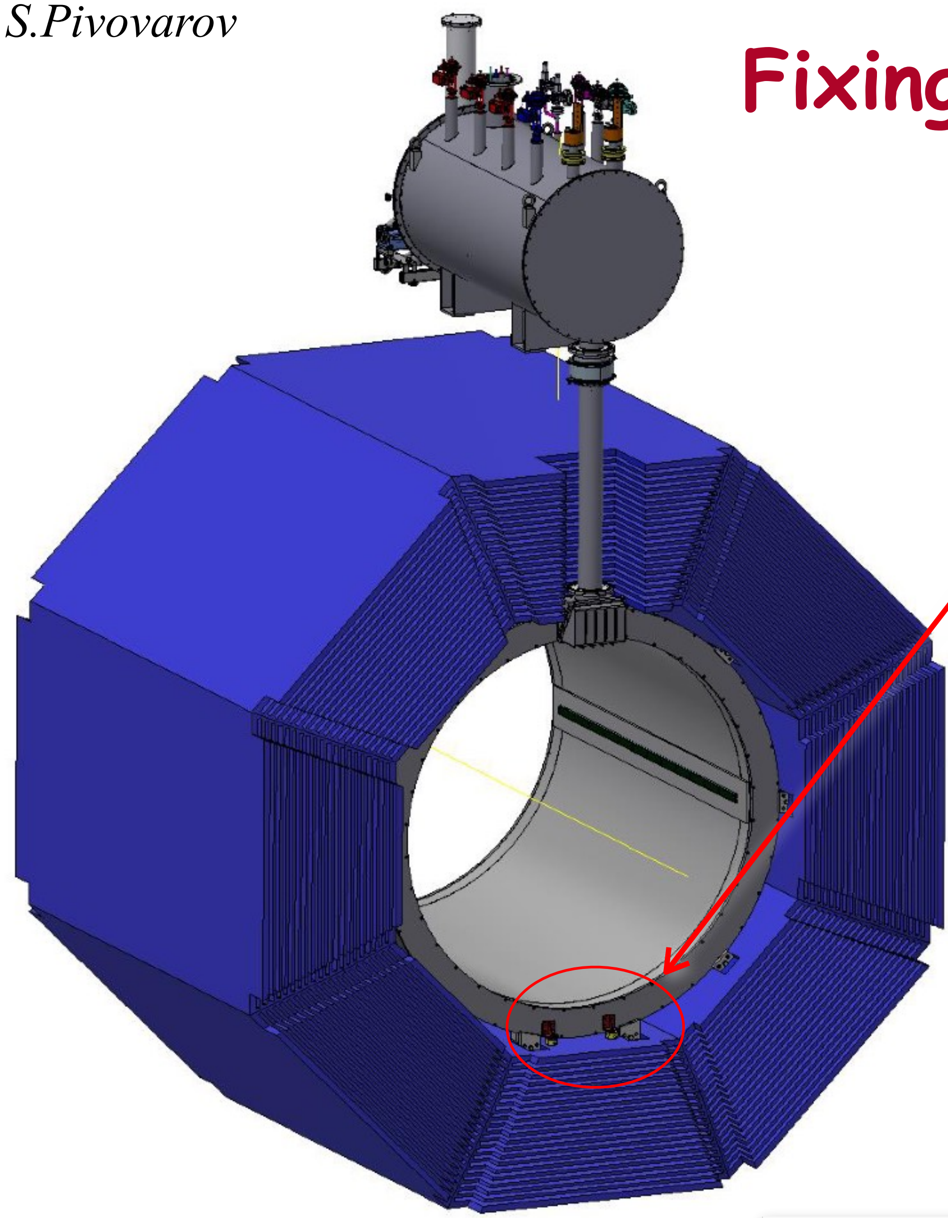
S.Gerasimov

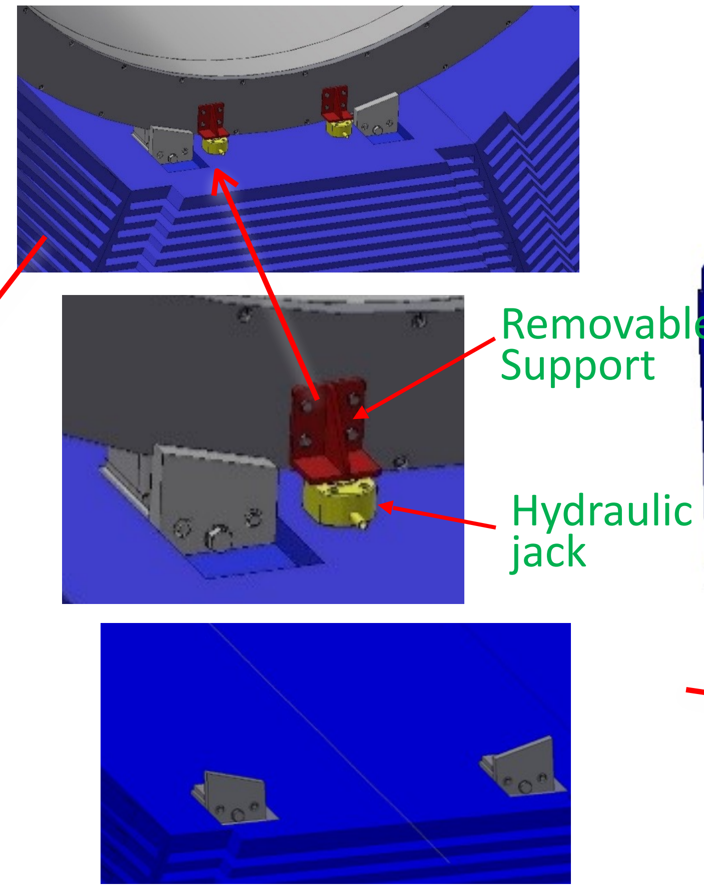
Installation of the cryostat in the yoke

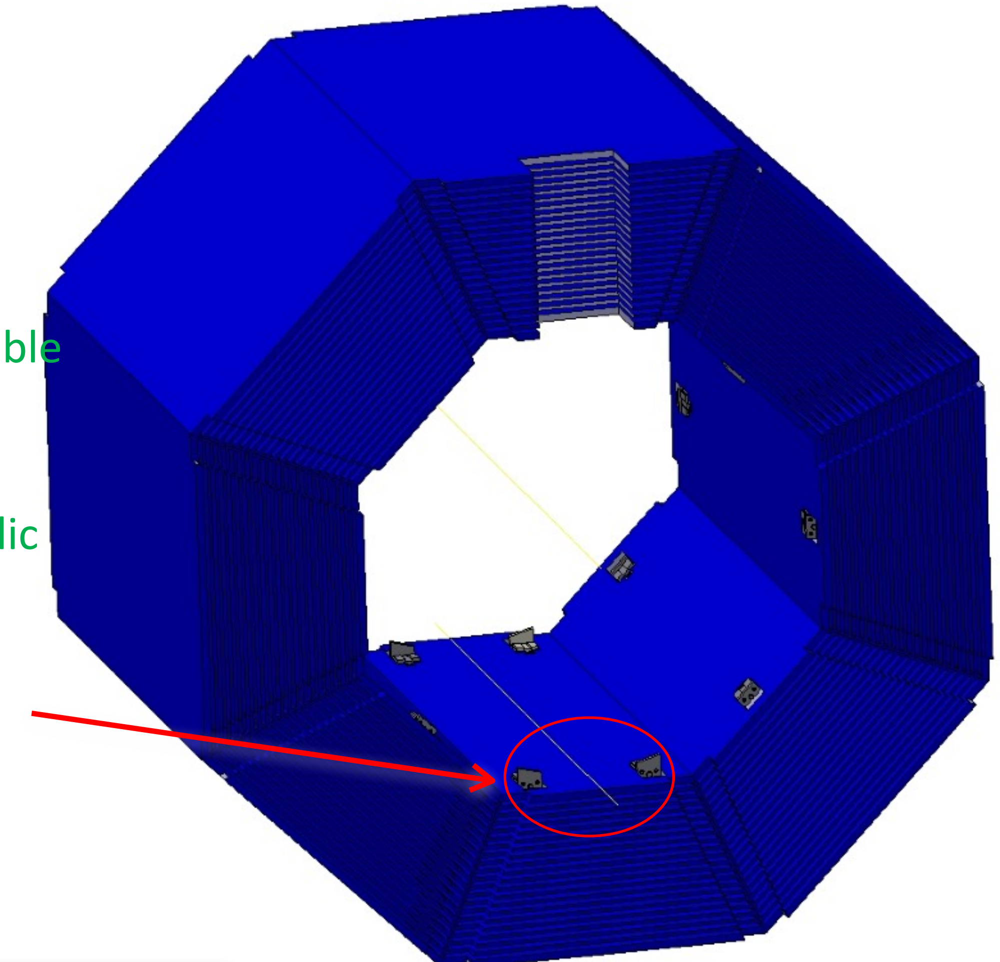


S.Pivovarov

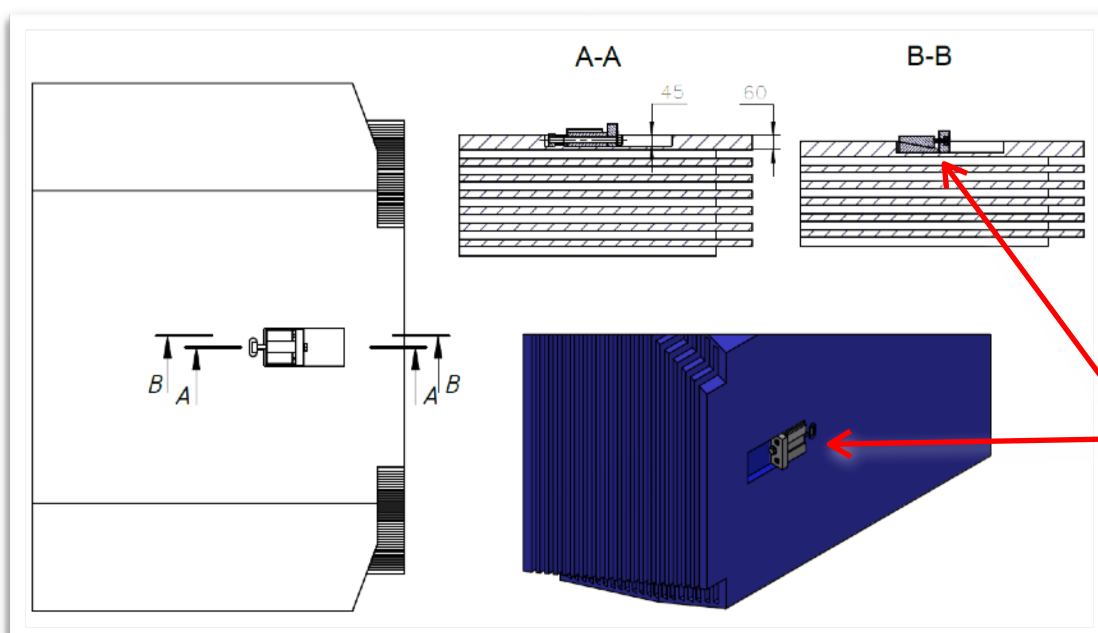
Fixing & positioning the magnet on the yoke







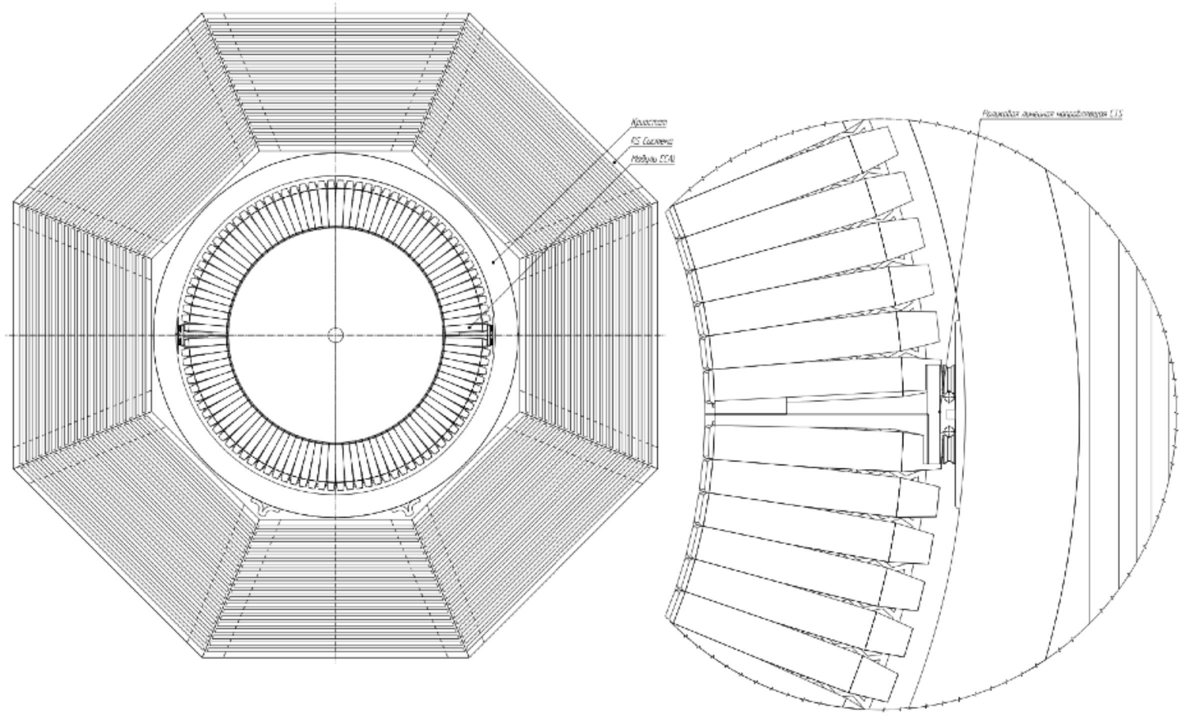
- The cryostat is positioned using hydraulic jacks
- The cryostat is fixed in an iron yoke by means of special adjustable supports fixed on octants

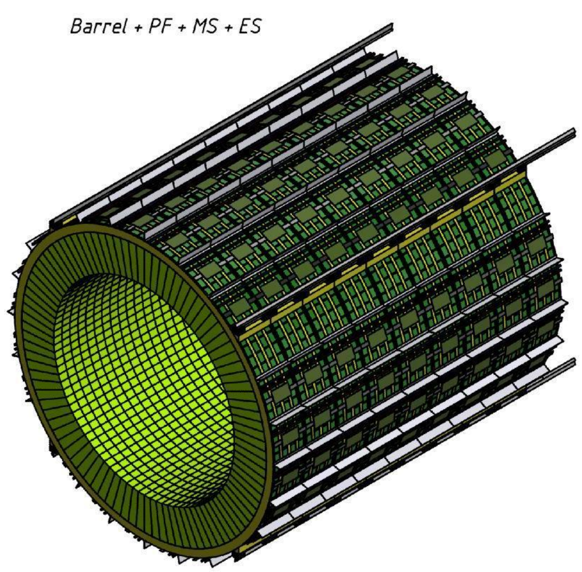


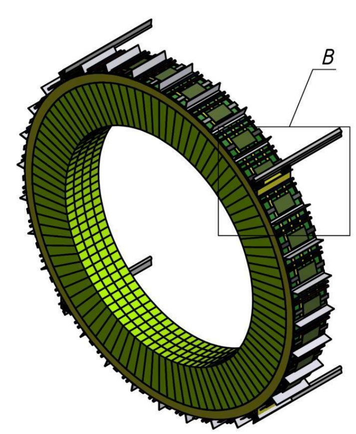
The wedge surface of the support serves to fix the cryostat after positioning the magnet using hydraulic jacks

ECal barrel in the form of rings (pros and cons)

from TDR





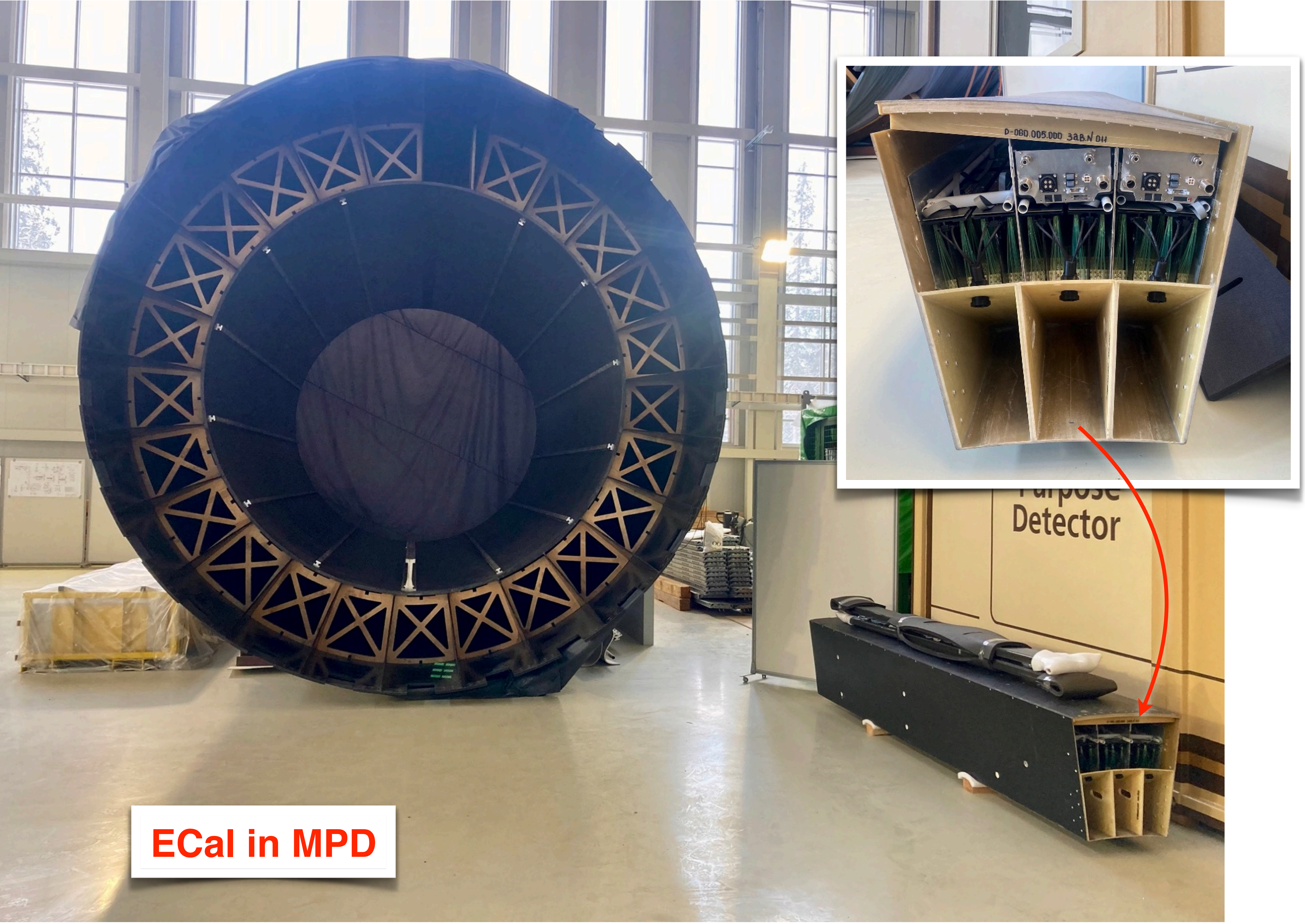


Pros of the ECal ring design

- Uniform azimuthal angle acceptance (good for physics)

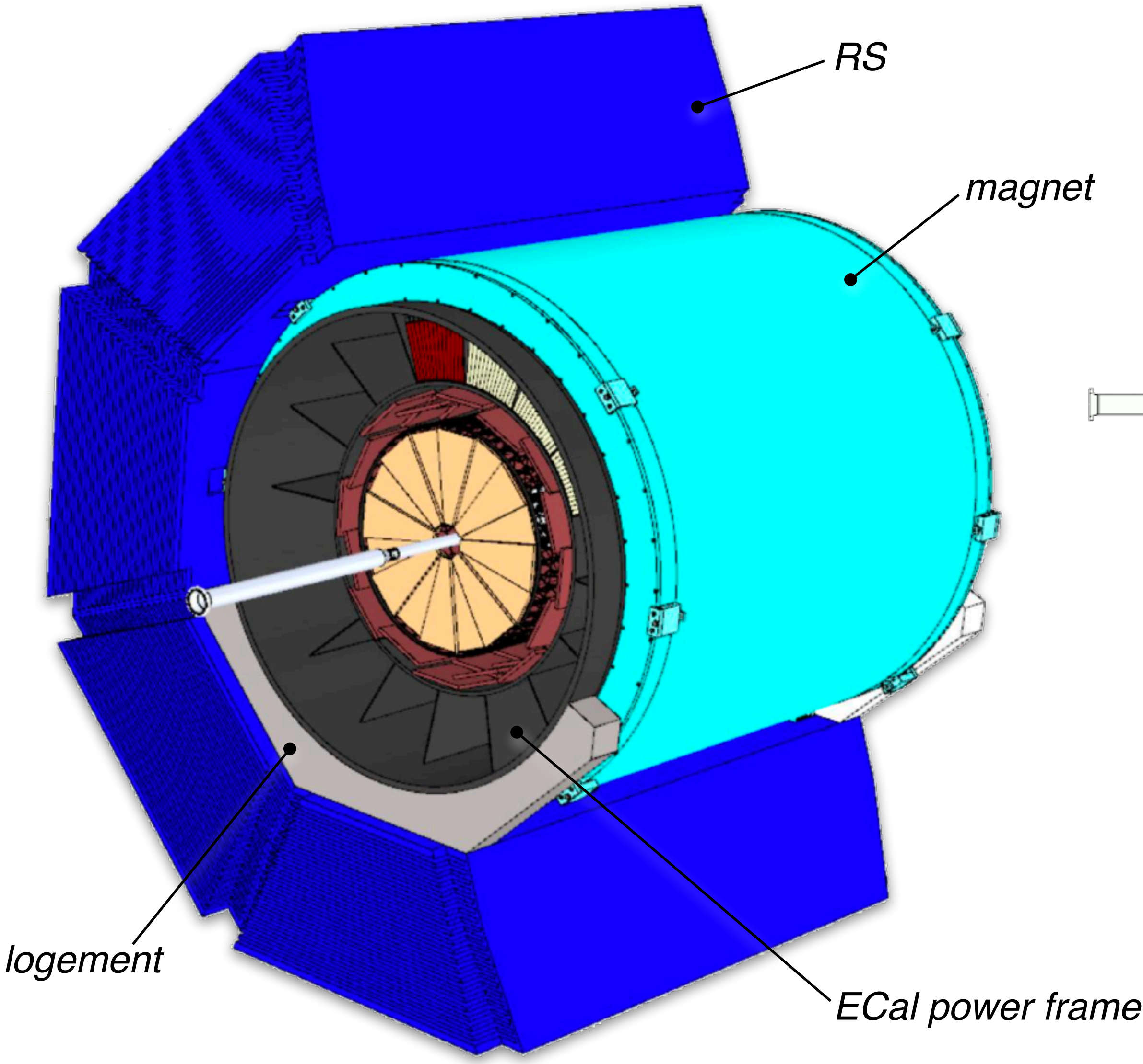
Cons of the ECal design in the form of rings

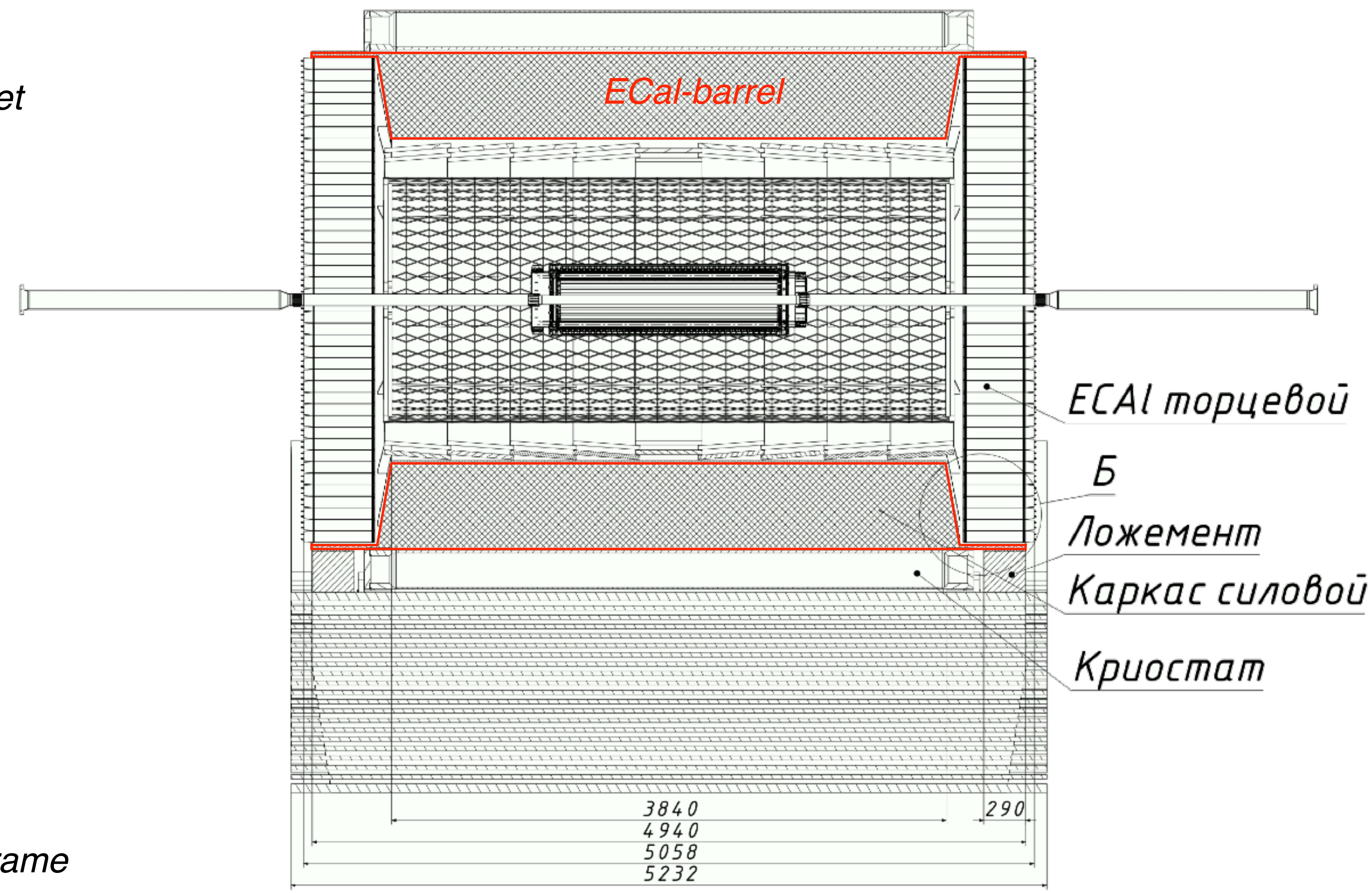
- In order to get to the inner rings (repairing electronics or installing new cells), it is necessary to disassemble the entire interior of the setup (ST, TOF, VD, BBC, FARICH)
- it is not clear how to ensure communications to the rings (cables, cooling water)
- The complexity of mounting the rings, as well as their installation in the working position
- Deflection of the cryostat magnet by 0.7 mm due to the ECal suspension on the inner shell of the magnet
- Lack of time and engineers capable of developing this design
  - there is no example of a similar calorimeter design in current experiments


ECal in MPD
Detector

New support scheme of ECal-barrel

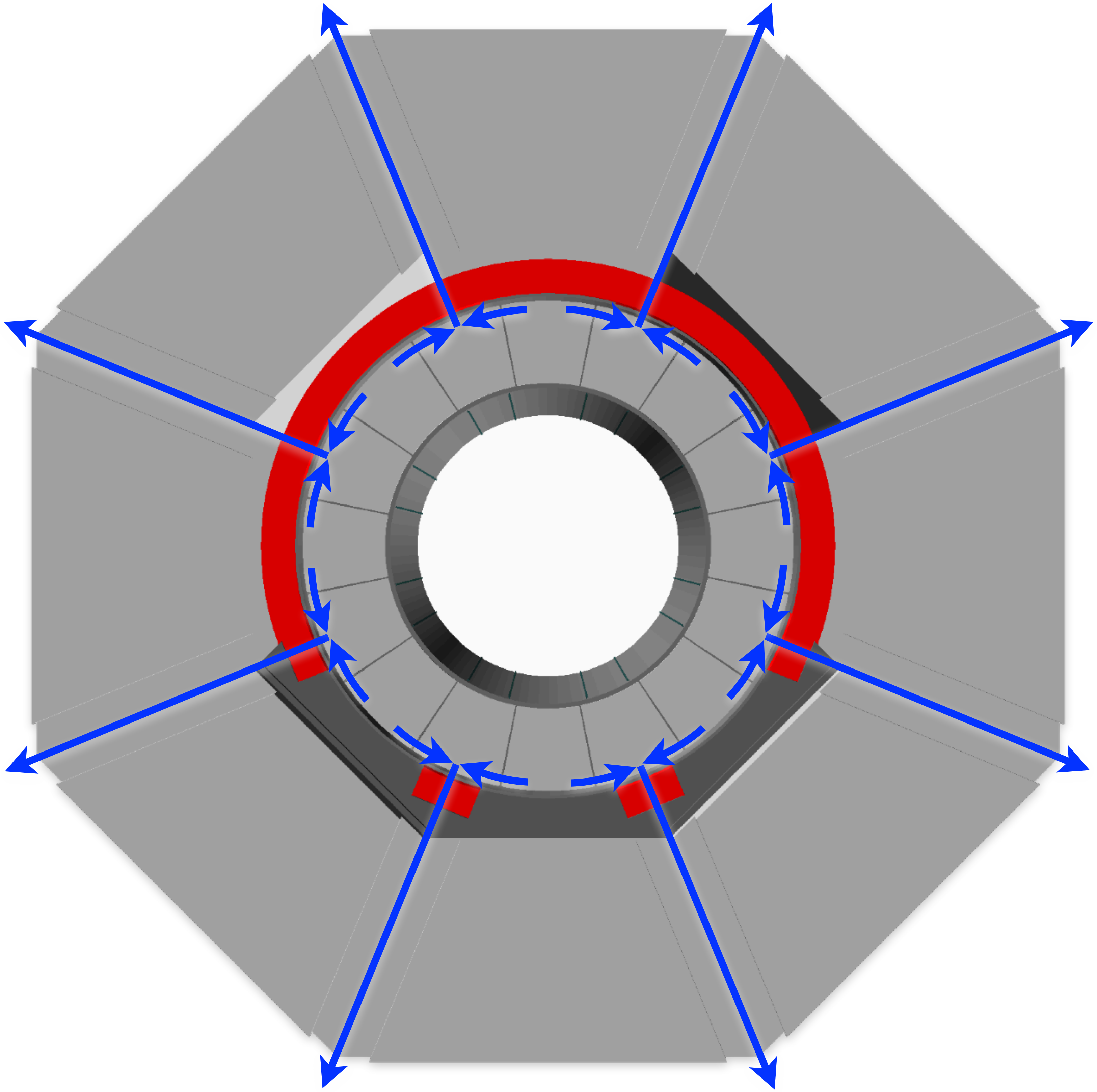
(not yet officially approved)





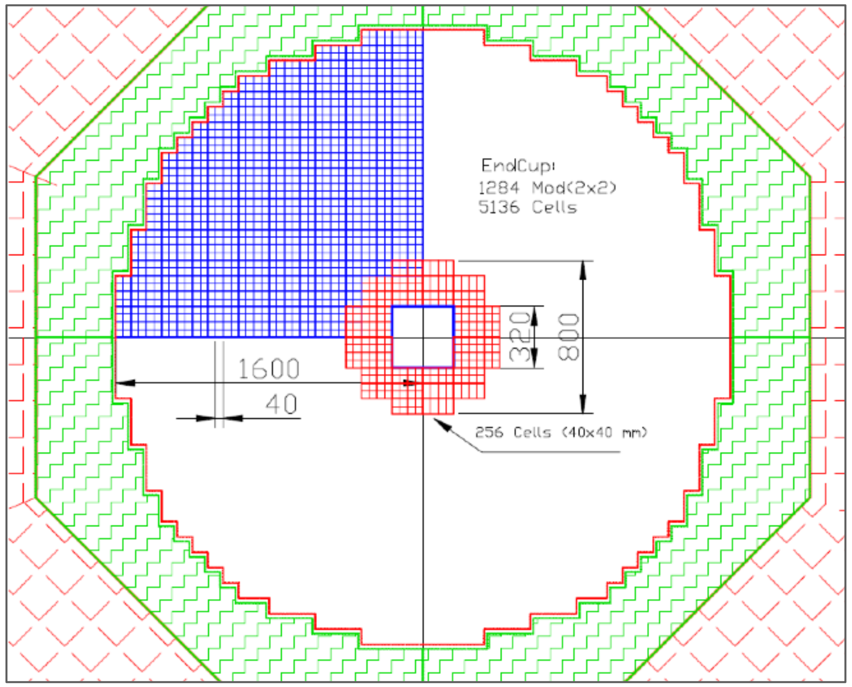
- The outer shell of the ECal-barrel has been expanded and it is supported on a lodgement
- Communication with engineers regarding the design and quotation is ongoing
- Procedure for loading the ECal power frame is the same as for the magnet

Exiting communications from ECal to the outside



O.Gavrishchuk

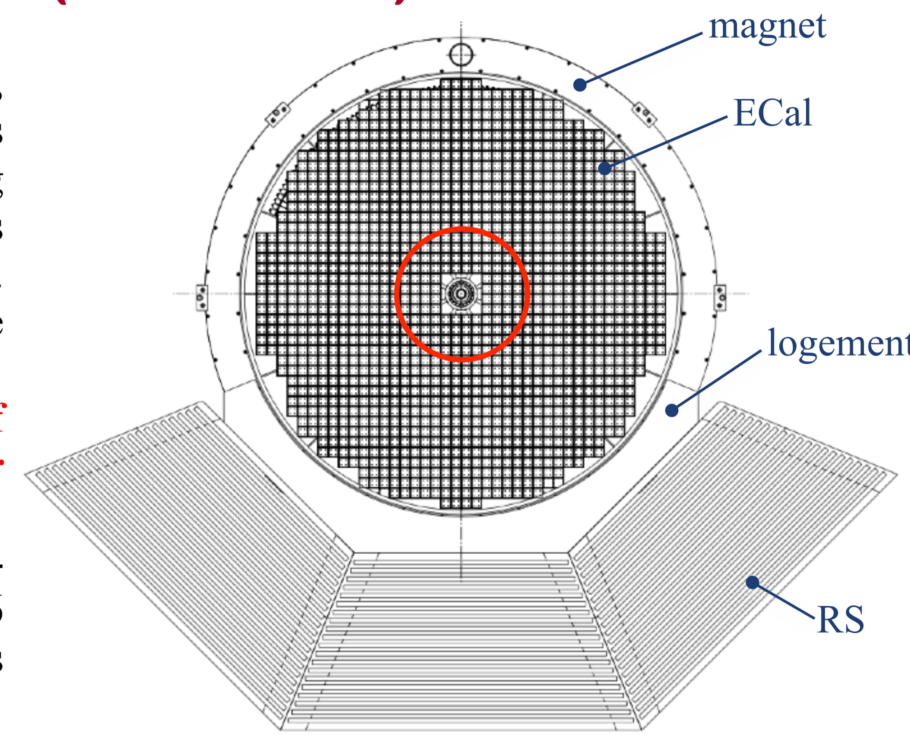
Proposal for the 1-st stage of SPD (256 cells)



This Figure shows in red 64 modules, consisting of 4 cells each. The weight of this assembly is 597 kg. This will require 130 kg of polystyrene, 465 kg of lead, as well as additives: 1.95 kg of P-terphenyl and 65 g. POPOP, and 2000 meters WLS fiber type Y-11.

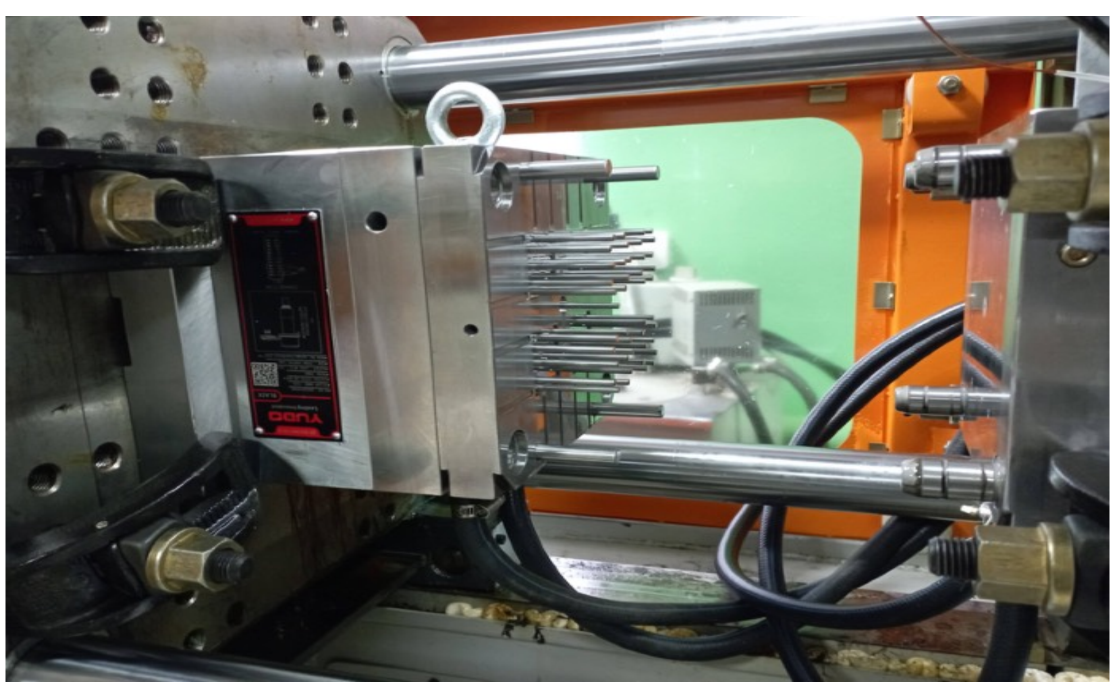
It is 1/20 part of end-cap and taken time of 36 Days to prepared 51200 scintillator plates.

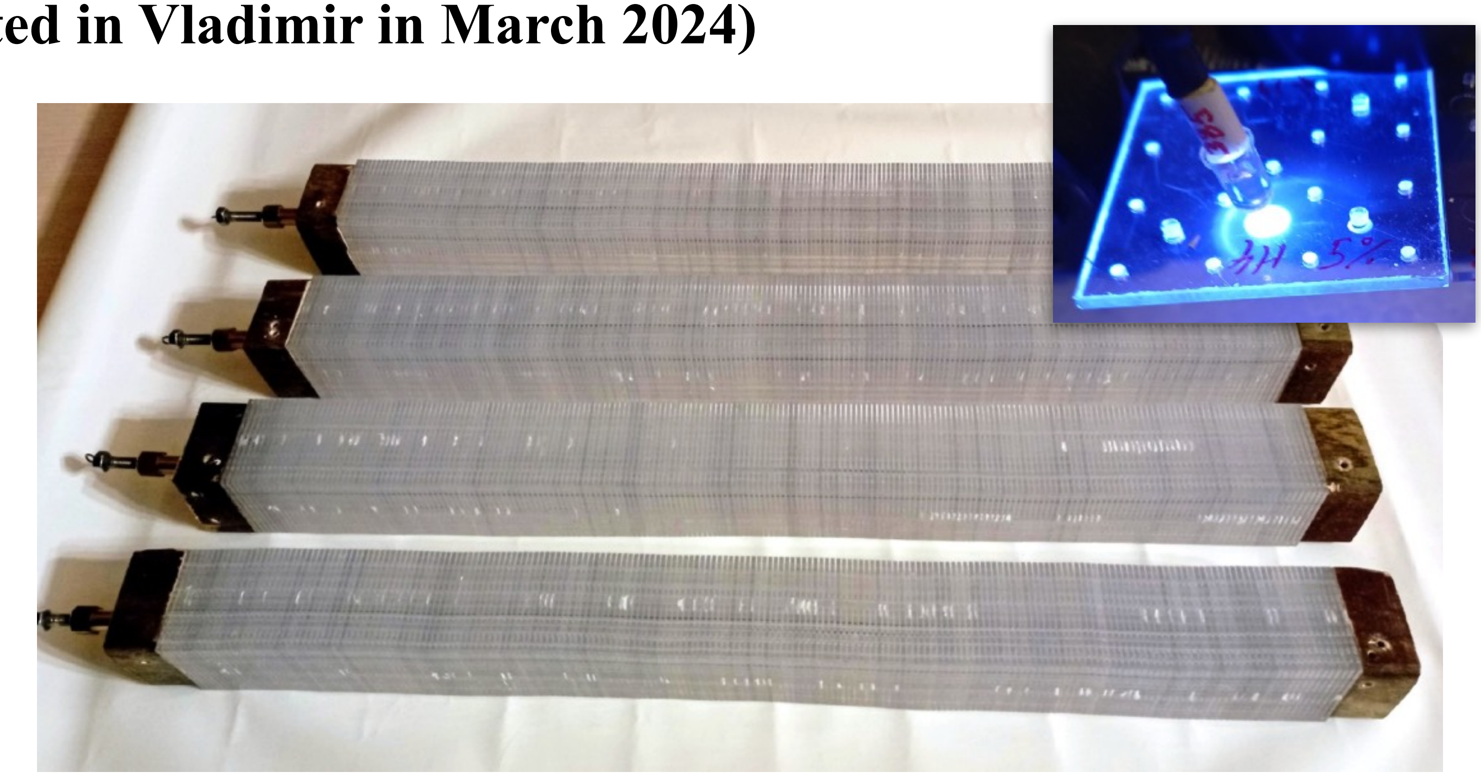
To read this setup, we need four ADC64 - 64-channel amplitude encoders, as well as 16 boards of 16-channel amplifiers and bias voltage regulators.



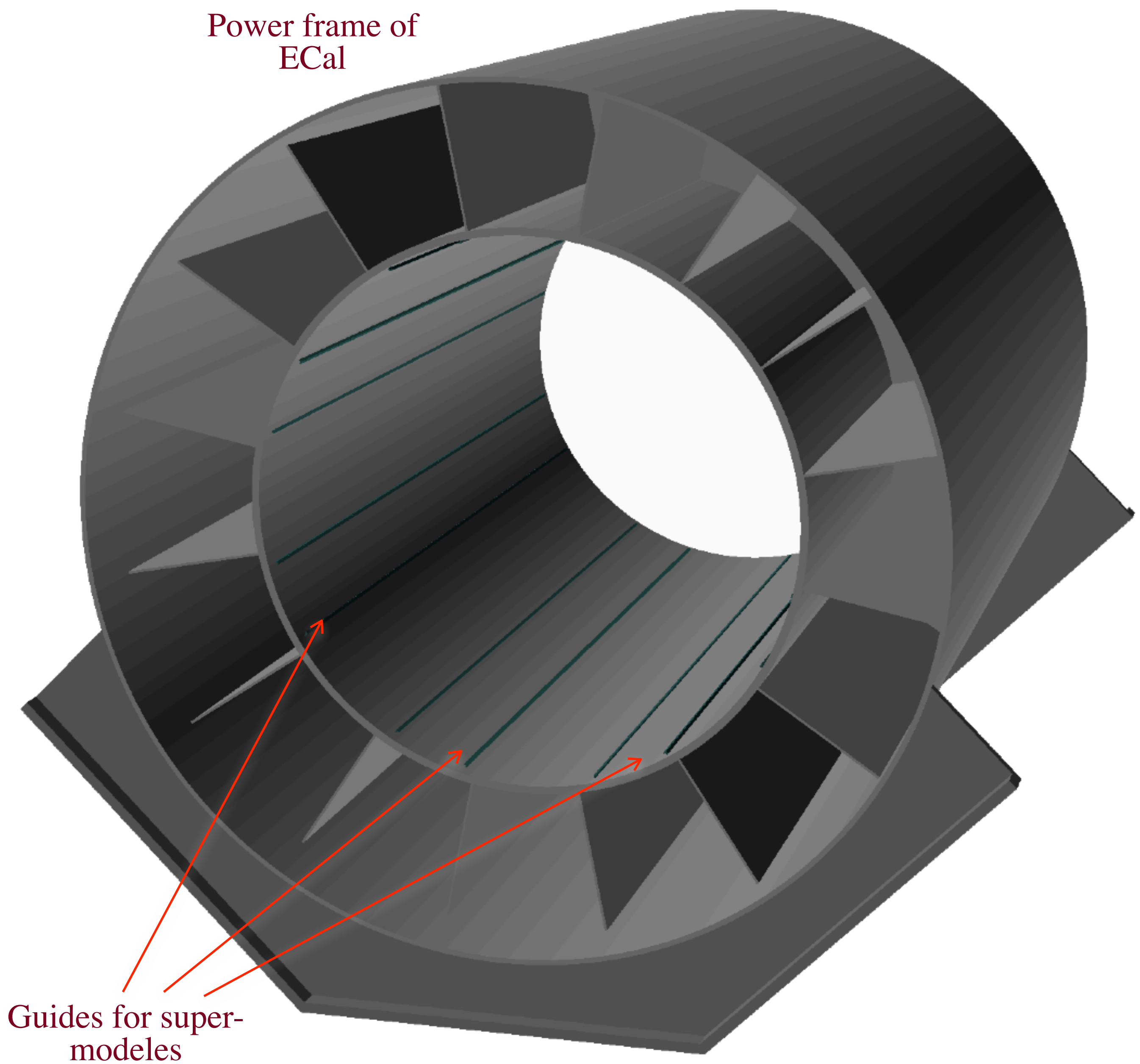
New matrix form for scintillators of 40×40×1.5 mm³ is ready

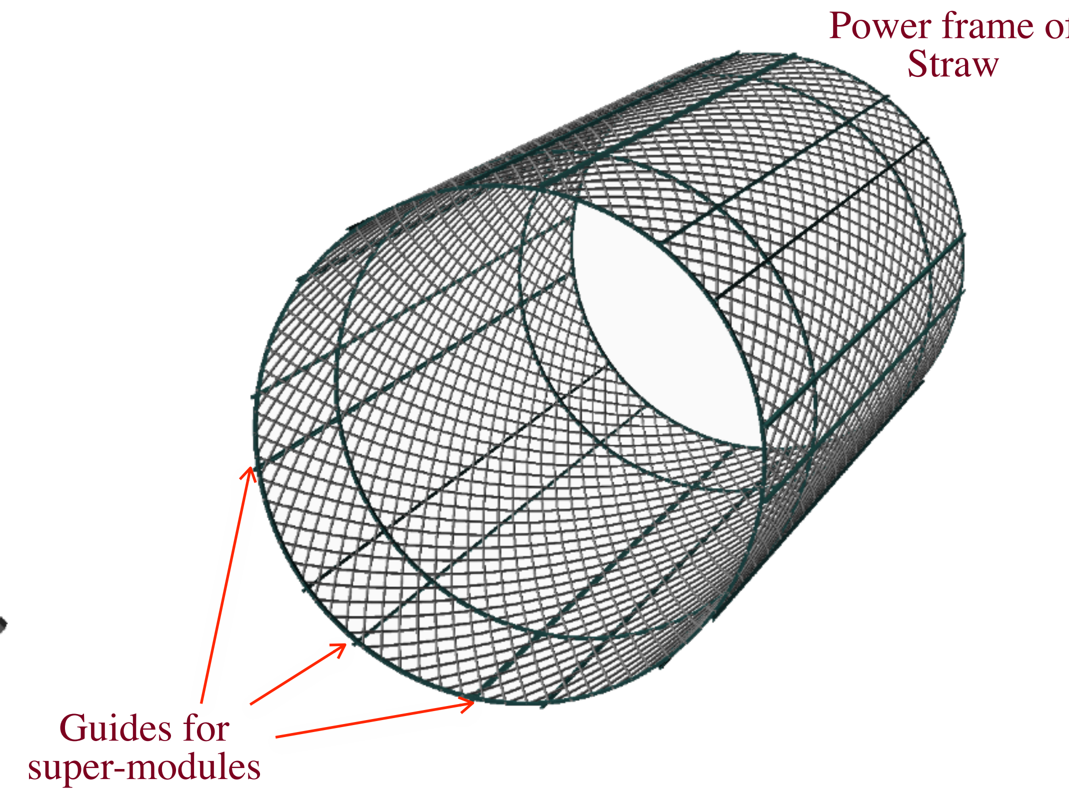
(It was tested in Vladimir in March 2024)

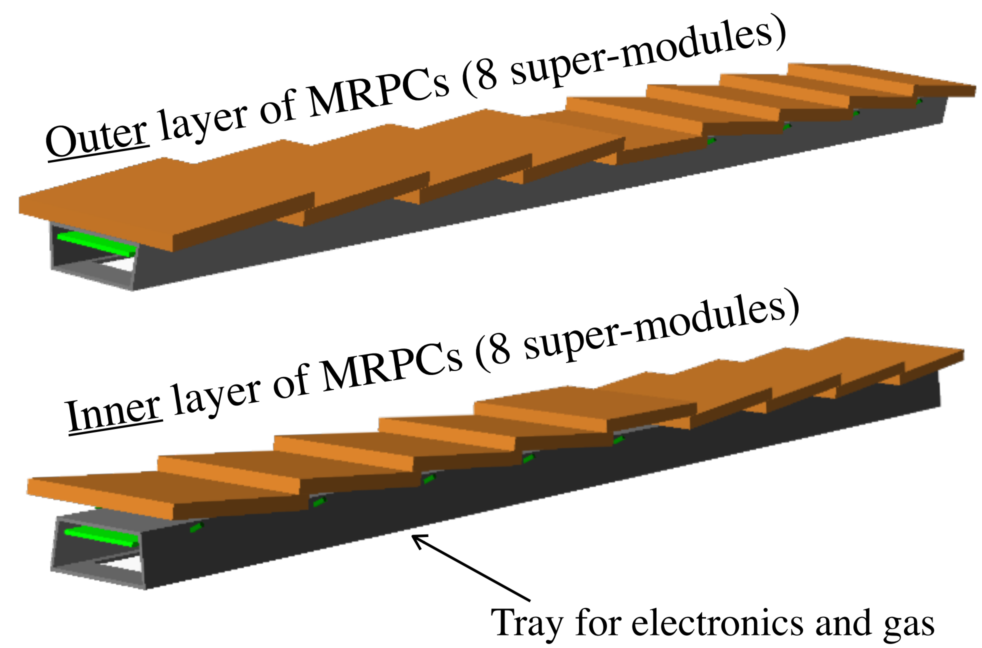




Option for the mounting scheme for TOF-barrel

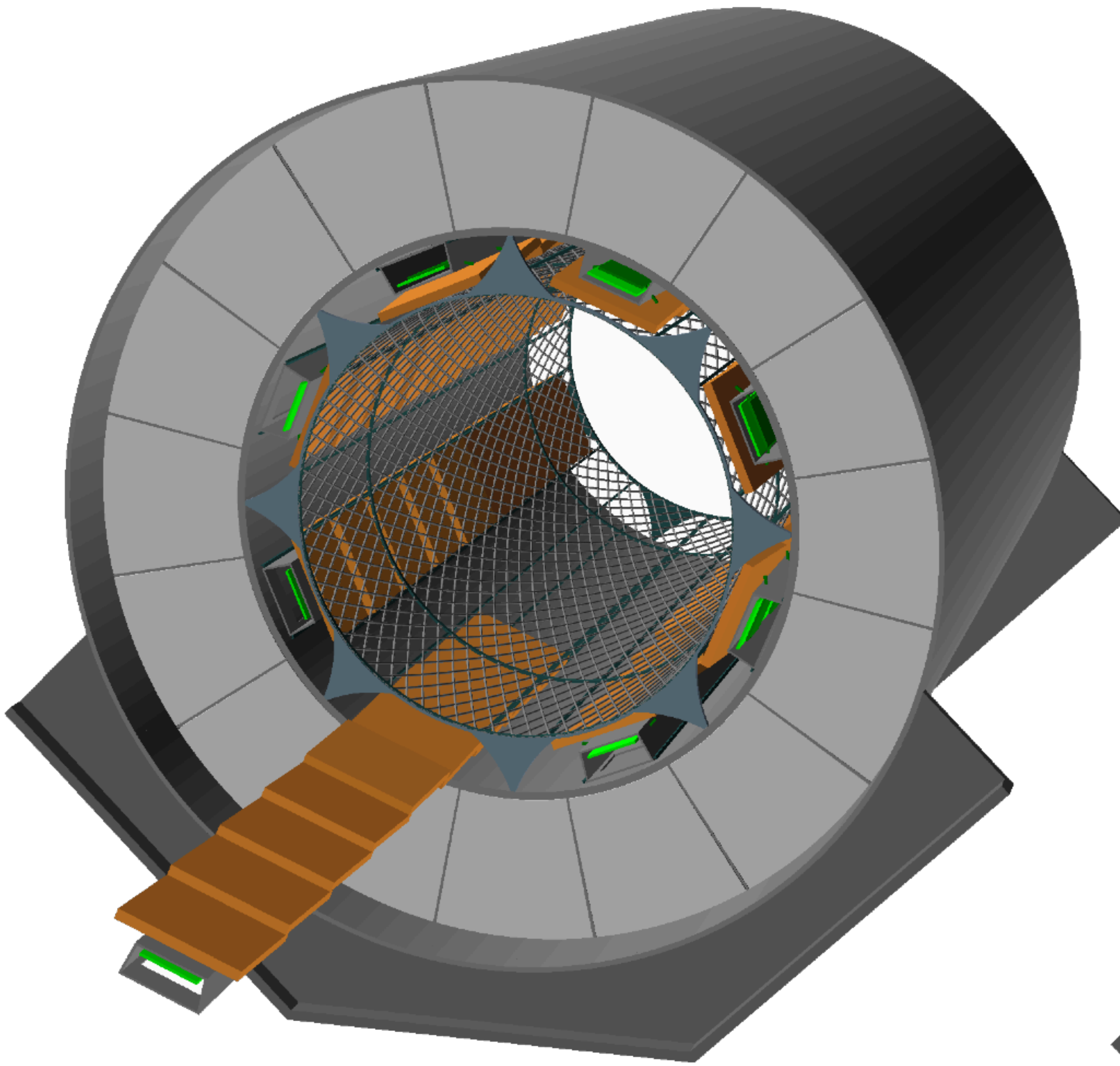




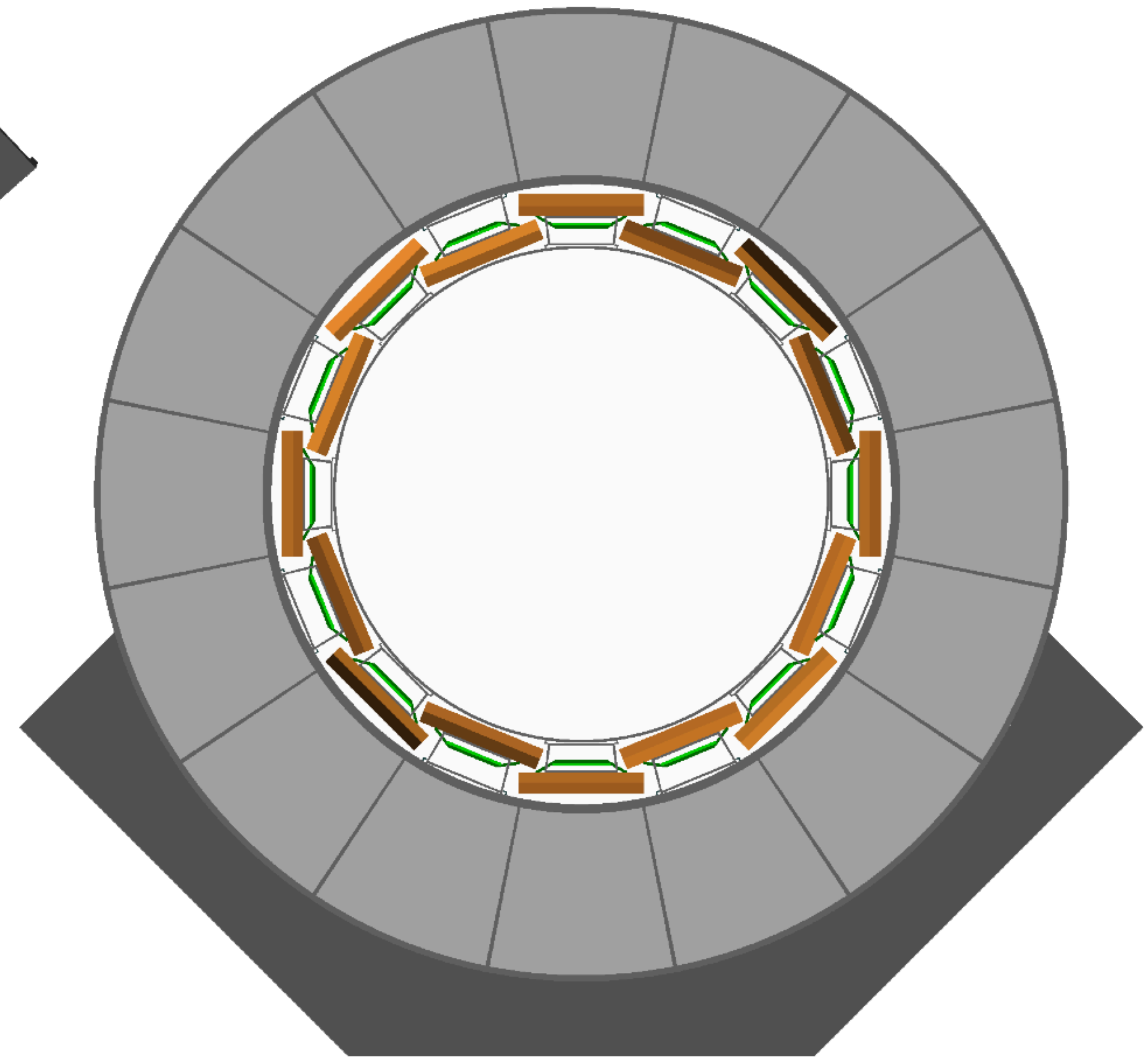


- The detector is assembled from 16 super-modules: 8 inner and 8 outer

Option for the mounting scheme for TOF-barrel

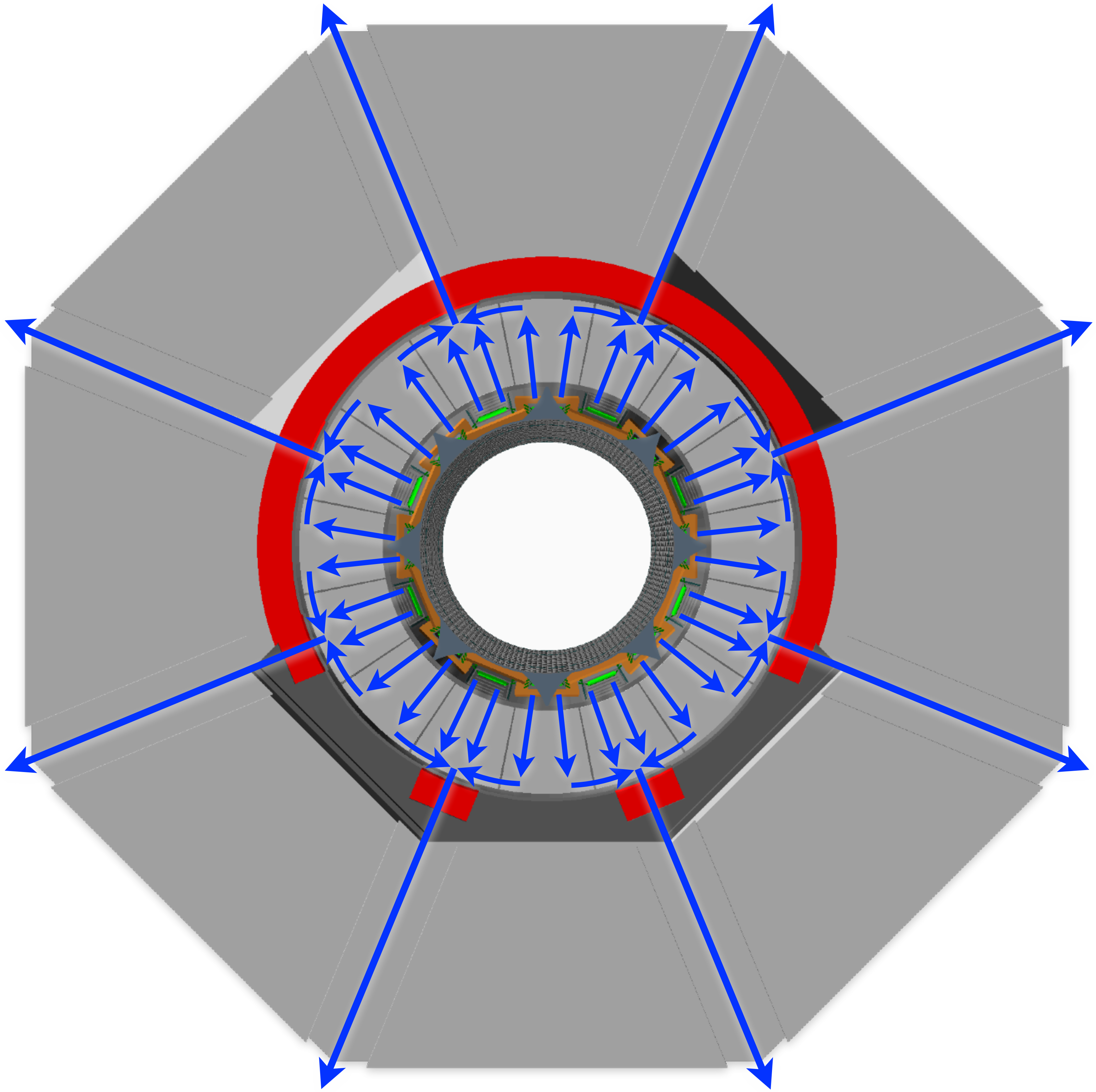


- TOF super-modules can be mounted and dismounted independently of inner detectors (straw, FARICH, …)



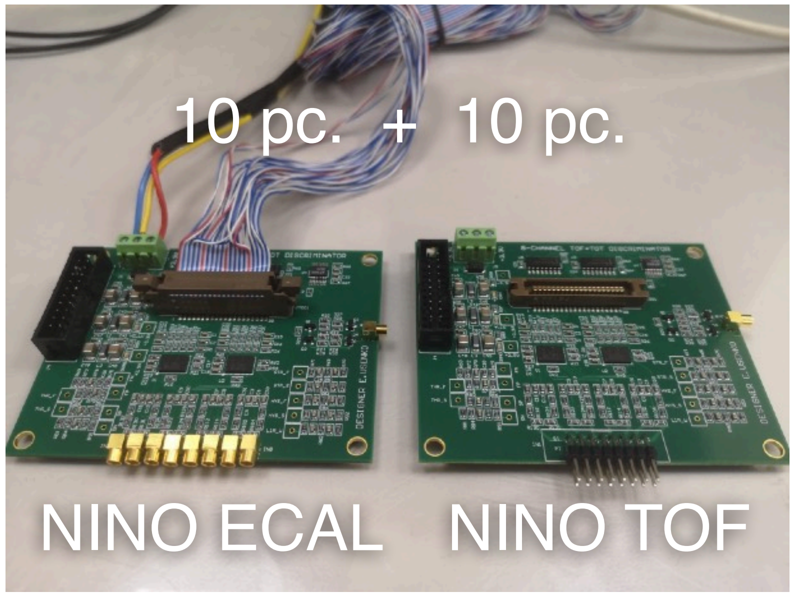
- 8 super-modules are mounted on ECal
- 8 super-modules are mounted on the power frame of straw

Exiting communications from TOF to the outside

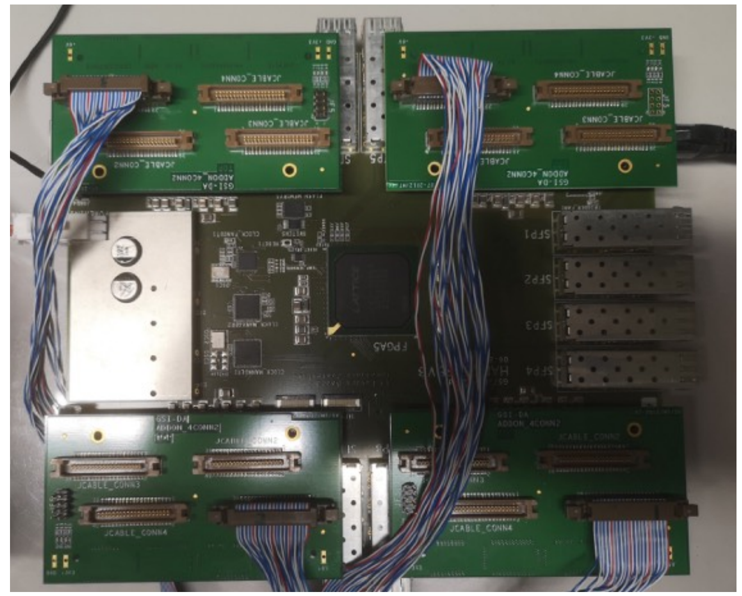


FEE/DAQ electronics for MRPC tests

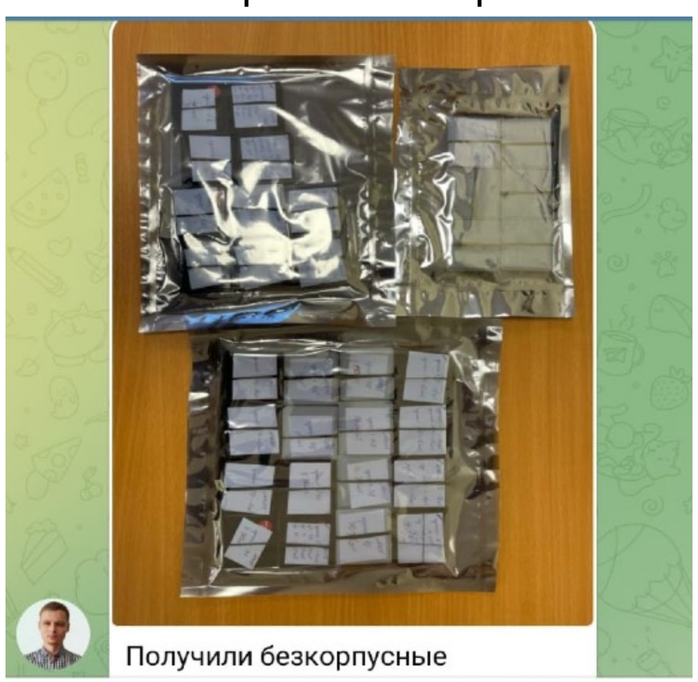
NINO board (analog)



TRBv3 (digitization)

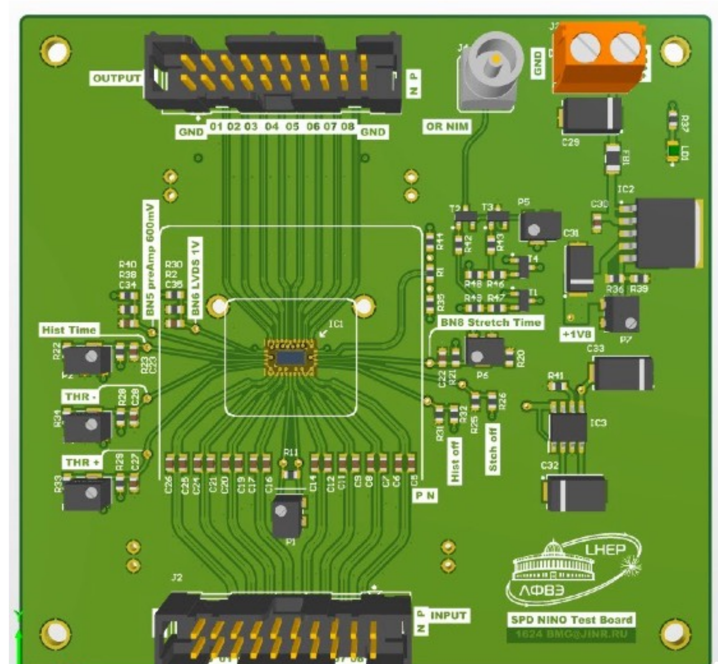


RUNO chips have been produced



MPW started in 2022

Evaluation board for RUNO



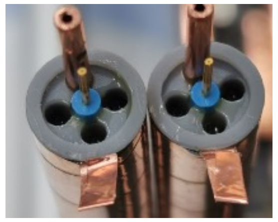
E.Usenko, M.Buryakov, 2024

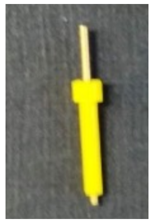
TRBv3 characteristic
48 V (40-50V), galvanically isolated on board
0.5A minimum without AddOns
GbE = max. 95 MBytes/s transfer per link
Slow control up to 400 registers/transfer, speed depends on GbE latency
Max. 8 SFPs, each 2GBit/s on board. With hub-addon: max. 32 SFP
Tr_rate = 300 kHz (depending on configuration and network size)
128 ch in TDC mode
Precision<20 ps
Pulse width <500 ps

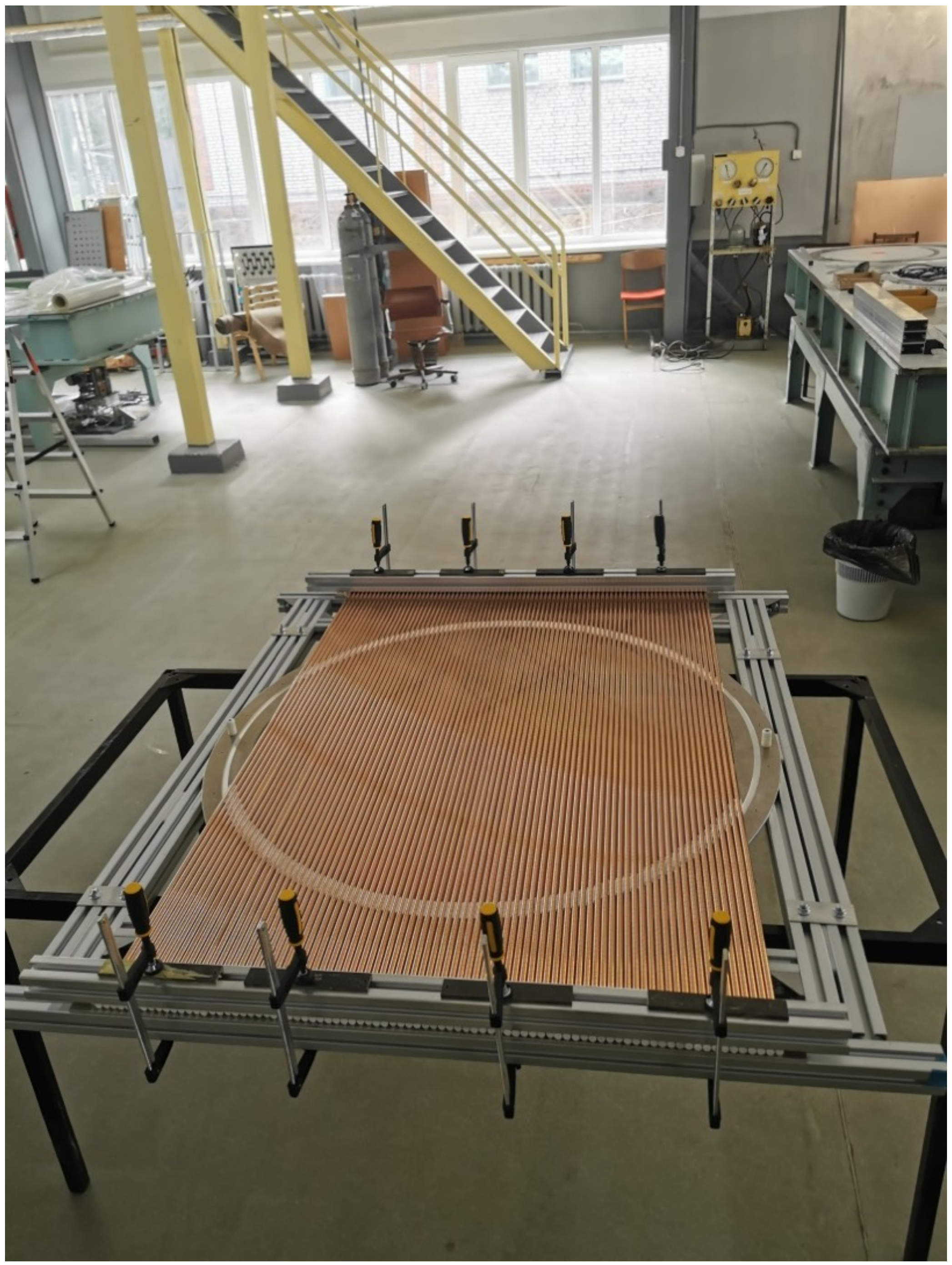
- TRBv3 boards are fully operational
- Can be applied to read out MRPCs

G.Kekelidze
V.Kramorenko

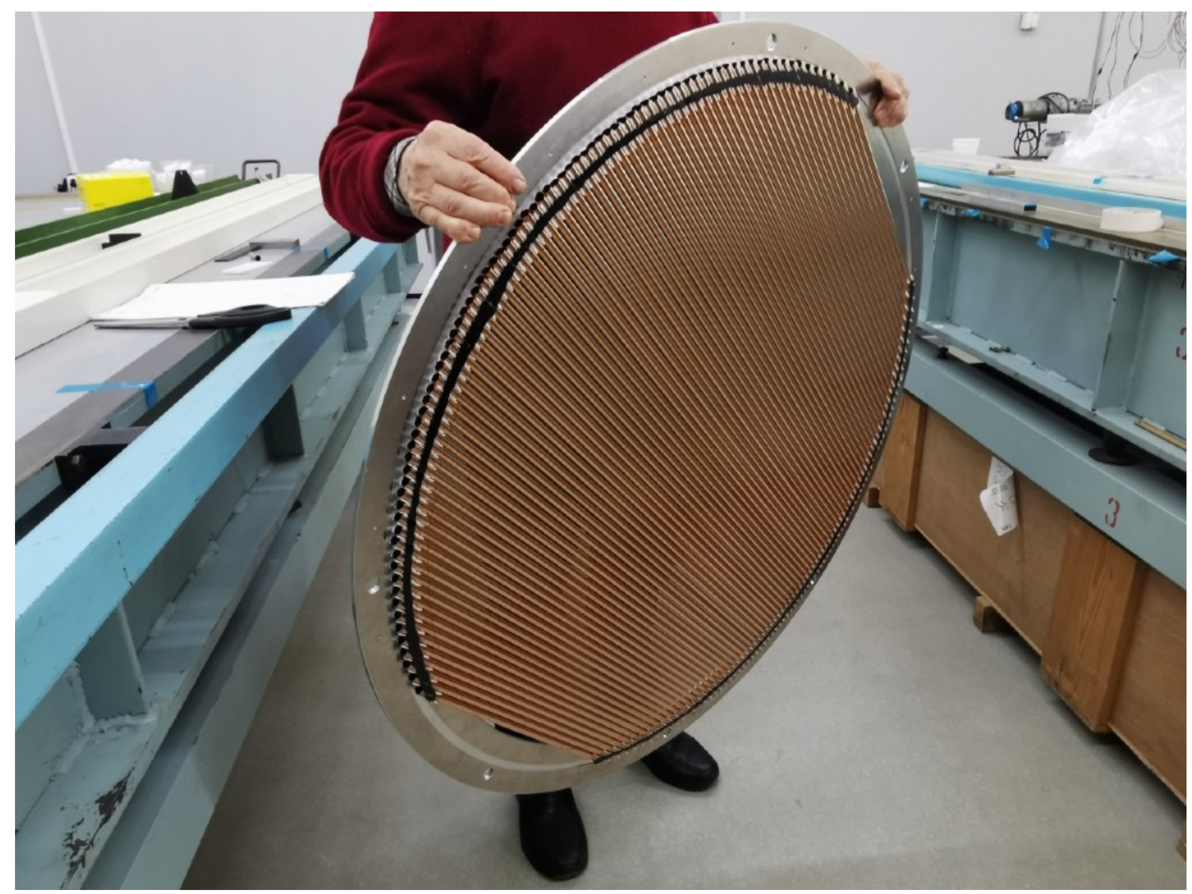
Progress on Straw-endcap







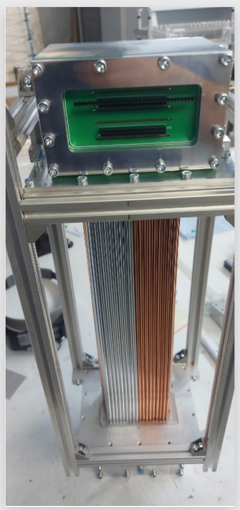
- The purpose of making the ∅=1 m prototype is to test the assembly technology:
    1. stretching straws before gluing them to the frame
    2. keep straws in a humid environment before gluing
- Behaviour of the tubes will be studied throughout the year in order to choose the best technology
- Fiberglass frame of full size ∅=1.6 m (including logements) will be ordered this year
- Assembling the full size prototype next year



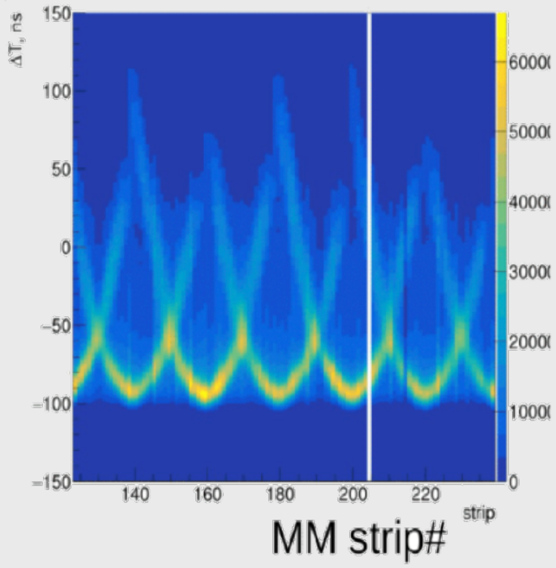
T.Enik and Co.

Progress on Straw-barrel

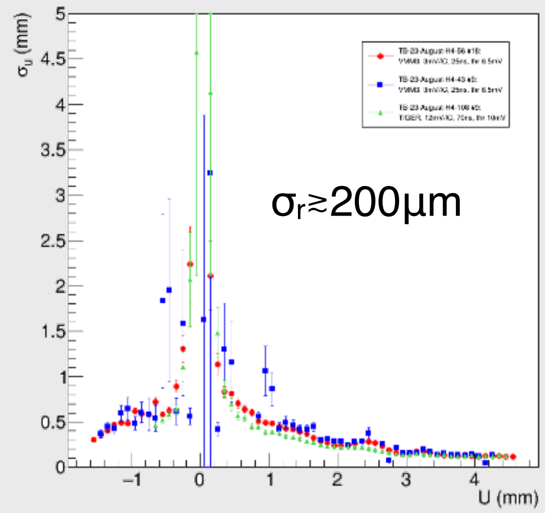
Analysis of the CERN testbeam data taken in 2023



R(t) for 10 mm straw



Space resolution vs R

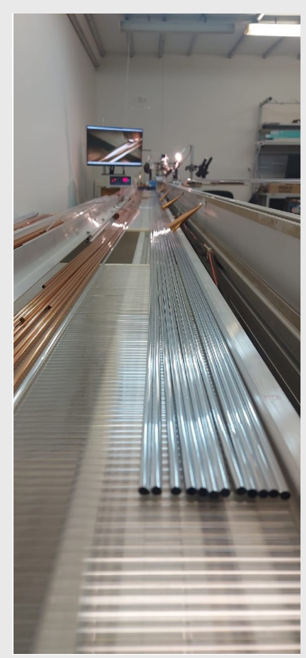


Plans for 2024

- Creating 2 straw tracker prototypes
- Restoration of the miniSPD stand
- Commissioning of electronics prototypes
- Participation in beam experiments on H4 SPS and PS in order to optimize FEE
- Elaboration of options for participation in accelerator beams at PNPI (Gatchina) and BINP (Almaty)
- Development of the gas supply system of the detector

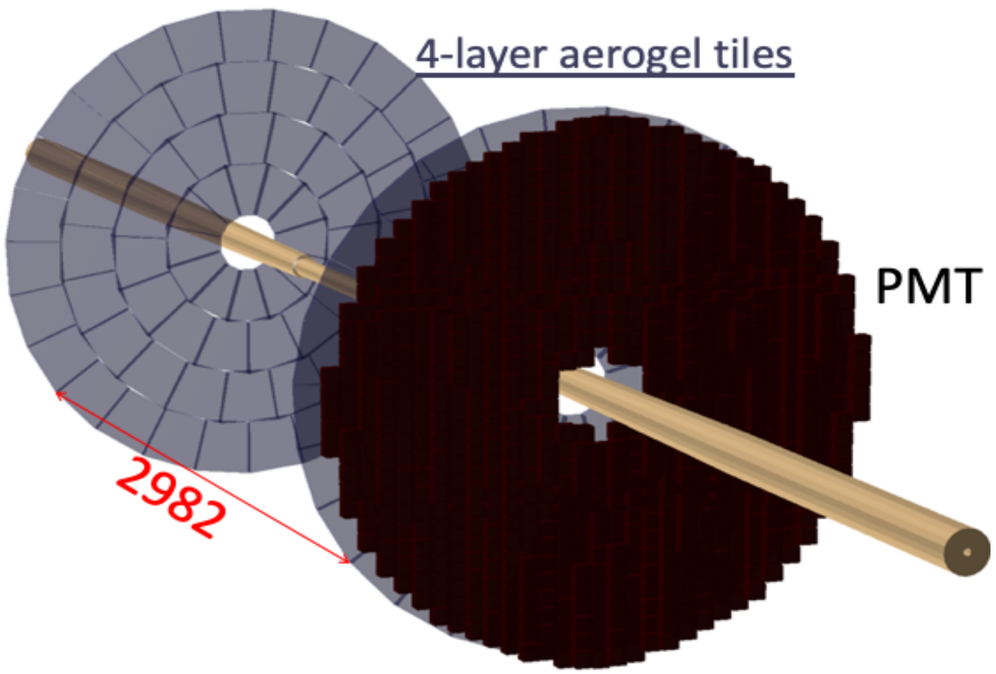
Production line and assembling place

- Area ~200 m^2, clean room ~100 m^2
- Production line length ~12 m
- Completion date: beginning of the 3rd quarter of 2024
- Commissioning works - beginning of the 4th quarter of 2024
- All necessary materials and equipment have been purchased
- Straw production speed ~1 m/min



A.Barnyakov

FARICH system of SPD

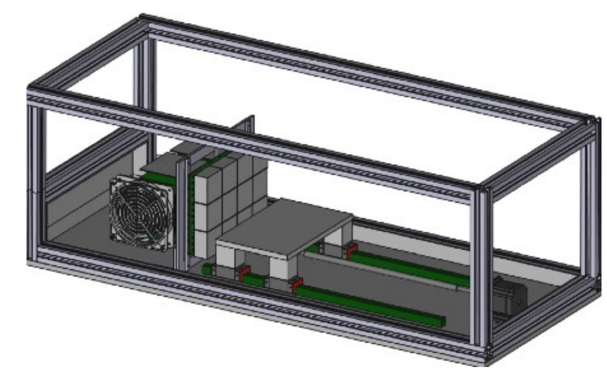


FARICH prototype (step #1 – 2024/25):

- 8÷9 PMTs with 6×6 mm² pixel
  - 4 MaPMT H12700 flat-panel (Hamamatsu)
  - 4 N6021 MCP PMTs (NNVT)
  - 1 Planacon XP851112 (Photonis)
- 2 DiRICH boards + TRB3 interface (GSI) to readout 768 pixels
- 4-layer aerogel 23×23×3.5 cm³, n_{max}=1.047, L_{sc}(400nm)≈60mm
- Relativistic e⁻ and mixed hadron beams

FARICH prototype (step #2 – 2025/26):

- 36 PMTs with 3×3 mm² pixel (Ekran FEP)
- 6 DiRICH boards + TRBv3 interface (GSI) to readout 2304 pixels



SPD – FARICH system concept

Aerogel:

- 2 end-caps × 74 tiles (4 form-factors)
- 4-layer focusing aerogel:
  - n_{max}≤1.05 (to be optimized soon)
  - Total thickness 35÷40 (to be optimized)
  - Focus distance ~20 cm

Position-sensitive MCP-PMT:

- 2 × 550 PMTs ~51×51 mm² (pixel 6×6 mm²), i.e. N6021 (NNVT)
- 2 × 2200 PMTs ~31×31 mm² (pixel 3×3 mm²) from Ekran FEP (soon)

- Implementation of FARICH simulation in SPD framework is going now
- Development of software for events reconstruction in FARICH is started

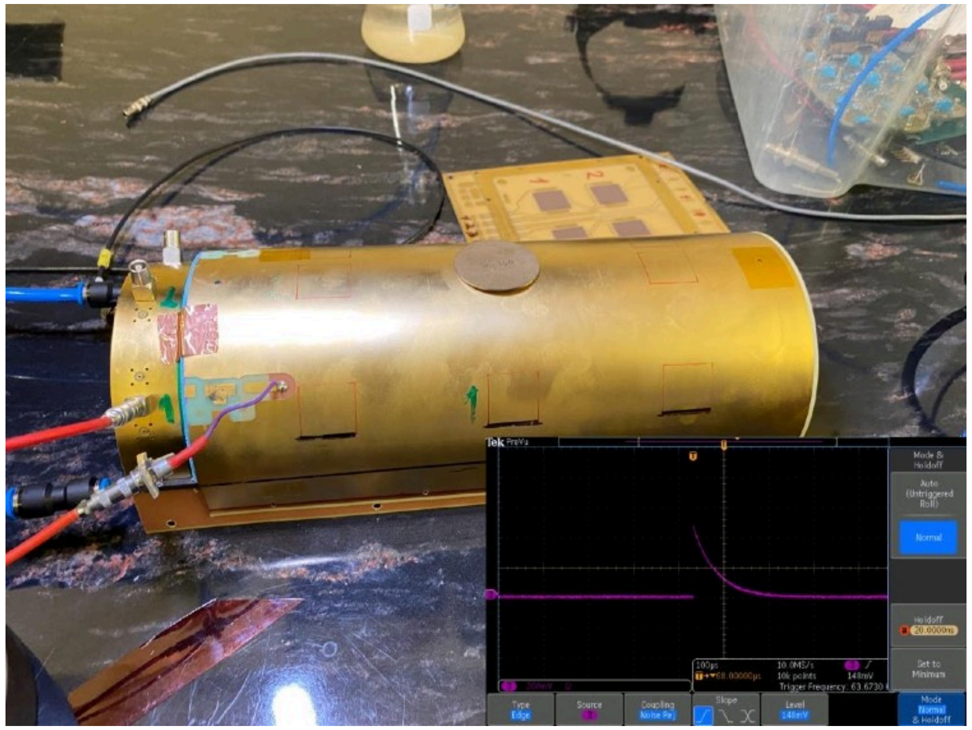
TO BE Started soon:

- R&D on proper and available readout electronics
- Design of mechanics for the FARICH system and its electronics cooling

D.Dedovich

Progress on MicroMegas central tracker

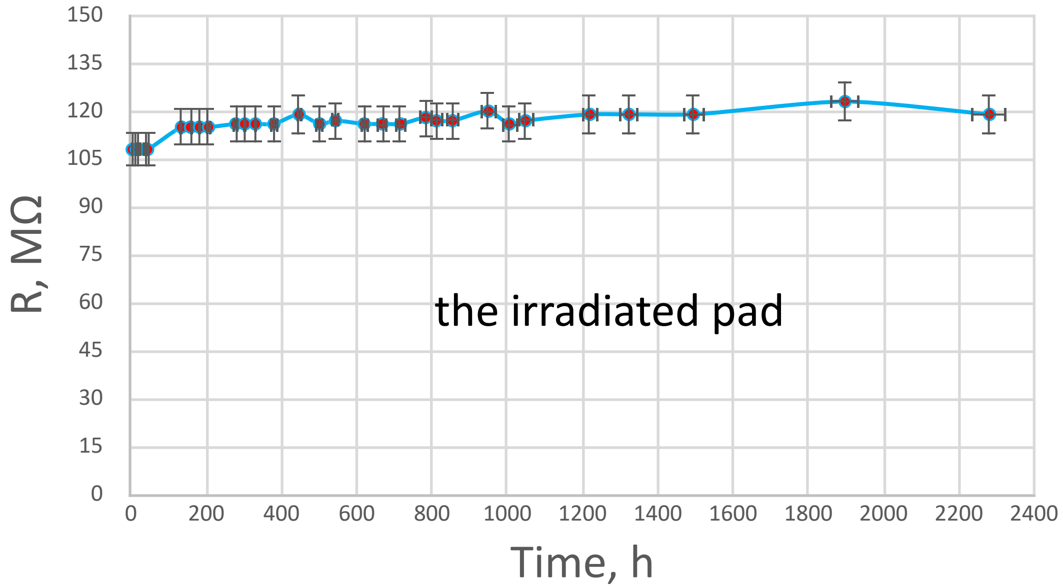
First prototype of cylindrical MM chamber

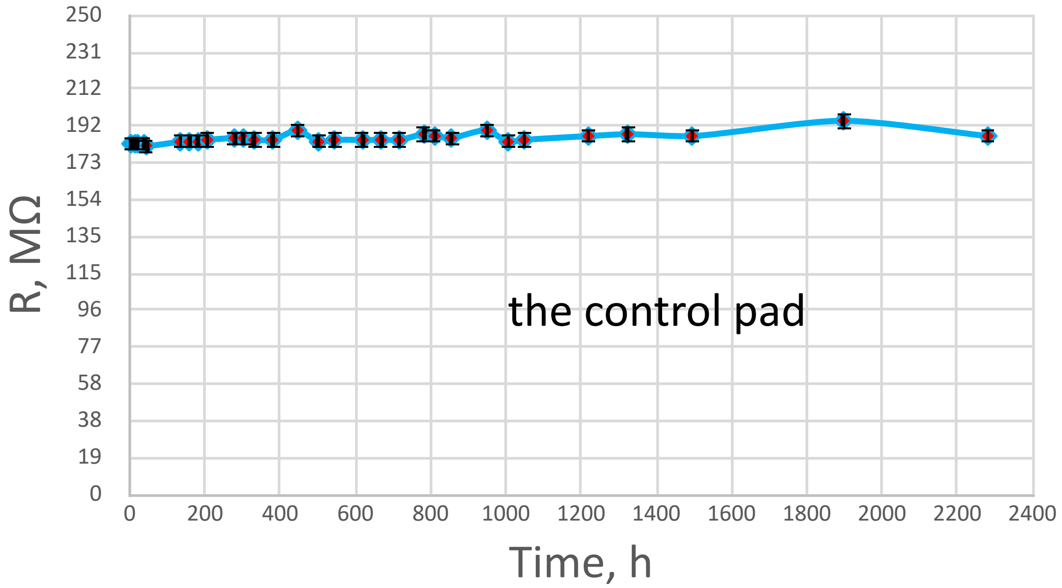


- Stable operation at gas gain above 10^4
- Good gain and breaking voltage uniformity

- Long-term test of DLC (Diamond Like Carbon) degradation due to discharge is completed
- No significant signs of degradation is observed
- Total discharge number ~9×10^8, equivalent of 7 Hz/cm² for 2 years of operation

Resistance of DLC coating layer for the irradiated and control samples

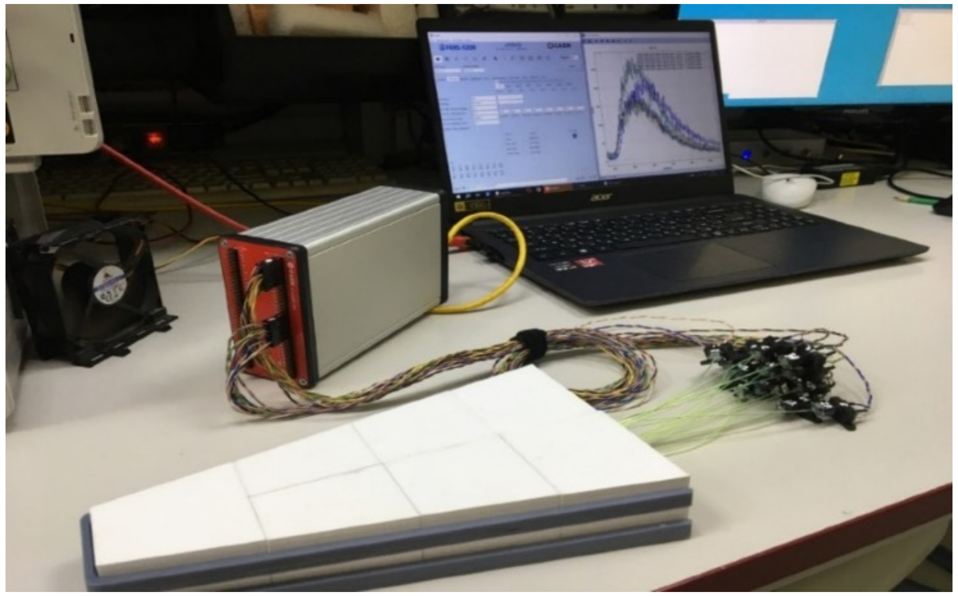




V.Ladygin
A.Tishevsky

Progress in developing the BBC detector

View of two sectors



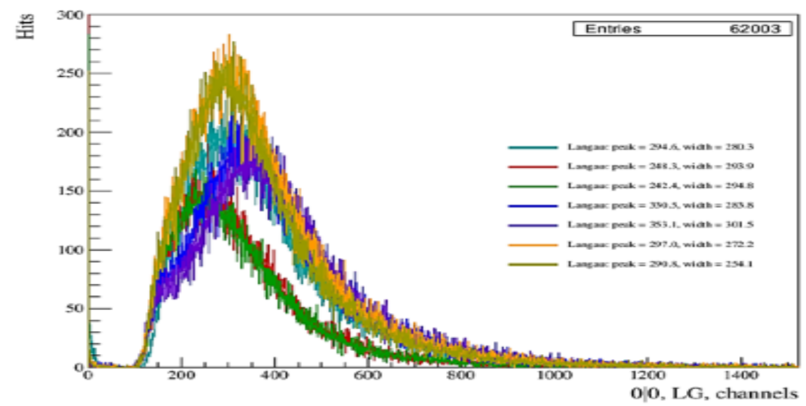
Selected options:

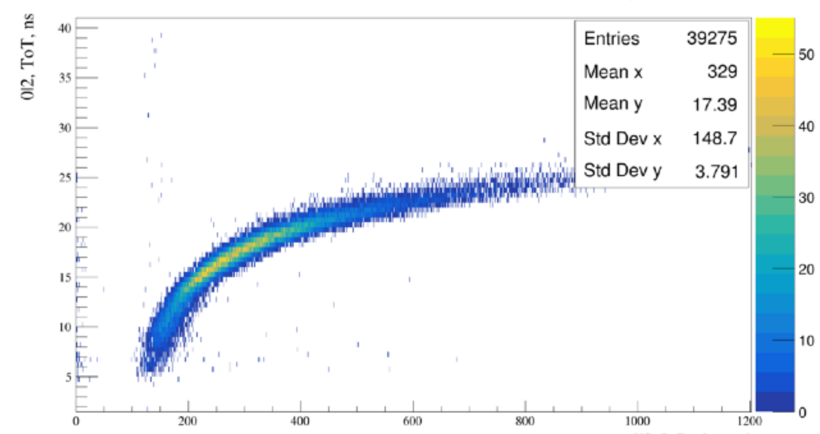
Scintillator: Uniplast-Vladimir (chemical mating)

Optical cement: CKTN Med mark B

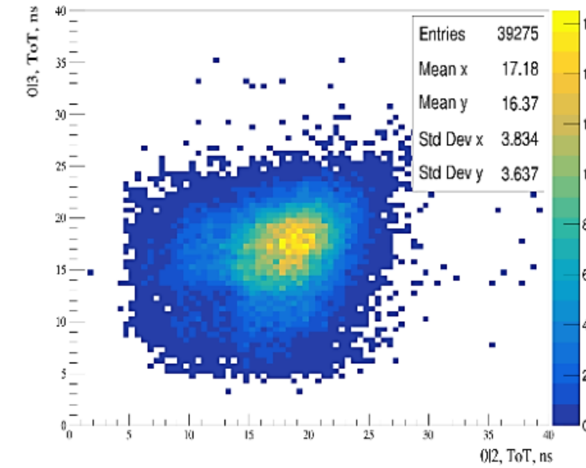
Fibers: Saint-Gobain Crystals (SG92S)

SiPMs: SensL 1x1 mm²

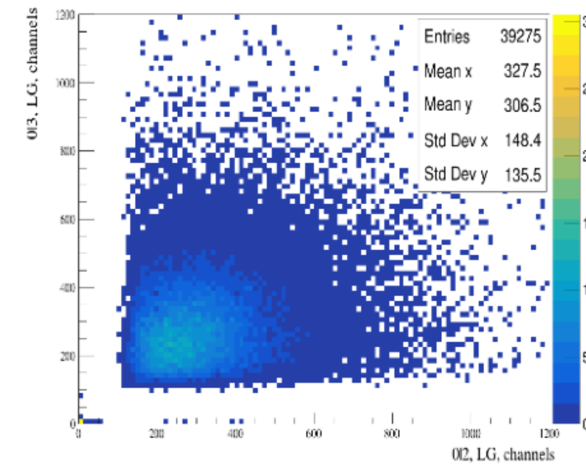




ToT correlations

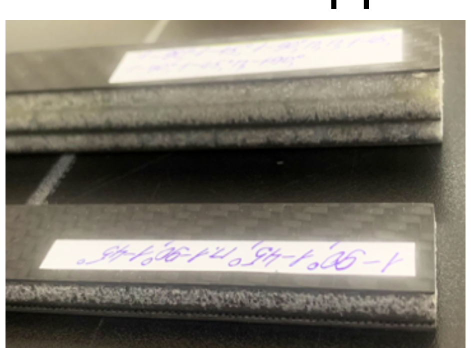


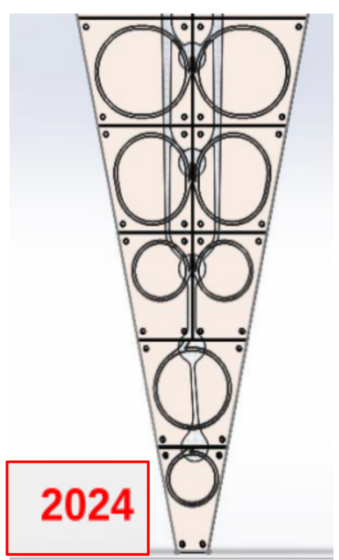
LG correlations



The 8-th tile is produced

Sandwich support





- ❑ The R&D phase for the scintillation tiles is almost finished.
- ❑ The main task for 2024 is to produce and to test the 8 tiles prototypes.
- ❑ The manufacture of 2 small BBC wheels (128 tiles each) for SPD-Phase 0 is planned for the end of 2024.

I.Alekseev

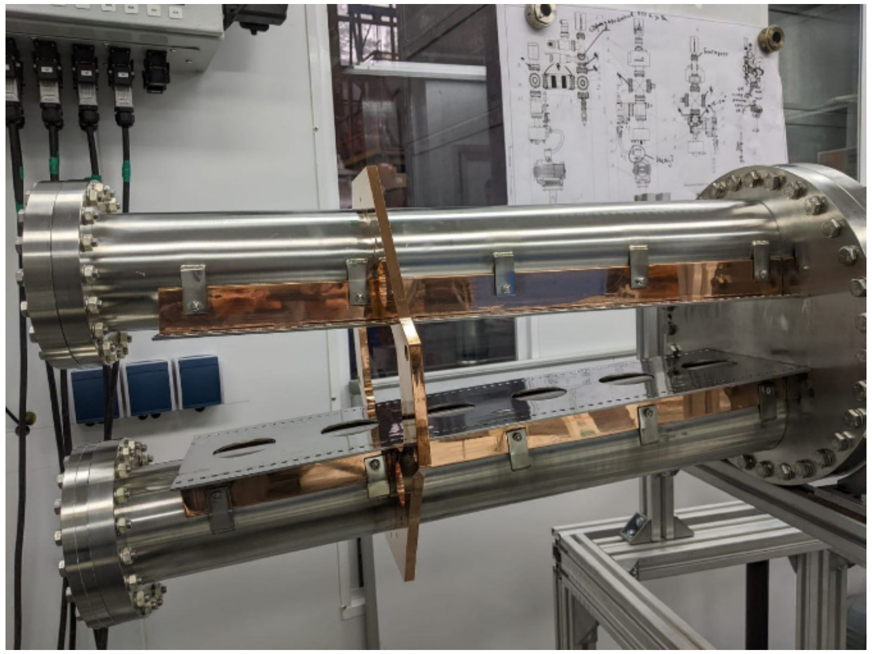
Progress in developing the ZDC detector

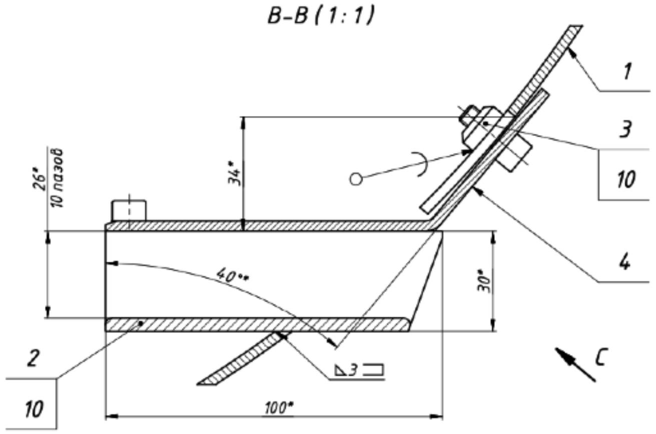
➔ Beam pipe sections for the ZDC (Y-sections) are received in JINR early October 2023. Tested by vacuum group, but still not inserted into cryostat. The place for ZDC is fine and well acceptable for installation.

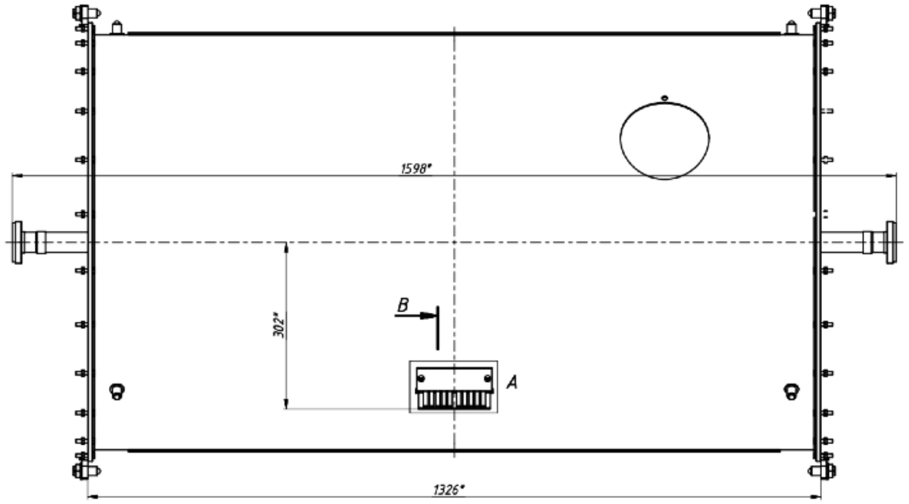
➔ The next step is a modification of the nitrogen screen so it would be possible to install signal cables later. In the full design we need to have 30 cables of 32 twisted pairs each for each calorimeter. Only one side of the screen can be modified for cables because the other has slits required for pumping.

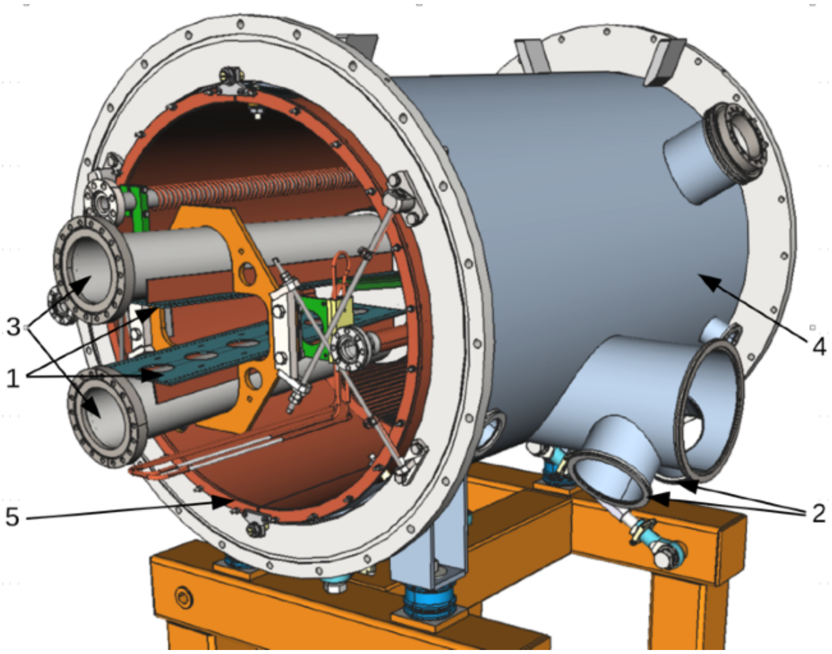
➔The cables will be terminated on both sides with D-sub 78 pins connectors DHS-78F. The feedthrough from the vacuum will be made by printed circuit boards glued with epoxy into special cylindrical extension of the flange.

➔For the initial test two ZDC planes with 31 scintillator tiles (no tiles in the corners) is being developed. Tiles of two different thicknesses 5 and 3 mm have been manufactured.









Yu.Gusakov

Progress in development

- (green) - is ongoing well (proven technology or successful R&D), not state of readiness
- (red) - open issue (to be defined or developed), at a conceptual level now

	Magnet (phase I)	RS (phase I)	ECal	Straw tracker (phase I)	TOF	FARICH
Power frame (mechanics)	contract for development of documentation	communication with manufacturer has begun	not decided yet	conceptual design		
Active part of the detector	based on the PANDA magnet		interest from Tsinghua Uni		interest from Tsinghua Uni	R&D in progress
Readout & control electronics		final phase of development				

	MicoMegas (phase I)	DSSD	MAPS	BBC (phase I)	BBC-MCP (phase I)	ZDC (phase I)
Power frame (mechanics)	3D model?	3D model provided by the group			to be confirmed by accelerator team	
Active part of the detector	R&D in progress					R&D in progress
Readout & control electronics	VMM3?			purchased		

FEE, DAQ on Monday after lunch →

16:00	Coffee break		16:00 - 16:30
	Current status of DAQ system	Dr Leonid Afanasyev	16:30 - 16:50
17:00	First prototype of L1 concentrator	Александр Бойков	16:50 - 17:10
	Status of firmware development for L2 concentrator	Vladislav Borchsh	17:10 - 17:30
	Current status of TSS development. TSS control protocol	Nikita Makarevich	17:30 - 17:50

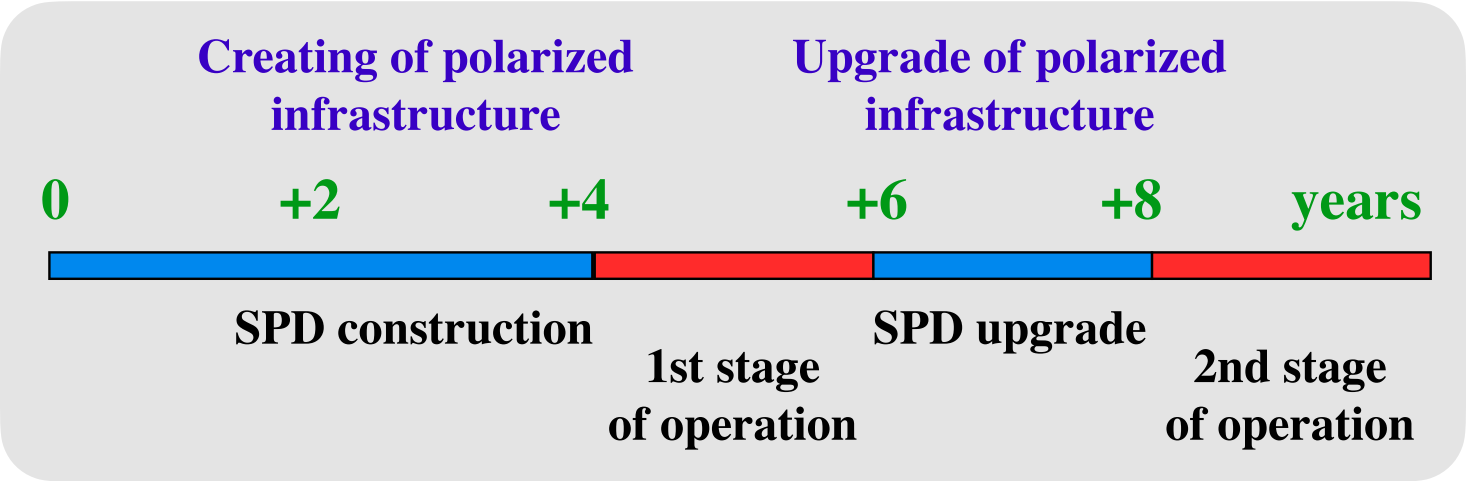
Magnet & detectors on Tuesday

10:00	Status of the SPD superconductive solenoid development	Sergey Pivovarov	10:00 - 10:18
	The cryogenic distribution box of the SPD superconductive solenoid	Tatiana Bedareva	10:18 - 10:36
	Power supply and energy extraction system of the SPD solenoid	Aleksandr Erokhin	10:36 - 10:54
11:00	Magnetic analysis of the SPD superconductive solenoid	Evgeny Antokhin	10:54 - 11:12
	Cryogenic system	Andrey Ponomarev	11:12 - 11:30
	Coffee break		11:30 - 12:00
12:00	RS status report	Guennadi Alexeev	12:00 - 12:20
	ECal status report	Oleg Gavrishchuk et al.	12:20 - 12:40
	TOF status report	Valery Chmill	12:40 - 13:00
13:00	Lunch break		13:00 - 14:00

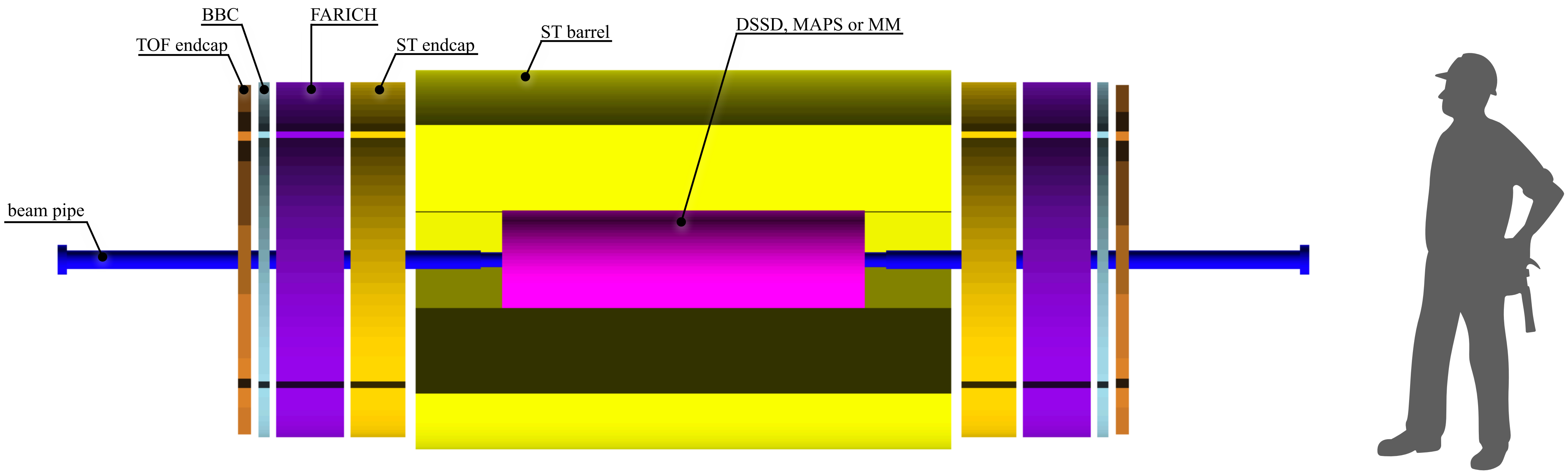
14:00	Straw-Barrel status report	Temur Enik	14:00 - 14:20
	Straw-Endcap status report	Viktor Kramorenko	14:20 - 14:40
	Application of the CAEN front-end readout system on the miniSPD facility	Sergei Romakhov	14:40 - 15:00
15:00	Development of FARICH detector for the SPD experiment: status and prospects	Alexander Barbyakov	15:00 - 15:20
	Coffee break		15:20 - 15:50
16:00	BBC status report	Aleksey Tishevsky	15:50 - 16:10
	Study on the BBC improvement in MEPhI	Peter Teterin	16:10 - 16:30
	BBC-MCP Detectors in the SPD experiment	Andrei Safonov	16:30 - 16:50
17:00	MicroMegas status report	Dmitry Dedovich	16:50 - 17:10
	ZDC status report	Igor Alekseev	17:10 - 17:30

Concluding remarks

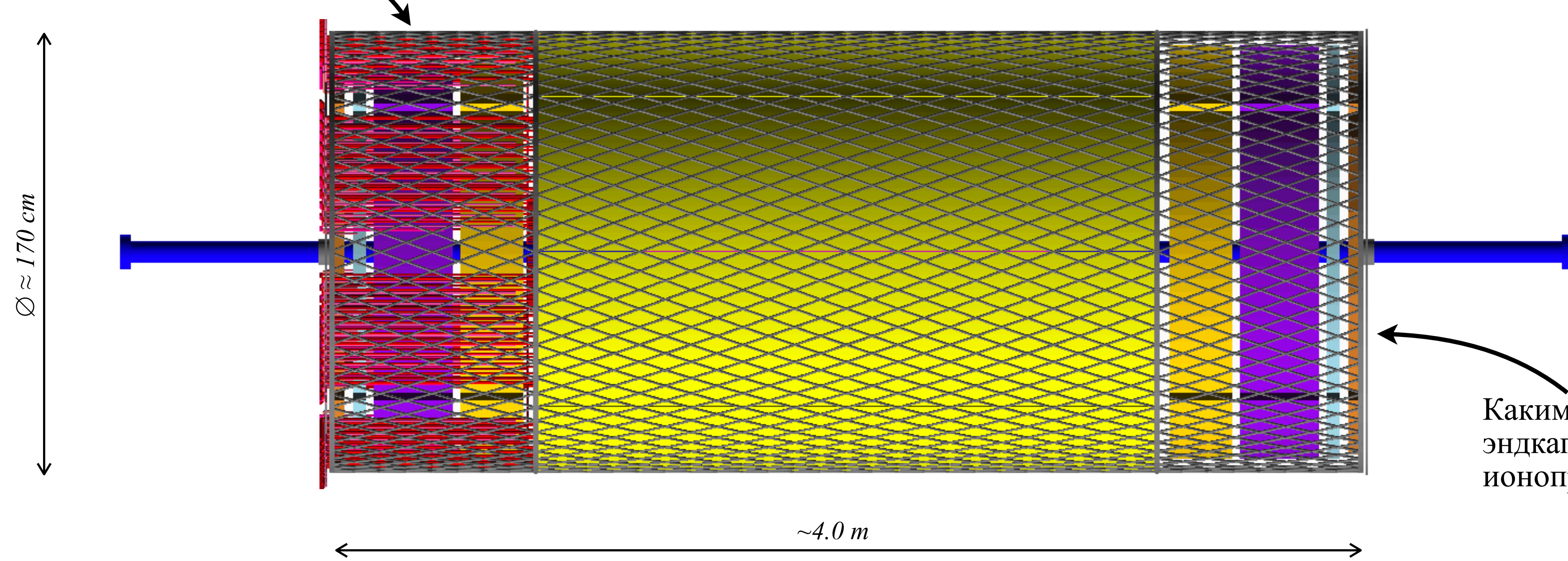
- Some progress is being made in many subsystems
- Special attention should be paid to the detectors of the 1st stage of the experiment
  - Lack of qualified engineering personnel capable of doing the work
- According to original plans, only 4 years left before the datataking starts. Clear planning required from corresponding groups.



backup



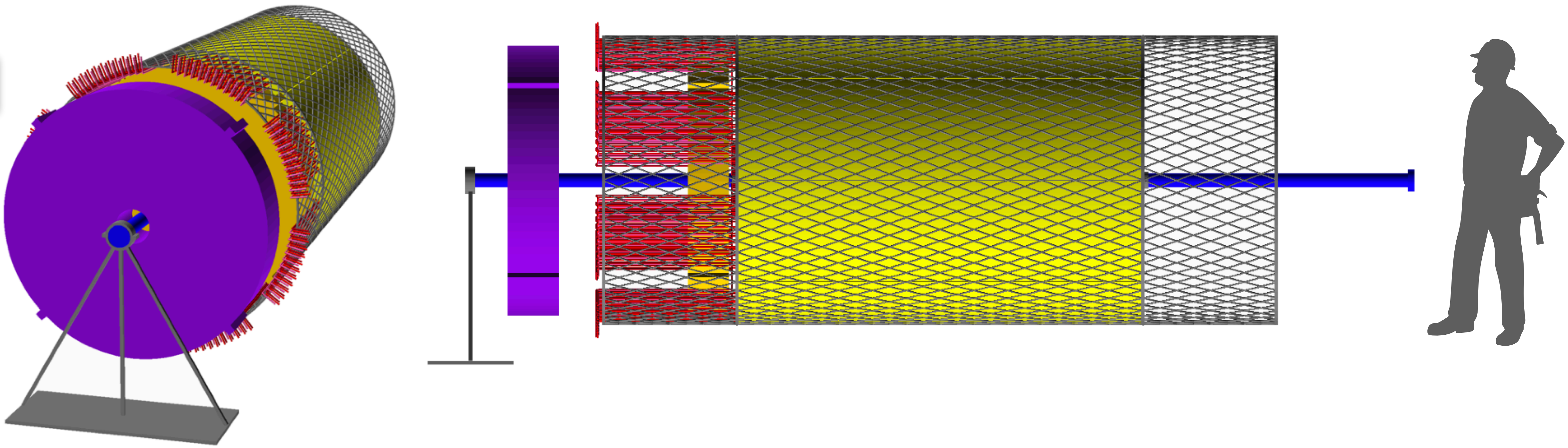
Каким образом вывести коммуникации со всех детекторов?



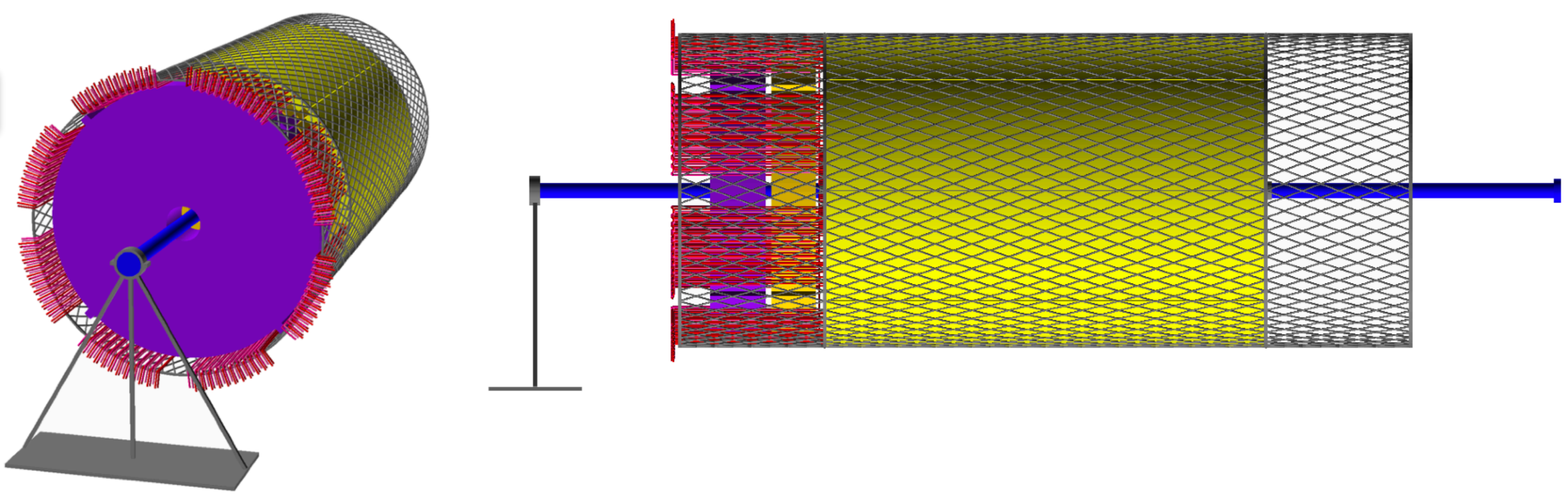
Каким образом устанавливать эндкапы, не повредив трубу ионопровода?

Монтаж FARICH

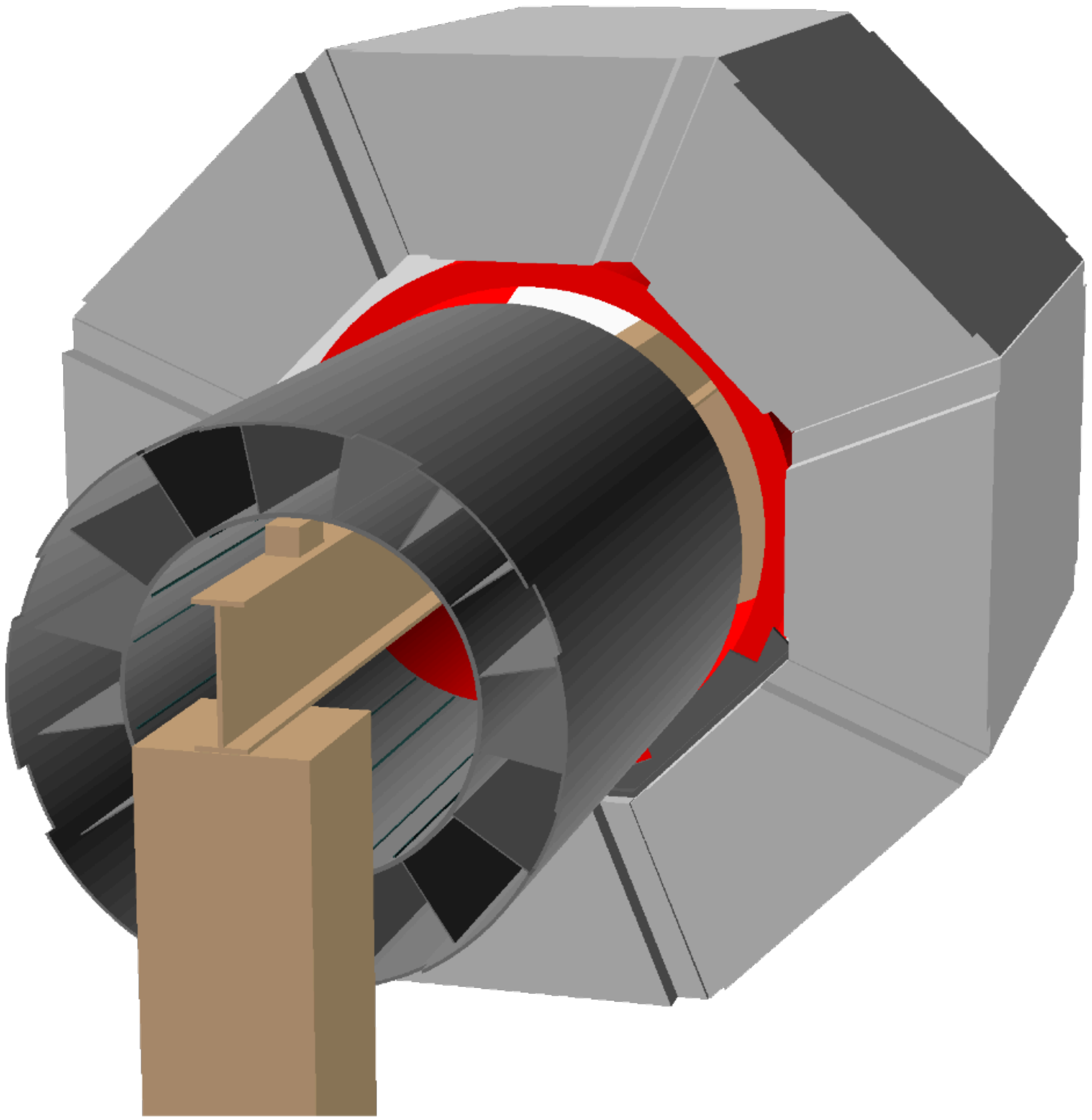
2



4

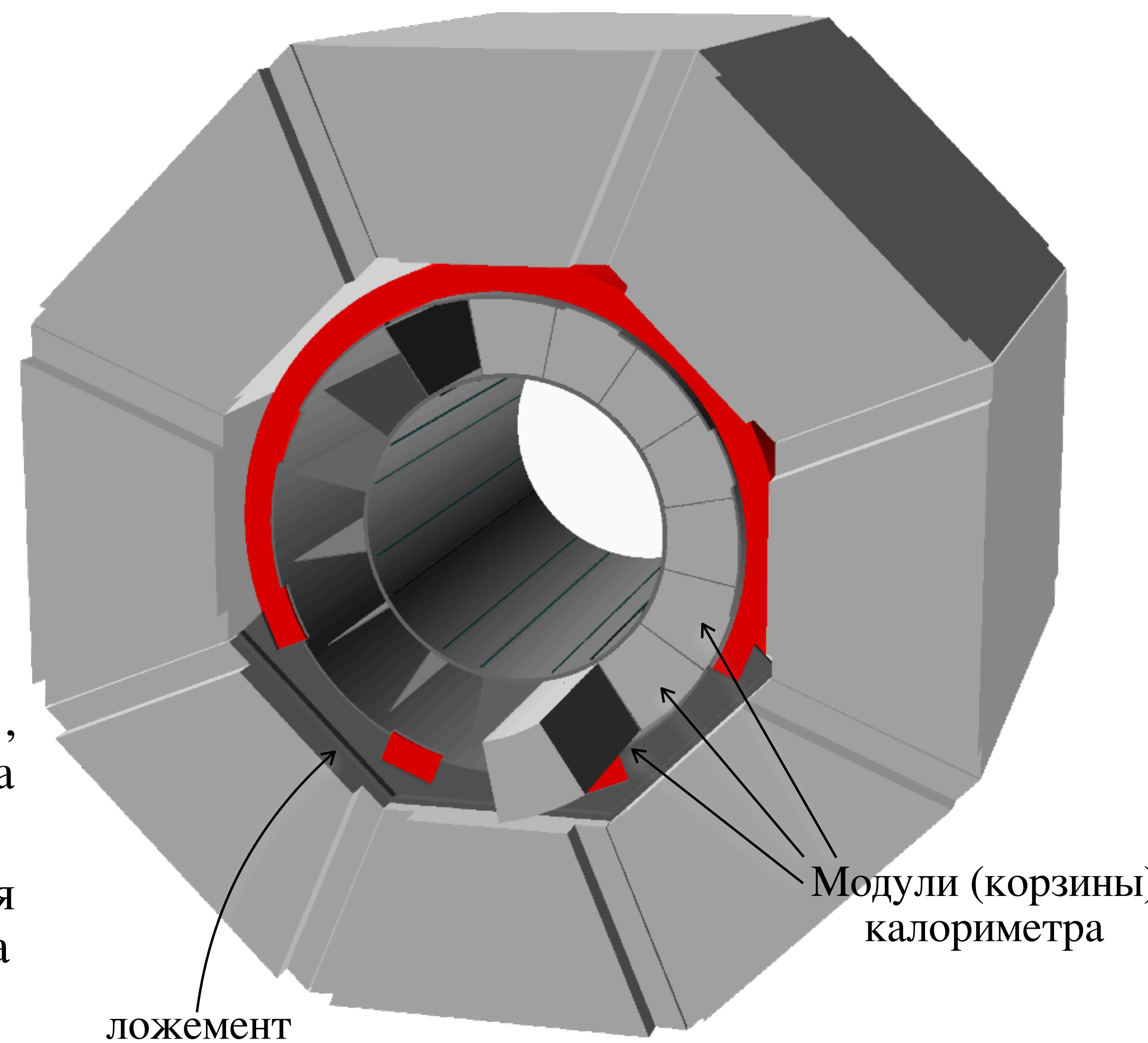


Бочка ECal в SPD



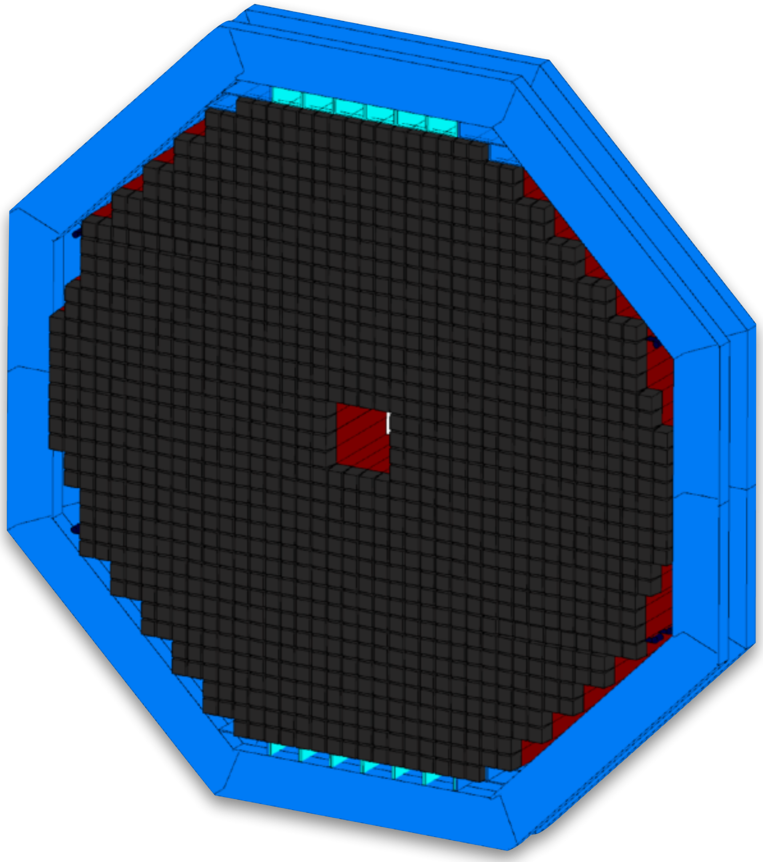
- Каркас калориметра загружается тем же методом, что и магнит

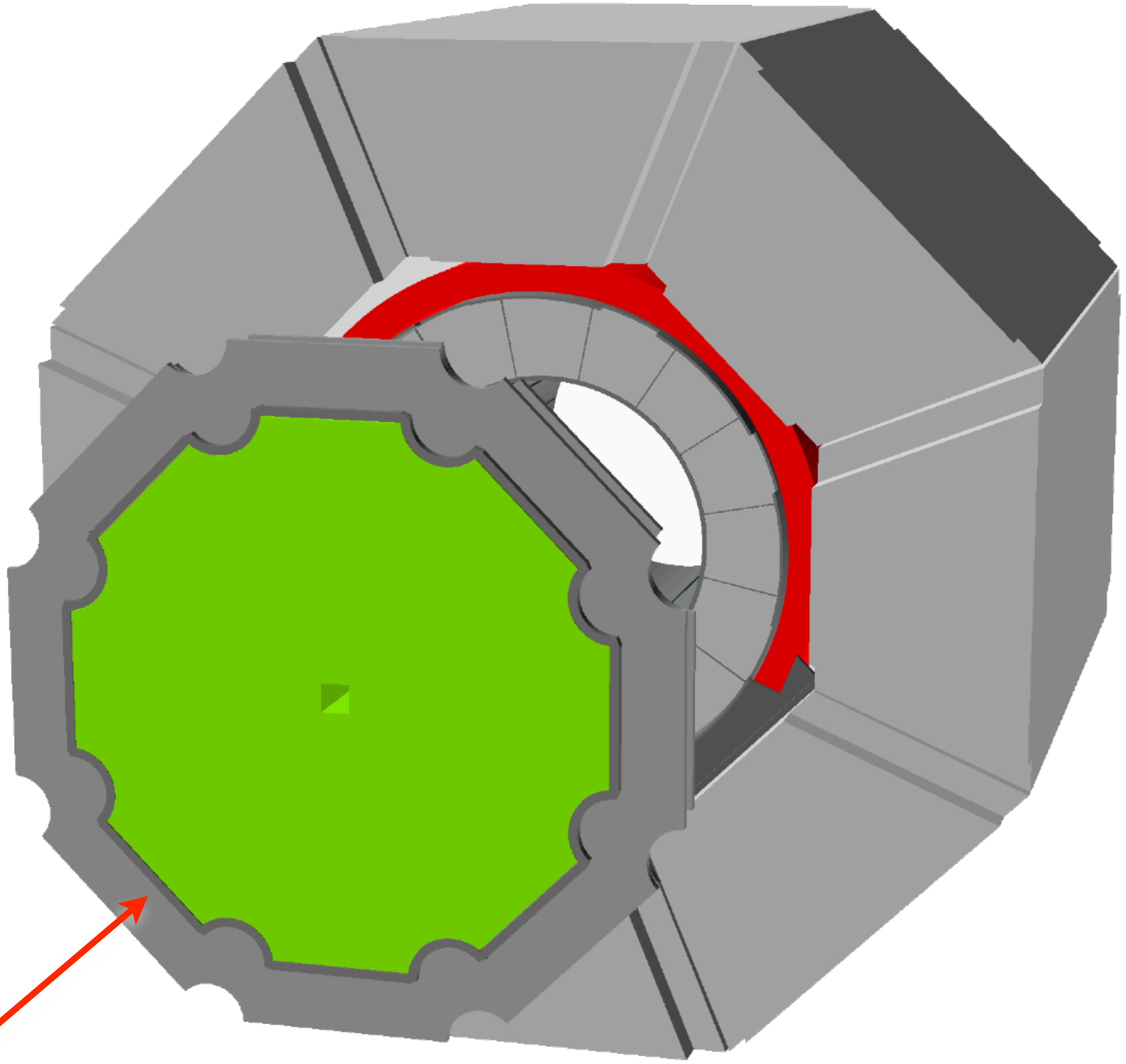
- Каркас опирается на ложемент, установленный на торцах. Магнита он не касается
- Модули калориметра загружаются по очереди, независимо друг от друга



Эндкапы ECal в SPD

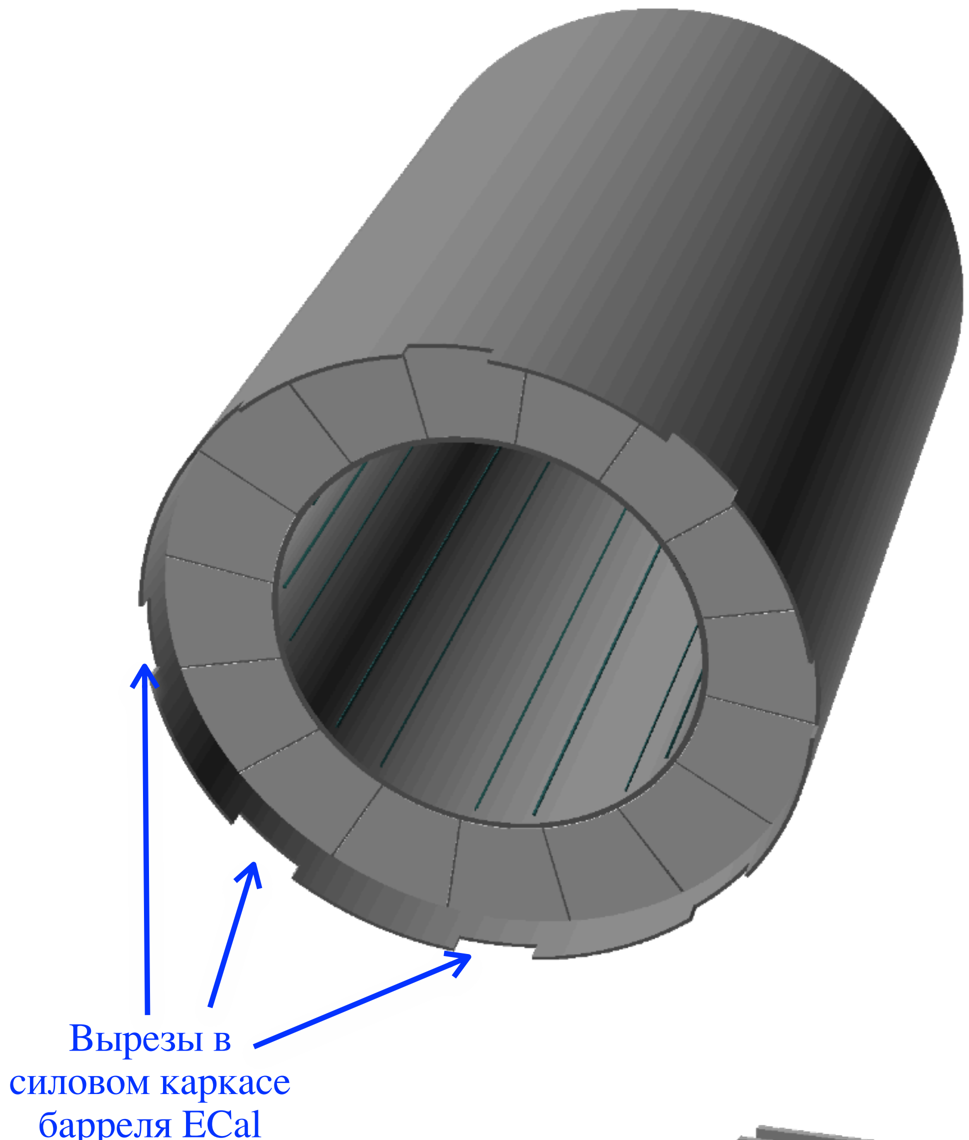
Модель эндкапа ECal **<u>без</u>** кабельных каналов

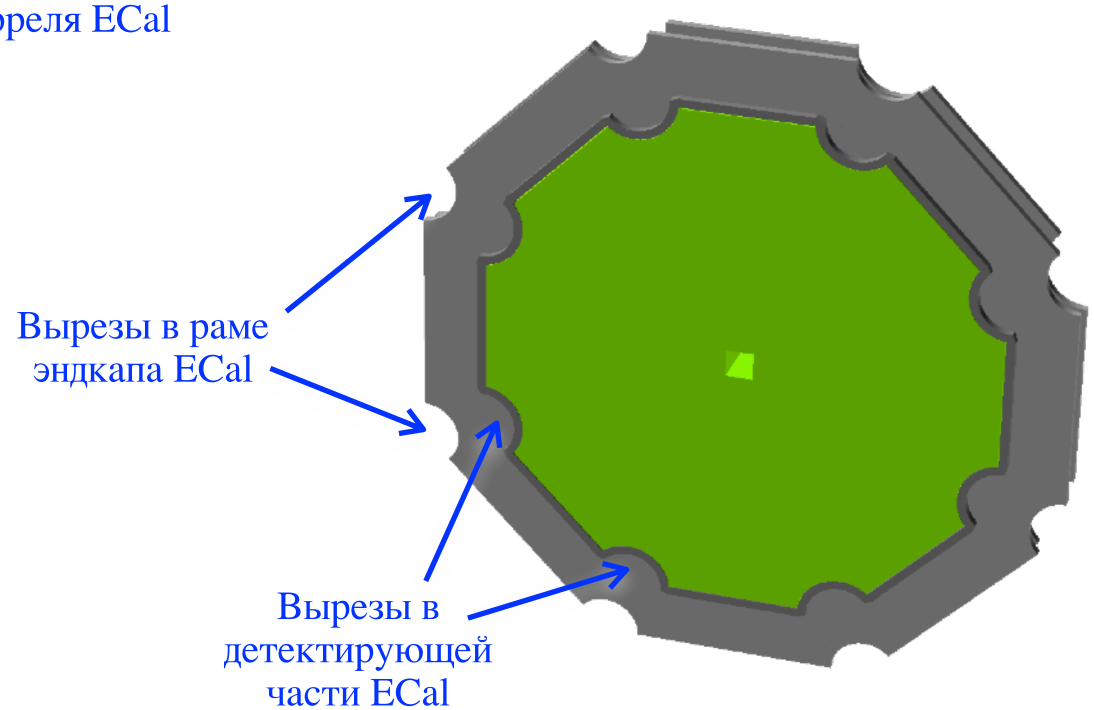


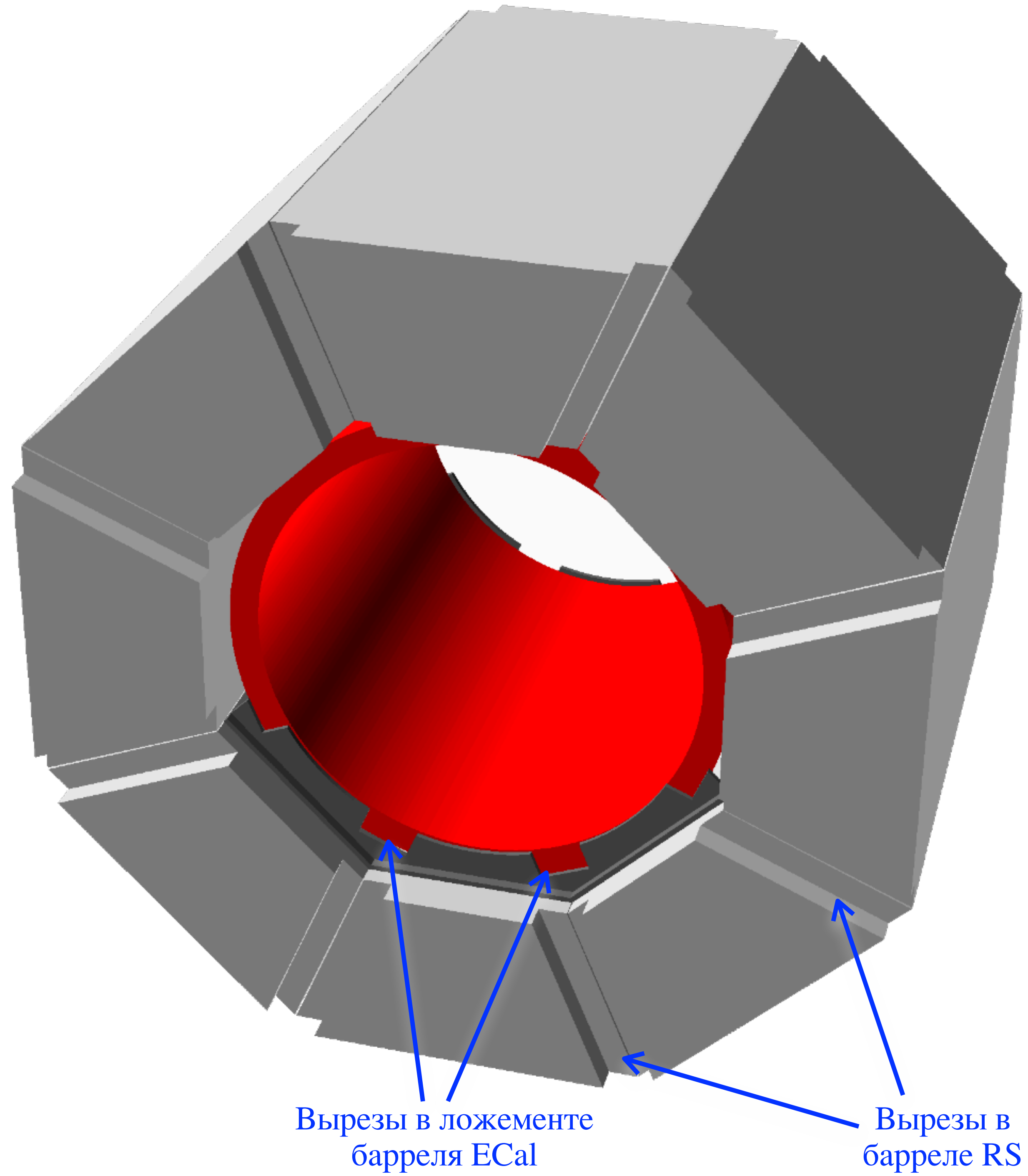


Эндкап ECal **<u>с</u>** кабельными каналами

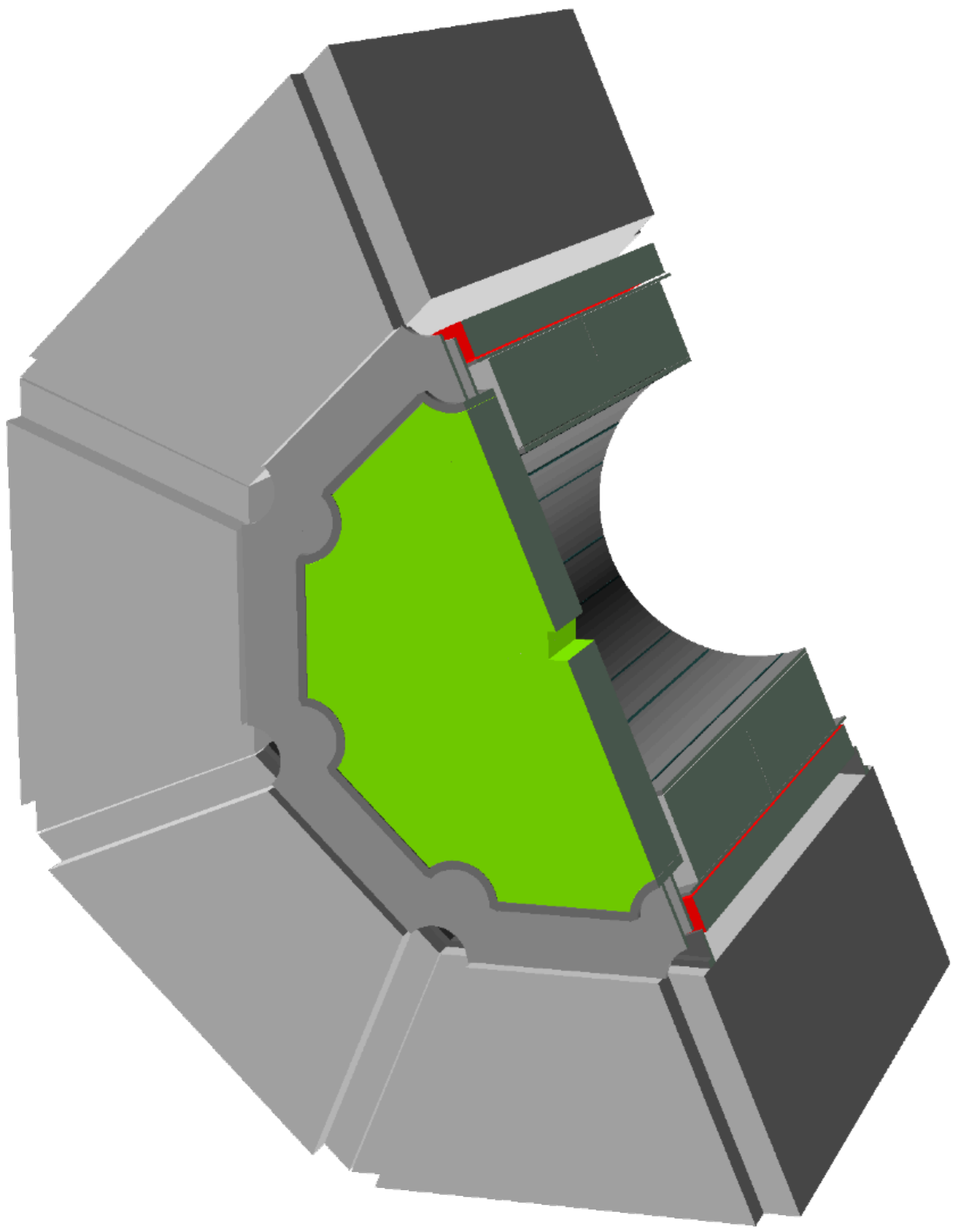
Кабельные каналы

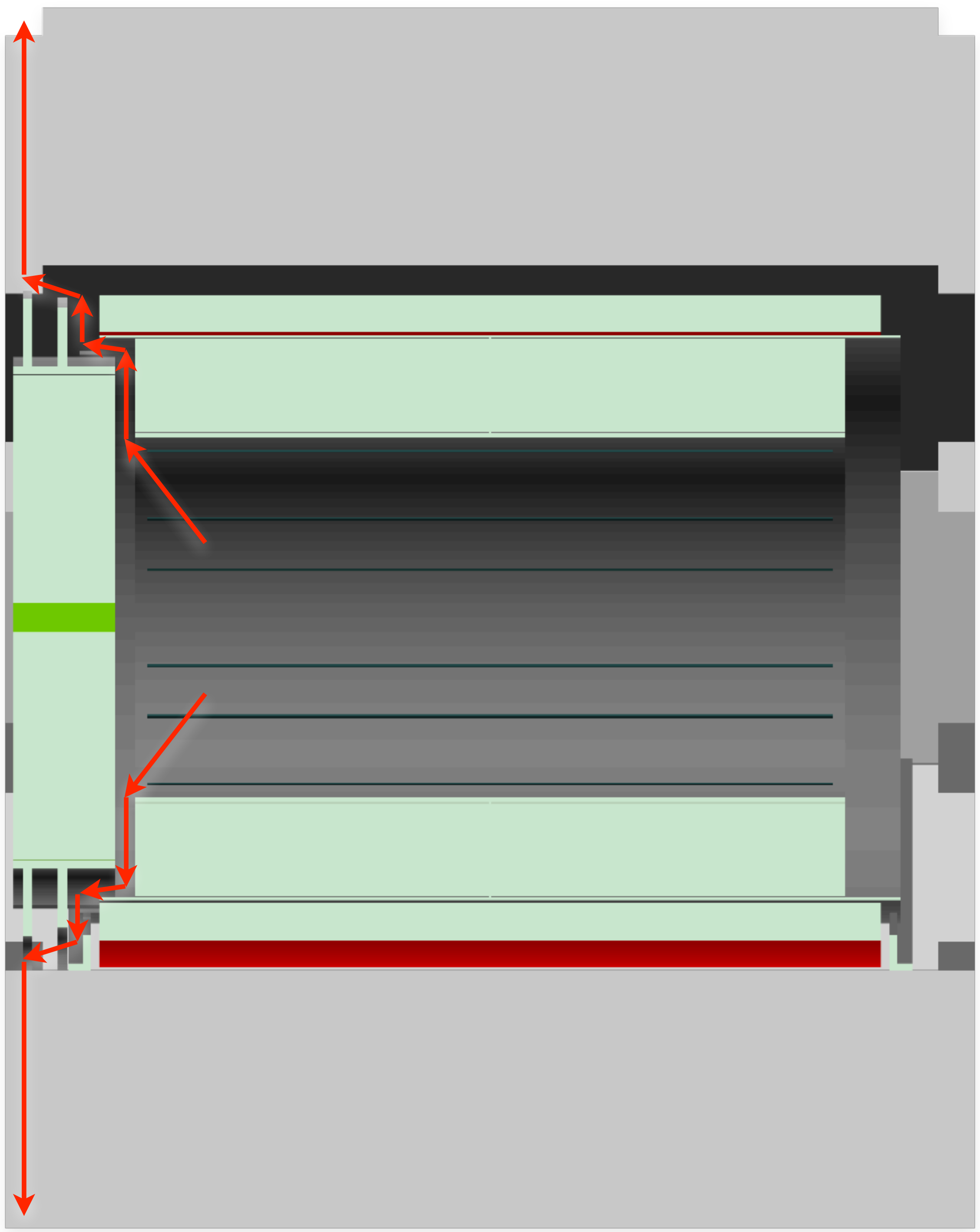






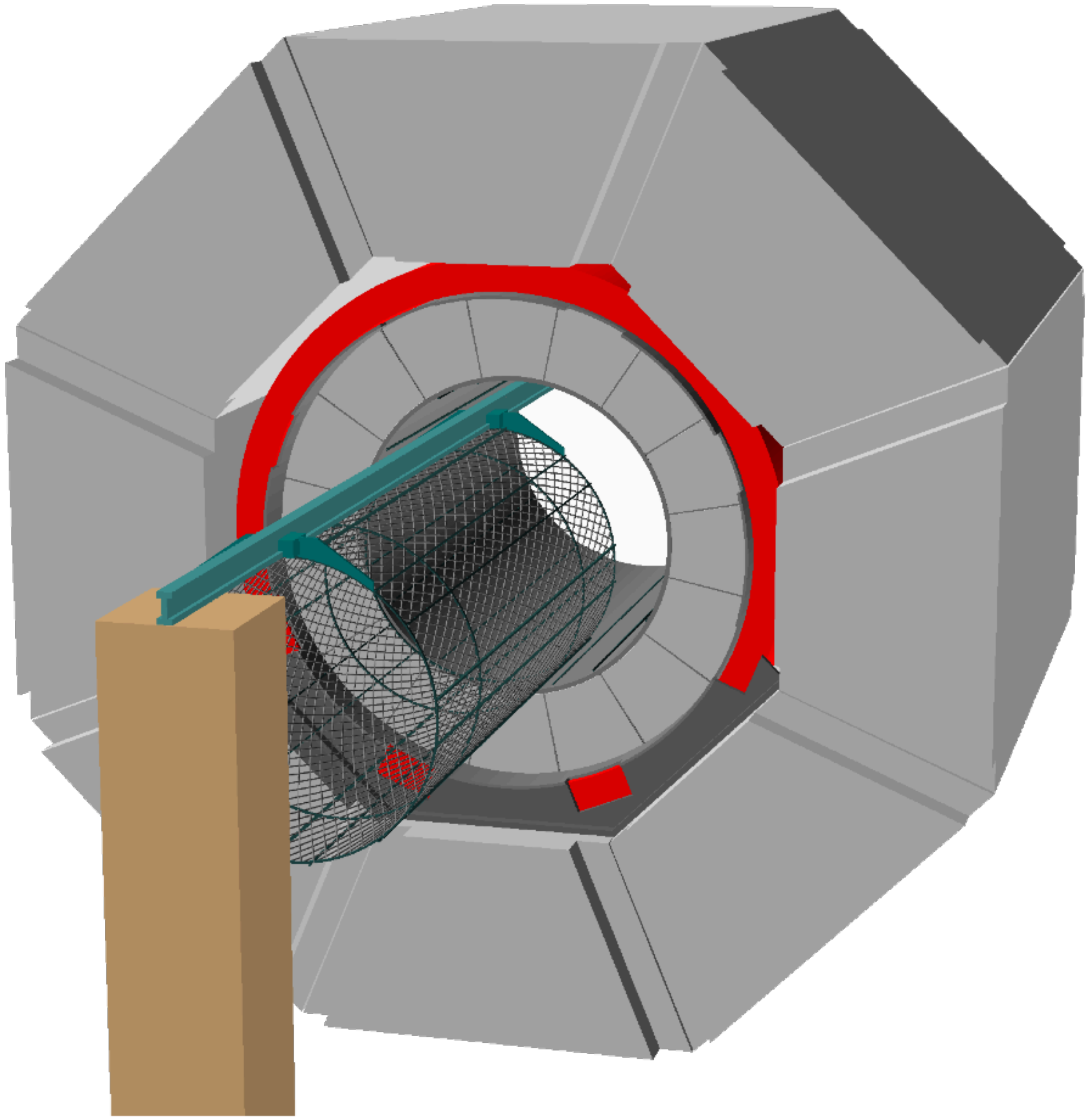
Кабельные каналы



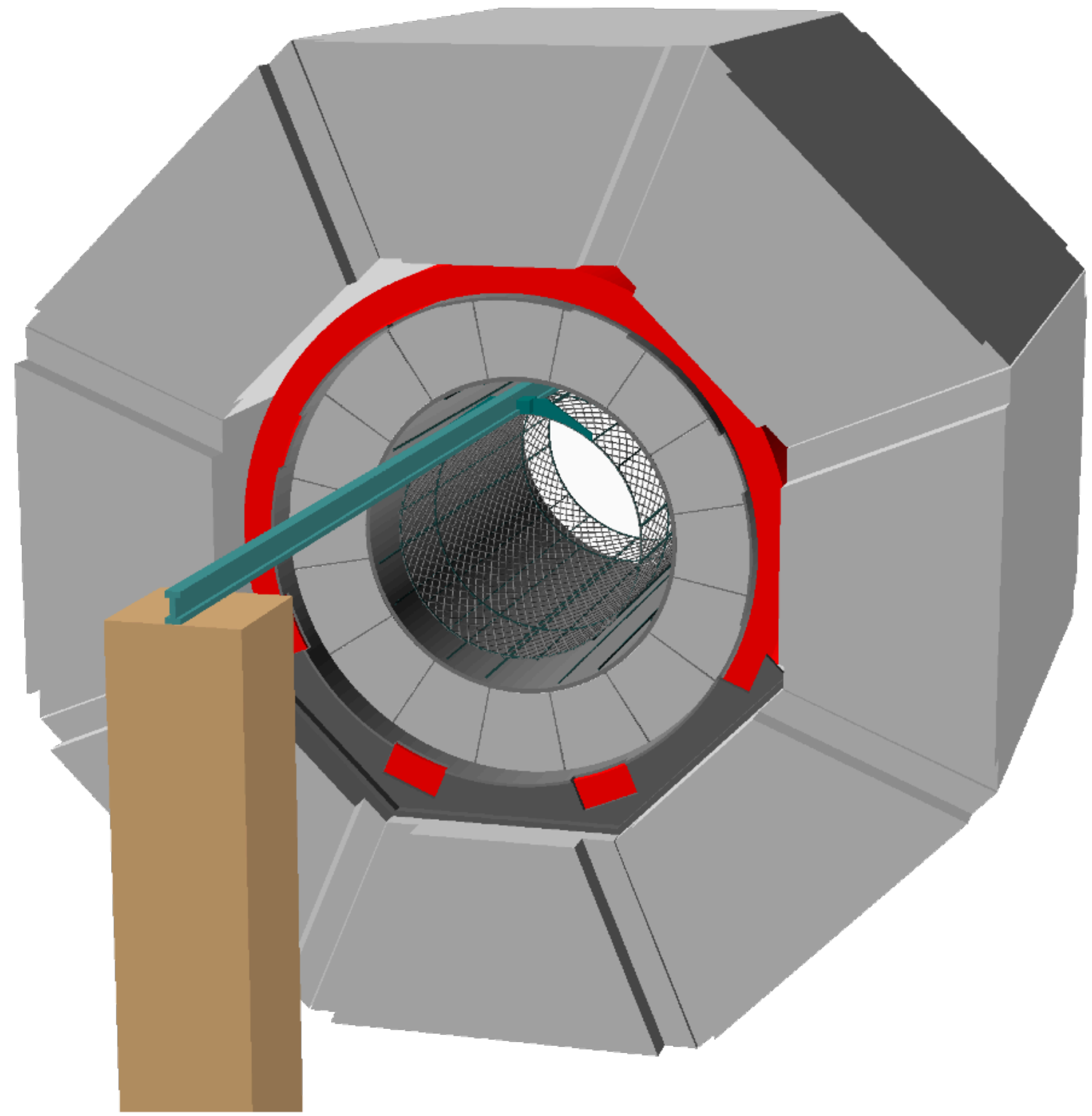


Установка бочки Straw

Положение снаружи



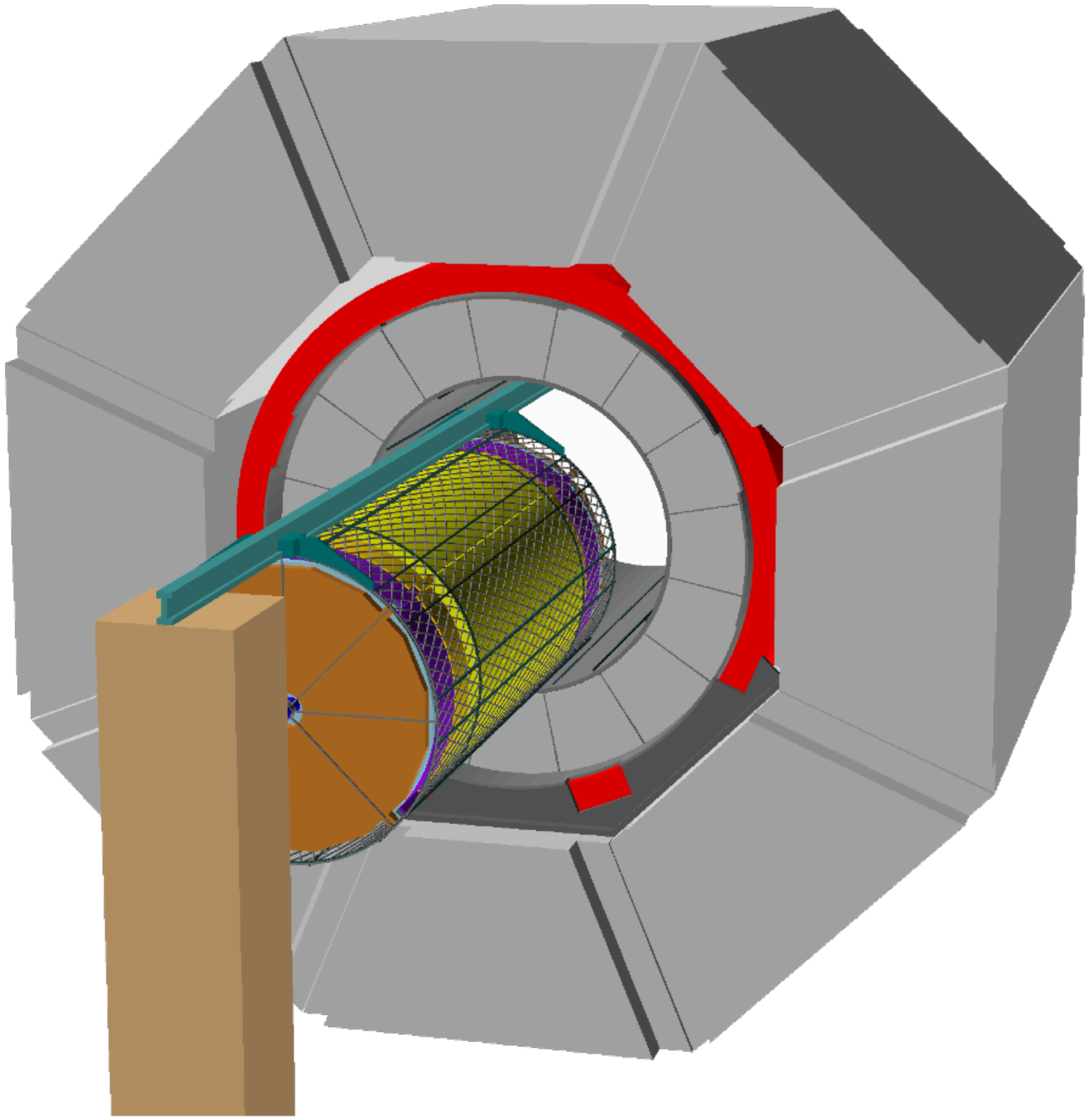
Положение внутри



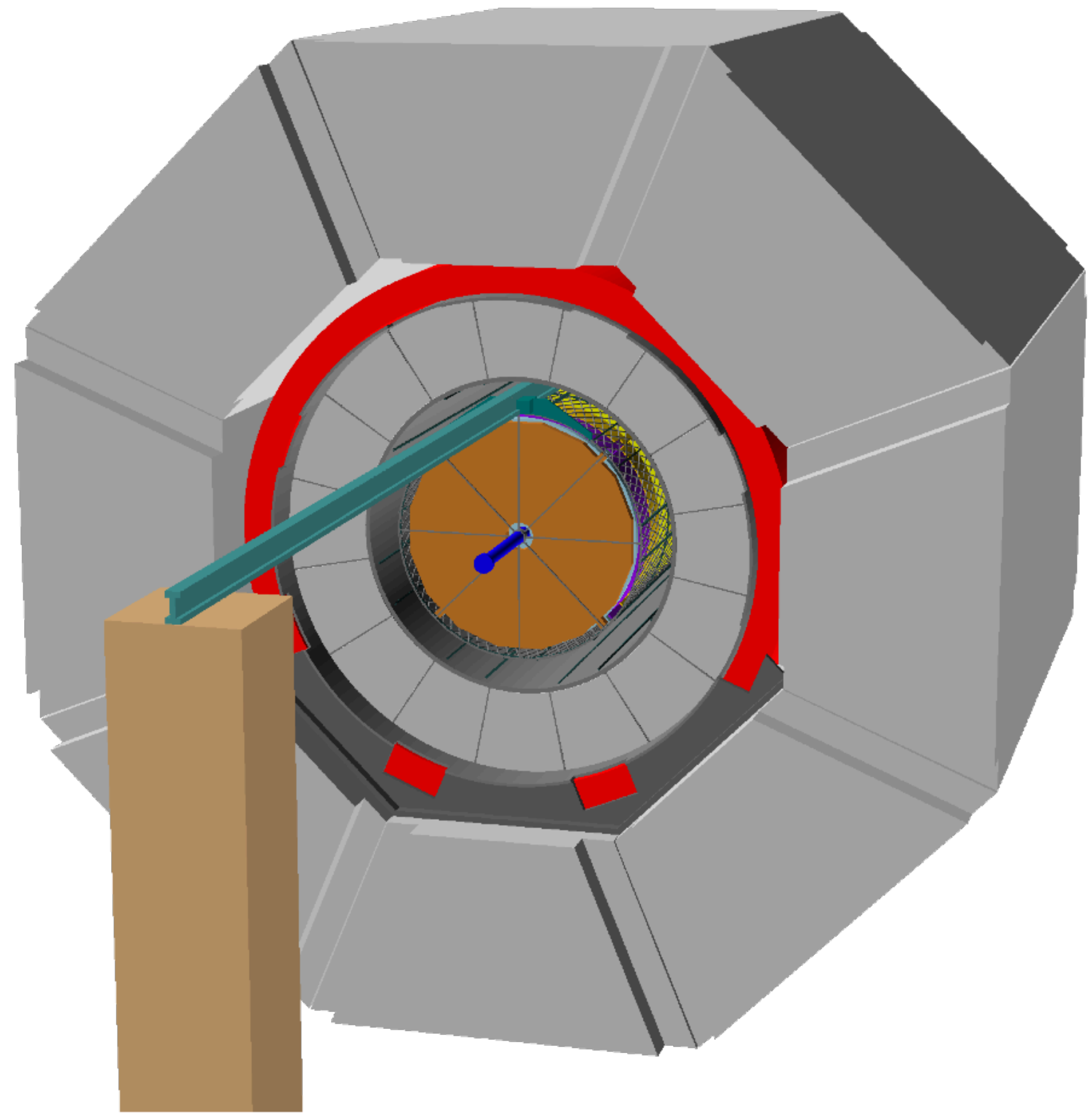
- Устанавливать можно как каркас бочки, так и бочку, заполненную детекторами

Установка бочки Straw

Положение снаружи

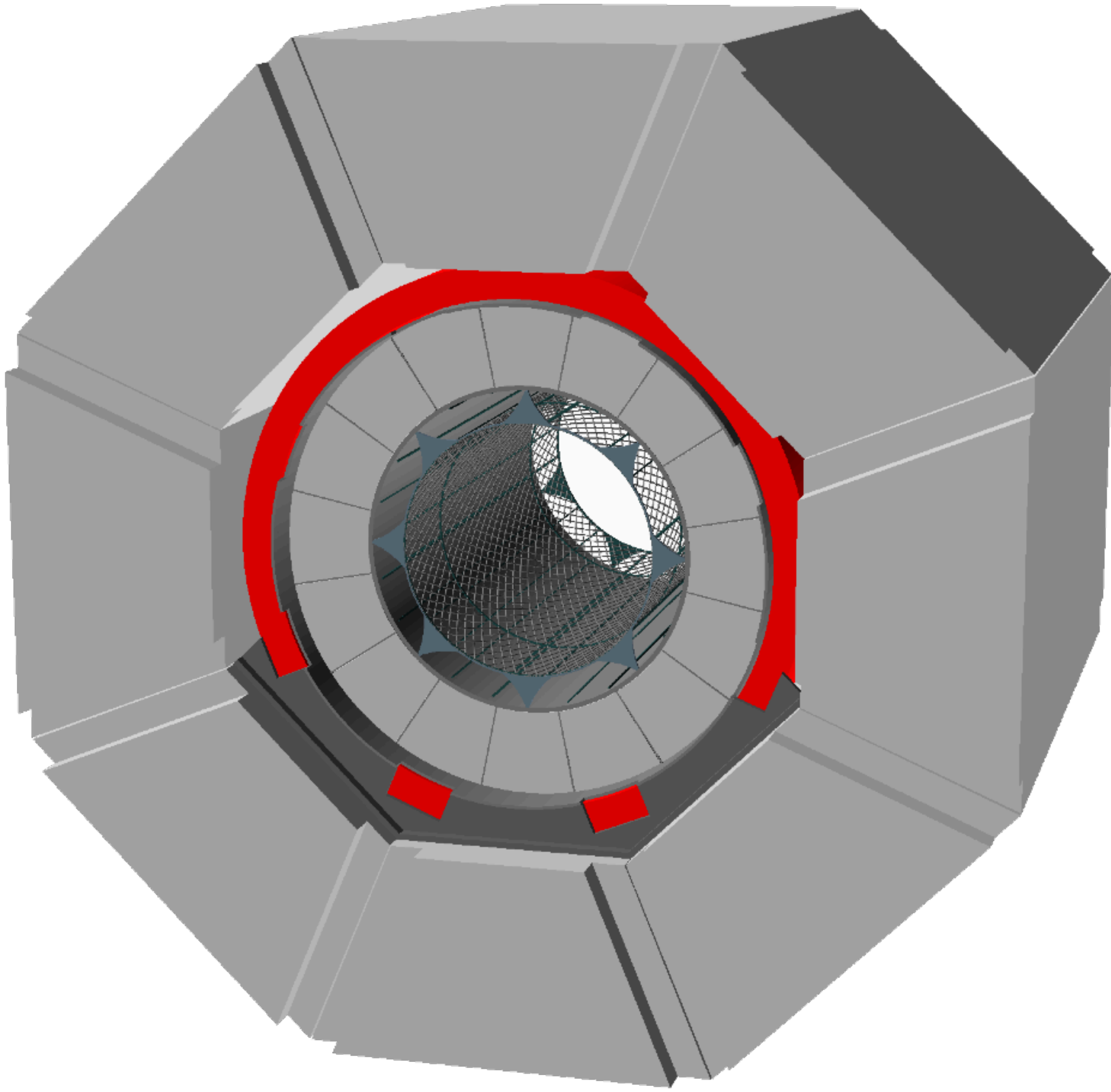


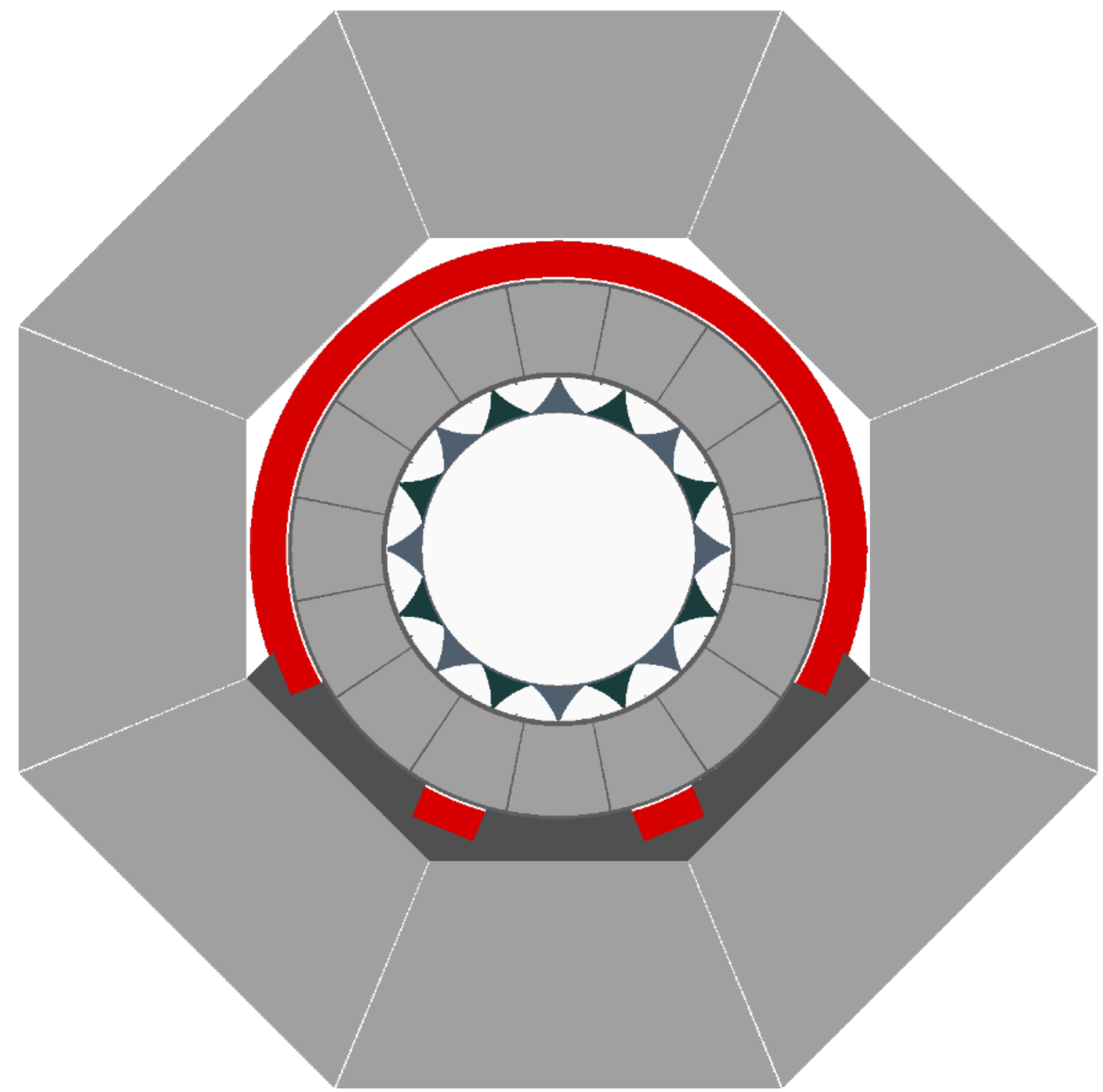
Положение внутри



- Устанавливать можно как каркас бочки, так и бочку, заполненную детекторами
- Вес заполненной бочки ~2 тонны

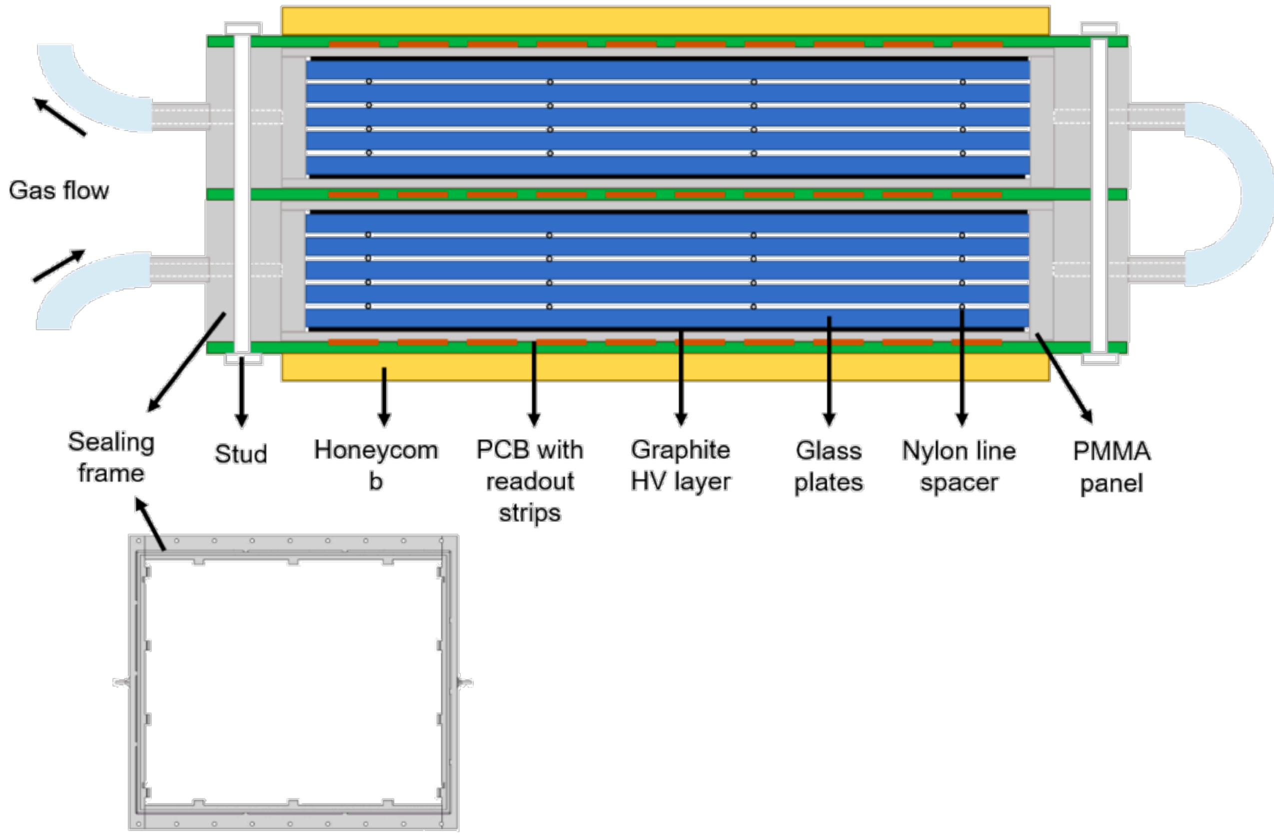
Установка бочки Straw



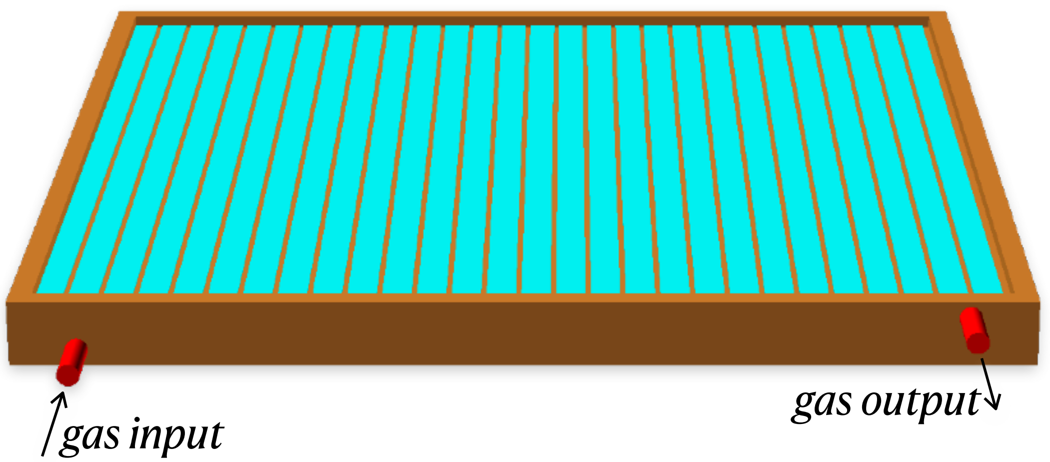


- Каркас бочки Straw крепится на фланцах на внутреннюю обечайку ECal

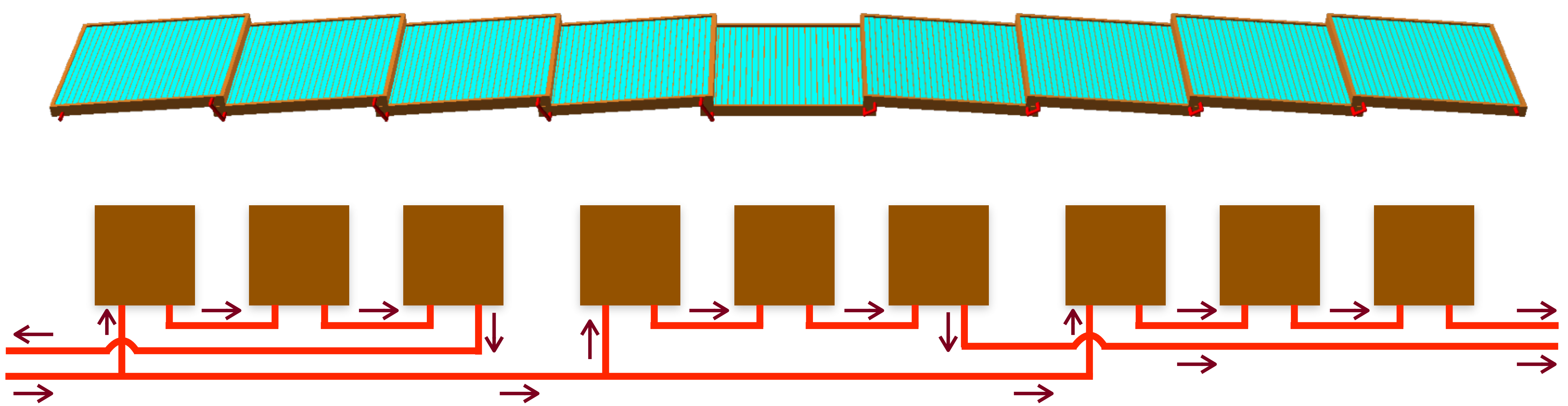
Sealed MRPC proposed for CBM-TOF



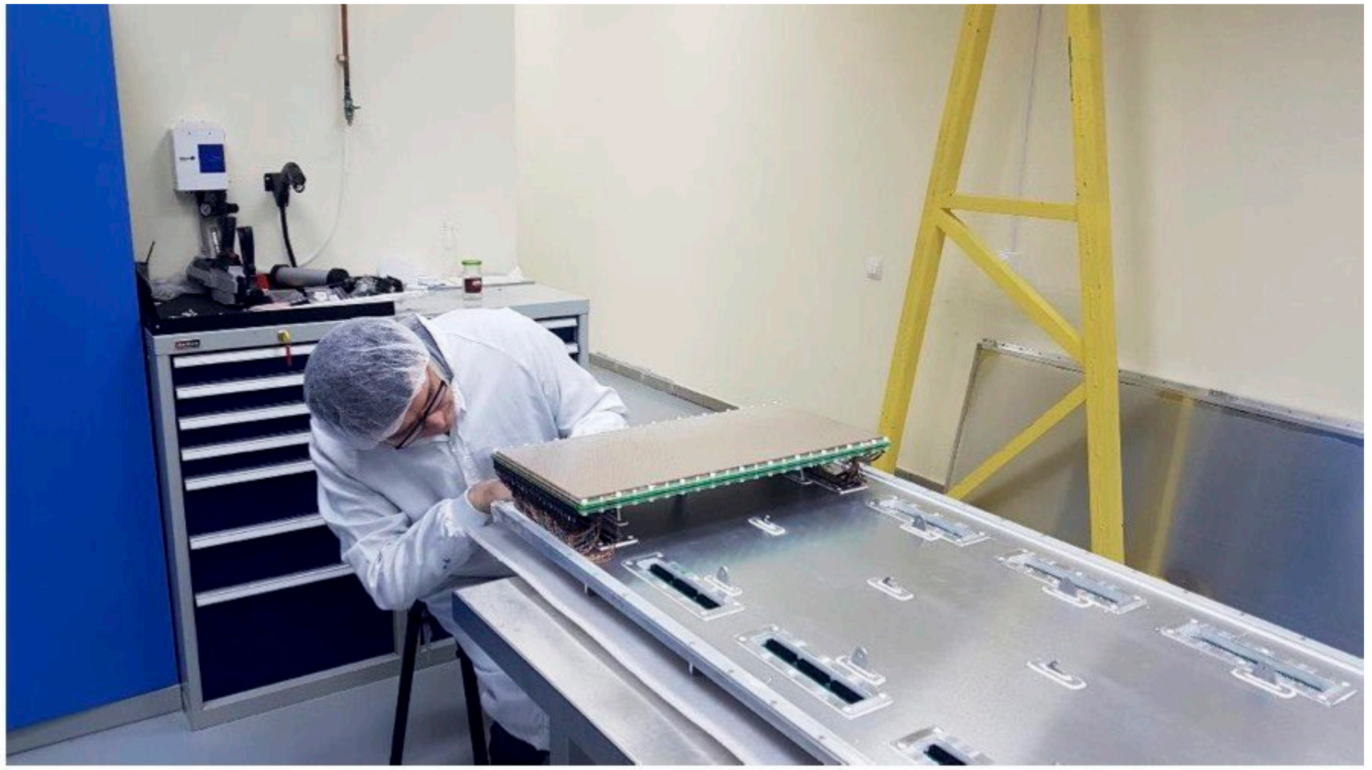
Sealed MRPC for SPD-TOF

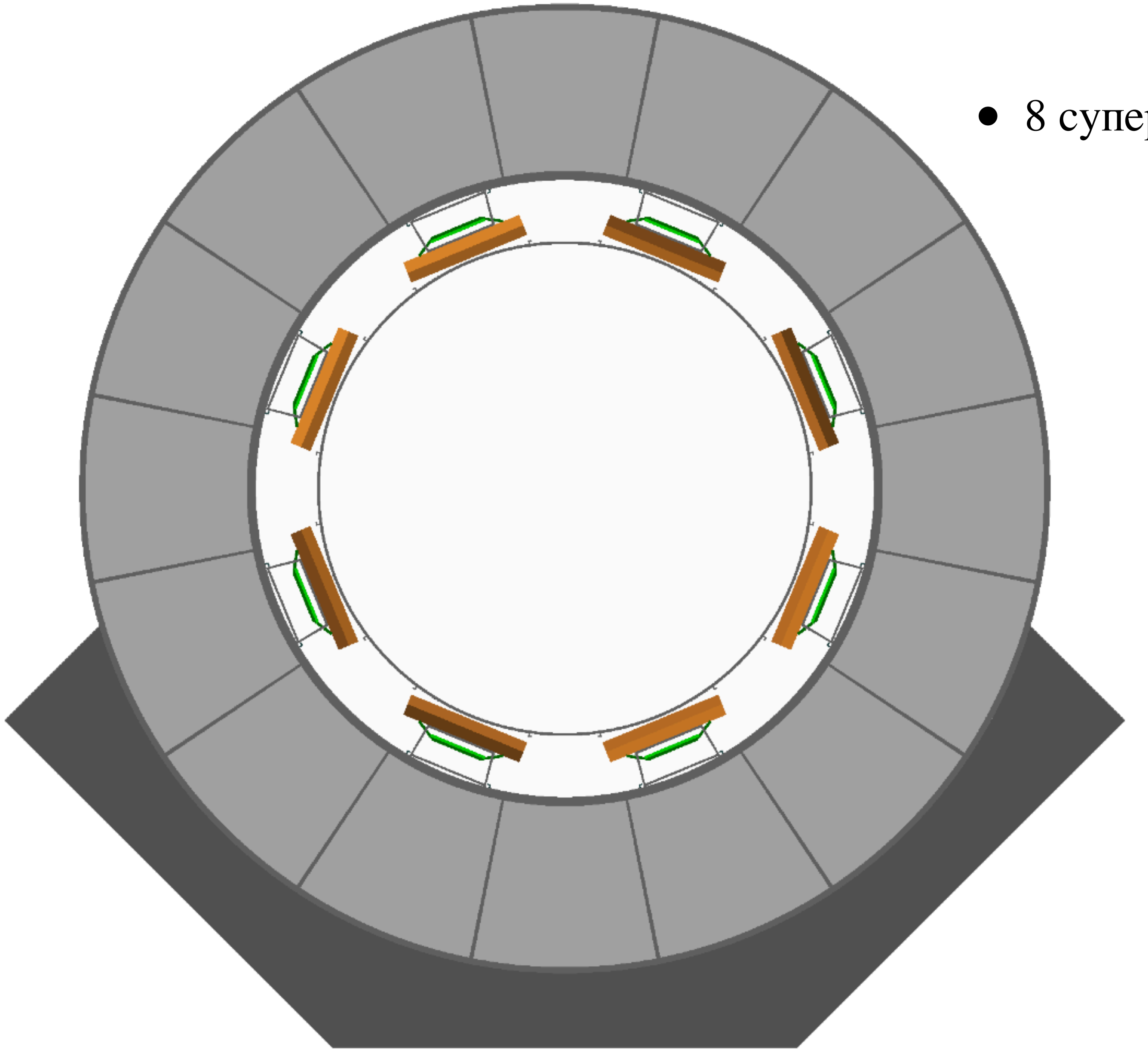


Serial gas connection of MRPCs in a single supermodule

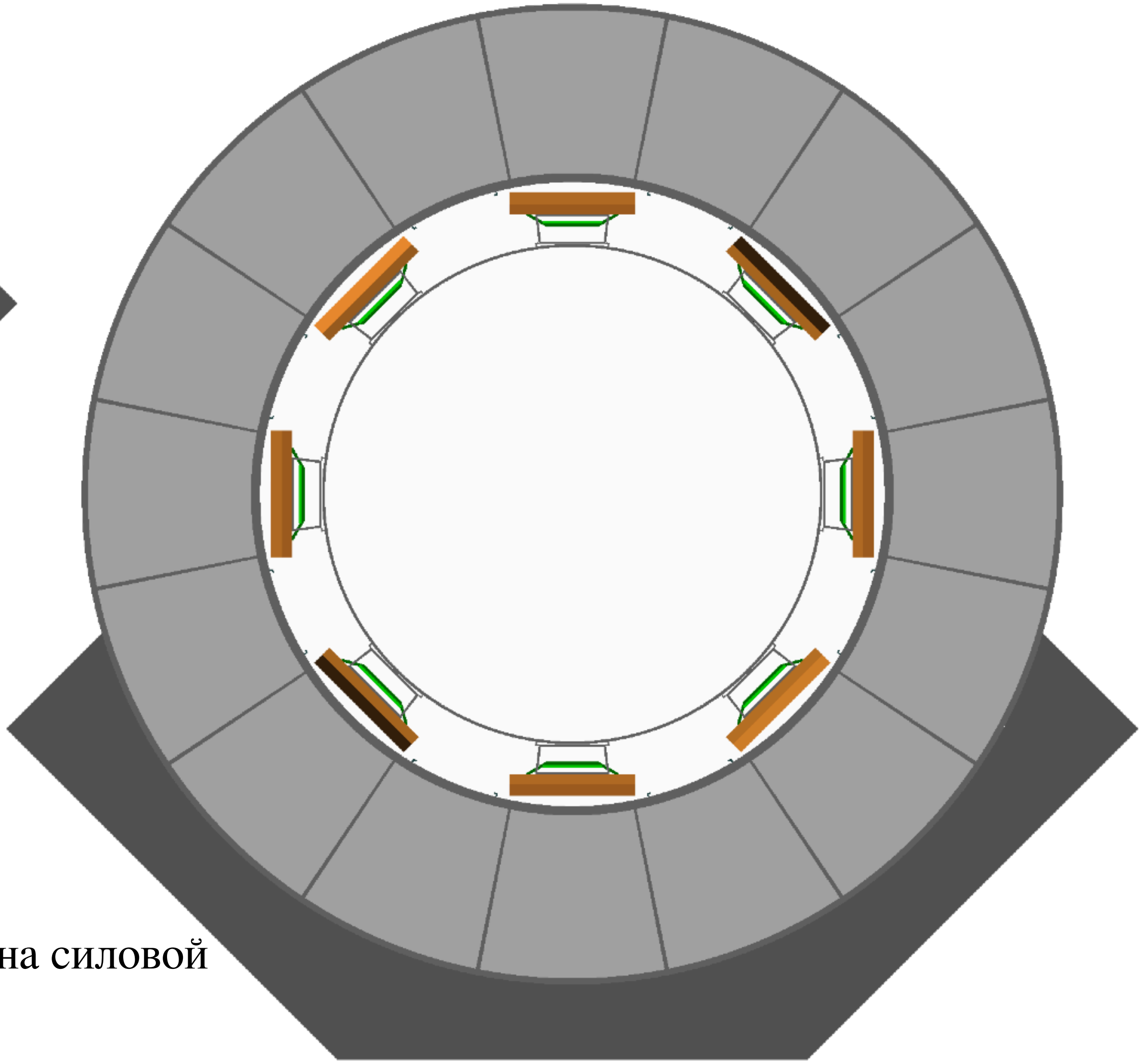


TOF в MPD

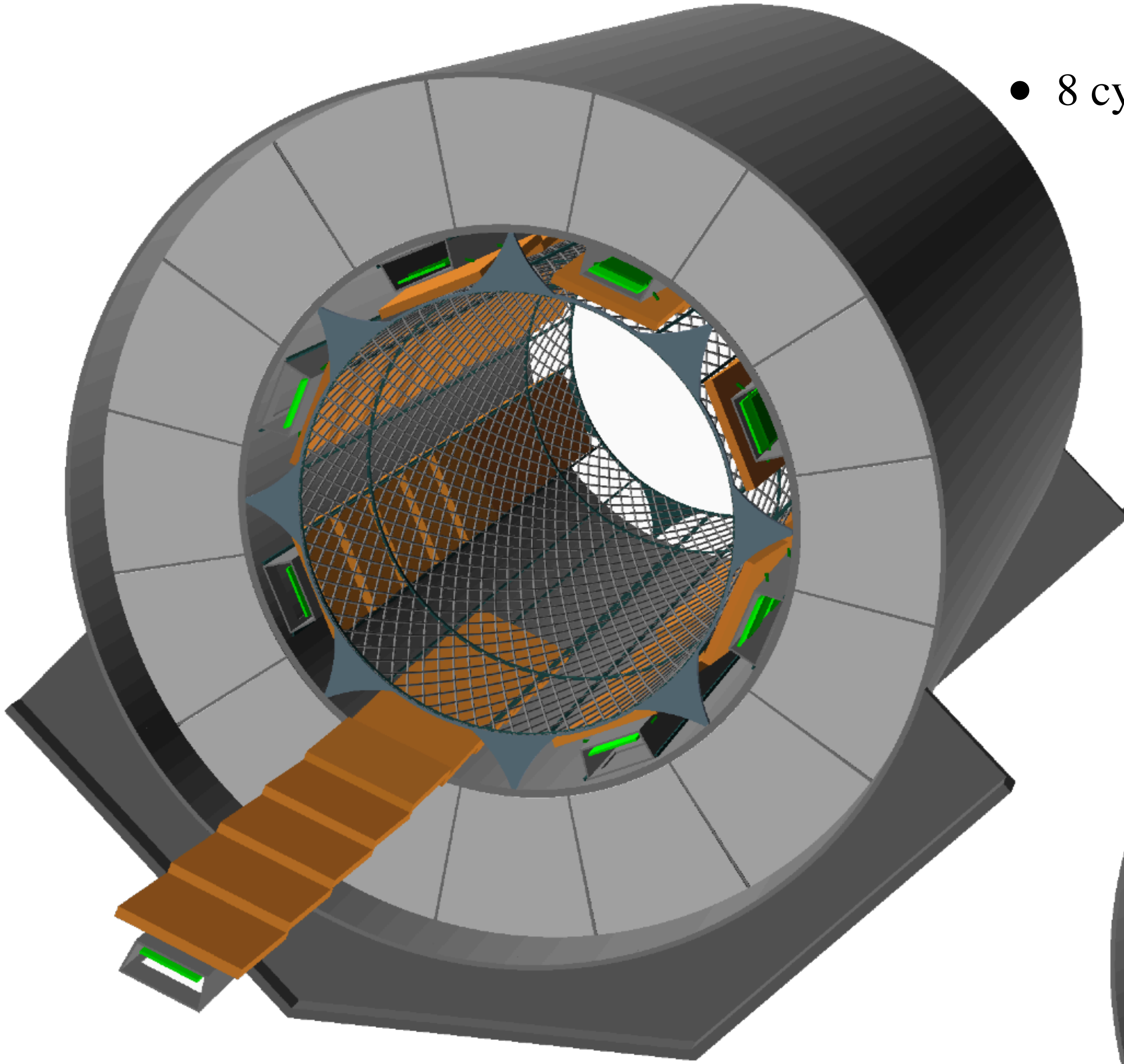




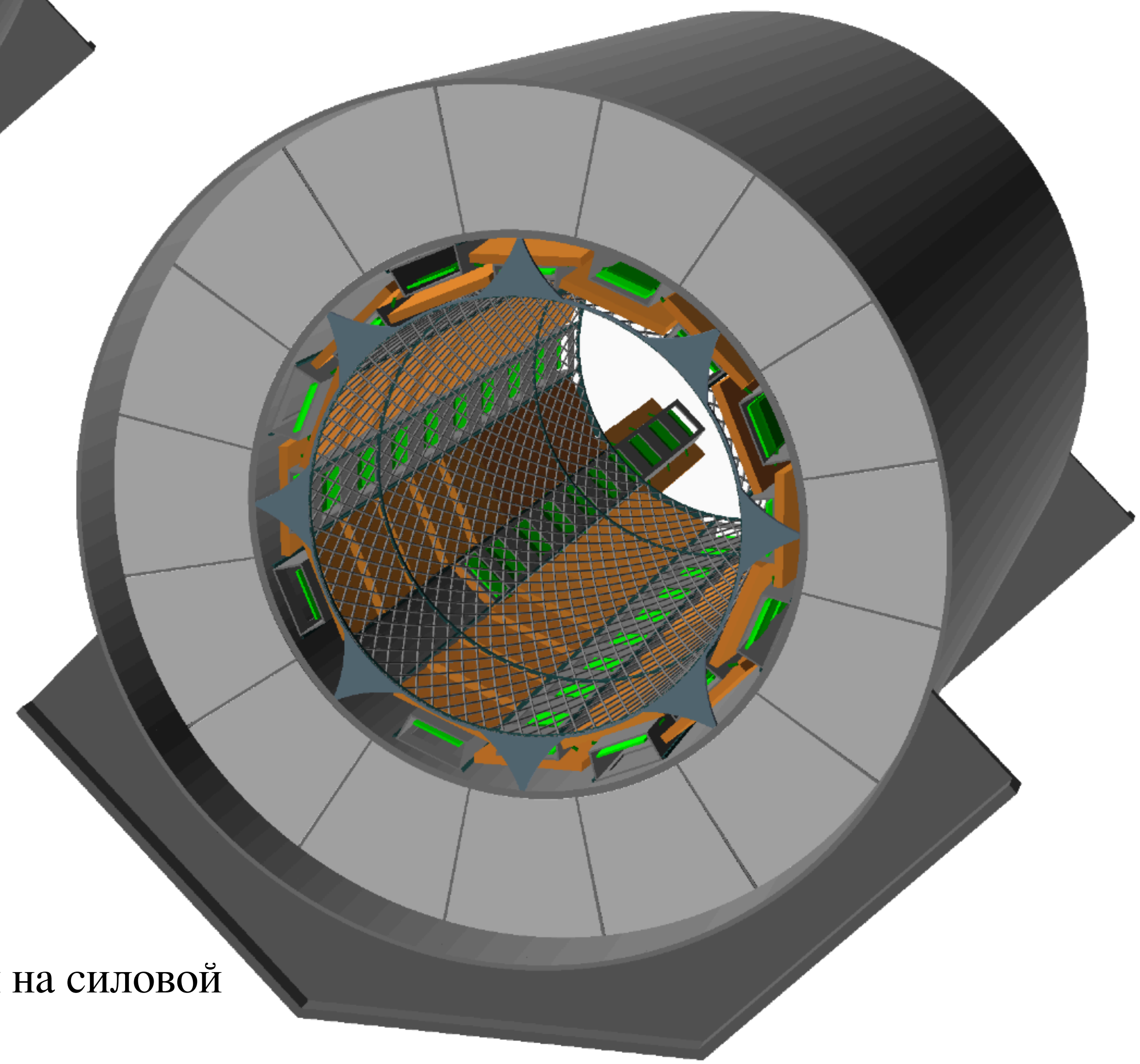
- 8 супермодулей крепятся на калориметр



- 8 супермодулей крепятся на силовой каркас Строу

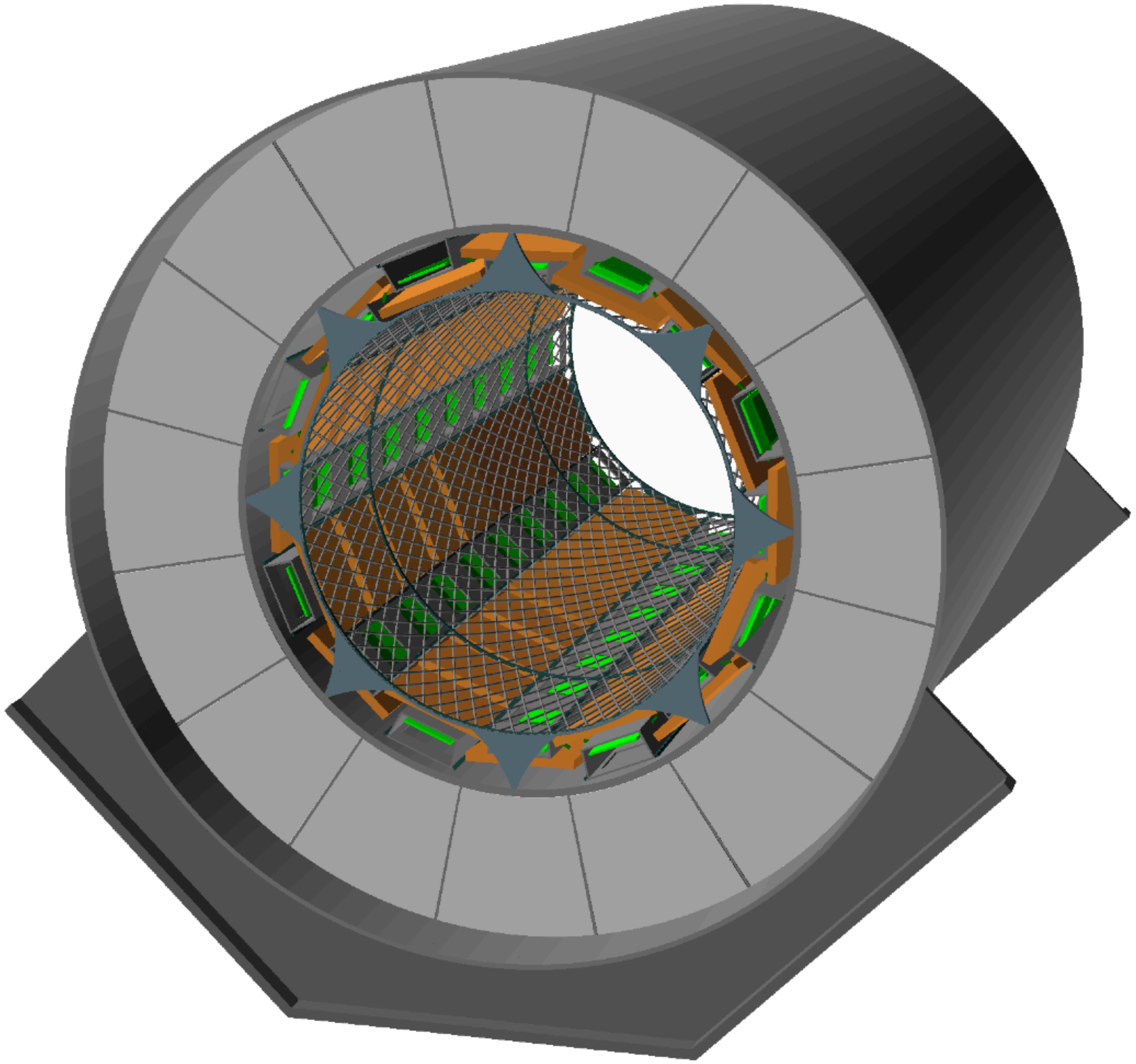


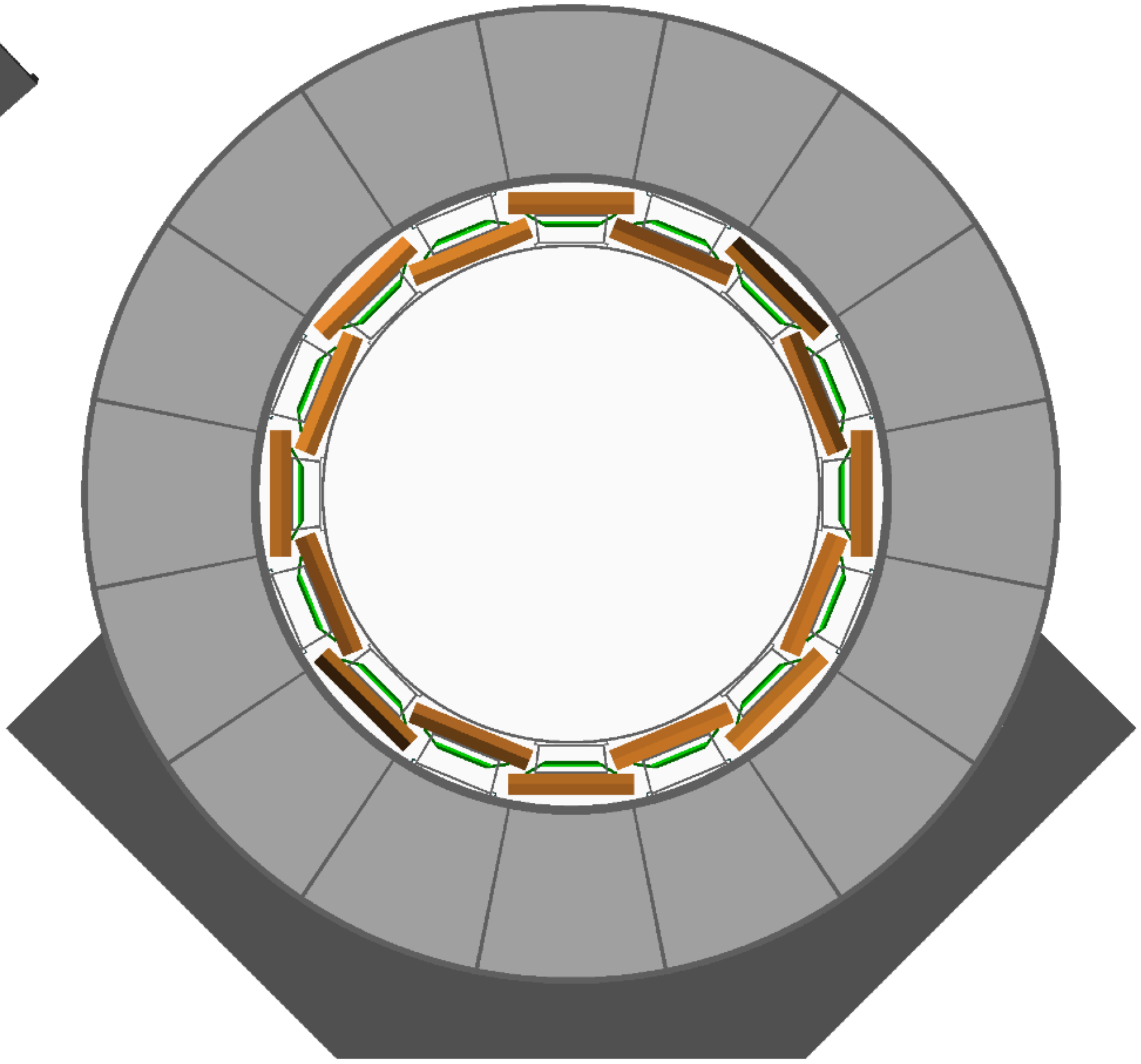
- 8 супермодулей крепятся на калориметр



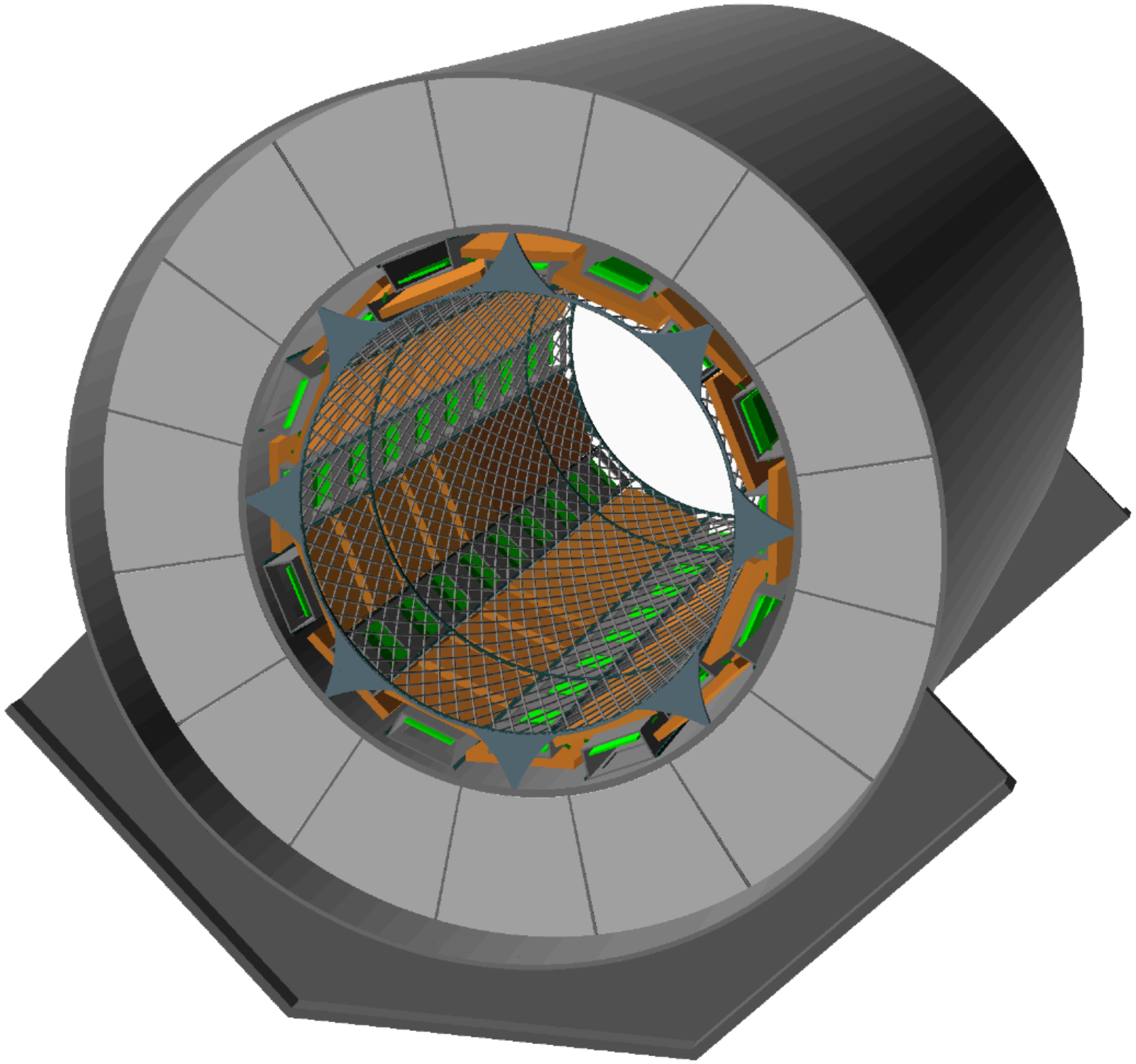
- 8 супермодулей крепятся на силовой каркас Строу

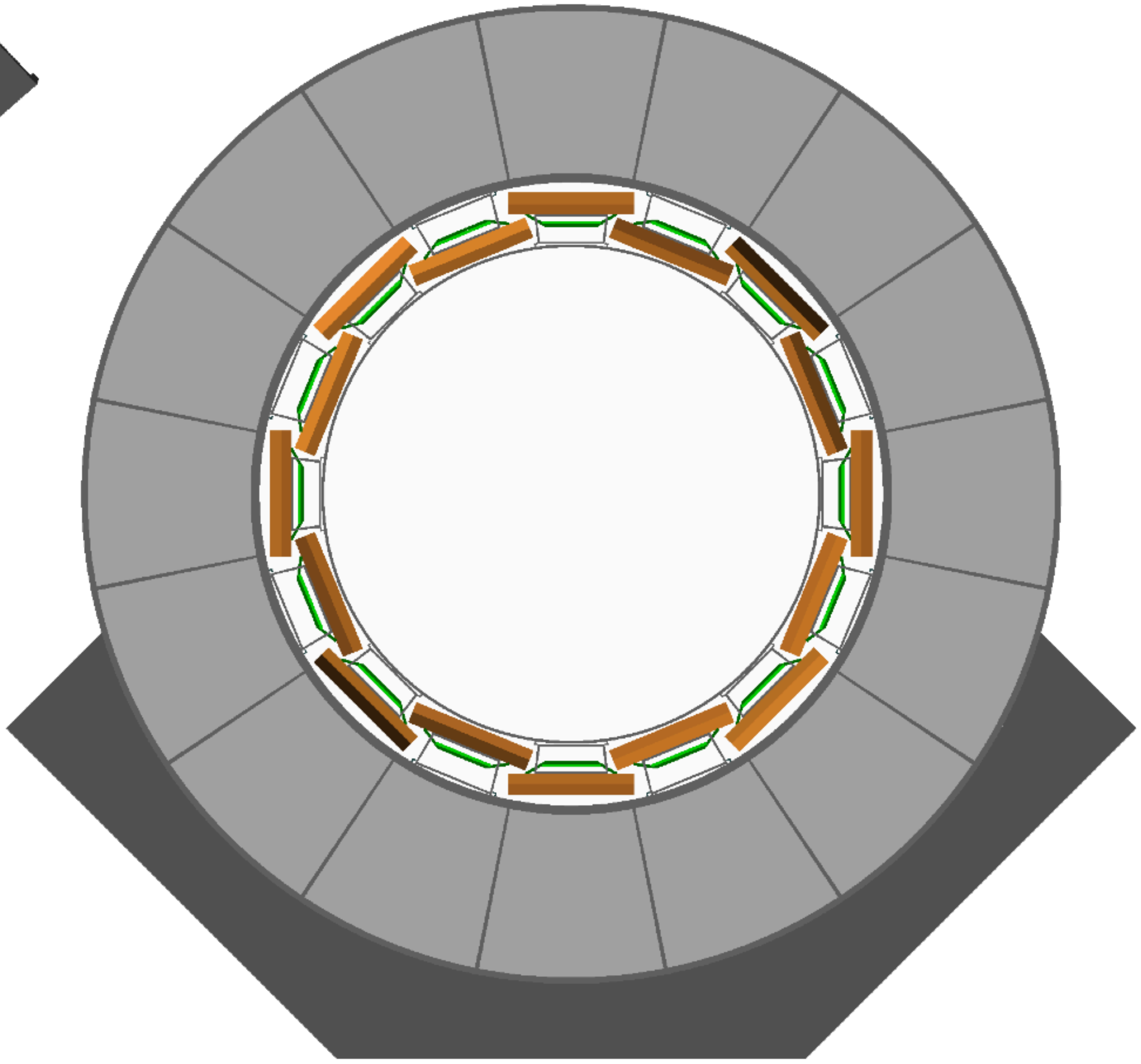
Бочка TOF в собранном виде





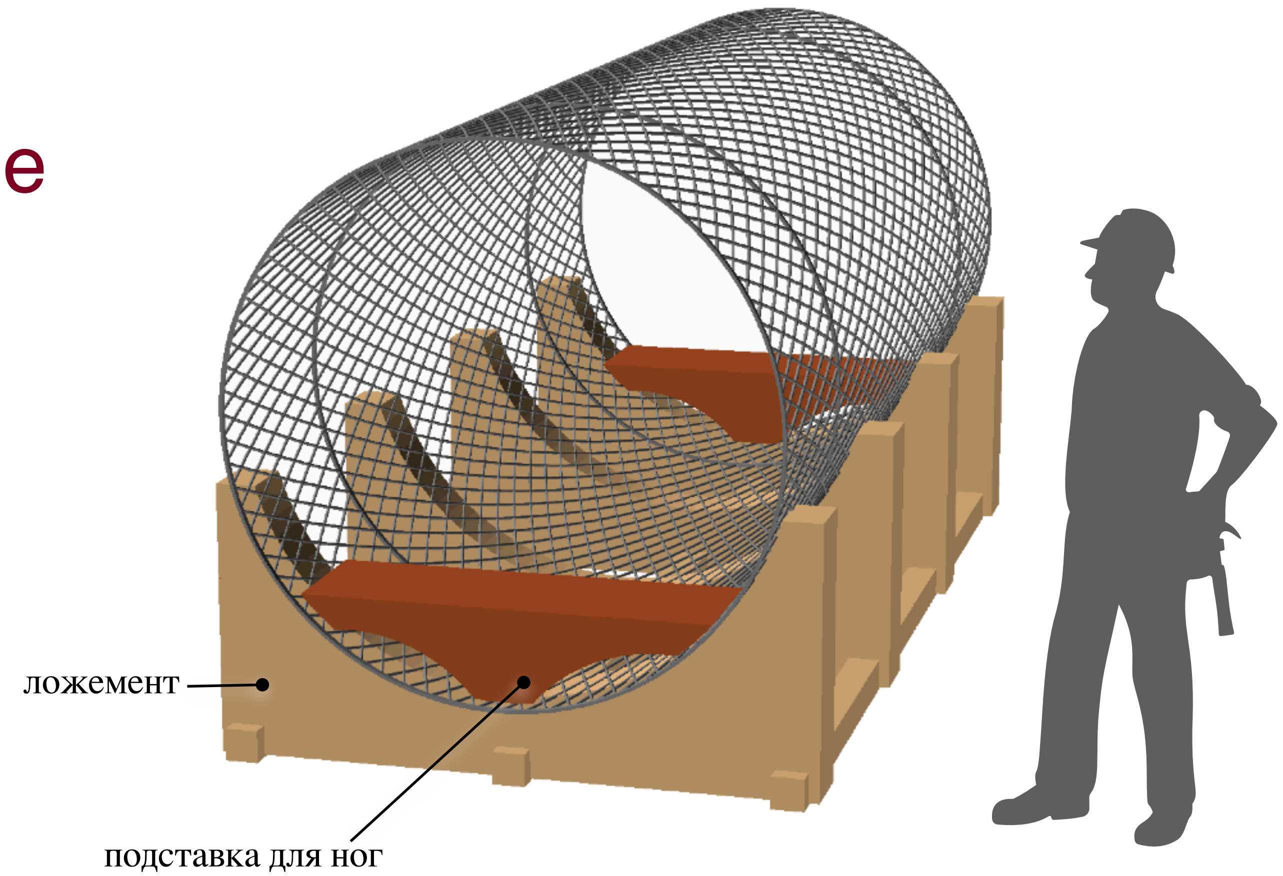
Бочка TOF в собранном виде



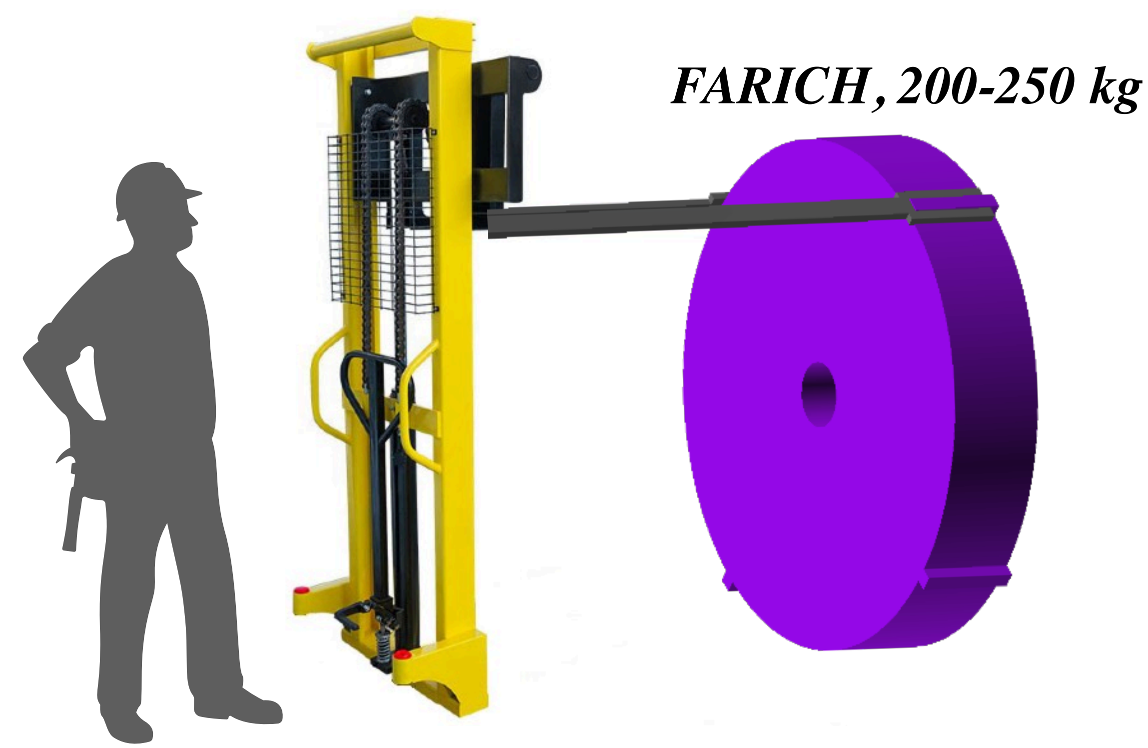


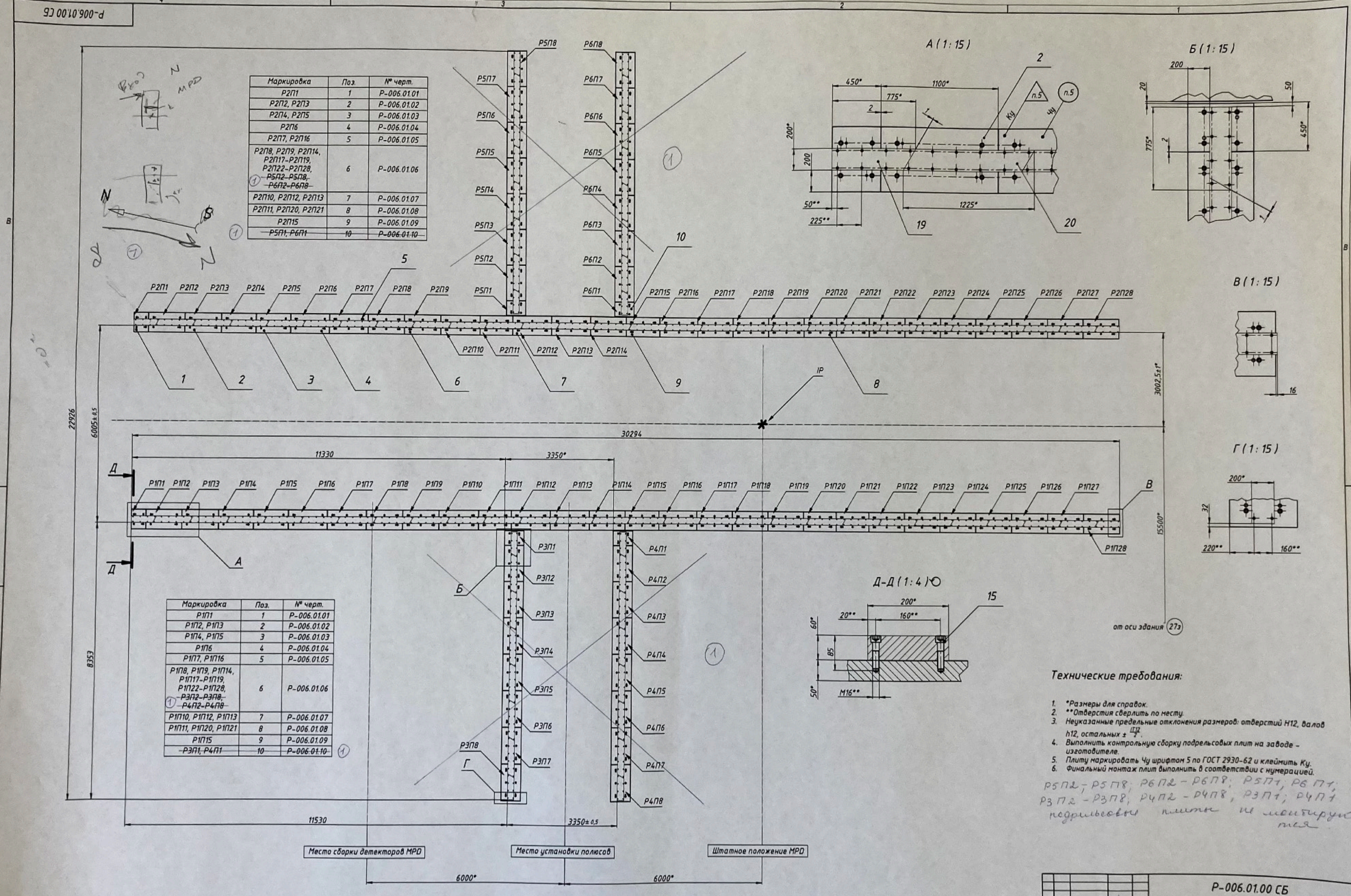
Вспомогательное оборудование

- Силовой каркас Straw будет установлен в модульном корпусе
- Установка модулей (октантов) Straw камер будет проходить там же
- Там же будет проводится тестирование электроники



Manual stacker (load capacity 1 ton)





Маркировка	Поз.	№ черт.
Р2П1	1	Р-006.01.01
Р2П2, Р2П3	2	Р-006.01.02
Р2П4, Р2П5	3	Р-006.01.03
Р2П6	4	Р-006.01.04
Р2П7, Р2П16	5	Р-006.01.05
Р2П8, Р2П9, Р2П14, Р2П17–Р2П19, Р2П22–Р2П28, ~~Р5П2–Р5П8, Р6П2–Р6П8~~	6	Р-006.01.06
Р2П10, Р2П12, Р2П13	7	Р-006.01.07
Р2П11, Р2П20, Р2П21	8	Р-006.01.08
Р2П15	9	Р-006.01.09
~~Р5П1, Р6П1~~	~~10~~	~~Р-006.01.10~~

Маркировка	Поз.	№ черт.
Р1П1	1	Р-006.01.01
Р1П2, Р1П3	2	Р-006.01.02
Р1П4, Р1П5	3	Р-006.01.03
Р1П6	4	Р-006.01.04
Р1П7, Р1П16	5	Р-006.01.05
Р1П8, Р1П9, Р1П14, Р1П17–Р1П19, Р1П22–Р1П28, ~~Р3П2–Р3П8, Р4П2–Р4П8~~	6	Р-006.01.06
Р1П10, Р1П12, Р1П13	7	Р-006.01.07
Р1П11, Р1П20, Р1П21	8	Р-006.01.08
Р1П15	9	Р-006.01.09
~~Р3П1, Р4П1~~	~~10~~	~~Р-006.01.10~~

Технические требования:

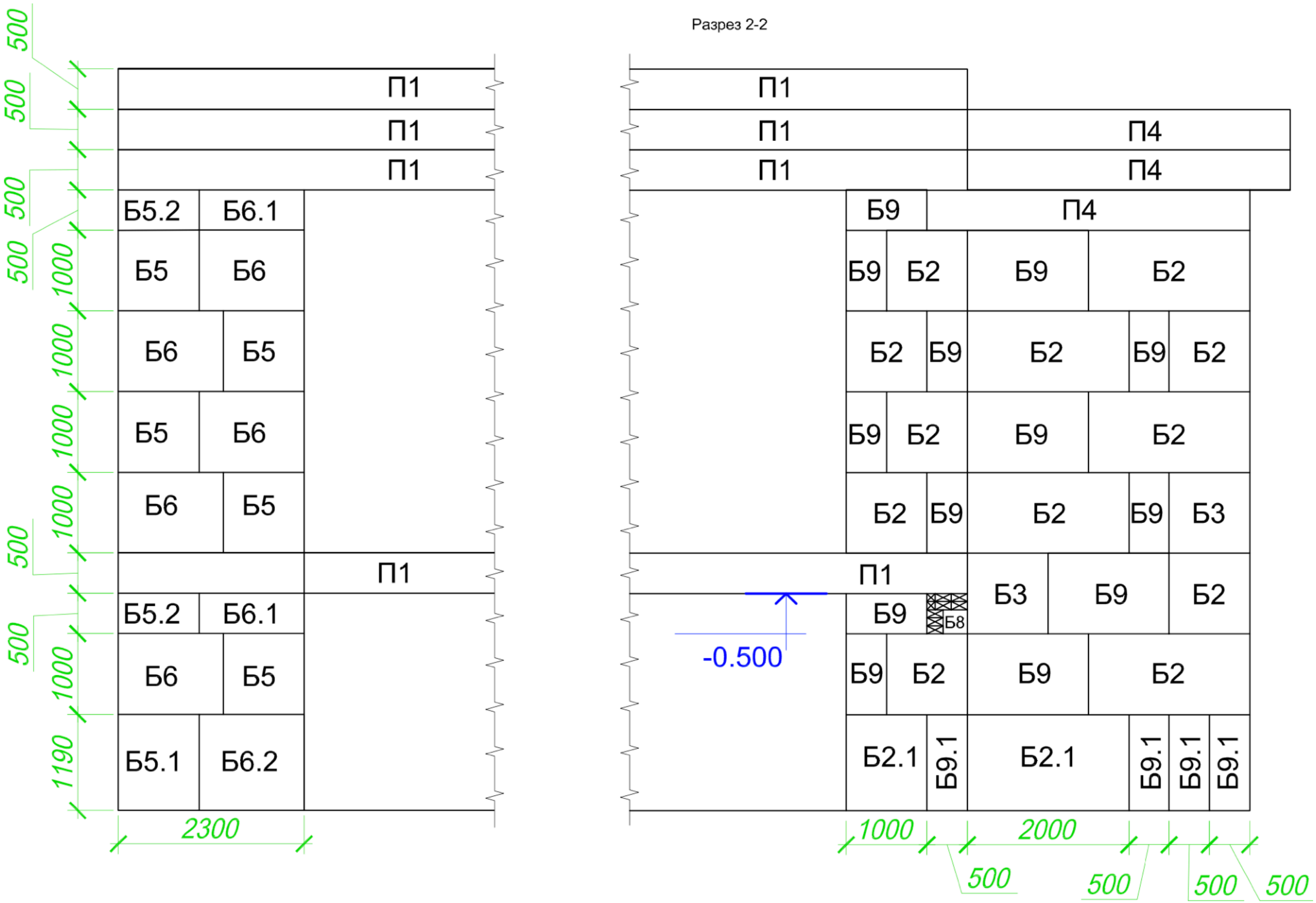
1. *Размеры для справок.
2. **Отверстия сверлить по месту.
3. Неуказанные предельные отклонения размеров: отверстий H12, валов h12, остальных $\pm\frac{IT12}{2}$.
4. Выполнить контрольную сборку подрельсовых плит на заводе – изготовителе.
5. Плиту маркировать Чу шрифтом 5 по ГОСТ 2930-62 и клеймить Ку.
6. Финальный монтаж плит выполнить в соответствии с нумерацией.

Р5П2 – Р5П8; Р6П2 – Р6П8; Р5П1, Р6П1; Р3П2 – Р3П8, Р4П2 – Р4П8, Р3П1; Р4П1 подрельсовые плиты не монтируются

Изм.	Лист	№ докум.	Подп.	Дата				
1	–	Кругова		2023	Р-006.01.00 СБ			
Разраб.		Круглова И.В.			Подрельсовые плиты. Сборочный чертеж	Лит.	Масса: 21666 кг	Масштаб: 1:50
Пров.		Топилин Н.Д.				Лист	Листов: 1	
Т. контр.						КО ЛФВЭ ОИЯИ		
Нач. отд.		Топилин Н.Д.						
Н. контр.								
Утв.								

Копировал Формат А1

Разрез 2-2


П1
П1
П1
Б5.2
Б6.1
Б5
Б6
Б6
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Б5.2
Б6.1
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Б6.2
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П4
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П4
Б9
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Б3
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Б2
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Б9.1
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