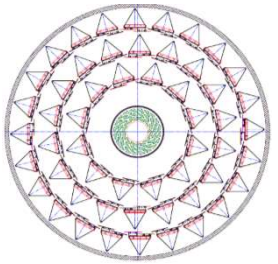


Mechanics for the beam pipe , FFD and ITS integration with TPC

Yuri Murin on behalf of the NICA MPD ITS Consortium

XIV MPD Collaboration Meeting, Dubna October 14, 2024

Outline

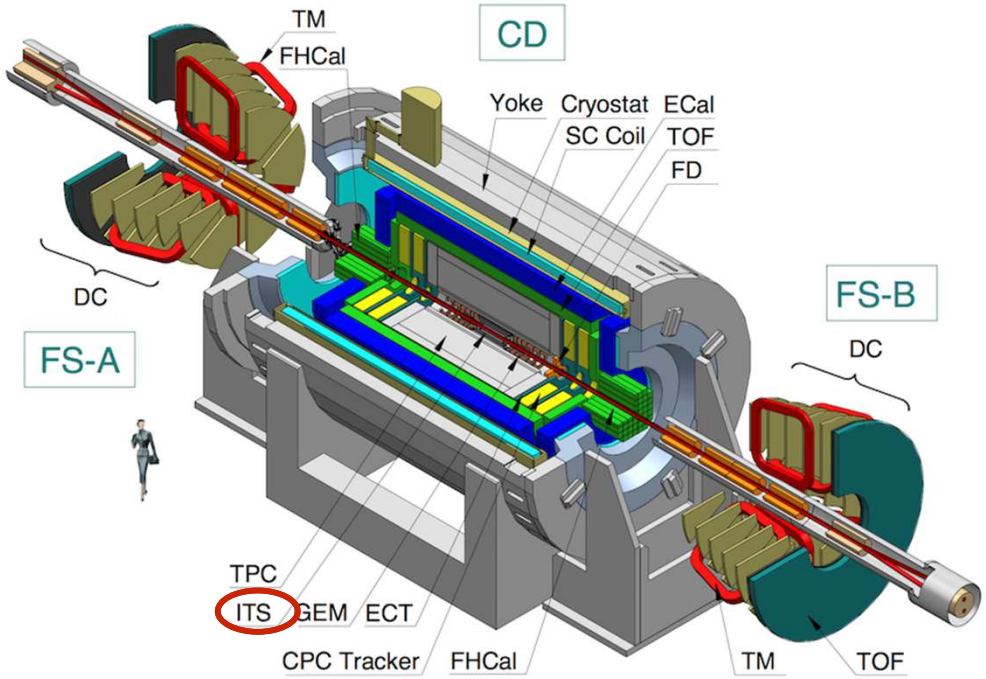
- MPD ITS Consortium introduction
- Igolkin's idea of integration with Installation Container
- The MPD Installation Container status and perspectives
- Timelines of milestones and deliverables
- Activity beyond IC:

1) Design, production and thermocycle tests of the wire-target unit
2) Computer simulations to estimate the "price" of compromises on BP

NICA MPD-Inner Tracking System based on ALICE ITS-2 technology

MPD-ITS structure: 3-layers Inner Barrel + 3-layers Outer Barrel .

It will supplement the TPC for the precise tracking, momentum determination and vertex reconstruction for **low Pt momenta hyperons** (Λ, Ξ, Ω) and identification of **D-mesons.**



Some of the MPD-ITS requirements:

- **Fast, high granularity CMOS pixel sensors with low noise level.**
- **Spatial resolution of track coordinate registration at the level of ~5–10 μm.**
- **Material budget as low as possible.**
- **Positioned as close as possible to the interaction diamond**

Yu. A. Murin and C. Ceballos, *"The Inner Tracking System for the MPD Setup of the NICA Collider"*, Phys. Part. Nuclei 52, 742–751 (2021).

Drifting from ALICE ITS2 to NICA ITS

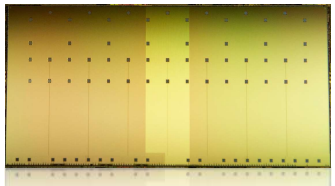
The MAPS chip - ALPIDE

» High-resistivity (> 1kΩ cm) p-type epitaxial layer (20μm - 40μm thick) on p-type substrate.

» Small n-well diode (2-3 μm diameter), ~100 times smaller than pixel => low capacitance.

» Deep PWELL shields NWELL of PMOS transistors, allowing for full CMOS circuitry within active area.

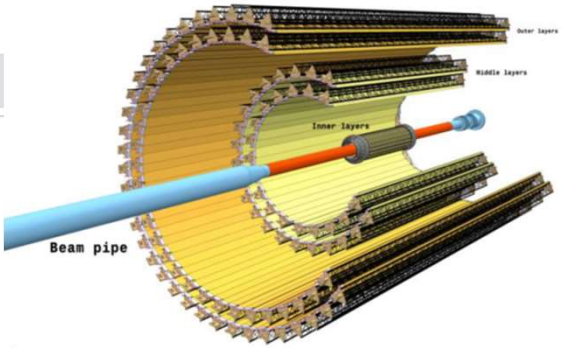
» Global shutter readout pixels' matrix

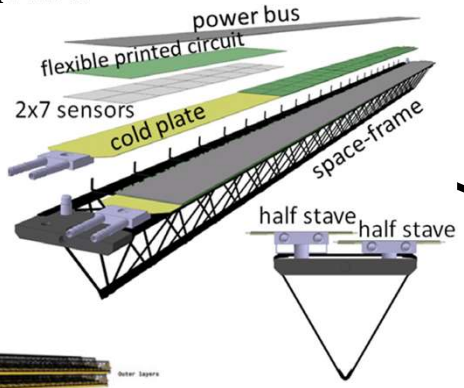


Sensor architecture

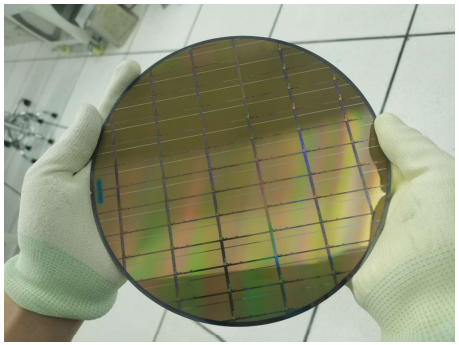
Size: 15mm x 30mm
Pixel pitch: 28μm x 28μm
Event time resolution: < 2μs
Power consumption: 39mW/cm²
Dead area 1.1mm x 30mm

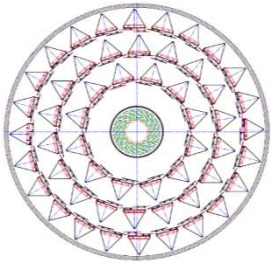
- 24120 pixel sensors
- ~12,5 Gpixels
- 10 m² active area





The MAPS chip - MICA





Number of staves
- IB = (12+16+20)x2
OB=(12+18+24)

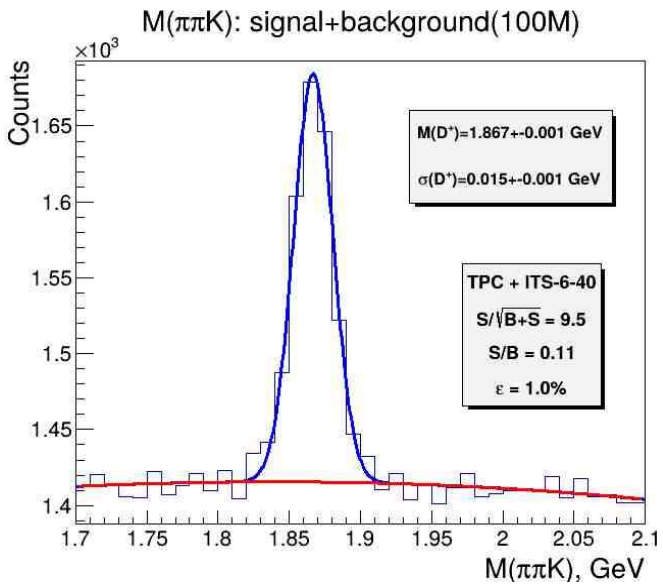
- 11556 pixel sensors
- ~5,8 Gpixels
- 5 m² active area

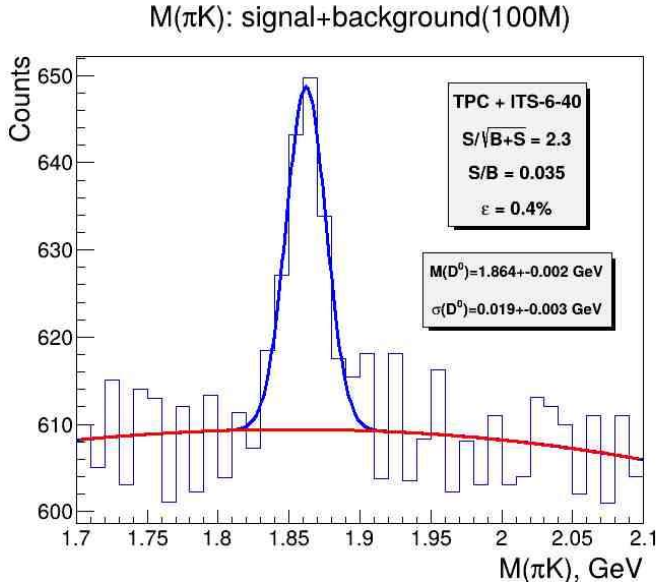
6 layers in 2 barrels final conceptional design and its optimization - by 2024

D^+ and D^0 reconstruction using KF with TPC-TOF PID

$D^+ \rightarrow K^- + \pi^+ + \pi^+$

$D^0 \rightarrow K^- + \pi^+$





N_D = 19 000 mesons/month for D^+

N_D = 3 200 mesons/month for D^0

Using the optimal BDT cut allows to reconstruct D^+ and D^0 with an efficiency of **1.0%** and **0.4%** respectively.

Particle	D^+	D^0
Efficiency, %	1.0	0.4
Significance	9.5	2.3
S/B(2σ) ratio	0.11	0.035

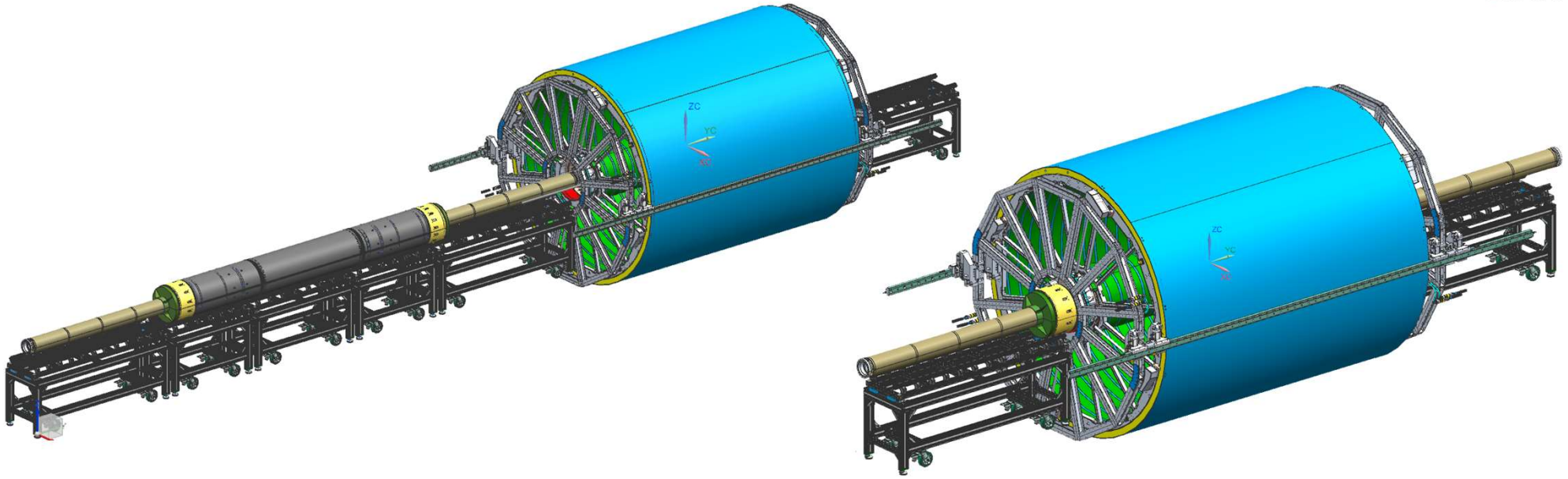
Courtesy of Prof. V.Kondratiev (SPbSU)

Establish the ‘NICA MPD-ITS Consortium’

- **In order to further cooperate between JINR and Chinese institutions, the "NICA MPD-ITS Consortium" has been established:**
  - The acting time for the consortium is 5 years;
  - The coordinator center within the Russian Federation will be the JINR and in China will be the CCNU
  - The other institutions participating in the Consortium will have each one representative on the project structure for decision making and control.

Courtesy of Prof. Xiangming Sun (CNNU)

The MPD Installation Container conceptual approach put forward by Sergei Igolkin (SpbSU,SPb)

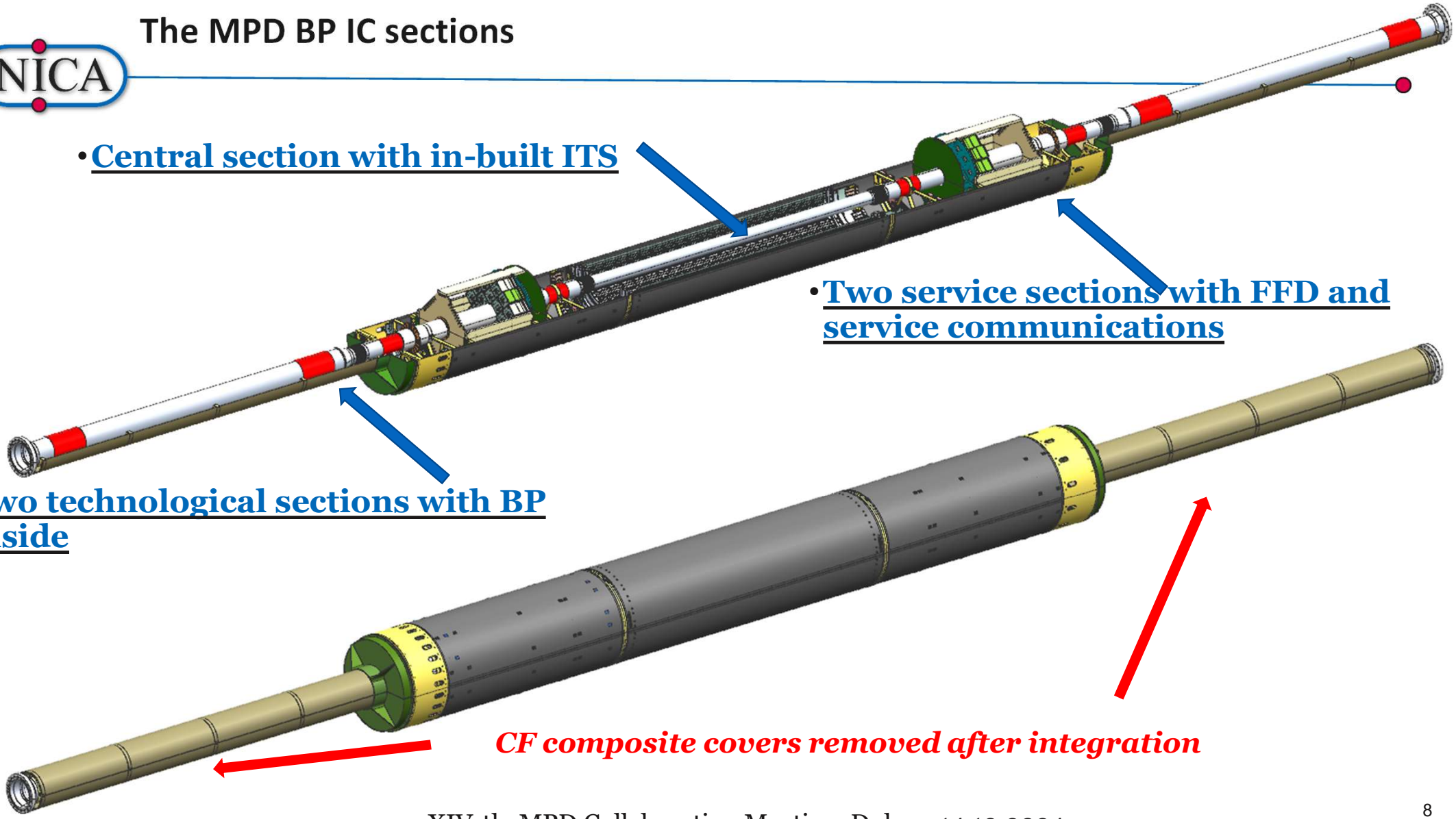


The 50 cm diameter of the TPC bore is too narrow to do otherwise !

XIV-th MPD Collaboration Meeting, Dubna 14.10.2024

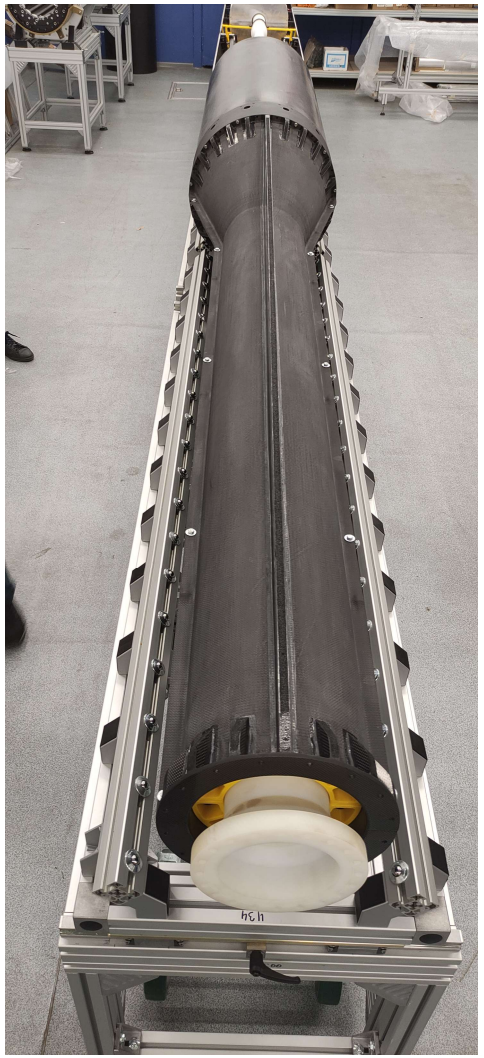
The MPD BP IC sections

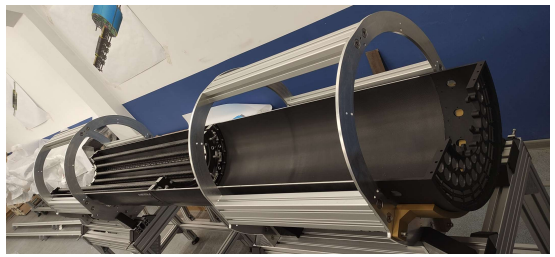
- Central section with in-built ITS
- Two service sections with FFD and service communications
- Two technological sections with BP inside

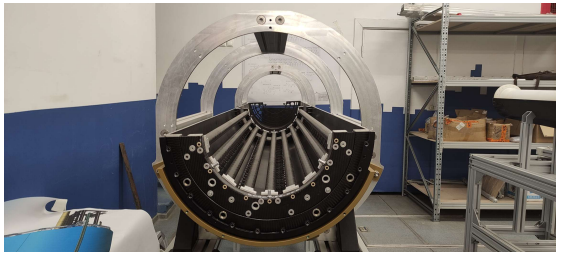


CF composite covers removed after integration

Current status: 95% IC readiness for dry tests of the integration scenario







- **Designed & produced in the house by D.Andreev +3**
- **GrafitPro (Moscow)cage manufacturing**

The yet-to-do list with timelines of major milestones

In the Lab (now – 27.12.2024)

- Design and production of BP fixtures for mounting and fixation BP inside IC
- Finalization of production of the support wheels for first additional layer of the ITS OB
- Design and production of the Interceptor
- Design and production of wire-target unit (together with AD)

In the MPD Hall (10.01.2025 – 27.06.2025)

- Dry test of the installation scenario with TPC dummy at different incline angles
- Design and production of auxiliary fixtures and tooling

Last but not least:

Computer simulations for estimation the impact of the beam pipe properties on expected momenta resolution and tracking efficiency in "TPC only" and "TPC+ITS(OB)" configurations and FXT mode

- **Beam pipe:** Stainless steal (80 mm); Ti (64 mm), Al(64 mm); Be(64 mm)
- **Pojectile nuclei:** 2.5AGeV Xe; 2.5AGeV Bi
- **Targets:** Be(50 um),Au(50um;2x25 um); W(?um)
- **Result:** relative transverse and full momenta resolution and tracking efficiency as function of momenta for identified secondaries; wires and beampipe images, etc.

Target R&D

- Production and thermocycle tests of few wire-targets carriers with mounted wires (anticipated materials Be, Au and W; anticipated method: US bonding or UHV compatible adhesive)

Credits and Thanks – to persons involved in mechanics in red

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Gaganova Maria
Peres Margarita
Udovenko Svetlana
Leontiev Vladimir
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Semchukova Tatiana
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高超松 [Gao Chaosong] (CCNU)
钱家俊 [Qin Jiajun] (USTC)
周扬 [Zhou Yang] (IHEP)

Musa Luciano
Di Mauro Antonello

Industrial partners : GrafitPro(Moscow), MELZ (Zaprudnia), Mezon Ltd(SPb)

Thanks for your attention!