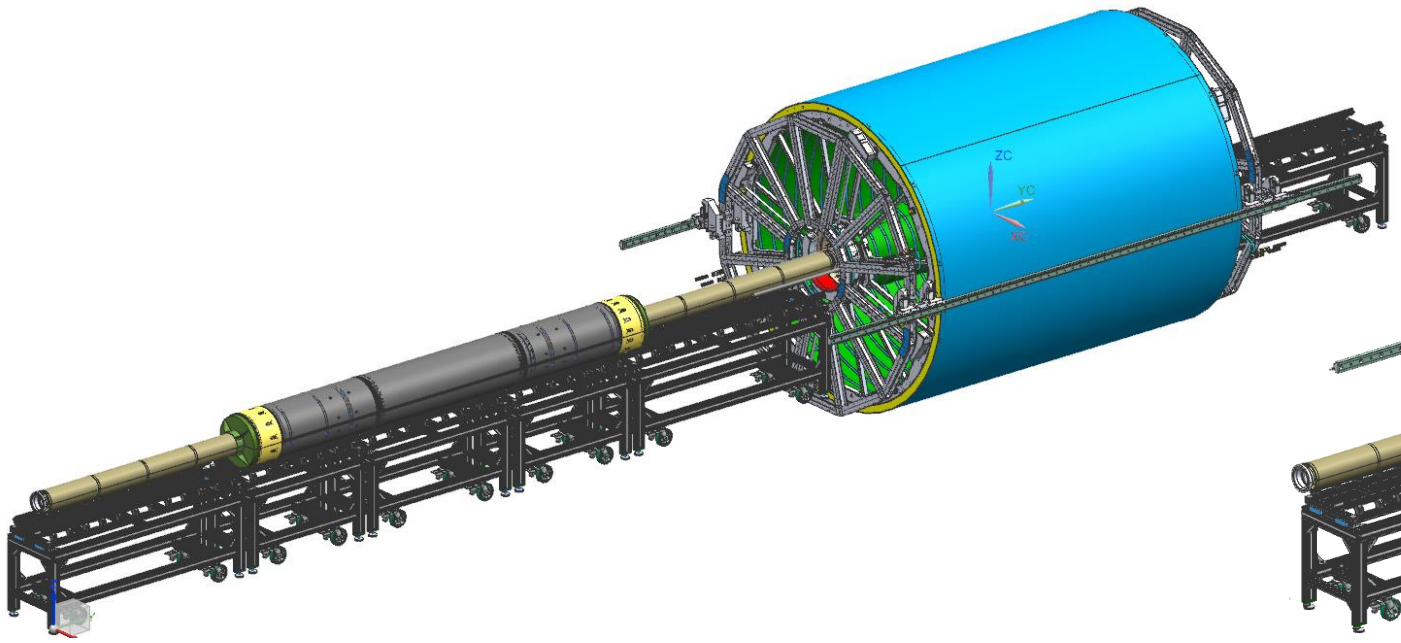
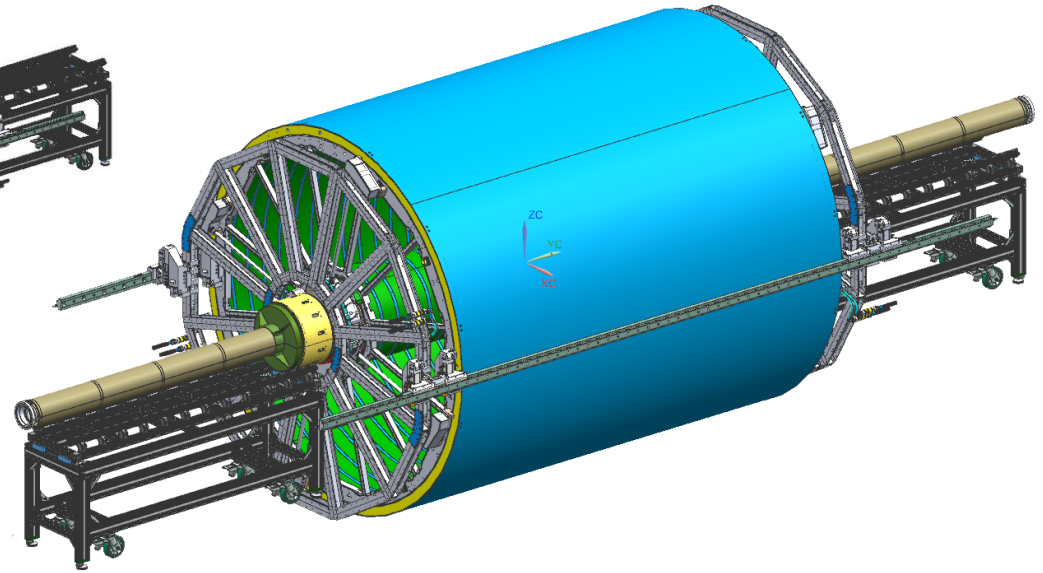
The MPD BP Installation Container; status and perspectives of the ITS

Murin Yuri for the MPD ITS Consortium



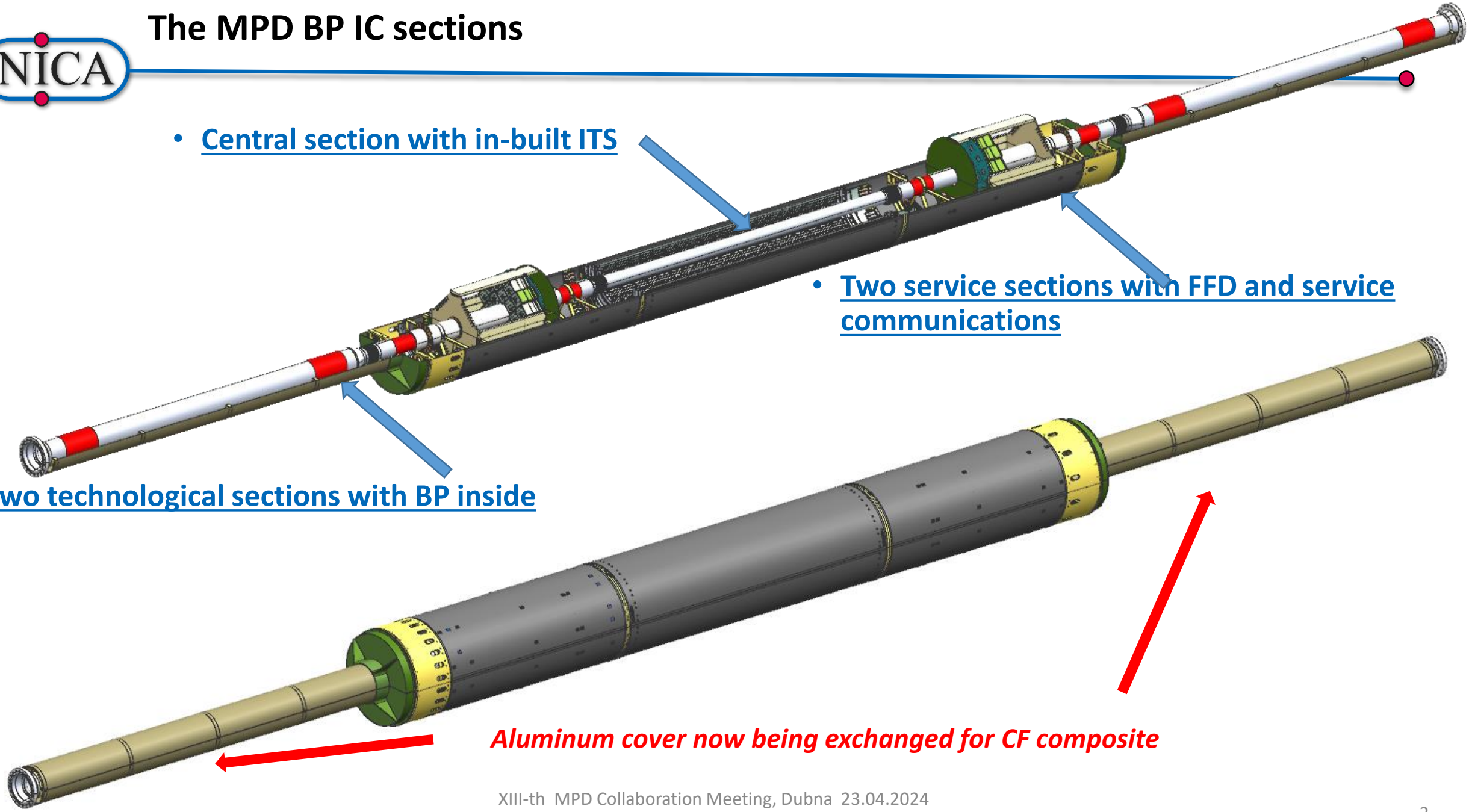


Original idea of Sergei Igolkin, SPbSU, SPb

murin@jinr.ru

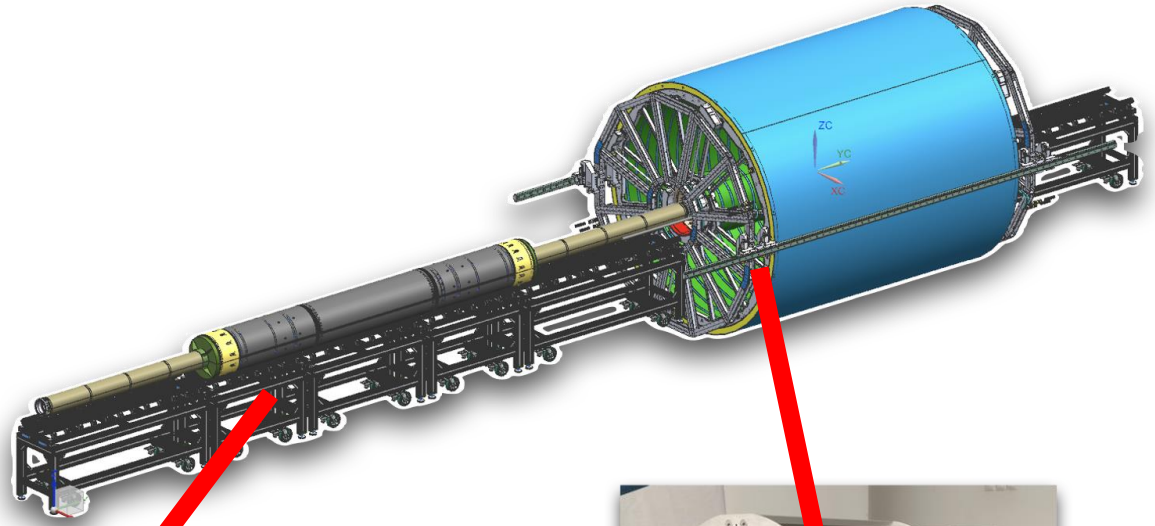
The MPD BP IC sections

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



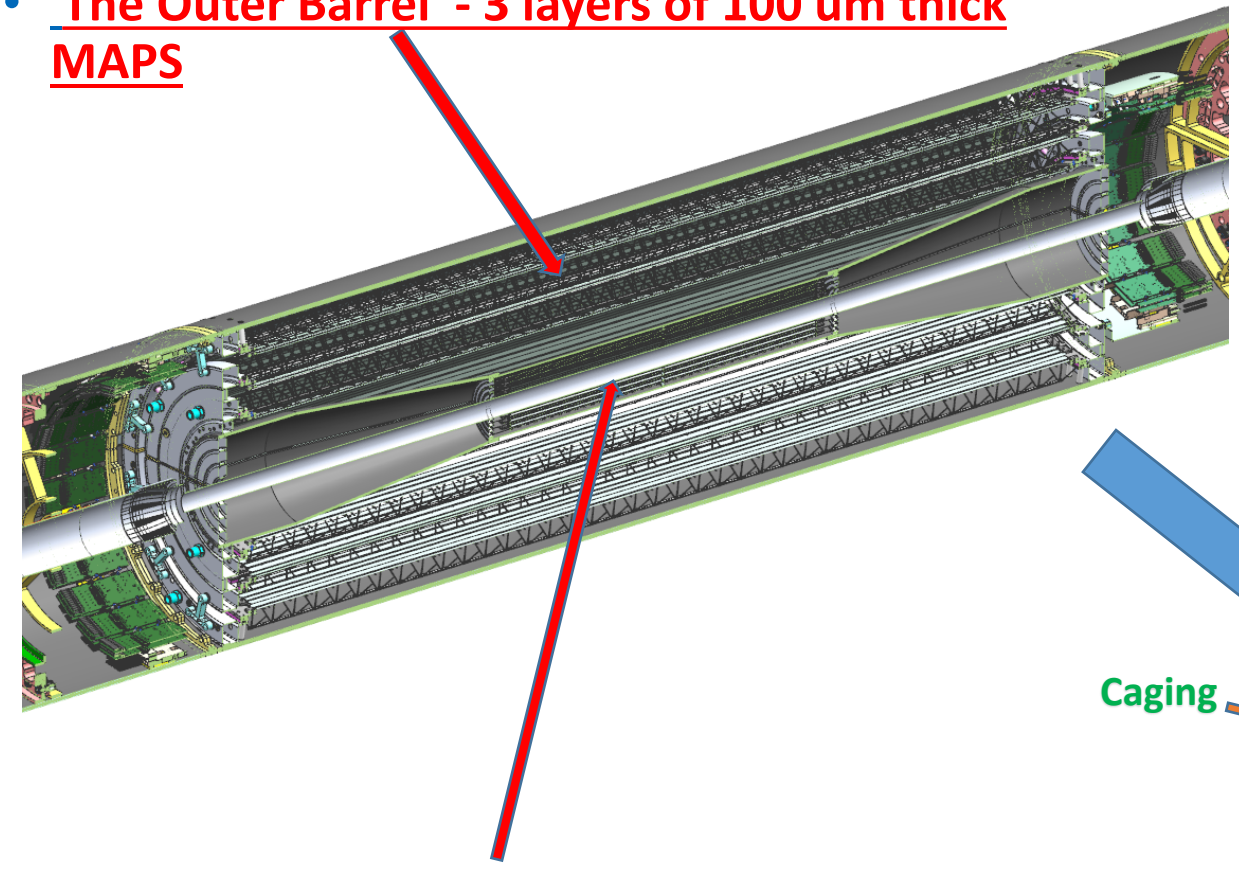
Aluminum cover now being exchanged for CF composite

Molds, jigs and tooling will be omitted in the talk



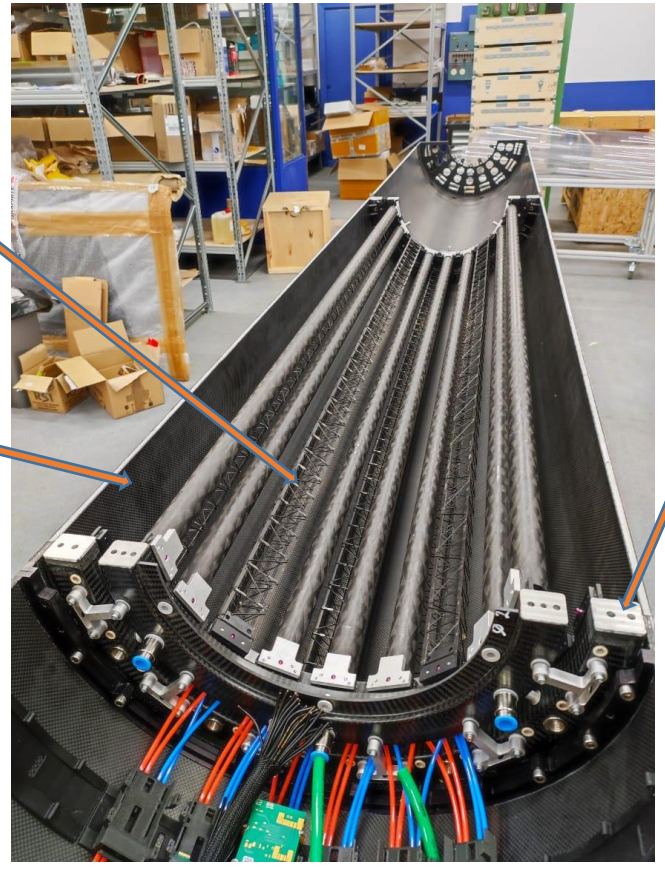
The IC Central Section from sketch to reality – work completed

- The Outer Barrel - 3 layers of 100 um thick MAPS

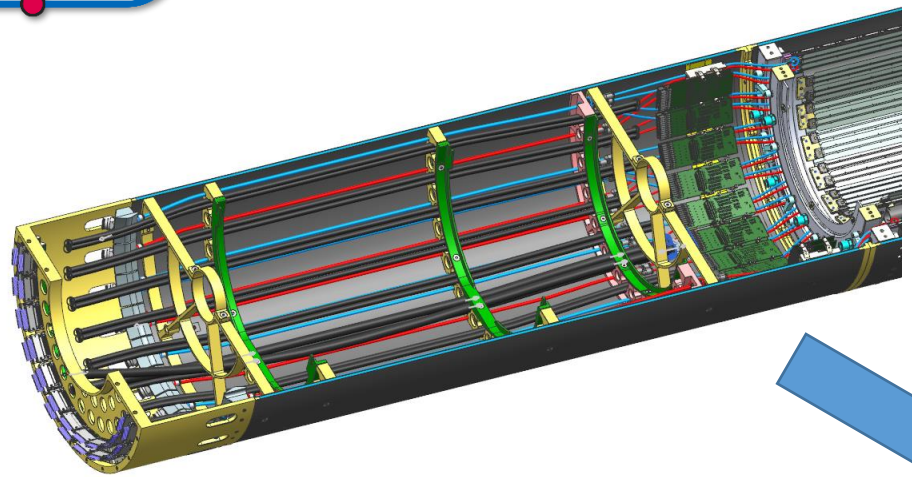


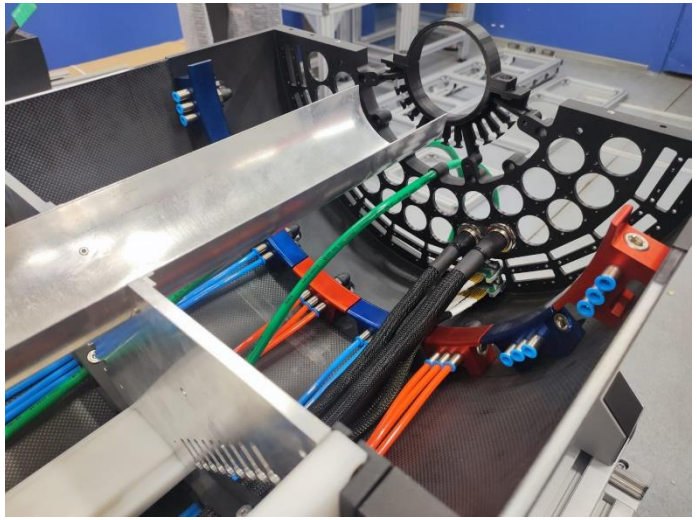
- The Inner Barrel - 3 layers of 50 um thick MAPS

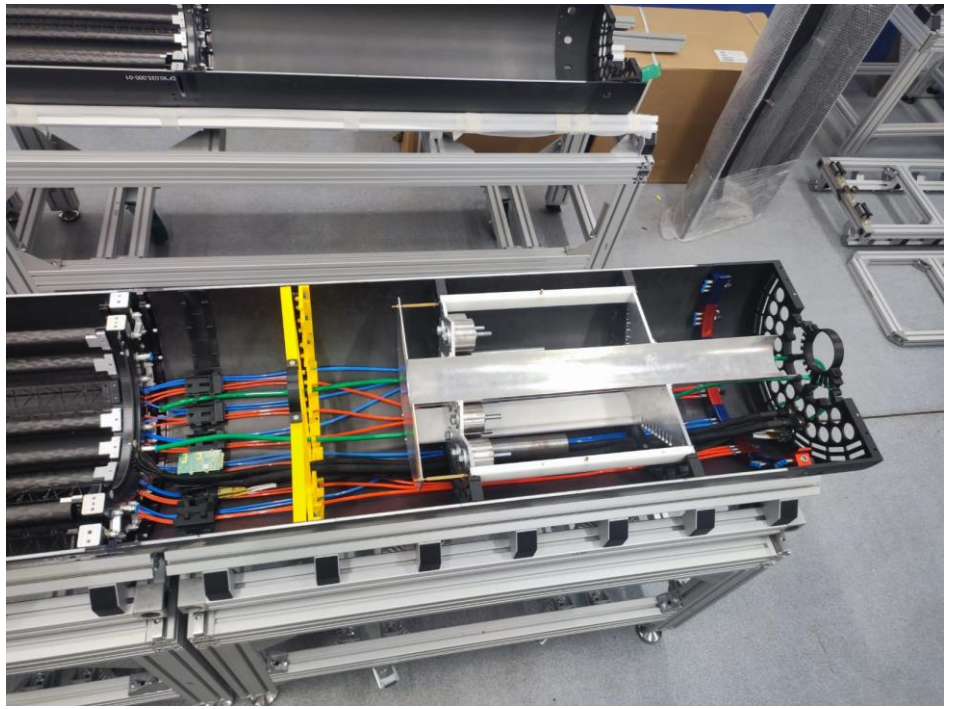
- Designed by S.Igolkin(SpbSU) and D.Andreev(VBLHEP)
- Produced by A.Voronin,A.Panfilov,T.Lygdenova (VBLHEP); V.Zherebchevsky et al.(SPbSU), and GrafitPro (Moscow)



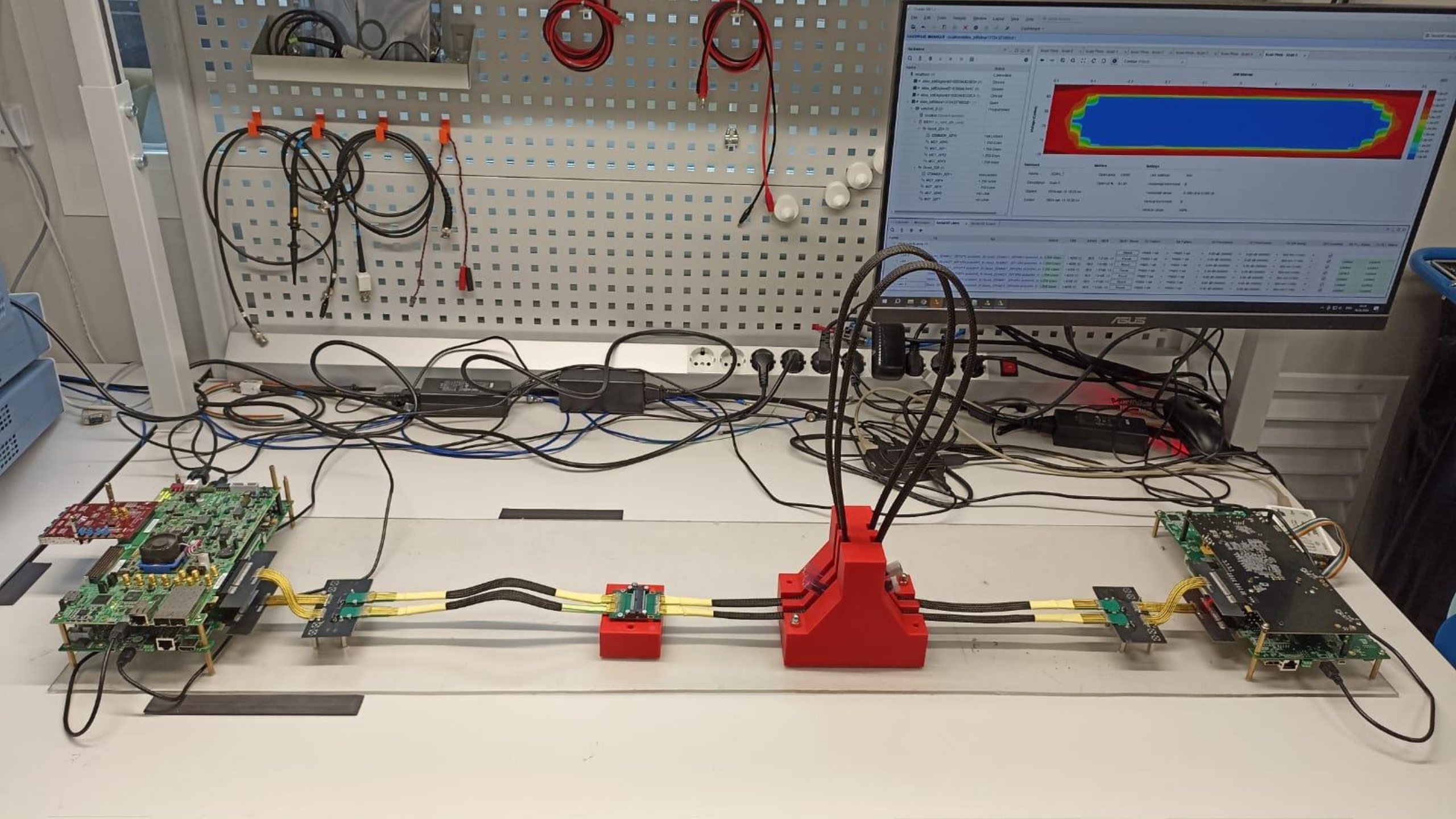
The Service Section from sketch to reality – work completed







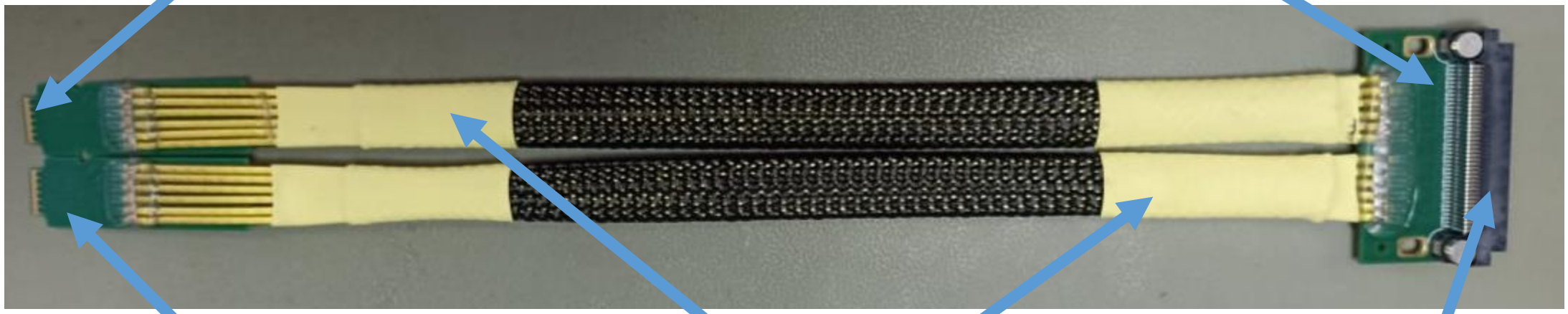
- Data communications by Raul Arteche & D.Andreev
- Power communications by A.Sheremetiev & D.Andreev
- Liquid & gas communications by D.Andreev & T.Lygdenova



INTERNAL DATA CABLE (From detector patch panel to the stave)

S-PCB-MOLEX-10006800107

ERF8-MOLEX-10006800107-V1-1



S-PCB-MOLEX-10006800107

Cables MOLEX-10006800107

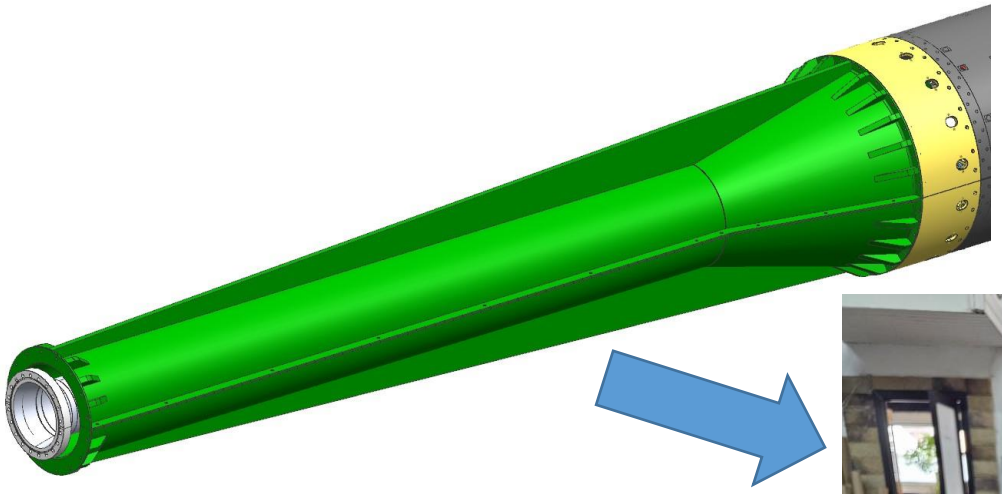
ERF8-040-01-S-D-RA-L

The MOLEX cables are in total 24 units of 1.25 meters, divided in 2 group of 12 cables.
Each group is formed by 6 cables on Top and 6 cables on Bottom

The following table reflects the total items required to assemble 1 unit of data cable to connect Half OB stave. We need 2 units per OB stave.

S-PCB-MOLEX-10006800107	Cables MOLEX-10006800107	ERF8-MOLEX-10006800107-V1-1	ERF8-040-01-S-D-RA-L
2 PCBs	24 Cables of 1.25 meters	1 PCB	1 Connector

The IC Technological Section from sketch to reality – work on-going

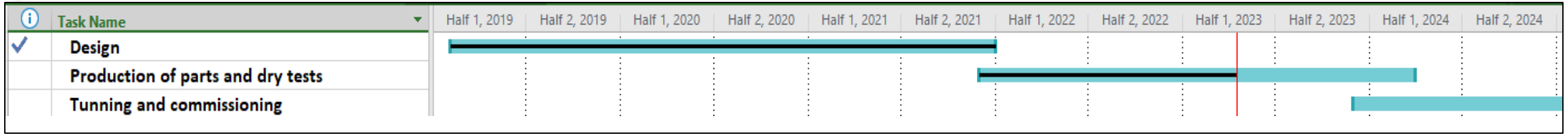


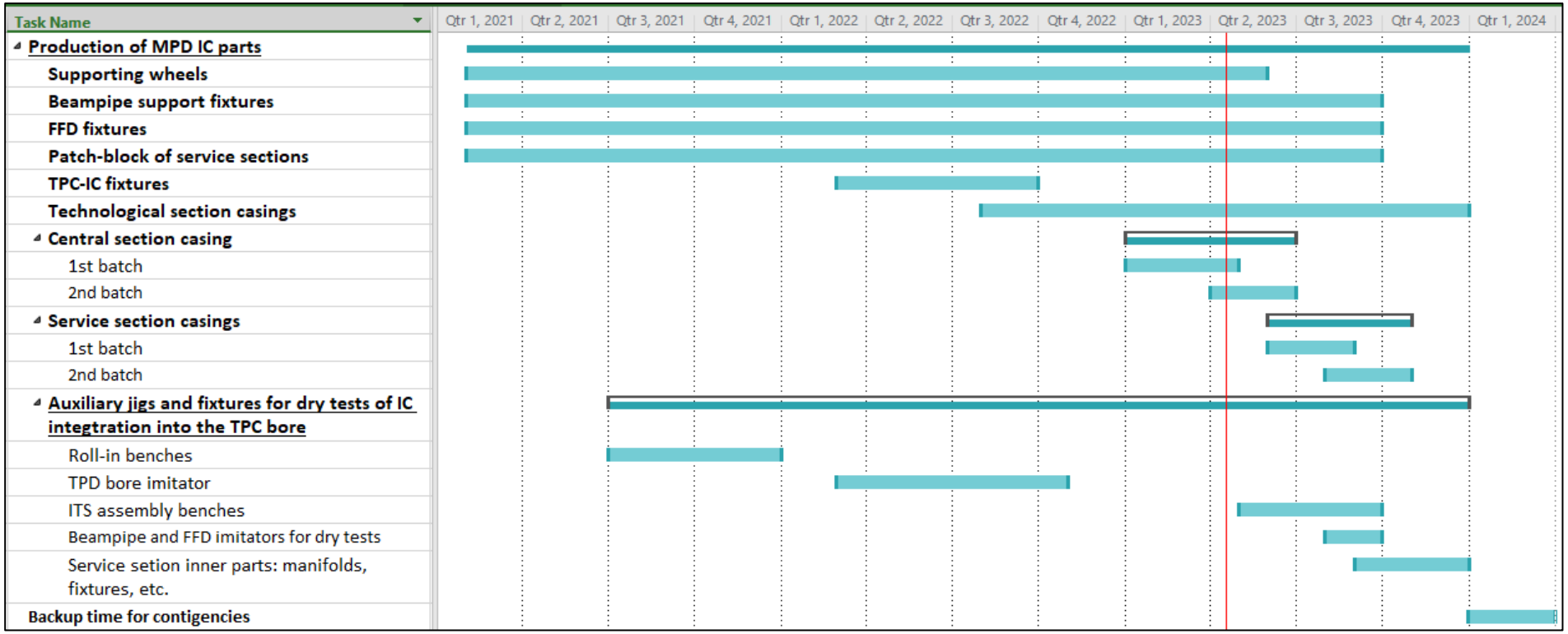
Ceramic mold

Preparations for CF lamination

- Designed by D.Andreev (VBLHEP)
- GrafitPro (Moscow) manufacturing

MPD Installation Container Workflow – 6 months accumulated delay





Summary - main achievements of the last six months

Good news

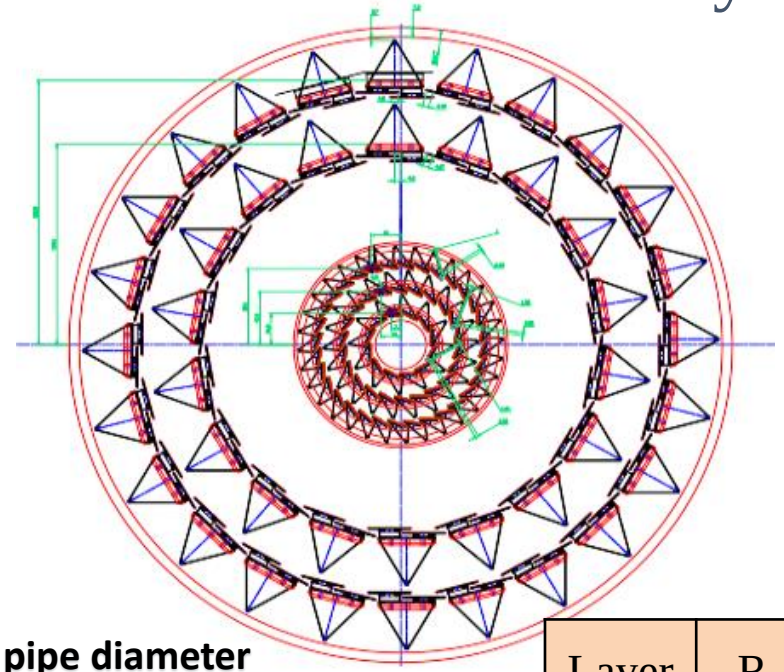
- MPD BP IC central & service secions completed
- Communications scheme for ITS finalization close to completion (Power lines are still to be acquired for serial production)
- Production of technological section caging by GrafitPro(Moscow) has stared

Bad news

- BP supports design is pending on unavailability of BP plastic mockup promised but not delivered by the collider vacuum team
- The IC interceptor design not yet started due to the same reason

Igolkin's upgrade of the ITS configuration – simulations on-going by V.Kondratiev et al (SPbSU)

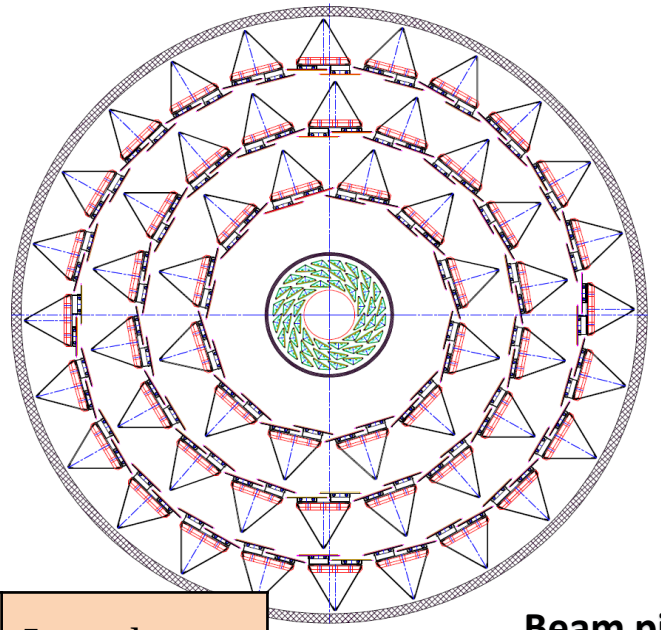
"Conservative" - 5 layers



Beam pipe diameter 65 mm

No chance for open charm ID !

"Progressive" - 6 layers



Beam pipe diameter 40 mm

Chance for open charm ID !

Layer	R_{min}, mm	R_{max}, mm	Length, mm
1	22.4	26.7	270-20-270
2	40.7	45.9	270-20-270
3	59.8	65.1	270-20-270
4	93.2	96.7	1526
5	144.5	147.9	1526
6	194.4	197.6	1526

Gap inbetween two HICs

Ups&Downs of the MPD ITS project

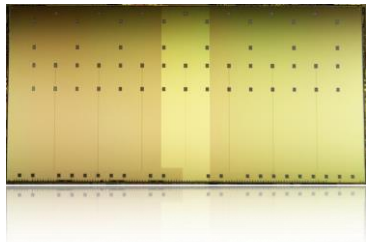
12 wafers (~ 500 chips) of MICA MAPS first prototype already ordered !

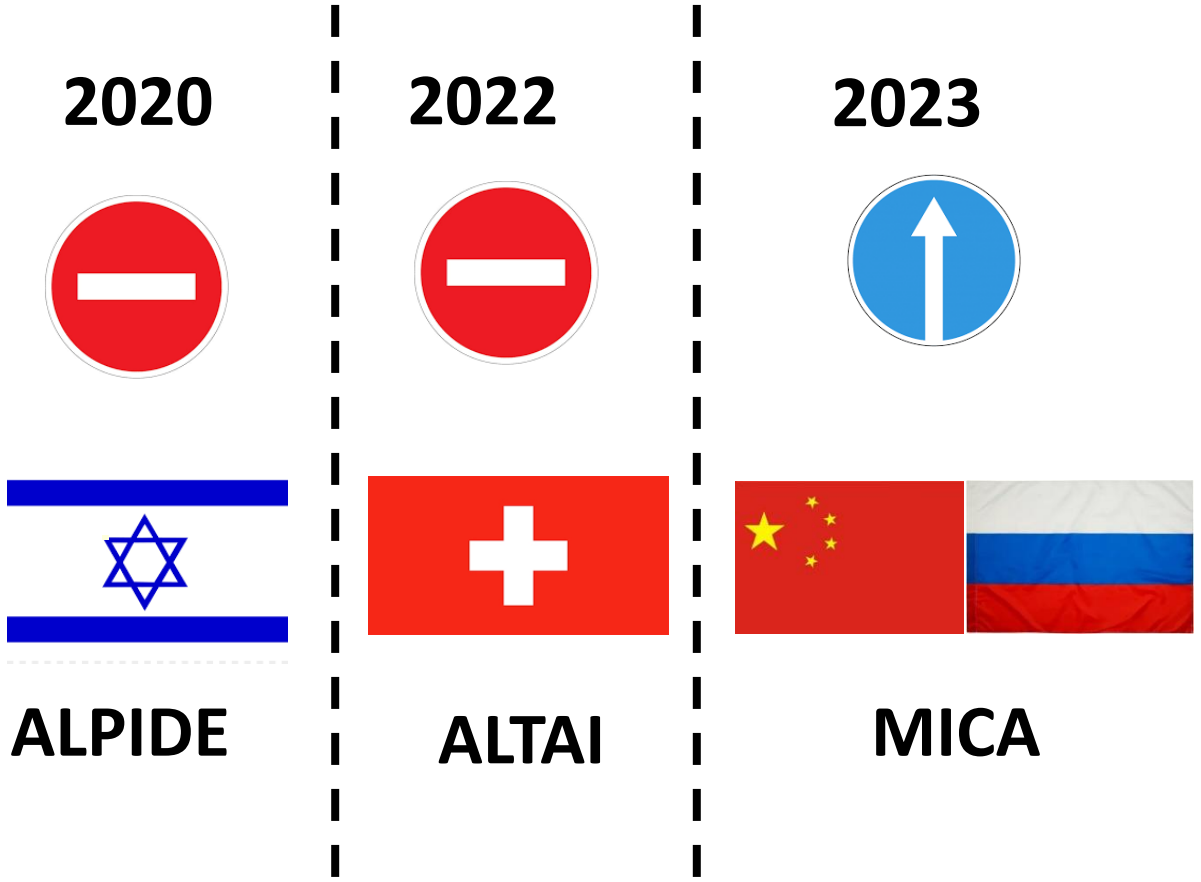
The tape-out of the MICA chip prototype already sent to the foundry at the end of February. Chips will be ready by July 2024.

The the first batch of 300 chips to be received at JINR by the end of 2024.

MICA MAPS pixel chip

- Domestic process
- Pixel Size: 27x31um^2
- Pixel Array: 512x980
- Front-end peaking time: < 2us
- Pulse discrimination time: 5-10 us
- ENC < 10e-
- Power consumption < 40mW/cm^2





The long-term sustainable cooperation with three Chinese teams

NICA-MPD/ITS Seminar on China-Russia Cooperation, Wuhan, 2023.06.15-16

Participants: JINR, CCNU, USTC, IHEP and IMP.

Our proposal: A joint development and construction of **Monolithic Active Pixel Sensors (MAPS)** for fundamental and applied science experiments **including front-end electronics** to make this technology **freely accessible** to China and Russia.

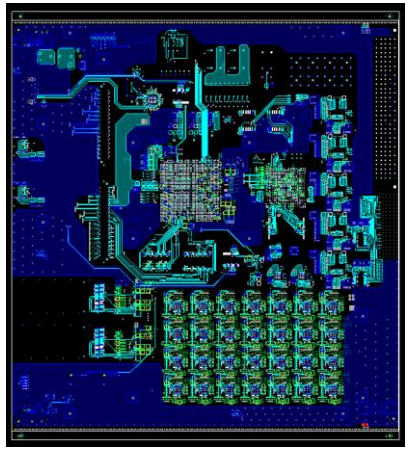
Main microeltectronics deliverables: MAPS, FPGA-based RU and ASICs-based RU.

murin@jinr.ru

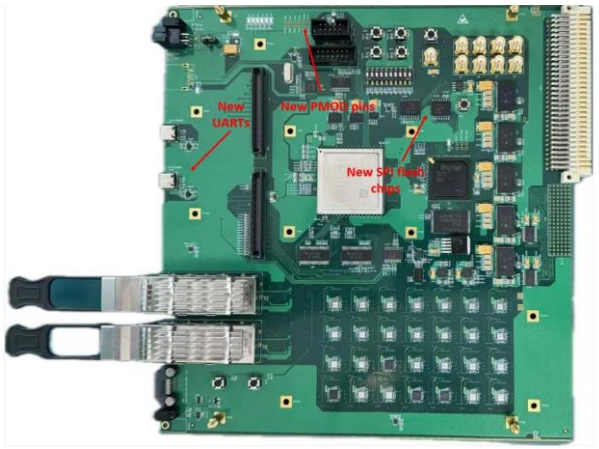
XIII-th MPD Collaboration Meeting, Dubna 23.04.2024
murin@jinr.ru

RU Prototype V2

- PCB fabrication has been completed
- PCB board has been soldered



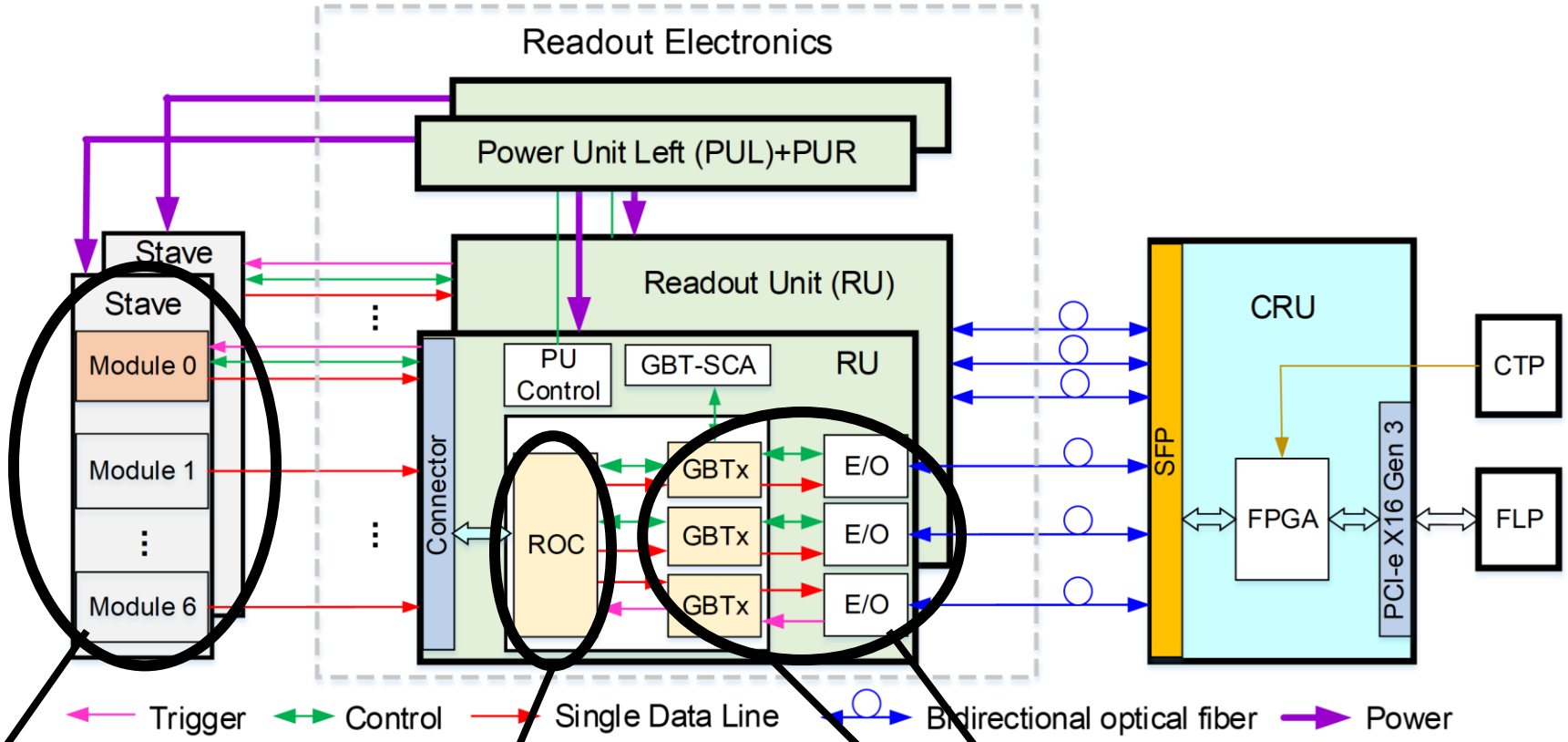
- Basic function of both FPGAs are tested
- UART ports are tested
- SelectMAP tested
- ICAP tested
- SEM core function tested
- GBT data link tested
- Manual error injection methods tested



FPGA-based RU is Ready now

Current Status - Readout Unit (ASICs-based)

"Courtesy of Di Guo (CCNU)"



Monolithic Active Pixel Sensor (MAPS) ASIC

NICA_ROC:
Data collection and control distribution ASIC

NICA_GBT family (3 chips + optical module)

NICA_ LD : Laser Driver ASIC

NICA_TIA : Transimpedance Amplifier ASIC(Receiver)

NICA_GBTx: Bi-directional data interface ASIC

Note: NICA_LD and NICA_TIA are inside the optical module

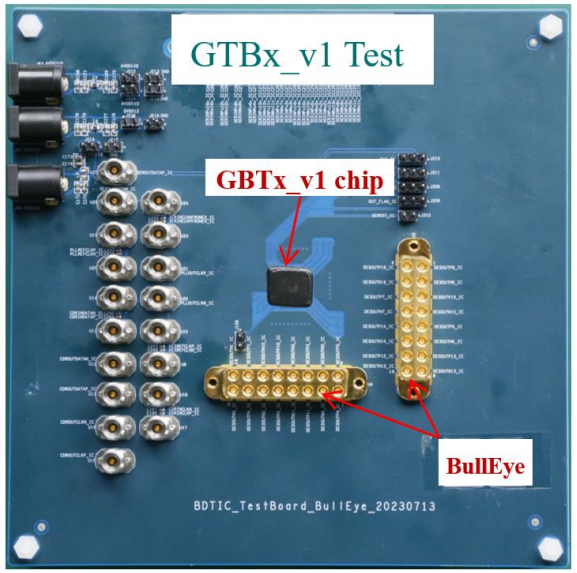
Current Status - Readout Unit (ASICs-based)

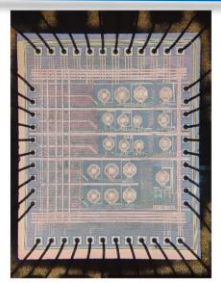
GBTx Series Chips

- Analog core sub-modules in GBTx ASIC have been designed, taped-out and verified:
  - 5.12 GHz PLL √
    RMS Jitter:474.70fs
    -113db@1MHz
  - 2.56 Gbps CDR √
  - 2.56 Gbps 1: 16 Deserializer √
  - 10.24 Gbps 16:1 Serializer √

- The first version of LD (Lase Driver) and TIA (Transimpedance Amplifier) ASICs have been designed and the core functions have been verified. √

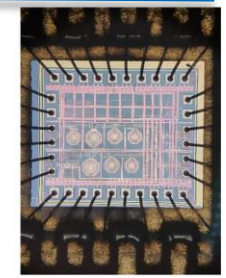
- Related results have been published on behalf of the collaboration work group.



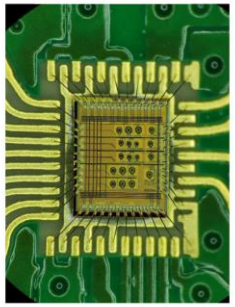


TIA Chip

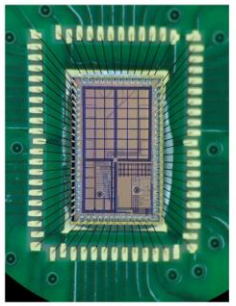
PLL+Deser for GBTx chip



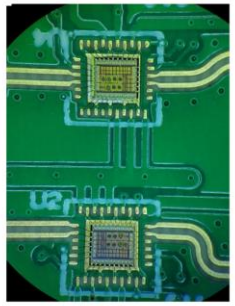
LD Chip



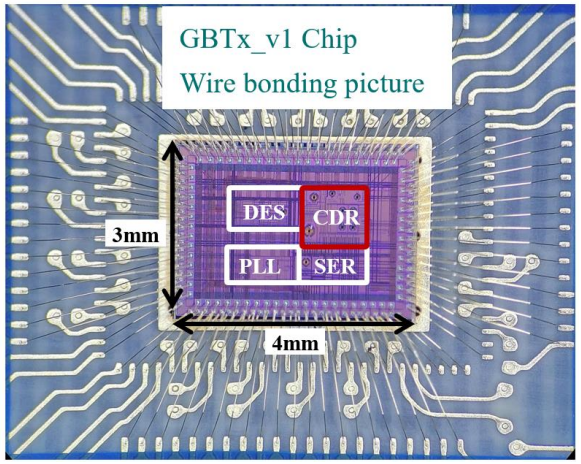
TIA Chip in test

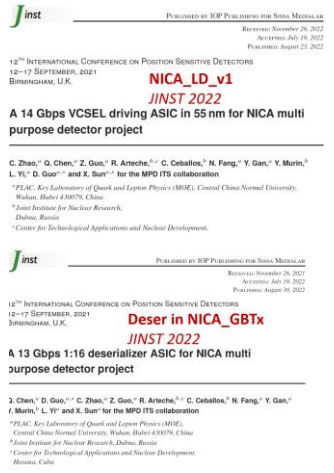


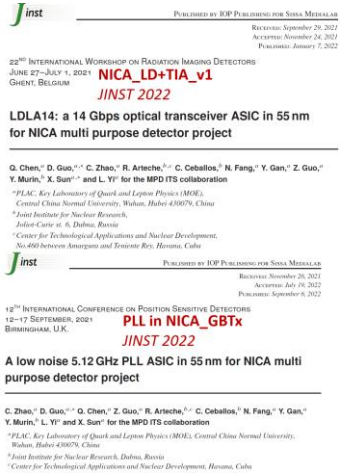
PLL+Deser in test



LD Chip in test



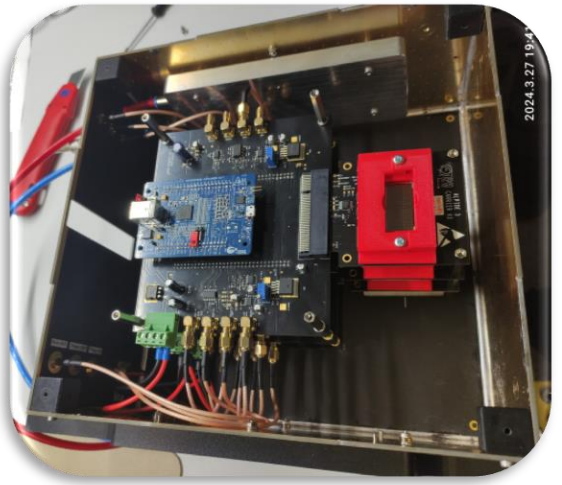




Preparations for the MICA in-beam test with 1 GeV protons (1/2)

- D.Dementev, A.Sheremetiev, M.Shitenkov,A.Kolzhvari,V.Leontiev, R.Arteche, A.Rodrigues

Beam telescope with 3 layers of MAPS & 6 layers of DSSD sensors



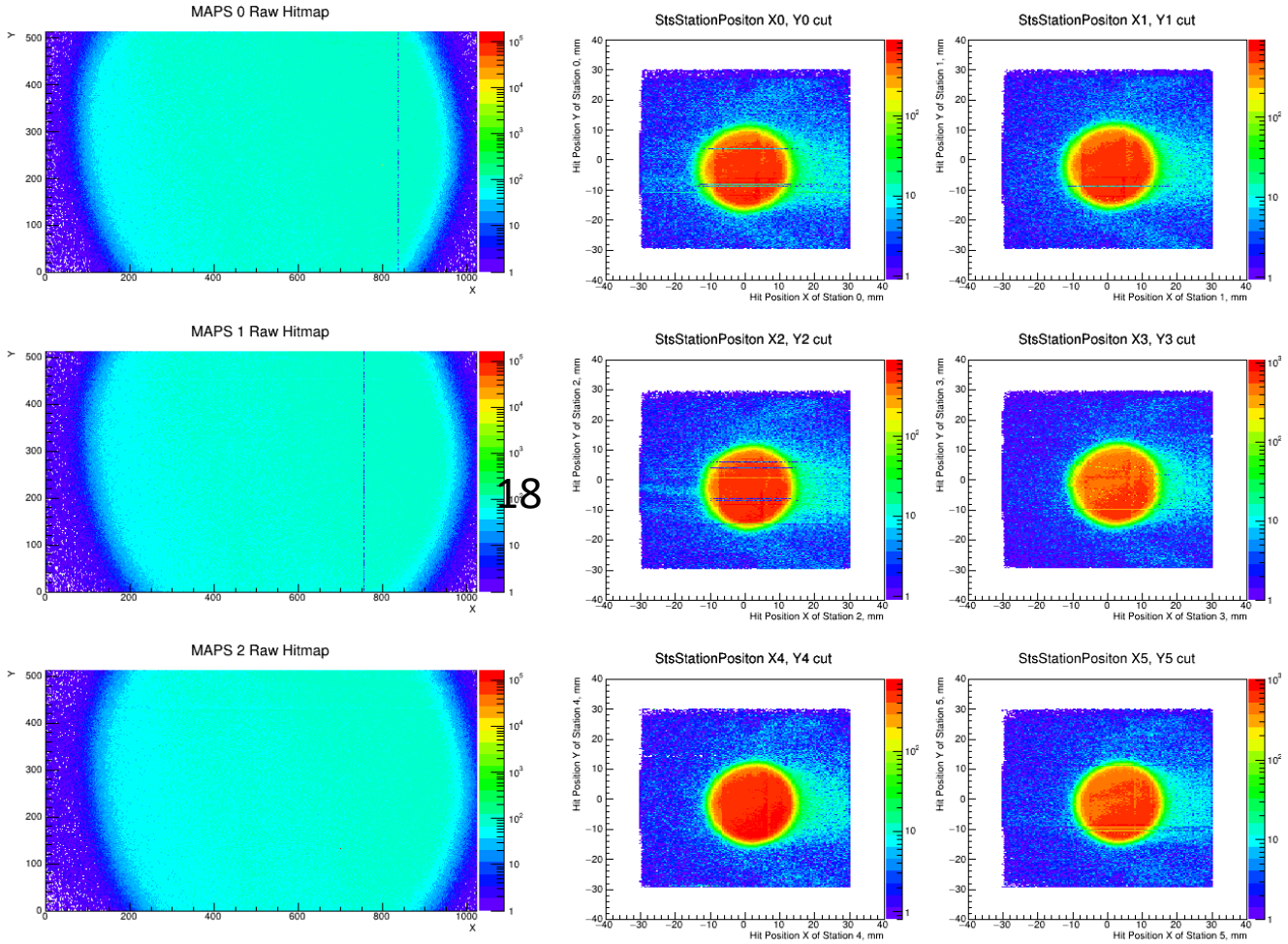
Three layers of MAPS detectors

Module with DSSD sensor (BM@N STS)

Tests at SC-1000 in PNPI (Gatchina) with the proton beams:

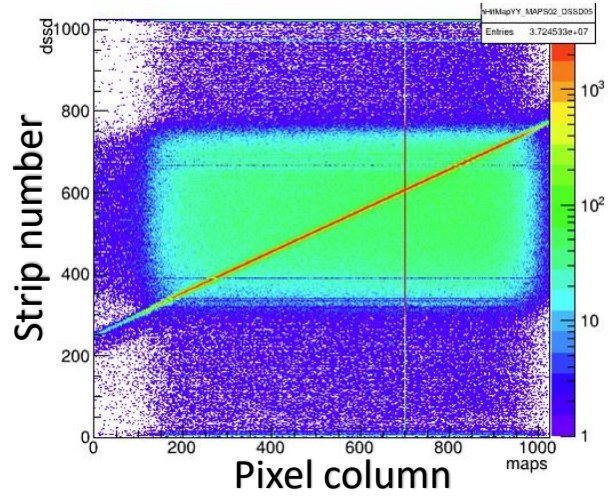
- 1 GeV protons with intensities $10^4 - 10^5 \frac{p}{cm^2 \cdot s}$
- 200 MeV protons with intensity $\sim 10^4 \frac{p}{cm^2 \cdot s}$

Preliminary results with 1 GeV protons (2/2) – analysis started by I.Rufanov

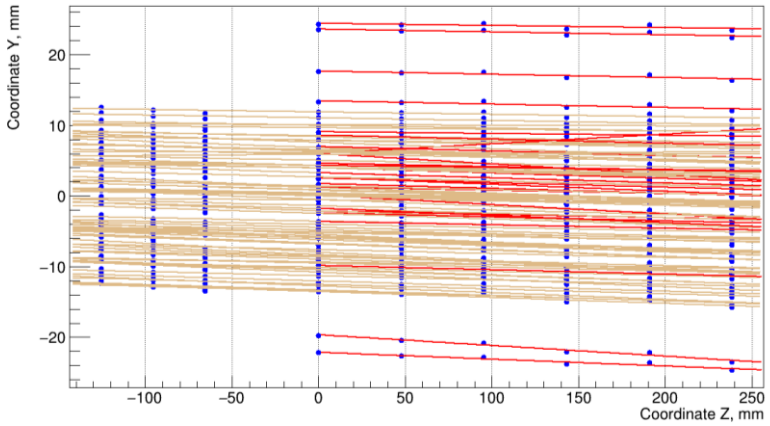


Beam profiles in MAPS (Sens. size: 15×30 mm²)

Beam profiles in DSSD (Sens. size: 60×60 mm²)

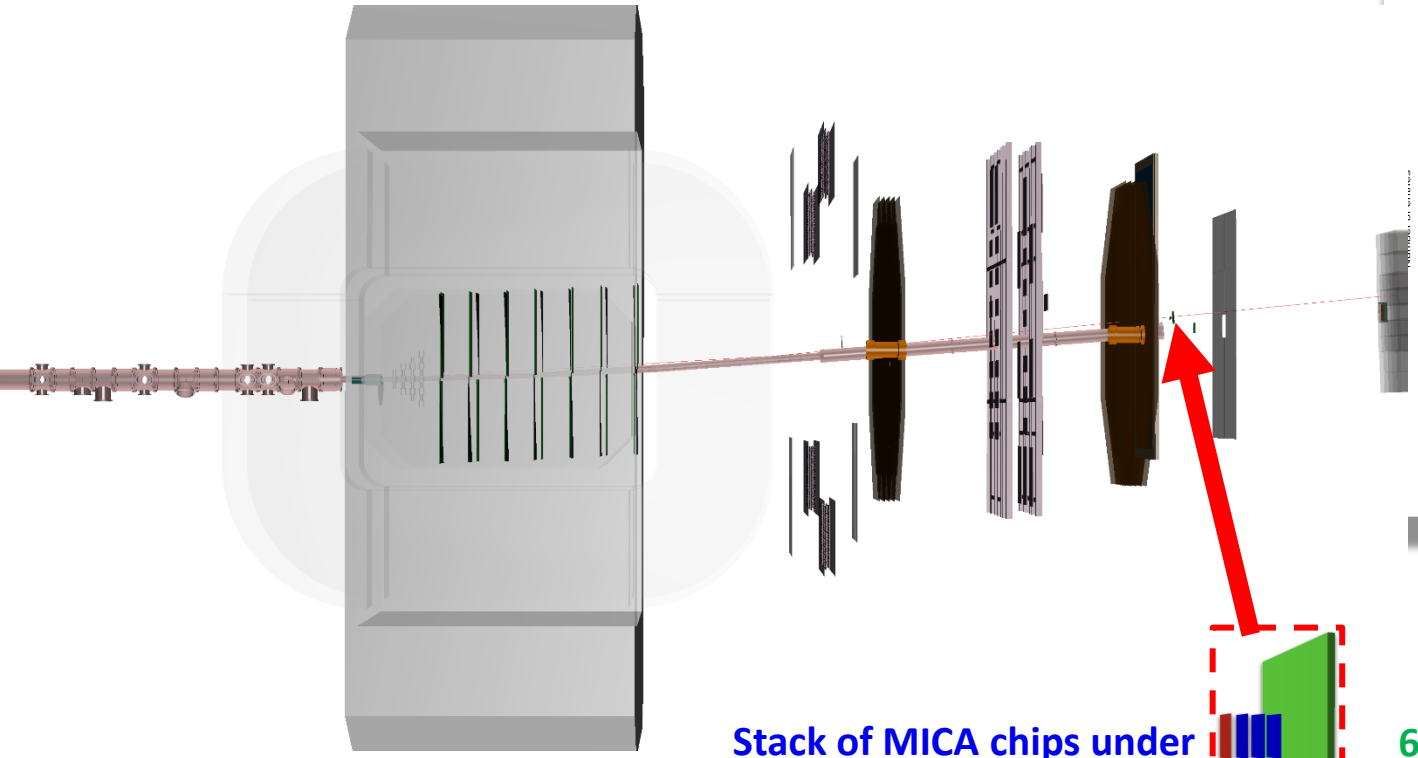


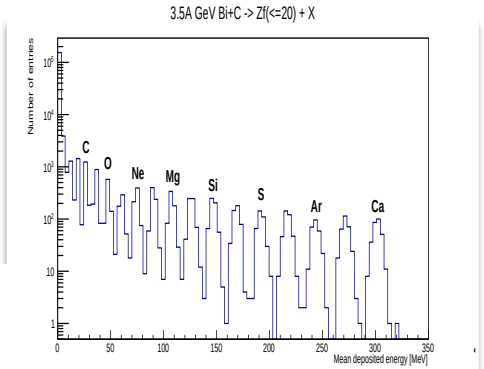
Space correlations between MAPS & DSSD

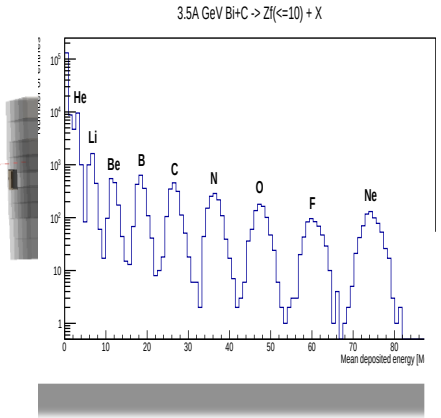


2D Tracks

MICA in-beam test with tagged fragments of projectile nuclei (2/2)

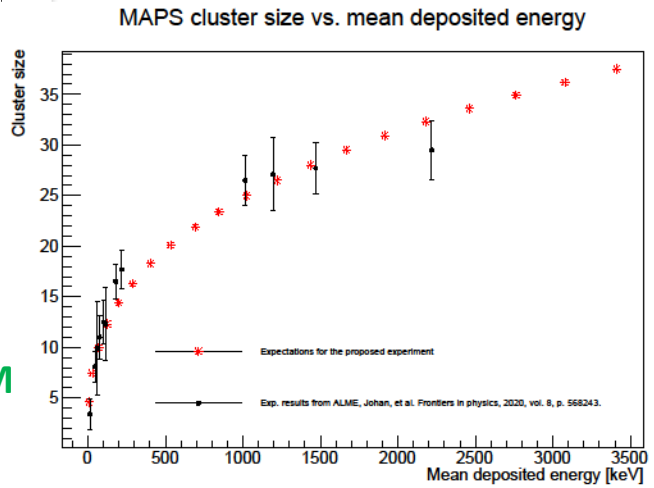






Stack of MICA chips under test

64 ch plastic hodo SiPM



- **R.Solne, et al. – to be presented at the BM@N Collaboration Meeting in mid May in Almaty**


NEVER
GIVE
UP


Thank You