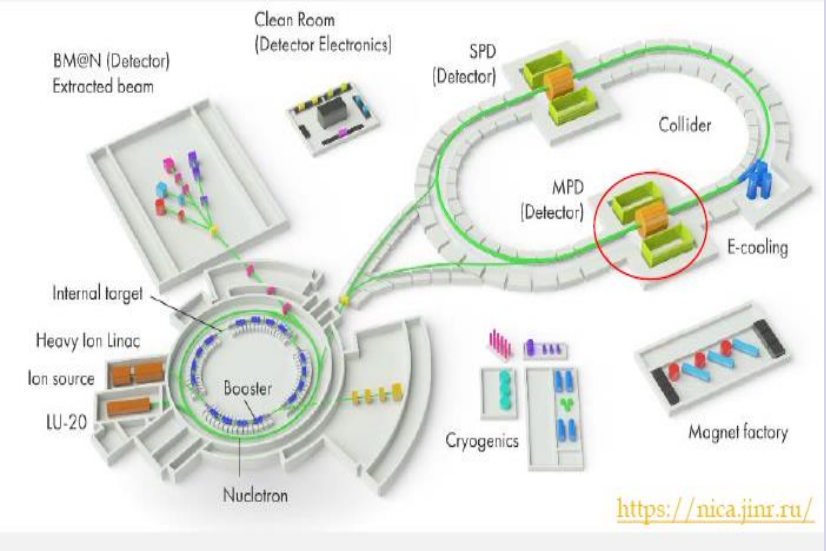
MPD TPC status (25.04.2022)

- TPC parameters
- ROC chambers
- Gating grid system
- TPC vessel assembly
- Front end electronics
- Gas, cooling, laser and SC systems
- Cabling and piping
- Integration TPC to MPD
- Time schedule



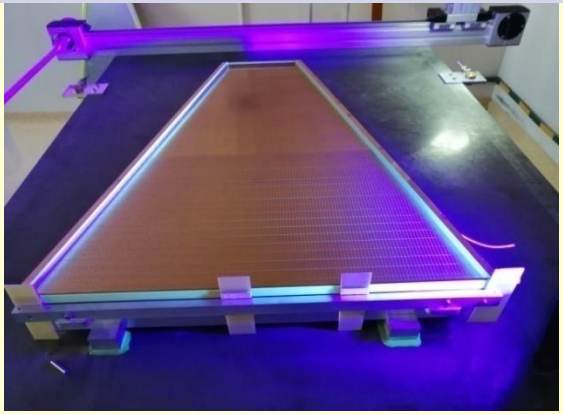
Presented by Sergey Movchan

JINR team: 24 persons
Belarus: 6 persons
~~**UW Poland: 5 persons**~~

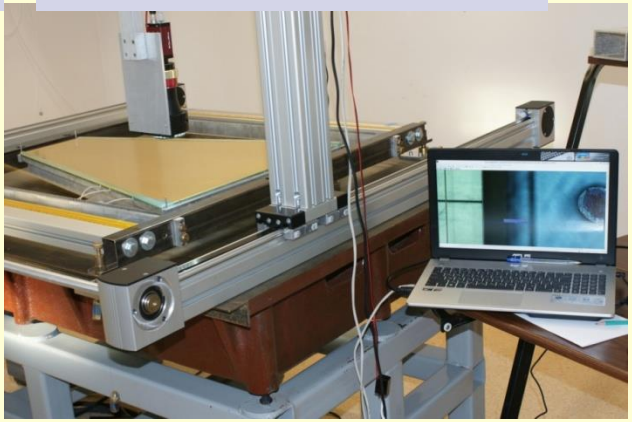
ROC chambers status

24 pc tested ROCs in stock

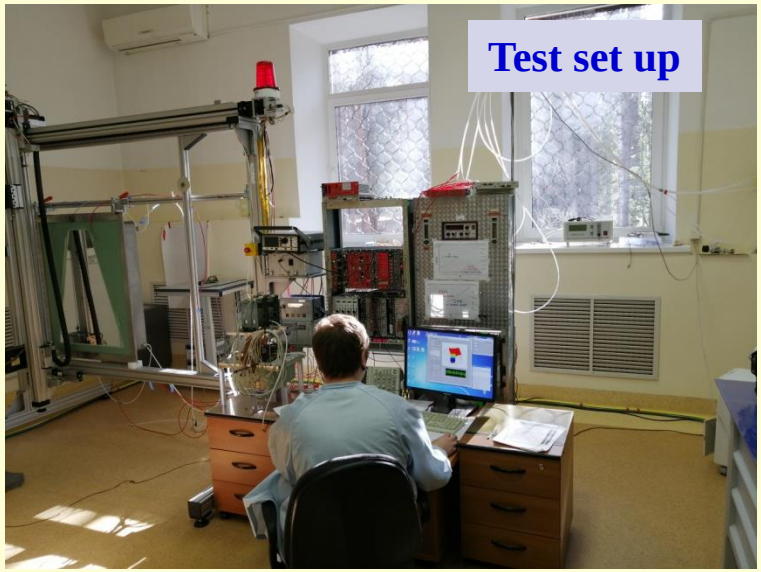
ROC cleaning procedure



Wire pitch check set up



Test set up

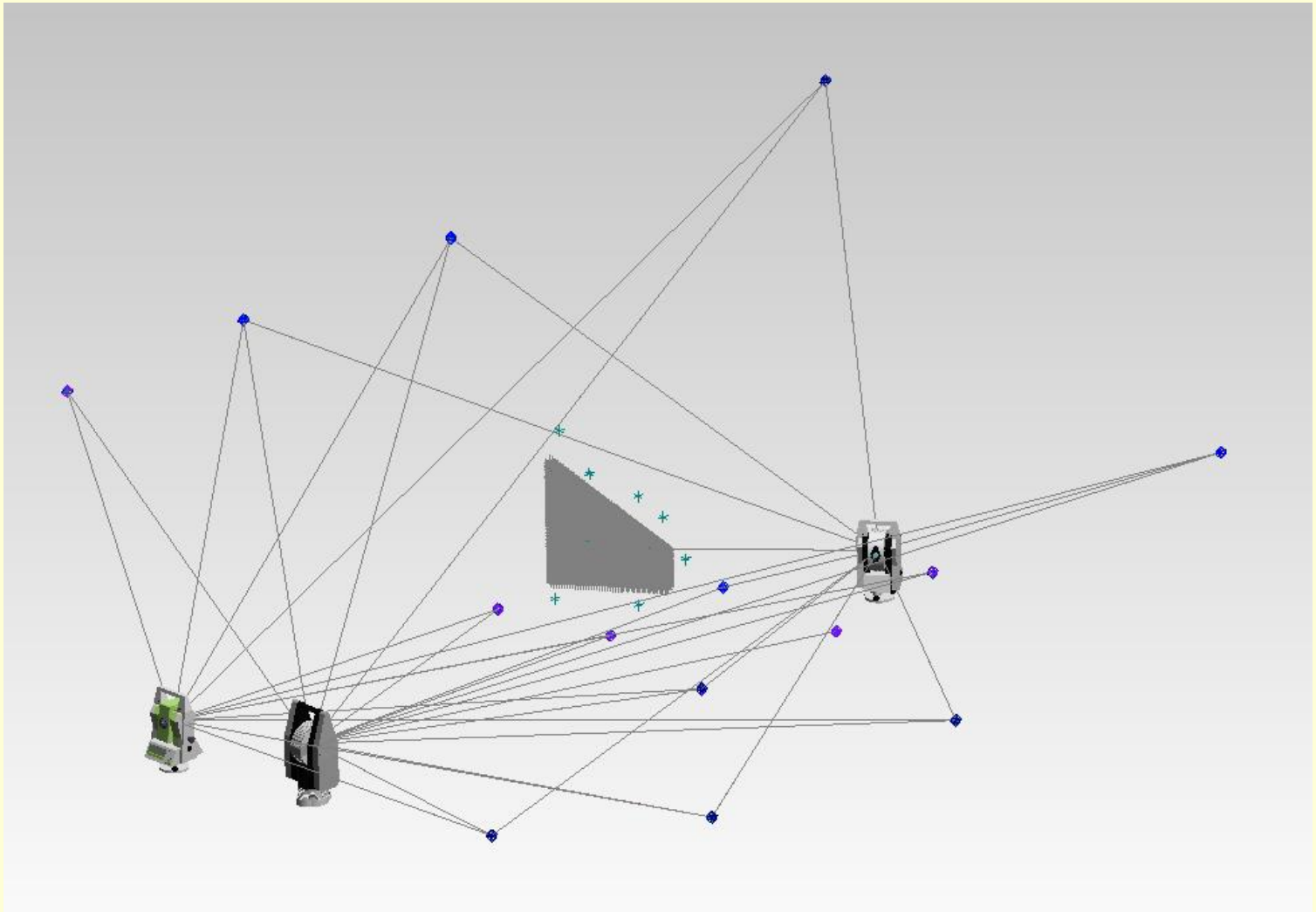


+ 2 pc spare – tests in progress

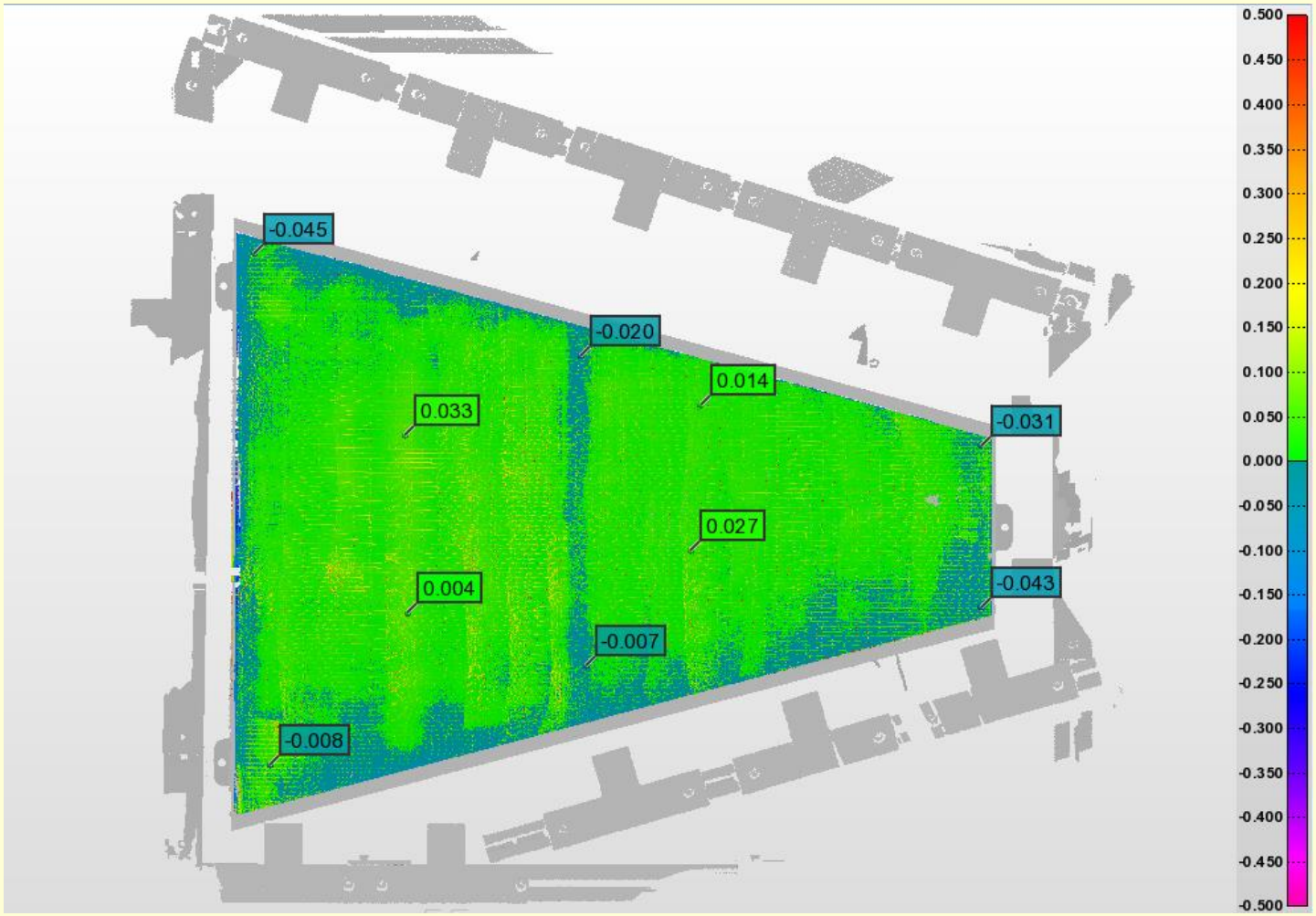
Set up for pads calibration respect to ROC alignment pins

Leica MS60 - 1 second
Leica AT960 +/-10 mkm +5 mkm/m
Leica AT403 +/-15 mkm +6 mkm/m
Scaner AS1+AT960 +/-50 mkm

Calibration scheme

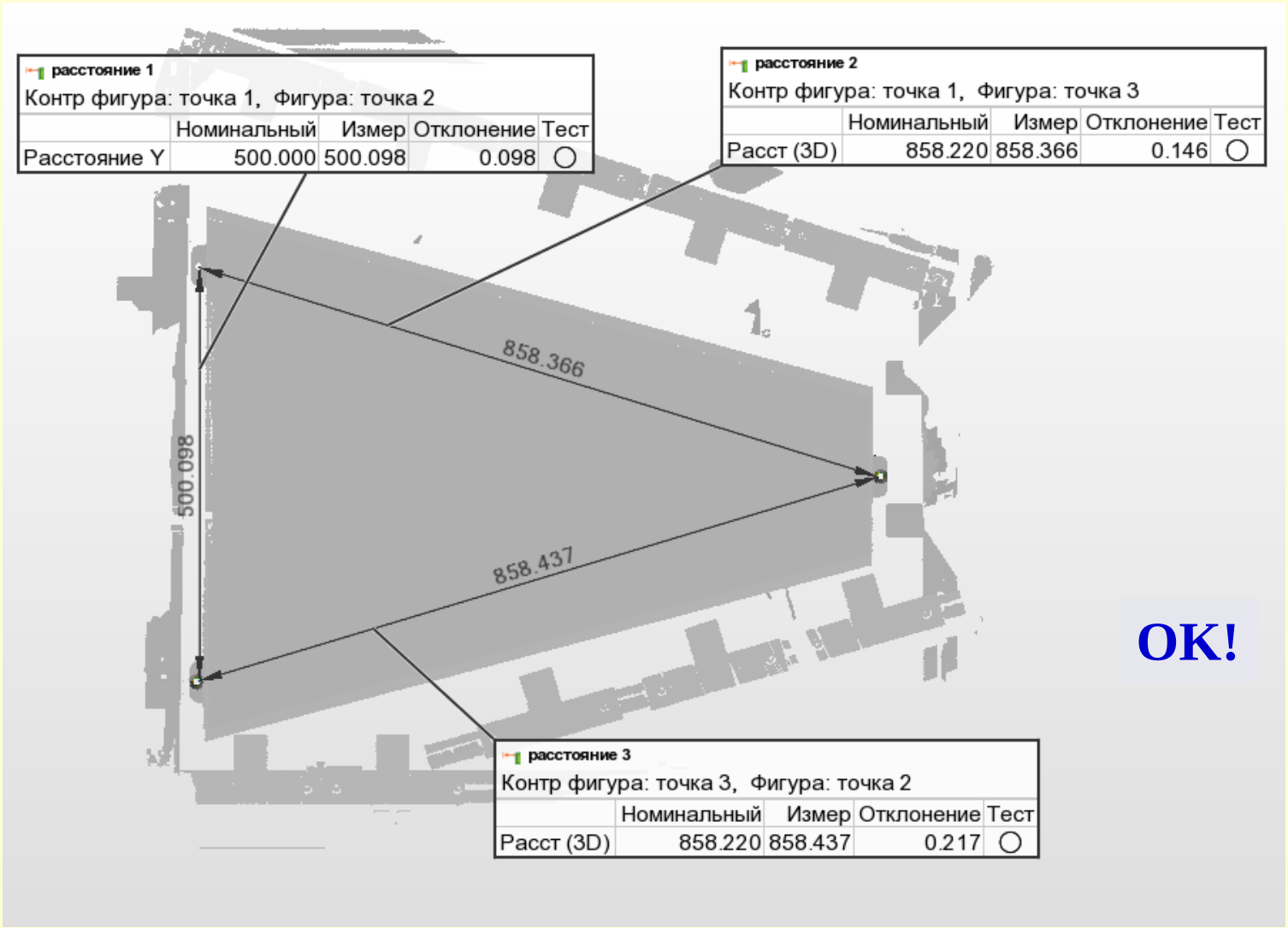


Pad plane unflatness: example



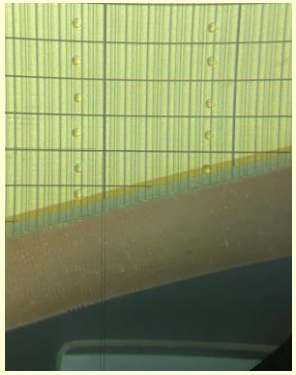
+/- 30 mkm

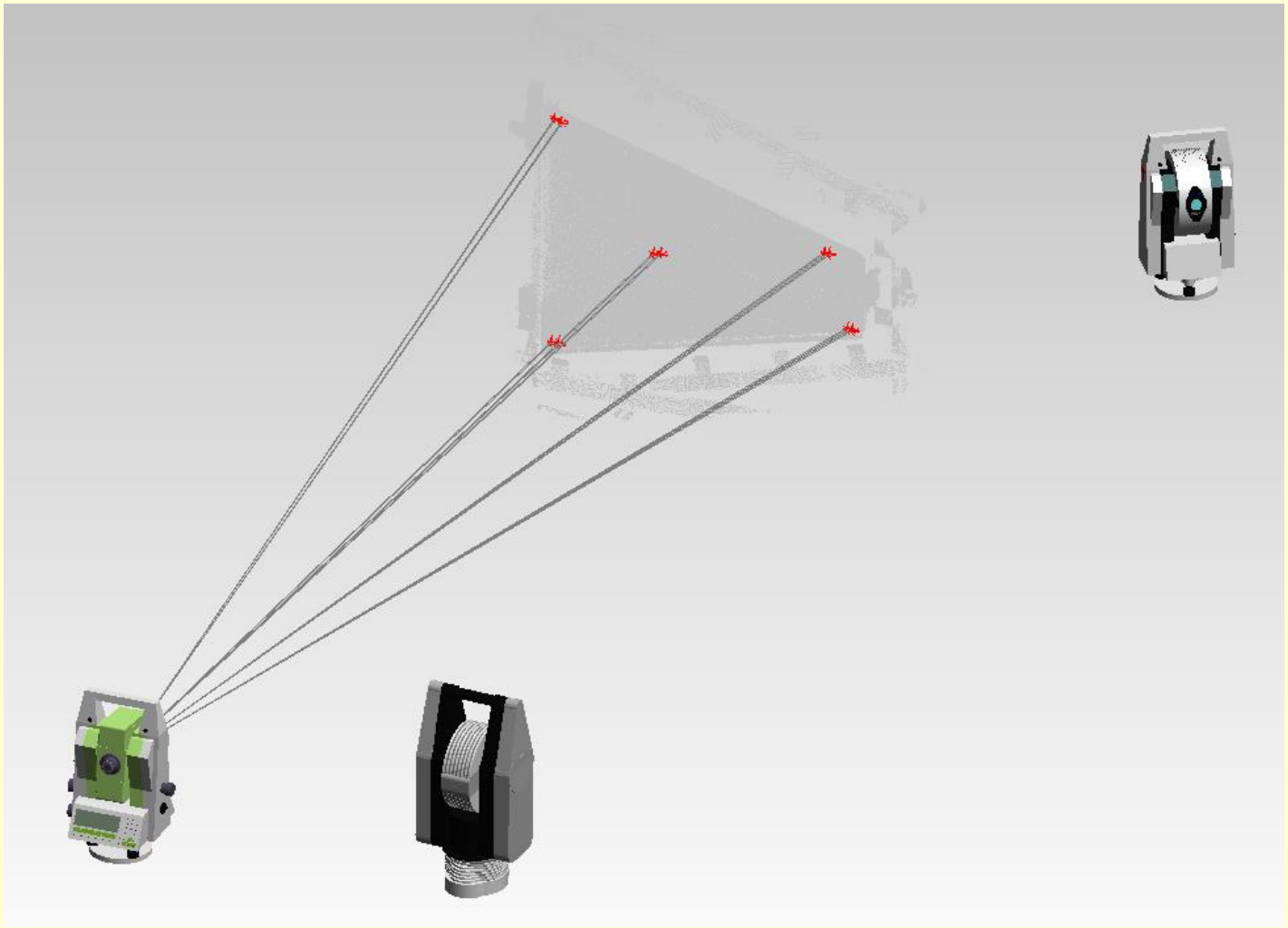
ROC frame geometry check



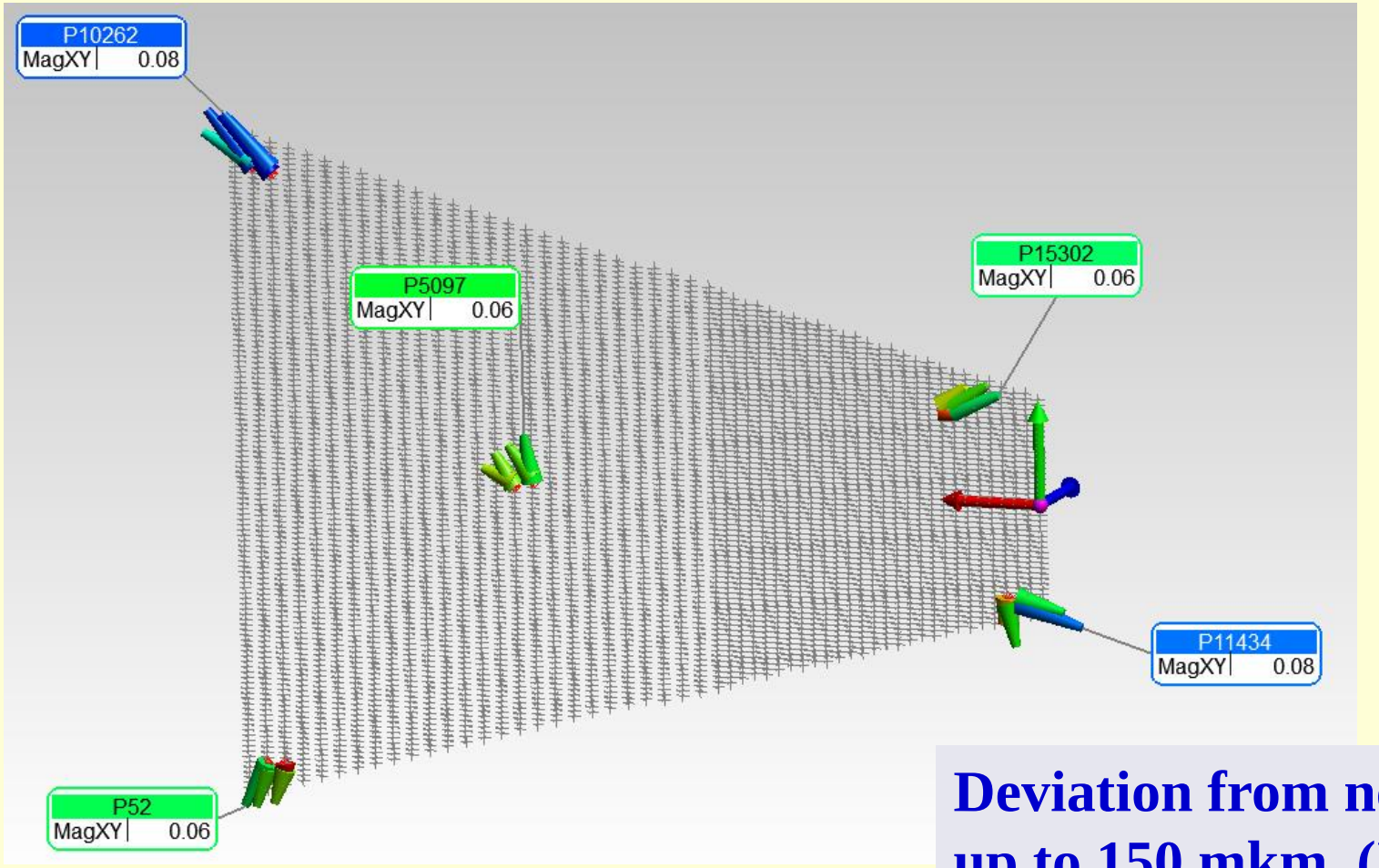
OK!

Pads position measurement scheme



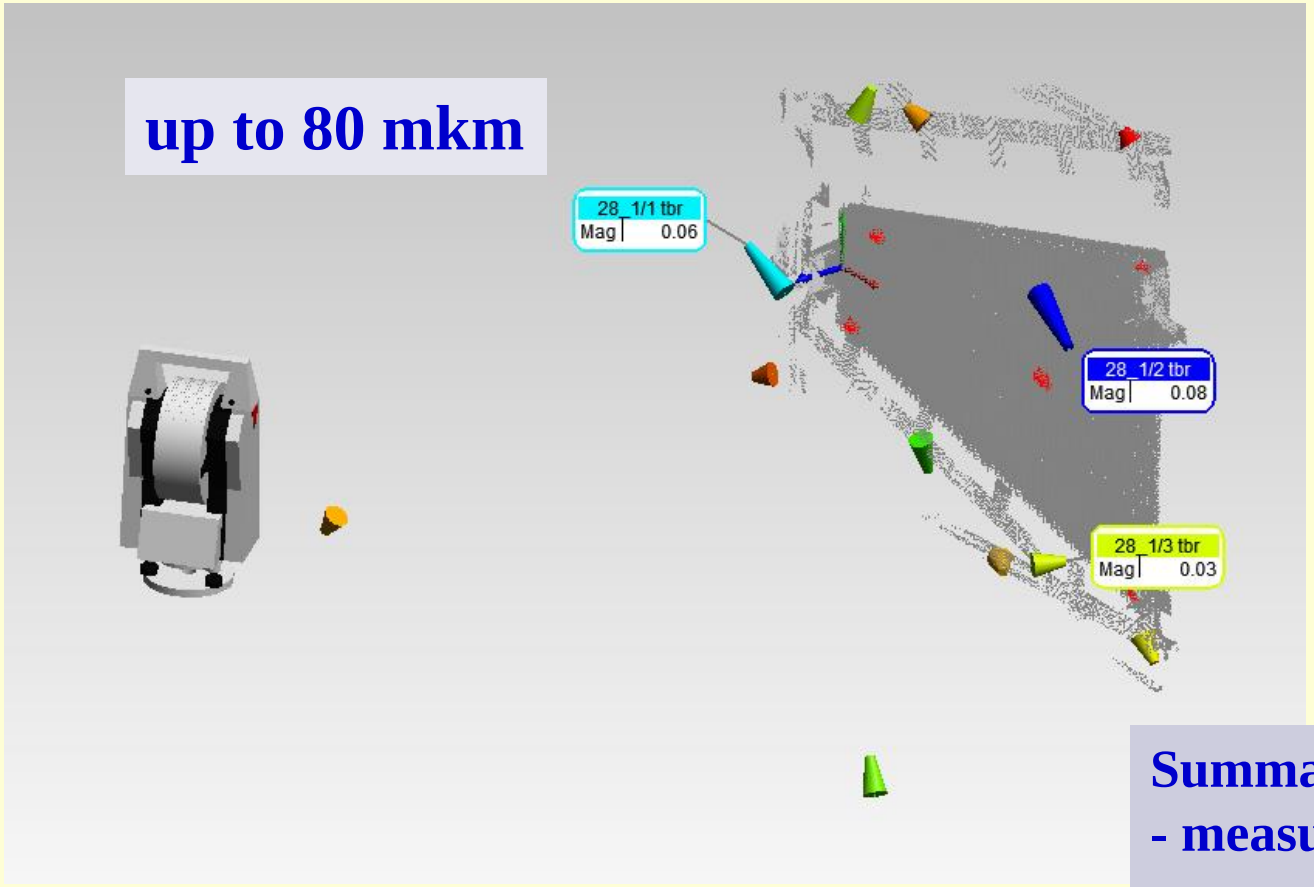


Pads geometry deviation from nominal: example



Deviation from nominal – up to 150 mkm (X and Y)

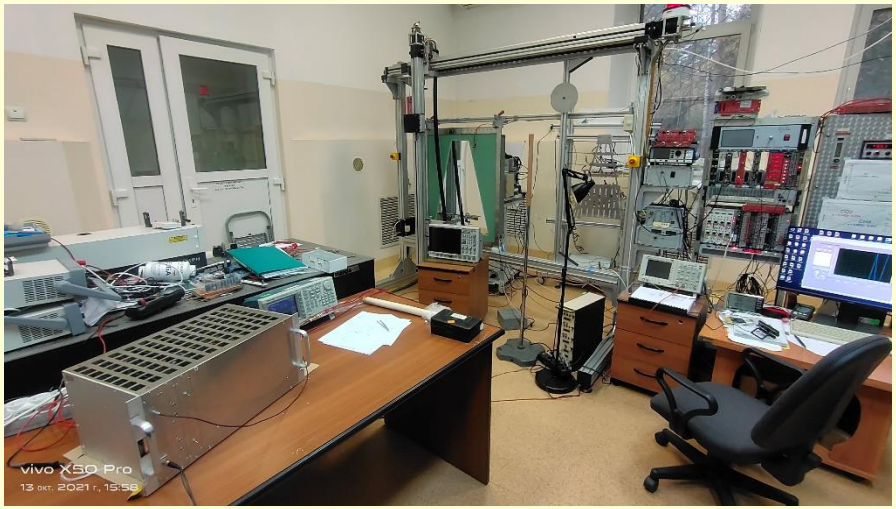
ROC alignment pins (deviation from nominal): example



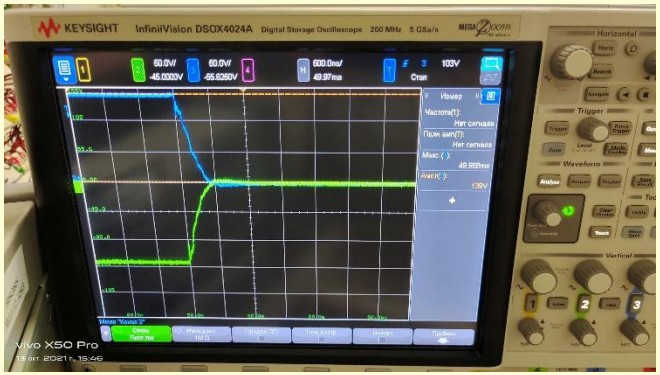
Full set of photogram-metry marks for all ROC chambers

Summary:
- **measurements for all 30 pc ROC – done**
- **ROC pins-pads alignment – in progress**

ROC gating grid system (Minsk)



Pulse rise time - 500 ns, OK!



Mass-production – started

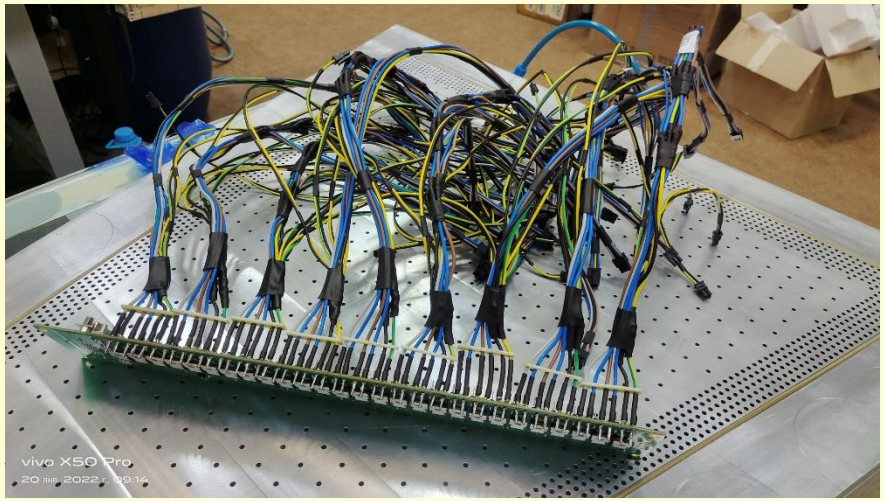
Delivery to JINR – Dec 2022

FE radiators and LVN9+ FE power cables

Delivered – Dec 2021

LVN9+ FE power cables

LVN9+FE power cables: one board



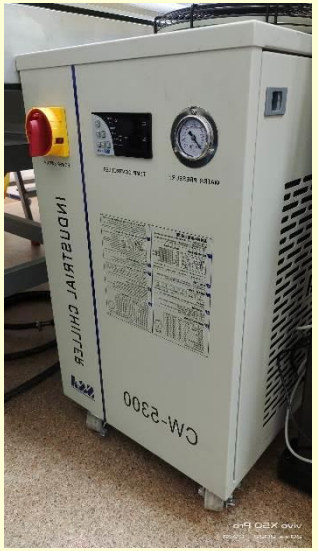
60 pc were send back to Minsk.
Power cables modification – done

Test of LVN9 with cooling radiators under full load (analog – 70 A, digital – 50 A) – in progress

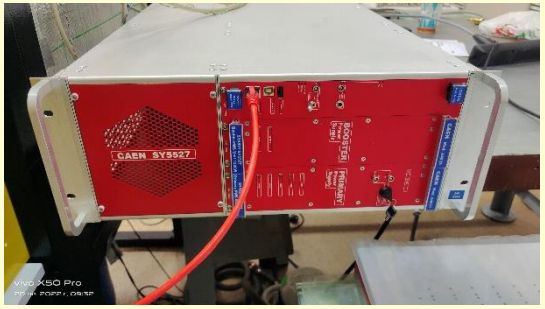
Set up for cooling tests (ROC+FE)

Set up

Chiller

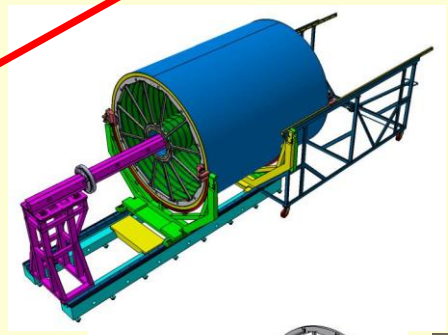


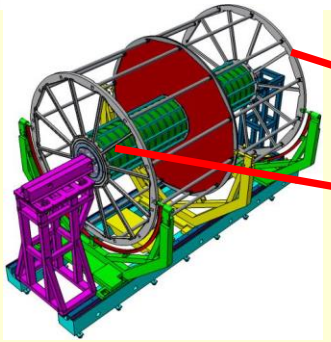
LV power

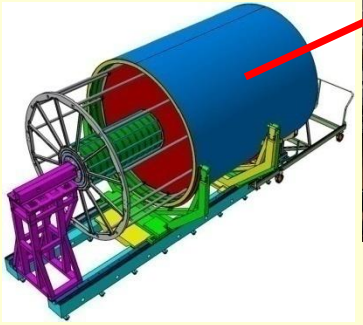


Tests – in progress

TPC vessel assembly (Bld.217) – common view

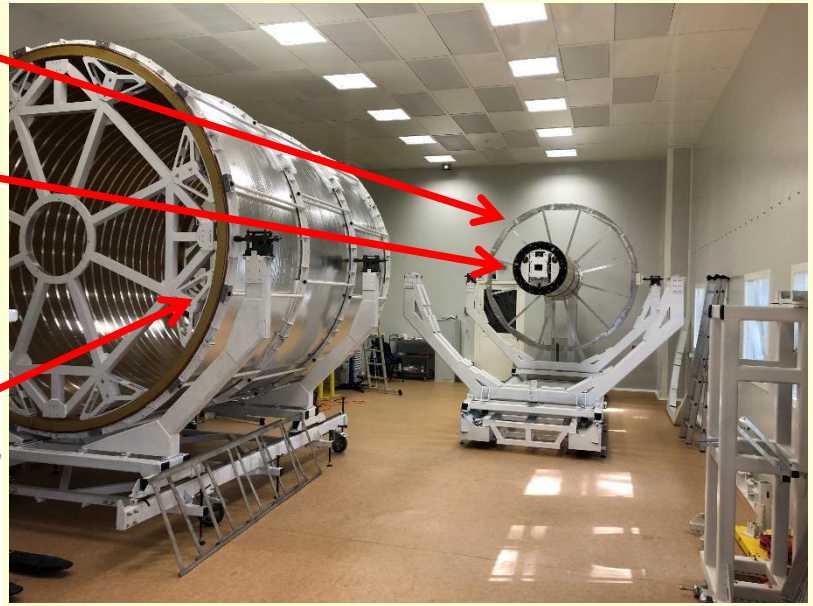






HV membrane – tested (NO corona)

Field cage roads – in assembly

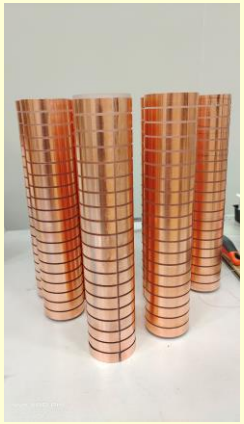


TPC assembly – in progress

TPC field cage rods assembly

Set up for field cage elements assembly

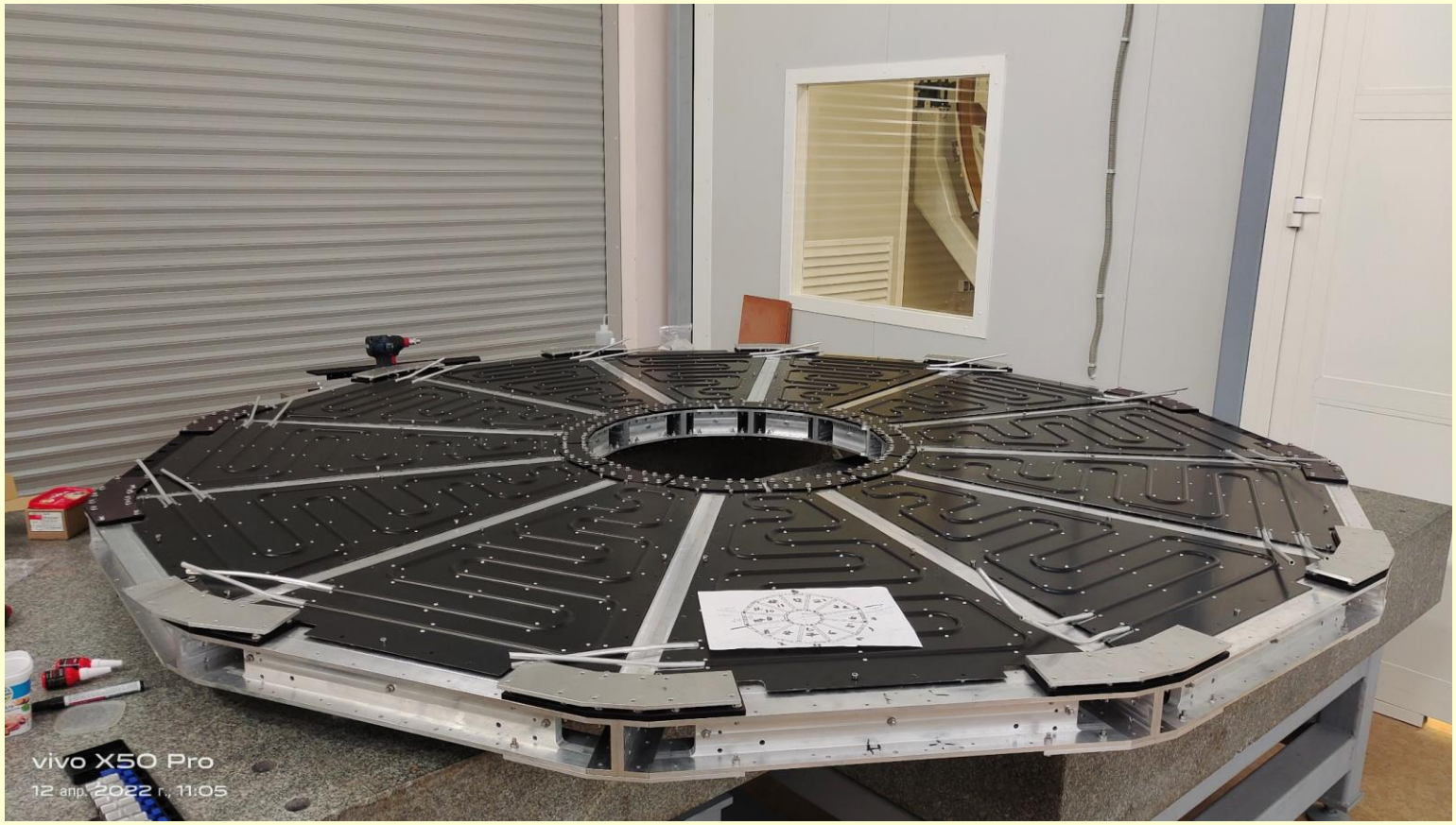
Set up for rods assembly



Rods D=30 mm – 30 pc assembled

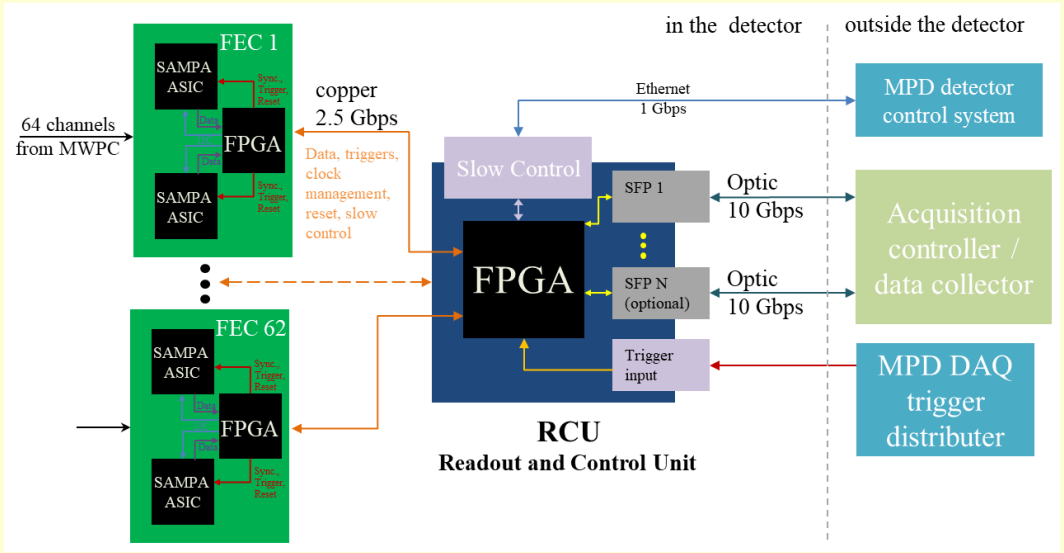
Rods D=60 mm – assembling started

TPC service wheel: status (Bld.217)

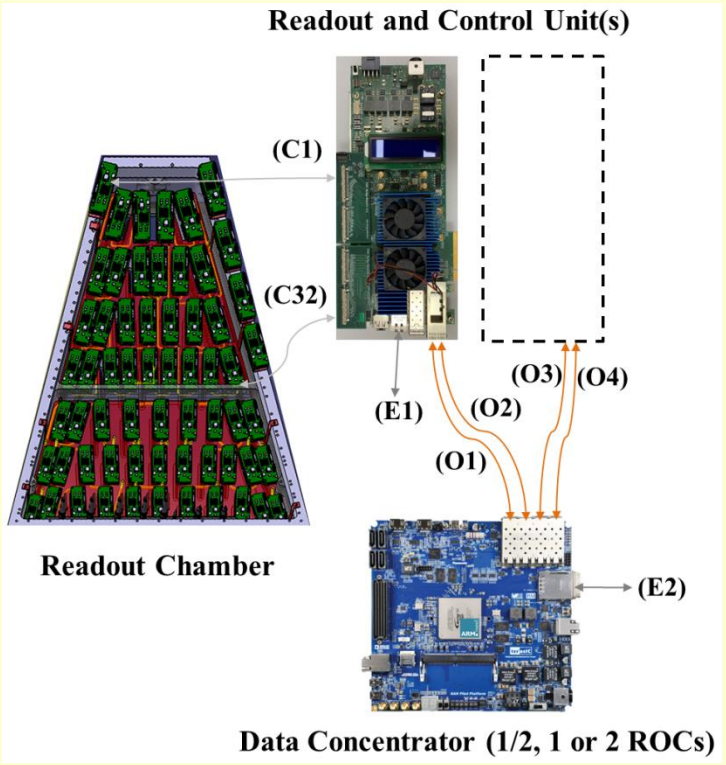


One service wheel - assembled

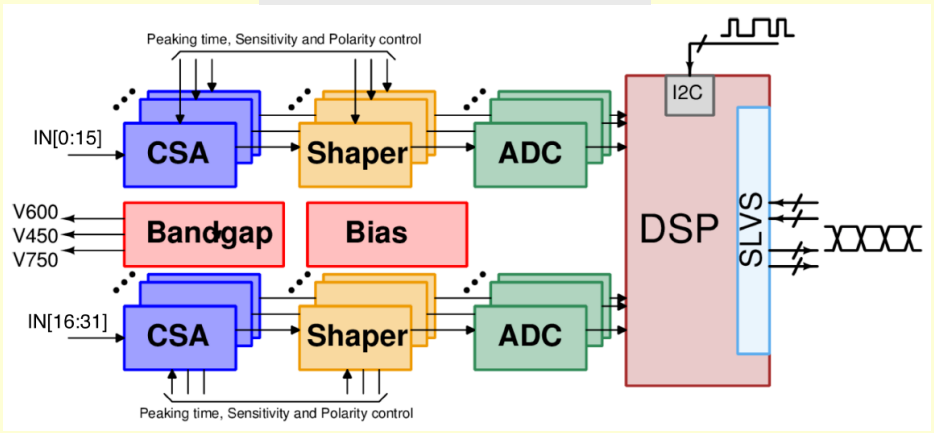
TPC electronics: block diagram of one chamber readout



RCU and data concentrator based on commercial kits

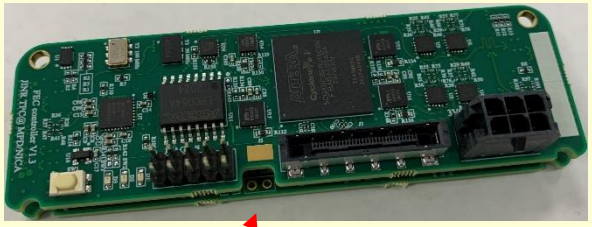


SAMPA chip



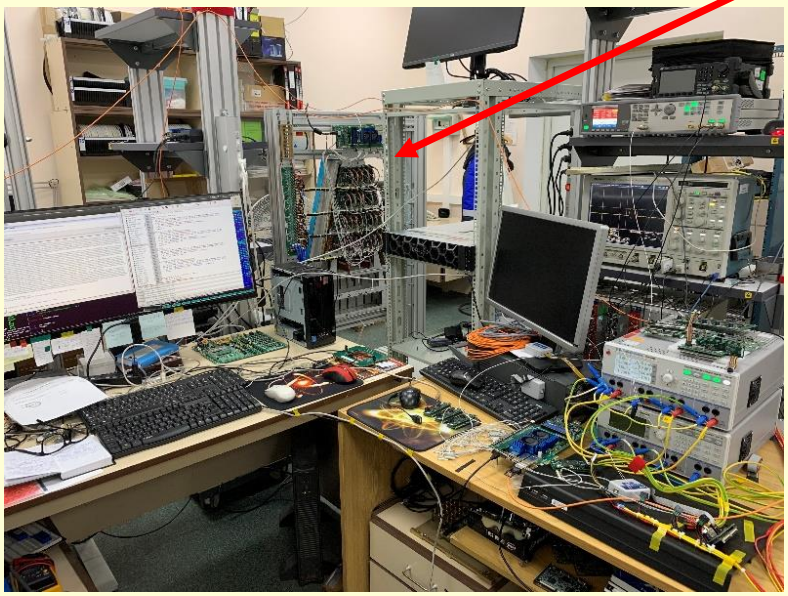
TPC electronics: test set up

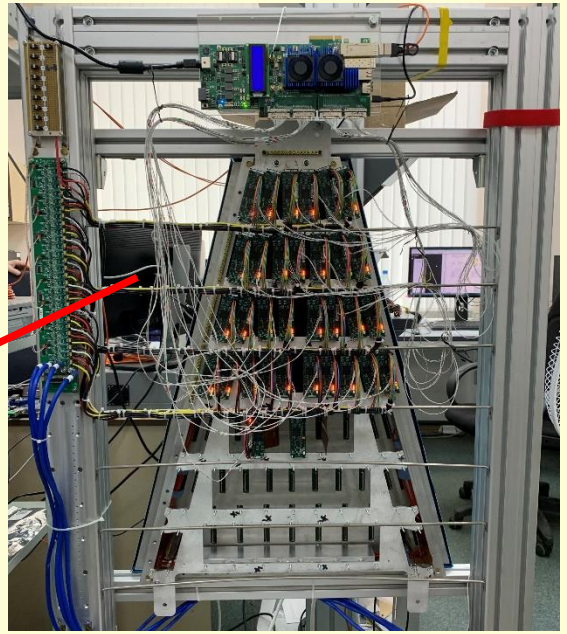
Production version of the FE card:



Connection holes for analog power supply added

2048ch readout system powered via LVDB

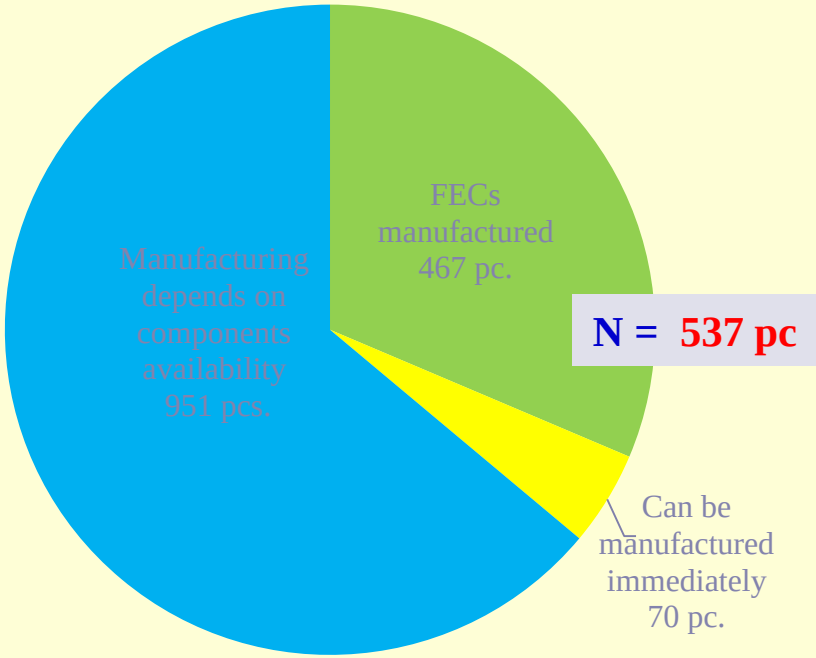




DAQ prototype:
32 FECs, RCU prototypes, ROC, LVDB, interface board to the Local Data Server - tests ongoing

TPC electronics: status

FECs Production status:

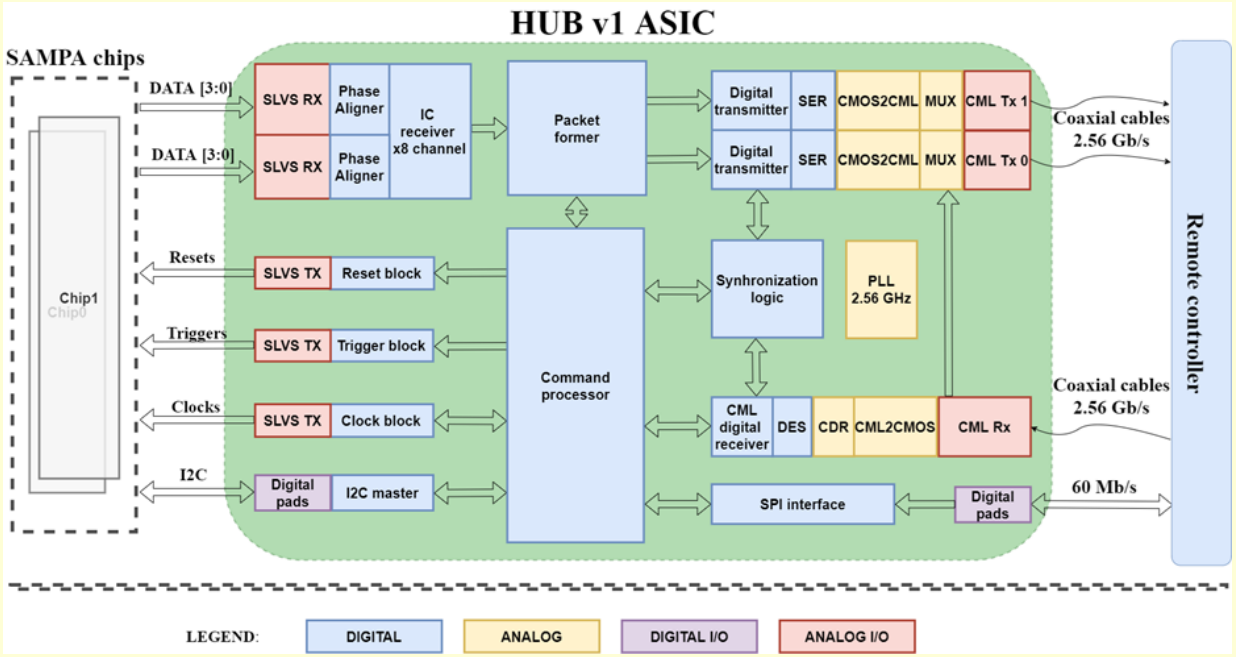


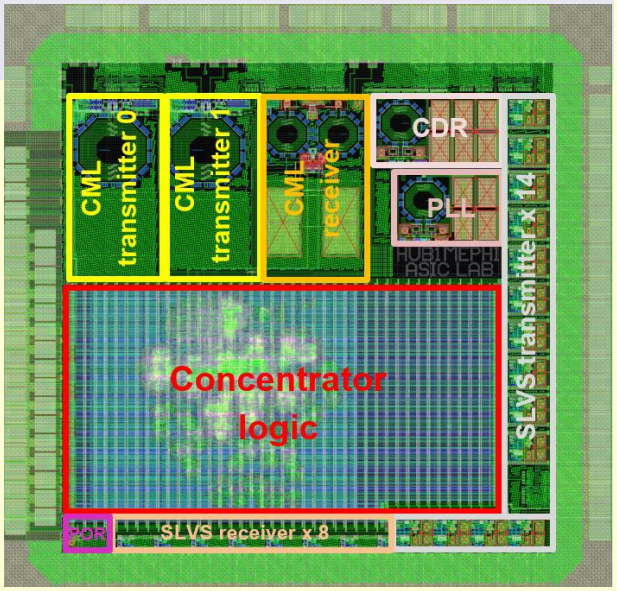
- 467 FECs of 1500 were produced.
- Tests of the FEC basic functionality were shown the target characteristics (Noise and stability).
- Testing of the readout system for one ROC is ongoing.

8 ROCs chambers will be completed at the end of 2022.

ASIC Hub v1: structure and specs

main functions: data concentration from two SAMPA chips and their transfer to counting room via fast 2.56 Gb/s bi-directional interface



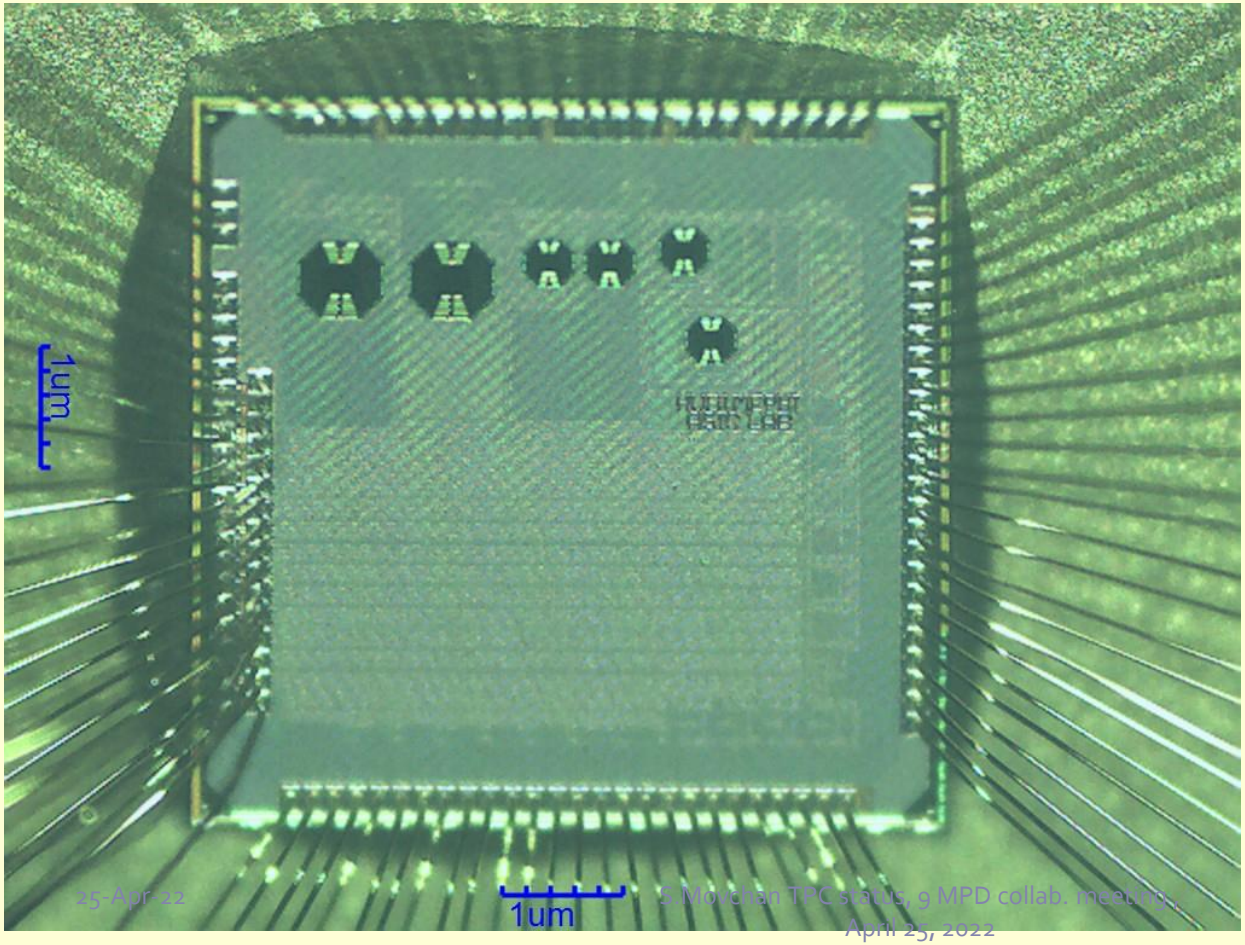


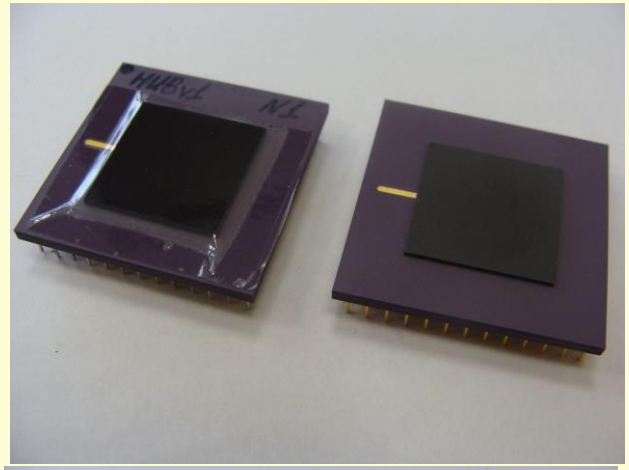
Specifications	Value
Technology	TSMC CMOS 65 nm
I/O voltage	2.5 V
Core voltage	1.2 V
Power consumption	< 500 mW

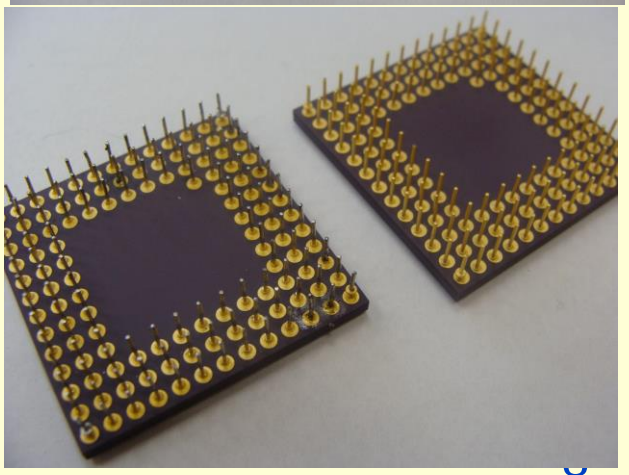
1) Process – TSMC65 LP MS RF 1P9M_6X1Z1U_RDL;
2) Chip area – 1980 x 1980 um;
3) Bond pads – 111 (37 type CUP staggered & 74 type IN-LINE)
   Pad size – 57 x 69 um
   Pad Pitch – 60 um
4) Technological run of Nov. 2020
5) Readiness – July 2021
2 types of packaging: CPGA 120 & caseless

Hub v1 photos (chip & case)

Fabricated are 10 pcs in CPGA-120 package and 80 pcs - caseless

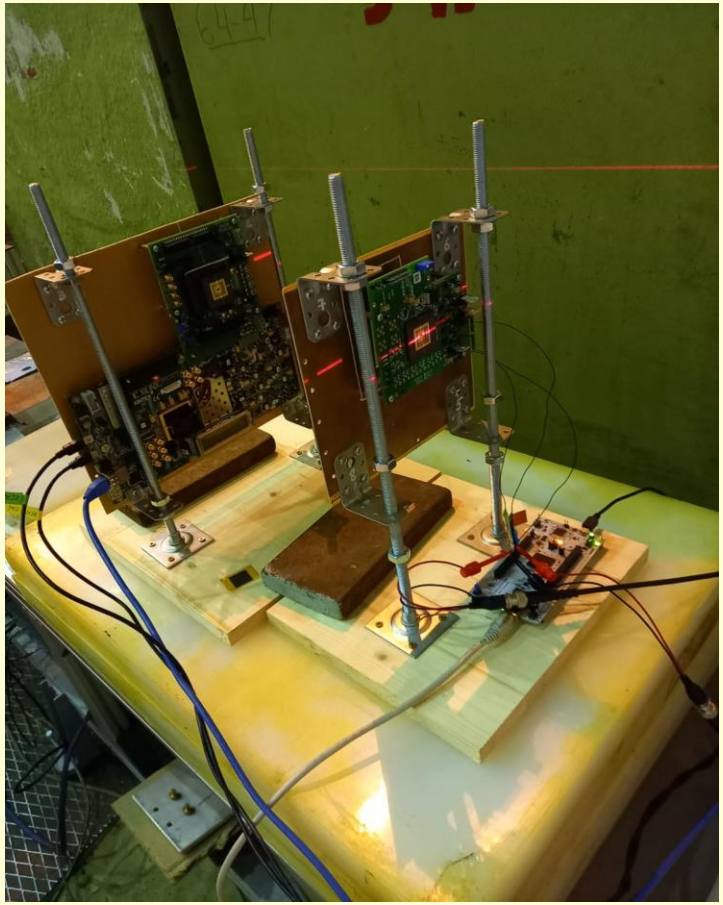






The lab testbench in calibrated beam

Purpose - checking functionality of the chip blocks against heavy particles. Tests were done at PNPI, Gatchina in Feb. 2022



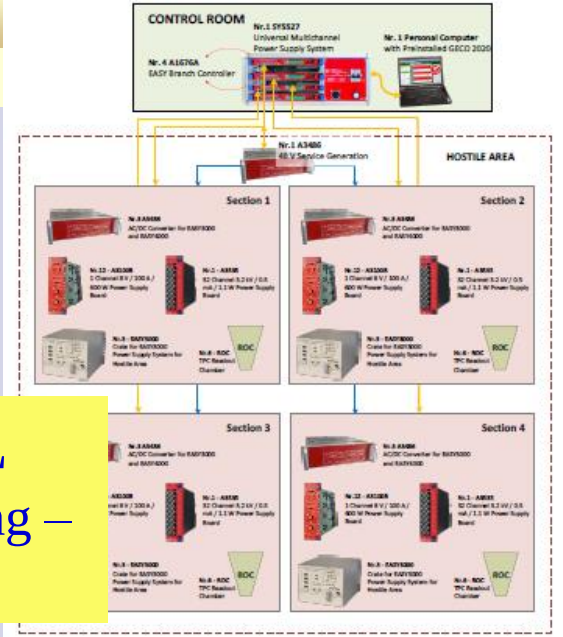
Chip status – see talk E.Atkin 27/04/2024

TPC LV+HV system

LV&HVsystem based on CAEN rad. hard design:
(up to 2000 Gauss and 15 kRad)
- **power converters A3486 AC/DC (380 V -> 48 V) – 15 pc**
- **EASY3000 crates – 13 pc**
- **LV module - A3100B (2÷7V/100A) – 55 pc**

Status:
- ***TPC LV+HV system – GSI tender finished (=> CAEN)***
  Expected delivery date:
  to GSI – Sept 2022
  to JINR – end of 2022 – beginning of 2023

CANCEL
New ordering – in progress



- test system – tests ongoing

LV cables (halogen free, low smoke):
S=50 mm2 – delivered to JINR (Dec 2019)
S=120 mm2 – delivered to JINR (Dec 2019)
LV bars - delivered to JINR (Dec 2021)
HV cables - ordered

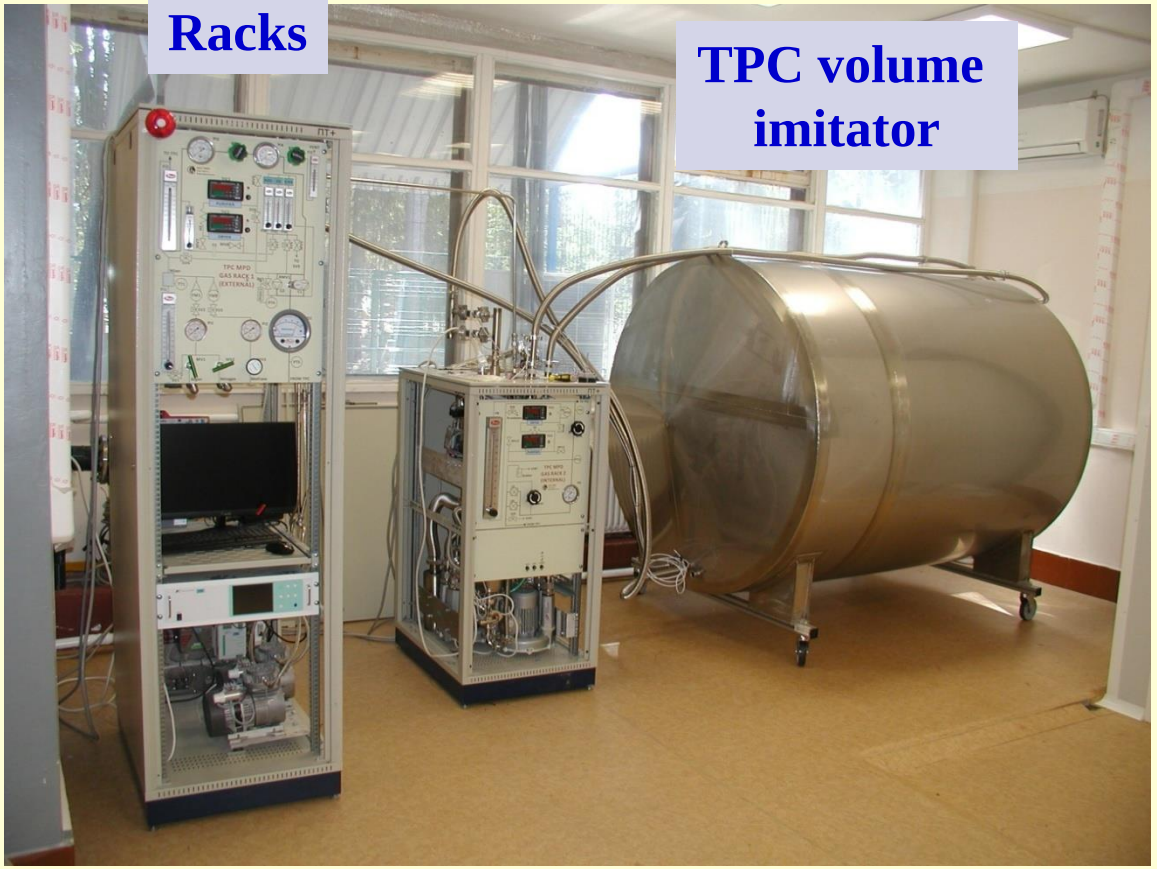
LVDB boards (60 pc) - delivered
INP BSU (Minsk)
Team for cabling and piping – contracted (Minsk)

TPC gas system

Gas supply

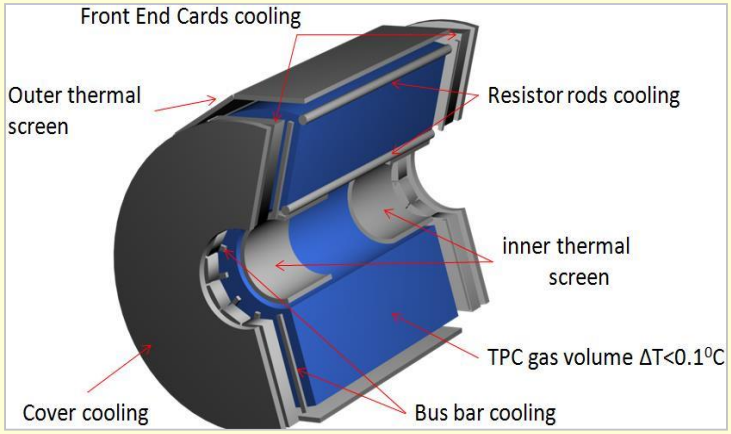
Racks

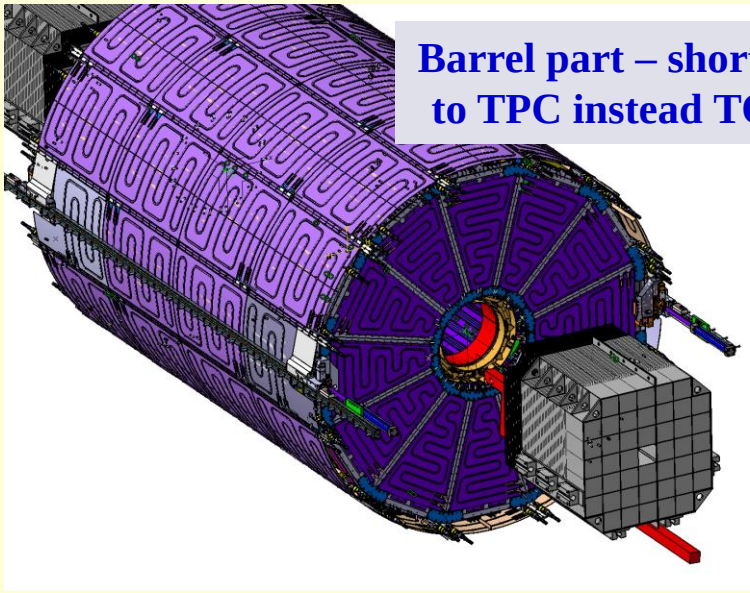
TPC volume imitator



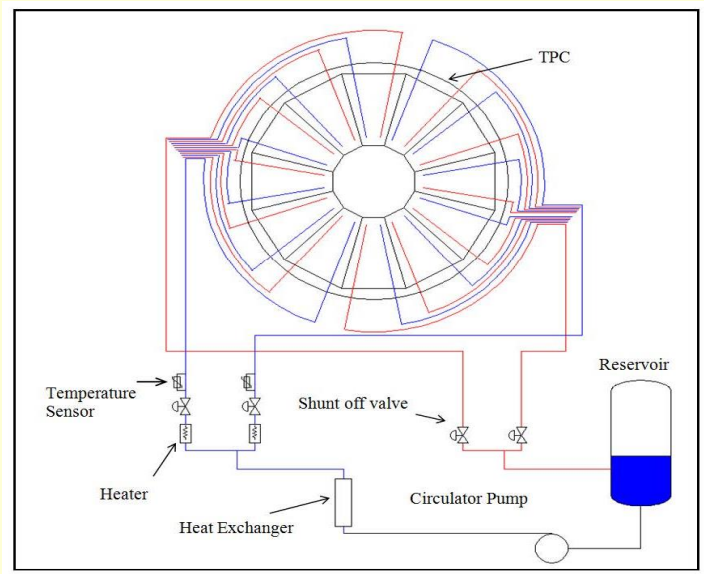
Tests - in progress

TPC cooling system

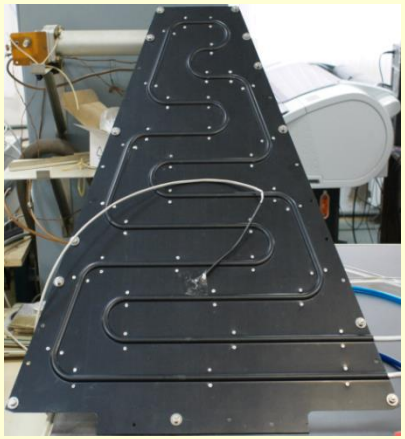




Barrel part – shorter and fixed to TPC instead TOF structure

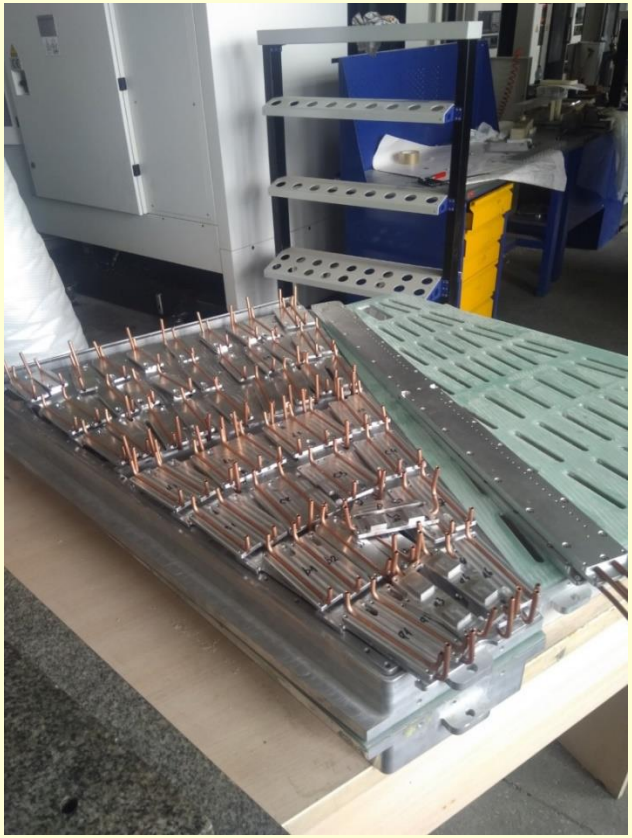


Full set – delivered



TPC: FE cooling radiators (INP BSU Minsk)

Bottom cooling plates



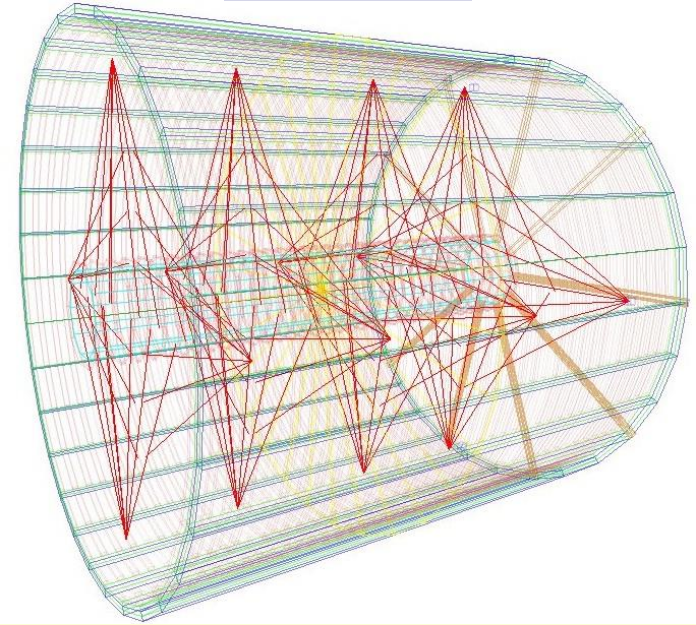
Set of top cooling plates

Cu tube Din - 3.16 mm
Plates thickness - (4+4) мм

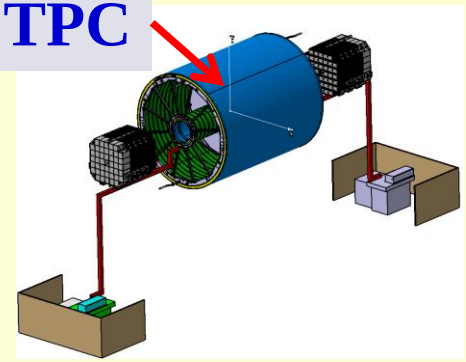
TPC+ECAL cooling system:
start tender – may 2022

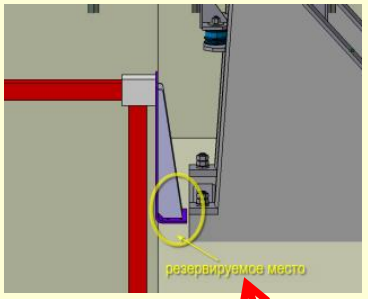
TPC laser calibration system: laser beams layout

½ TPC

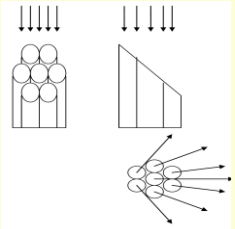


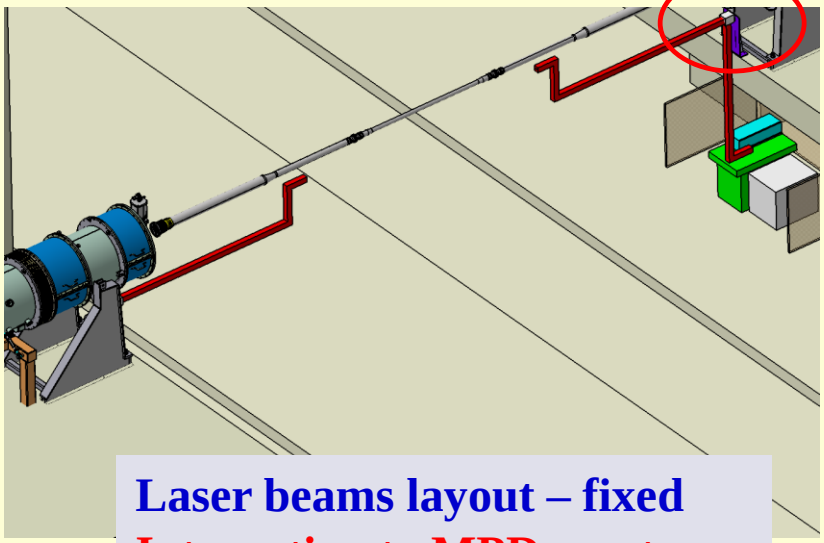
TPC





micro-mirror bundles

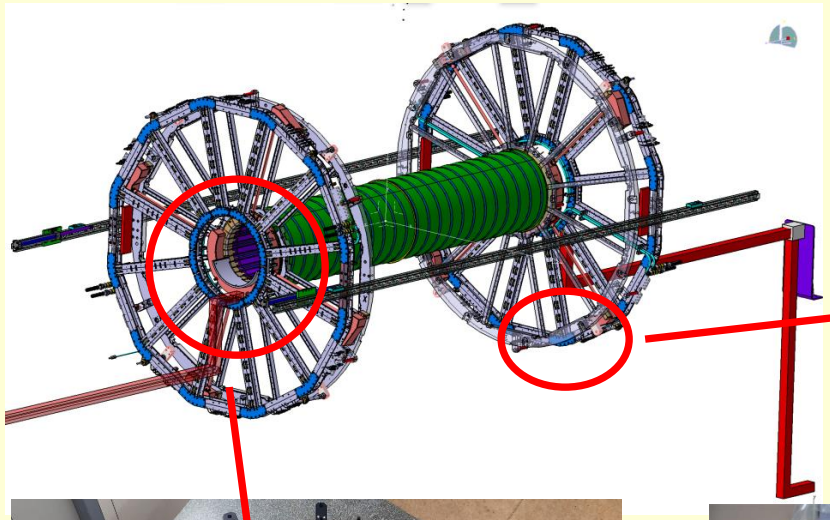




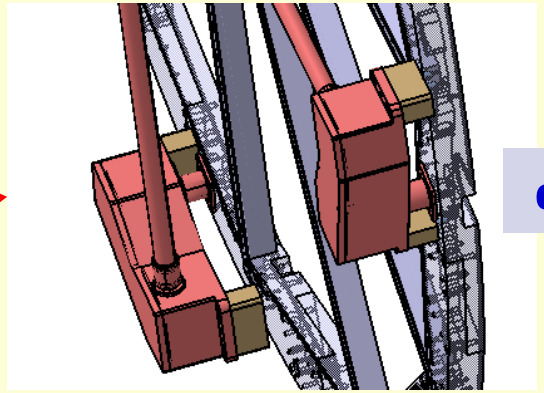
Laser “planes” - 4
Micro-mirrors bundles per plane - 4
Beams from micro-mirrors bundle - 7
Laser “tracks”, N - 112x2=224

Laser beams layout – fixed
Integration to MPD – not started yet

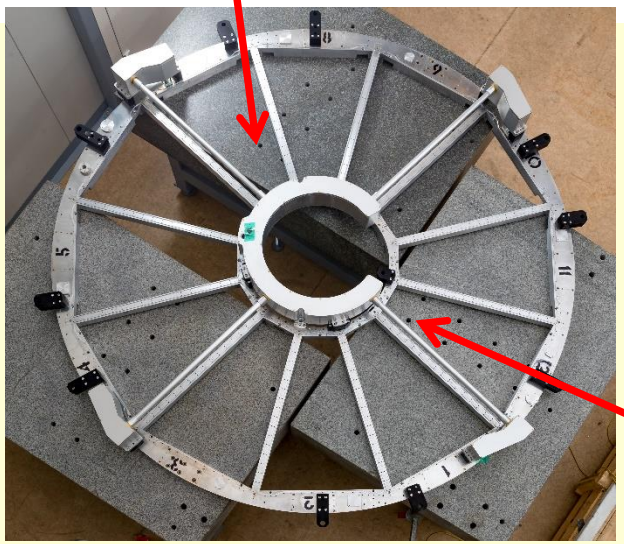
TPC laser calibration system

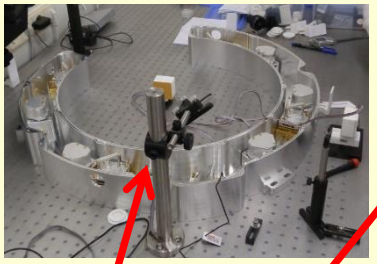


Semi transparent mirror & prism



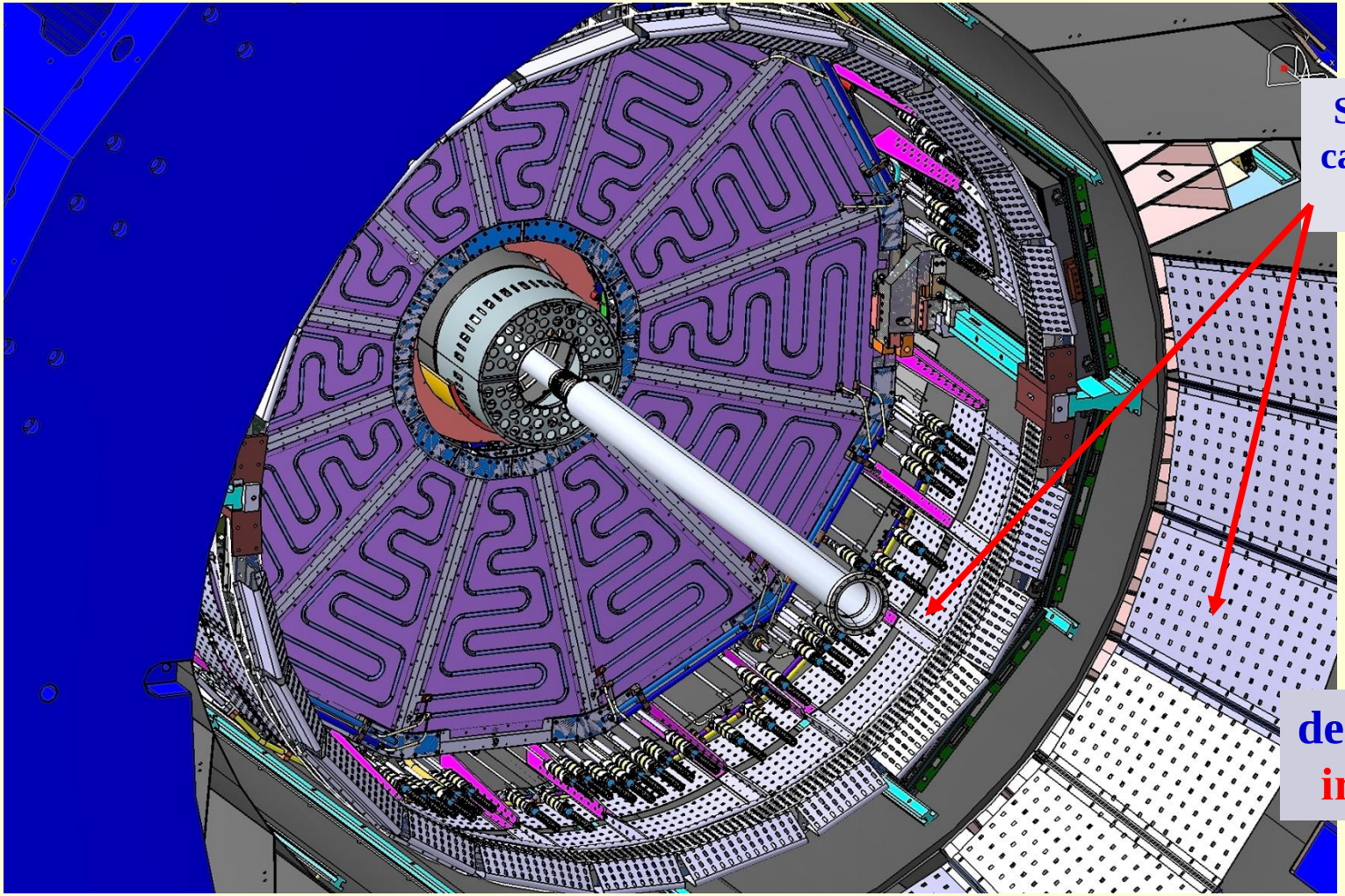
delivered





- full set of micro-mirror bundles - assembled
- 2 lasers – commissioned
- laser beam splitter – installed to flange
- laser beam monitors - prototype under tests

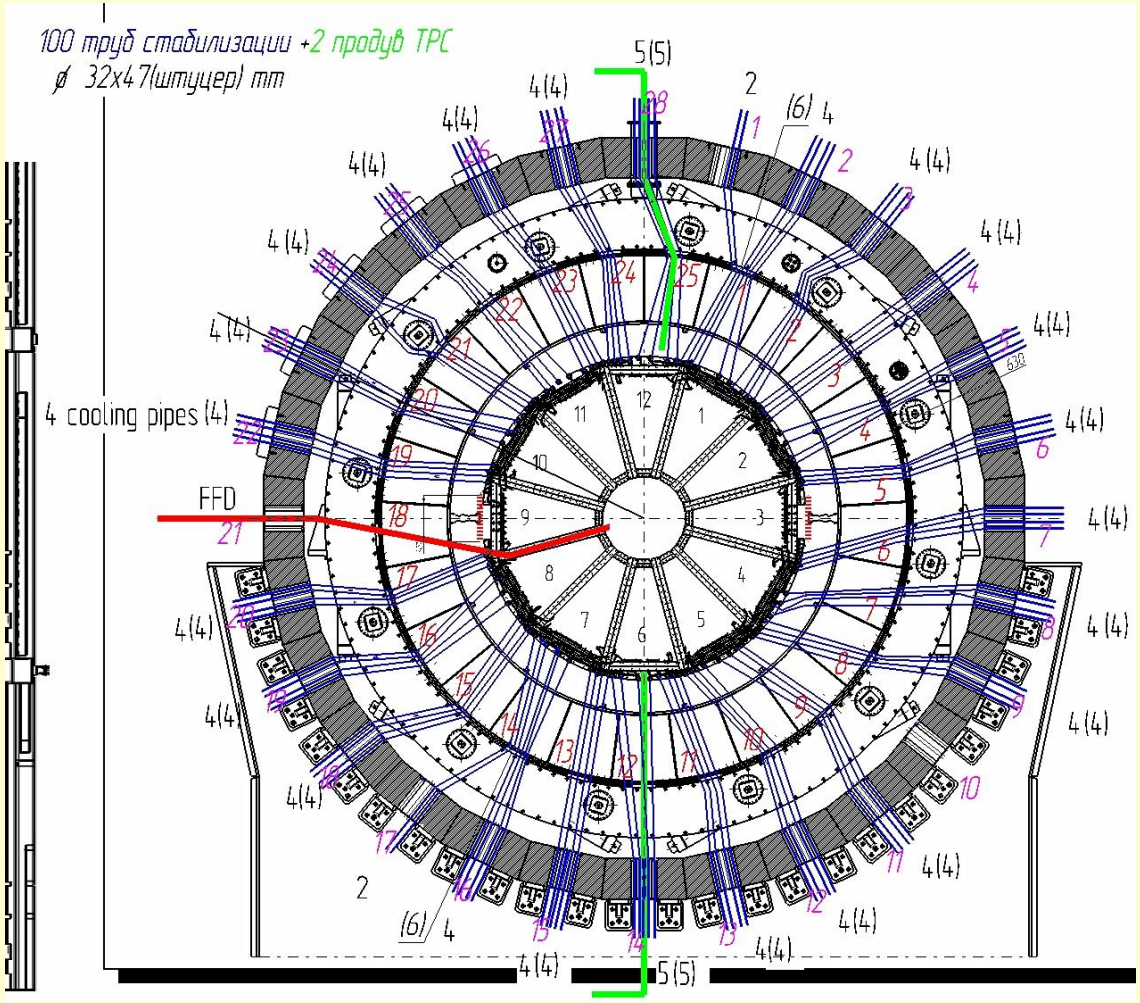
TPC cables and pipes integration

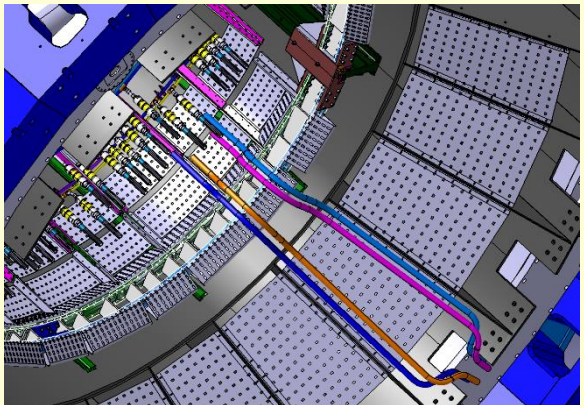


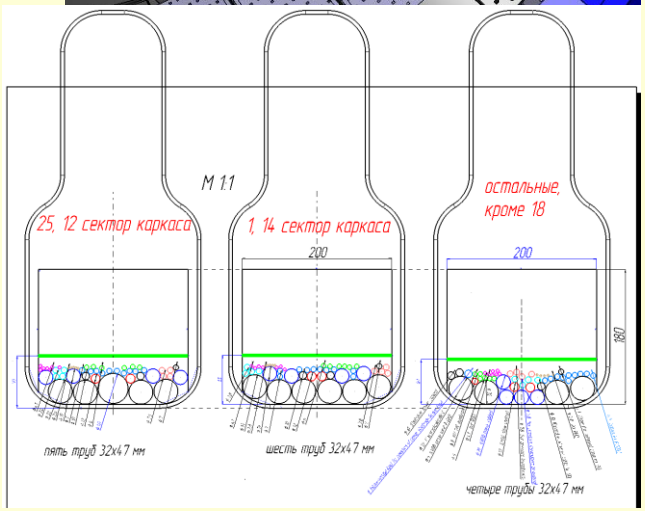
Structures for cables and pipes fixation

design – in progress …

TPC cables and pipes integration

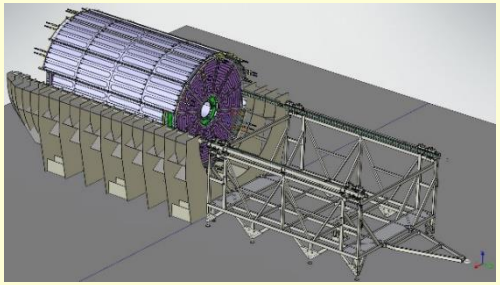


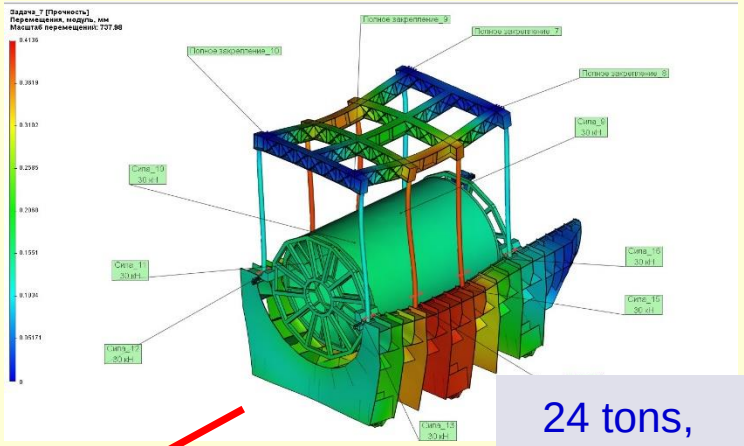




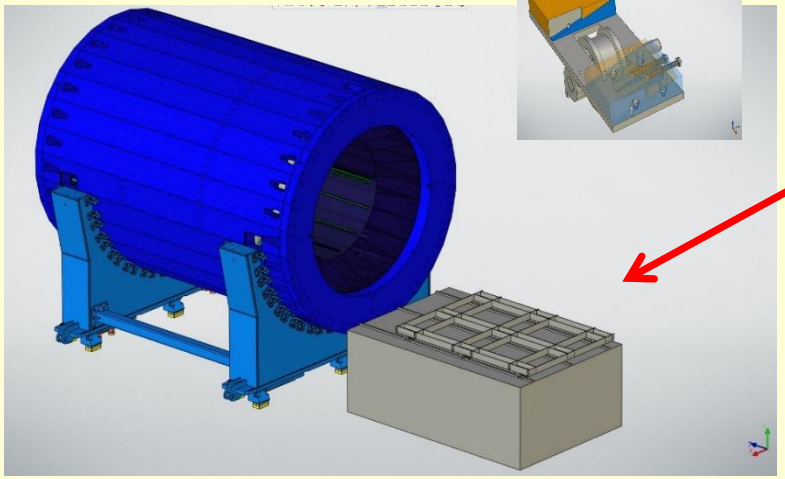
design –
in progress …

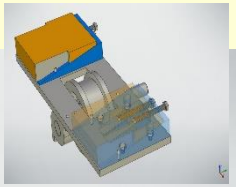
Integration TPC to MPD: tooling design - started

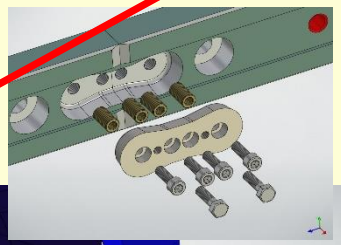


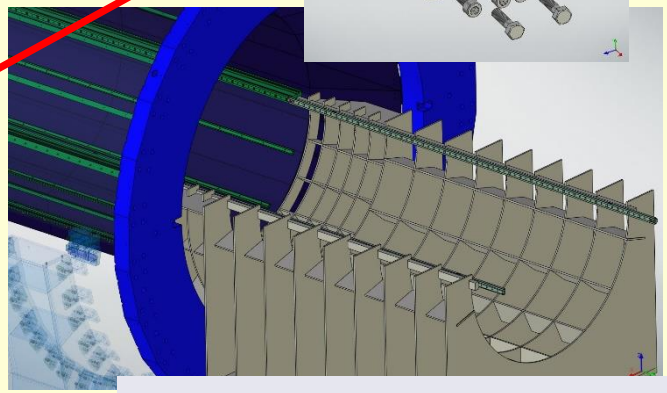


24 tons,
max=0.41 mm

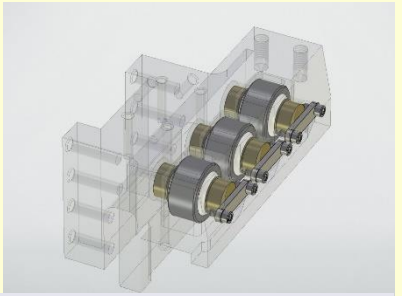






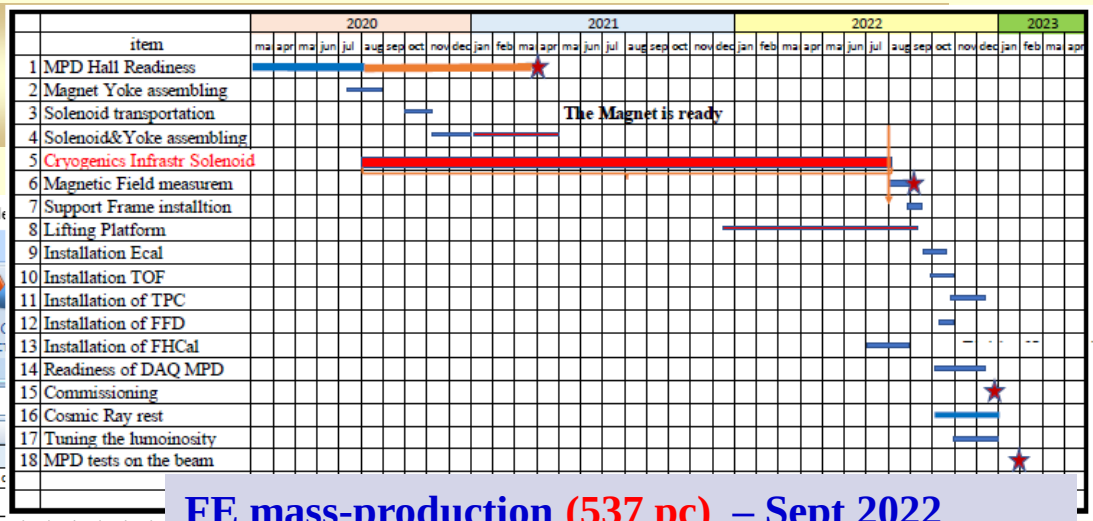


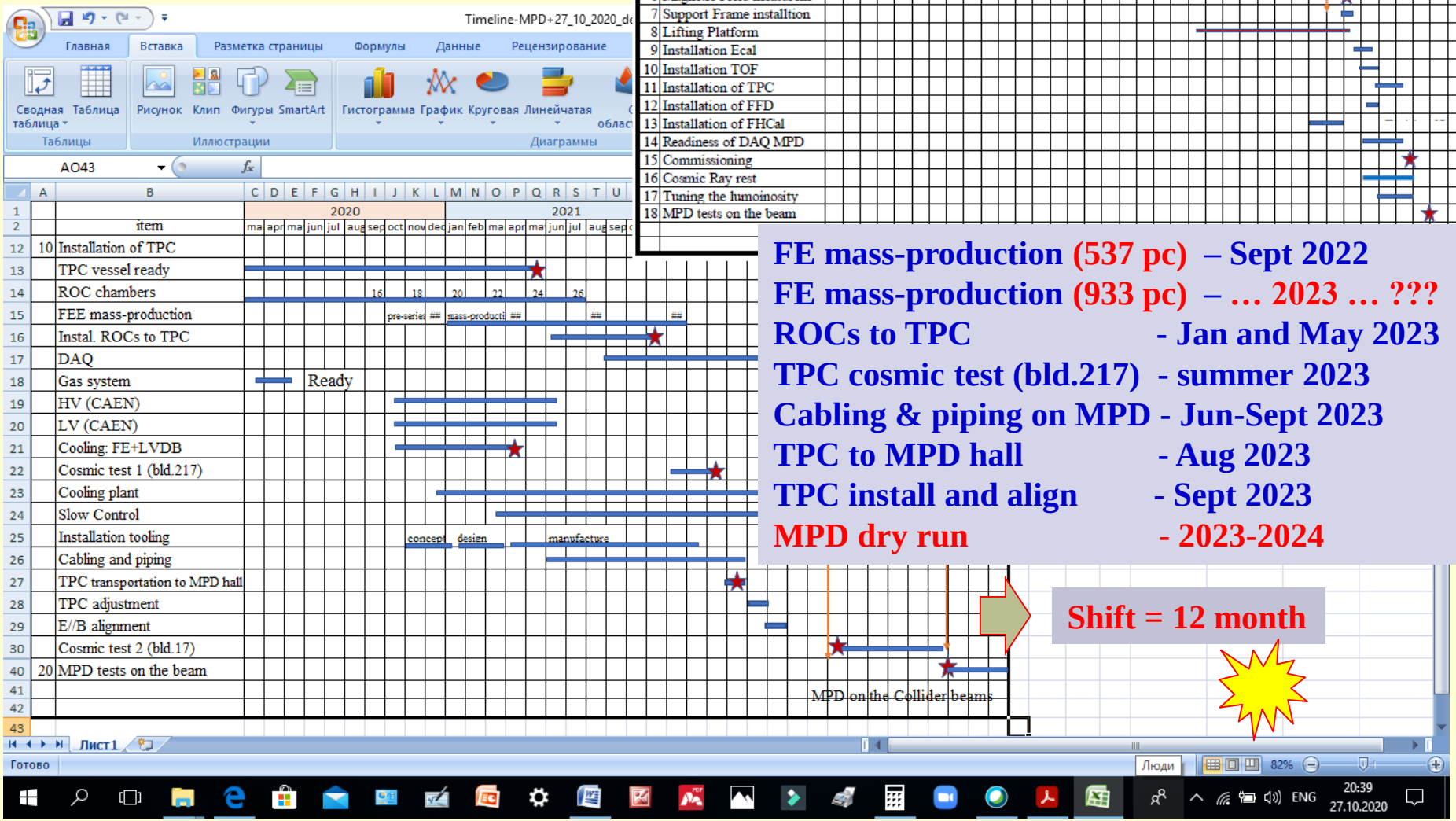
Rollers for
TPC moving



Tooling manufacture – end of 2022-2023

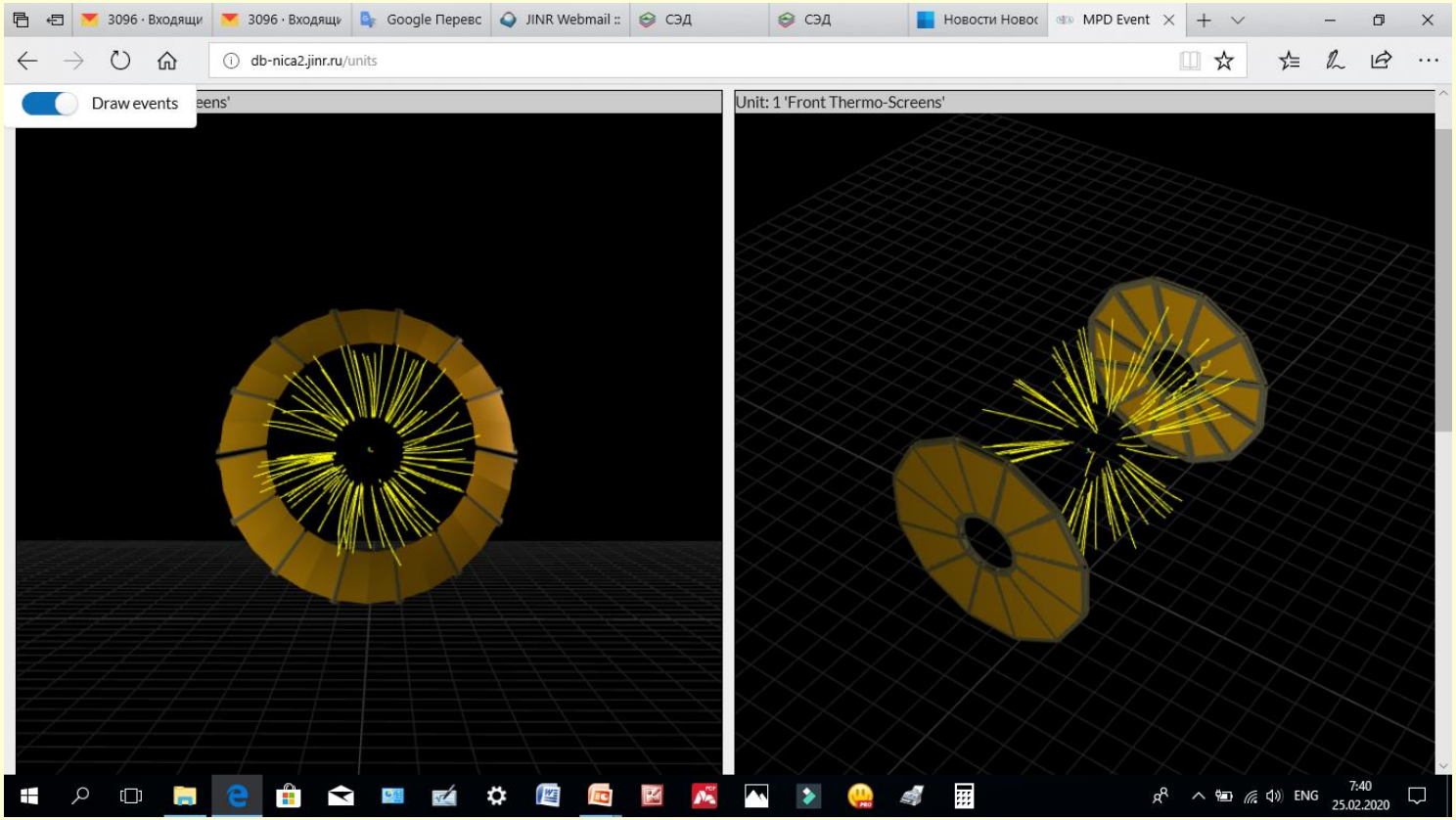
TPC schedule





FE mass-production (537 pc) – Sept 2022
FE mass-production (933 pc) – … 2023 … ???
ROCs to TPC - Jan and May 2023
TPC cosmic test (bld.217) - summer 2023
Cabling & piping on MPD - Jun-Sept 2023
TPC to MPD hall - Aug 2023
TPC install and align - Sept 2023
MPD dry run - 2023-2024

MPD event display - http://db-nica2.jinr.ru/ (V.Krilov)

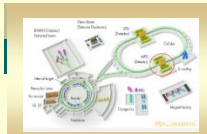
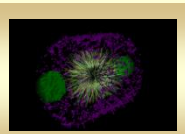


Example for TPC

http://nica.jinr.ru/
http://mpd.jinr.ru/

TPC TDR – http://mpd.jinr.ru/wp-content/uploads/2019/01/TpcTdr-v07.pdf

Thank you for attention!

MPD TPC status 2022: summary


Status:

- **TPC:**

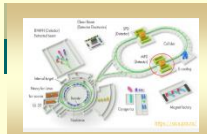
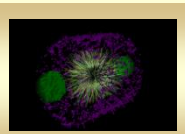
C1-C2 and C3-C4 cylinders	- assembled
TPC field cage assembly	- May -> June 2022
TPC vessel ready	– Sept 2022
TPC service wheels assembly	- one – assembled, second - ongoing …

- **ROC chambers** - 24 pc tested + 2 pc (spare)+4 pc

Test of FE (32 cards) with ROC	- preparation ongoing
Flat cables (28 sets + spare)	- ready
FE radiators (28 sets)	- narrow plates– modification in progress
LVN9 stabilization boards (28 sets)	- tests in progress
FE power cables (28 sets)	- ready
Alignment pins (120 pc)	- manufactured, ready
Pads alignment (calibration)	- April 2022 (laser scanner and photogrammetry) – in progress
Assembly FE with ROC	- awaiting
Test of installation ROC to TPC	- move to May 2022 (will be used mock up at bld.205)
Gating Grid system (GGS)	– Dec 2022

- **Electronics:**

FE electronics (537 cards (36%))	- July 2022
FE electronics (933 cards (62%))	- … 2023 … ???
RCU controller	- design done, prototype manufactured, preparation for tests
Integration RCU controllers to TPC	- 2022
RCU mass-production	- 2023

MPD TPC status 2022: summary


Status:

Sub-systems:

DAQ:

local TPC DAQ prototype	- tests in progress
DAQ set up #1 (ROC test at bld.40)	- ok
DAQ set up #2 (FE tests at room 107)	- ok
DAQ set up #3 (FE tests at Minsk)	- April 2022 - > May 2022

Gas system - tests ongoing, integration to MPD started

TPC cooling system - tender (Feb-March 2022 - > May 2022) **on critical path**

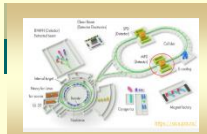
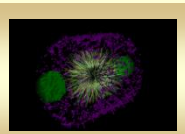
HV+LV systems (CAEN) - 10% delivered, GSI tender finished, delivery to JINR – CANCEL
new tender at JINR – > May 2022

Laser calibration system - UV lasers and beam distribution systems - delivered, rest parts – ordered

Slow control system – integration to common TPC SC system not started yet (Win CC OA)

• **Cabling and piping:**

TPC cabling and piping design	- in progress
TPC trays design	- in progress
TPC trays manufacture	- spring 2023
LV bars and LV cables manufacture	- spring 2023
HV cables manufacture	- spring 2023
Gas piping	- spring 2023
Cooling piping	- spring 2023
Patch panels	- spring 2023

MPD TPC status 2022: summary


Status:

- **Integration TPC to MPD:**

TPC racks (8pc)	- layout optimization in progress
TPC rails (calculations, manufacture)	- Feb 2022 –> May 2022 **on critical path**
Rails installation to MPD, tests	- summer 2022

Tooling for installation TPC to MPD:

concept	- fixed
design	- started … May 2022 – August 2022 (4 month)
tooling manufacture	- June - > Sept 2022 – Feb 2023 (6 month)
delivery to JINR	- March 2023
TPC cooling systems (2 pc)	- Sept 2023

- **TPC schedule:**

TPC installation to MPD	- start Sept 2023
MPD dry run	- 2023-2024 (shift by 12 month)