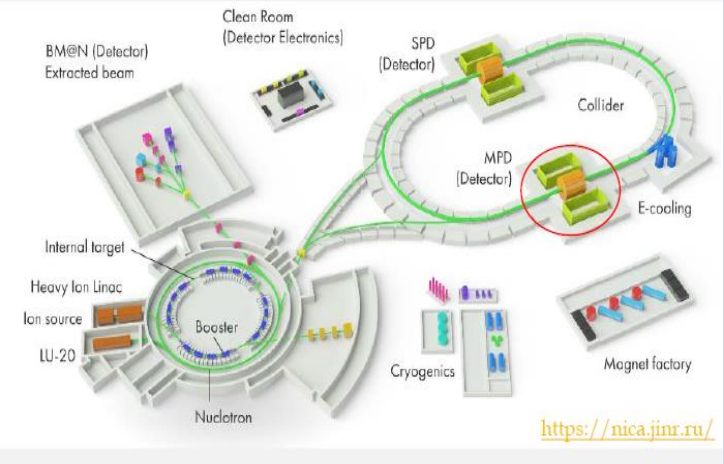
MPD/NICA TPC assembling (12.10.2021)



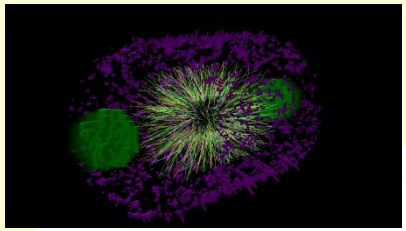
- TPC parameters
- ROC chambers
- TPC assembly
- front end electronics
- gas, cooling, laser and SC systems
- cabling and piping
- integration TPC to MPD
- time schedule

Presented by Sergey Movchan

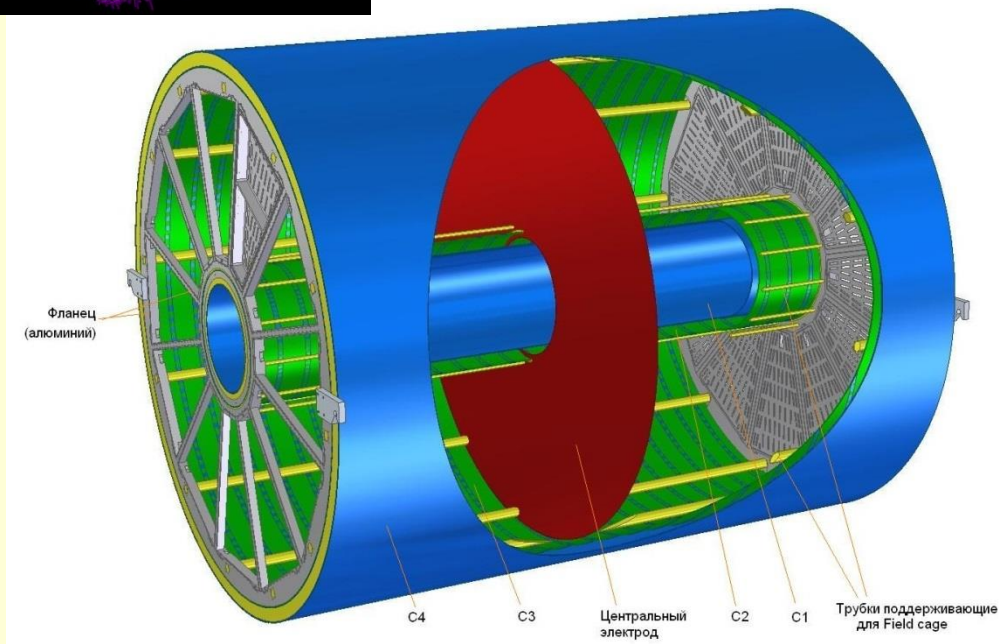
JINR team: 24 persons
Belarus: 6 persons
UW Poland: 4-6 persons

- slides with actual info

MPD TPC parameters



Корпус TPC/ MPD



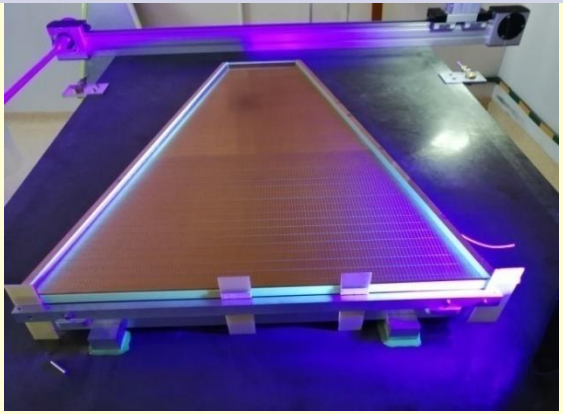
TPC TDR – http://mpd.jinr.ru/wp-content/uploads/2019/01/TpcTdr-v07.pdf

Item	Dimension
Length of the TPC	340cm
Outer radius of vessel	140cm
Inner radius of vessel	27 cm
Outer radius of the drift volume	133cm
Inner radius of the drift volume	34cm
Length of the drift volume	170cm (of each half)
HV electrode	Membrane at the center of the TPC
Electric field strength	~140V/cm;
Magnetic field strength	0.5 Tesla
Drift gas	90% Ar+10% Methane, Atmospheric pres. + 2 mbar
Gas amplification factor	~ 10^4
Drift velocity	5.45 cm/μs;
Drift time	< 30μs;
Temperature stability	< 0.5°C
Number of readout chambers	24 (12 per each end-plate)
Segmentation in φ	30°
Pad size	5x12mm^2 and 5x18mm^2
Number of pads	95232
Pad raw numbers	53
Pad numbers after zero suppression	< 10%
Maximal event rate	< 7 kHz (Lum. 10^{27})
Electronics shaping time	~180 ns (FWHM)
Signal-to-noise ratio	30:1
Signal dynamical range	10 bits
Sampling rate	10 MHz
Sampling depth	310 time buckets

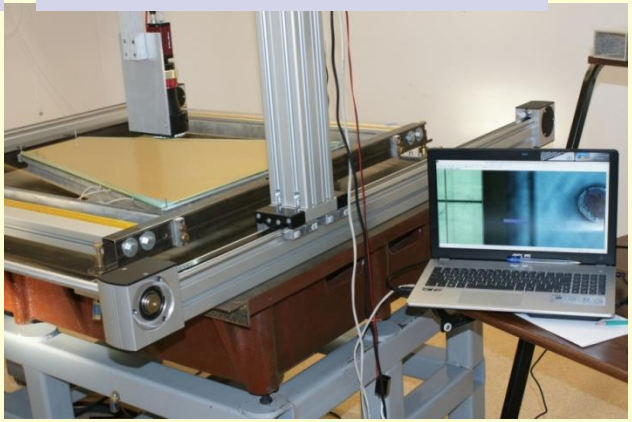
ROC chambers status

24 pc tested ROCs in stock

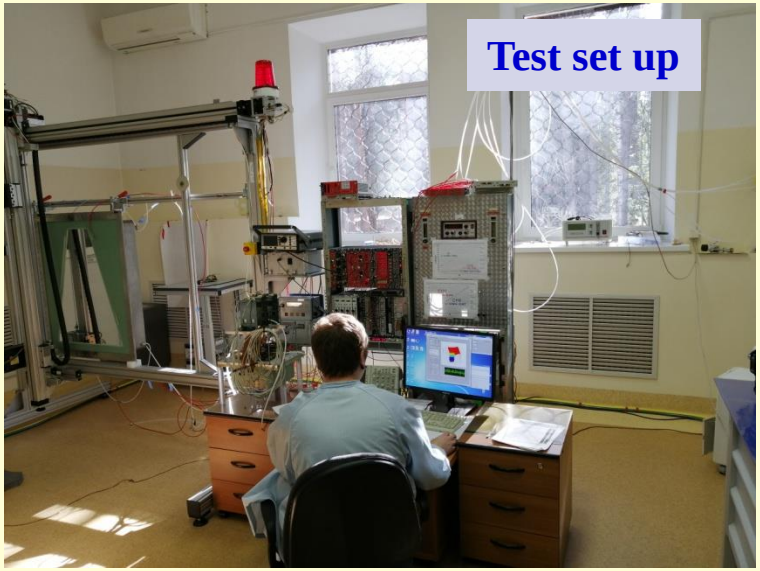
ROC cleaning procedure



Wire pitch check set up



Test set up



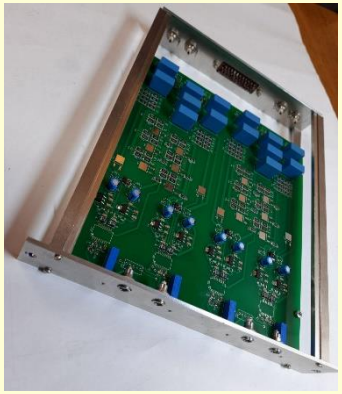
+ 2 pc spare – tests in progress

ROC gate system (Minsk)

May 2021 test results: huge noise in the ROC FE electronics (up to x 10 times) due to GATE power supplies (pulse type)

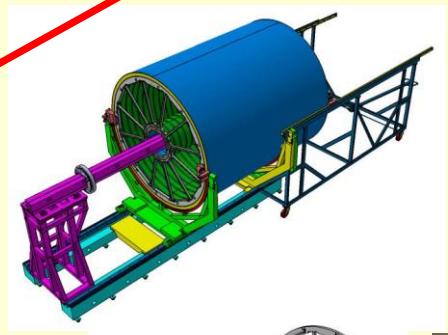
NEW switch module

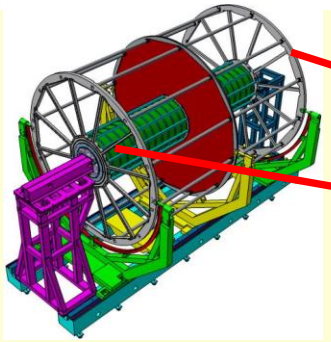
NEW prototypes:
- switch module
- power supplies:
+/- 300V & - 40V

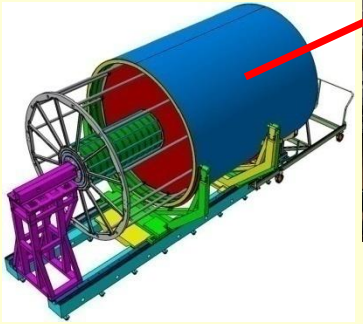


Test with ROC chamber – on this week

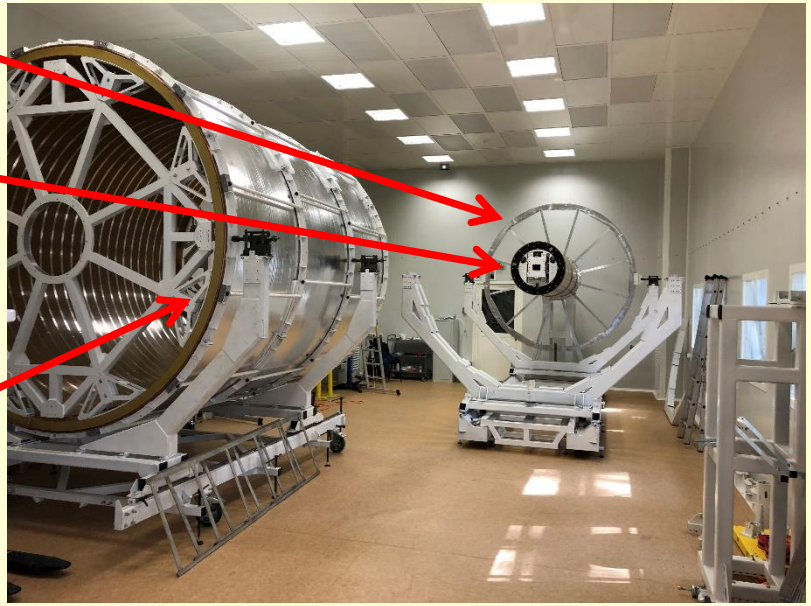
TPC assembly (Bld.217) – common view







HV membrane – tested (NO corona)
Field cage roads – in assembly



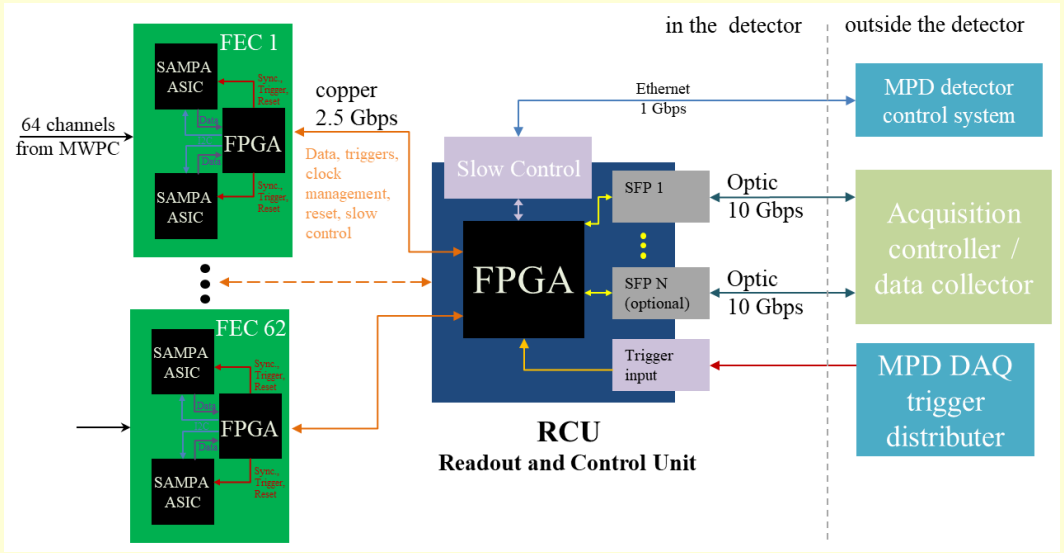
TPC assembly – in progress

TPC field cage rods assembly (Bld.40)

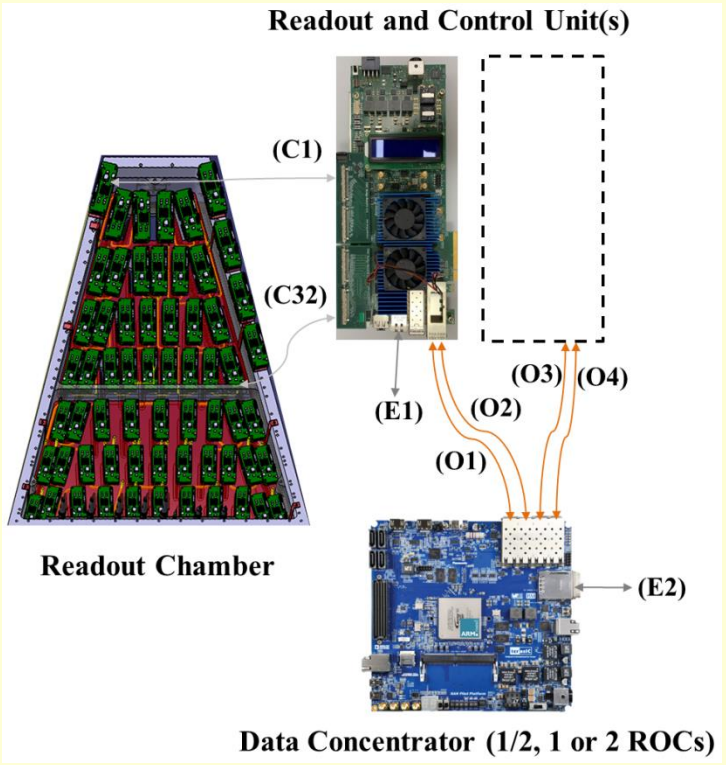
Set up for roads assembly

Roads D=30 mm - 30pc assembled
Roads D=60 mm - assembling

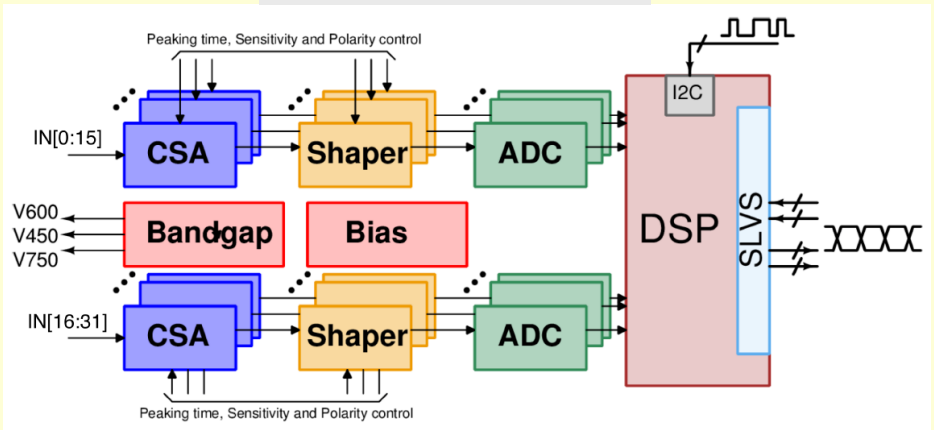
TPC electronics: block diagram of one chamber readout



RCU and data concentrator based on commercial kits

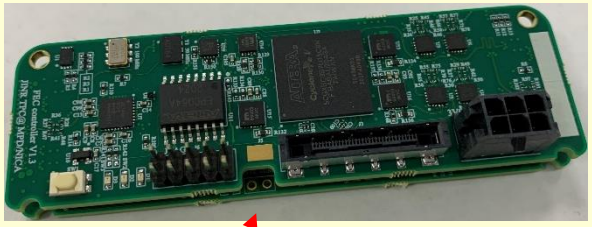


SAMPA chip



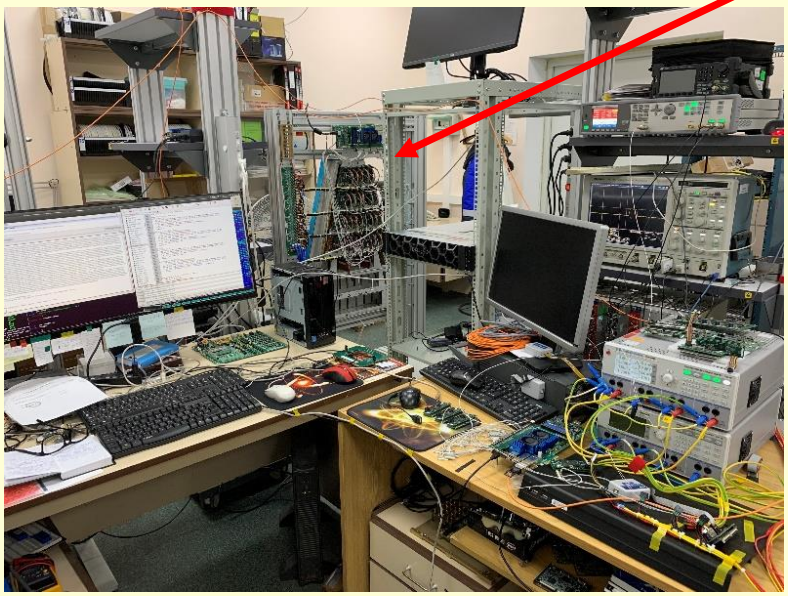
TPC electronics: status

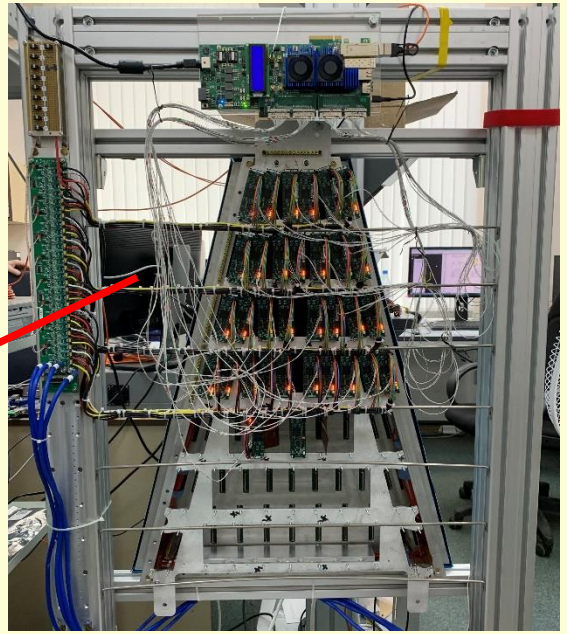
New version of the FE card:



Connection holes for analog power supply added

2048ch readout system powered via LVDB





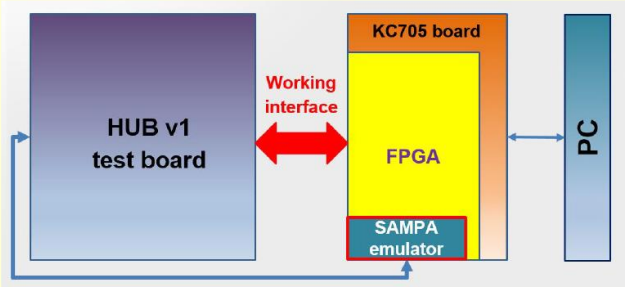
DAQ prototype:
32 FECs, RCU prototypes, ROC, LVDB, interface board to the Local Data Server - tests ongoing

TPC electronics: status

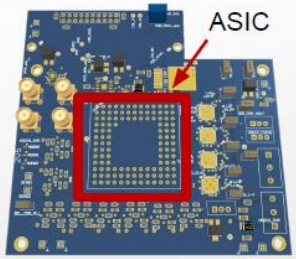
- 477pc pre-serial FECs were produced (~32% of the whole amount).
- A new data transmission protocol with redundancy check between FECs and RCU (FEC Transfer Protocol - FTP) was developed and realized in the firmware. Testing is going.
- Testing of the readout system which includes 32 FECs, RCU prototypes, ROC, LVDB, interface board to the Local Data Server is ongoing towards having a 1/24 full-featuring readout system.
- The data transmission speed of 5 GB/s was achieved via PCIe between DCU card and Local Data Server.
- RCU v1 for 64 FECs is under adjustment:

Data concentrator ASIC (NRNU MEPHI)

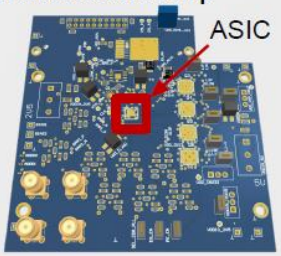
Test set up diagram



PCB with CPGA-120 socket



PCB with caseless chip



Hub v1 testing plans

October - November 2021

1. Functional testing of the digital part at a reduced frequency

November 2021

2. 2.56 Gbit/s transceivers performance and maximum load testing

December 2021- February 2022

3. Testing the Hub v1 as a part of the demonstrator

December 2021- February 2022

4. Performance testing in a radiation environment

March 2022

5. Specification clarification for version 2 of the HUB

for more info - see E.Atkin's talk

TPC LV+HV system

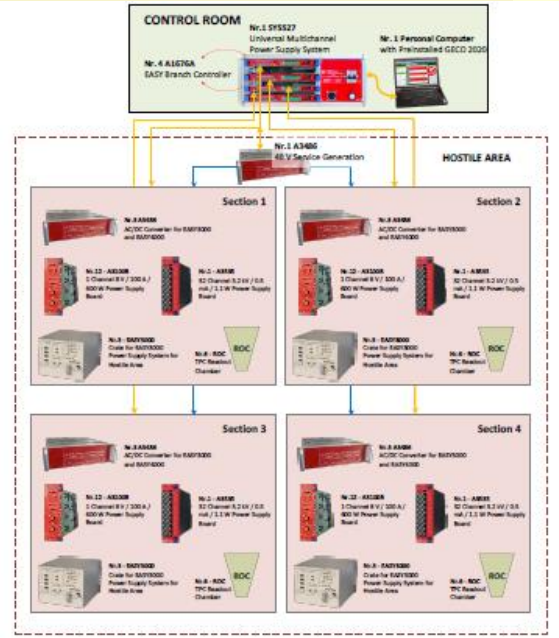
LV&HVsystem based on CAEN rad. hard design:

(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)***
- ***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)

HV cables - ordered

LVDB boards (60 pc) - delivered

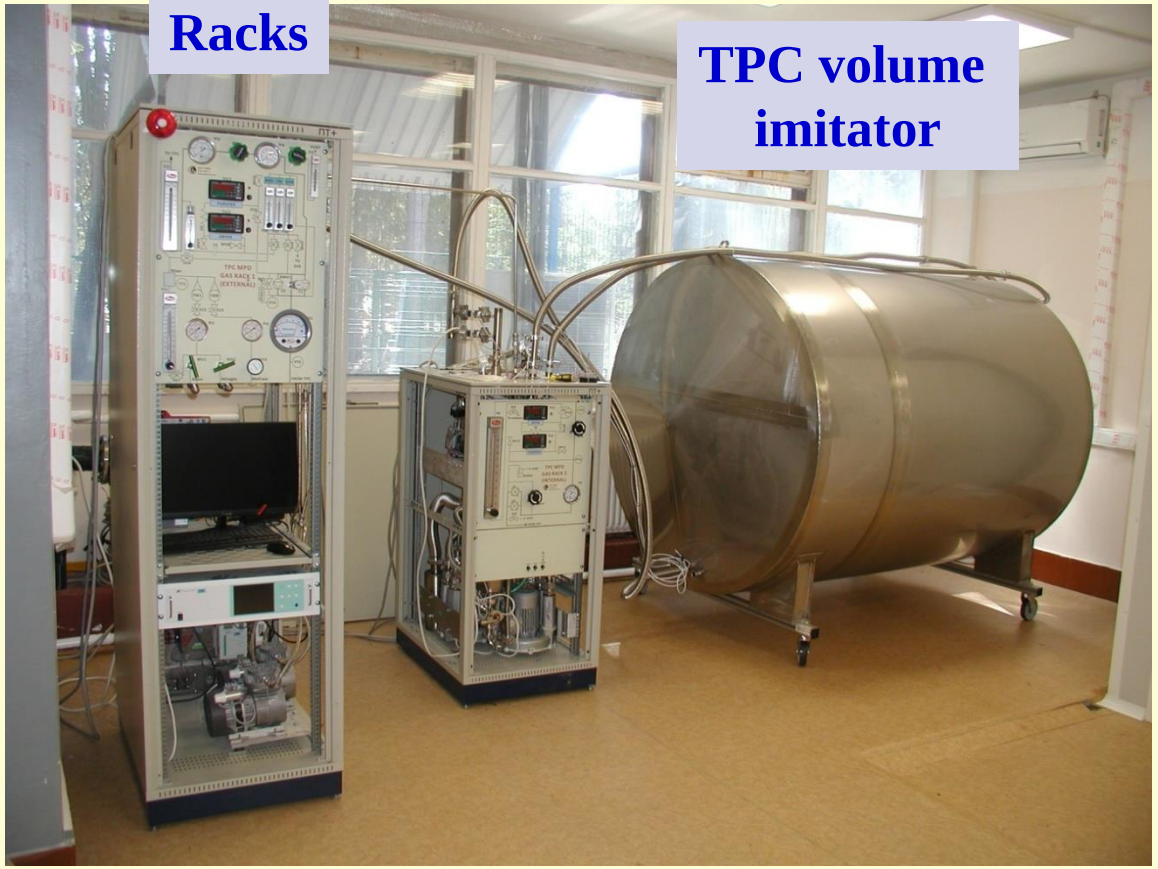
INP BSU (Minsk)

Team for cabling and piping – contracted

TPC gas system

Racks

TPC volume imitator

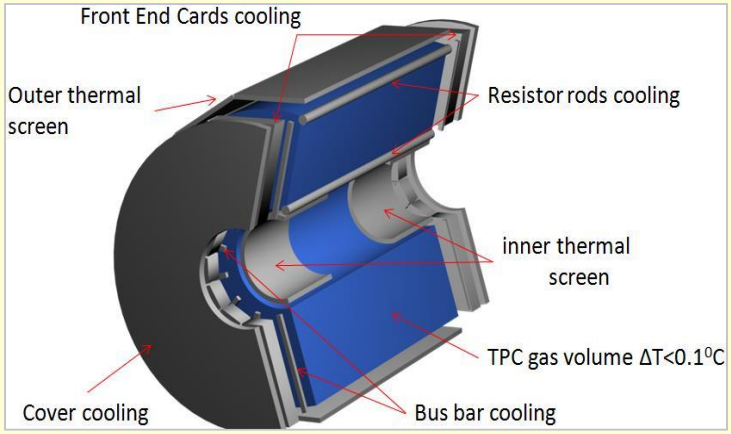


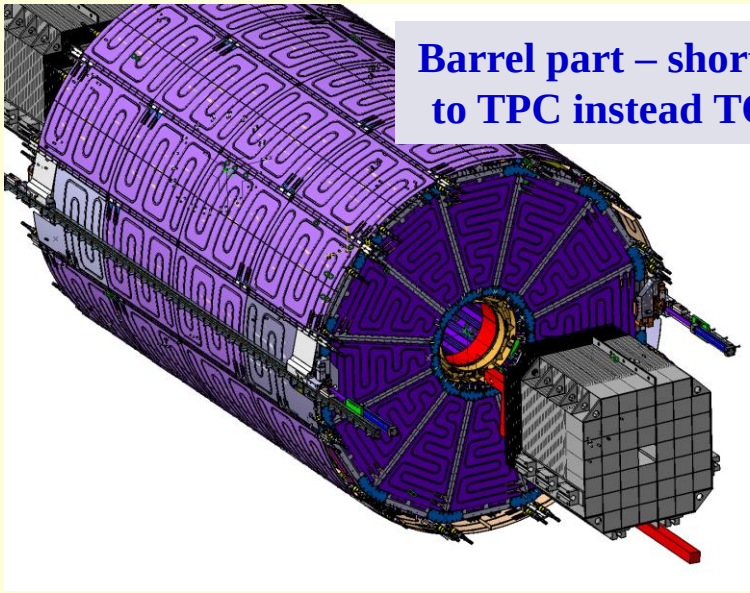
Gas supply

Commissioning - in progress

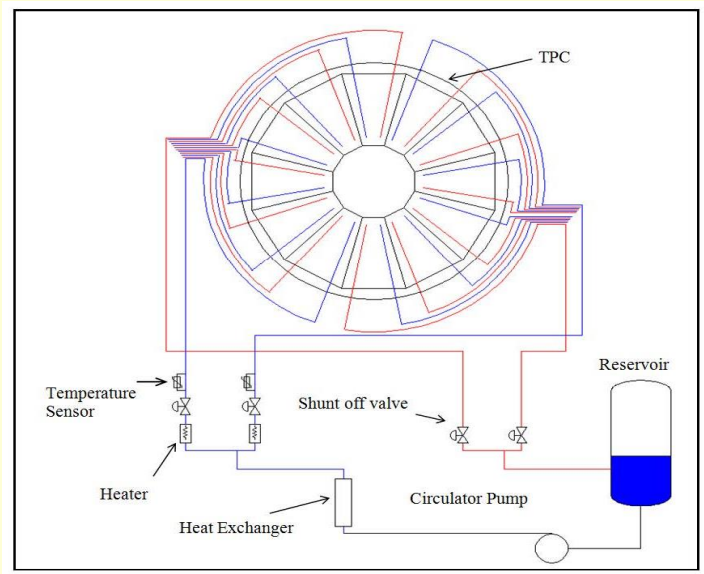
Status - commissioned (Bld.217)

TPC cooling system

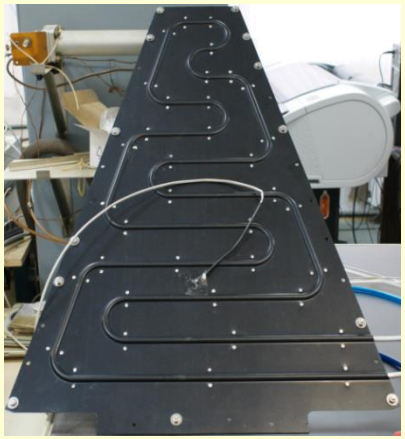




Barrel part – shorter and fixed to TPC instead TOF structure

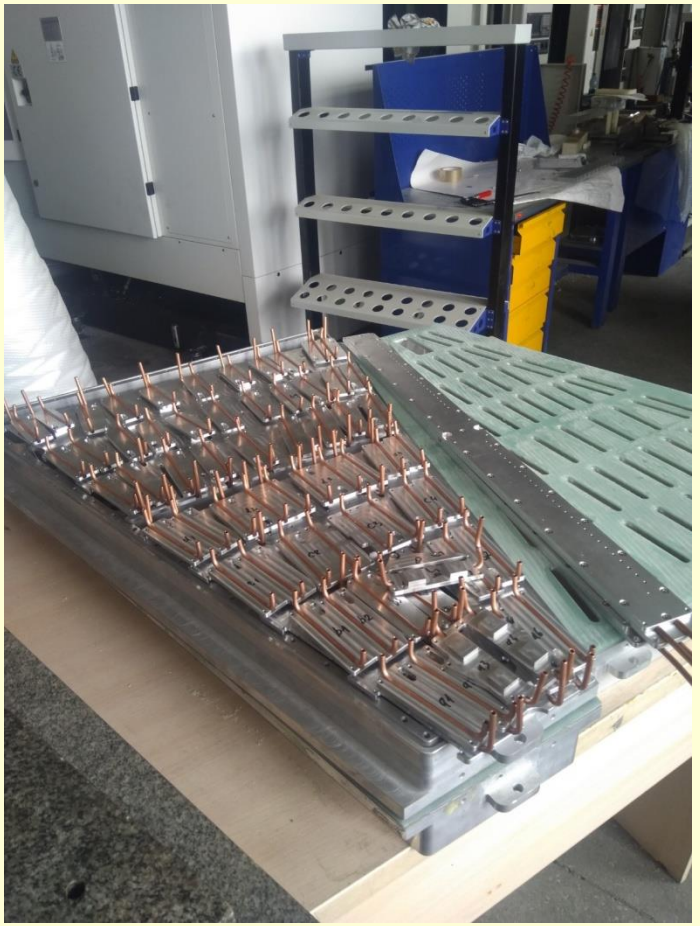


Full set – delivered



TPC: FE serial cooling radiators (INP BSU Minsk)

Bottom cooling plates

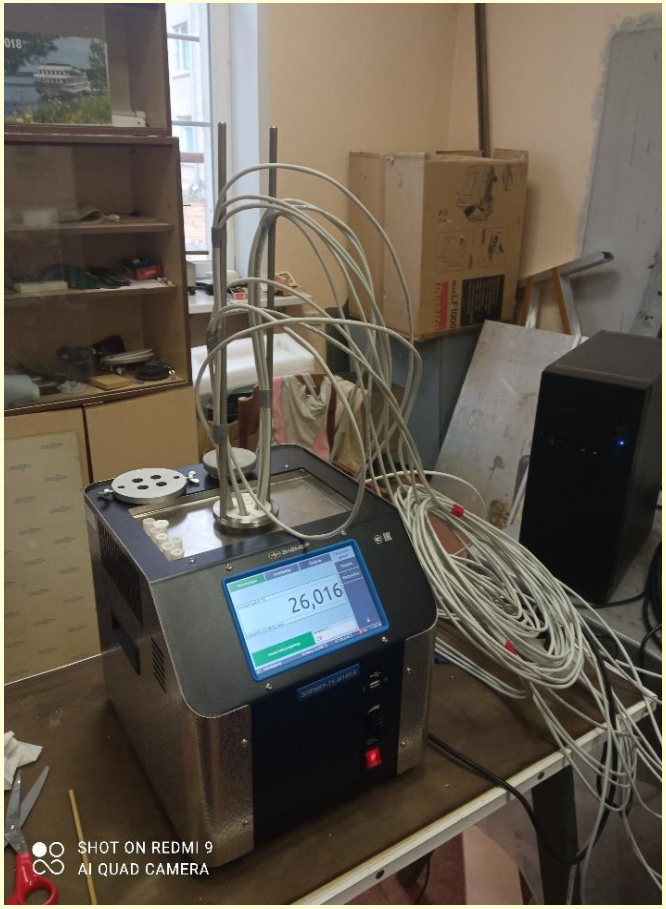


Set of top cooling plates

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

TPC cooling system: T-sensors calibrator

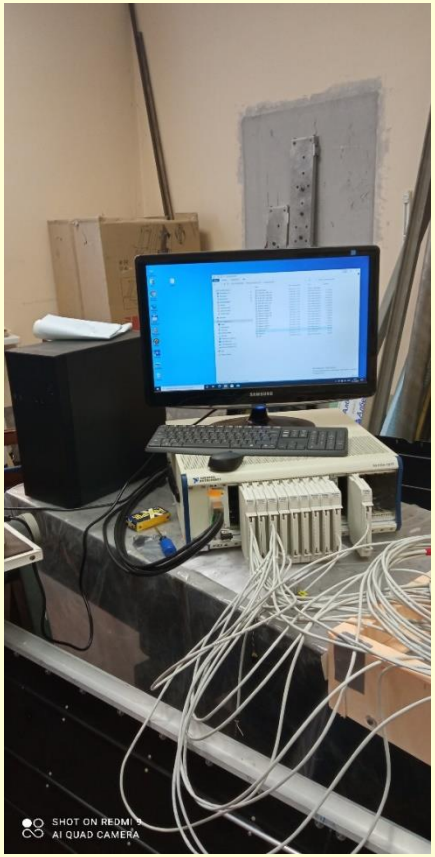
Calibrator
ЭЛЕМЕР-ТК-М150-К



Диапазон воспроизведения температуры, °С	**–42...+95**
Пределы допускаемой абсолютной погрешности воспроизведения температуры в режиме жидкостного калибратора, °С	±(0,02 + 0,0002 × |t|)
Нестабильность поддержания температуры за 30 мин, °С, не более	±0,01
Нестабильность поддержания температуры в сменном блоке за 30 мин, °С	±0,005
Неравномерность температуры в рабочем объёме, °С	от ±0,01
Диаметр ванны, мм	54

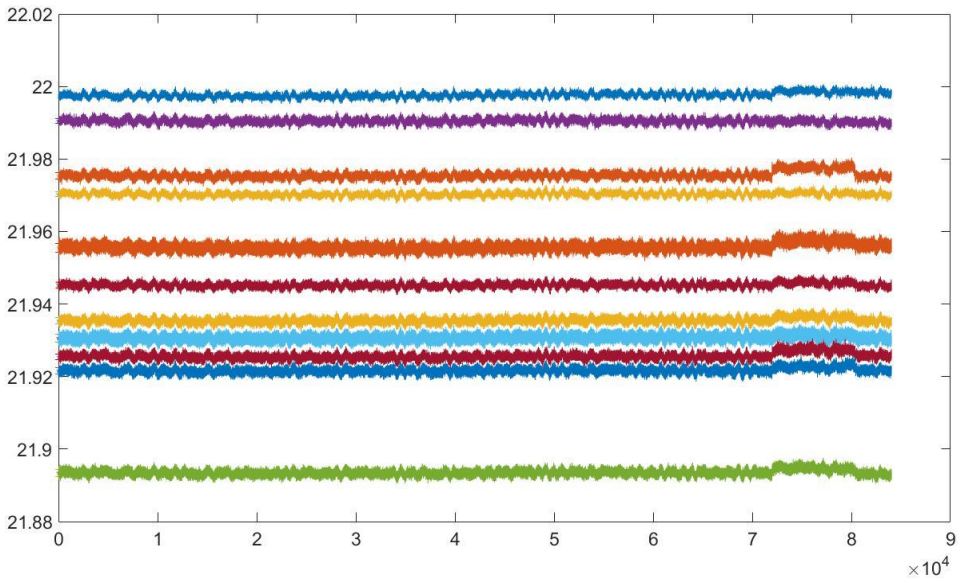
TPC cooling system: Pt100 calibration

Readout:
NI PXIe-4353, 24 bit ADC



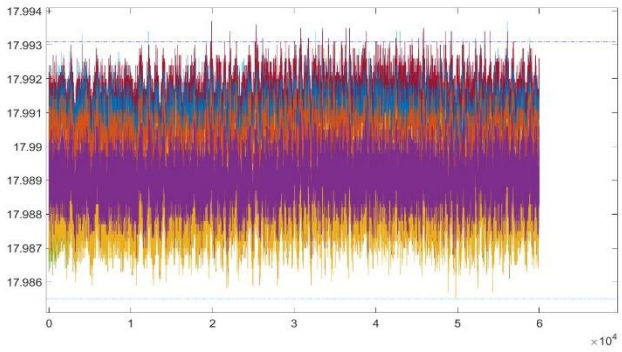
Pt100 (grade AA): N=10pc
T=18 ^{0}C, 22 ^{0}C, 26 ^{0}C and 30 ^{0}C
T measurement – up to 19.4 h
R/O rate – 1.1 Hz

T=22 ^{0}C, row data

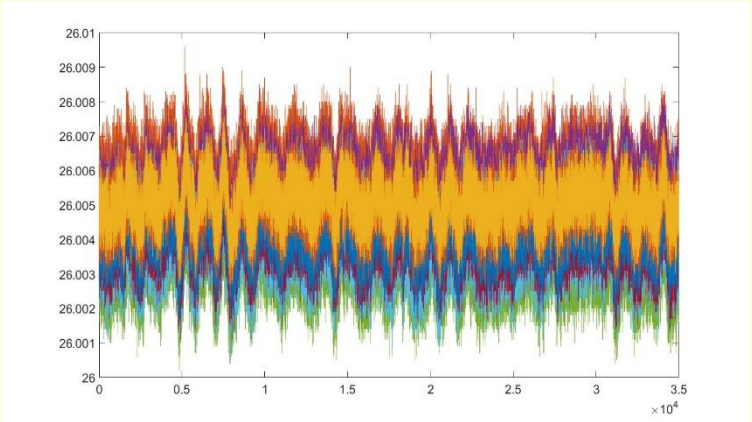


TPC cooling system: Pt100 calibration

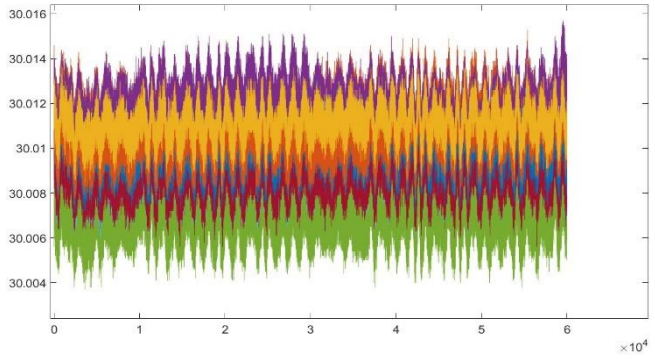
T=18 ^{0}C



T=26 ^{0}C



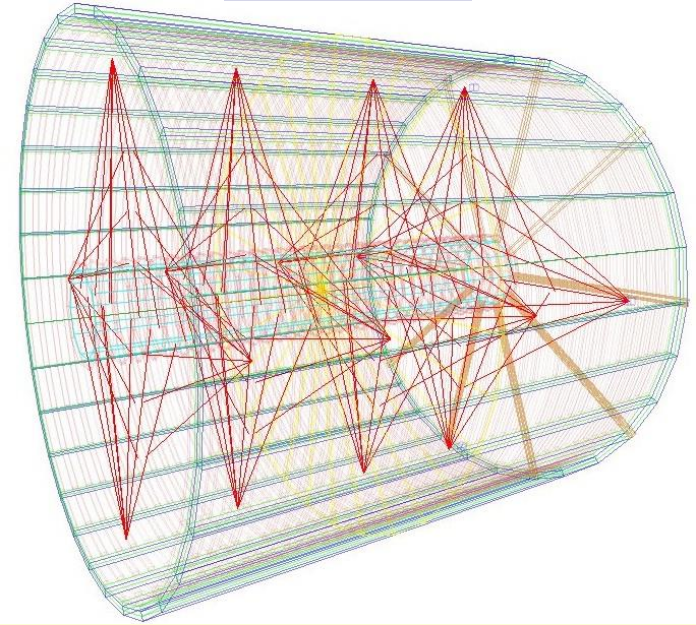
T=30 ^{0}C



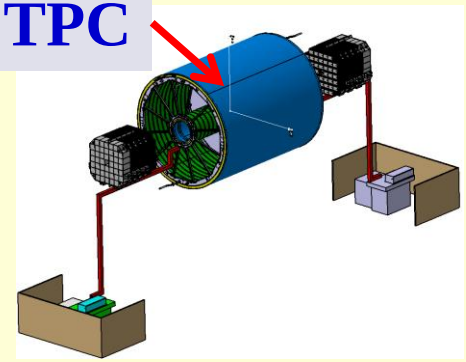
Pt100 calibration results:
Etalon sensor: T= 21.9452^{0}C ± 8.0e-4 (sigma=0.005 ^{0} C)
After sensors calibration:
"T=18 ^{0}C" sigma=0.009 ^{0} C
"T=26 ^{0}C" sigma=0.005 ^{0} C and
"T=30 ^{0}C" sigma=0.009 ^{0} C
Pt100 sensors precision (after calibration) can be achieved about 0.01 ^{0} C for temperature range T=+(18-30) ^{0}C

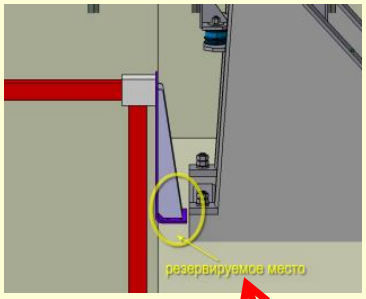
TPC laser calibration system: laser beams layout

½ TPC

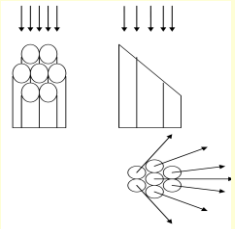


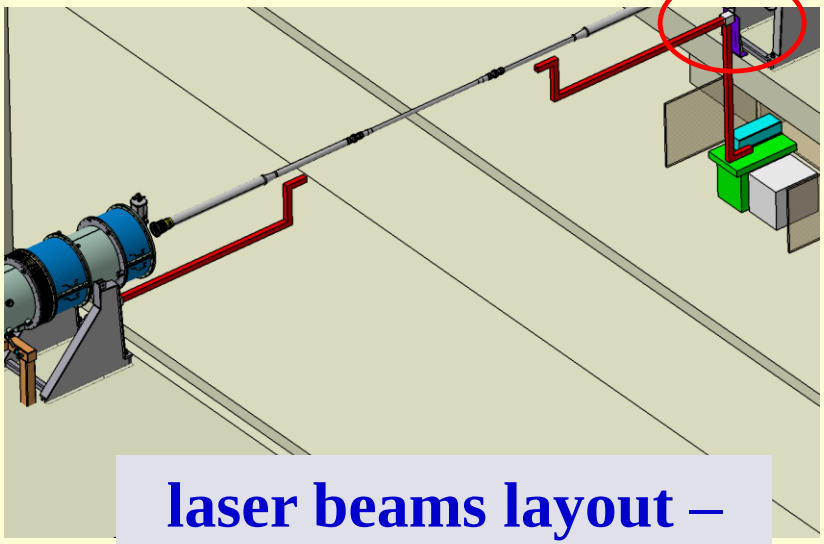
TPC





micro-mirror bundles

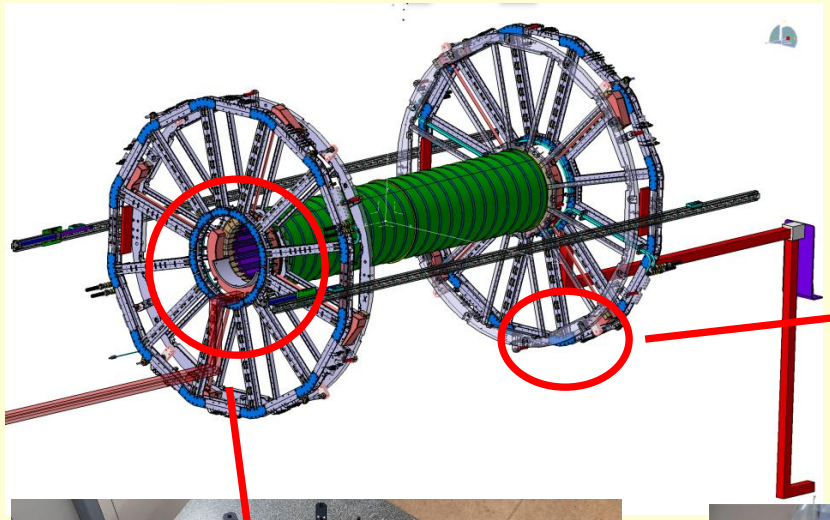




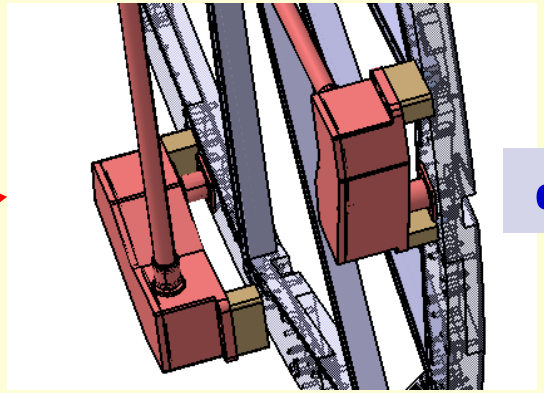
Laser "planes" - 4
Micro-mirrors bundles per plane - 4
Beams from micro-mirrors bundle - 7
Laser "tracks", N - 112x2=224

laser beams layout – fixed

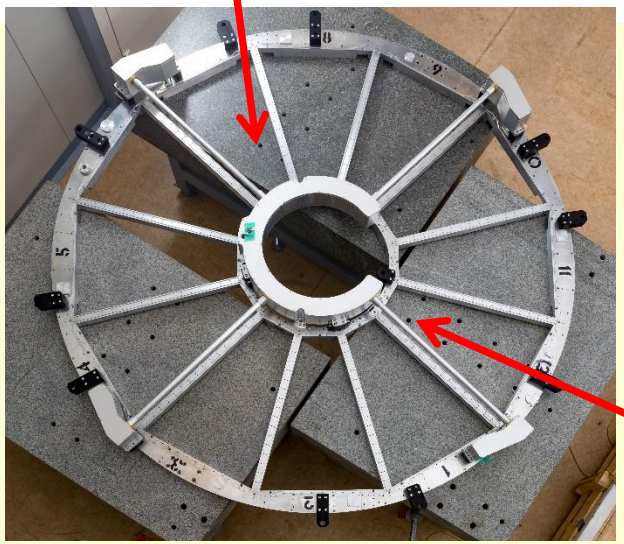
TPC laser calibration system

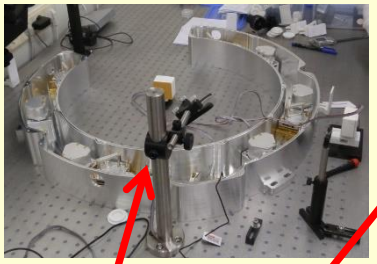


Semi transparent mirror & prism



delivered

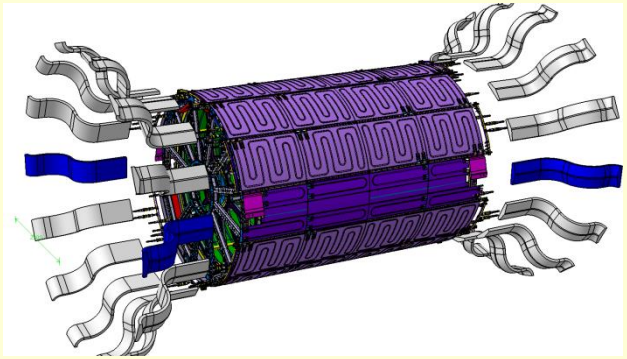


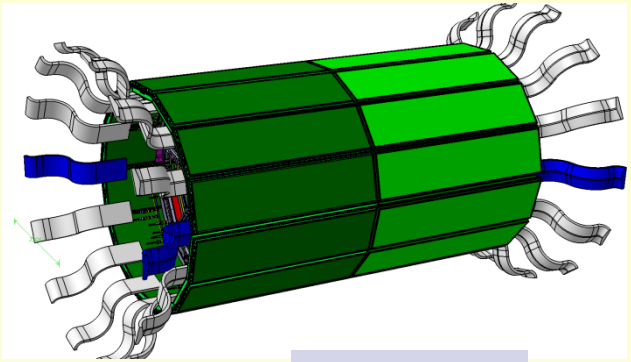


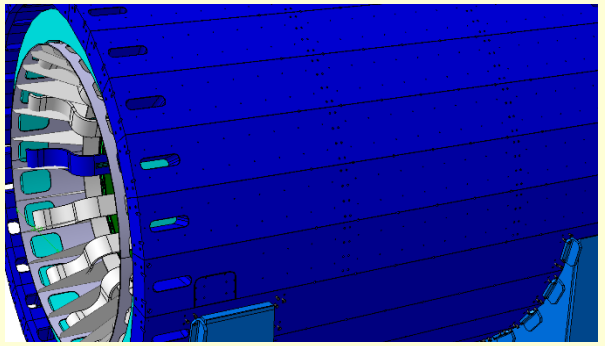
- full set of micro-mirror bundles - assembled
- 2 lasers – commissioned
- laser beam splitter – installed to flange
- laser beam monitors - prototype under tests

TPC cables and pipes integration

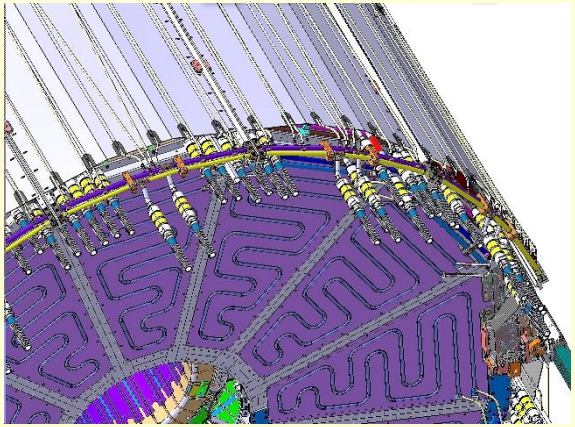
Trays layout concept

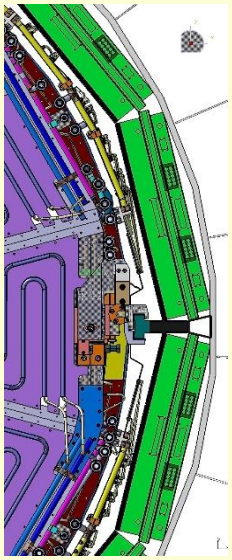




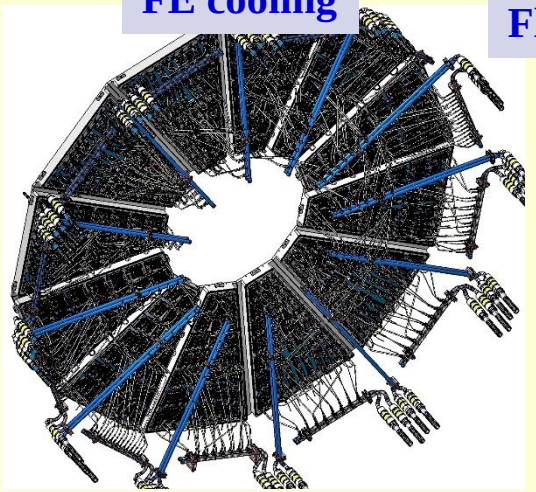


TPC services

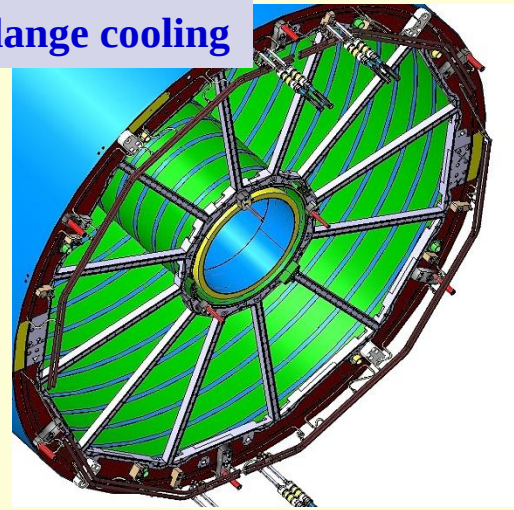




FE cooling

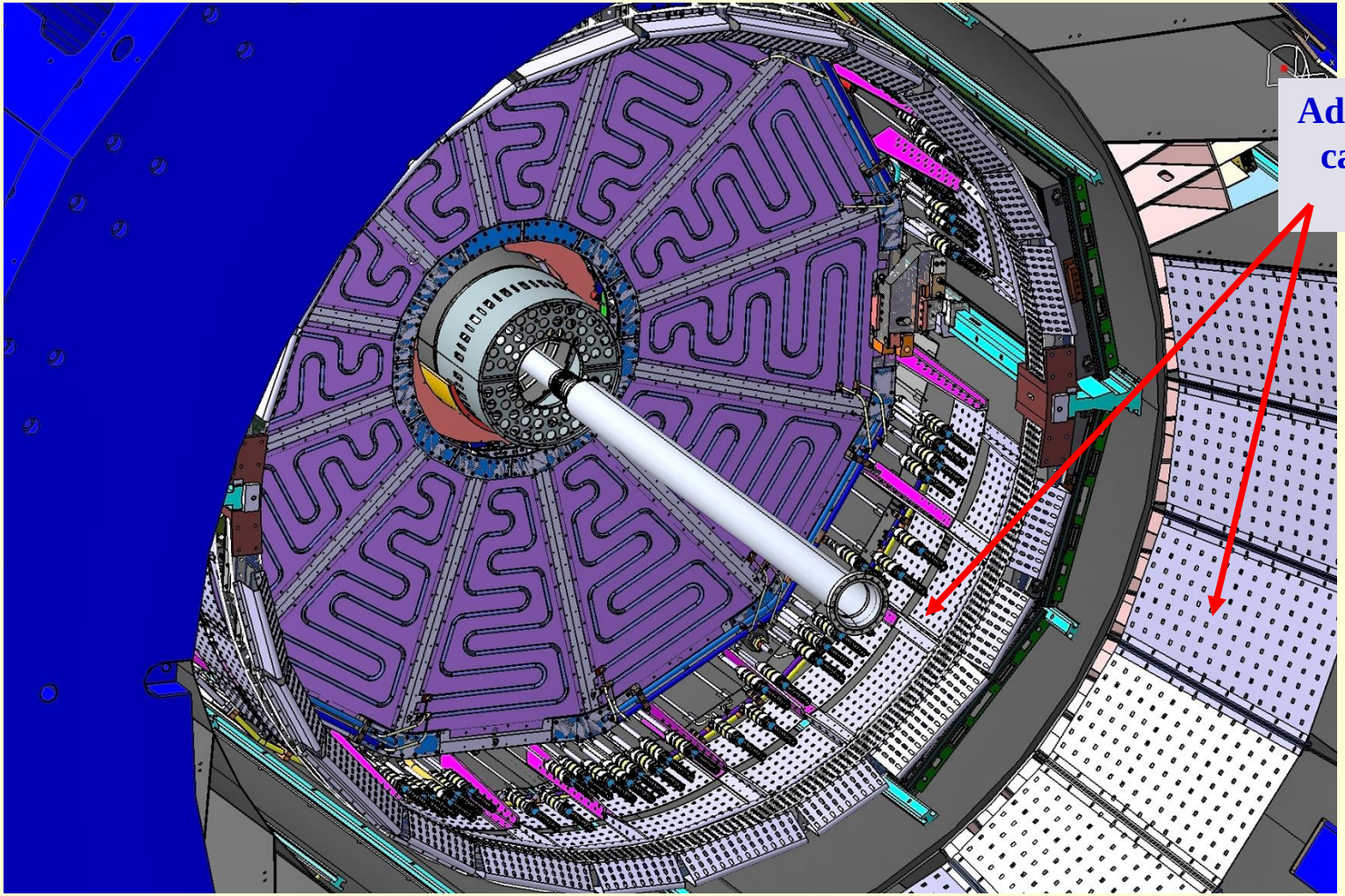


Flange cooling



Optimization - in progress

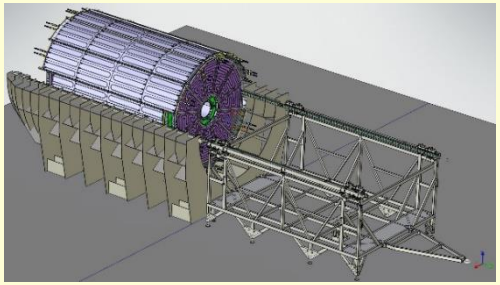
TPC cables and pipes integration

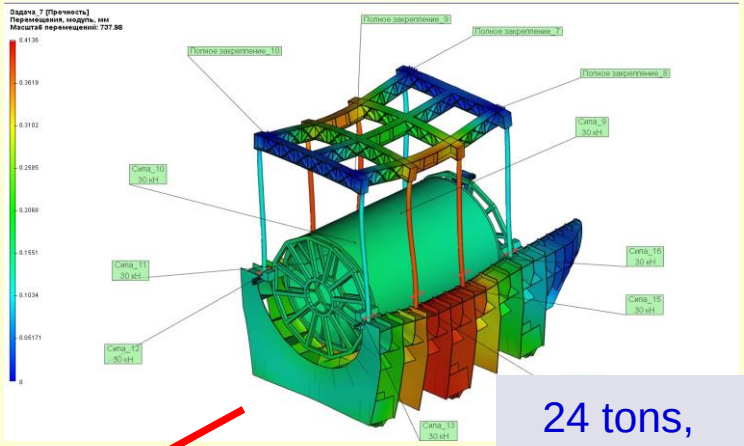


Add structures for cables and pipes fixation

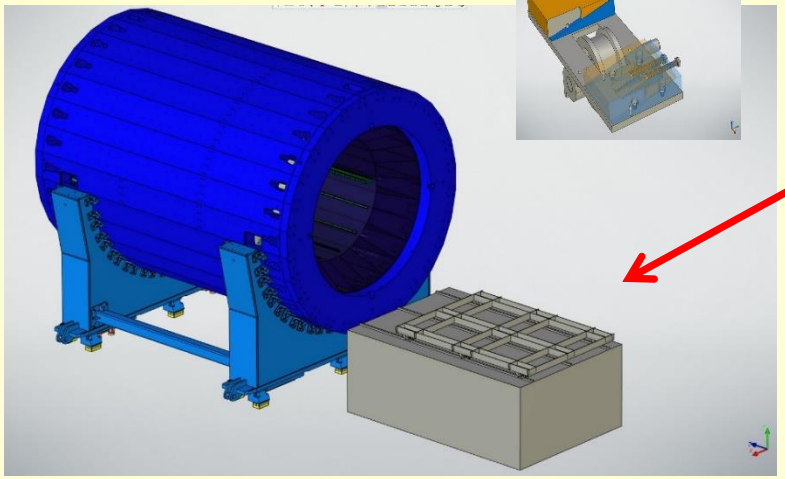
design – in progress …

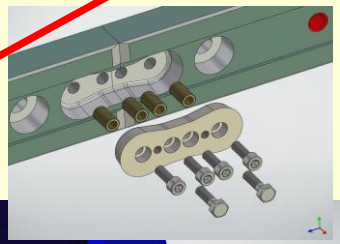
Integration TPC to MPD: concept

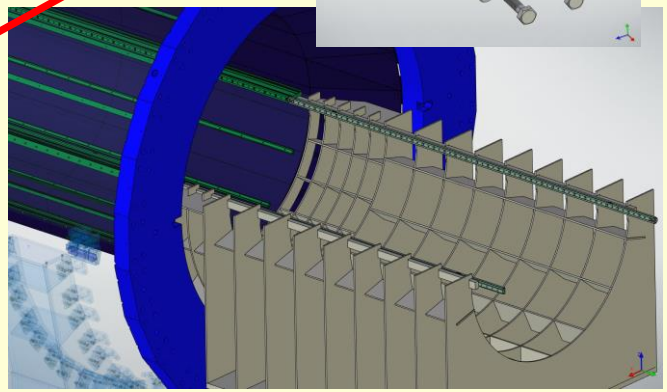




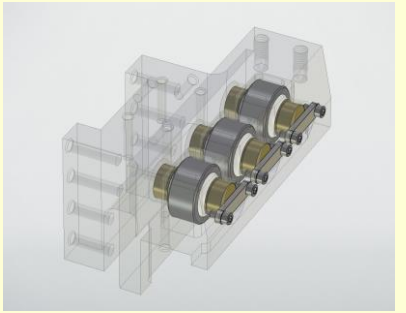
24 tons,
max=0.41 mm



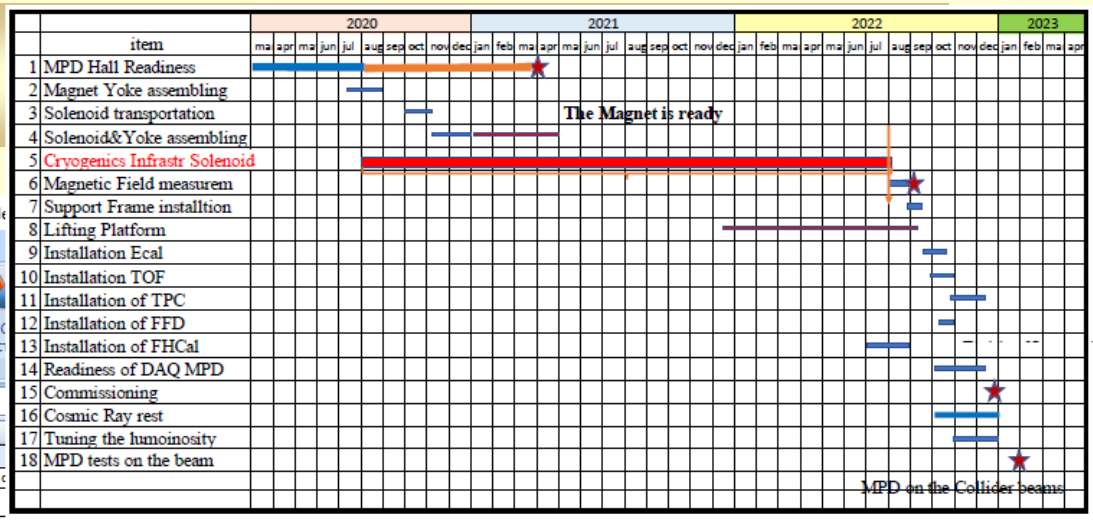




Rollers for
TPC moving

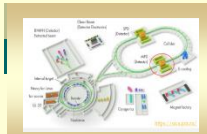
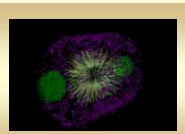


TPC schedule



FE mass-production – May-July 2022
ROCs to TPC - Aug 2022
TPC cosmic test (bld.217) – Sept 2022
TPC to MPD hall - Oct 2022
TPC install and align – Nov 2022
Cabling & piping - Nov-Dec 2022
MPD commissioning - Dec 2022

Shift = 2 month

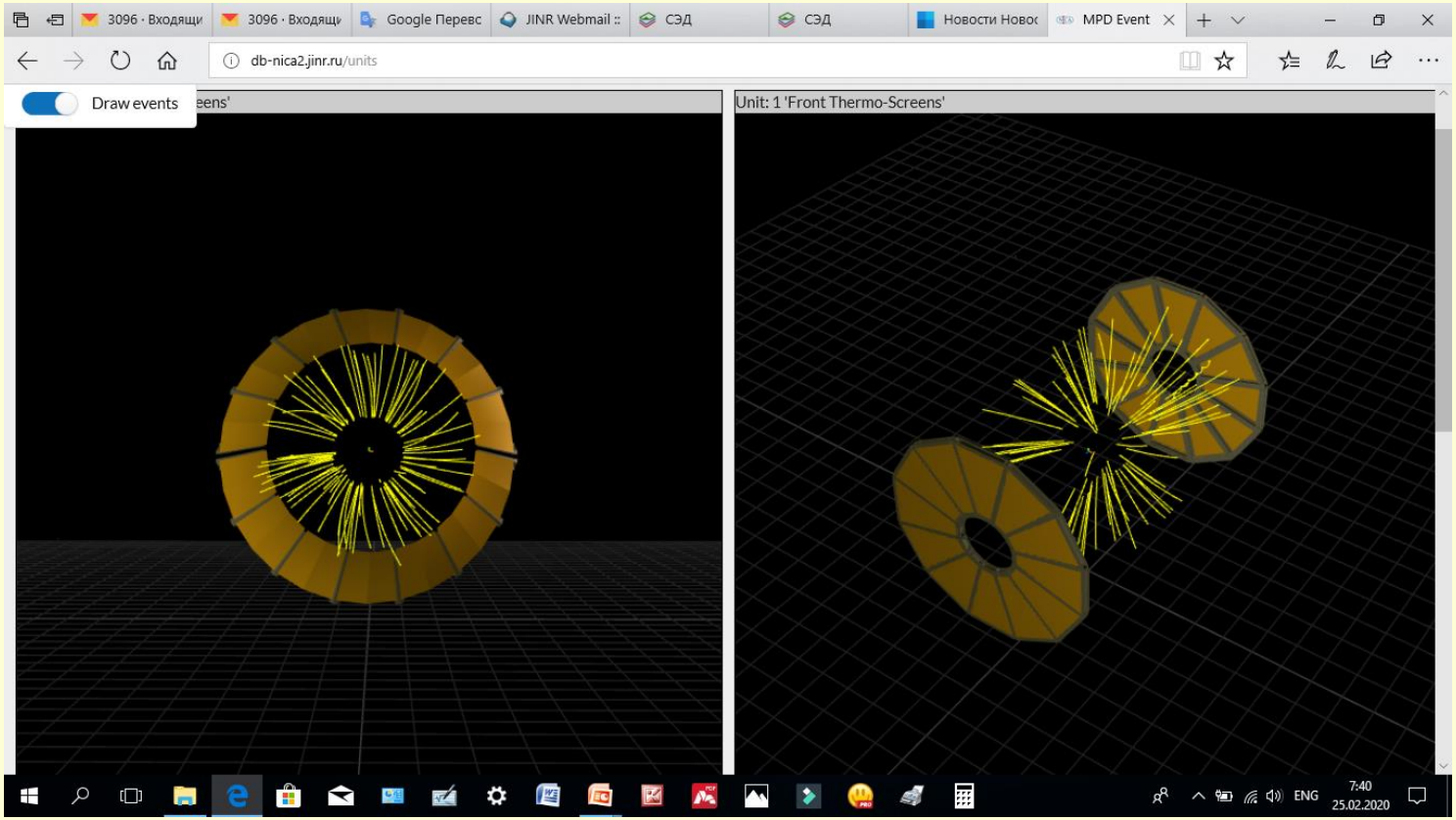



MPD TPC status 2021: summary


Status:

- **TPC:**
  - C1-C2 and C3-C4 cylinders - assembled
  - TPC field cage assembly - Dec 2021
- **ROC chambers (24pc)** - 24 pc tested, +2 pc (spare)– under tests
- **Electronics:**
  - FE electronics (477 cards (32%)) - manufactured and delivered, testing
  - RCU controller - design done, prototype manufactured, preparation for tests
  - FE (32 cards) + ROC tests - preparation for tests
  - FE radiators mass-production - done
  - FE cards mass-production and tests - 2021 -> 2022
- **Sub-systems:**
  - local TPC DAQ prototype - tests in progress
  - Gas system - commissioned, integration to MPD started
  - Cooling system: full set of thermal panels - delivered, FE cooling radiators – delivered
  - HV+LV systems - 10% delivered, GSI tender finished -> CAEN
  - 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 - in progress
  - MPD TPC trays - in progress
- **Integration TPC to MPD**
  - TPC racks (8pc) layout - in progress
  - tooling for installation TPC to MPD - in progress
- **TPC schedule**
  - TPC installation to MPD - Nov 2022
  - MPD commissioning - Dec 2022

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!