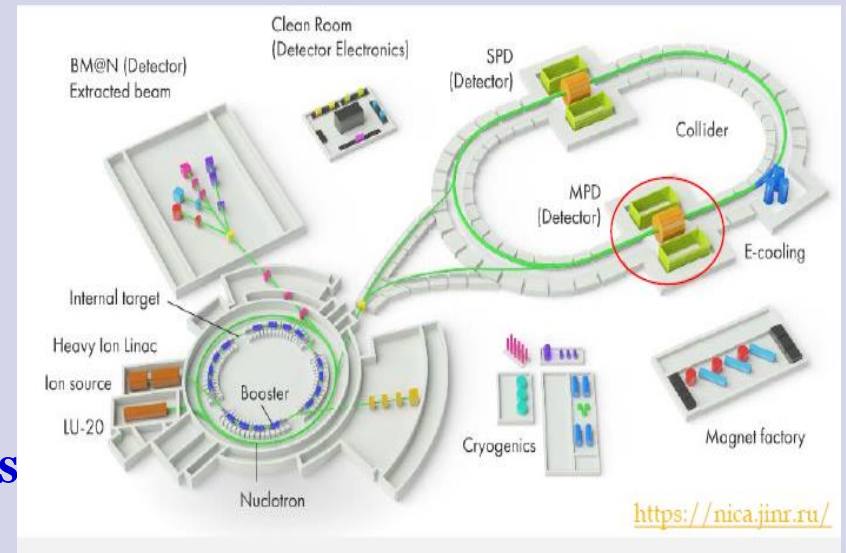


## MPD/NICA TPC status (26.10.2021)

- 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



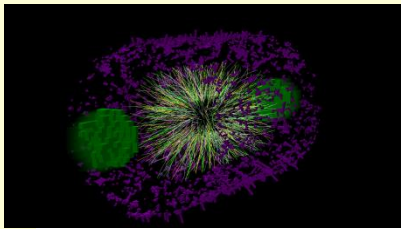
Presented by Sergey Movchan

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

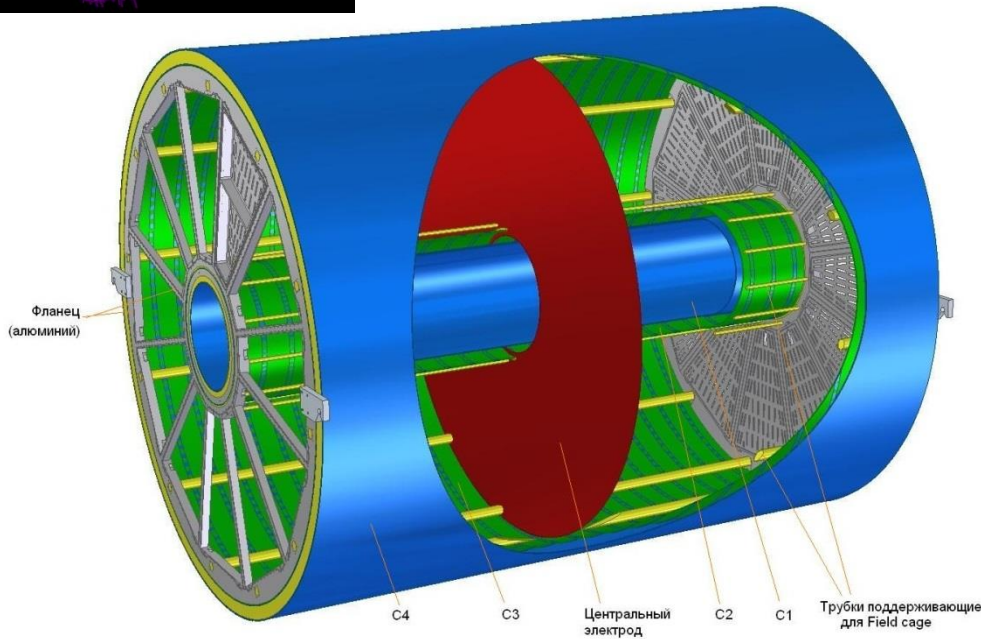


- slides with actual info

# MPD TPC parameters



Корпус TPC/MPD



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

S.Movchan MPD TPC status, NTNPD-2021,  
Warsaw, Oct 26, 2021

25-Oct-21

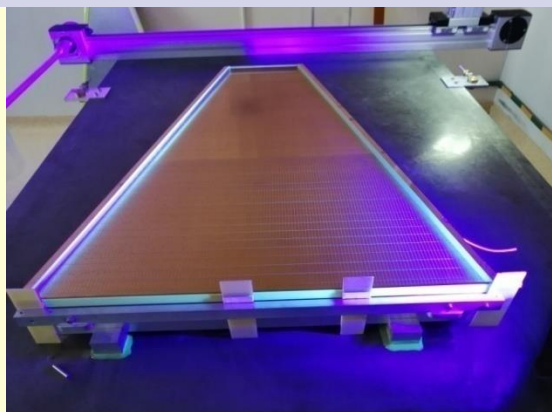
Item	Dimension
Length of the TPC	340cm
Outer radius of vessel	140cm
Inner radius of vessel	27 cm
Outer radius of the drift volume	133cm
Inner radius of the drift volume	34cm
Length of the drift volume	170cm (of each half)
HV electrode	Membrane at the center of the TPC
Electric field strength	~140V/cm;
Magnetic field strength	0.5 Tesla
Drift gas	90% Ar+10% Methane, Atmospheric pres. + 2 mbar
Gas amplification factor	~ 10 <sup>4</sup>
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 <sup>2</sup> and 5x18mm <sup>2</sup>
Number of pads	95232
Pad raw numbers	53
Pad numbers after zero suppression	< 10%
Maximal event rate	< 7 kHz ( Lum. 10 <sup>27</sup> )
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

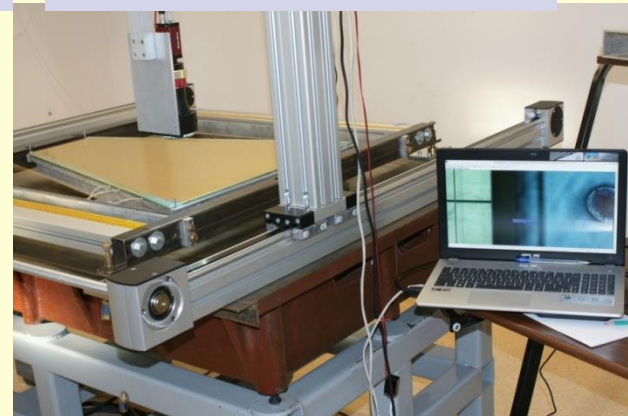
24 pc tested ROCs in stock



ROC cleaning procedure



Wire pitch check set up



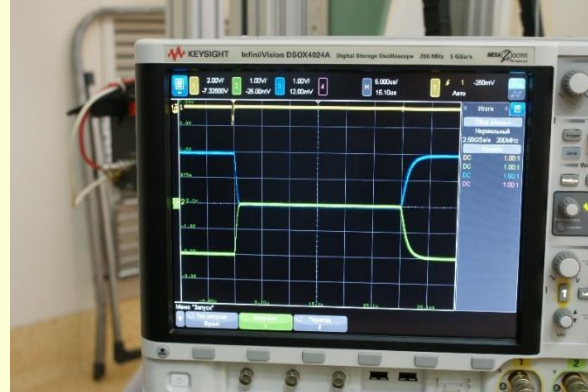
Test set up



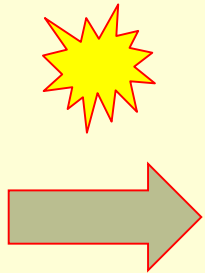
+ 2 pc spare – tests in progress



# ROC gating grid 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 prototypes:**  
(October 2021)  
- switch module  
- power supplies:  
+/- 200V & - 40V

## NEW switch module

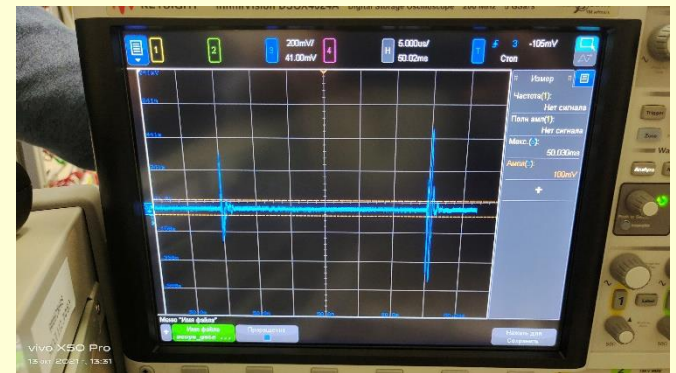




# ROC gating grid system (Minsk)



**Pulse rise time - 500 ns, OK!**



**SAMPA output: cross-talk**

- match cable resistance with ROC gate
- suppress pulse cross-talk to SAMPA



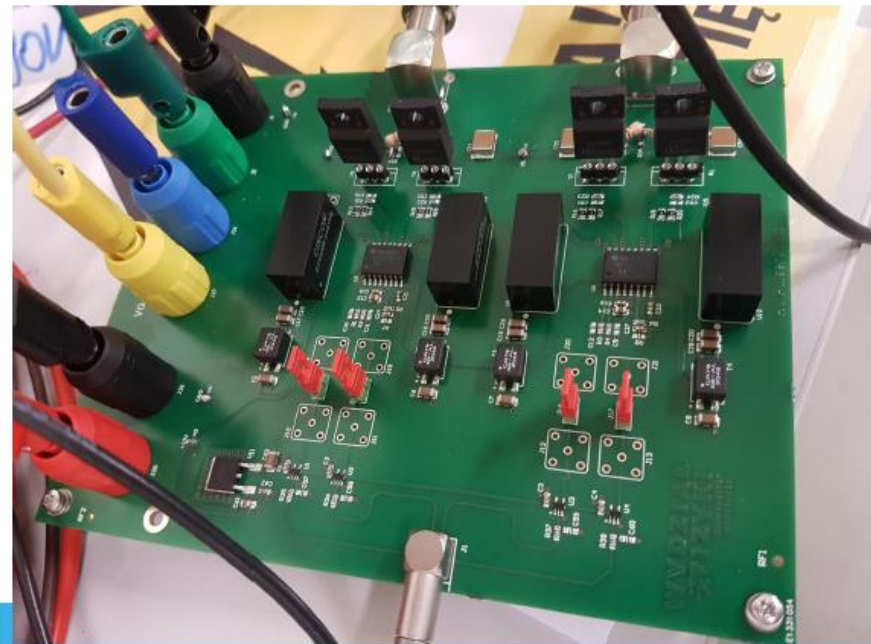
# ROC gating grid system (Warsaw)

## Test station

## Pulser made by Wojtec Oklinski:

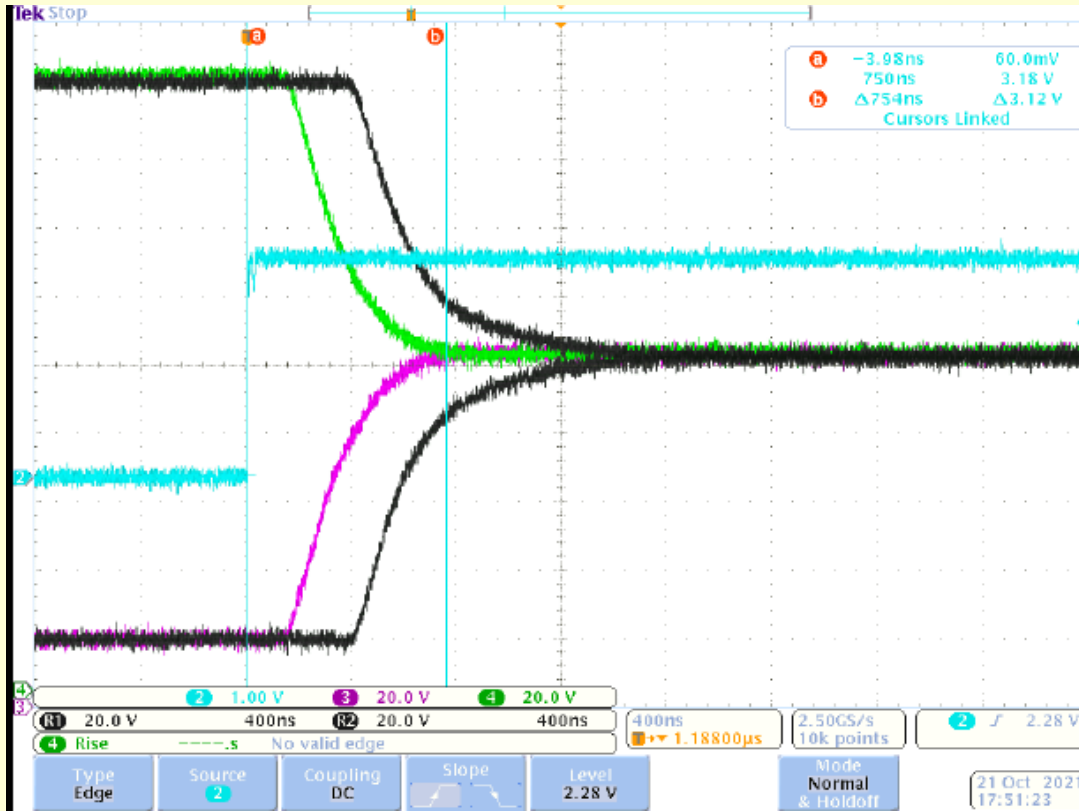
- Module based on ALICE gating grid pulser; made by Wojtek Okliński
- 3 HV ( $U_{G^-}$ ,  $U_{G^+}$ ,  $U_{G^+}$ )
- 2 BNC for ROC connections
- LV (+12 V)
- Trigger LVTTTL or TTL

- Test station:
  - HV power supplies HSPY, 200V 3A
  - standard laboratory LV power supply
  - oscilloscope Tektronix DPO 4054 (500 MHz)
  - function generator Tektronix AFG3252
  - 25 m HV cable





# ROC gating grid system (Warsaw)



- Test with 25 m HV cable
- Voltage settings:  
 $U_g = 100 \text{ V}$   
 $\Delta U_g = 80 \text{ V}$
- Cyan – trigger
- Green/Purple – prototype pulser
- Black – Alice pulser
- MPD pulser faster by 700 ns than ALICE one
- Pulser prototype was also tested with various inductive coils to match the cable inductivity; best results without any additional coil

**Pulse rise time - 600 ns, OK!**

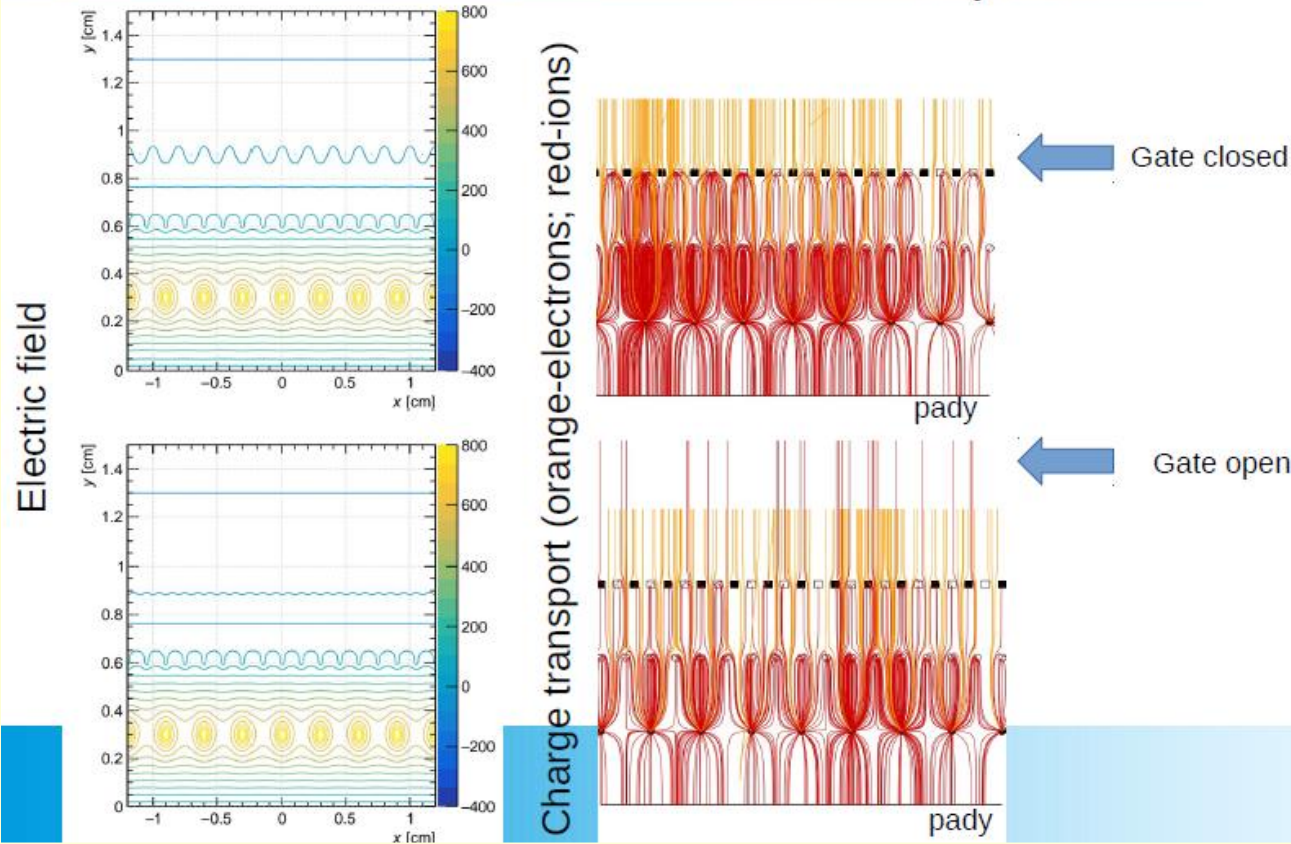
## Plan:

- test prototype with ROC chamber at Dubna
- choose best prototype for mass-production
- gating grid system ready – December 2022



# ROC gating grid system (Warsaw)

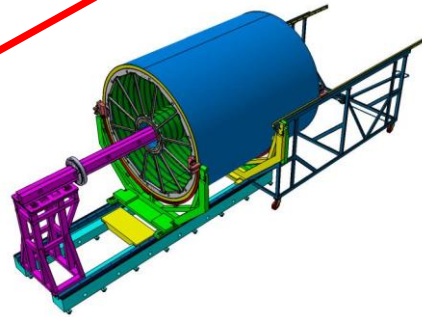
Garfield simulation example:  $U_s = 1400 \text{ V}$   
 $U_g = 100 \text{ V}$   
 $\Delta U_g = 50 \text{ V}$



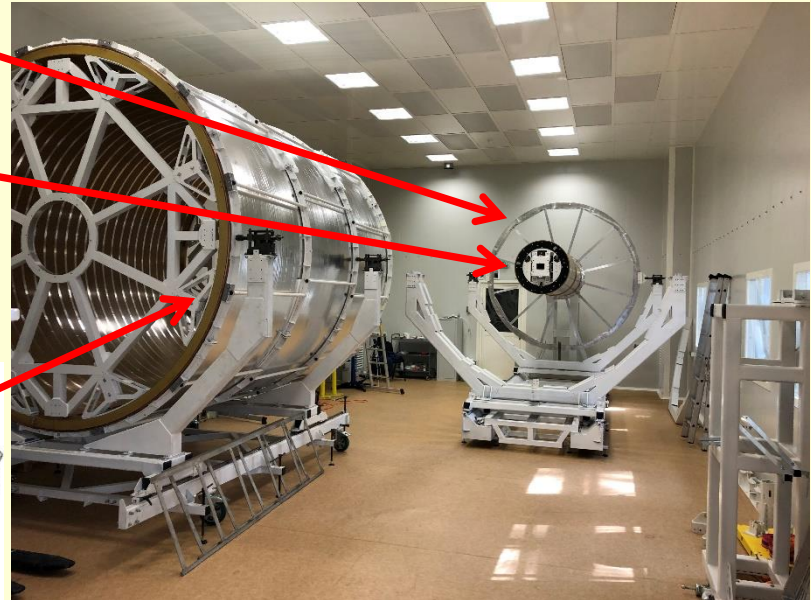
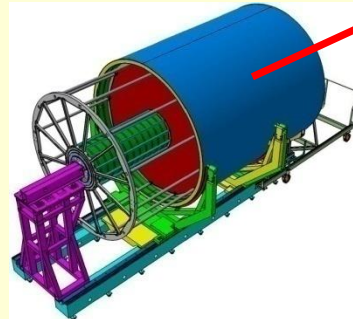
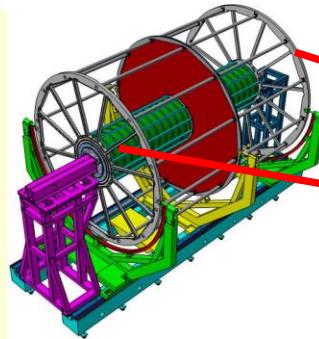
Simulations from  
Magda Kuich



# TPC vessel assembly (Bld.217) – common view



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



TPC assembly – **in progress**



ISO-6

S=84 m2



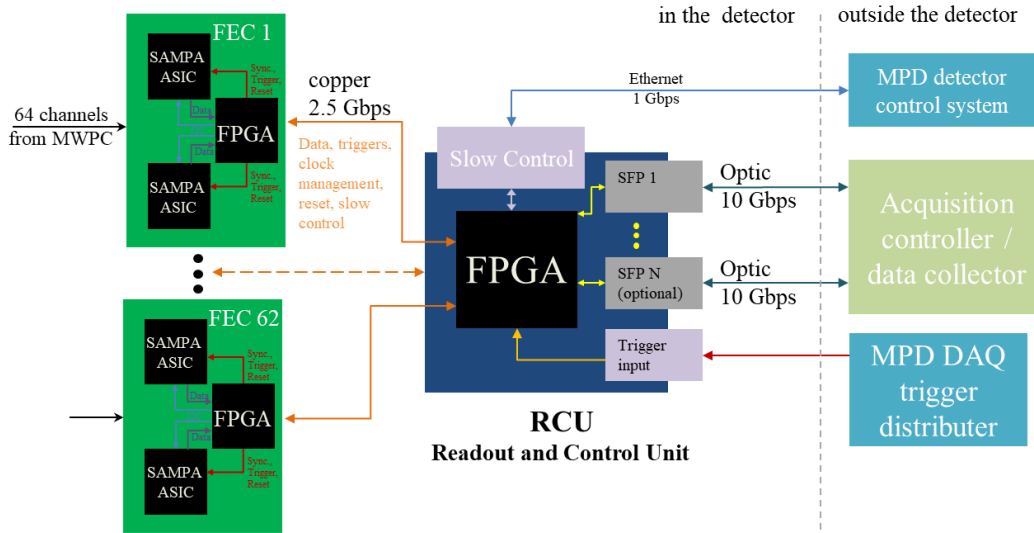
## TPC field cage rods assembly (Bld.40)

Set up for roads assembly

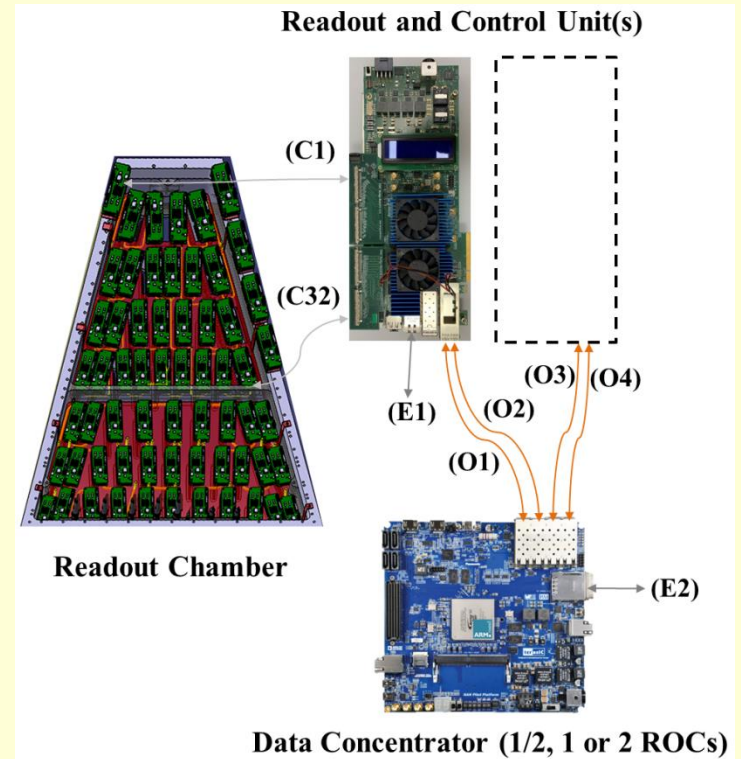


**Roads D=30 mm - 30pc assembled**  
**Roads D=60 mm - assembling**

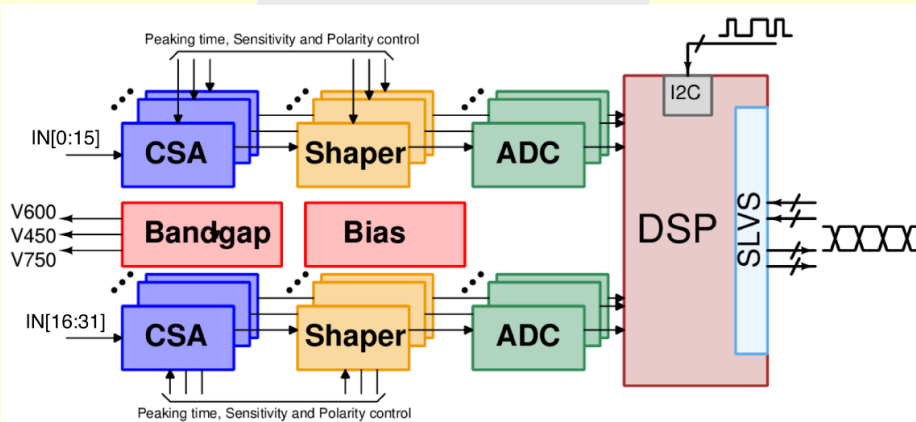
# TPC electronics: **block diagram** of one chamber readout



**RCU and data concentrator based on commercial kits**



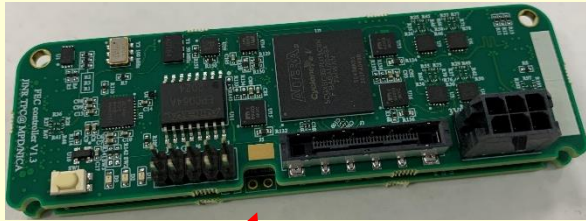
## SAMPA chip





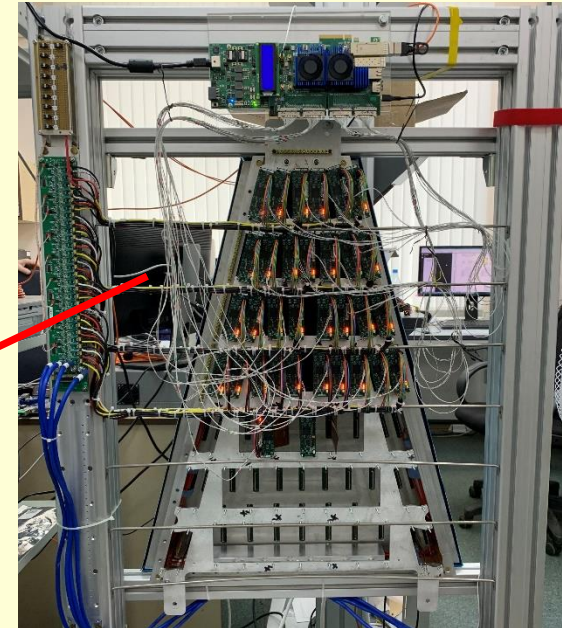
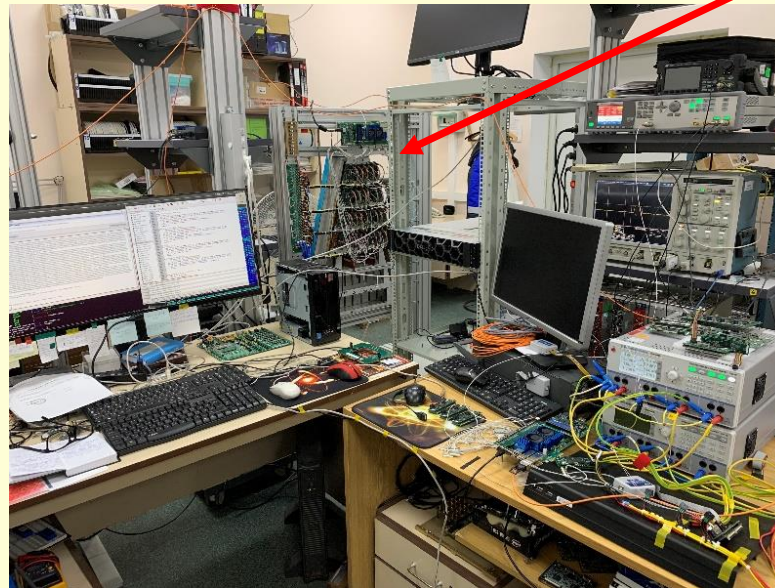
# TPC electronics: status

New version of the FE card:



2048ch readout system  
powered via LVDB

Connection holes  
for analog power  
supply added



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



## TPC electronics: status

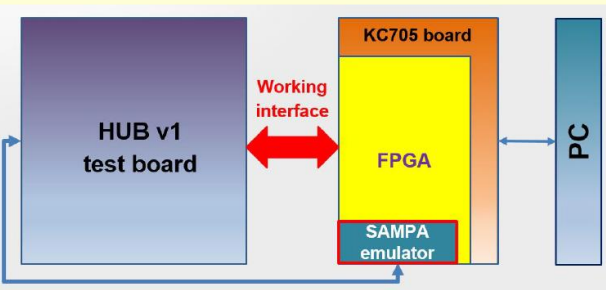
- 477pc pre-serial FECs were produced (~32% of the whole amount).
- A new data transmission protocol with redundancy check between FECs and RCU (FEC Transfer Protocol - FTP) was developed and realized in the firmware. Testing is going.
- Testing of the readout system which includes 32 FECs, RCU prototypes, 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:



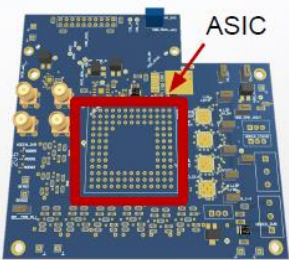


# Data concentrator ASIC (NRNU MEPhi)

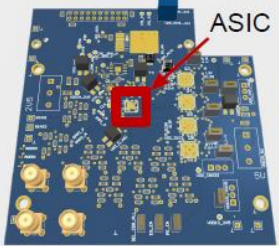
## Test set up diagram



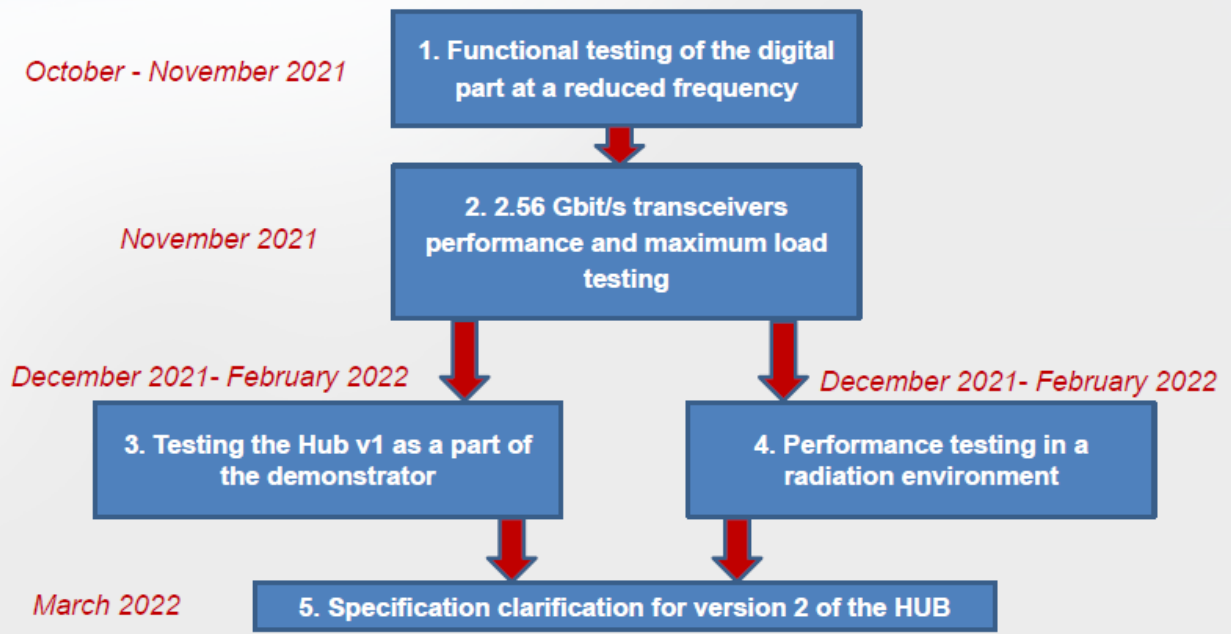
PCB with CPGA-120 socket



PCB with caseless chip



## Hub v1 testing plans



for more info - see E. Atkin's talk

# TPC LV+HV system

## LV&HV system 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 mm<sup>2</sup> – delivered to JINR (Dec 2019)

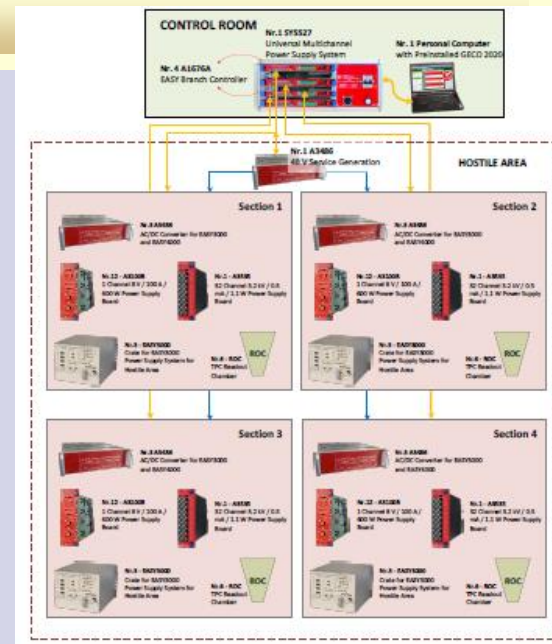
S=120 mm<sup>2</sup> – delivered to JINR (Dec 2019)

HV cables - ordered

LVDB boards (60 pc) - delivered

INP BSU (Minsk)

Team for cabling and piping – contracted



# TPC gas system

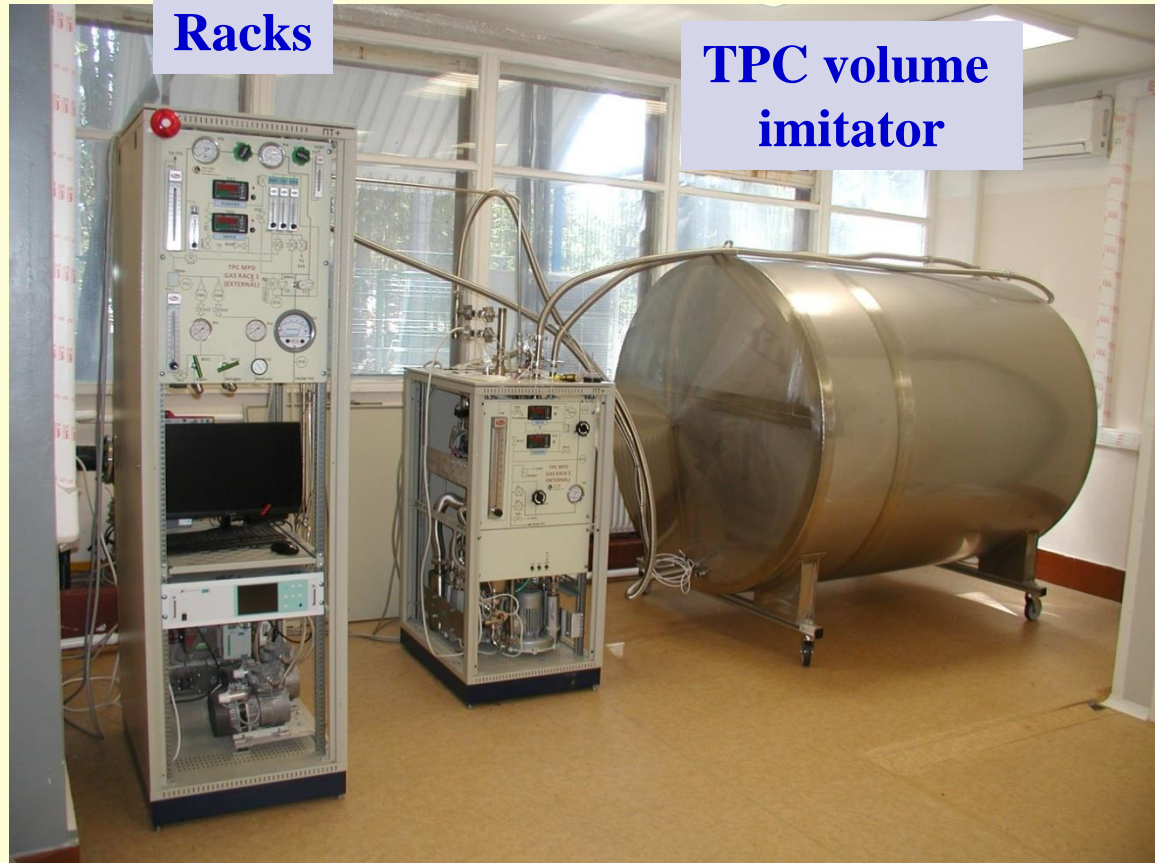
Gas supply



Commissioning -  
in progress

Racks

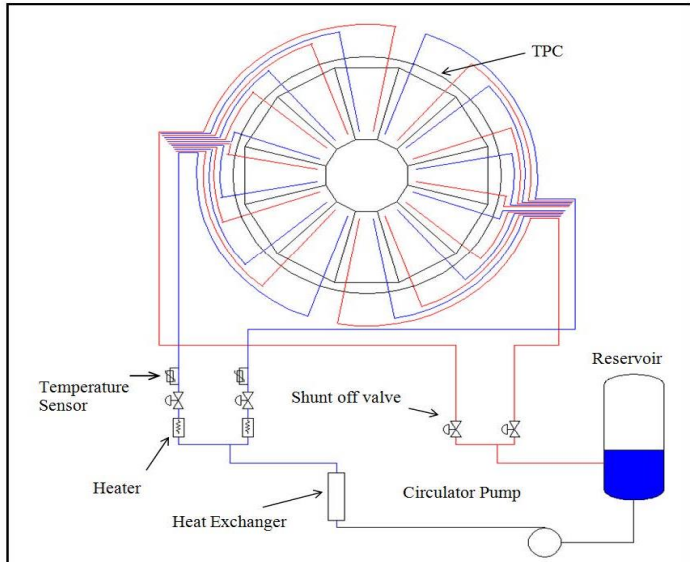
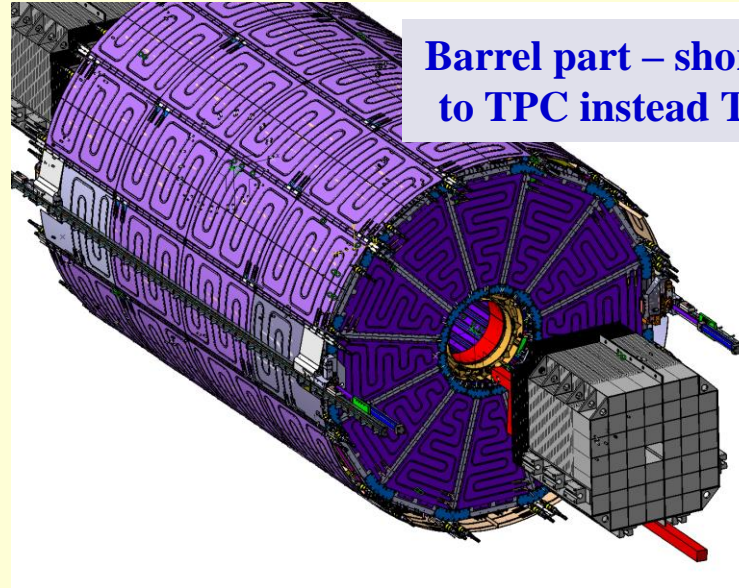
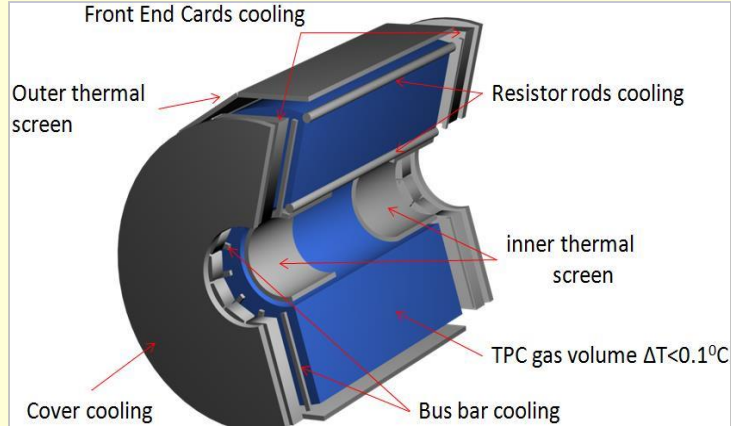
TPC volume  
imitator



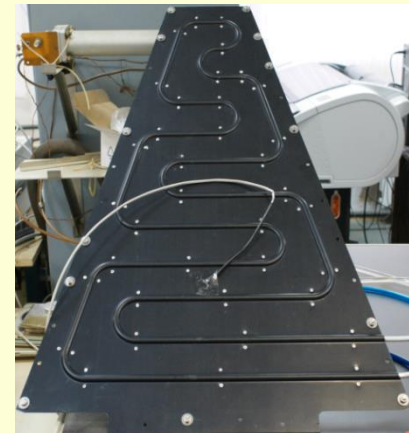
Status - **commissioned** (Bld.217)



# TPC cooling system

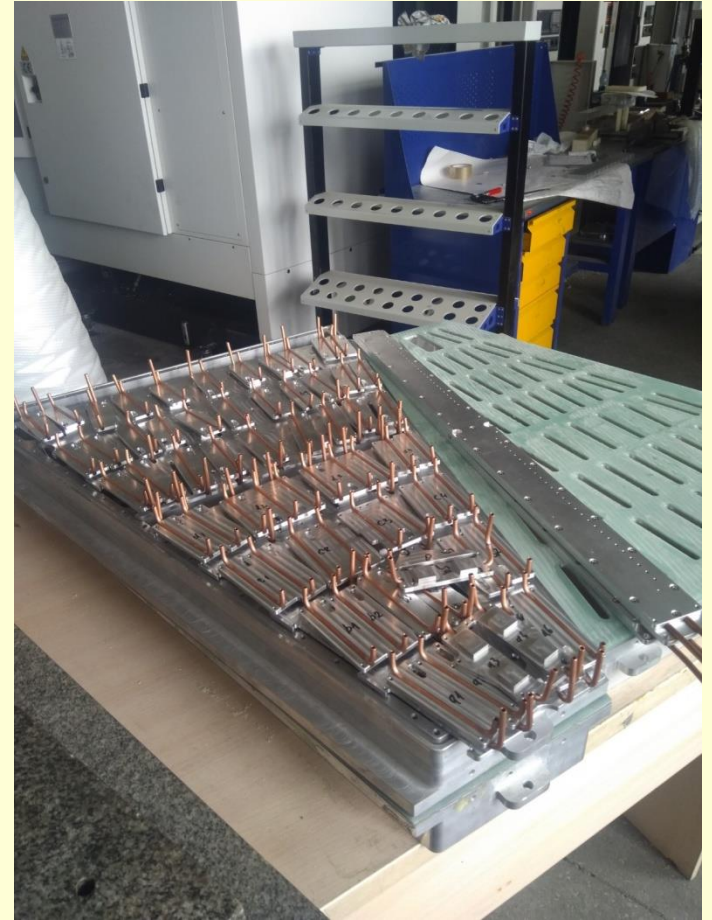


Full set – delivered



# 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) mm**



# TPC cooling system: T-sensors calibrator

Calibrator

ЭЛЕМЕР-ТК-М150-К



Диапазон воспроизведения температуры, °C	-42...+95
Пределы допускаемой абсолютной погрешности воспроизведения температуры в режиме жидкостного калибратора, °C	$\pm(0,02 + 0,0002 \times  t )$
Нестабильность поддержания температуры за 30 мин, °C, не более	$\pm 0,01$
Нестабильность поддержания температуры в сменном блоке за 30 мин, °C	$\pm 0,005$
Неравномерность температуры в рабочем объёме, °C	от $\pm 0,01$
Диаметр ванны, мм	54

Precision  $dT = \pm 0.01$  degree



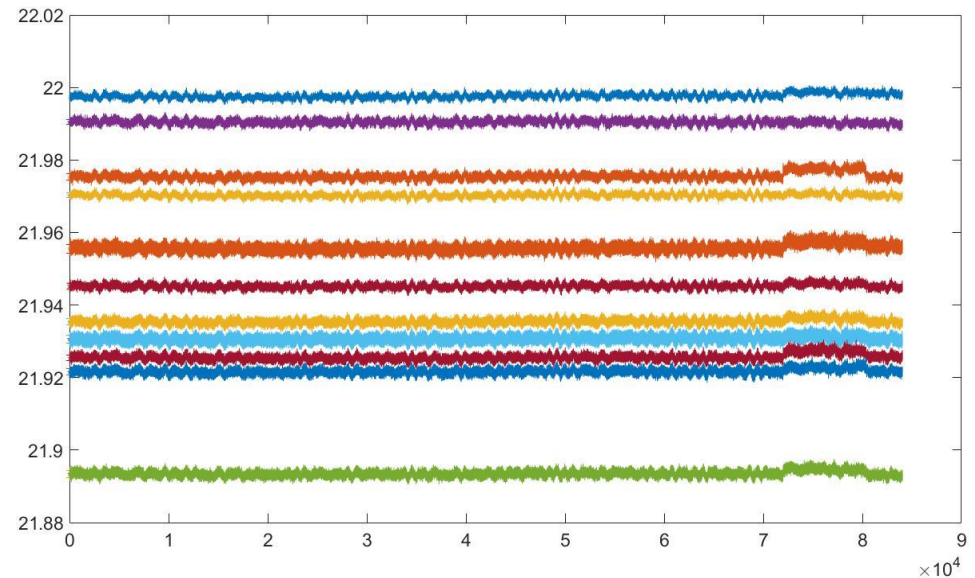
# TPC cooling system: Pt100 calibration

**Readout:**  
NI PXIe-4353, 24 bit ADC

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



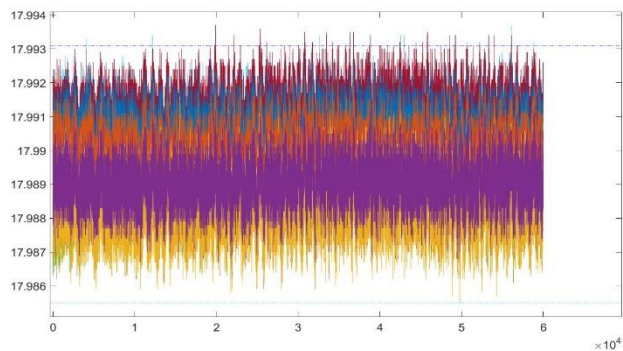
**T=22 °C, row data**



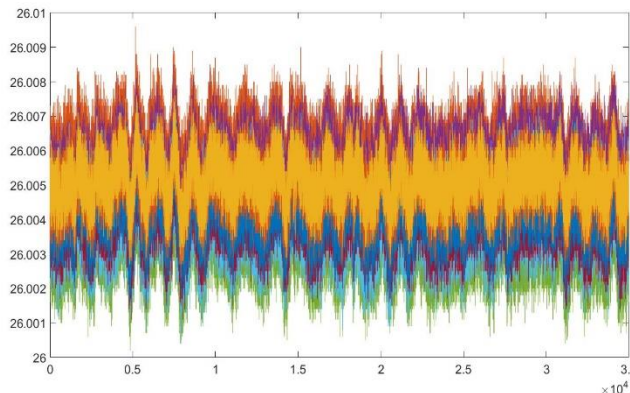


# TPC cooling system: Pt100 calibration

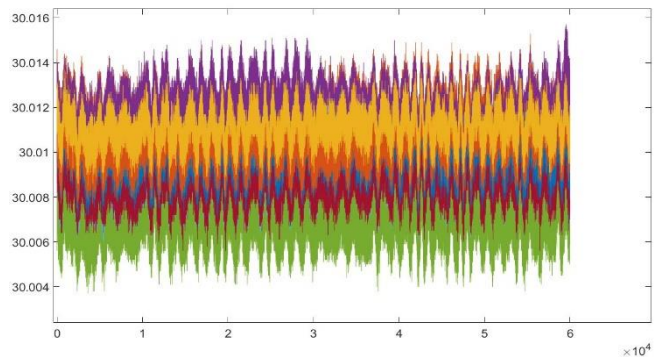
T=18 °C



T=26 °C



T=30 °C



**Pt100 calibration results:**

**Etalon sensor:  $T = 21.9452^{\circ}\text{C} \pm 8.0\text{e-}4$  ( $\sigma=0.005^{\circ}\text{C}$ )**

**After sensors calibration:**

**“T=18 °C”  $\sigma=0.009^{\circ}\text{C}$**

**“T=26 °C”  $\sigma=0.005^{\circ}\text{C}$  and**

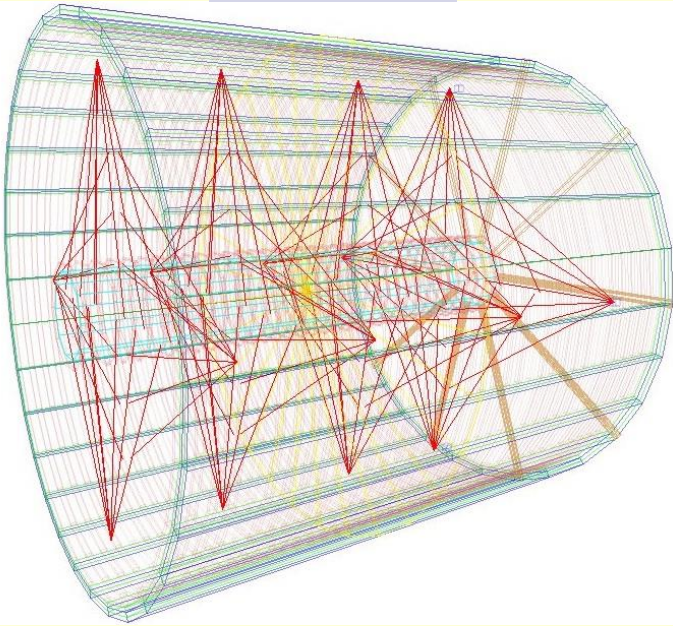
**“T=30 °C”  $\sigma=0.009^{\circ}\text{C}$**

**Pt100 sensors precision (after calibration) can be achieved about  $0.01^{\circ}\text{C}$  for temperature range  $T=+(18-30)^{\circ}\text{C}$**

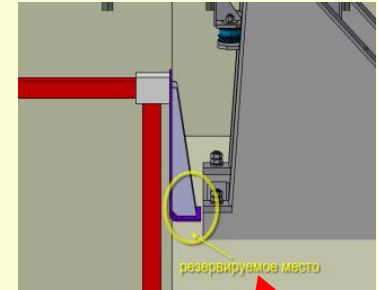
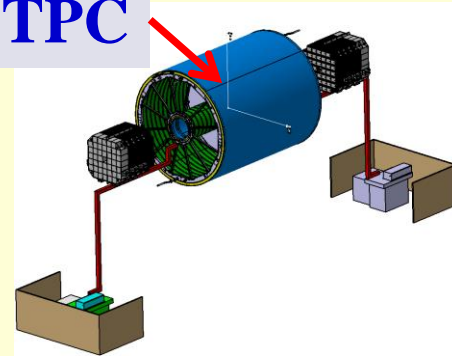
**Precision  $dT=+/-0.005$  degree**

# TPC laser calibration system: laser beams layout

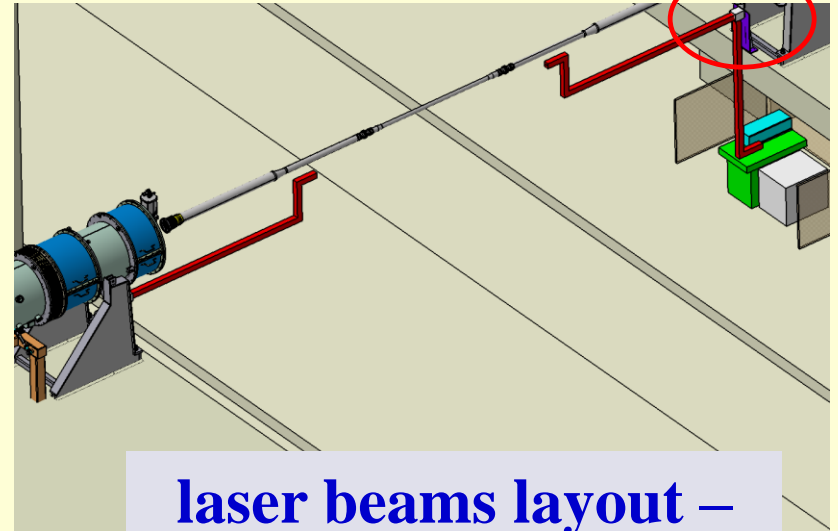
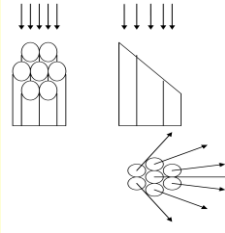
½ TPC



TPC



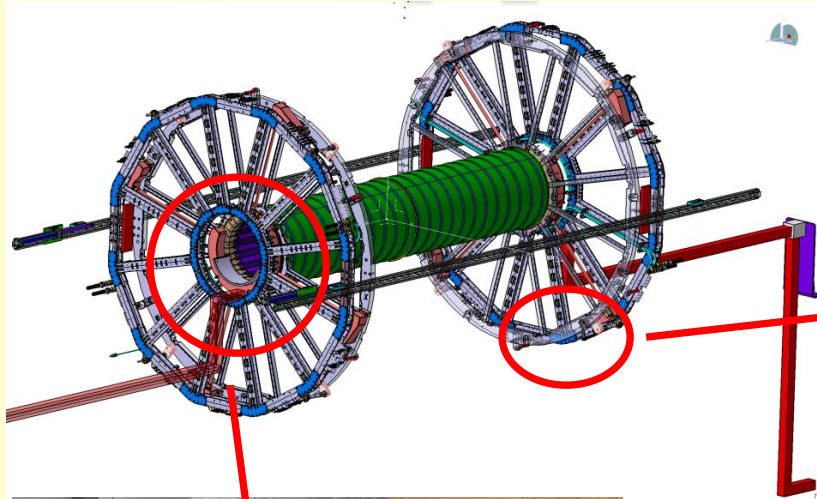
micro-mirror bundles



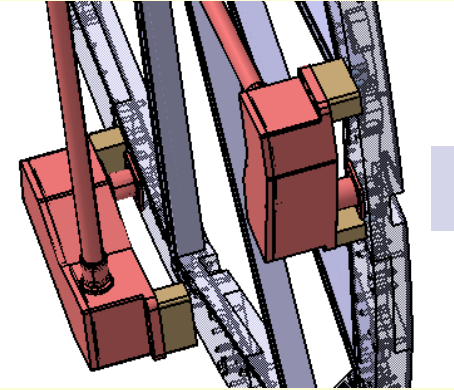
laser beams layout –  
**fixed**

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

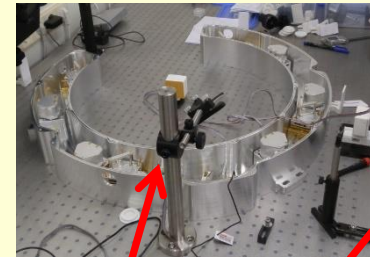
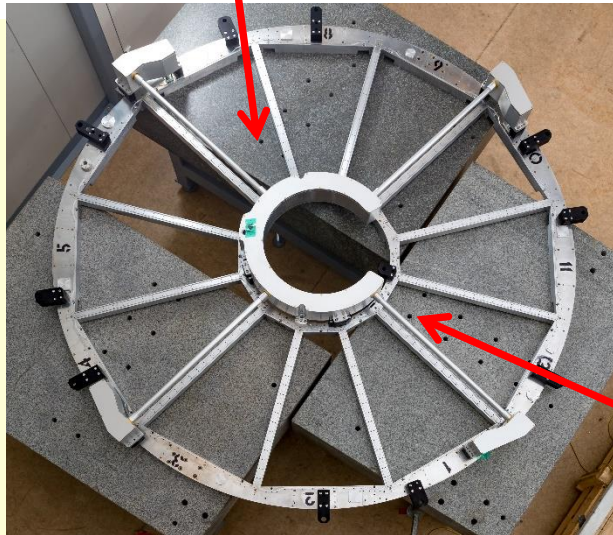
# TPC laser calibration system



Semi transparent mirror & prism



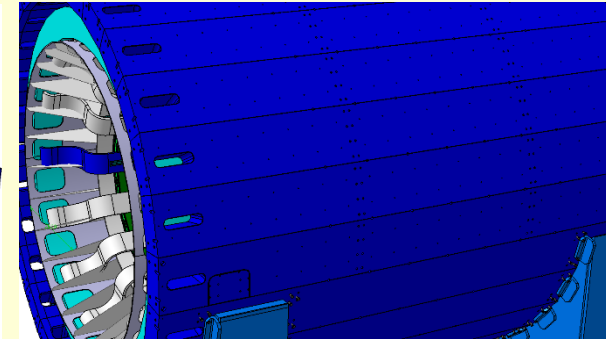
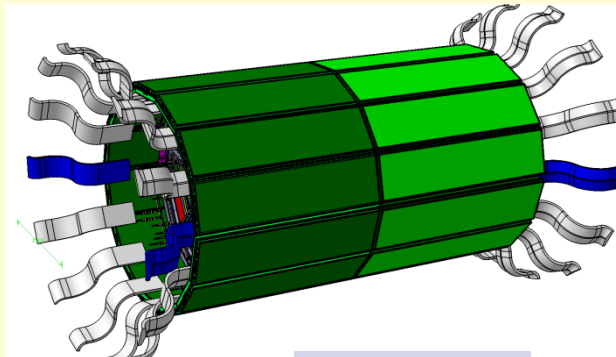
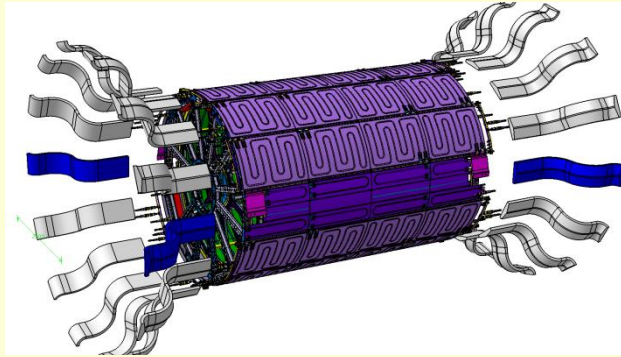
delivered



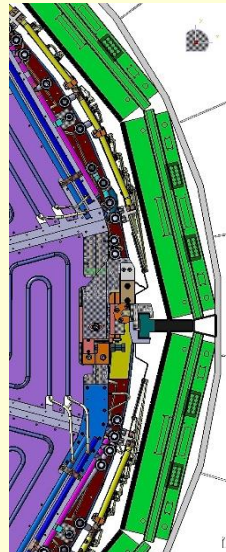
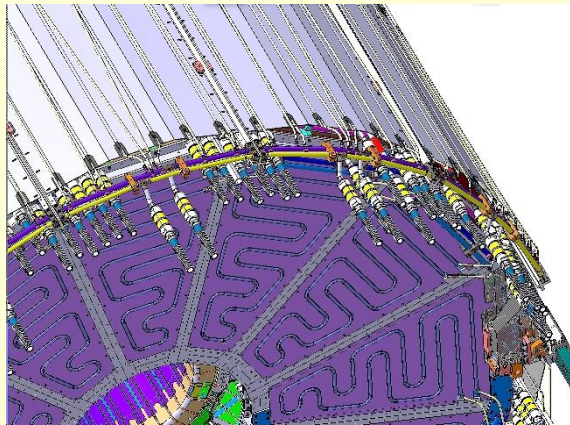
- full set of micro-mirror bundles - assembled
- 2 lasers – commissioned
- laser beam splitter – installed to flange
- laser beam monitors - prototype under tests

# TPC cables and pipes integration

Trays layout concept



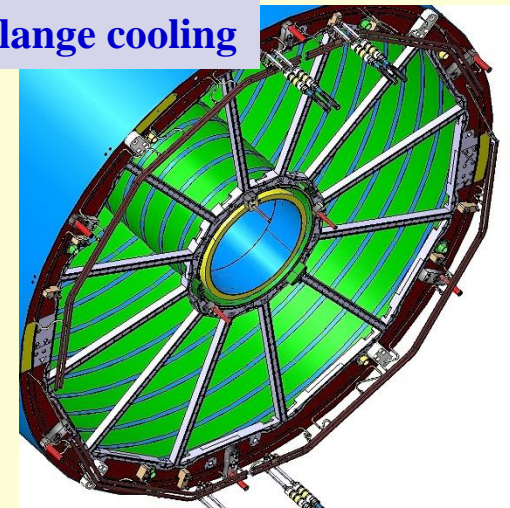
TPC services



FE cooling



Flange cooling

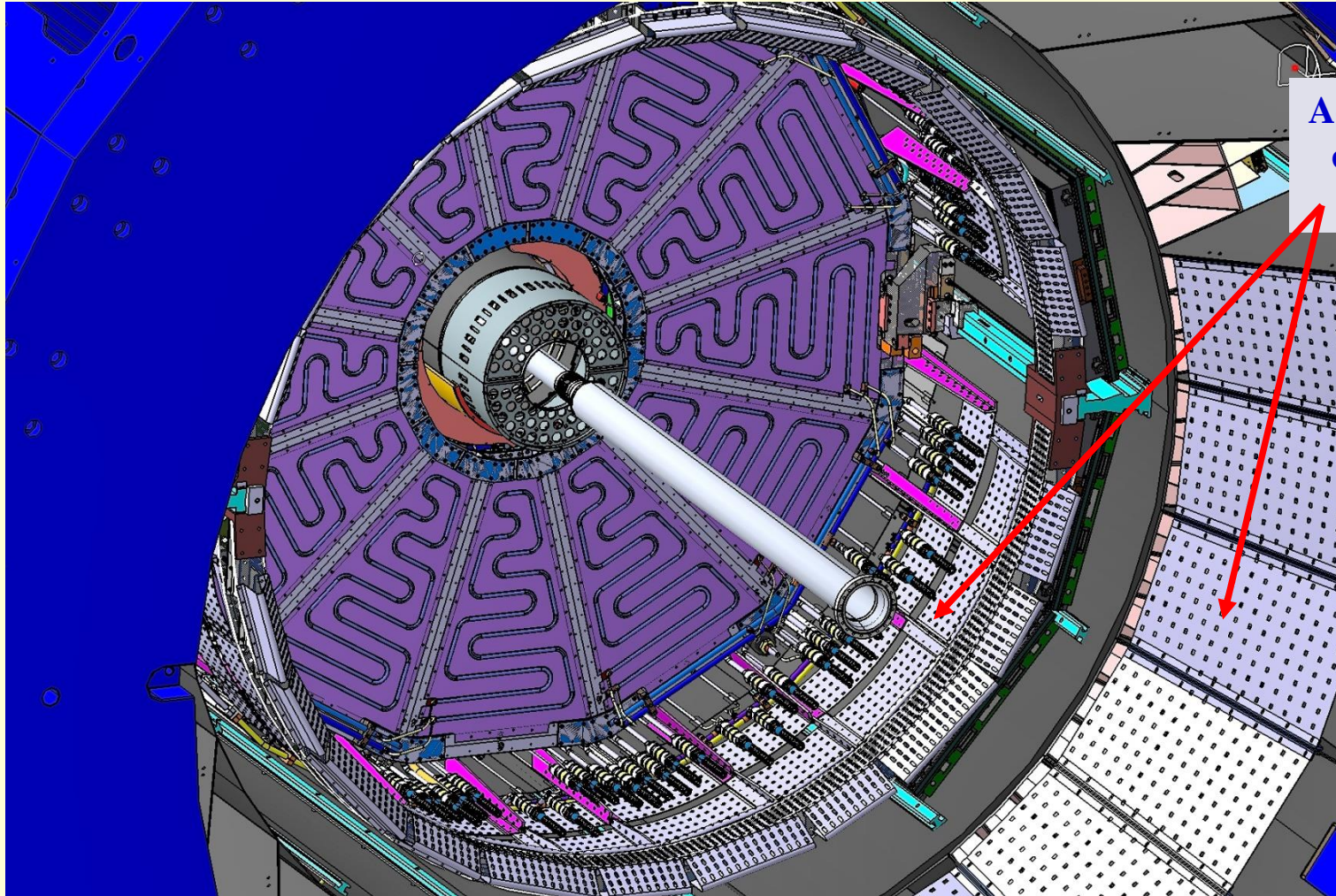


**Optimization - in progress**





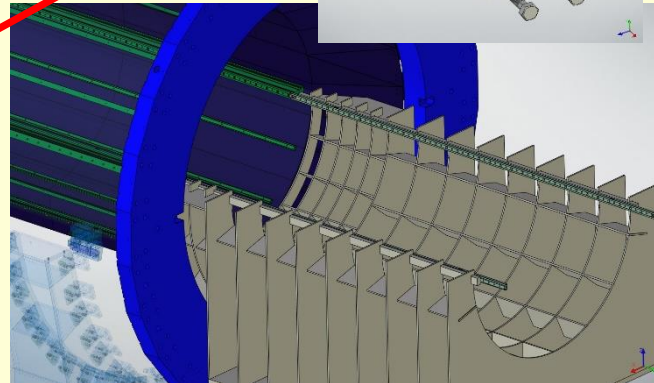
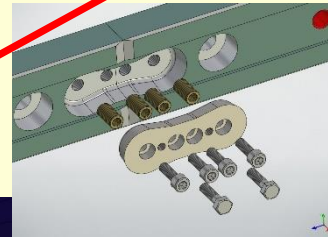
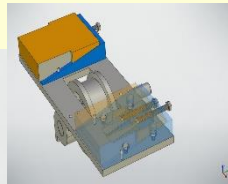
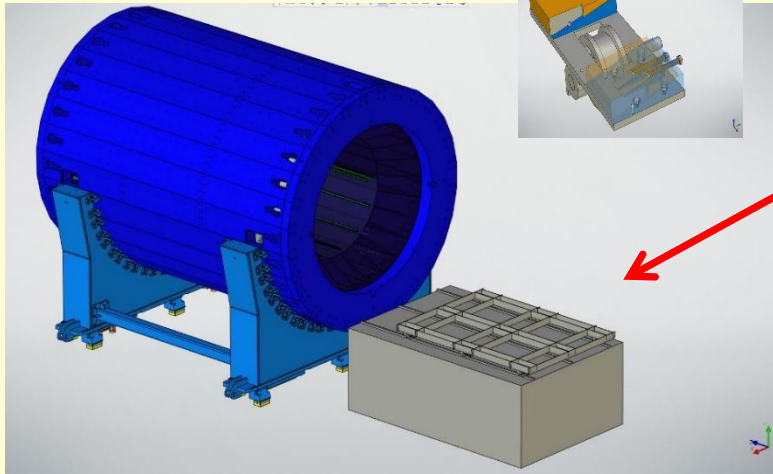
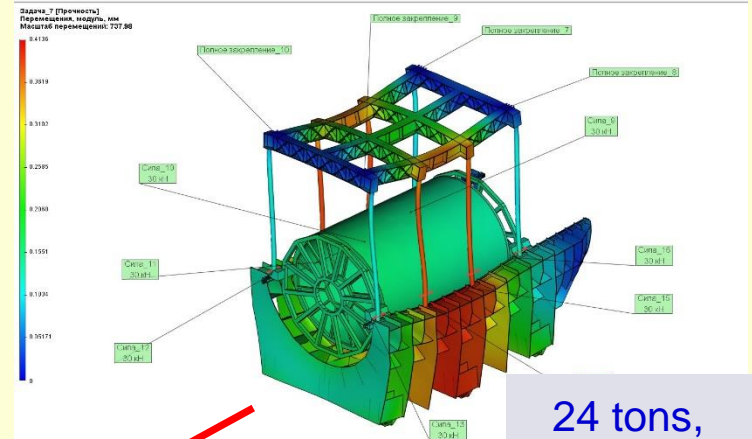
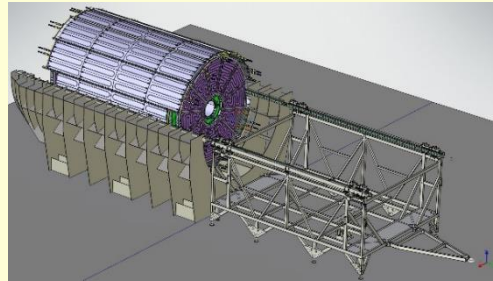
## TPC cables and pipes integration



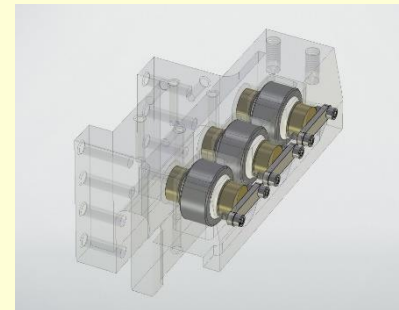
Add structures for  
cables and pipes  
fixation

design –  
in progress ...

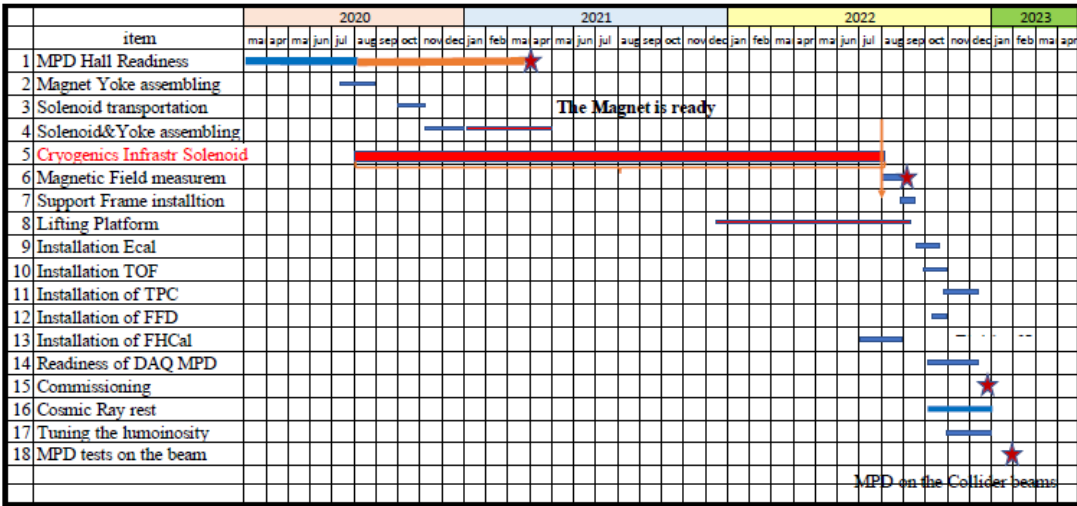
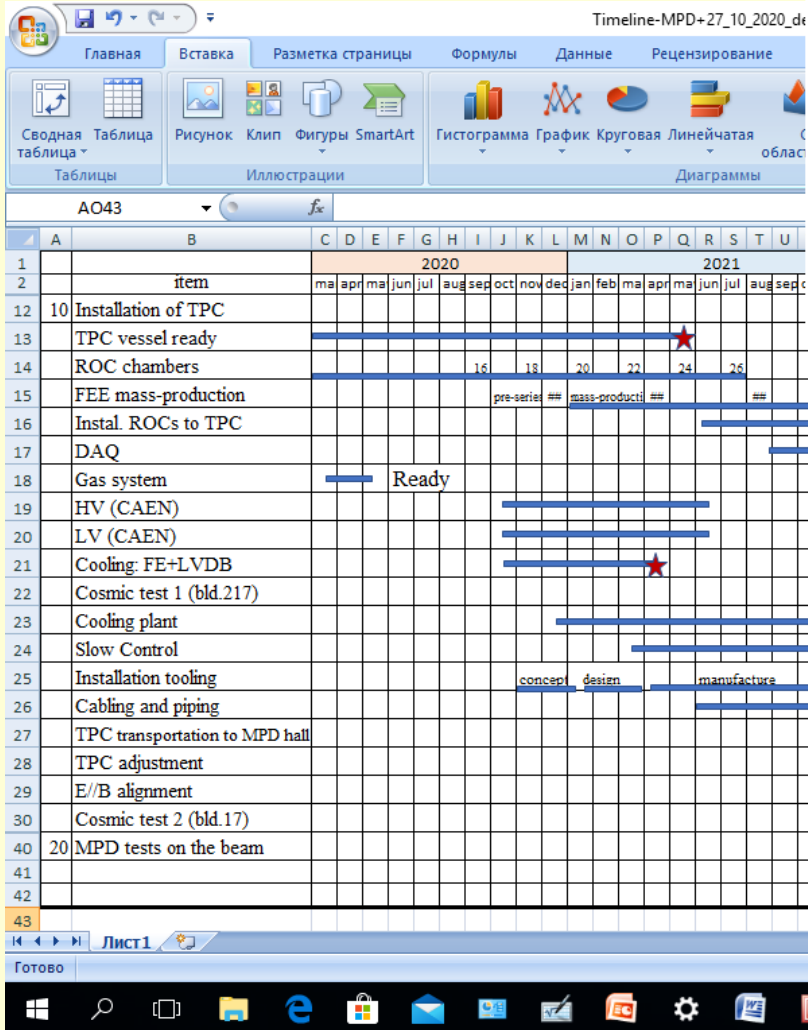
# Integration TPC to MPD: **concept**



Rollers for  
TPC moving



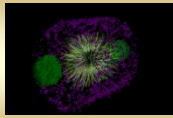
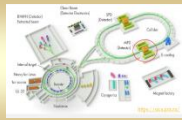
# TPC schedule



- 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 - tender started  
 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  
 TPC trays - design in progress

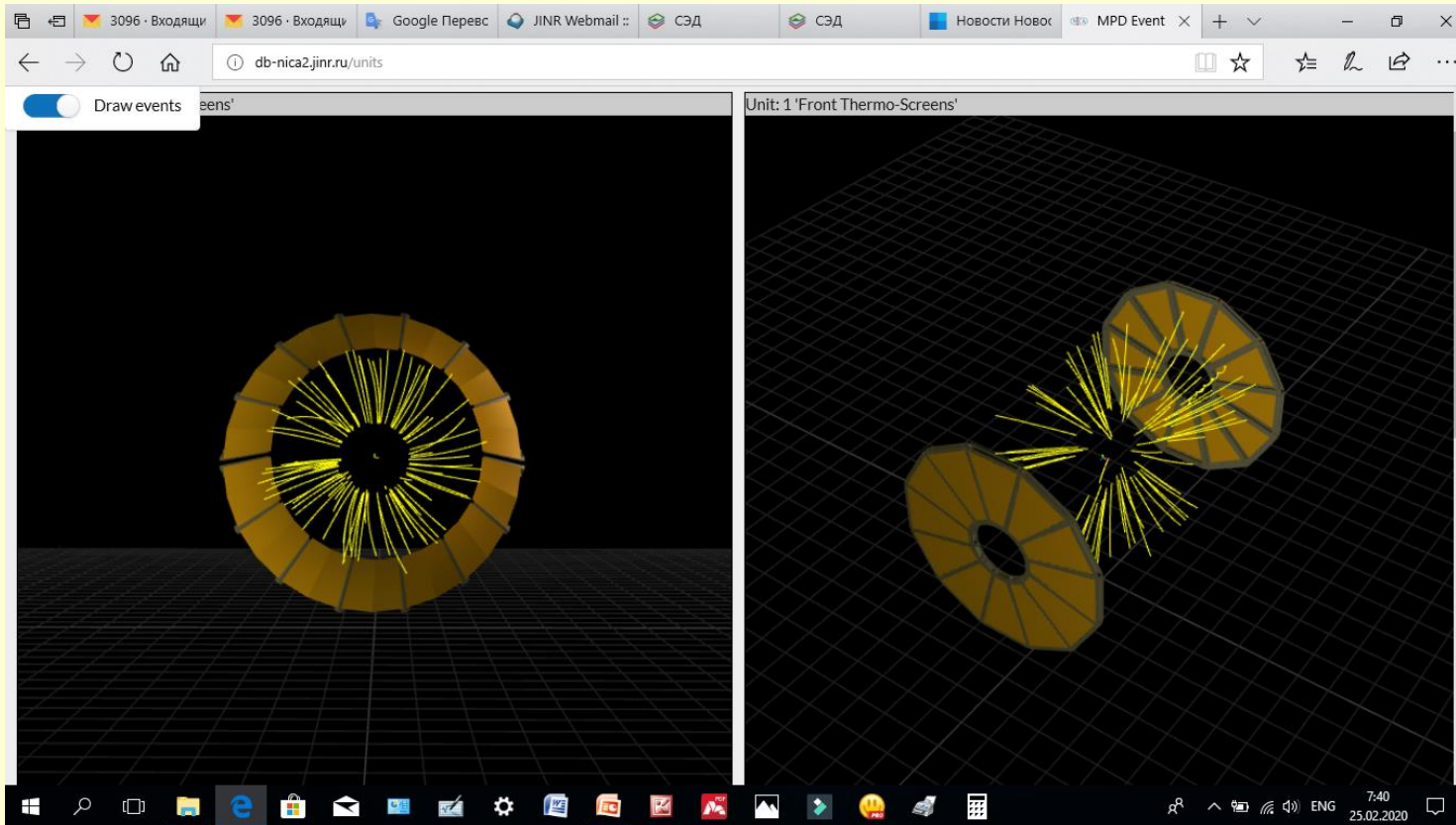
### • Integration TPC to MPD

TPC racks (8pc) - layout optimization in progress  
 Tooling for installation TPC to MPD - concept fixed, design started

### • 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!**

