

## MPD/NICA TPC status (30.10.2018)

- clean room and tooling for TPC assembly
- TPC body main components
- ROC chambers
- front end electronics
- gas, cooling and laser systems
- integration TPC to MPD
- time schedule

Presented by Sergey Movchan

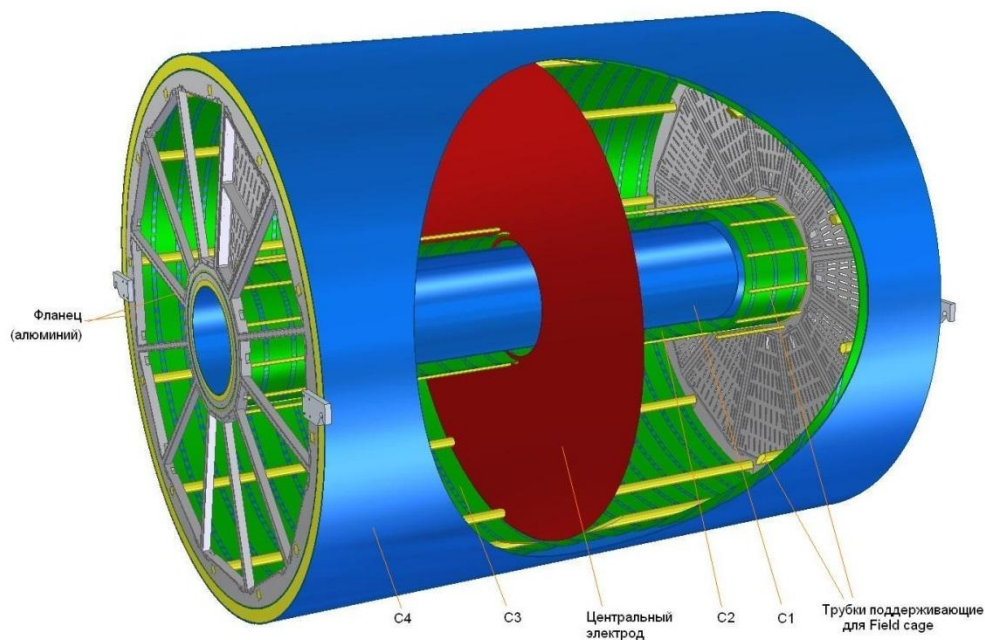
**JINR team: 23 persons**

**Belarus: 5 persons**

*(INP BSU- ARTMASH: A.Litomin, V.Tchekhovskiy, S.Savitskiy, V.Baev, K.Afanasiev)*

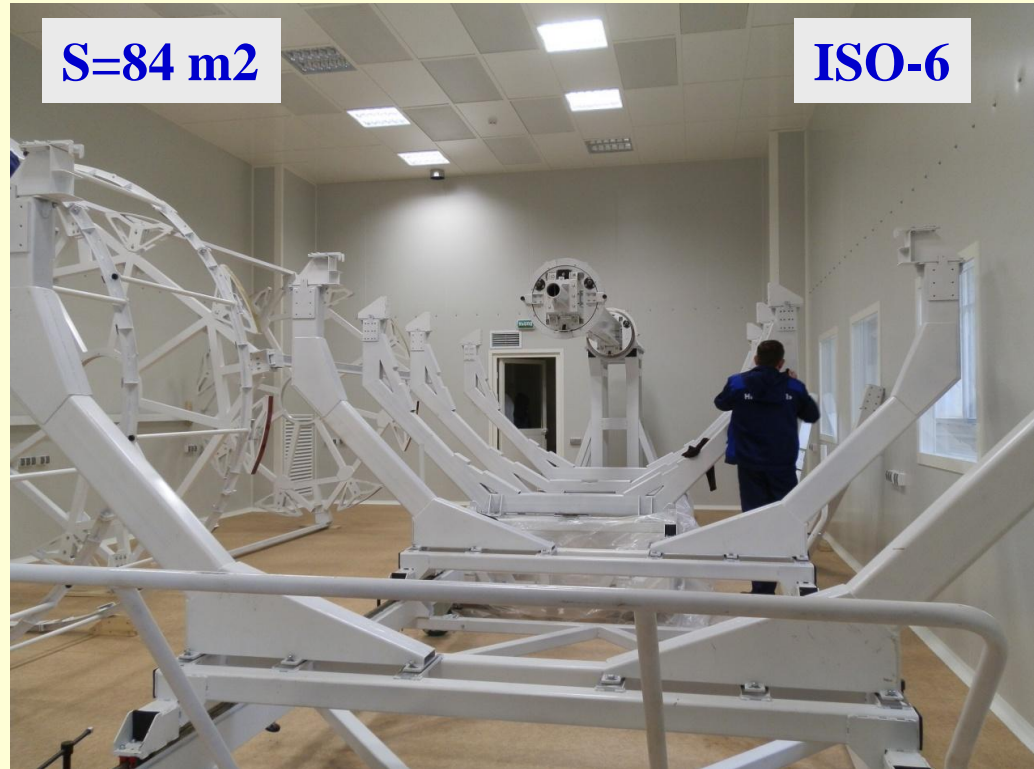
# MPD TPC parameters

Корпус TPC/MPD



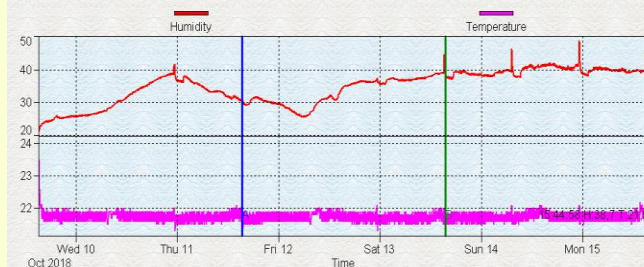
Item	Dimension
Length of the TPC	340cm
Outer radius of vessel	140cm
Inner radius of vessel	27 cm
Outer radius of the drift volume	133cm
Inner radius of the drift volume	34cm
Length of the drift volume	170cm (of each half)
HV electrode	Membrane at the center of the TPC
Electric field strength	~140V/cm;
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

# TPC clean room (LHEP, bld.217) – common view



S=84 m2

ISO-6



**H ≤ 40%**  
**T=(21.5-22) degree**



# TPC cylinders: C1-C4

C1



- Length: 3.4 m
- Diameter: 0.54 m

C2

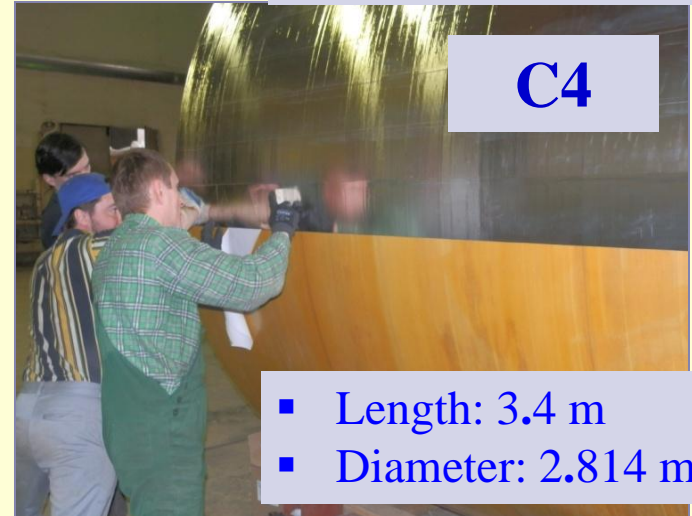


- Length: 3.4 m
- Diameter: 0.676 m



C3

- Length: 3.4 m
- Diameter: 2.66 m



C4

- Length: 3.4 m
- Diameter: 2.814 m

# INP BSU-ARTMASH: HV electrode prototype



**HV test – OK!**

**load test and geometry check –  
in preparation  
manufacture technology  
optimization – in progress**

**Serial HV electrode manufacture  
– Oct 2018**

## Briansk: tooling

### HV rods assembly



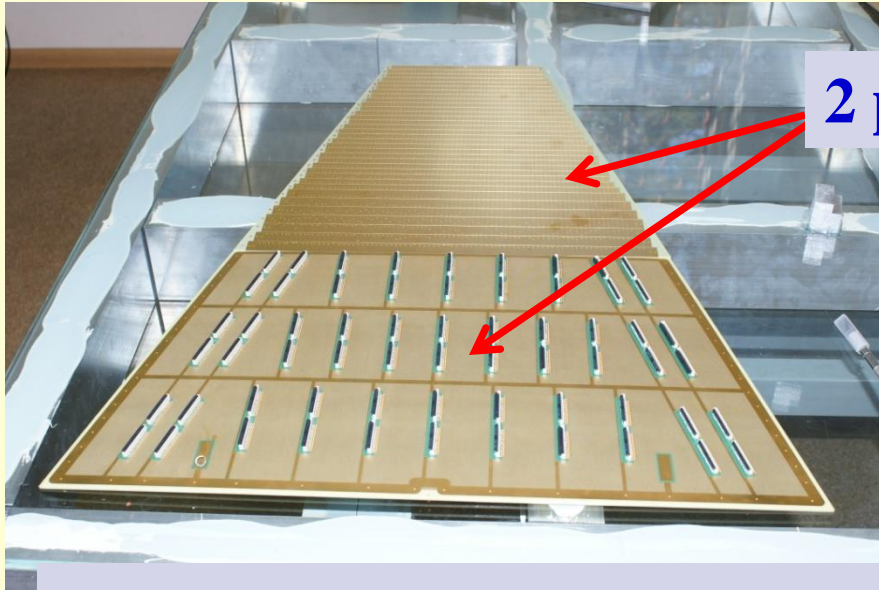
### Mylar strips manufacture



**Status: delivered to JINR**

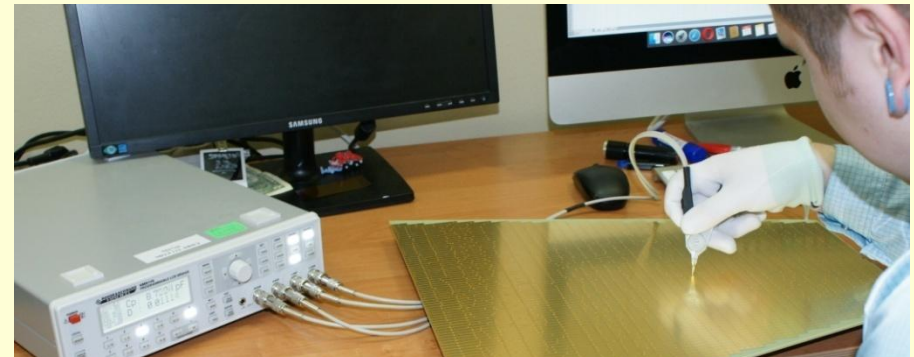


## ROC chamber: pad plane from 2 parts



2 parts

Pads capacitor  
measurement



Chamber with 2 sections pad plane - **manufactured and under tests**

New pad plane from Italy - **tested**

# TPC and ROC: summary

## TPC assembly:

clean room	– ready
C1-C4 cylinders	– ready
flanges (2pc)	- ready
serial HV electrode	– Oct -> Nov 2018
field cage rods (30 pc + 30 pc)	– Nov-Dec 2018
field cage mylar strips manufacture	– Dec 2018
adjust. and align. TPC ass tooling	– Dec 2018
start of TPC assembly (C3+C4)	- Dec 2018
flanges + HV electrode + field cage	- 2019

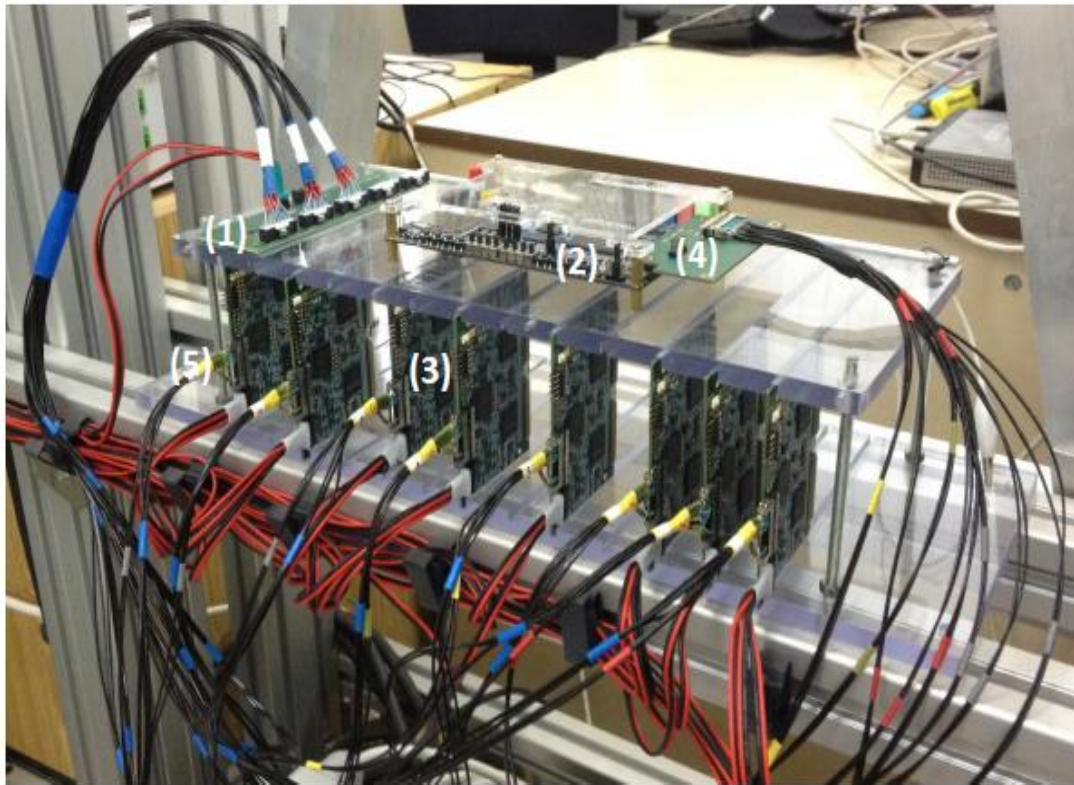
## ROC chambers:

frames (26 pc)	- ready
serial pad planes (30 pc)	– ordering started
HV for ROC gate electrode	– design started
test chamber with 512 ch r/o system	– Dec 2018
serial ROC chamber manufacture	- 2019



## Pilot system – 512 ch

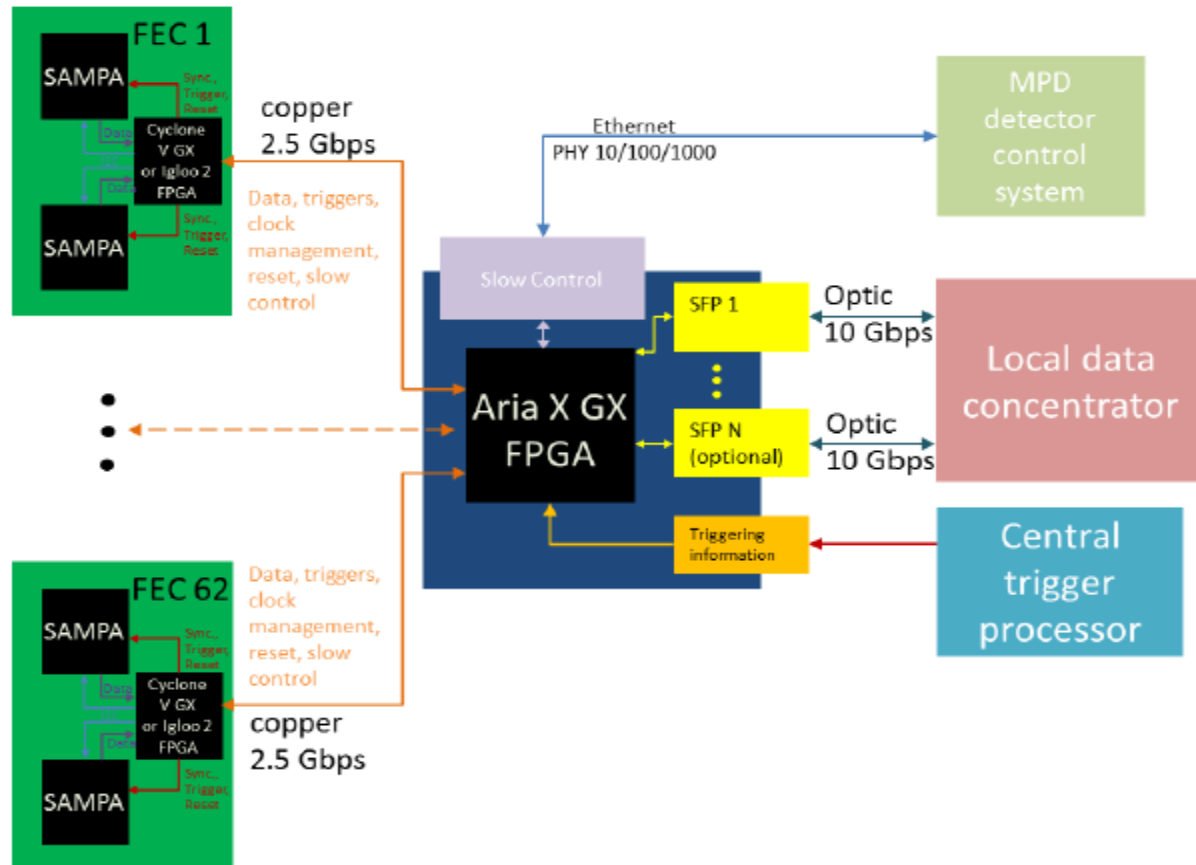
Eight cards pilot system



- 1) Trigger, clock, reset distr. board .
- 2) System controller.
- 3) 64-ch SAMPA- FEC.
- 4) HSSI (up to 2.5 GBps; up to 8 FECs).
- 5) Data/conf. full duplex HSSI port; clock 40 MHz, trigger, reset.

# ROC data concentrator block-diagram - proposal

Block diagram of one chamber readout



# Data Concentrator ASIC development

**ASIC Lab**    **NRNU MEPHI**



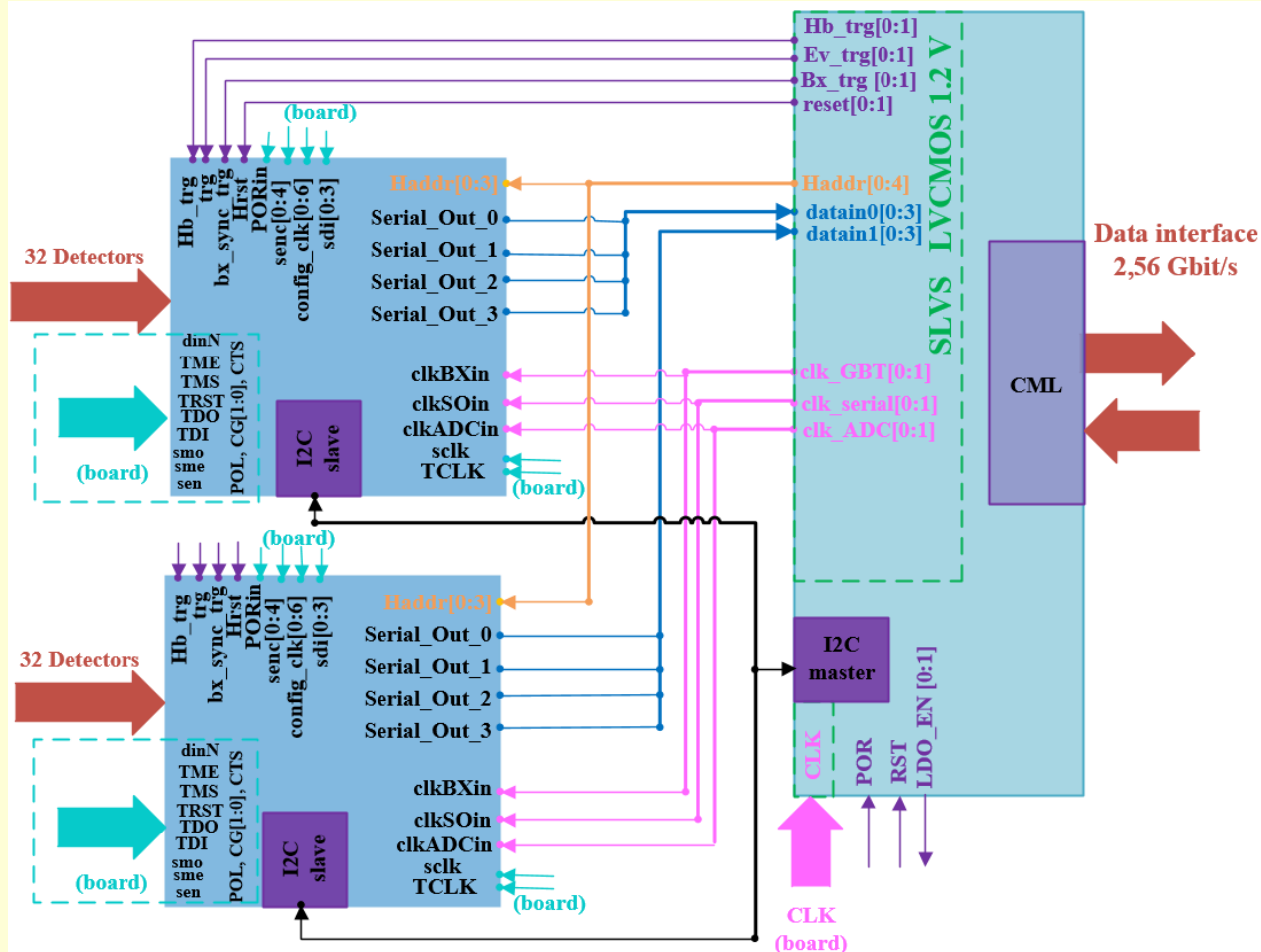
29-Oct-18

S.Movchan MPD/NICA TPC status

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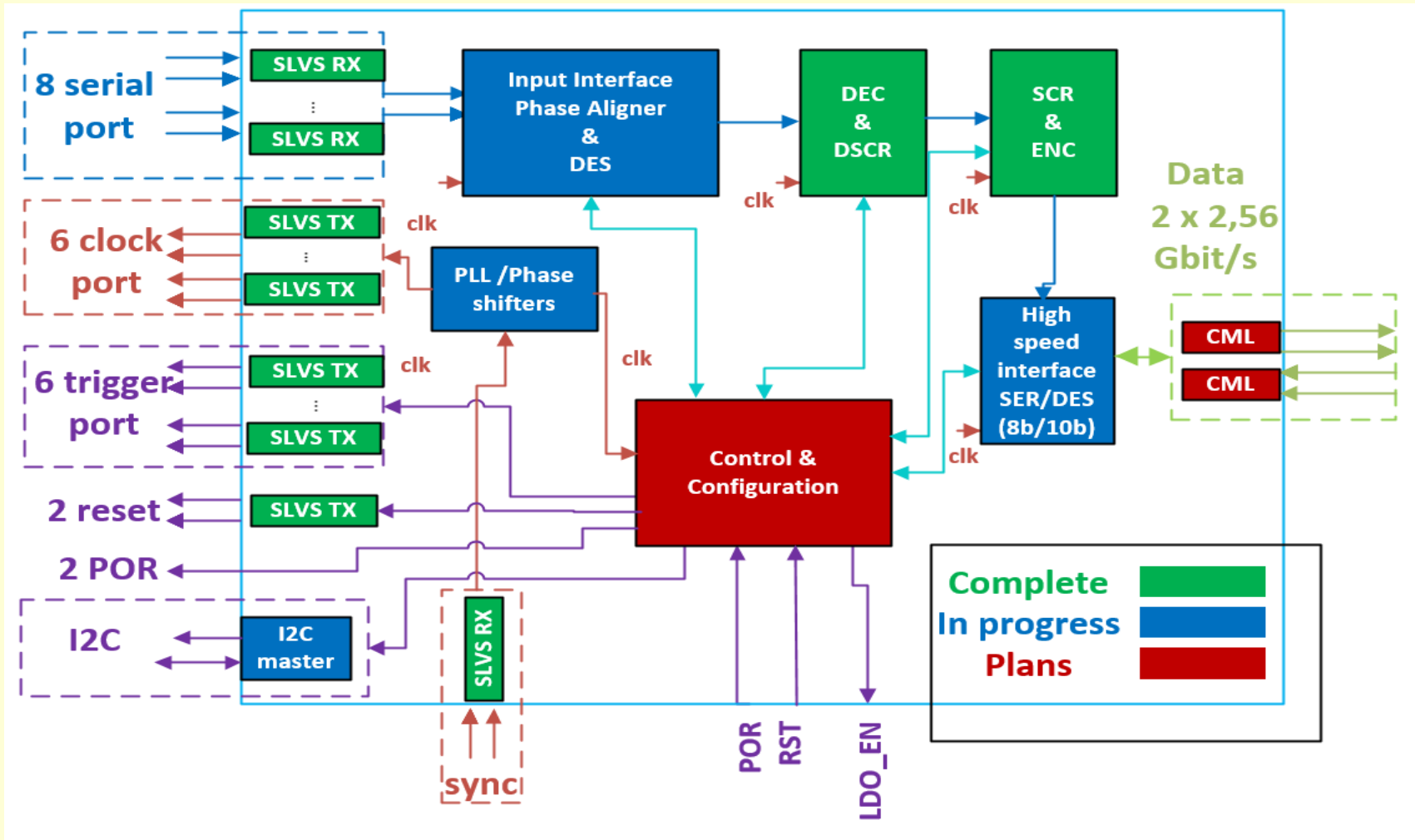
# Concentrator ASIC

is intended for data concentration and transfer from two SAMPA chips to counting room via fast bi-directional interface having 2.56 Gb/s speed for getting data out in trigger mode

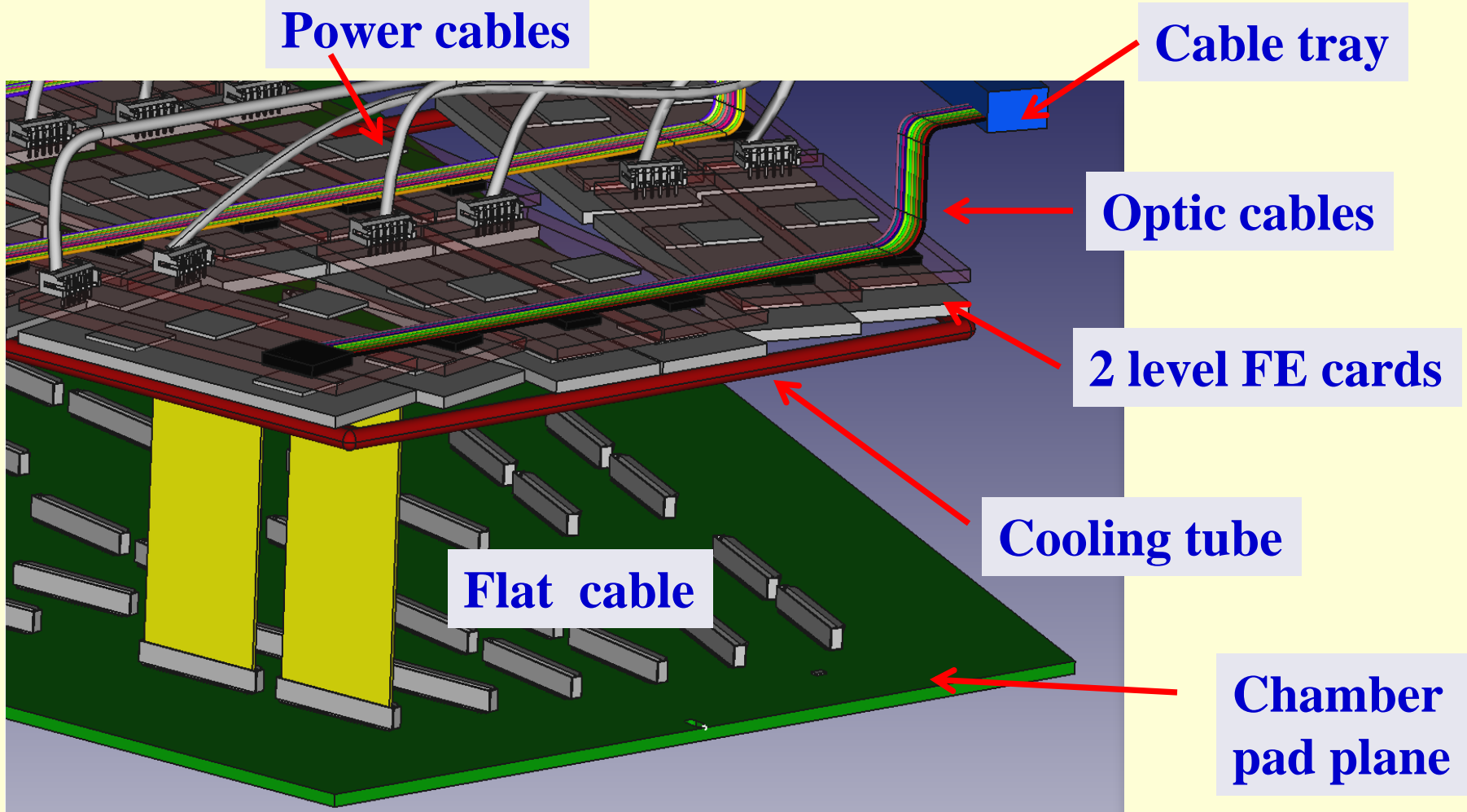




# Block diagram and progress

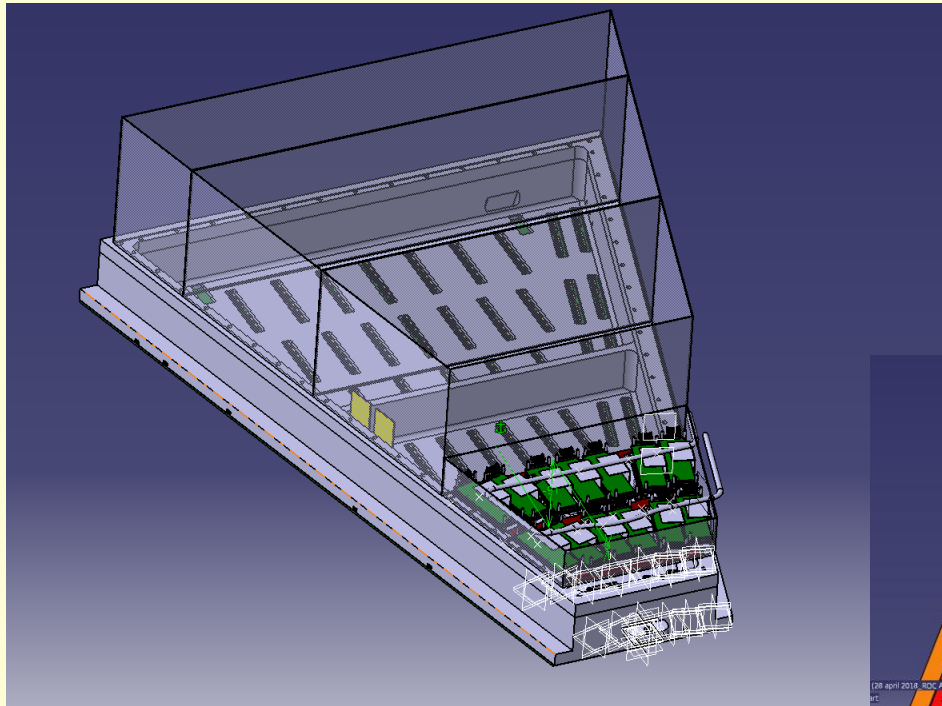


# ROC chamber + electronics integration: **concept**

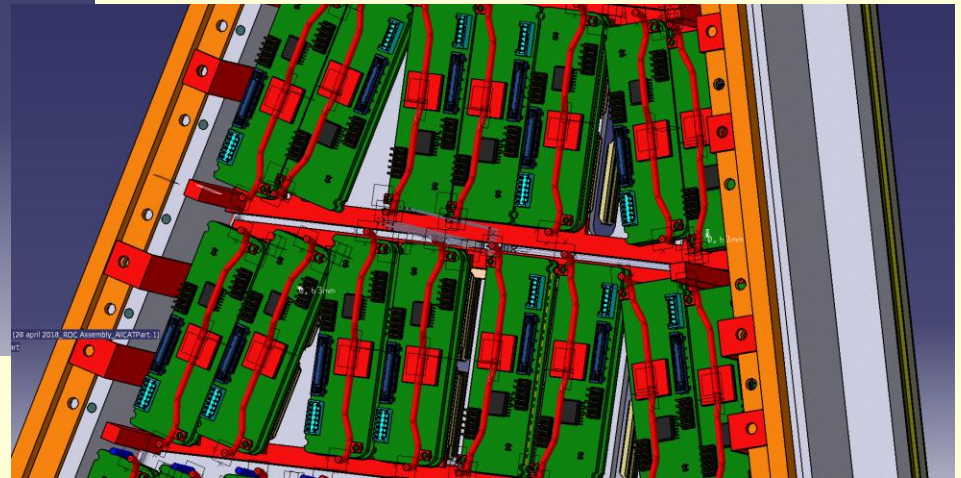


# ROC chamber + electronics integration: **concept**

**Shielding: 4 boxes**

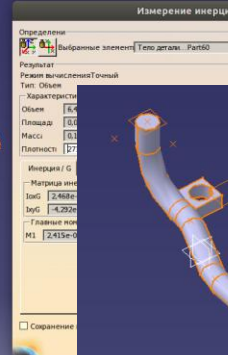
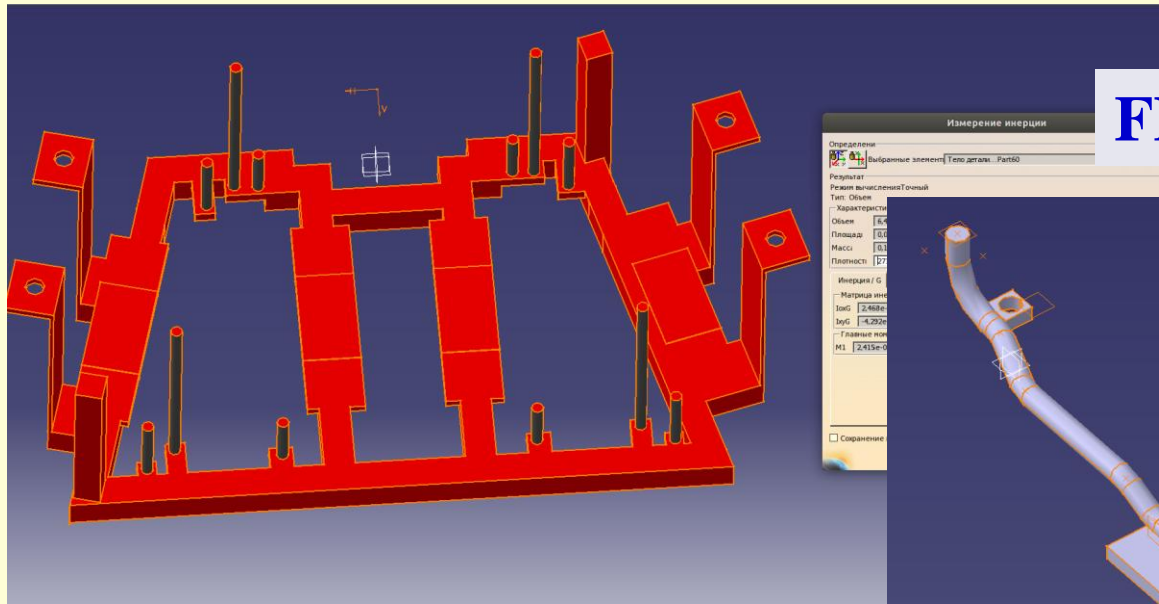


**FPGA cooling**

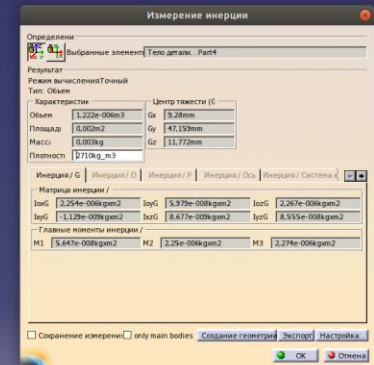
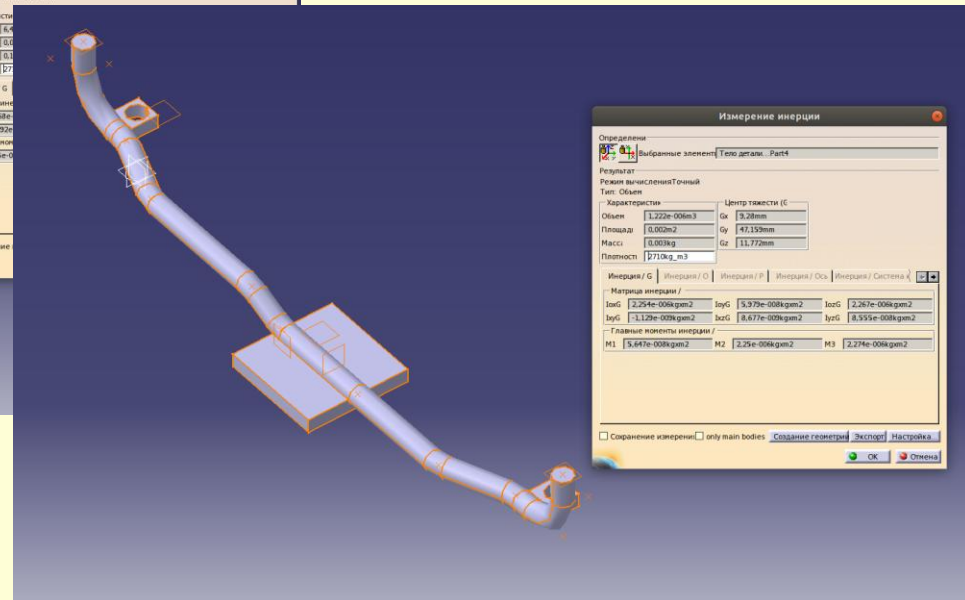


# ROC chamber + electronics integration: design

## SAMPA cooling radiator



## FPGA cooling radiator





# TPC electronics: summary

## FE electronics:

- 512 ch system – tests ongoing
- test with ROC chamber – Dec 2018
- SAMPA chips (4500 pc) – payment in progress
- Aria 10 GX FPGA for controller (3 pc) - ordered
- Data concentrator chip (NRNU MEPHI) - design started
- FEC64SAM rev.02 (10 pc) – in manufacture
- FE cards integration with ROC chamber - in progress
- FE cards cooling design – in progress, mock up – ordered
- ROC+FE cards temperature distribution – started (calculations + meas.)

Electronics radiation environment (**preliminary**, per 10 years with safety factors x 5):

### Fluence:

- charge particles -  $2 \cdot 10^{**8}$  particles/cm<sup>2</sup>
- gamma -  $2 \cdot 10^{**7}$  gamma/cm<sup>2</sup>
- neutron -  $2 \cdot 10^{**7}$  neutrons/cm<sup>2</sup>
- ions -  $2 \cdot 10^{**6}$  ions/cm<sup>2</sup>

**Dose** – about **20 Rad** (similar like for Apollo and Shuttle space flights, D=2 Rad/year)

### Data rates:

- trigger mode - **20 GByte/sec** ( $N=1000$  tracks)
- continuous readout mode - **300 GByte/sec**

## INP BSU (Minsk): TPV LV system

<b>Pre-serial prototype LVDB cooling plate</b>	<b>– in manufacture</b>
<b>Pre-serial prototype tests</b>	<b>– designed, in manufacture</b>
<b>Mass-production (60 pc)</b>	<b>– done</b>
	<b>- 2018 -2019</b>

### **LV system (2 options):**

- Wiener Marathon (Type AL (300G) MDC 02/07)**  
**up to 300 Gauss and 30 Rad**
- CAEN EASY3000 LV system (modules A3050B 2÷7V/50A)**  
**up to 5000 Gauss and 200 Rad**

[https://indico.cern.ch/event/699390/contributions/2868537/attachments/1593340/2522493/Neolite\\_RandD\\_effortSummary.pdf](https://indico.cern.ch/event/699390/contributions/2868537/attachments/1593340/2522493/Neolite_RandD_effortSummary.pdf)

### **Status - quotation and invoice requests**

**Wiener**

**CAEN**

**Delivery time – (3-4) months**

# TPC gas system

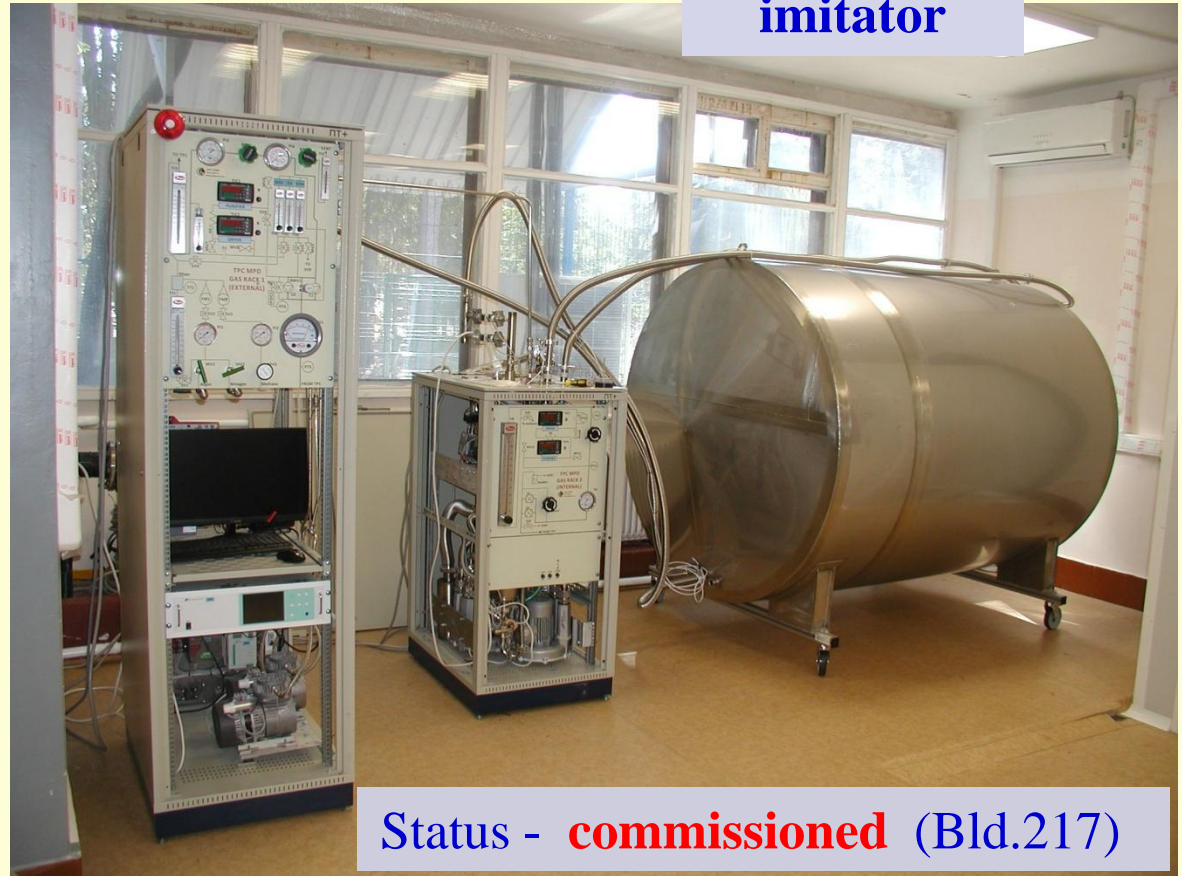
Gas supply



Status - **commissioning**  
in progress

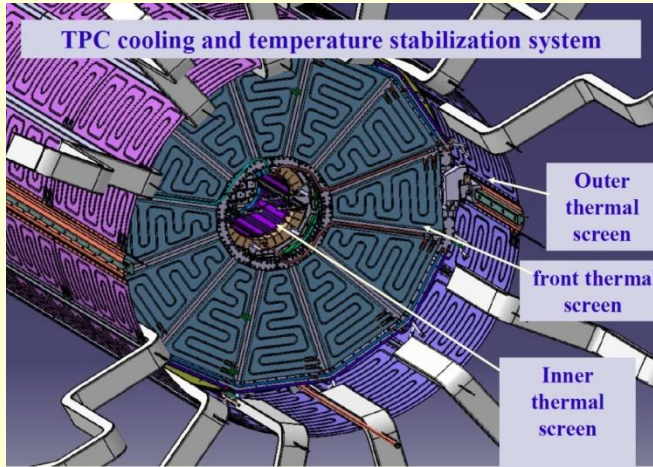
Racks

TPC volume imitator

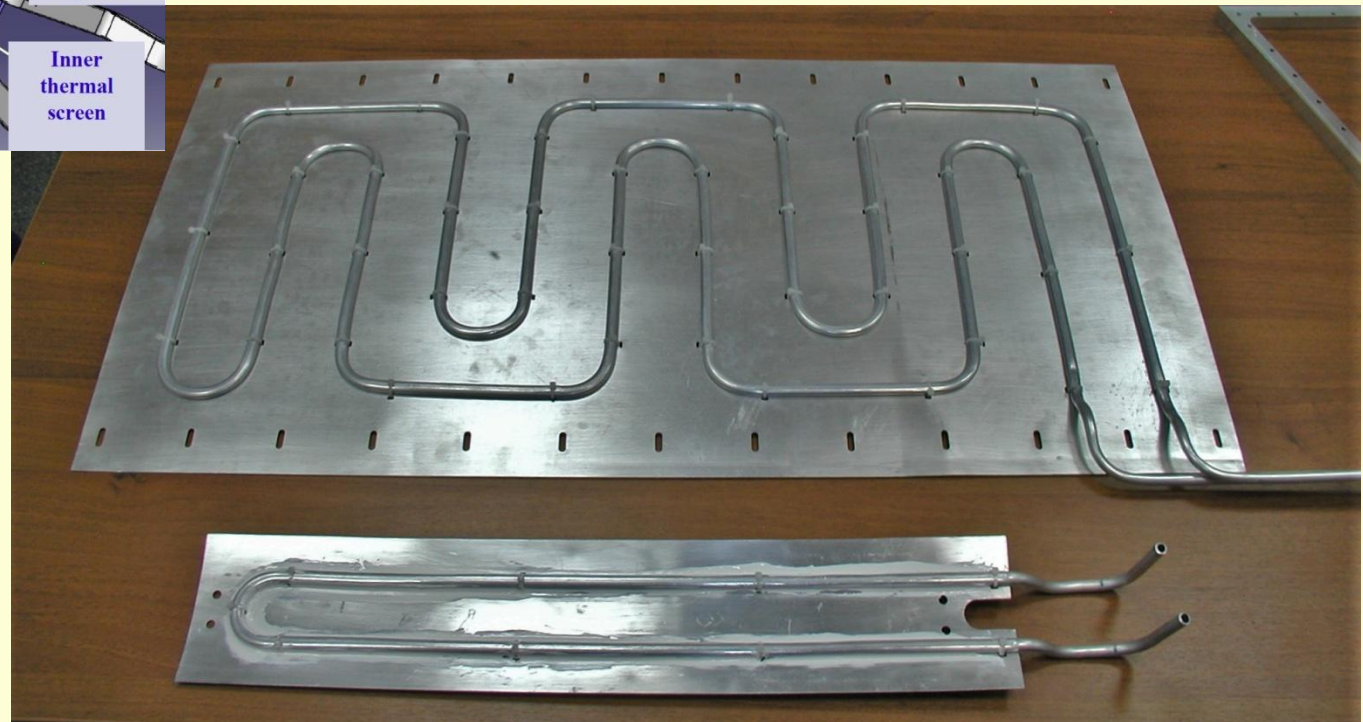


Status - **commissioned** (Bld.217)

# TPC cooling system: barrel thermal screen panel prototypes

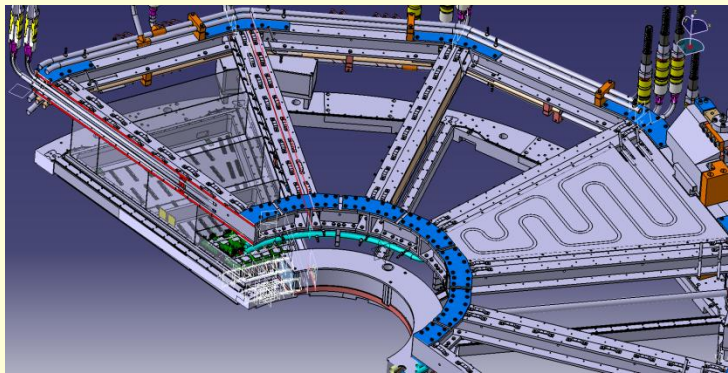


Al plate – 0.5 mm  
Al tube -  $D=8/6$  mm



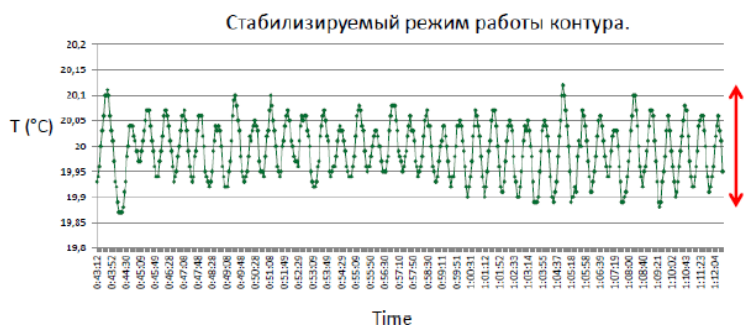
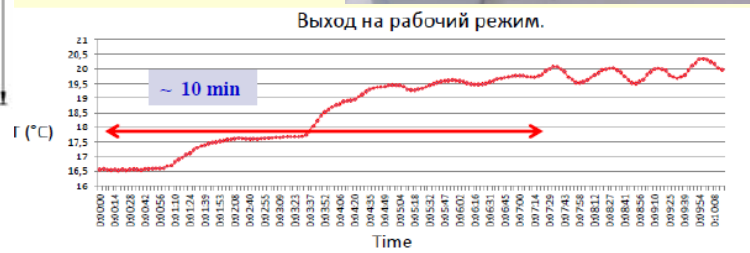
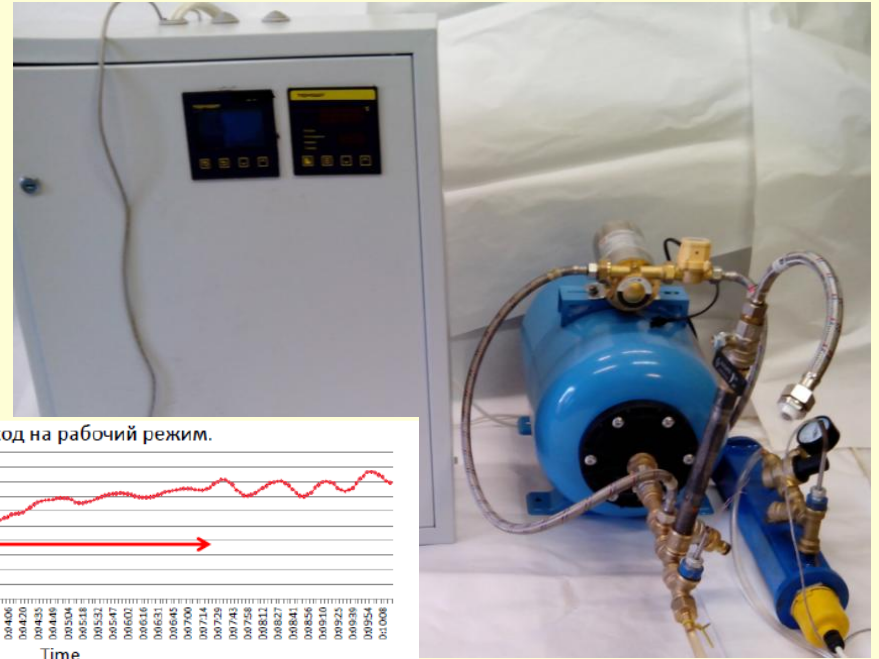
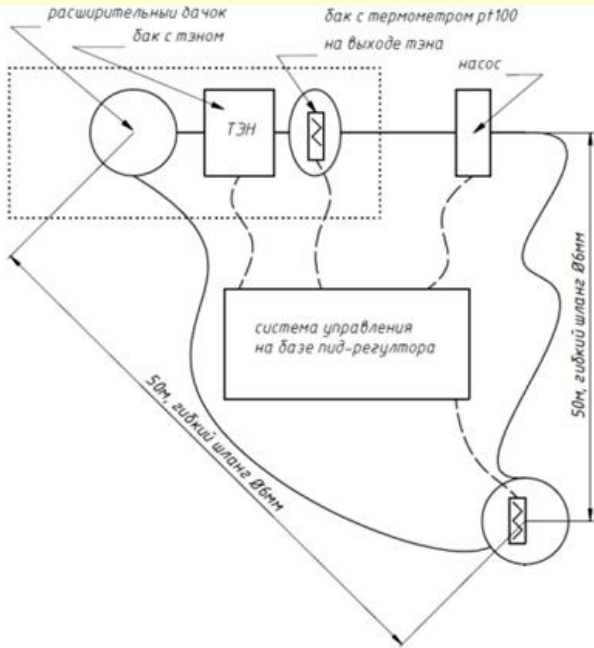


# INP BSU-ARTMASH: end cap thermal screen panel prototype



Al plate – 0.5 mm  
Al tube -  $D=8/6$  mm

# Cooling system: prototype

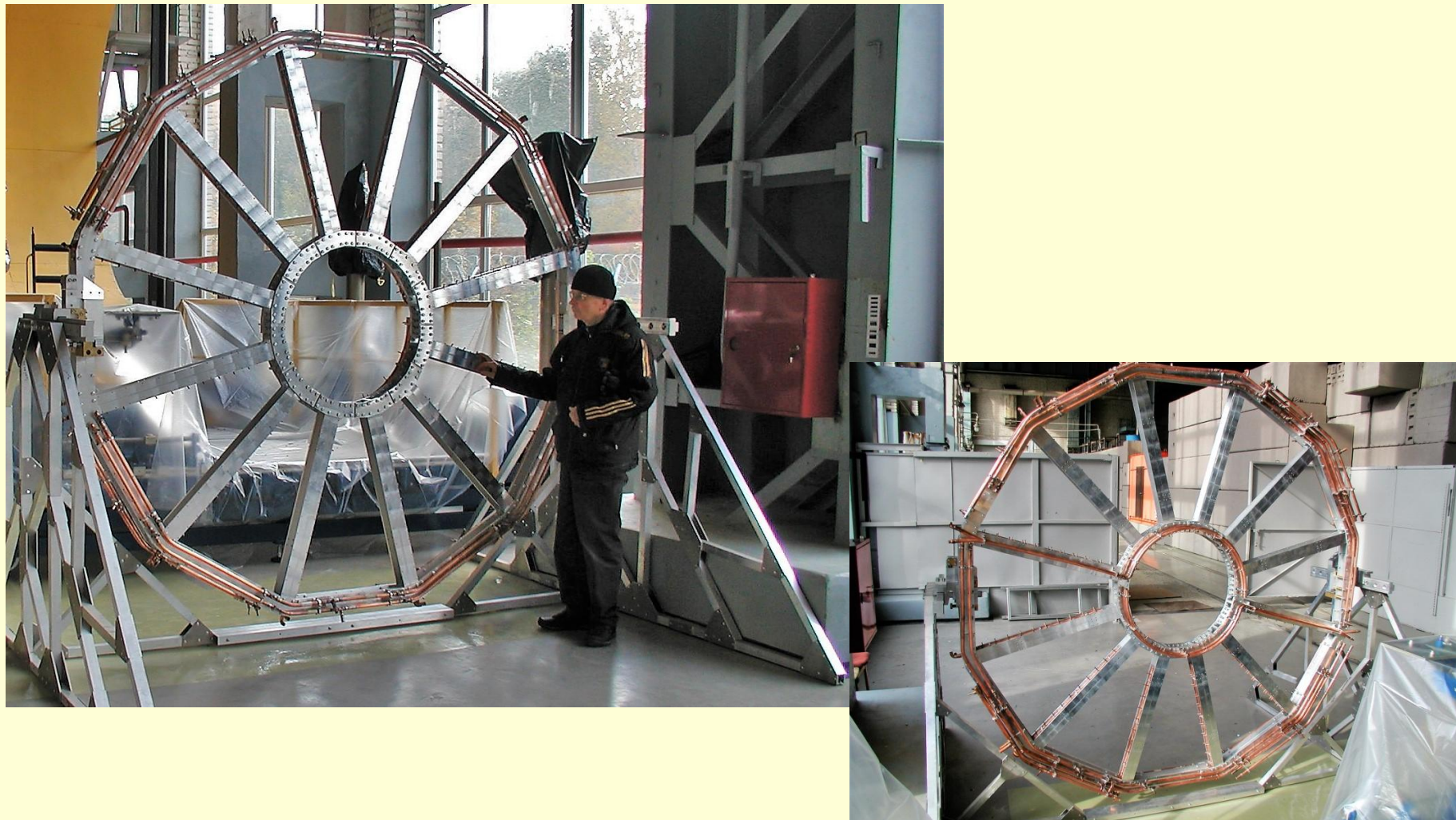


**dT = 0.2 degree**  
(requirement: dT=0.5)

**prototype delivered to JINR July 2018**



## TPC cooling system : tubes layout prototyping

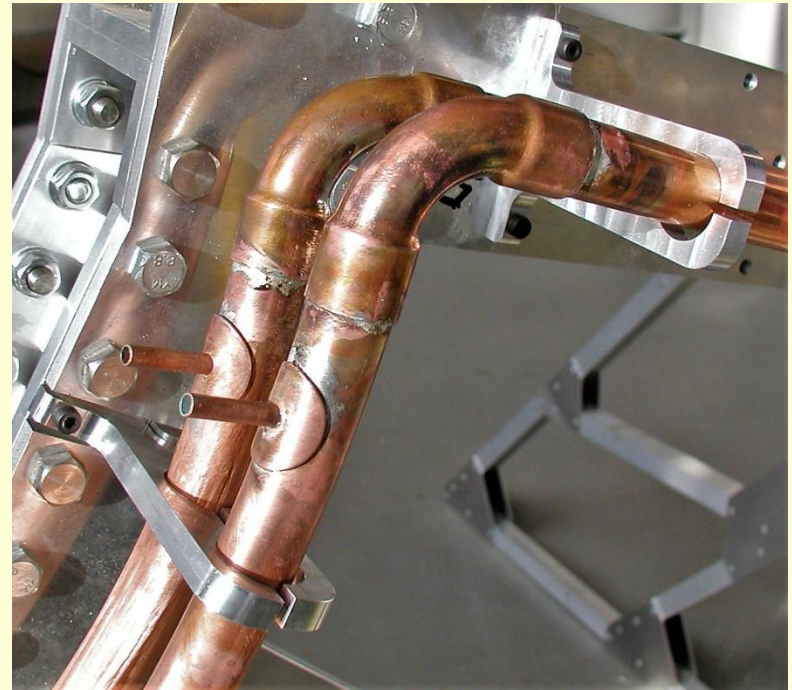


## cooling tubes layout: examples

Pipes for ROC electronics cooling

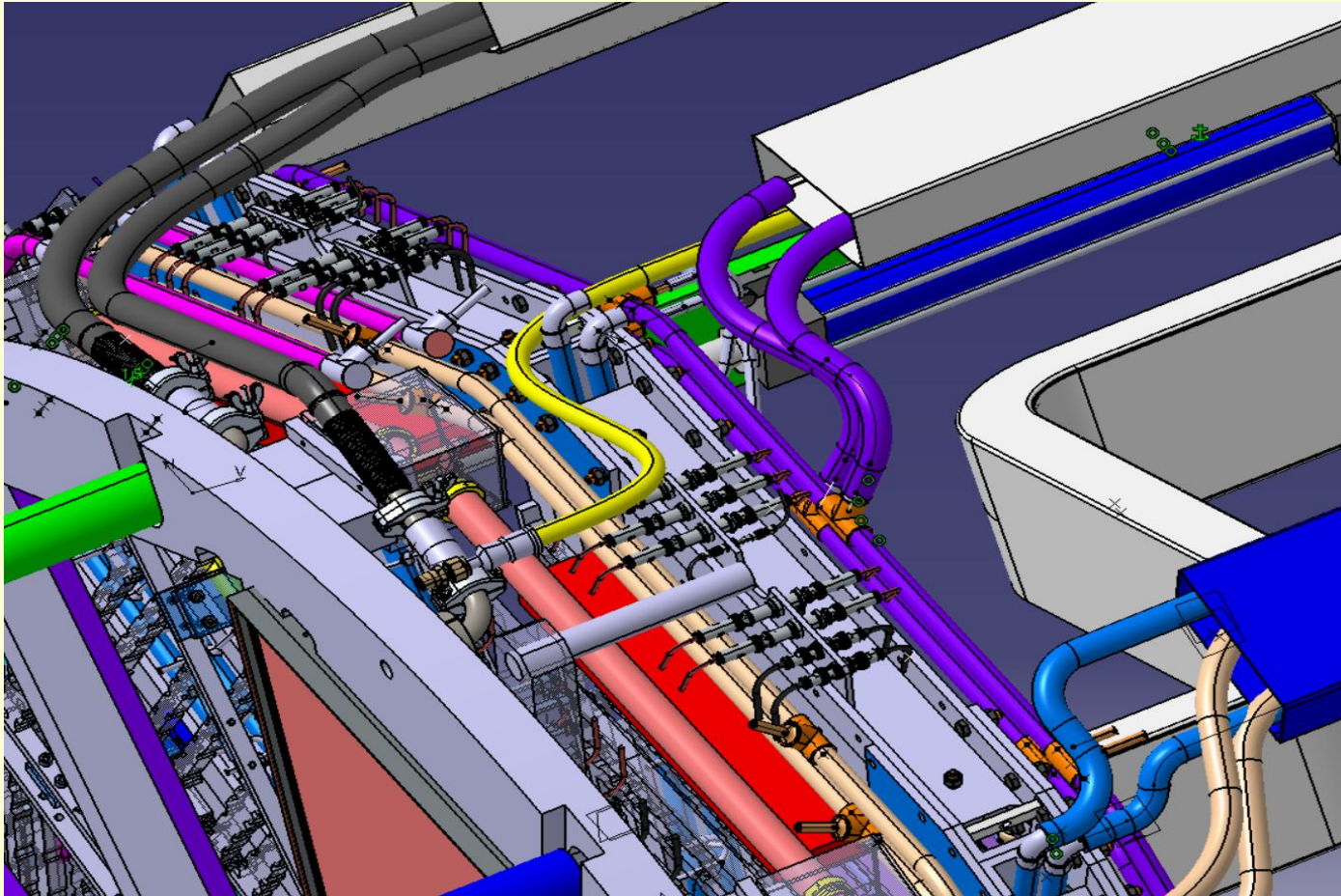


Cooling inner ring for barrel termo-screen panels





## TPC services: cabling and tubing



**Optimization - in progress**

# TPC services: summary

## LV system:

- pre-serial LVDB + cooling plate (4 pc) – ready, tested
- Wiener Marathon or CAEN EASY3000 system - under discussion, quotation and invoice requests

## HV system:

- CAEN (crate + module) - under test
- full set HV ordering - 2019

## Gas system:

- commissioned

## Cooling system:

- prototype – ready
- measurements with prototype – in progress
- barrel and end cap cooling panels – prototypes ready
- Service wheel cooling tubes routine – optimization started (prototyping)

# TPC summary

## Laser calibration system:

- lasers (2 pc) – commissioned
- laser beam distribution system - ordered
- WEB cameras + optics – chosen in progress
- 2 channels for laser beam inside MPD – **position not fixed yet**

## TPC sub-systems integration:

- in good shape

Integration TPC into MPD – **not started yet** (waiting for ECAL design and its integration to MPD)

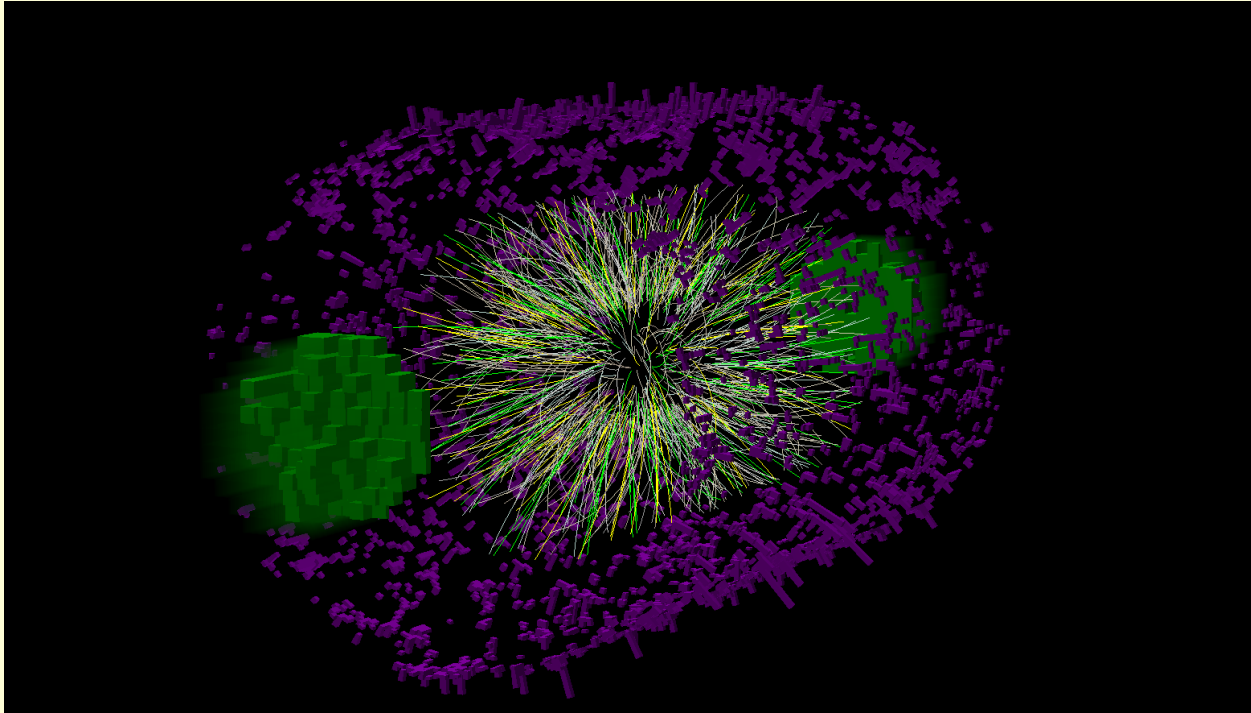
# TPC commissioning stage

## TPC commissioning - end of 2019-2020

№	Items	2019				2020			
		I	II	III	IV	I	II	III	IV
1	Installation TPC with barrel thermal screens to MPD, survey				■				
2	TPC cooling system installation				■				
3	TPC gas system installation				■				
4	SSW: cabling and services, patch panels installation				■				
5	MPD balconies: HV, LV, gas rack, optic switches ... installation				■				
6	Counting room: optic cables cabling and servers installation					■			
7	TPC laser calibration system installation					■			
8	ROC FE cards and controllers assembly to chambers					■	■		
9	TPC cosmic test					■	■		
10	TPC adjustment (E//B)							■	
11	TPC beam test								■
12	TPC READY for data taken								■



**Thank you for attention!**



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

**TDR TPC - [http://mpd.jinr.ru/wp-content/uploads/2017/05/TDR\\_TPC\\_v6\\_2017.pdf/](http://mpd.jinr.ru/wp-content/uploads/2017/05/TDR_TPC_v6_2017.pdf/)**