



MPD TPC STATUS (02.12.2022)

TPC:

- vessel assembly, ROC chambers, gating grid system

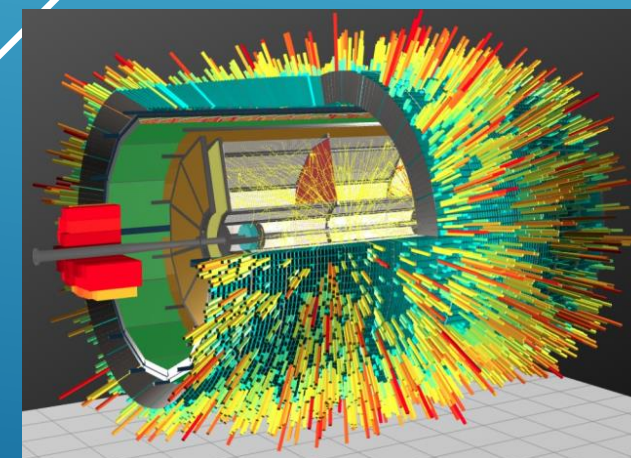
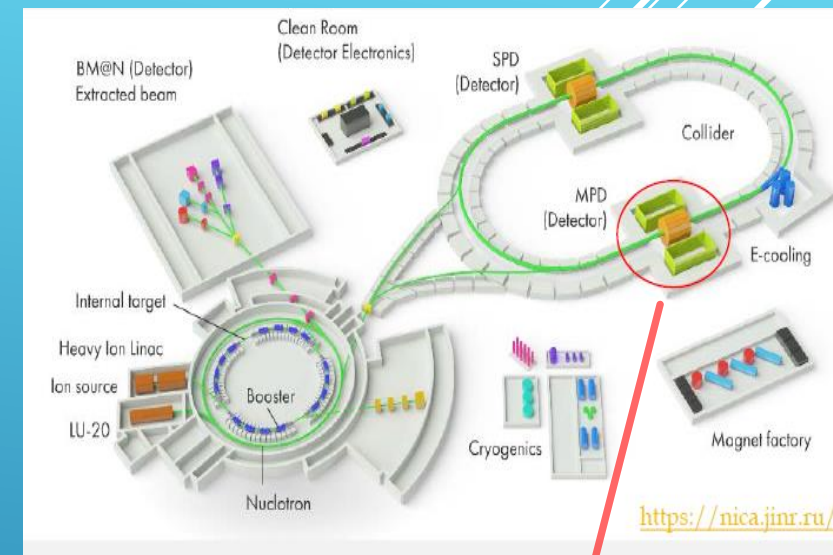
Sub-systems:

- Electronics
- LV+HV system (CAEN)
- Gas and cooling systems
- Laser calibration

Integration TPC to MPD

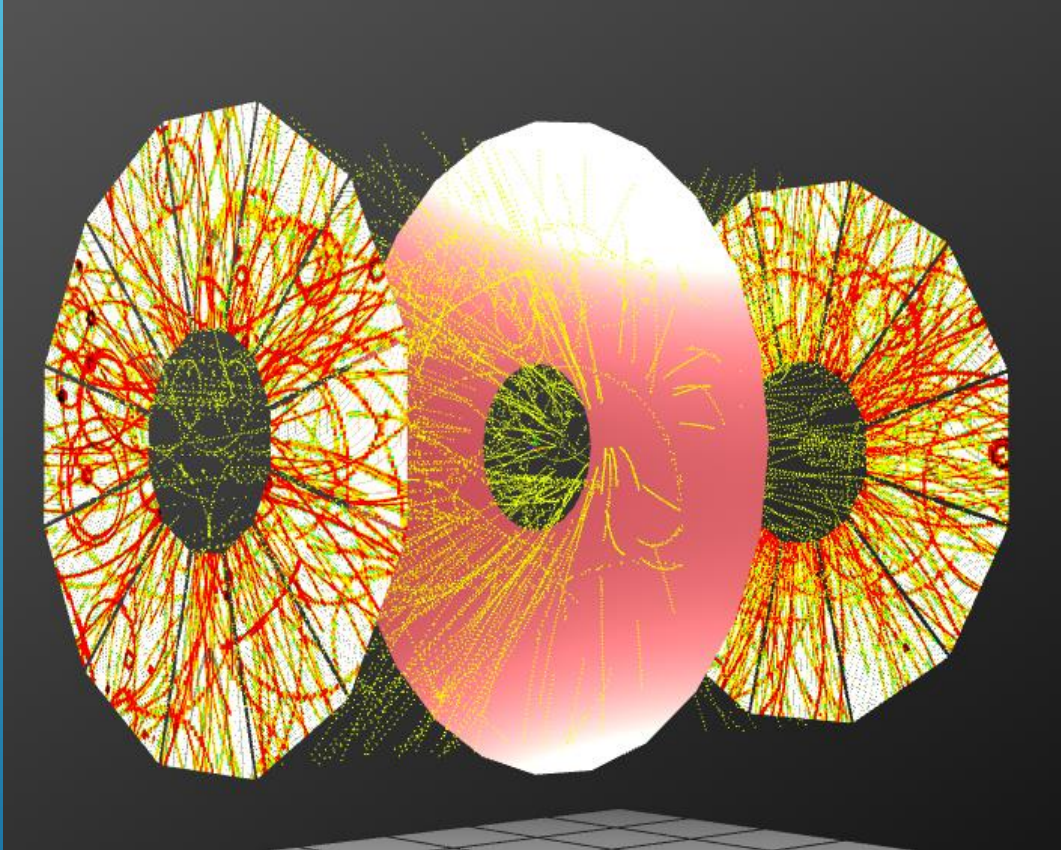
- Electronics platform
- Cabling and piping
- Installation TPC to MPD

Time schedule



Presented by S.Movchan

MPD TPC MAIN PARAMETERS

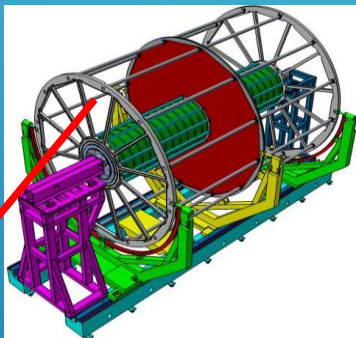
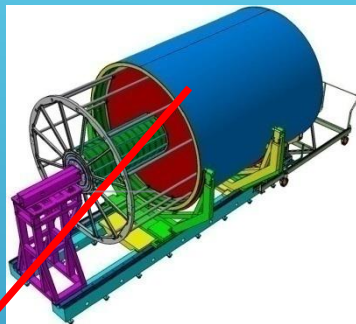


Item	Dimension
Length of the TPC	340cm
Outer radius of vessel	140cm
Inner radius of vessel	27 cm
Outer radius of the drift volume	133cm
Inner radius of the drift volume	34cm
Length of the drift volume	170cm (of each half)
HV electrode	Membrane at the center of the TPC
Electric field strength	~140V/cm;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

TPC VESSEL ASSEMBLY



Bld. 217



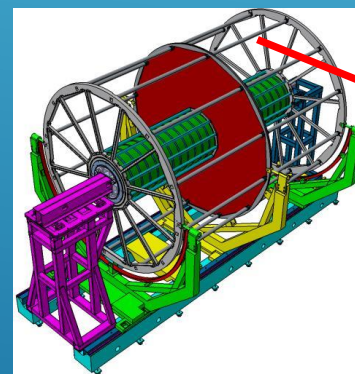
Service wheel **thermal panels** (12pc)



Both service wheels - **assembled**



ISO-6



Rods (30 pc) - **assembled**



C1-C2 and C3-C4 cylinder – assembled
 TPC service wheels (2pc) – assembled
 HV membrane – tested
 TPC field cage assembly – **Jan-Feb 2023**
 TPC vessel ready – **March 2023**

TPC vessel assembly – **in progress**

ROC CHAMBERS AND GATING GRID SYSTEM (GGS): STATUS

Test set up for ROC certification

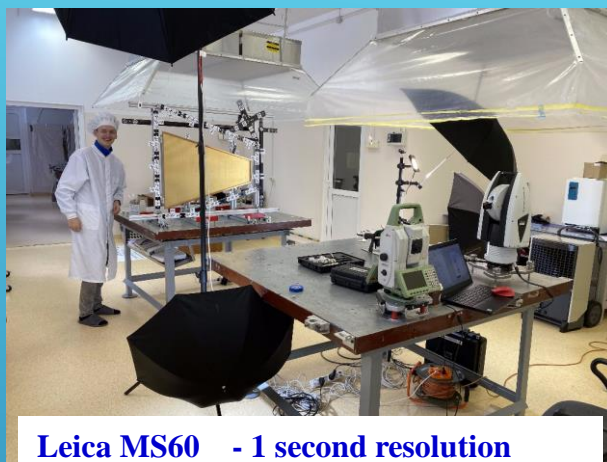


24 pc ROCs – tested



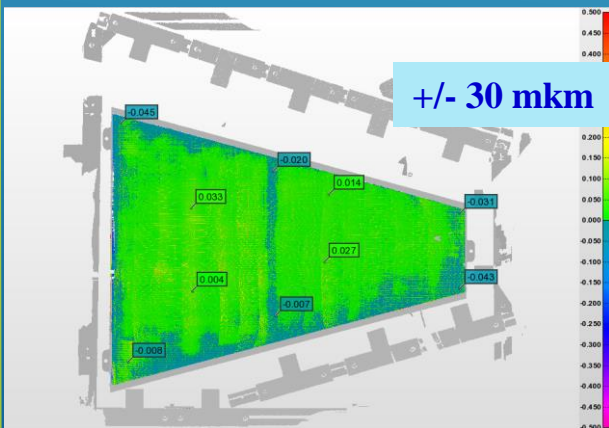
24 pc serial ROCs –
READY!

Test set up for pads calibration

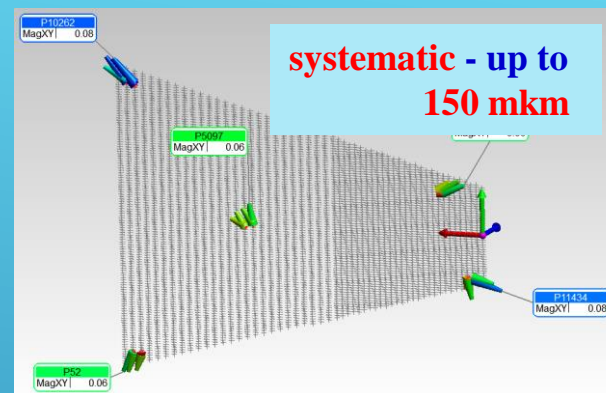


Leica MS60 - 1 second resolution
Leica AT960 +/-10 mkm +5 mkm/m
Leica AT403 +/-15 mkm +6 mkm/m
Scanner AS1+AT960 +/-50 mkm

Pad plane unflatness: example



Check pads geometry



Full set of ROC alignment marks



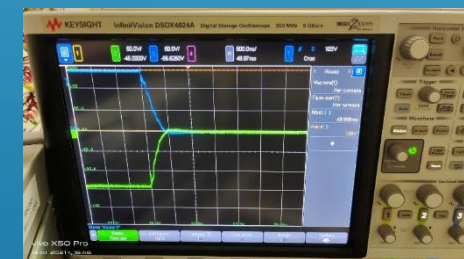
Summary:

- measurements to do for all ROCs
- **calibration** of ROC marks and 3968 pads respect to ROC
- “reference hole” - in progress

ROC gating grid system: test set up



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

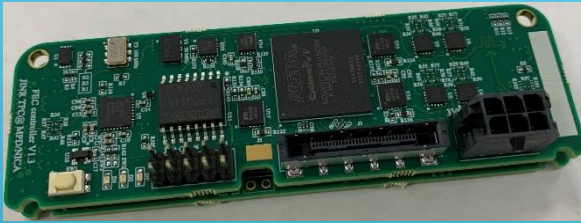


Mass-production – started
Delivery to JINR – Feb 2023

TPC SUB-SYSTEMS: ELECTRONICS

FE water cooling

Production version of the FE card:

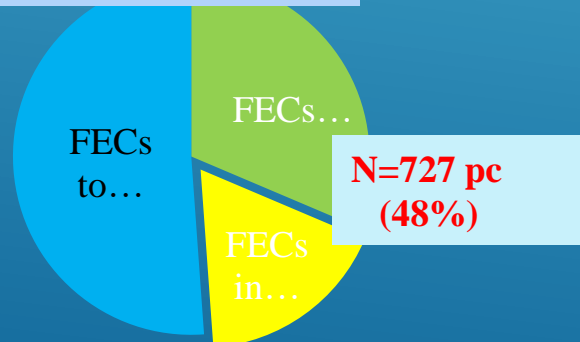


DAQ prototype:
62 FE cards, RCU prototypes,
ROC, 2pc LVDBs, server interface
board - tests ongoing

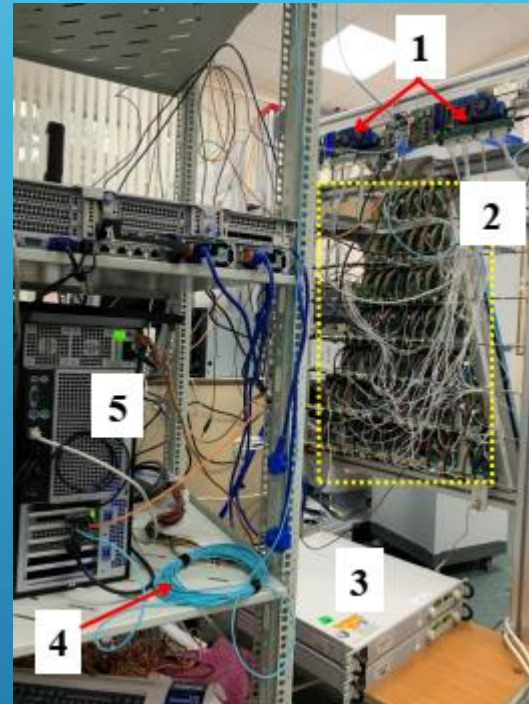
LVN9 stabilizer



TPC FE cards production
status



11 ROCs chambers will be completed
at the **end of 2022**.



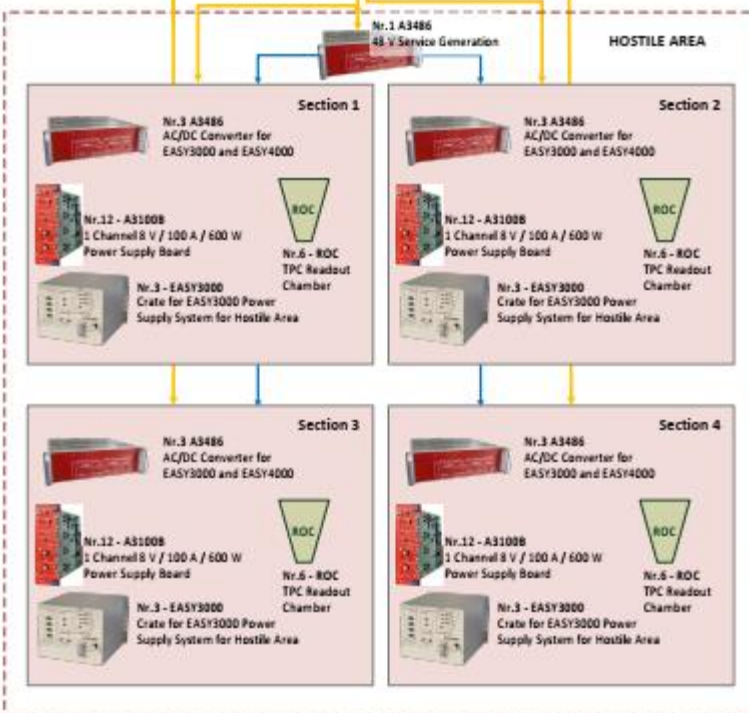
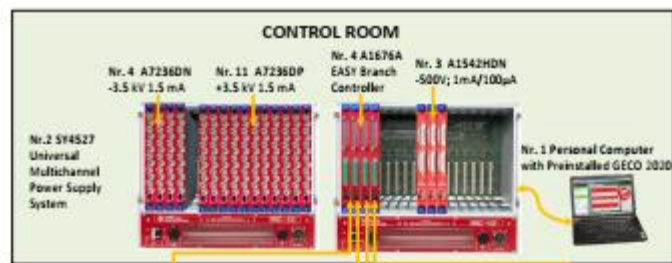
1. RCU prototypes
2. FECs on the ROC (62 pc)
3. LV power supply
4. DCU card connected with RCU's via fibers
5. Readout server



60 pc LVN9 were send back to Minsk:
- modification connection of power cables to LVN9 - **in progress**
- modification of LVN9 output voltages to FECs - **in progress**
- test of LVN9 with cooling radiator under full load (analog – 70 A, digital – 50 A) – **in progress**

- **727 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**.

TPC SUB-SYSTEMS: LV+HV (CAEN)



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+3 pc
- EASY3000 crates – 14+2 pc
- LV module - A3100B (8V/100A) – 48+8 pc
- LV module - A3100HBP (14V/50A) – 6 +2 pc
- HV modules –A3540P (+4kV/1mA) – 8+3 pc
- HV modules –A3540N (- 4kV/1mA) – 2+2 pc

Status:

LV+HV system: JINR-CAEN *contract signed*

Expected delivery date to JINR: *August 2023*

test system – *tests ongoing*

LV cables (halogen free, low smoke):

new cable S=50 mm² – contract *signed*

delivery date to JINR - *Feb 2023*

HV cables - ordered



TPC SUB-SYSTEMS: GAS AND COOLING

Gas system (Ar/CH₄, 90:10)



Gas supply

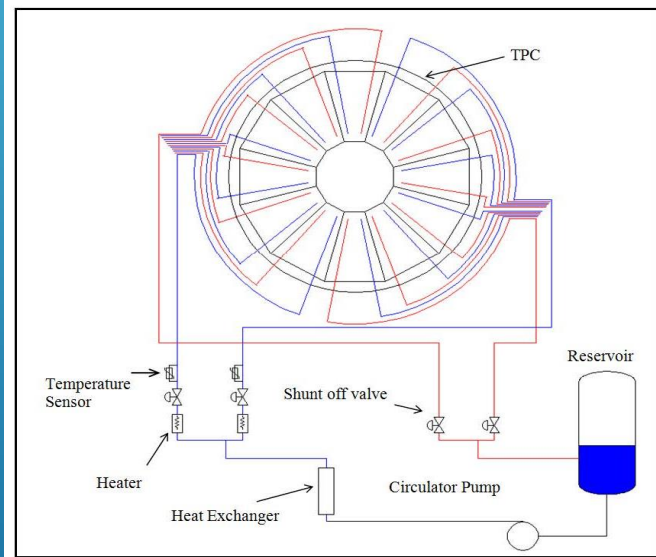
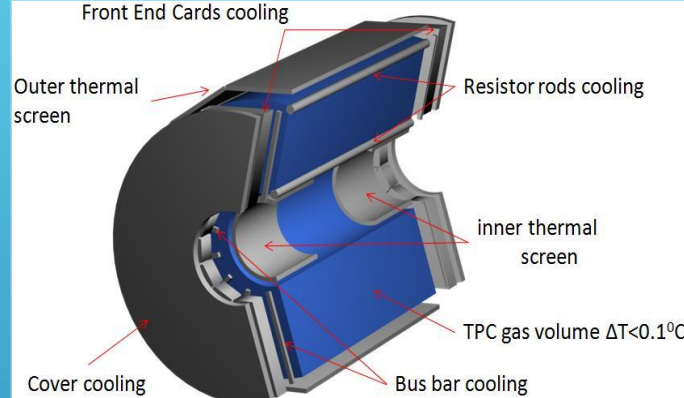
Racks

TPC volume imitator

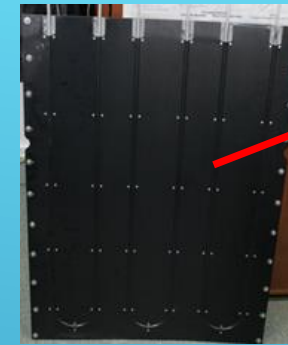


Tests - **in progress**
(H₂O and Q₂ sensors are replaced)

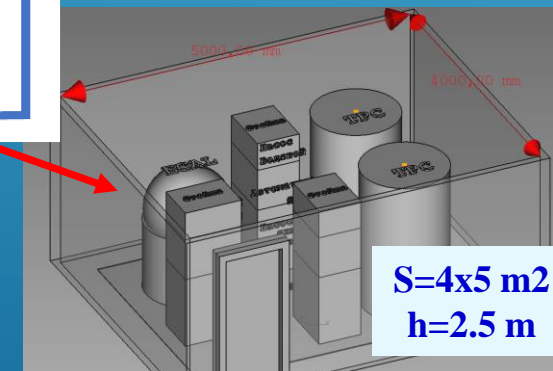
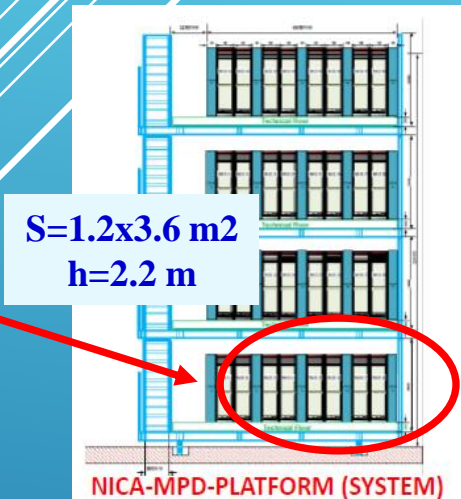
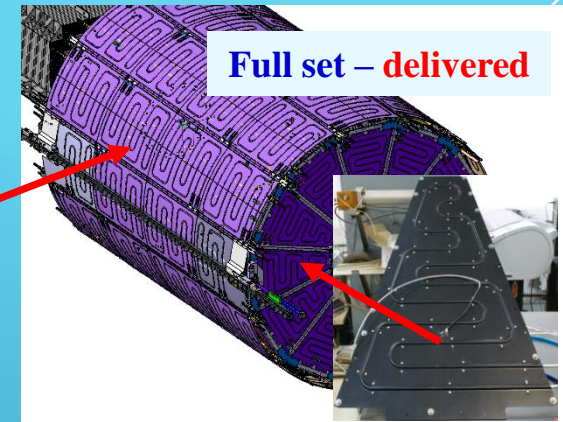
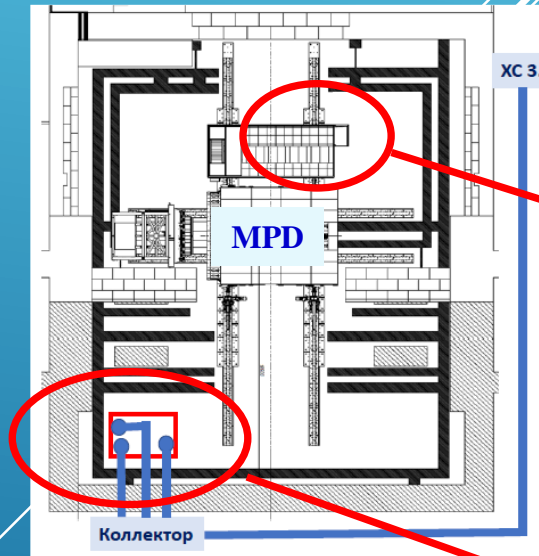
Water cooling system



contract JINR-INP BSU (Minsk) – in progress
delivery – 30 September 2023
 operation under manual control – during beam test 2024
 fully automatic control – **30 September 2024**

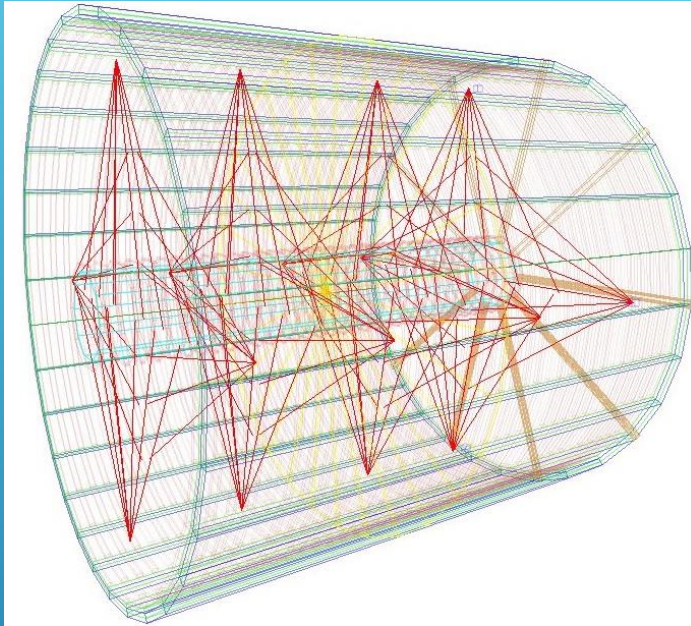


MPD hall



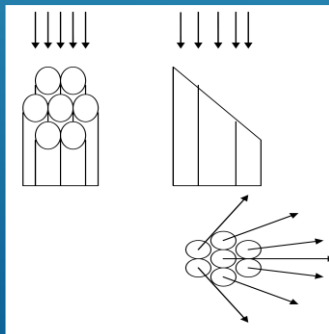
TPC SUB-SYSTEMS: LASER CALIBRATION

Scheme for 1/2 TPC

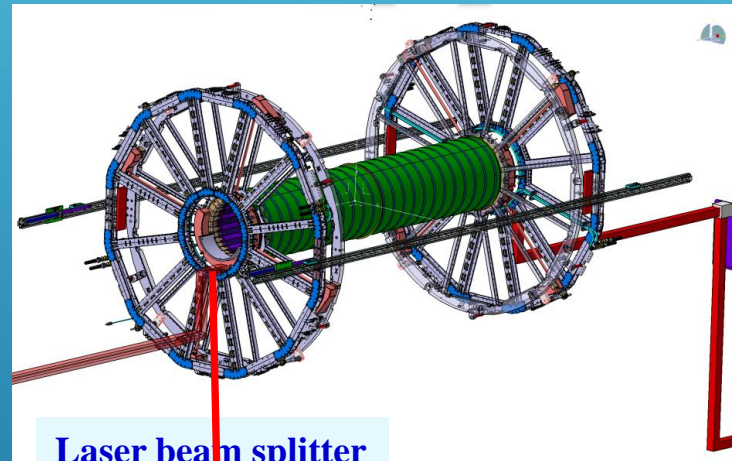
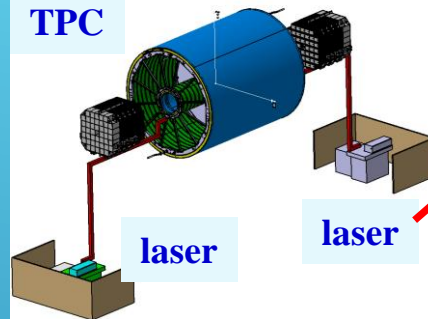


- Laser “planes” - 4
- Micro-mirrors bundles per plane - 4
- Beams from micro-mirrors bundle - 7
- Laser “tracks” (N = 112x2) - 224

micro-mirror
bundles



TPC



Laser beam splitter



Laser beam monitor



TPC laser calibration for electron drift velocity (root version)

MPD

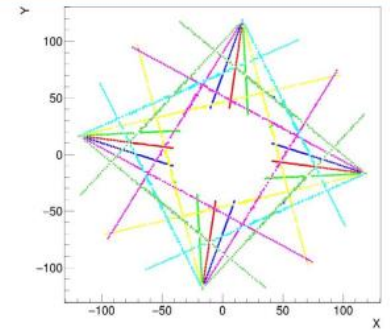
Space-charge distortion in TPC volume change the electron drift velocity (≤ 1 sec.)— corrections are needed.

Bychkov A.

Reasons:

- Variation in drift velocity caused by gas mixture, temperature, pressure and electric field variation.
- Radial inhomogeneities of magnetic and electric field.
- Space charge distortions due to high multiplicity in nucleus-nucleus collisions.
- TPC misalignment in the magnet and existence of the global E X B effect.

Reconstructed hits of the laser grids



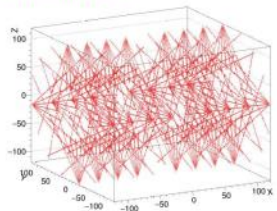
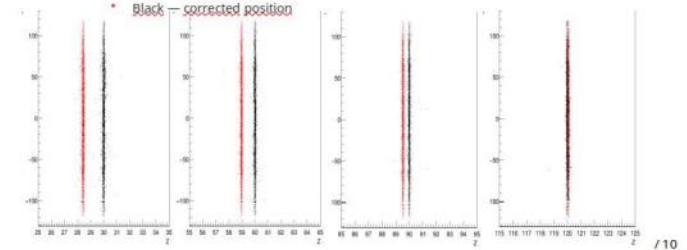
TPC electron drift velocity calibration (standalone fast version)

MPD

Test for drift velocity correction

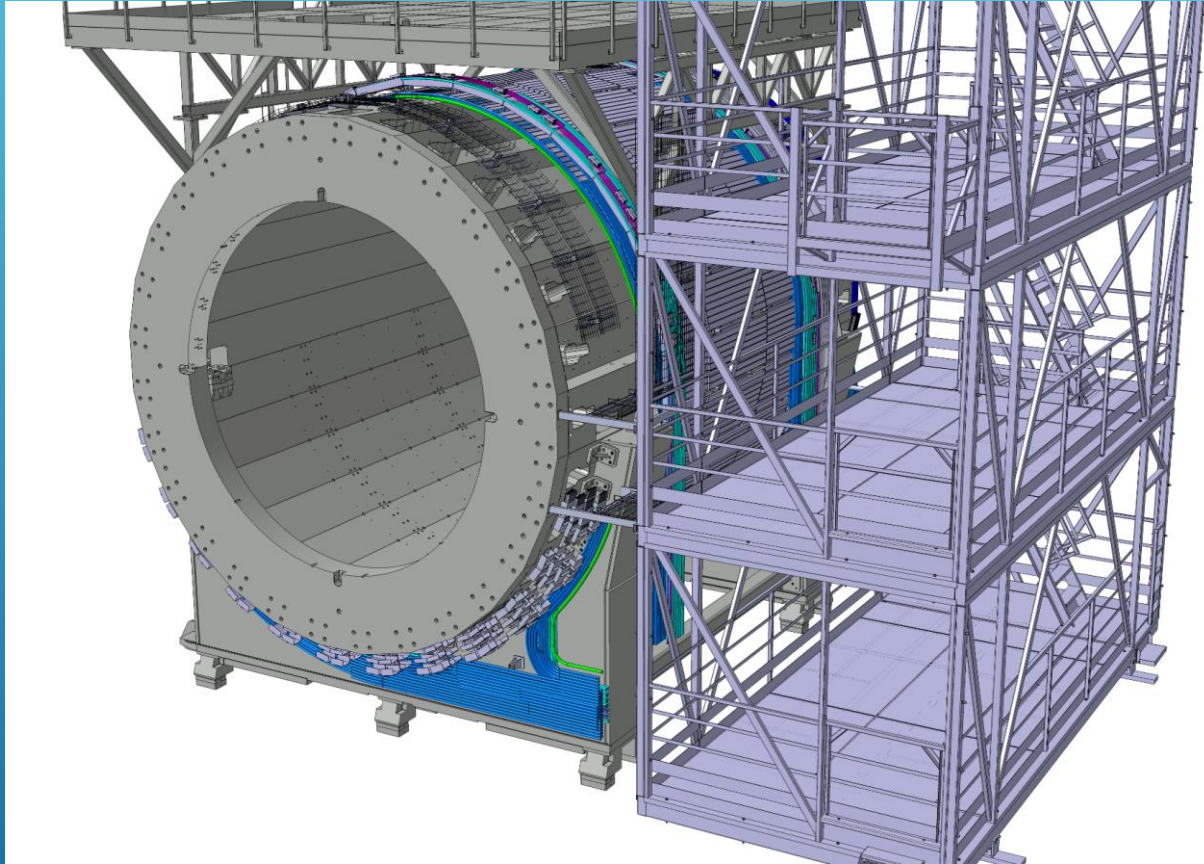
Bychkov A.

- Source data
 - True drift velocity = 5.5 cm/us
 - Simulated drift velocity = 5.4 cm/us
 - Test on laser grid itself
- Red — measured position
- Black — corrected position

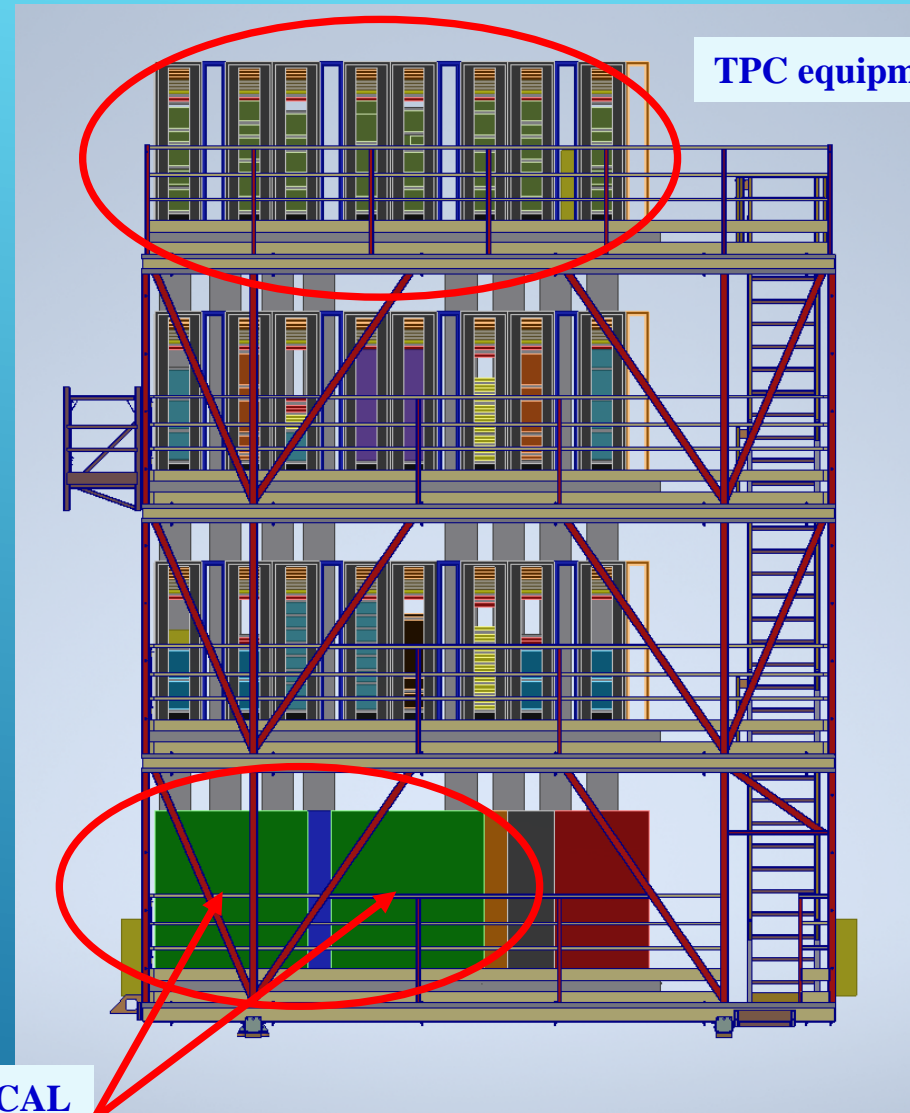


NICA-MPD-PLATFORM (NMP)

Common view



TPC + ECAL
cooling



Design and integration –
in progress ...

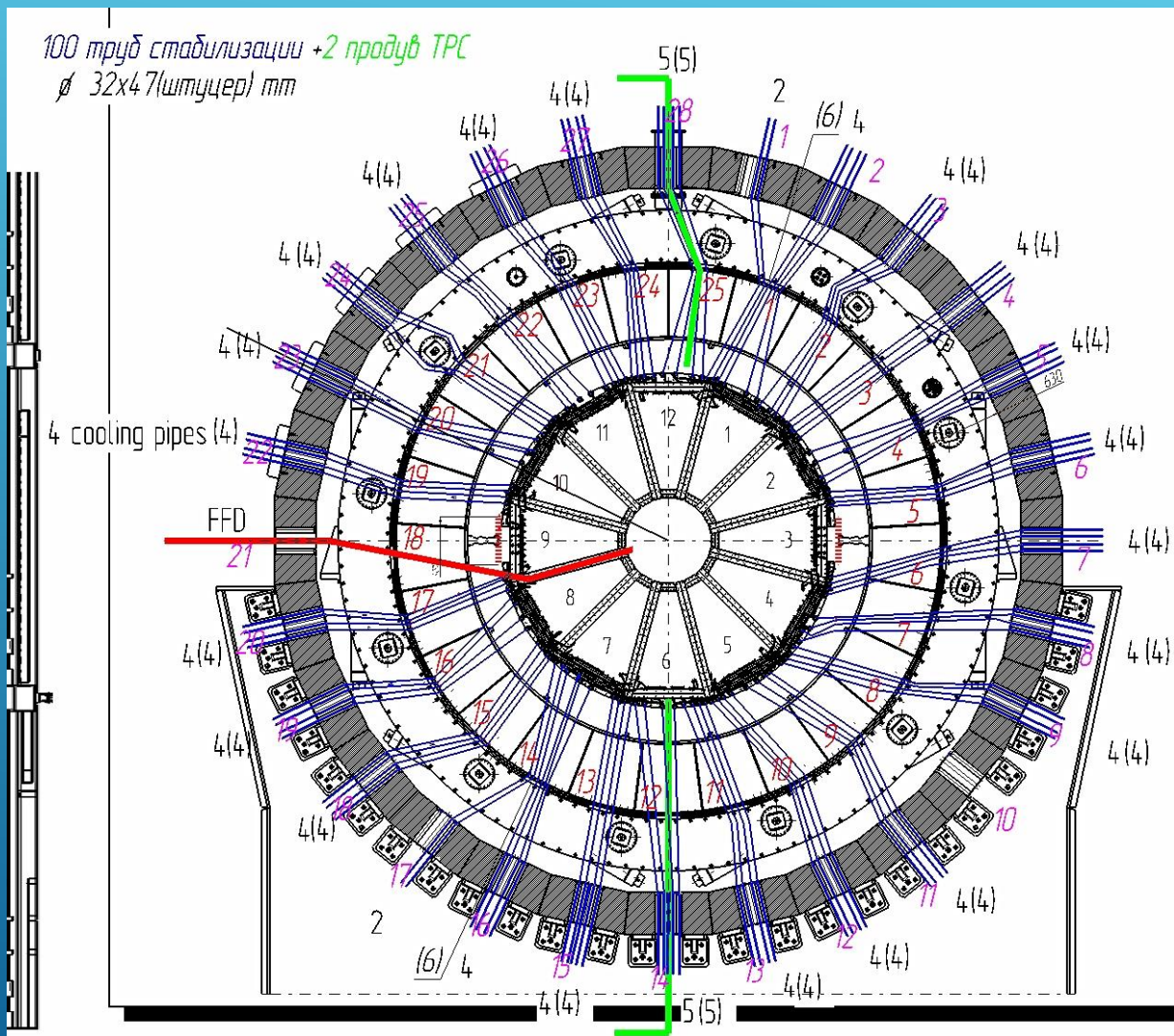
MPD ELECTRONIC PLATFORM

TPC equipment in racks on the 4th floor

F4-R1 (empty)	F4-R2 LV	F4-R3 LV	F4-R4	F4-R5	F4-R6 (LV)	F4-R7 (LV)	F4-R8 (empty)
47	47	47	47	47	47	47	47
46	46	46	46	46	46	46	46
Cable organizer	Cable organizer	Cable organizer	Cable organizer	Cable organizer	Cable organizer	Cable organizer	Cable organizer
45	45	45	45	45	45	45	45
Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber	Patch Panel Fiber
44	44	44	44	44	44	44	44
Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg	Aruba 3810M 24G (146W) 6kg
43	43	43	43	43	43	43	43
Система GATE	A3486 Nr1 (380VAC-40VDC)	A3486 Nr4 (380VAC-40VDC)	A3486 Nr7 (380VAC-40VDC)	A3486 Nr8 (380VAC-40VDC)	A3486 Nr9 (380VAC-40VDC)	A3486 Nr12 (380VAC-40VDC)	A3486 Nr15 (380VAC-40VDC)
40W x 12 камер x 500W	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	Питание SC для всех крайних EASY	Питание SC для всех крайних EASY	3kW, max.4kW 380V/15A 30kg	3kW, max.4kW 380V/15A	max.1.5kW 380V/15A
40	40	40	40	40	40	40	40
220V/10A	30kg	30kg	380V/15A, 1 kW (max. 4 kW), 30kg	Питание +48V 2x крайних EASY	30kg	30kg	30kg
39	39	39	39	39	39	39	39
20kg							
38	38	38	38	38	38	38	38
Crate EASY 3000 Nr1	Crate EASY 3000 Nr4	Crate EASY 3000 Nr6 (HV)	Crate EASY 3000 Nr8 (HV)	Crate EASY 3000 Nr9 (HV)	Crate EASY 3000 Nr12	Crate EASY 3000 Nr15	Crate EASY 3000 Nr15
Система GATE	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486
40W x 12 камер x 500W							
220V/10A							
20kg	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg
33	33	33	33	33	33	33	33
32	32	32	32	32	32	32	32
31	31	31	31	31	31	31	31
30	30	30	30	30	30	30	30
Система SPECTRA	A3486 Nr2 (380VAC-40VDC)	A3486 Nr5 (380VAC-40VDC)	Crate SC для LVN9	Crate SY4527 (HV)	A3486 Nr10 (380VAC-40VDC)	A3486 Nr13 (380VAC-40VDC)	Система GATE
1050W	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	300W	700W, max. 1.2kW	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	40W x 12 камер x 500W
220V/15A	30kg	30kg	220V/10A	220V/10A	30kg	30kg	220V/10A
26	26	26	26	26	26	26	26
50kg			6kg	(8 модулей x 12chx96ch=1.5kW/1mA +			20kg
25	25	25	25	25	25	25	25
Crate EASY 3000 Nr2	Crate EASY 3000 Nr5	Система модульного покрытия	Система модульного покрытия	Система модульного покрытия	Crate EASY 3000 Nr10	Crate EASY 3000 Nr13	Система GATE
Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486
24	24	24	24	24	24	24	24
Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486
23	23	23	23	23	23	23	23
22	22	22	22	22	22	22	22
21	21	21	21	21	21	21	21
20	20	20	20	20	20	20	20
Модуль термометрии NI							
19	19	19	19	19	19	19	19
200W							
220V	30kg	30kg	30kg	30kg	30kg	30kg	30kg
5kg							
17	17	17	17	17	17	17	17
A3486 Nr3 (380VAC-40VDC)	A3486 Nr6 (380VAC-40VDC)	A3486 Nr9 (380VAC-40VDC)	A3486 Nr11 (380VAC-40VDC)	A3486 Nr14 (380VAC-40VDC)	A3486 Nr16 (380VAC-40VDC)	A3486 Nr19 (380VAC-40VDC)	Система SPECTRA
3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	3kW, max.4kW 380V/15A	500W
15	15	15	15	15	15	15	15
30kg	30kg	30kg	30kg	30kg	30kg	30kg	30kg
14	14	14	14	14	14	14	14
TPC Laser system synchronization							
200W, 220V							
13	13	13	13	13	13	13	13
5kg							
12	12	12	12	12	12	12	12
11	11	11	11	11	11	11	11
Crate EASY 3000 Nr3	Crate EASY 3000 Nr6	Crate EASY 3000 Nr9	Crate EASY 3000 Nr12	Crate EASY 3000 Nr15	Crate EASY 3000 Nr18	Crate EASY 3000 Nr21	Crate EASY 3000 Nr24
Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486	Питание + 48V Seperts от A3486
10	10	10	10	10	10	10	10
TPC HV membrane - 30kV							
9	9	9	9	9	9	9	9
350W							
220V	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg	42.5kg
8	8	8	8	8	8	8	8
7kg							
7	7	7	7	7	7	7	7
6	6	6	6	6	6	6	6
5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1

TPC CABLING AND PIPING

W side: cooling and gas pipes scheme



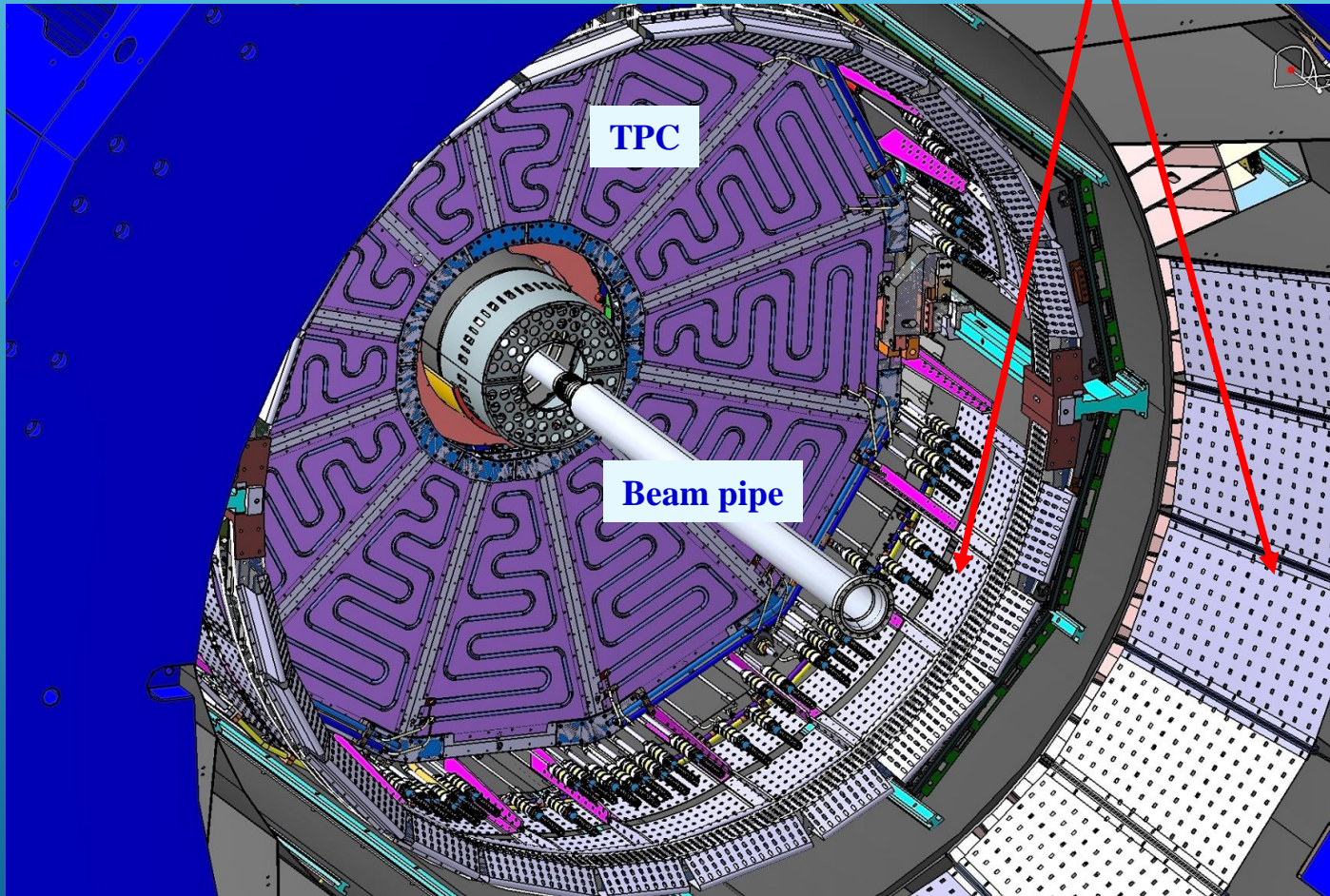
TPC list of cables and pipes

List of cables and pipes																	
	Purpose	Diameter, mm	14	12	10	8	6	4	2	1	3	5	7	9	11	13	
			Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	Qty	
EDTC	Data cable	3	0	6	12	18	24	30	36	42	48	54	60	66	72	78	
ESPC	Sensor cable	9,4	0	3	6	9	12	15	18	21	24	27	30	33	36	39	
EPWC	Power cable	14,7	0	3	6	9	12	15	18	21	24	27	30	33	36	39	
ESRL	Service cable(1)	3x13	0	3	6	9	12	15	18	21	24	27	30	33	36	39	
EWCT	Watercooling tubes	~30	0	2	4	6	8	10	12	14	16	18	20	22	24	26	
EACT	Air cooling tubes for FE and BOX	~30	0	2	4	6	8	10	12	14	16	18	20	22	24	26	
TSGC	Signal	13	10	20	30	40	50	60	70	80	90	100	110	120	130	140	
THVC	HV	8,5	0	4	4	8	8	12	12	16	16	20	20	24	24	28	
TLVC	LV Cable	13	1	1	2	2	3	3	4	4	5	5	6	6	7	8	
TUTC	UTP	6	1	1	2	2	3	3	4	4	5	5	6	6	7	8	
TRIL	Trigger (OR)	10	2	2	4	4	6	6	8	8	10	10	12	12	14	16	
TGST	Gas Pipes	12	2	2	4	4	6	6	8	8	10	10	12	12	14	16	
TPC gas system																	
TGTT	Purge TPC (In/out)	40	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
LV																	
TLPC	LVDI: low-voltage cable supply	12	0	8	8	16	16	24	32	32	32	32	40	40	48	48	
TLSC	LVDI: sense wire	2,5	0	4	4	8	8	12	16	16	16	16	20	20	24	24	
TCPC	Controller: low-voltage cable supply	12	0	2	2	4	4	6	8	8	8	8	10	10	12	12	
TCSC	Controller: sense wire	2,5	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TLCC	LVDI: slow control cable	9	0	2	2	4	4	6	8	8	8	8	10	10	12	12	
DAQ																	
TDCC	Controller: slow control	7	0	2	2	4	4	6	8	8	8	8	10	10	12	12	
TDGO	Controller: DATA GSPF	opt. 3,3	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TOTD	Controller: data and trigger/ sync SFP+	opt. 3,3v1,8	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TOTC	Controller: trigger	6	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TOTB	Controller: reset	6	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TOSC	Controller: Sync	6	0	1	1	2	2	3	4	4	4	4	5	5	6	6	
TDQO	Reserve cables GSPF	opt. 3,3	0	1	1	1	1	1	2	2	2	2	2	2	2	2	
TOSD	Reserve cables SFP+	opt. 3,3v1,8	0	1	1	1	1	1	2	2	2	2	2	2	2	2	
ROC chamber																	
TRAC	for ROC: HV power supply for anode sections	4,1	0	0	4	4	8	8	8	8	12	16	16	20	20	24	
TRBC	for ROC: HV electrode adjusting supply	4,1	0	0	1	1	2	2	2	2	3	4	4	5	5	6	
TRVC	for ROC: HV locking grid	4,1	0	0	2	2	4	4	4	4	6	8	8	10	10	12	
TRCC	for ROC: cameras electrode (cathode), test signal	4,1	0	0	1	1	2	2	2	2	3	4	4	5	5	6	
TRSC	from ROC: signal cable (anode)	4,1	0	0	4	4	8	8	8	8	12	16	16	20	20	24	
Sensors																	
TSSC	Temperature sensor cable Pt100	8	0	0	3	3	6	6	6	6	9	12	12	15	15	18	
TSPC	Cables from pressure sensors on pipes cooling + stabilization	7,8	0	0	4	4	8	8	8	8	12	16	16	20	20	24	
TSTC	Cables from temperature sensors on pipes cooling + stabilization	7,8	0	0	4	4	8	8	8	8	12	16	16	20	20	24	
HV TPC central resistance																	
THIC	Central HV electrode TPC	8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	
THRC	low-voltage cable input for resistors (centr), HV electrode	10	0	0	0	0	0	0	0	0	1	1	1	1	1	1	
Thermoisolabilisation																	
TTOT	external thermal screen stabilization pipes	32	0	0	2	2	2	4	4	6	6	7	8	8	10	10	
TTTT	and Thermal Shield Stabilization Pipes	32	0	0	0	0	1	2	2	2	2	2	2	3	4	4	
TTIT	inner thermal shield stabilization pipes	32	0	0	2	2	2	2	2	2	2	2	2	2	2	2	
TTIR	Pipes stabilisation ROC chambers housings	32	0	0	0	0	0	0	0	0	0	2	2	2	2	2	
TTIT	TPC flange stabilisation pipes with spikes	32	0	0	0	0	0	0	1	3	4	4	4	4	4	4	
TTST	Stabilisation pipes FE SAMPA	32	0	4	4	6	8	9	12	12	15	16	17	20	20	24	
Cooling (12 loops)																	
TCLT	Cooling pipes LVDI, controllers & FE FPGA	32	0	0	0	1	2	2	2	2	2	2	3	3	4	4	
TPC laser system																	
TLVC	Cable for WEB camera control system floor laser beam	7	0	0	1	1	1	1	1	1	1	2	2	2	2	2	
TPC gas system																	
TGST	Purge of C1C2 and C1C4 (input/output)	12	0	0	0	0	0	0	0	0	0	0	1	1	1	1	
Hydraulic actuators																	
TSGC	Position centers hydraulic cylinder	6	0	4	4	4	4	4	4	4	4	4	4	4	4	8	

TPC CABLING AND PIPING

Integration ...

Structures for
cables and pipes
fixation



Design - in progress

Prototype for cabling and piping



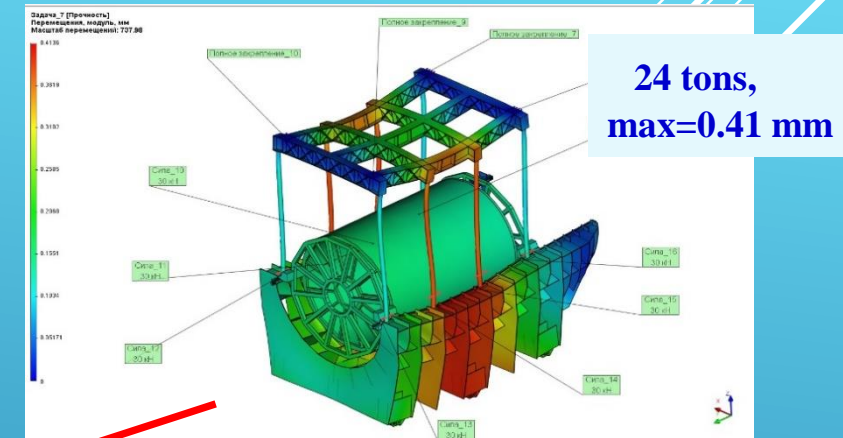
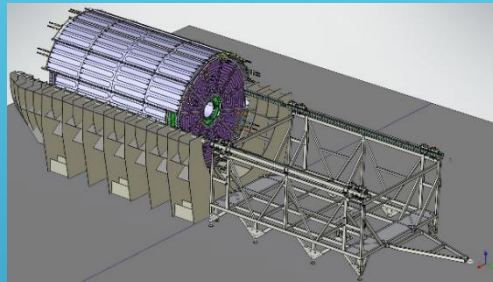
TPC+TOF+ECAL cabling – **finished**
Piping – not started yet

TOOLING FOR INSTALLATION TPC TO MPD

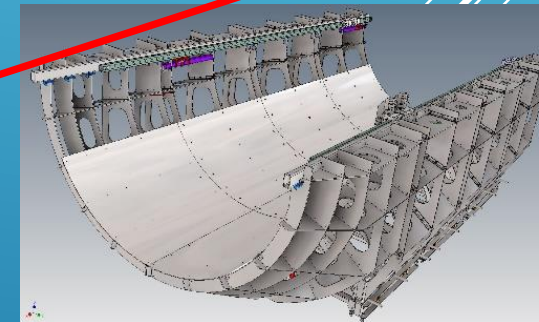
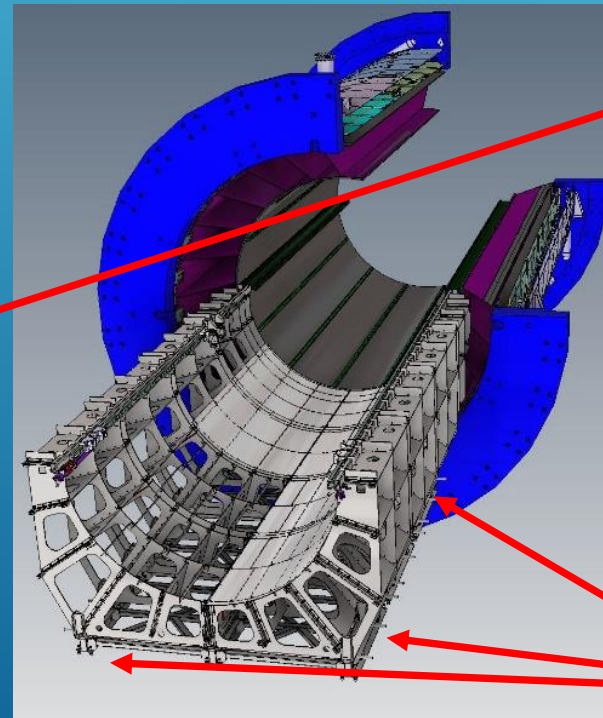
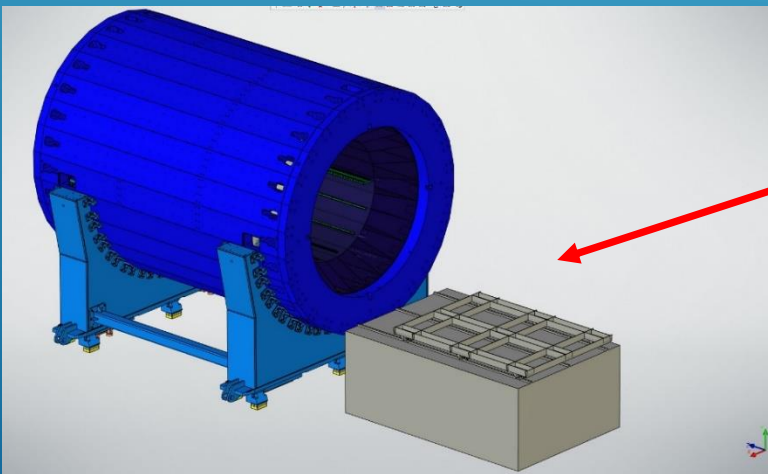
Bld. 217



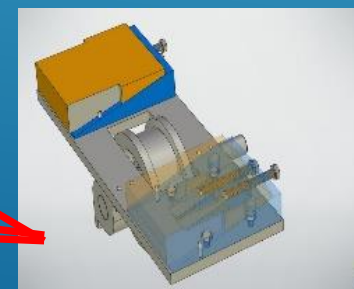
Bld. 217 (MPD)



Design under
discussions



4 units for adjustment X, Y, Z



Tooling manufacture –
Jan-July 2023
Delivery to JINR –
August 2023

TIME SCHEDULE AND CONCLUSION

Status:

Integration TPC to MPD:

TPC racks (8pc) - layout optimization in progress

TPC rails (calculations, manufacture) - Feb 2023 → June 2023 **on critical path !!!**
rails installation to MPD - July 2023

Tooling for installation TPC to MPD:

design - under discussion

tooling manufacture - Jan-July 2023 (7 month)

delivery to JINR - August 2023

TPC+ECAL cooling systems installation – up to Sept 30 2023

TPC schedule:

TPC installation to MPD Oct-Nov 2023

cabling and piping Sept-Nov-Dec 2023

MPD commissioning Jan-Feb 2024

Thank you !