

Status of the Time Projection Chamber for the MPD-NICA project

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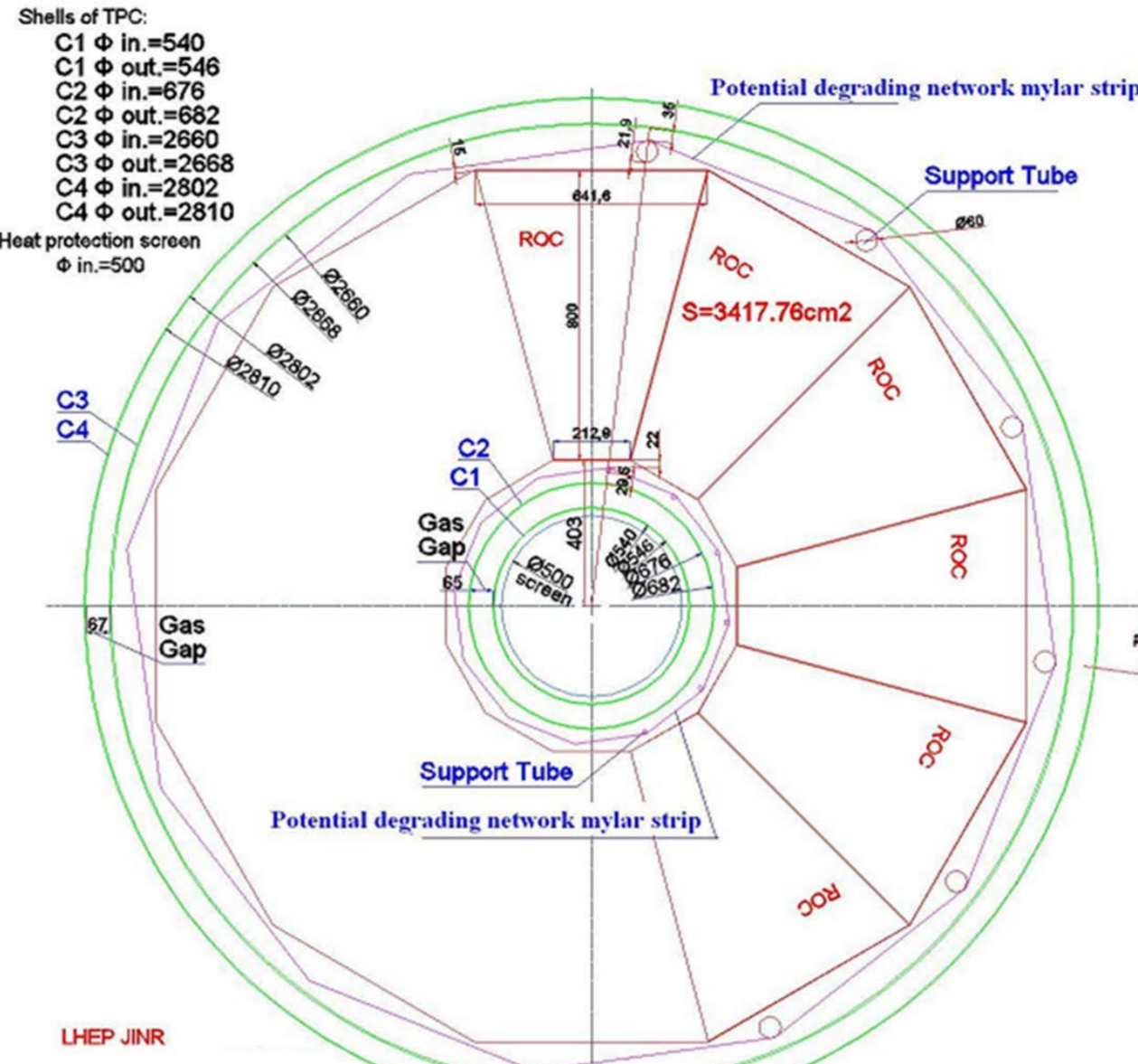
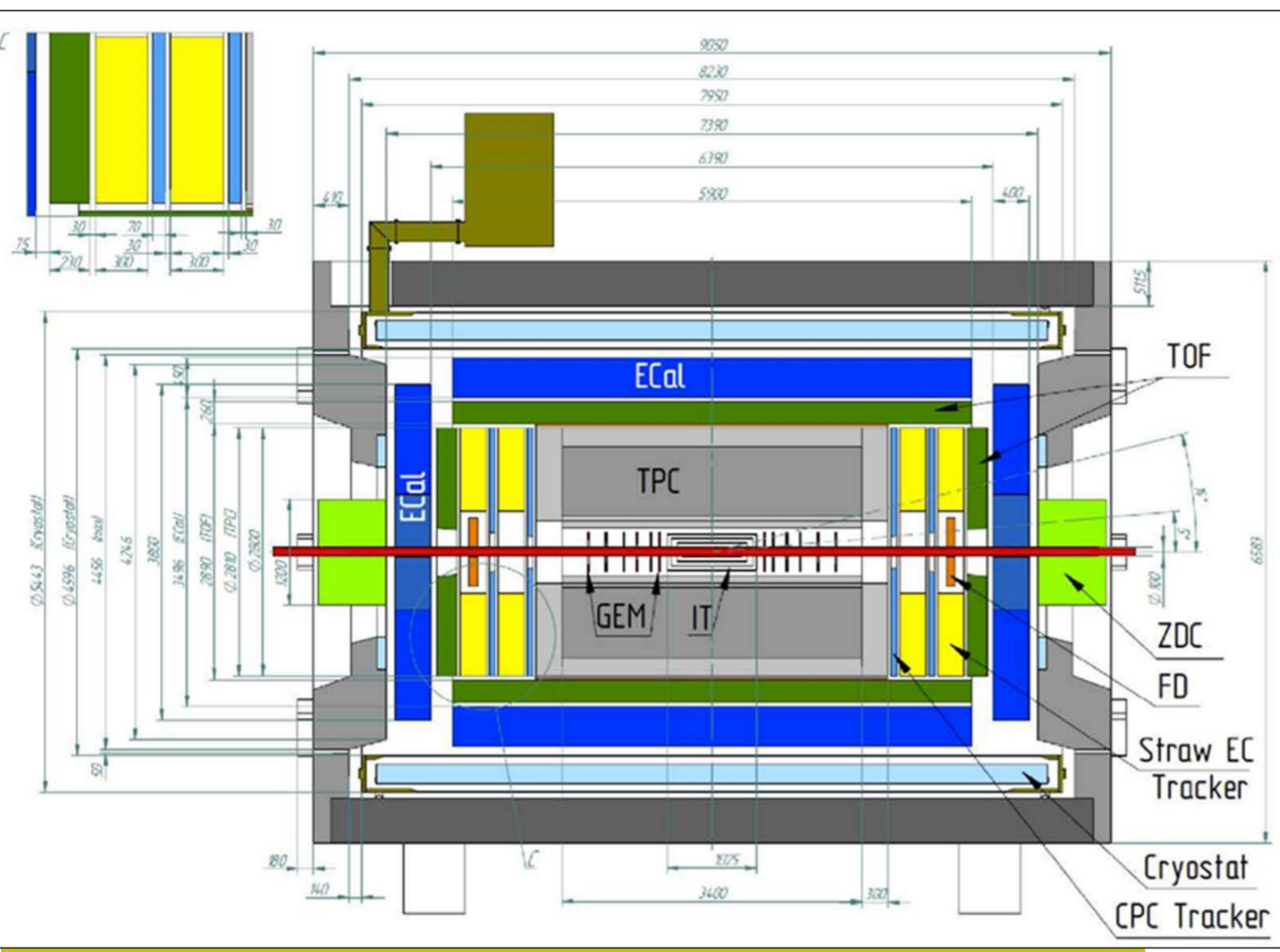
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The Time-Projection Chamber (TPC) is the main detector for tracking and charged particles identification in the MPD experiment at the NICA collider.

Central barrel of Multi-Purpose Detector (MPD)

TPC front view

TPC parameters



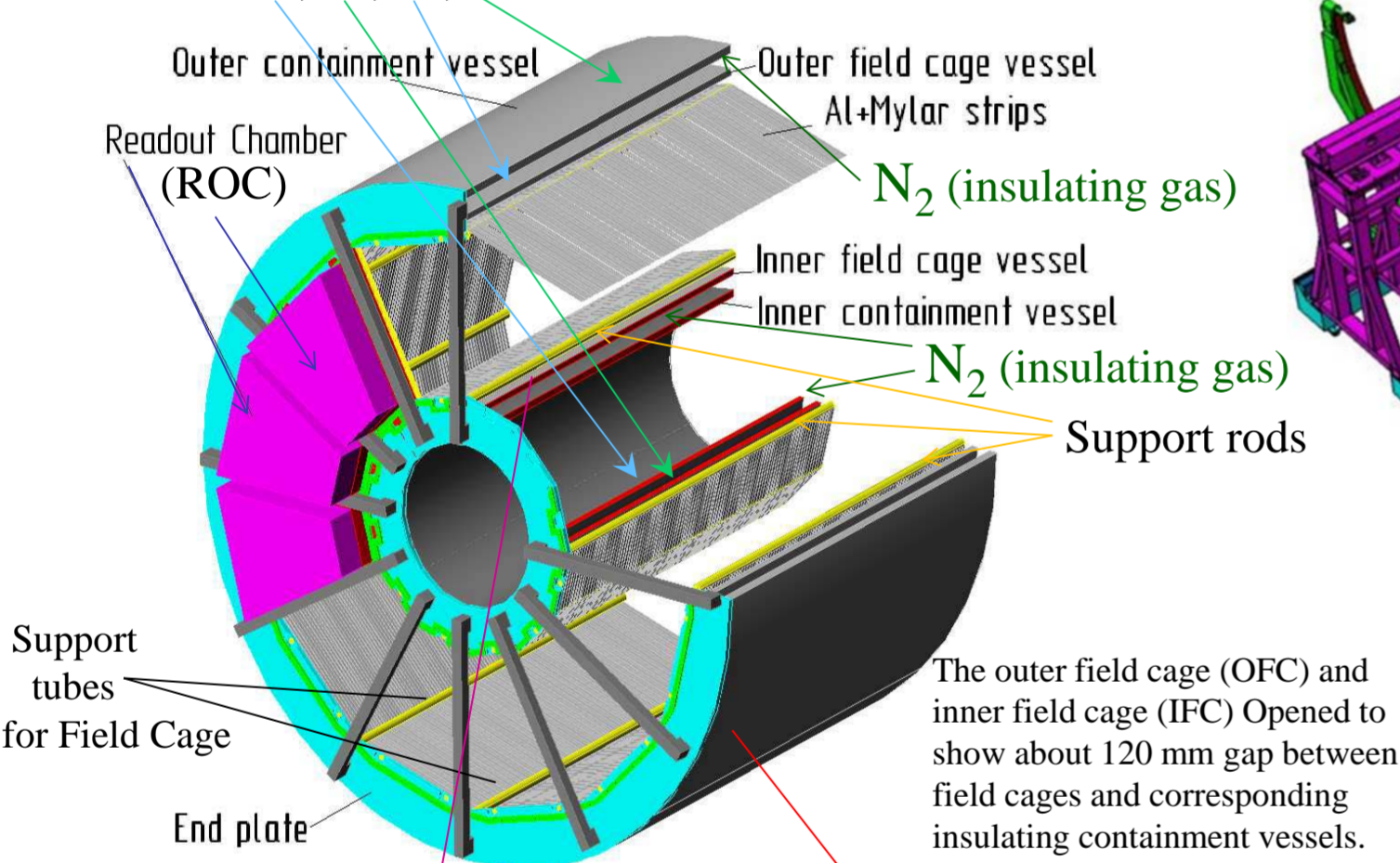
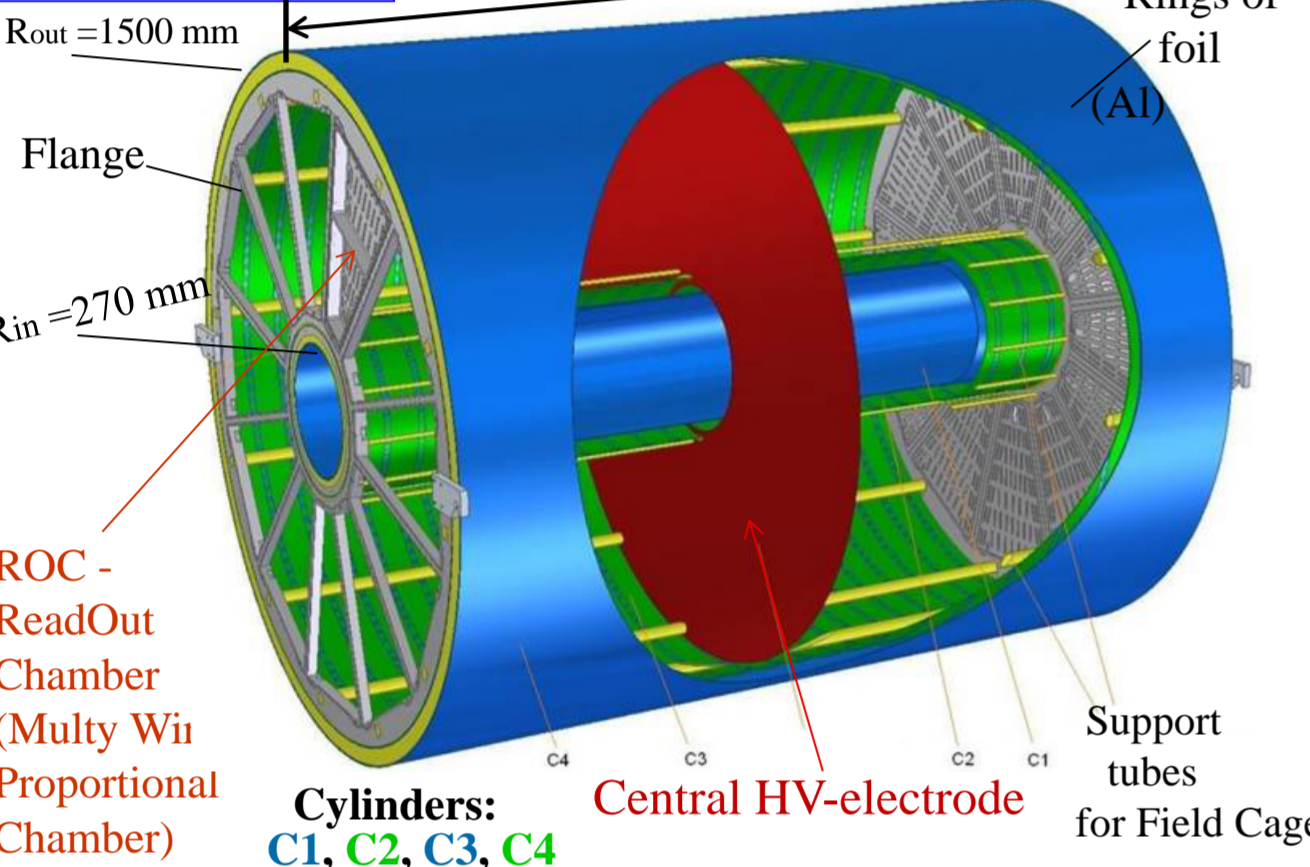
Item	Dimension
Length of the TPC	340 cm (without FEE)
Outer radius of vessel	140 cm
Inner radius of vessel	27 cm
Outer radius of drift volume	133 cm
Outer radius of drift volume	34 cm
Length of the drift volume	163 cm (of each half)
Cathode	Membrane at the center of the TPC
Electric field strength	~140 V/cm (for Ar/CH ₄)
Magnetic field strength	0.5 Tesla (max.)
Drift gas	90% Ar + 10% CH ₄ (P10) at Atmospheric pres. + 2 mbar
Gas amplification factor	~ 10 ⁴
Drift velocity	5.45 cm/μs for P10 gas mixture
Drift time	~ 30 μs
Temperature stability	< 0.5 °C
Readout chambers	24 (12 per end plate) sectors [MWPC or GEM + pads]
Segmentation in φ	30°
Multiplicity (max.)	~ 1000 (central collision)
Pad size	5x12 mm ² and 5x18 mm ²
Number of pads	95232
Pad raw numbers	53
Maximum rate	~ 7 kHz (Lum. 10 ²⁷)
Electronics shaping time	~180 ns (FWHM)
Signal to noise ratio	30:1
dE/dx	better than 8 %
Δp/p	≤ 3% in 0.1 < p _t < 1 GeV/c

TPC requirements

Spatial resolution: $\sigma_{x,y} \sim 600 \mu\text{m}$, $\sigma_z \sim 1 \text{ mm}$;
Two track resolution: about 10 mm;
Momentum resolution: $\Delta p/p \leq 3\%$ ($0.1 < p_t < 1 \text{ GeV}/c$);
dE/dx resolution: better than 8%;
Overall acceptance of $|\eta| \leq 1.2$;
Max. multiplicity: ~ 1000 (central collision Au+Au at 11 GeV).

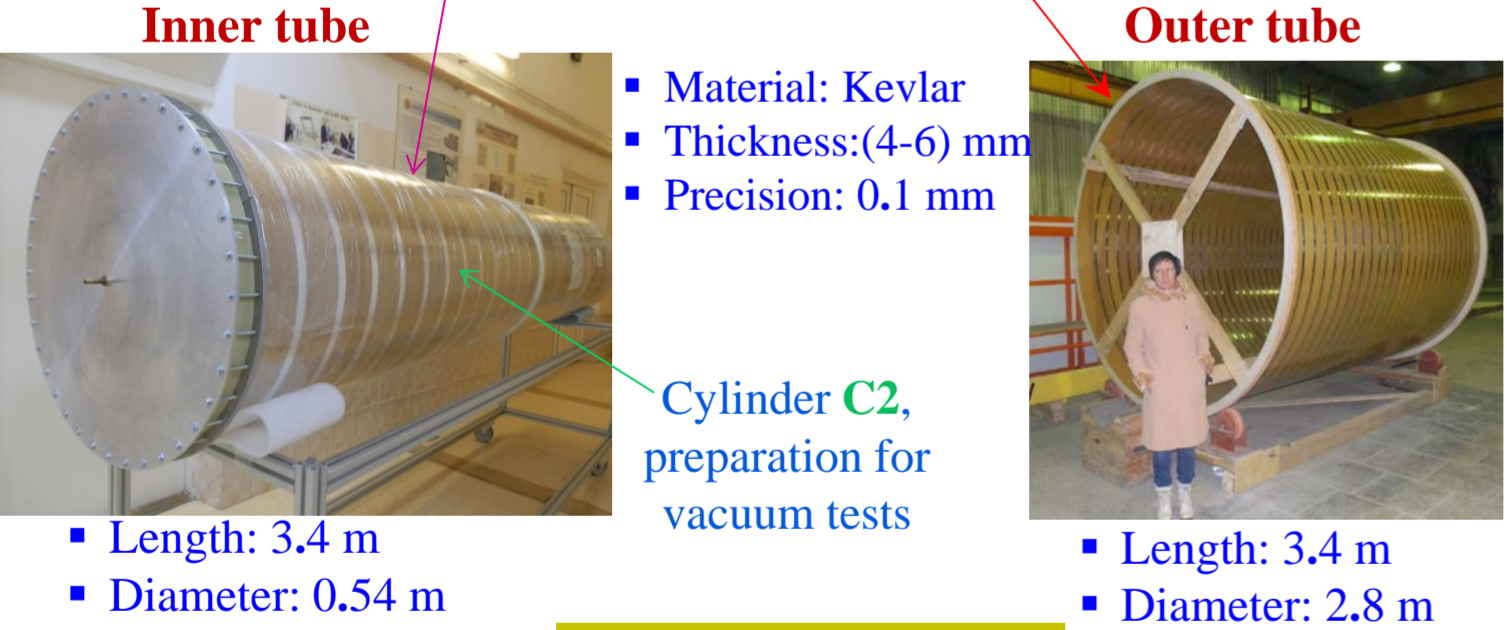
TPC structure

Advantages:
 • low material budget
 • high rate capability (~ 7 kHz)

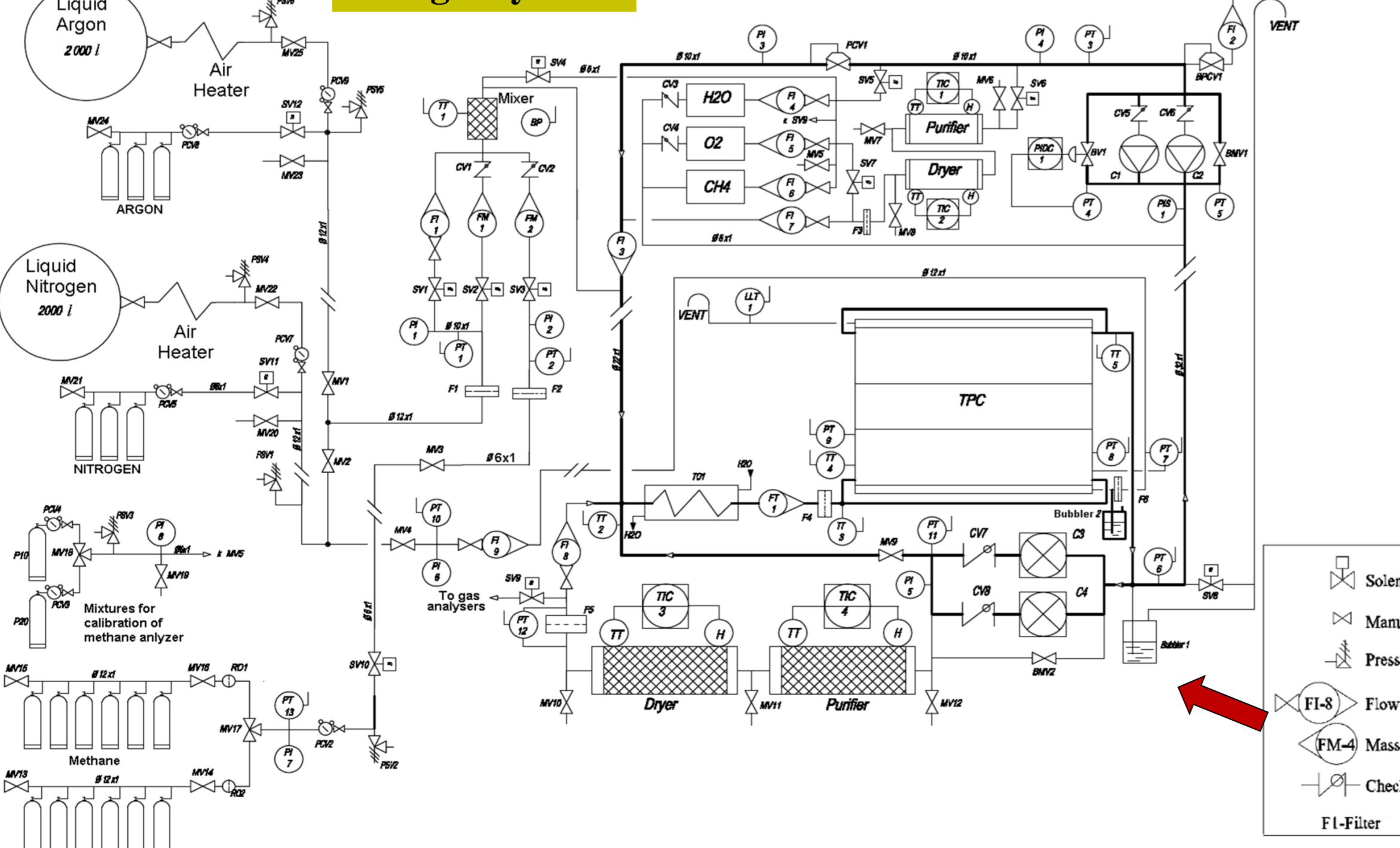


TPC cylinders

A technology elaborated how to produce hermetic large diameter Kevlar vessels.

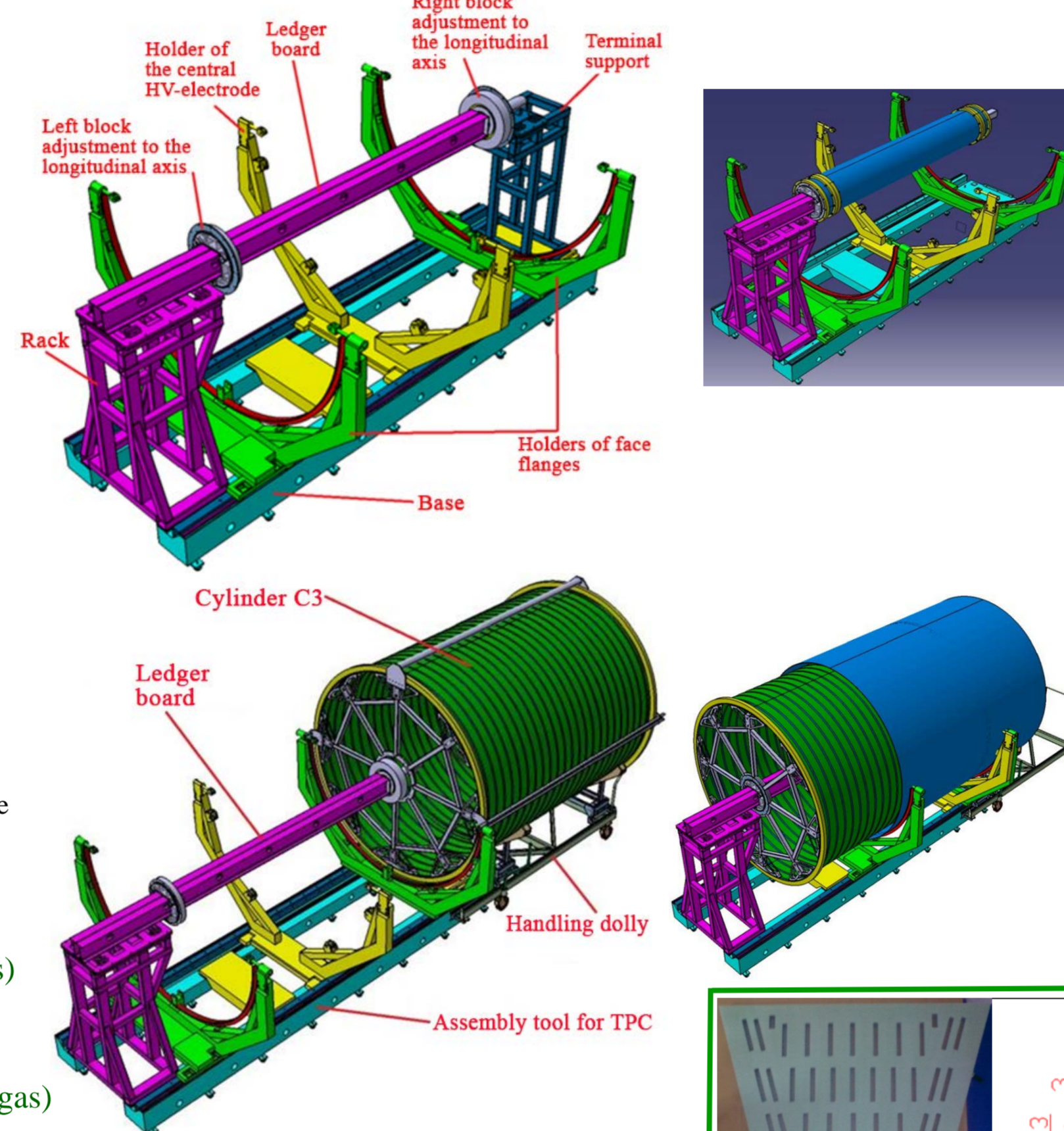


TPC gas system

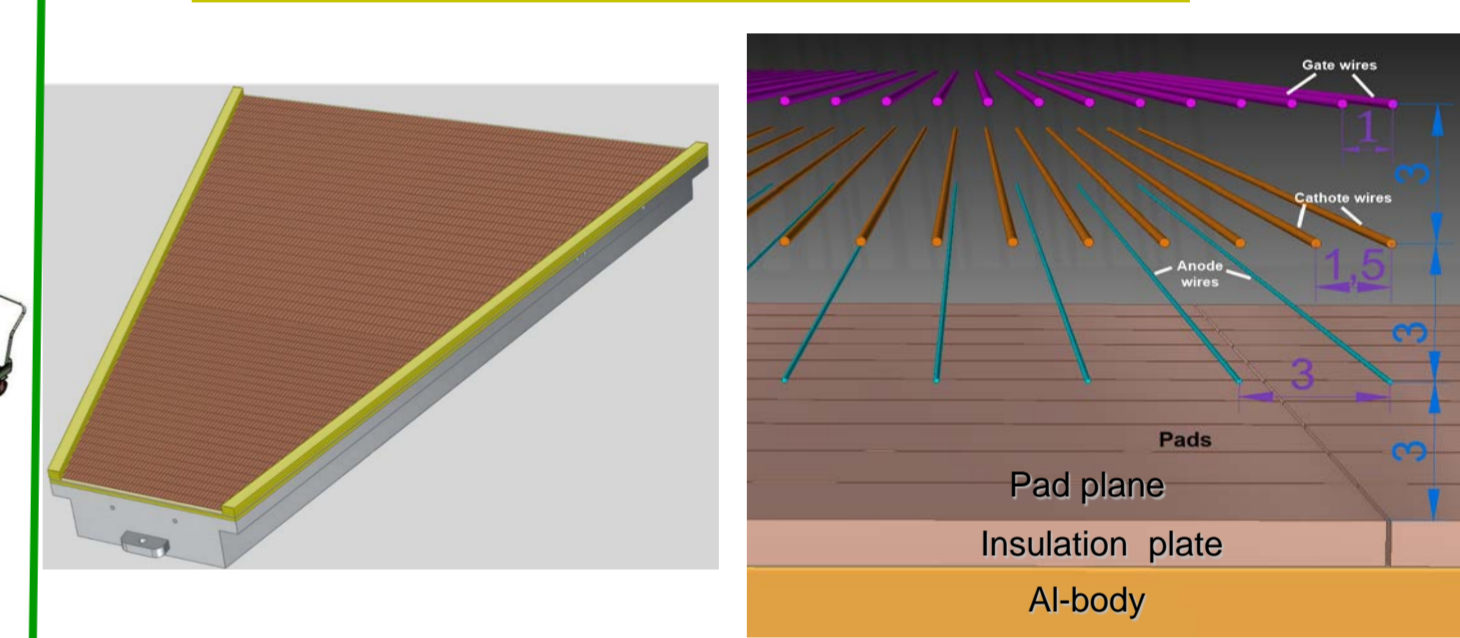


Tools for TPC assembling

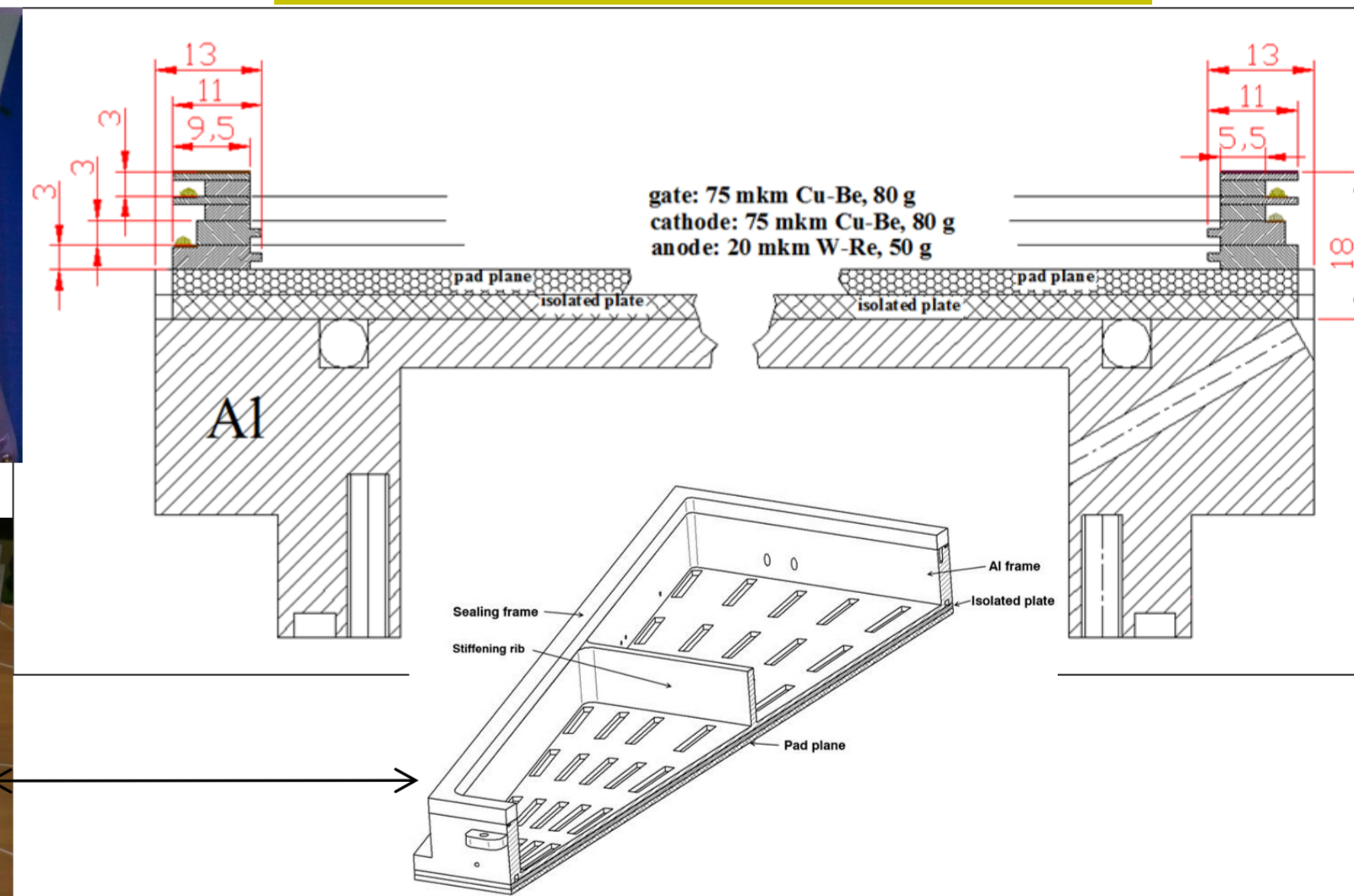
Status: under design



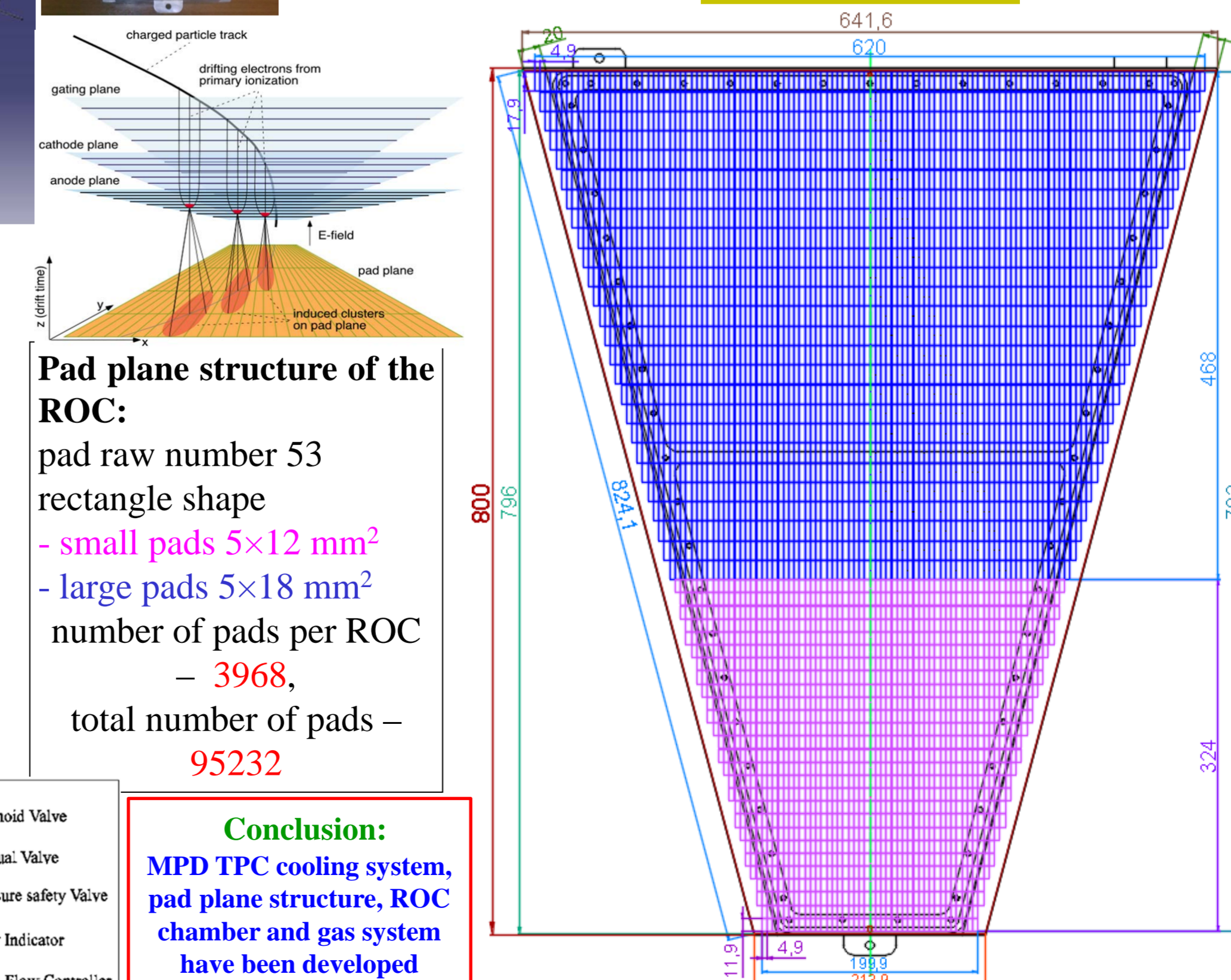
Schematic view of ROC chamber



Cross-section of the ROC chamber



Pad plane



Pad plane structure of the ROC:
 pad raw number 53
 rectangle shape
 - small pads 5x12 mm²
 - large pads 5x18 mm²
 number of pads per ROC - 3968,
 total number of pads - 95232

Conclusion:
 MPD TPC cooling system, pad plane structure, ROC chamber and gas system have been developed according to the specifications (performance required).

TPC readout pad plane and front view of aluminum frame of readout chamber