Pellet target report

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Forschungszentrum Jülich, Germany

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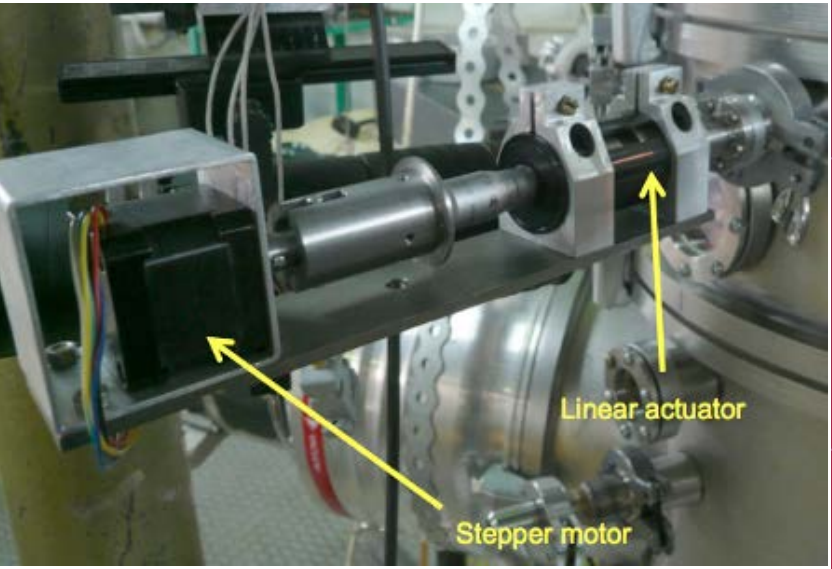
Main status

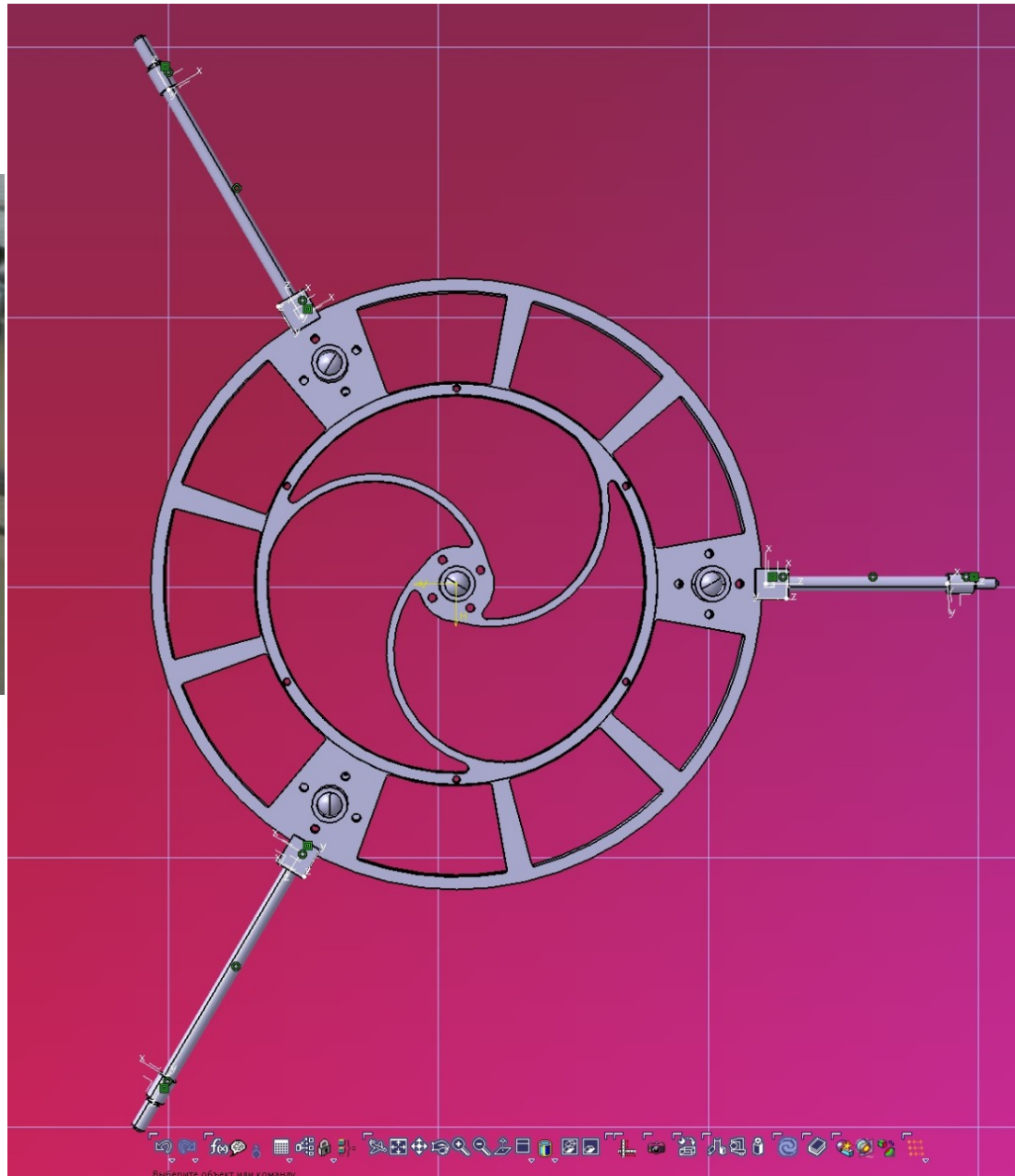
1. Continue R&D for TDR
2. Preparation of the TDR

Current activities of young colleagues

1. Operation and study of the adjustment system.
2. 3D design of the Pellet target
3. Simulation of temperature distribution inside the target

Adjustment system elements

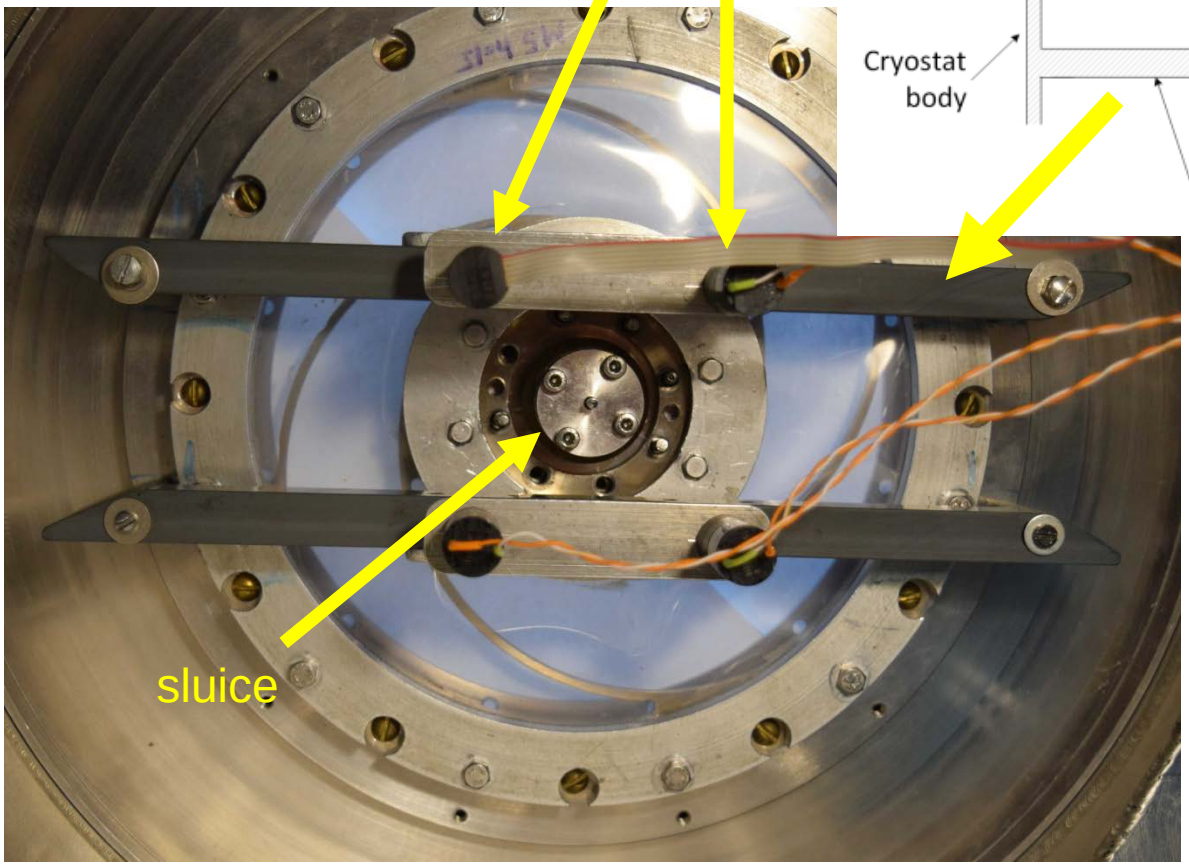


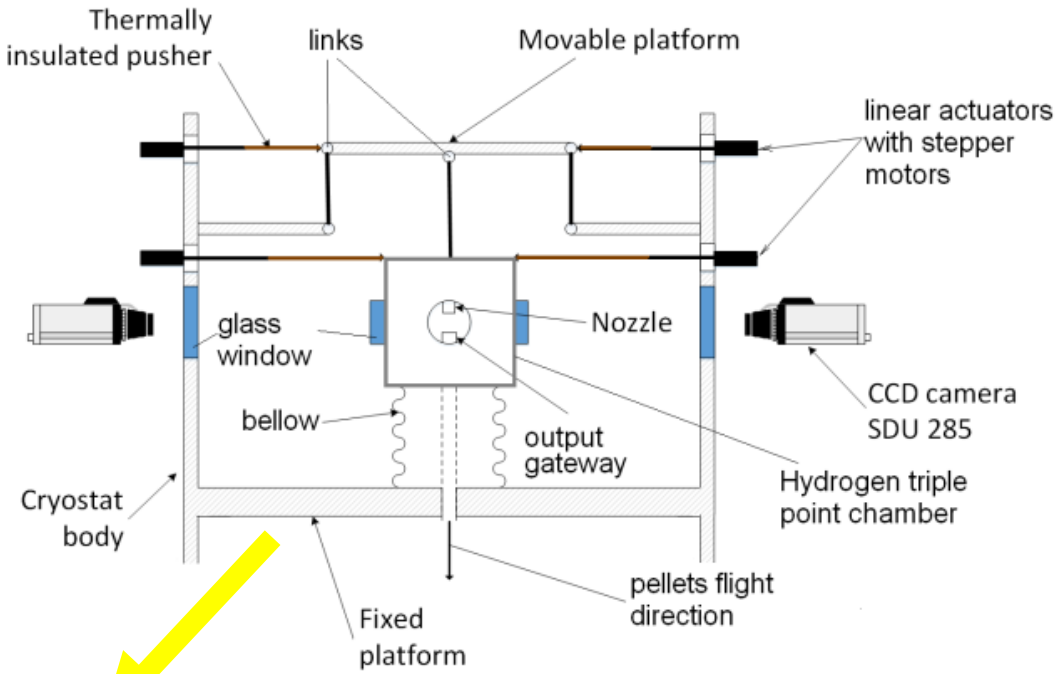


operated via **L-CARD E14-140** controller for four axes:
- 4 stepper motors
- Tested with L-Card controller and Delphi prog.

Development of the adjustment system

Inclination of sluice by 4 motors



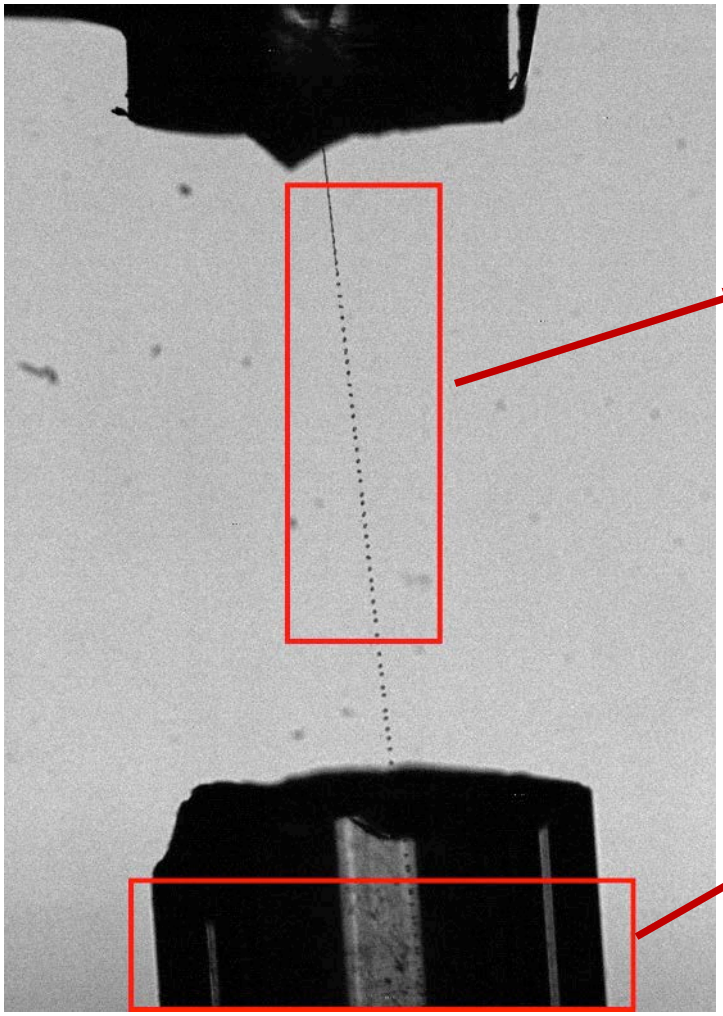


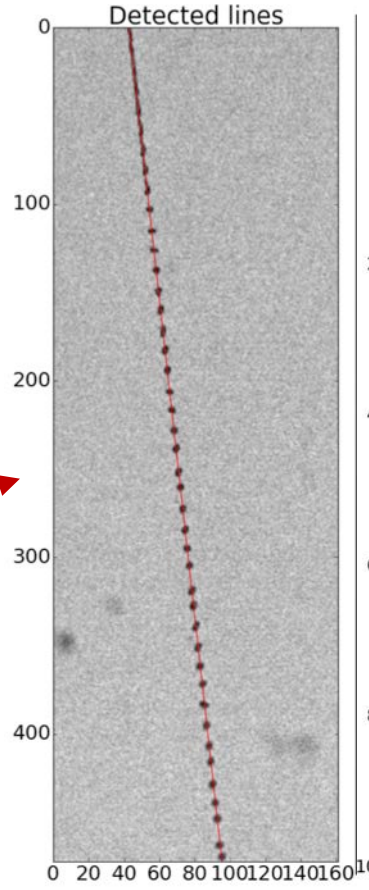
New elements are installed.
Commissioning and tests are going on.
New construction of sluice is tested.

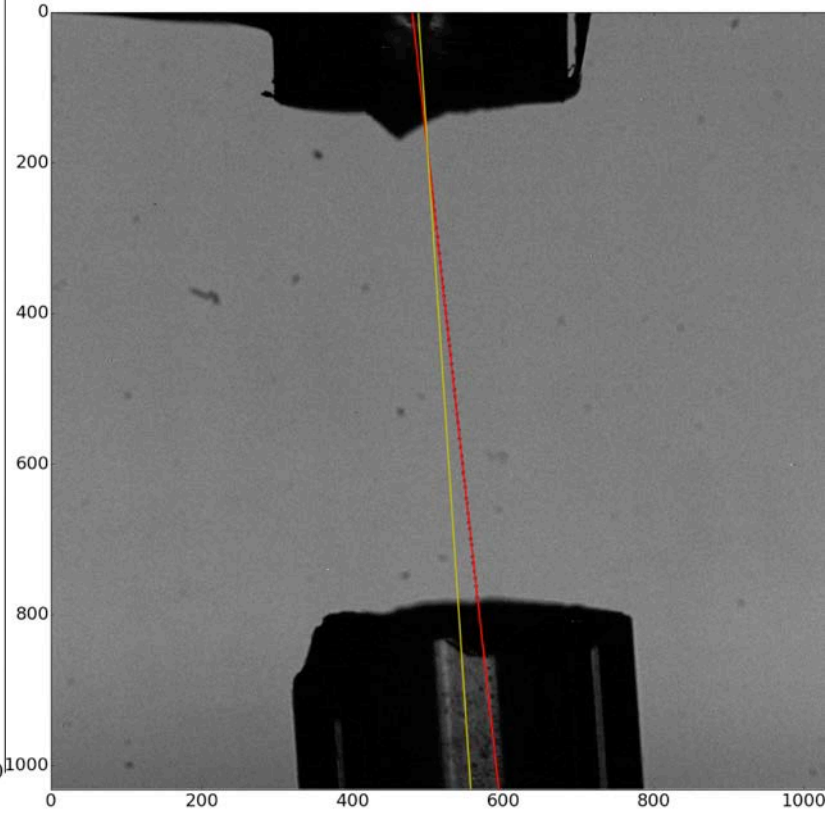
Visualization of the nozzle axis deviation relative to the output sluice

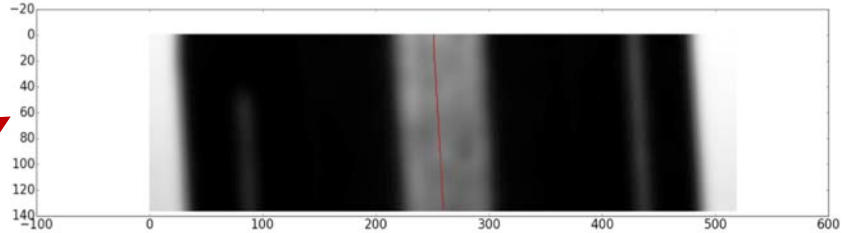
Images: TIFF file 12 bit
(1392x1032 pixels)
Processing: Python Software

- Gateway angle: 86.14 °
- Nozzle angle: 83.64 °



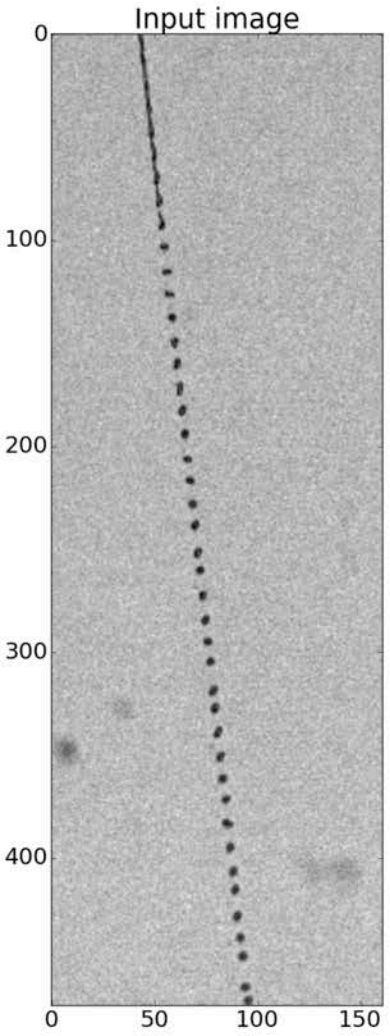


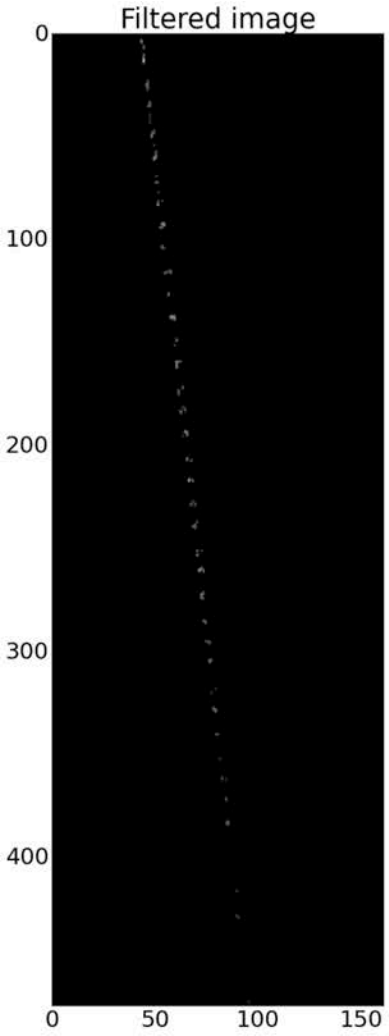


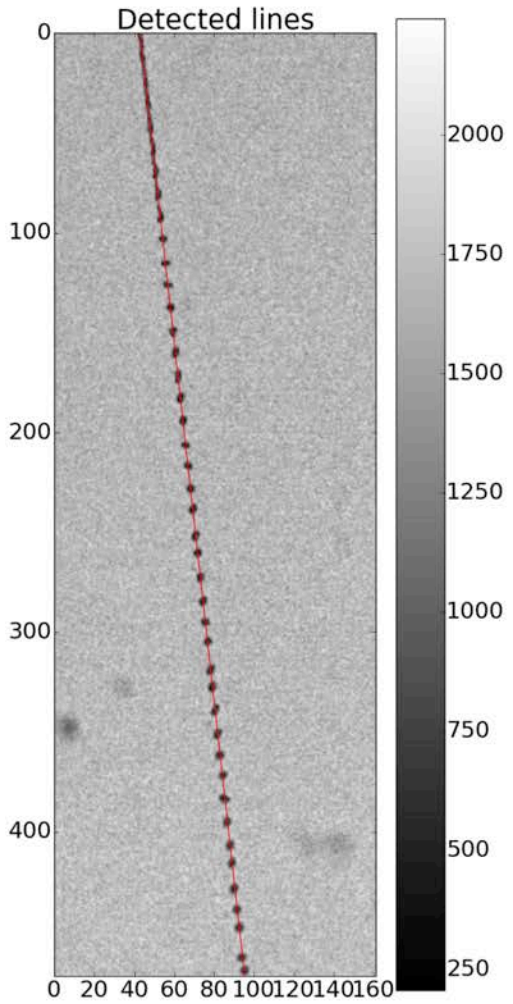


Search for a straight line of hydrogen droplets.

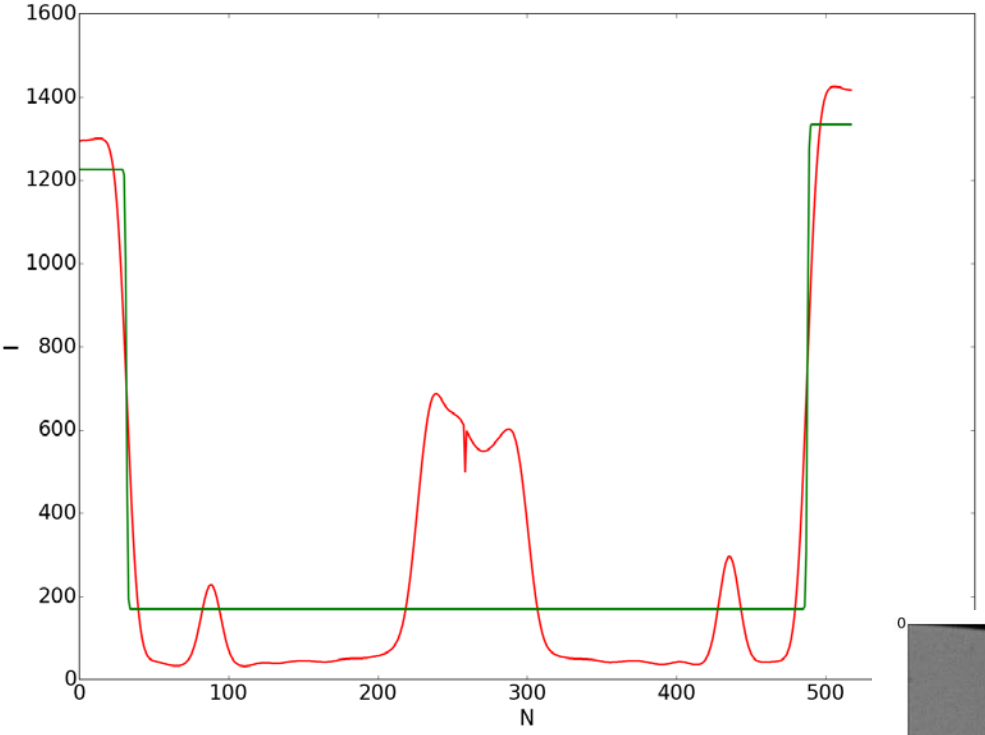
The Hough transform algorithm for the program search of droplets jet position





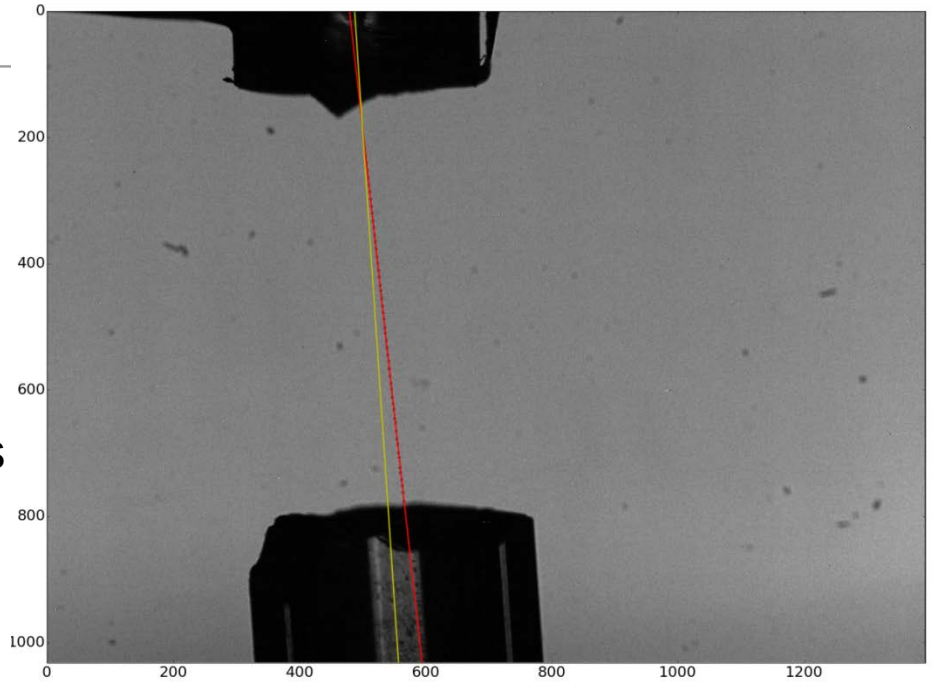


Search of the sluice axis

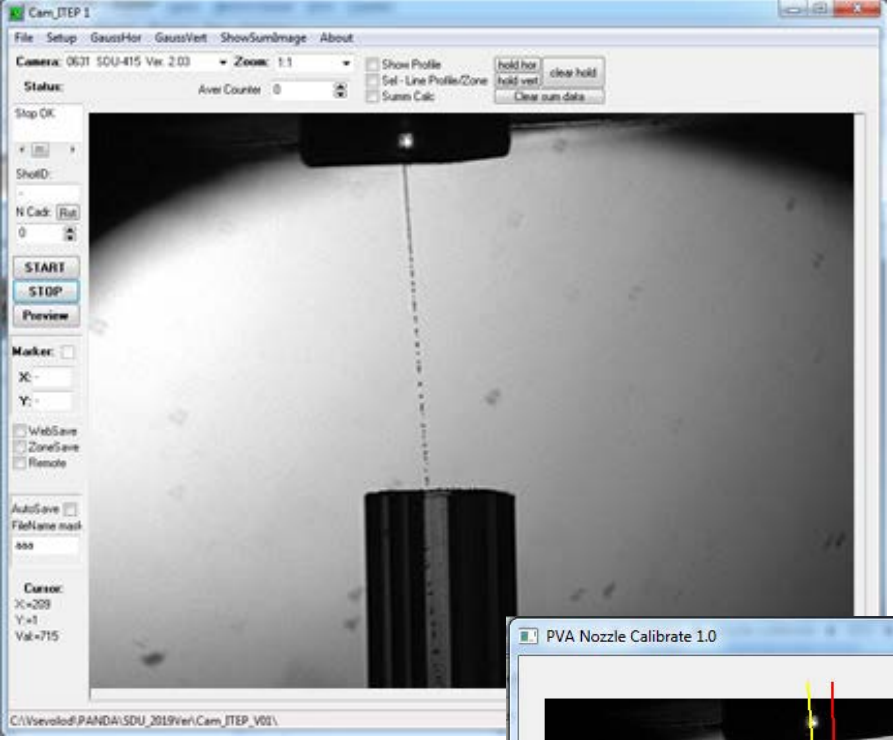


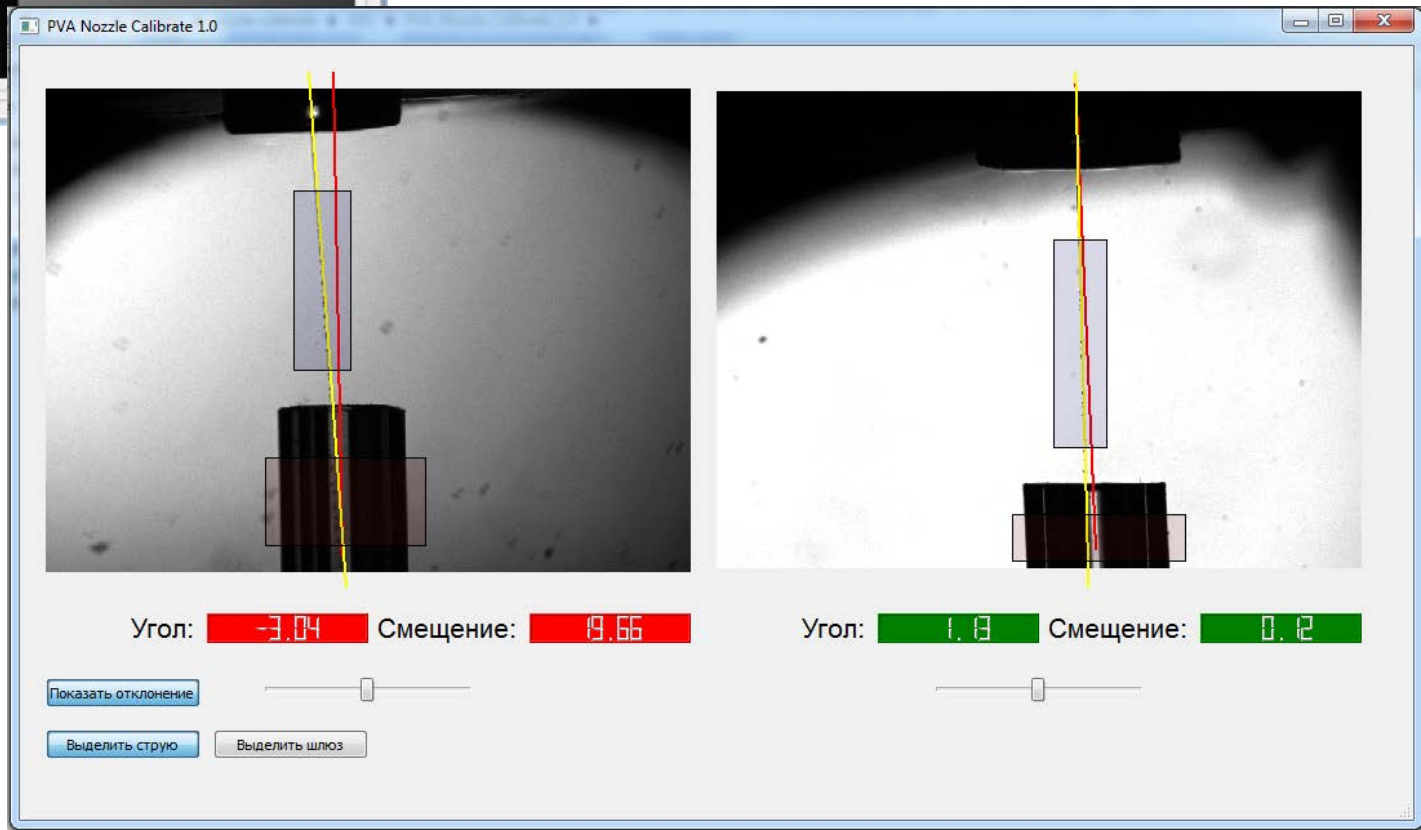
Fitting of the output sluice profile obtained from the shadowgraphy image.

The result of visualization of the nozzle axis deviation relative to the output sluice of the triple point chamber (sluice rotation angle relative to the vertical axis is 3.86˚ , nozzle rotation angle is 6.36˚).



Software to the real time measuring of the spatial displacement and inclination angle of the hydrogen jet.



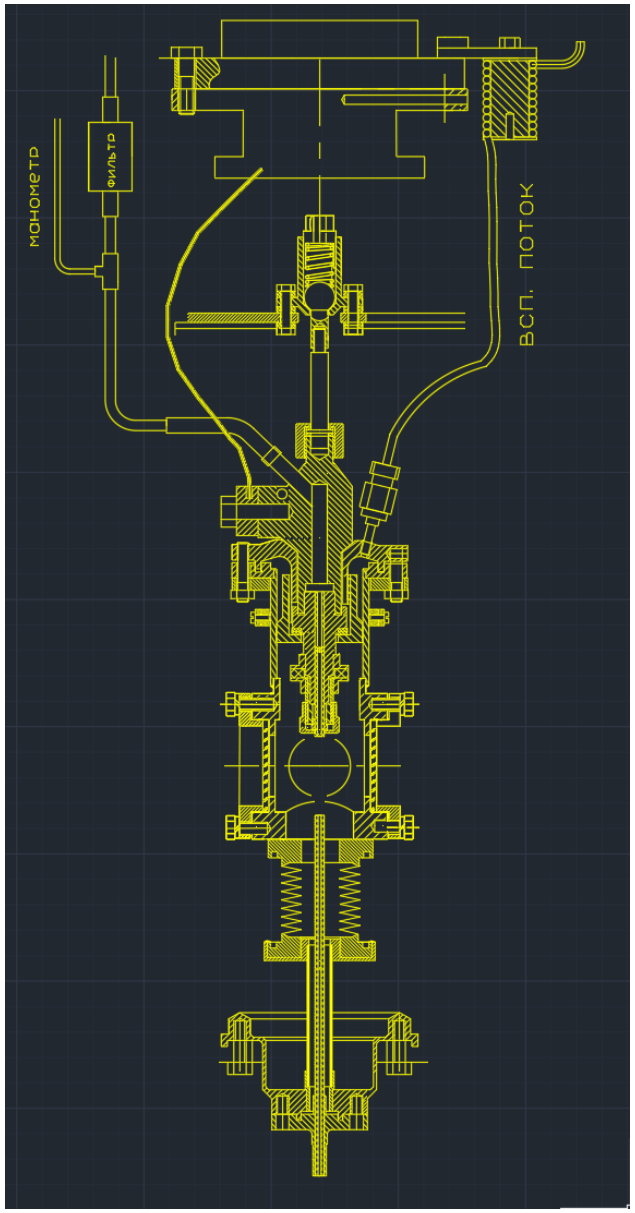


3D target design in CATIA

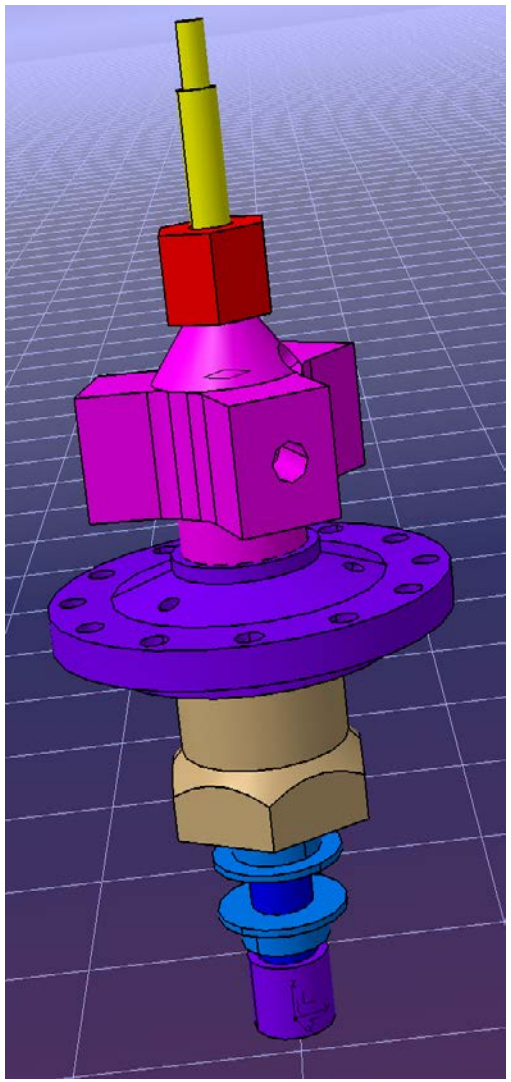
Tasks

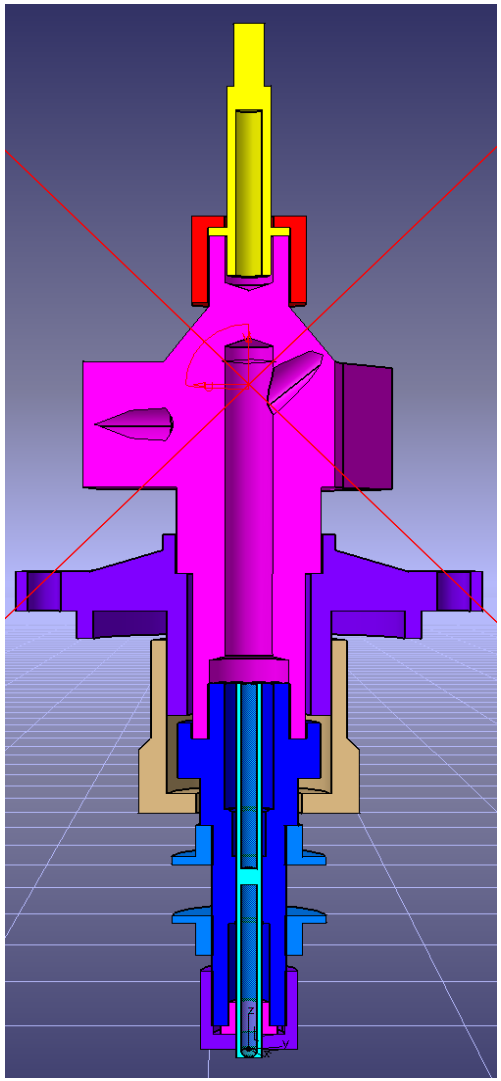
- ✓ Development and optimization of the construction of a pellet target for the PANDA experiment using the CATIA software package
- ✓ Using of 3D design of a pellet target to select a construction with an optimal distribution of heat and mass flows.
- ✓ Presentation of 3D construction of a pellet target for Technical Design Report.

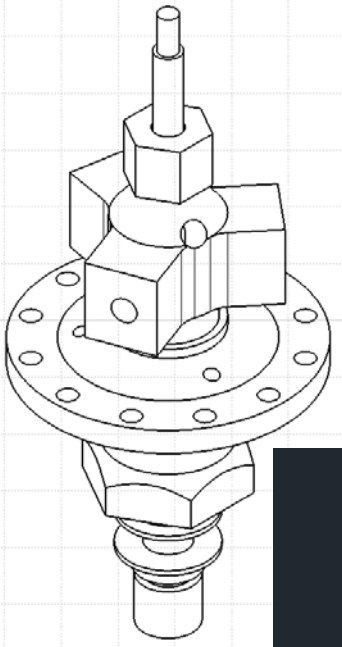
Liquid formation unit

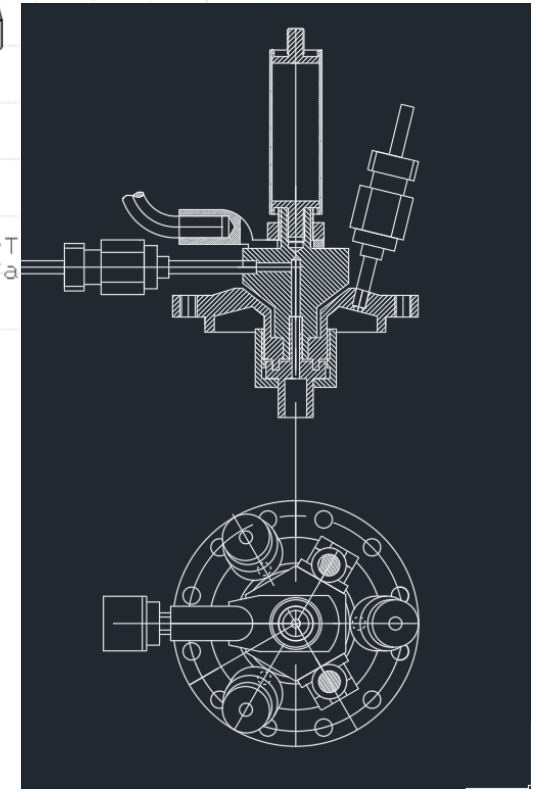


Cooler condenser and nozzle



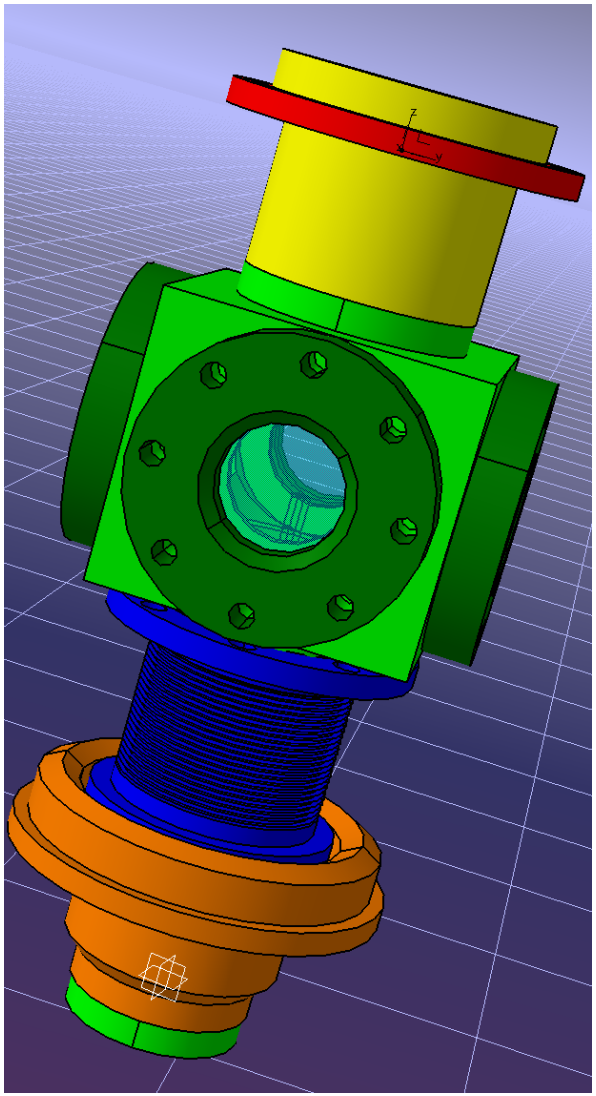


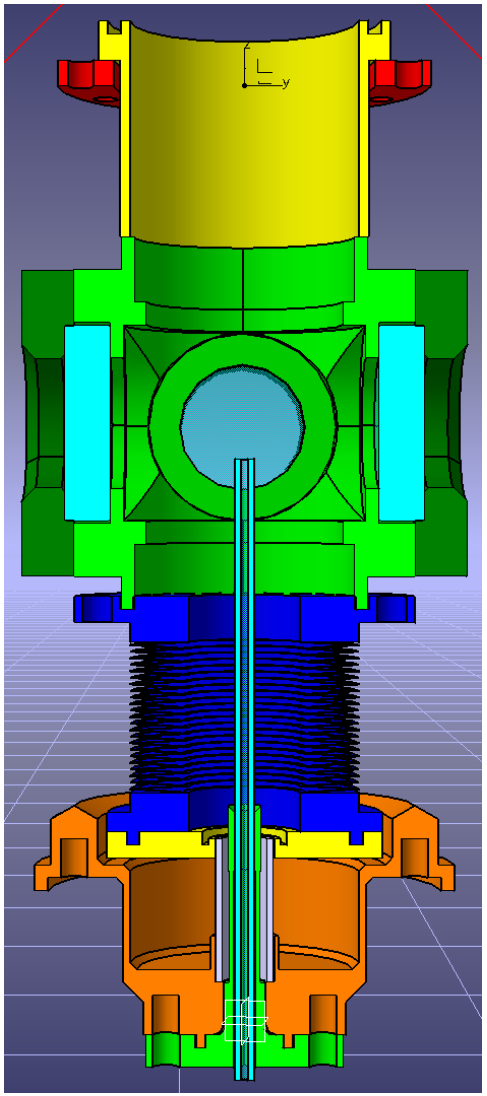




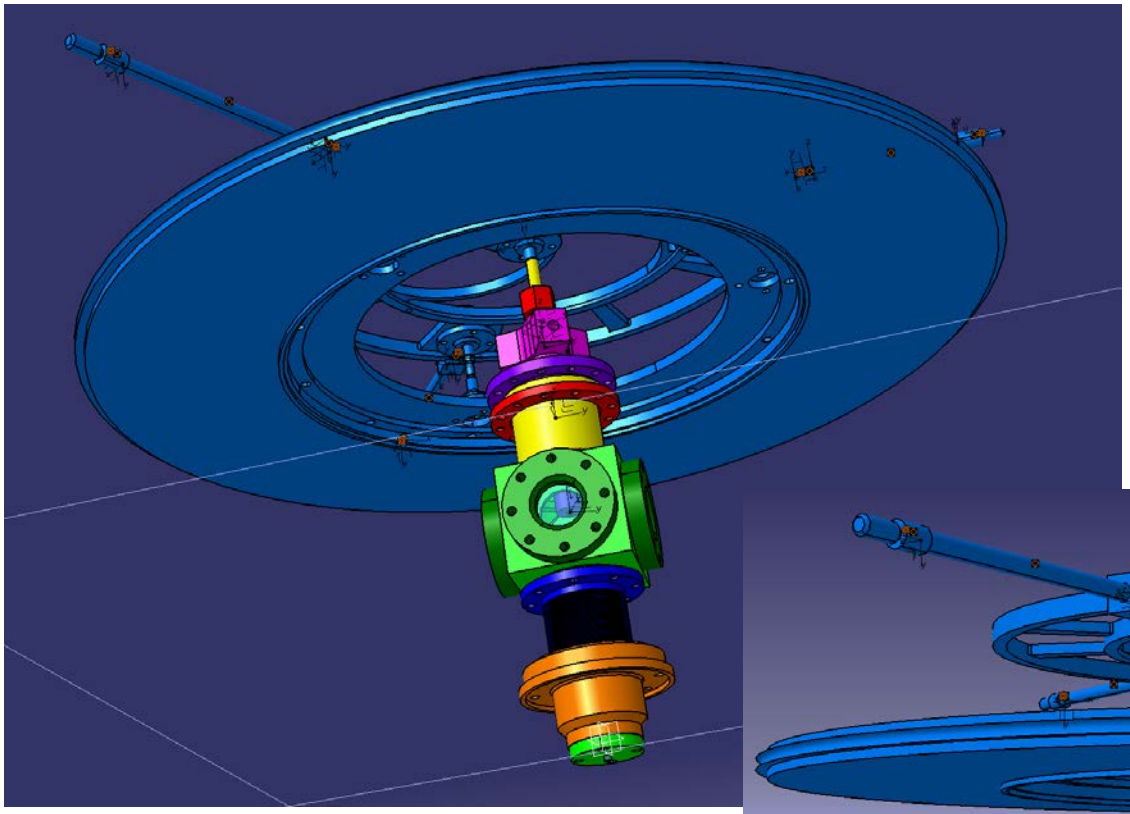
Drawing in CATIA

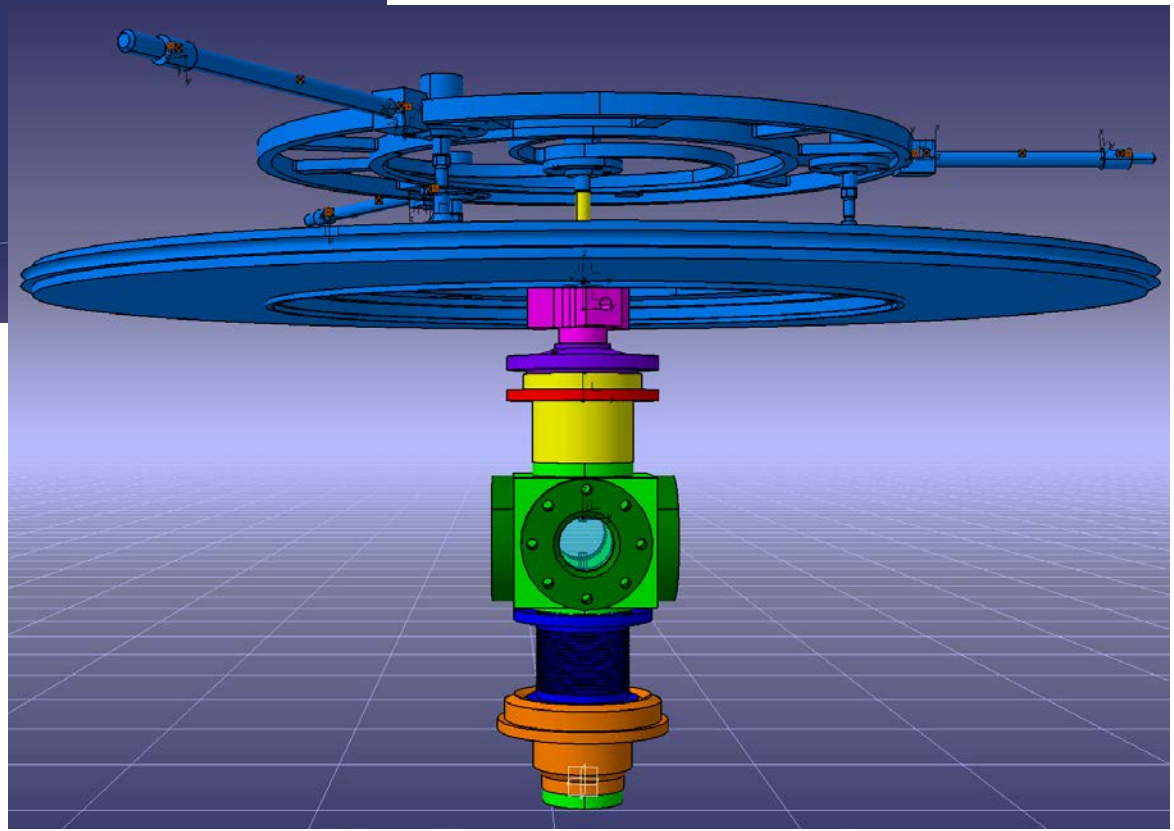
Triple Point chamber and sluice unit





Current result





Study of heat transfer in the triple point chamber of the Pellet target

Issues:

1) Make sure that program calculations coincide with the experimental data

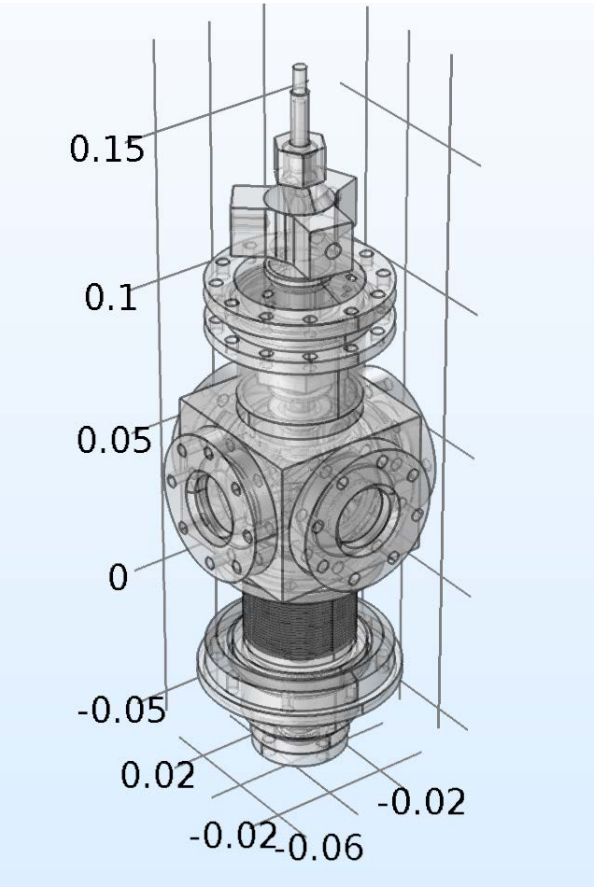
2) Build an existing picture of the temperature distribution in the triple point chamber

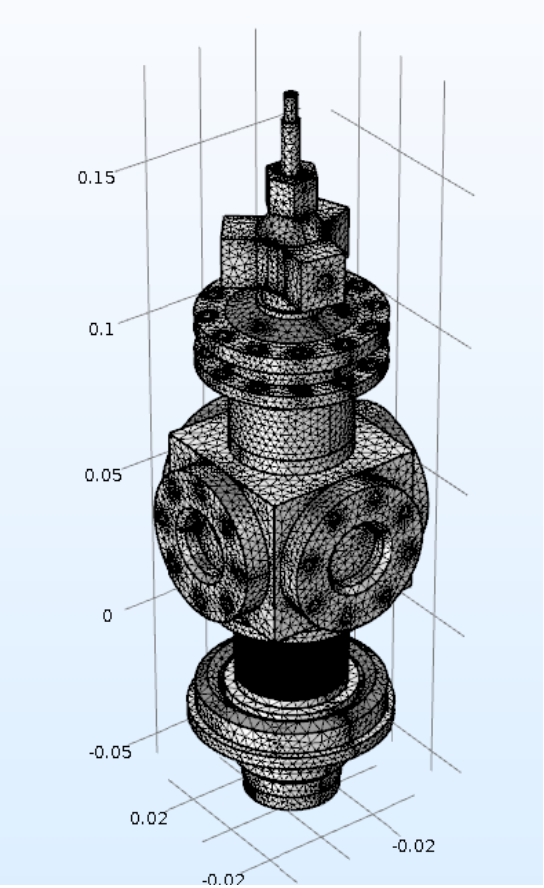
3) Evaluate the effect of convection of the main and additional flows

4) Evaluate the effect of radiation from the walls

5) Design optimization to achieve the required temperature during operational in normal mode

The object of the work



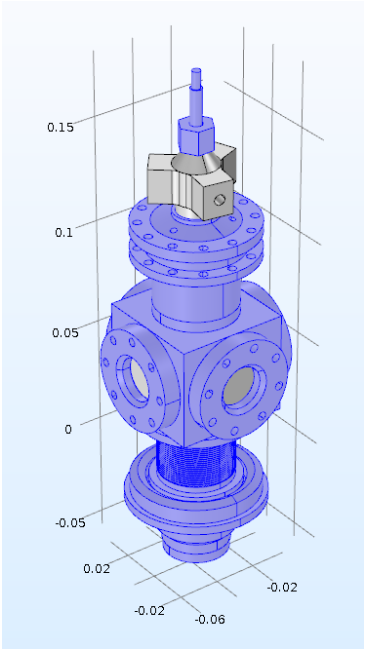


- characteristics of the Assembly chamber of the triple point

  Domains: 28. Faces: 1013. Edges: 2201. Points: 1384. CAD objects: 28.

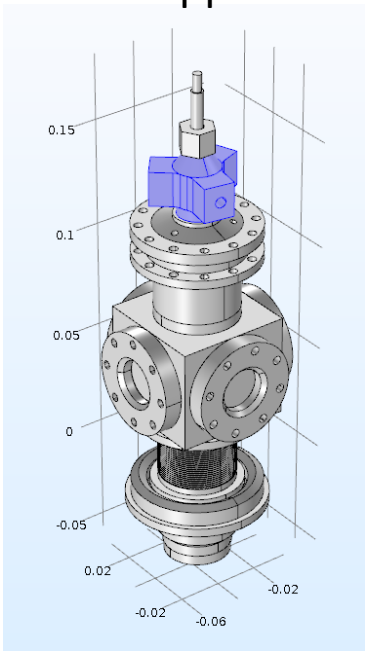
Material characterization

Steel



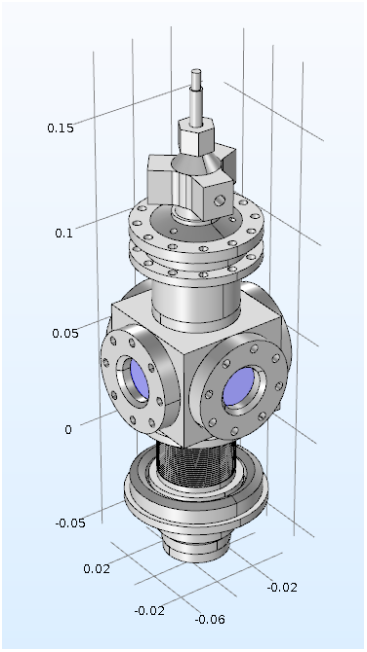
Property	Name	Value	Unit
Heat capacity at constant pres...	Cp	475[J/(k...	J/(kg·K)
Density	rho	7850[kg...	kg/m³
Thermal conductivity	k	44.5[W/...	W/(m·...
Relative permeability	mur	1	1
Electrical conductivity	sigma	4.032e6[...	S/m
Coefficient of thermal expansi...	alpha	12.3e-6[...	1/K
Relative permittivity	epsilonr	1	1
Young's modulus	E	205e9[Pa]	Pa
Poisson's ratio	nu	0.28	1

Copper



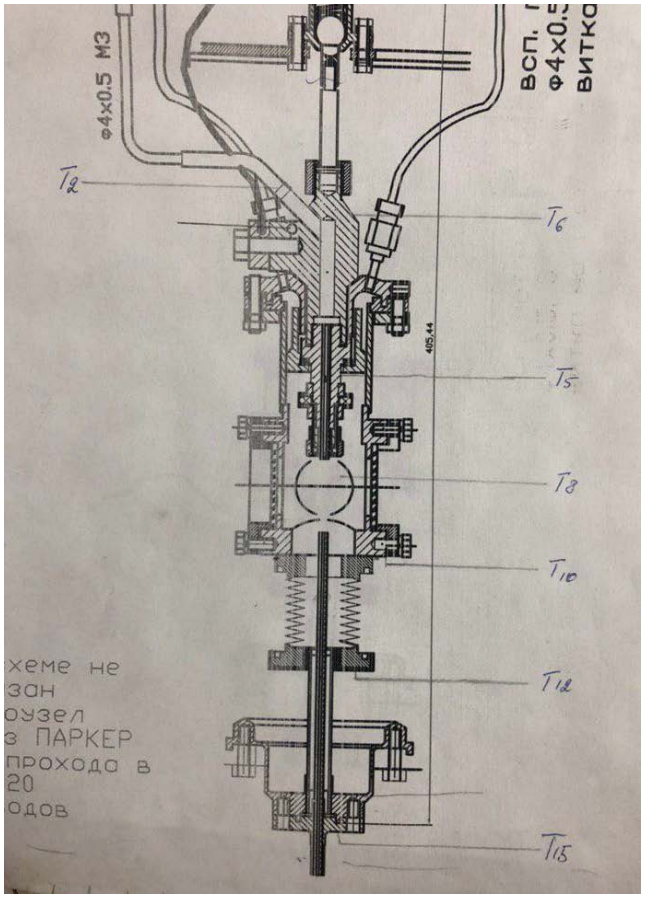
Property	Name	Value	Unit
Heat capacity at constant pres...	Cp	385[J/(k...	J/(kg·K)
Density	rho	8960[kg...	kg/m³
Thermal conductivity	k	400[W/(...	W/(m·...
Relative permeability	mur	1	1
Electrical conductivity	sigma	5.998e7[...	S/m
Coefficient of thermal expansi...	alpha	17e-6[1/...	1/K
Relative permittivity	epsilonr	1	1
Young's modulus	E	110e9[Pa]	Pa
Poisson's ratio	nu	0.35	1
Reference resistivity	rho0	1.72e-8[...	Ω·m
Resistivity temperature coeffic...	alpha	0.0039[1...	1/K
Reference temperature	Tref	298[K]	K

Glass

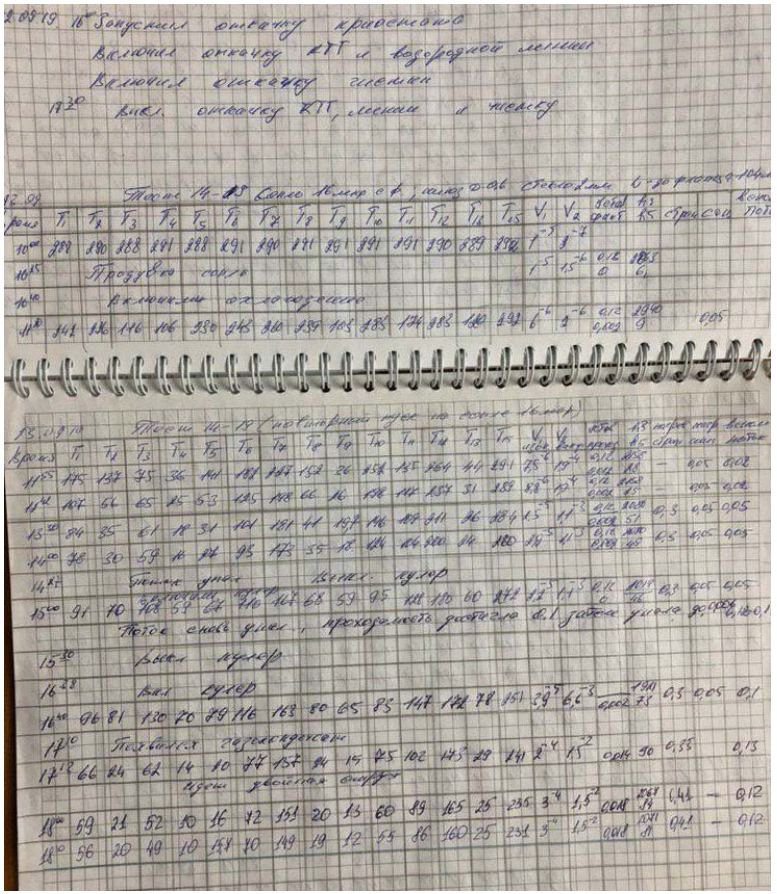


Property	Name	Value	Unit
Density	rho	2210[kg...	kg/m³
Thermal conductivity	k	1.4[W/(...	W/(m·...
Heat capacity at constant pres...	Cp	730[J/(k...	J/(kg·K)
Relative permeability	mur	1	1
Electrical conductivity	sigma	1e-14[S/...	S/m
Relative permittivity	epsilonr	4.2	1
Refractive index, real part	n	1.5	1
Refractive index, imaginary part	ki	0	1

Initial temperature data

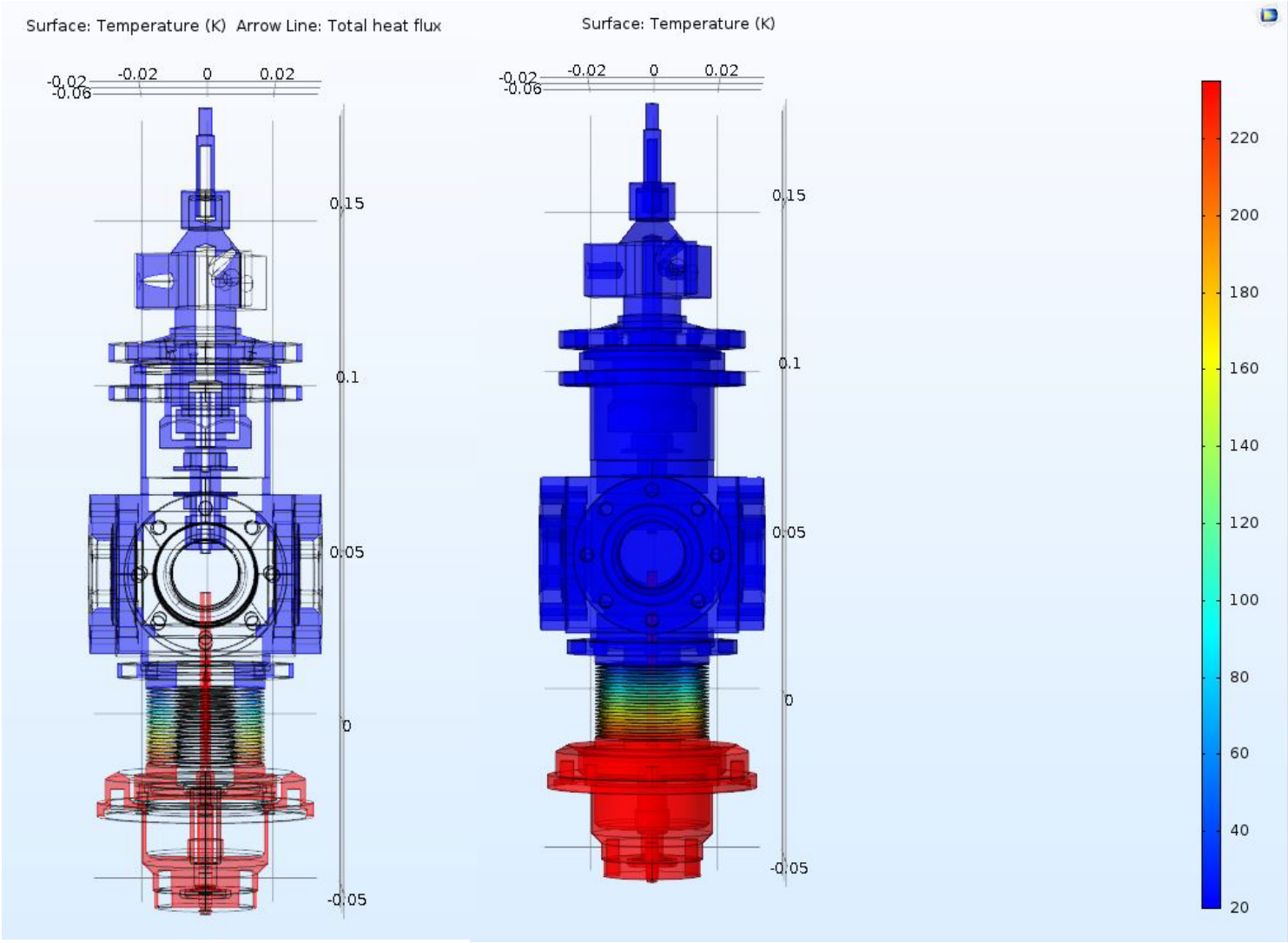


sensor layout diagram



experimental data from the test 14-19

Calculation result



Results

1) The first test results of the program were obtained.
2) The great potential of this software is visible if you sort out some of the nuances.
3) The ability to visualize almost any physical process occurring inside the target