Joint Institute for Nuclear Research
SCIENCE BRINGS NATIONS TOGETHER

Frank Laboratory of Neutron Physics

Technological systems of pelletized cold neutron moderators based on hydrocarbons

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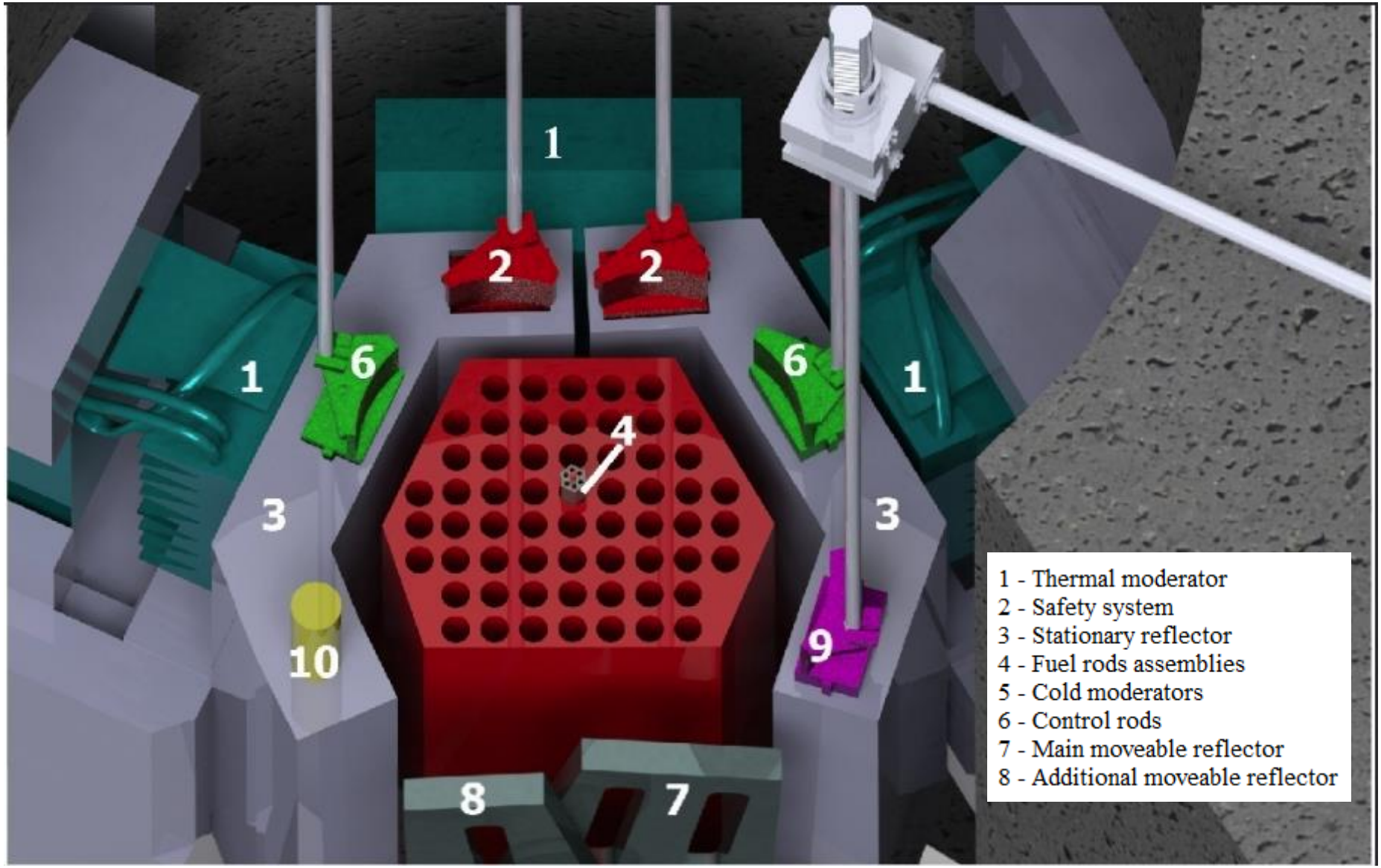
FLNP JINR – CSNS Workshop
13-15 May 2024

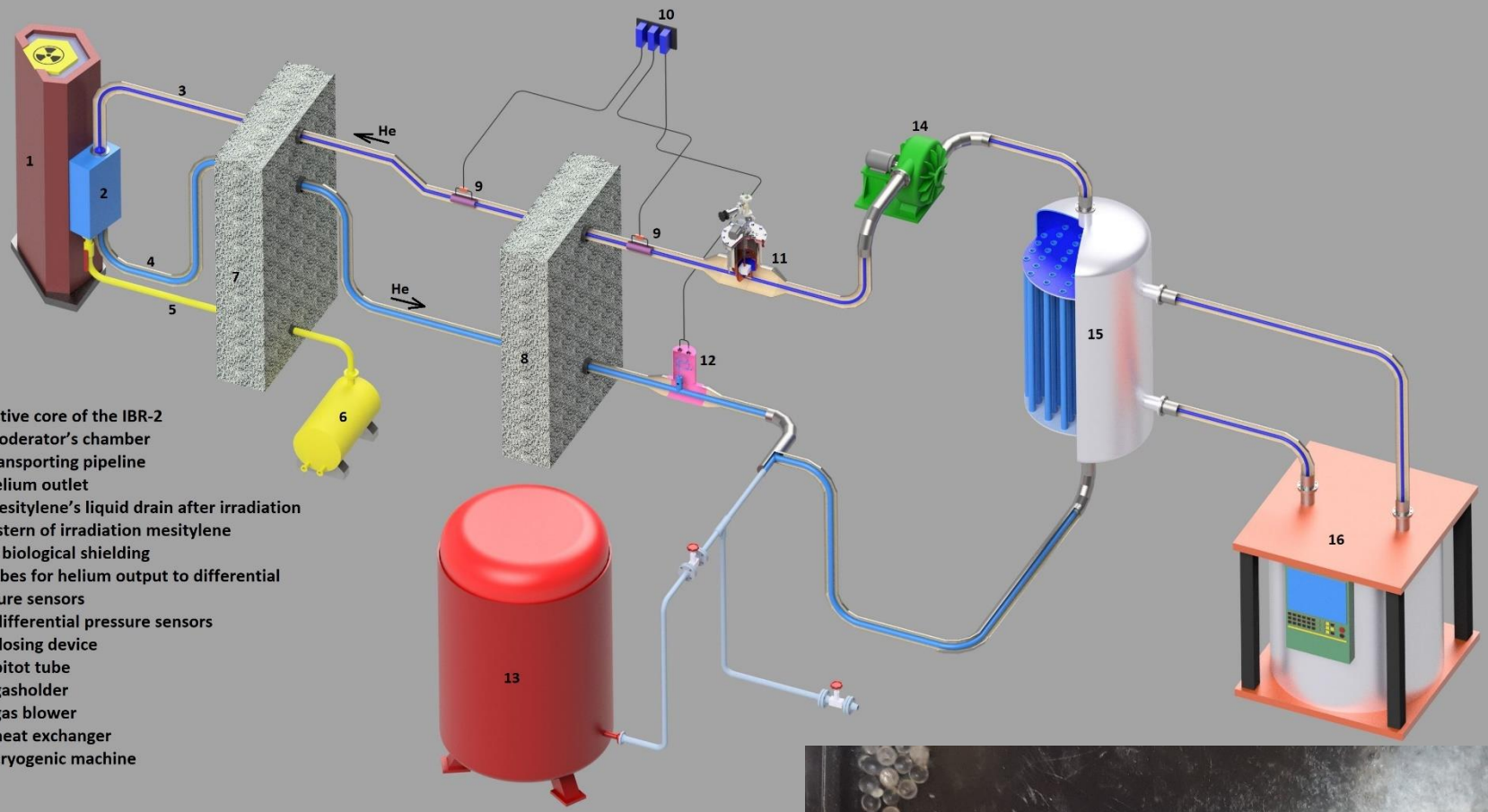
Plan of the talk

1. Principle of work of the pelletized cold neutron moderator and its main technological system
2. Chamber with beads and test stand
3. Charging devise
4. Sensors of beads' transport control
5. Management and control system
6. Cryogenic system
7. Radiolitic hydrogen and irradiated mesitylene
8. Producing of frozen beads from mesitylene
9. System of fast charging/discharging
10. Producing of methane beads

Scheme of the IBR-2



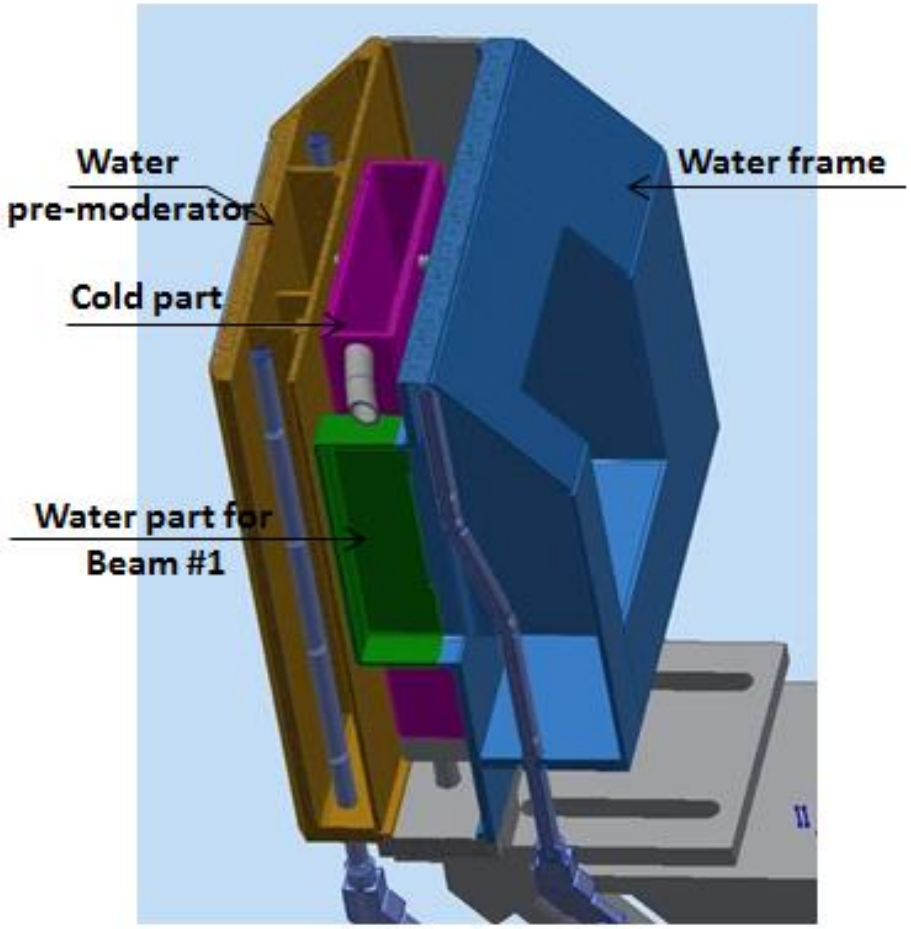
Principle of work

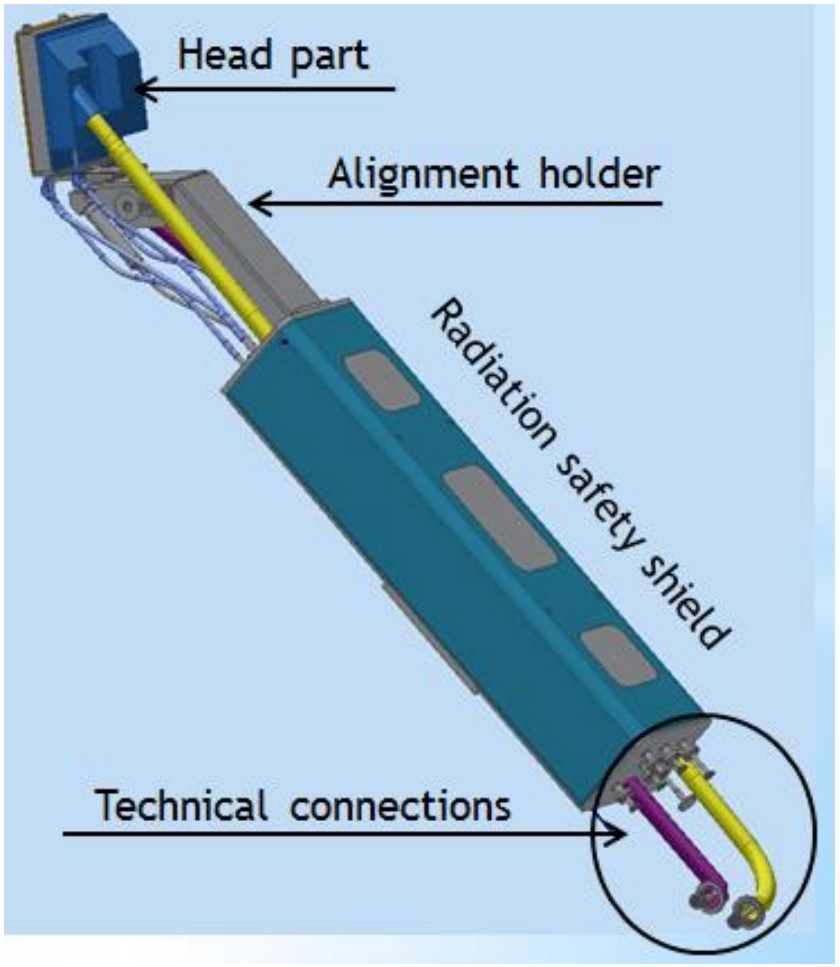


1 – active core of the IBR-2
2 – moderator's chamber
3 – transporting pipeline
4 – helium outlet
5 – mesitylene's liquid drain after irradiation
6 – cistern of irradiation mesitylene
7, 8 – biological shielding
9 – tubes for helium output to differential pressure sensors
10 – differential pressure sensors
11 – dosing device
12 – pitot tube
13 – gasholder
14 – gas blower
15 – heat exchanger
16 – cryogenic machine

Chamber of moderators

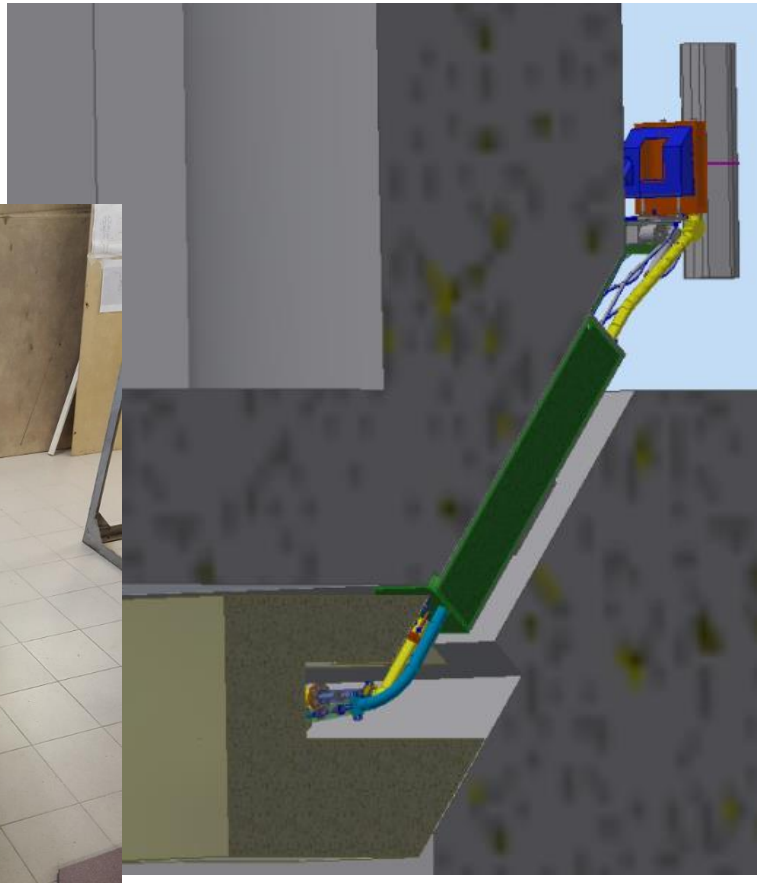
Moderator for central direction
(beams: 1, 4, 5, 6, 9) – 6 instruments

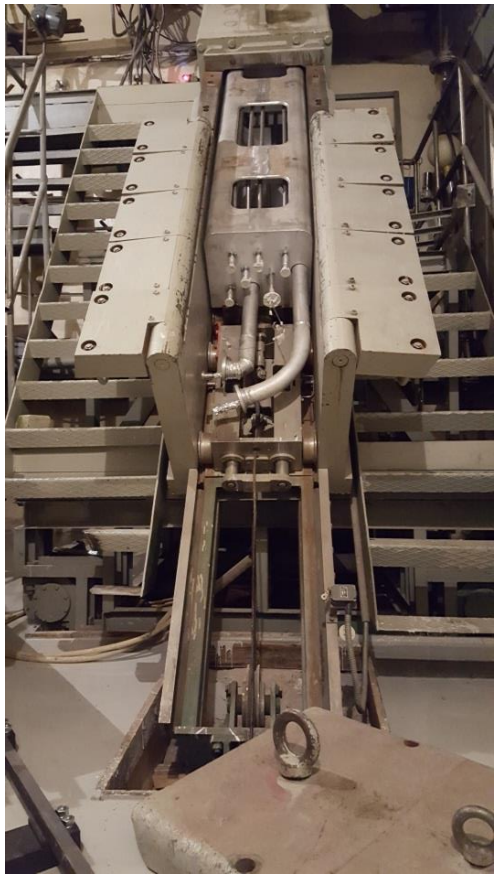




Chamber of moderators

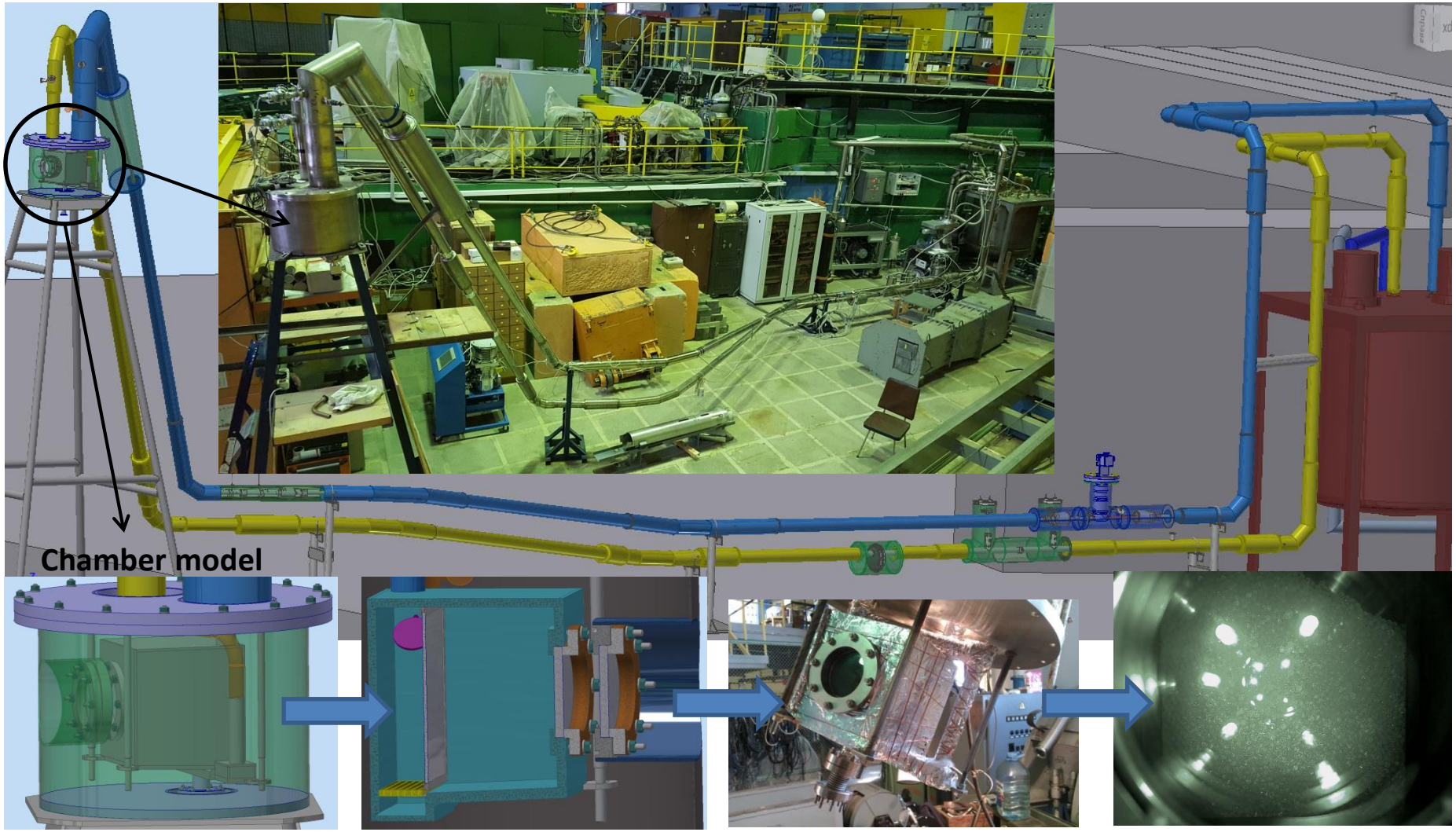
Moderator for central direction



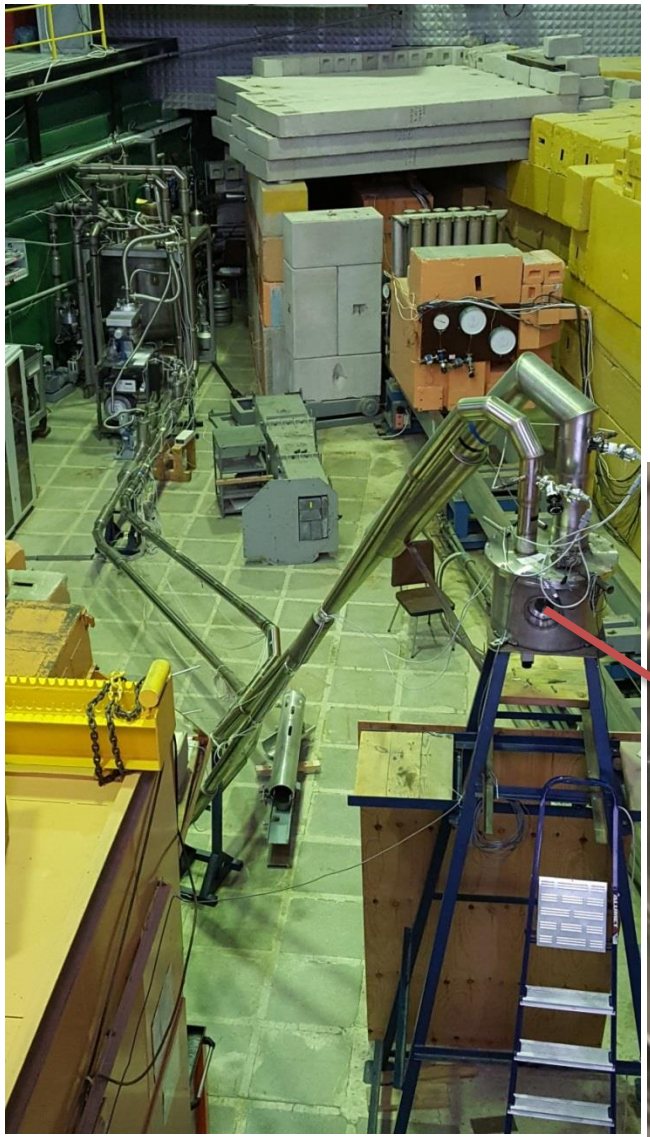


Test stand

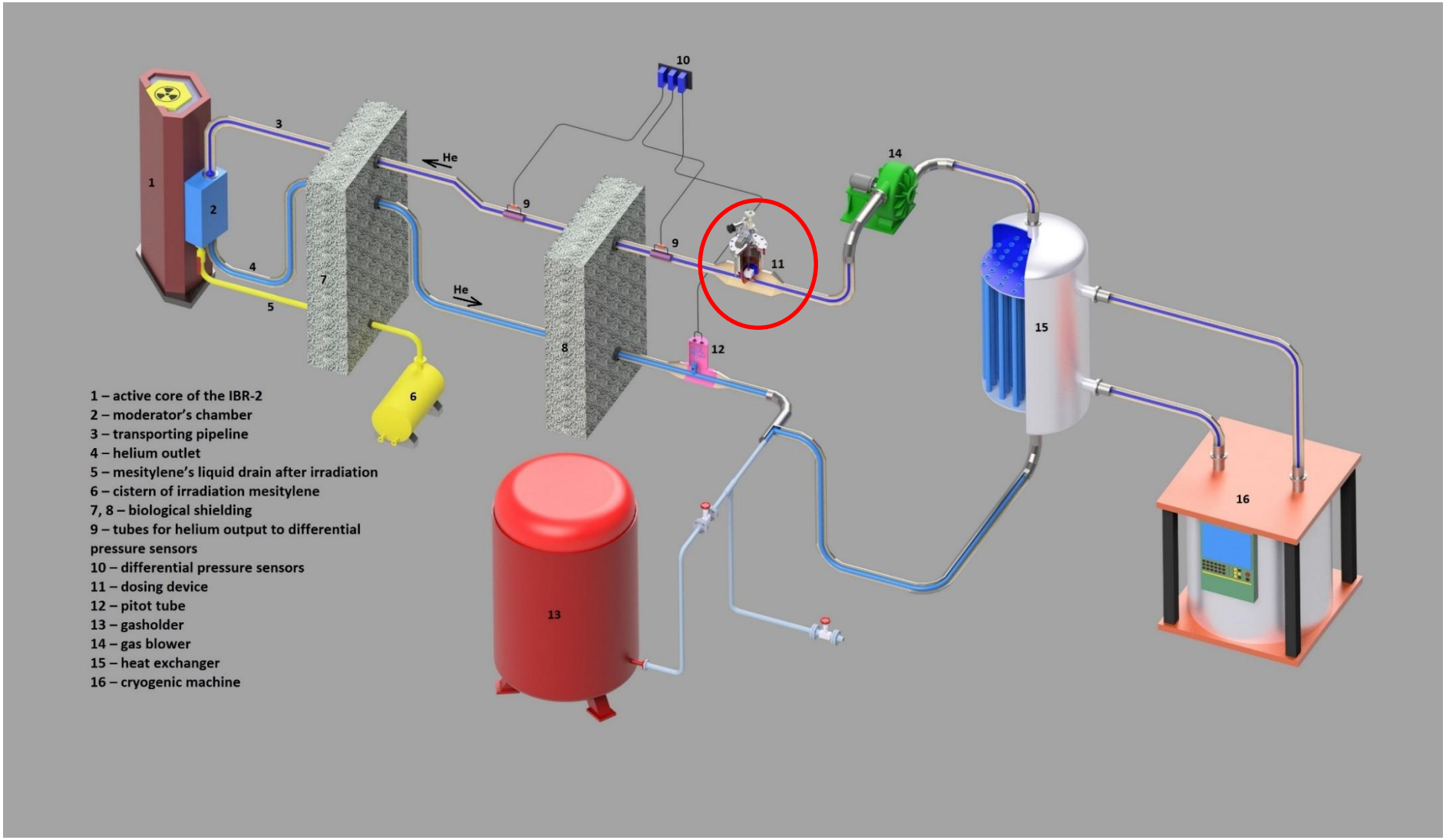
The full-scale test stand of the cold moderator



Test stand



Dosing device



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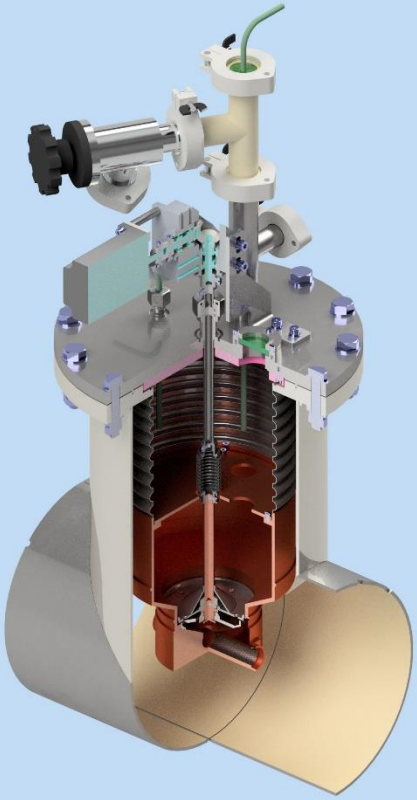

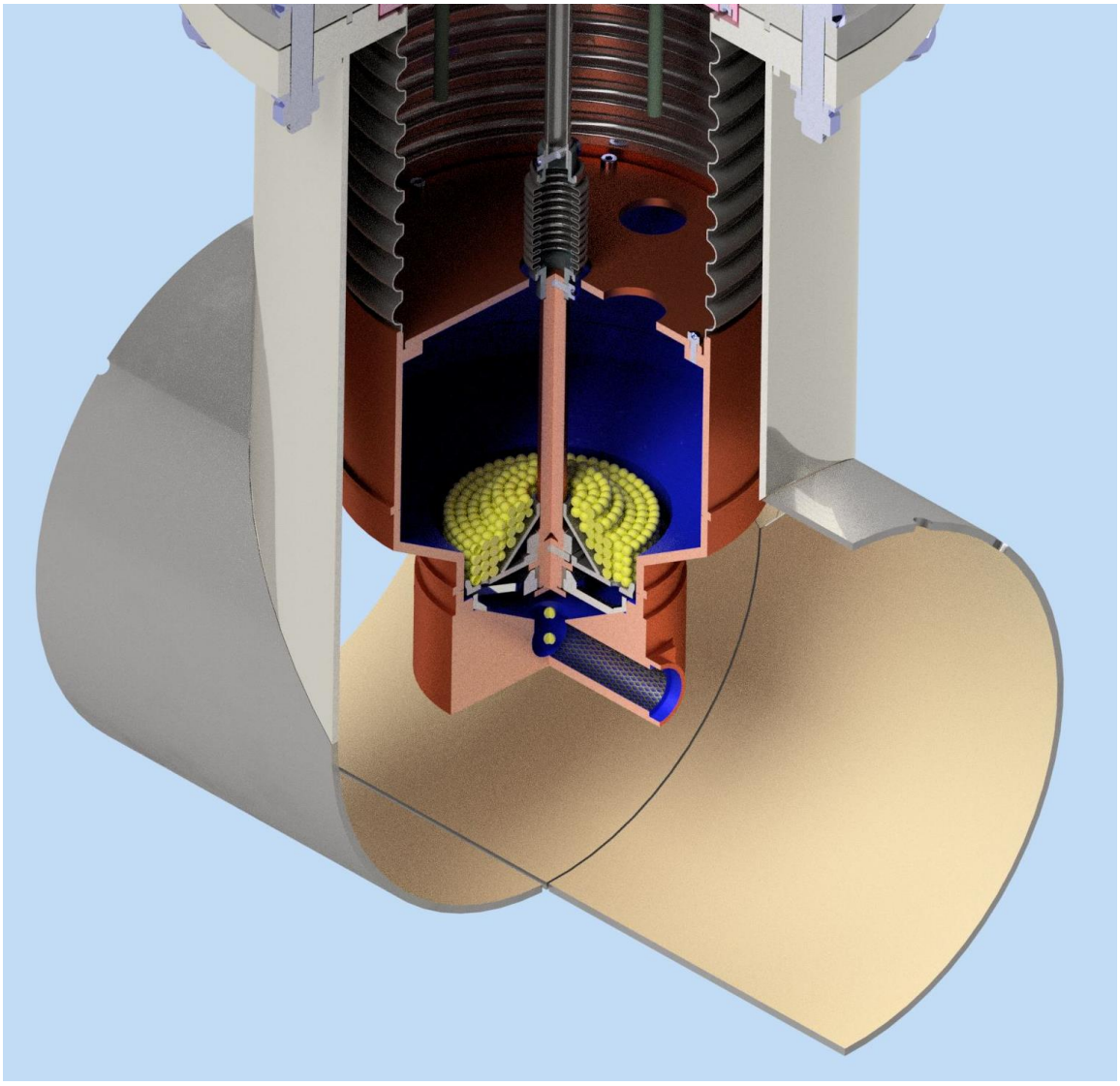

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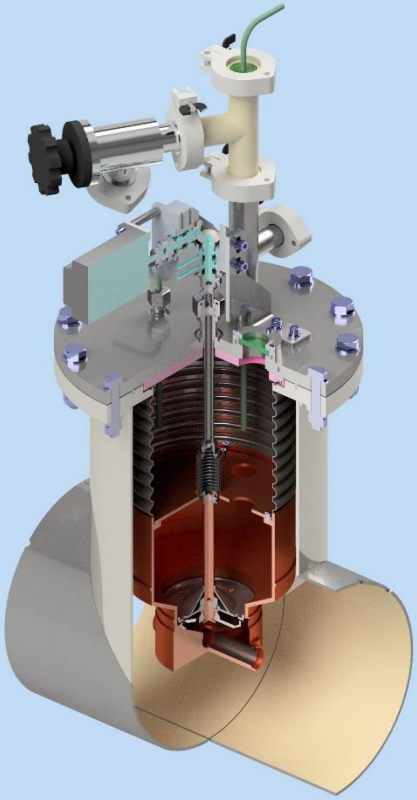

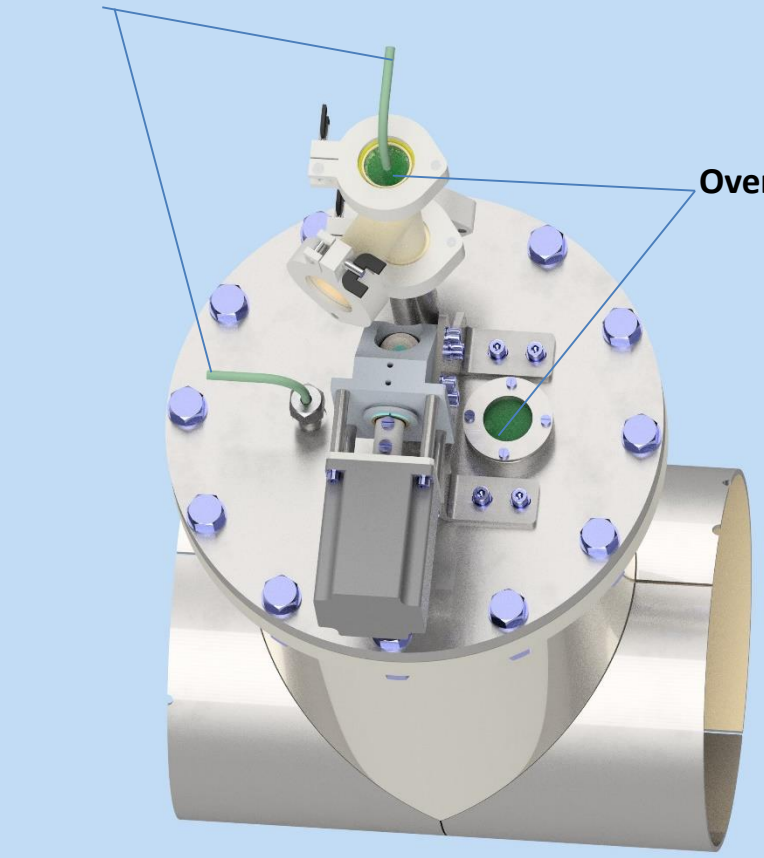

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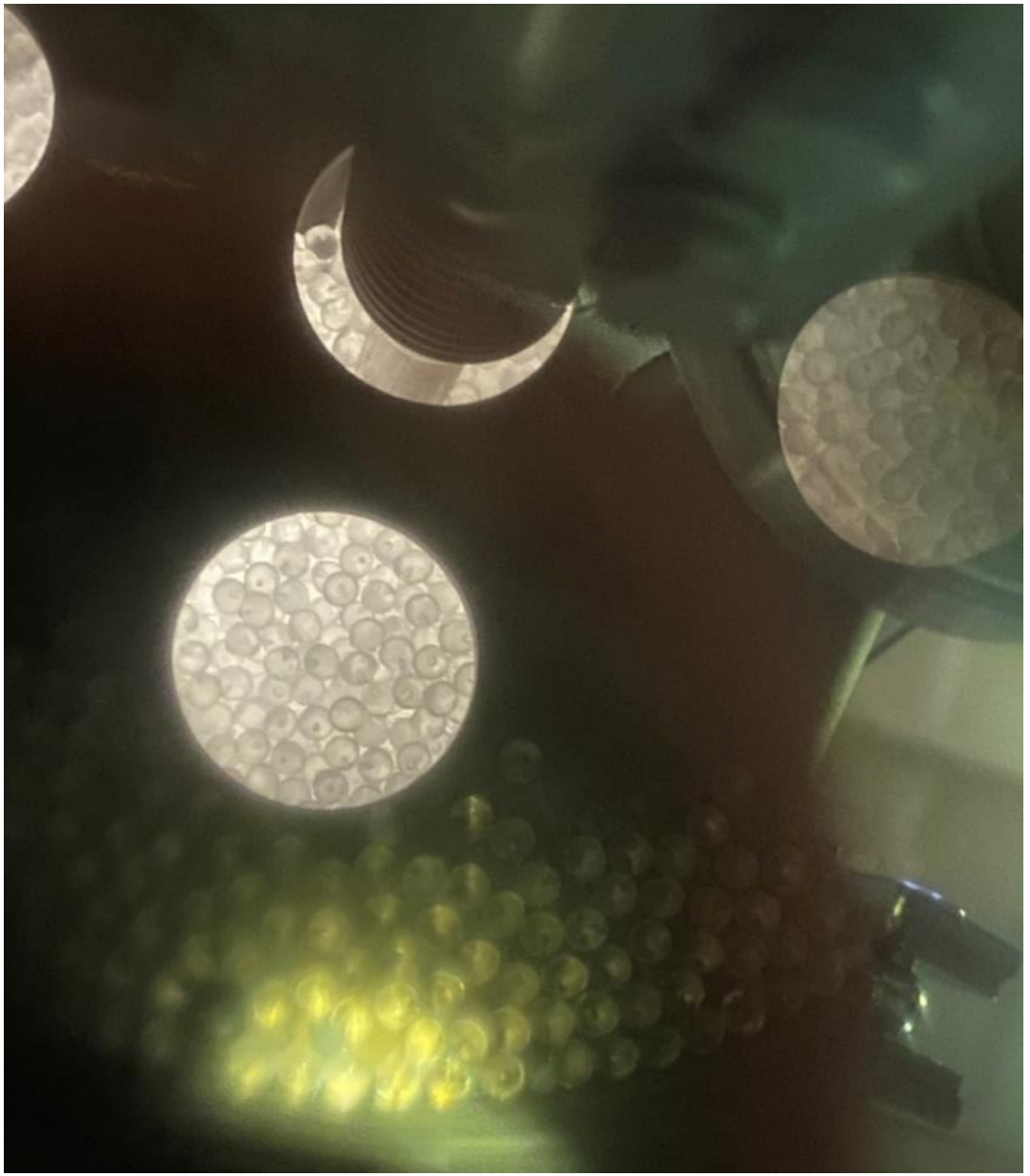
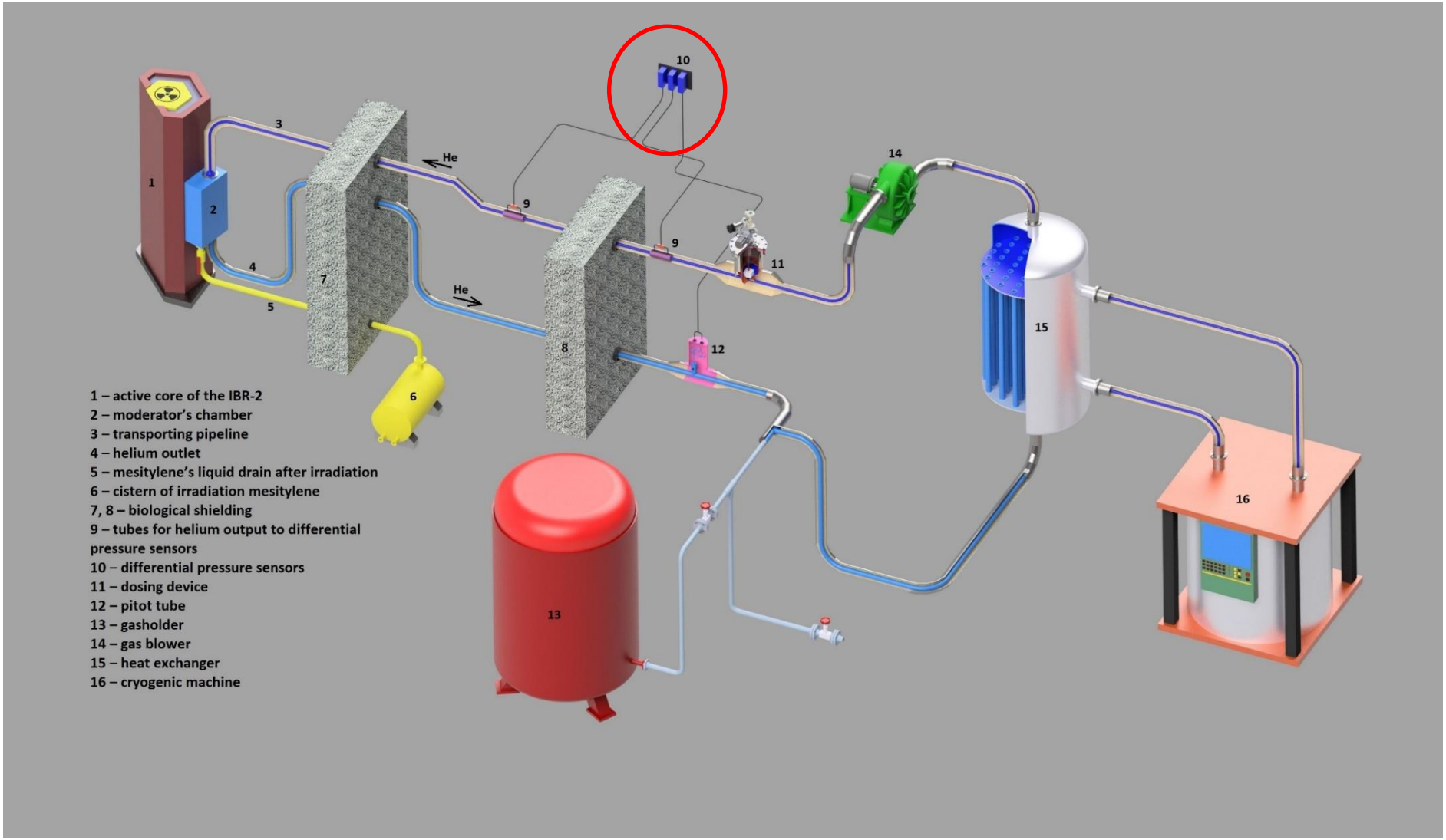
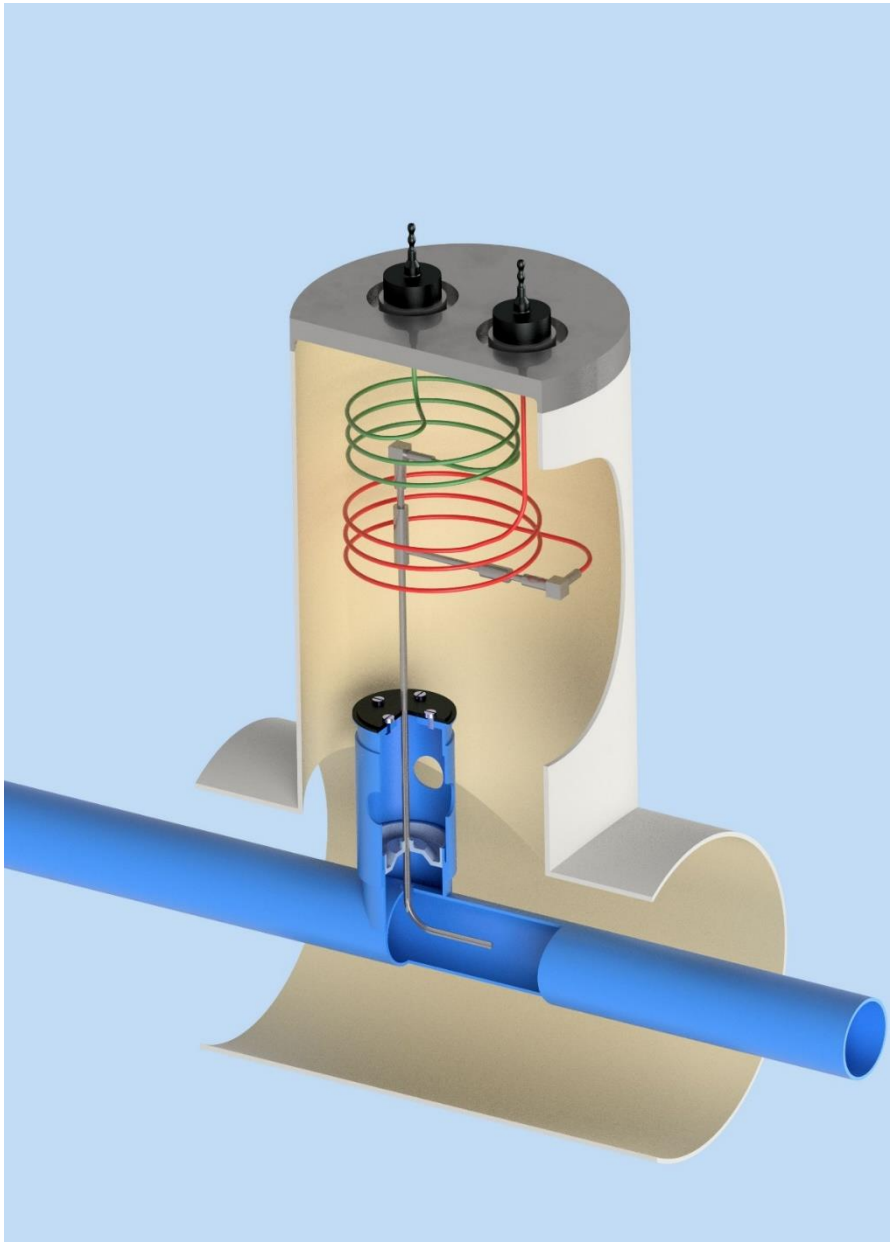


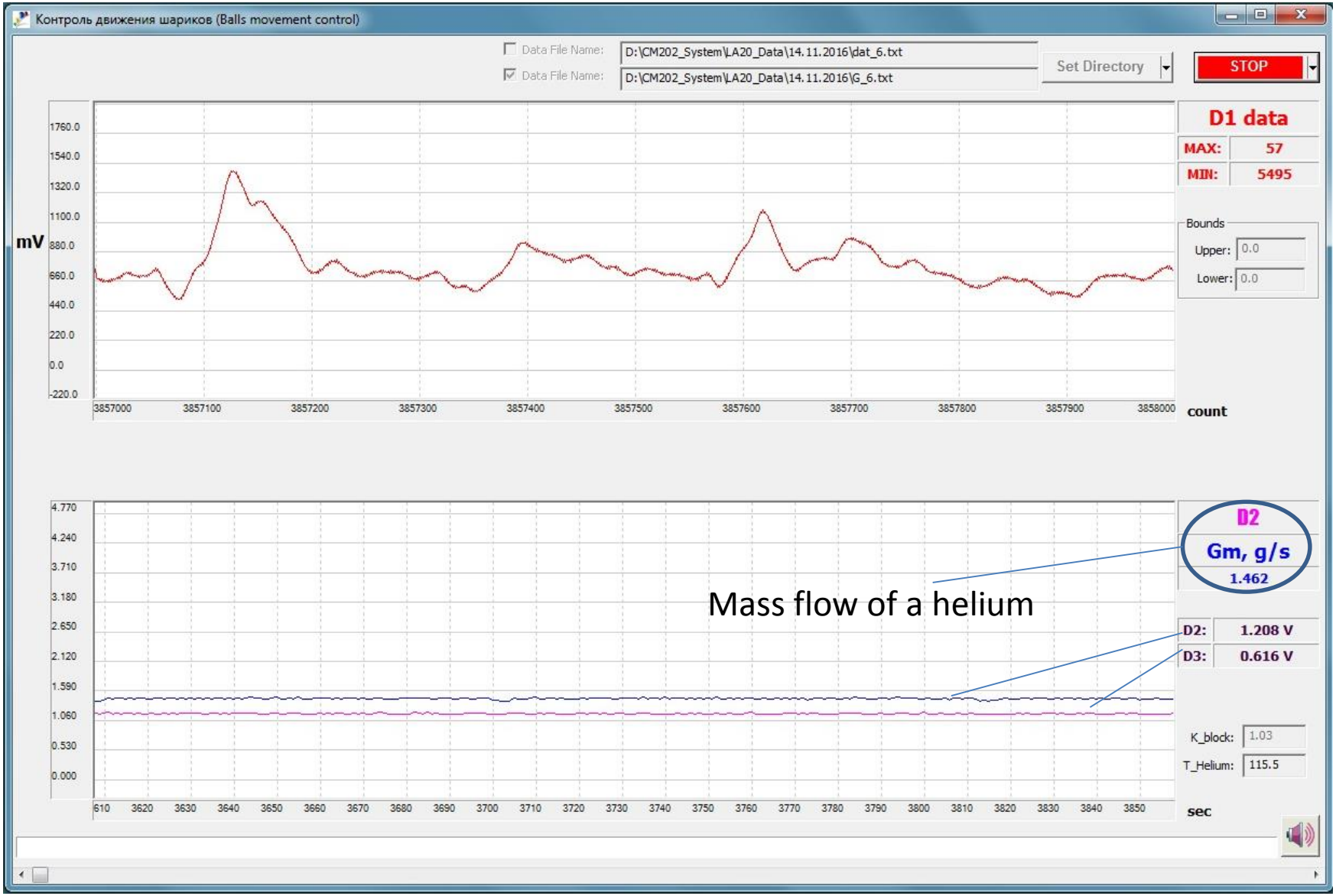
Beads' transport and gas flow sensors



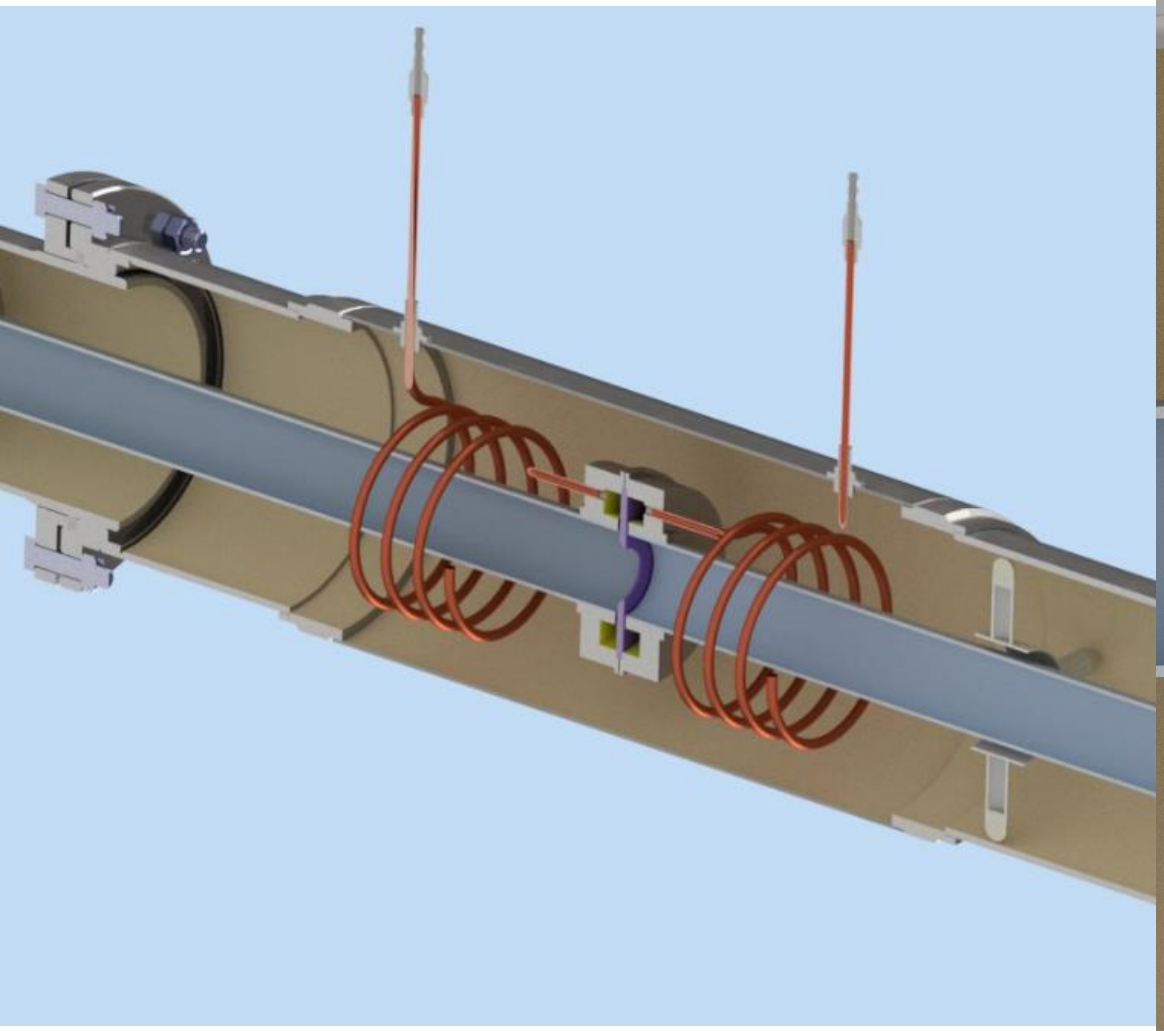
Beads' transport and gas flow sensors: Pitot tube

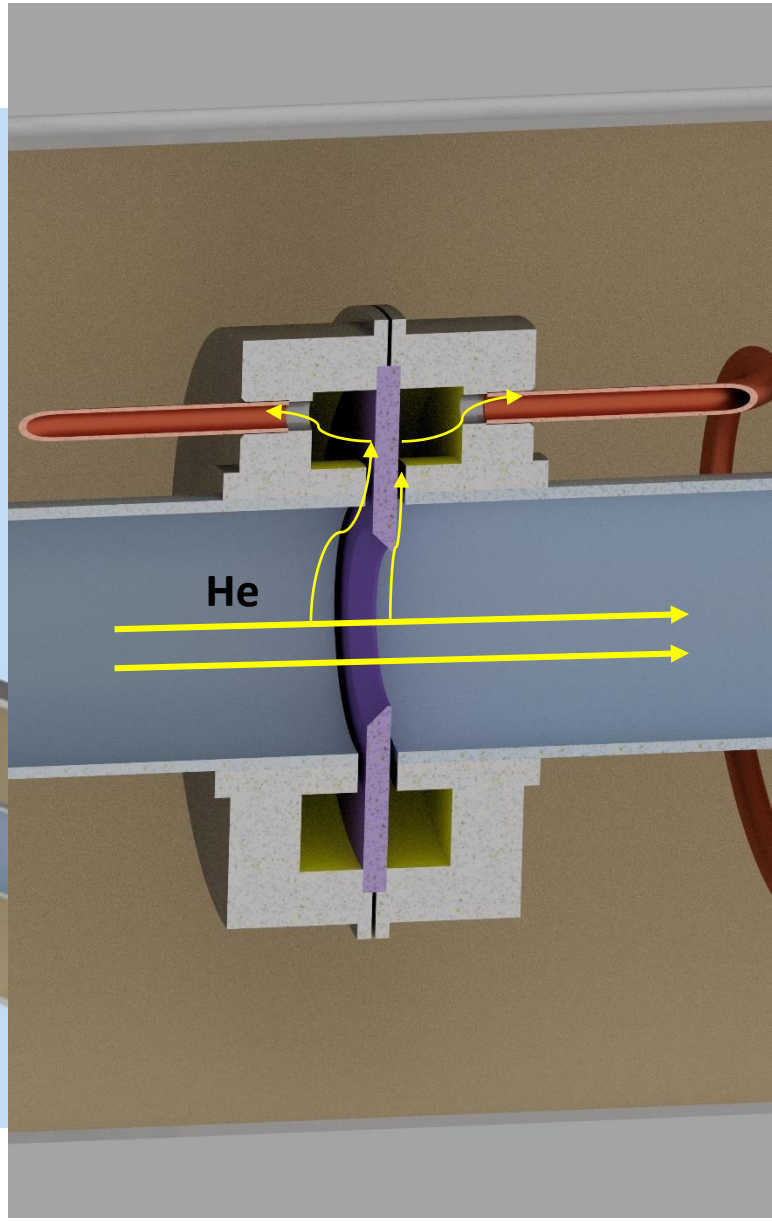


Beads' transport and gas flow sensors: Pitot tube

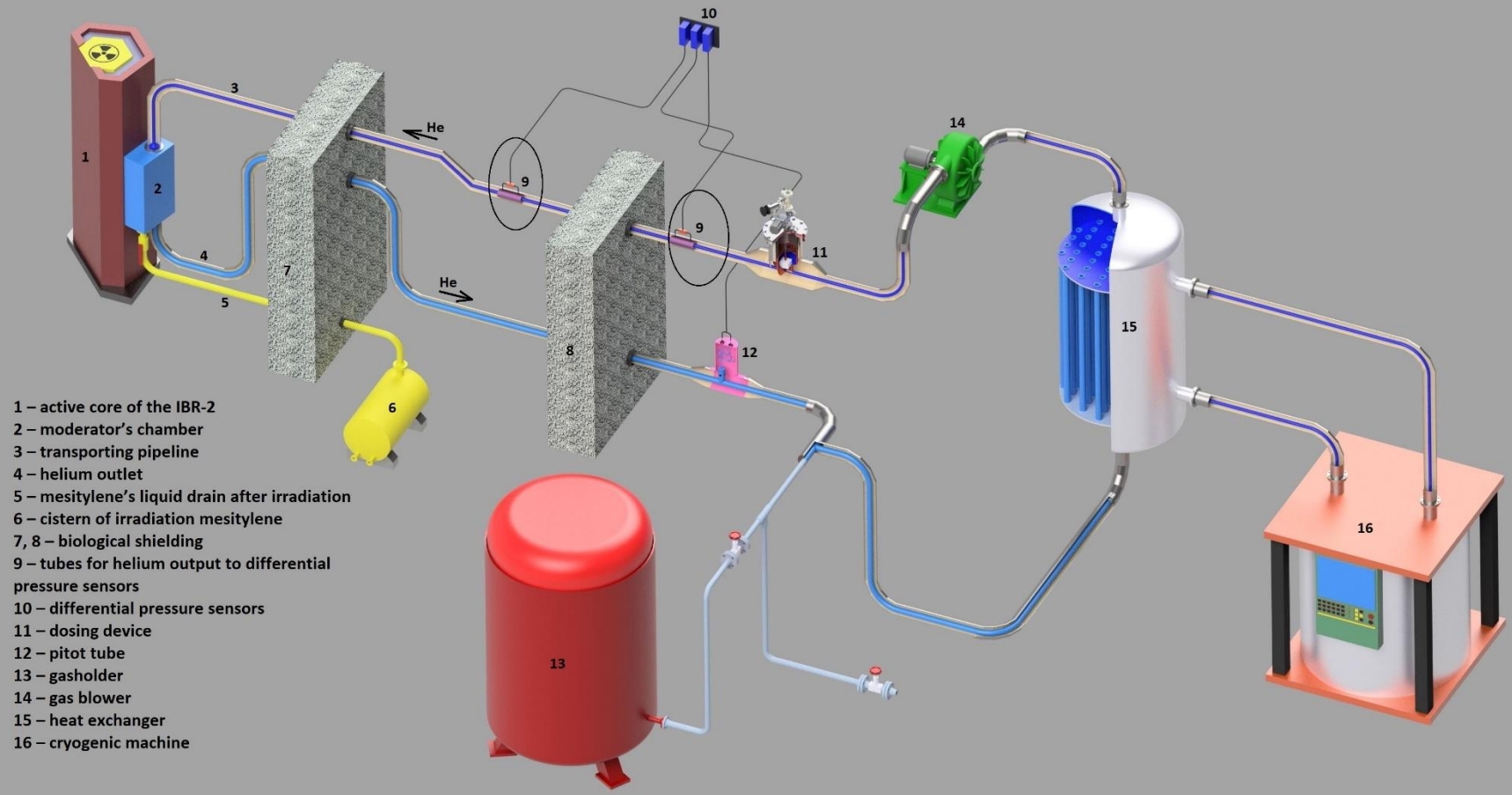


Beads' transport and gas flow sensors: diaphragm

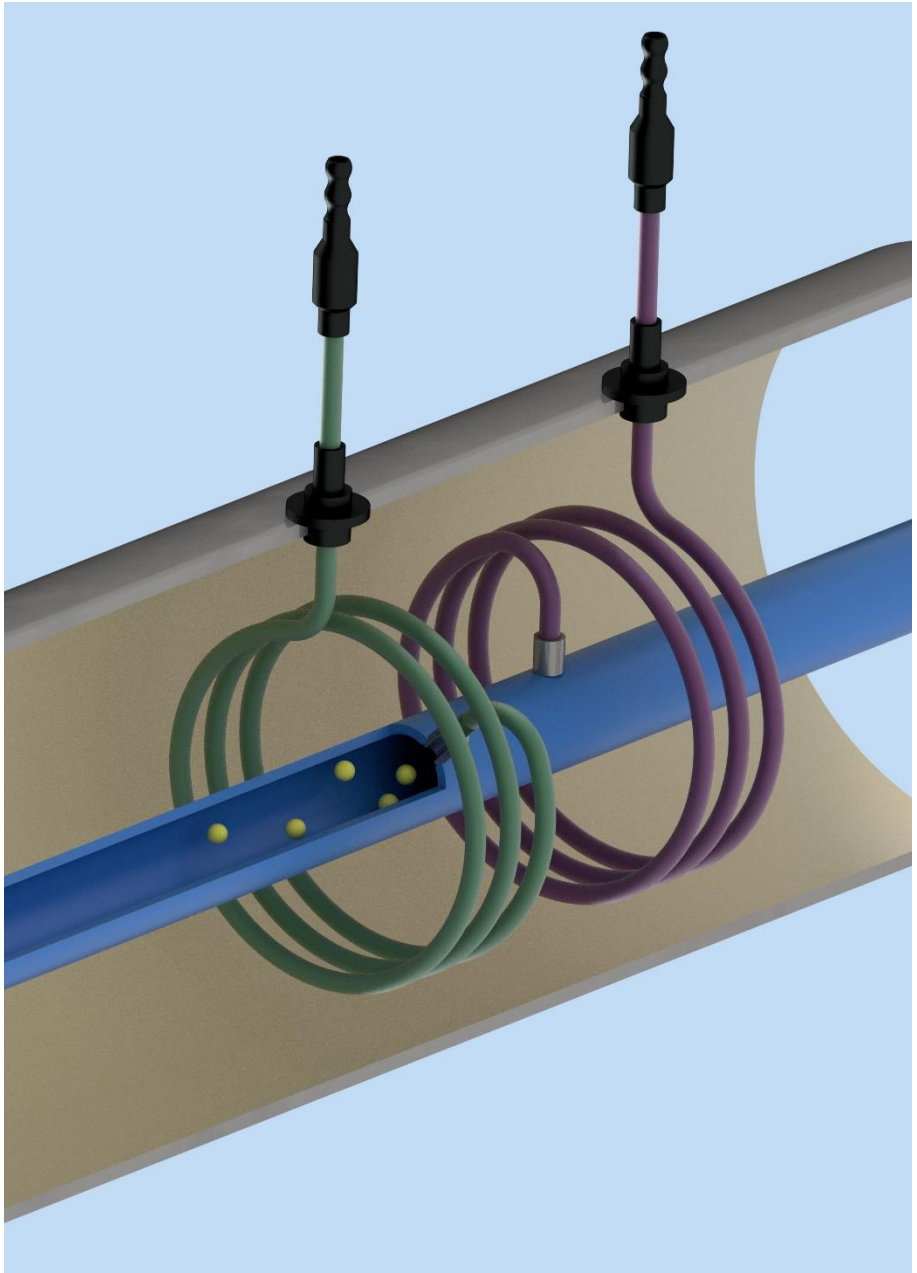




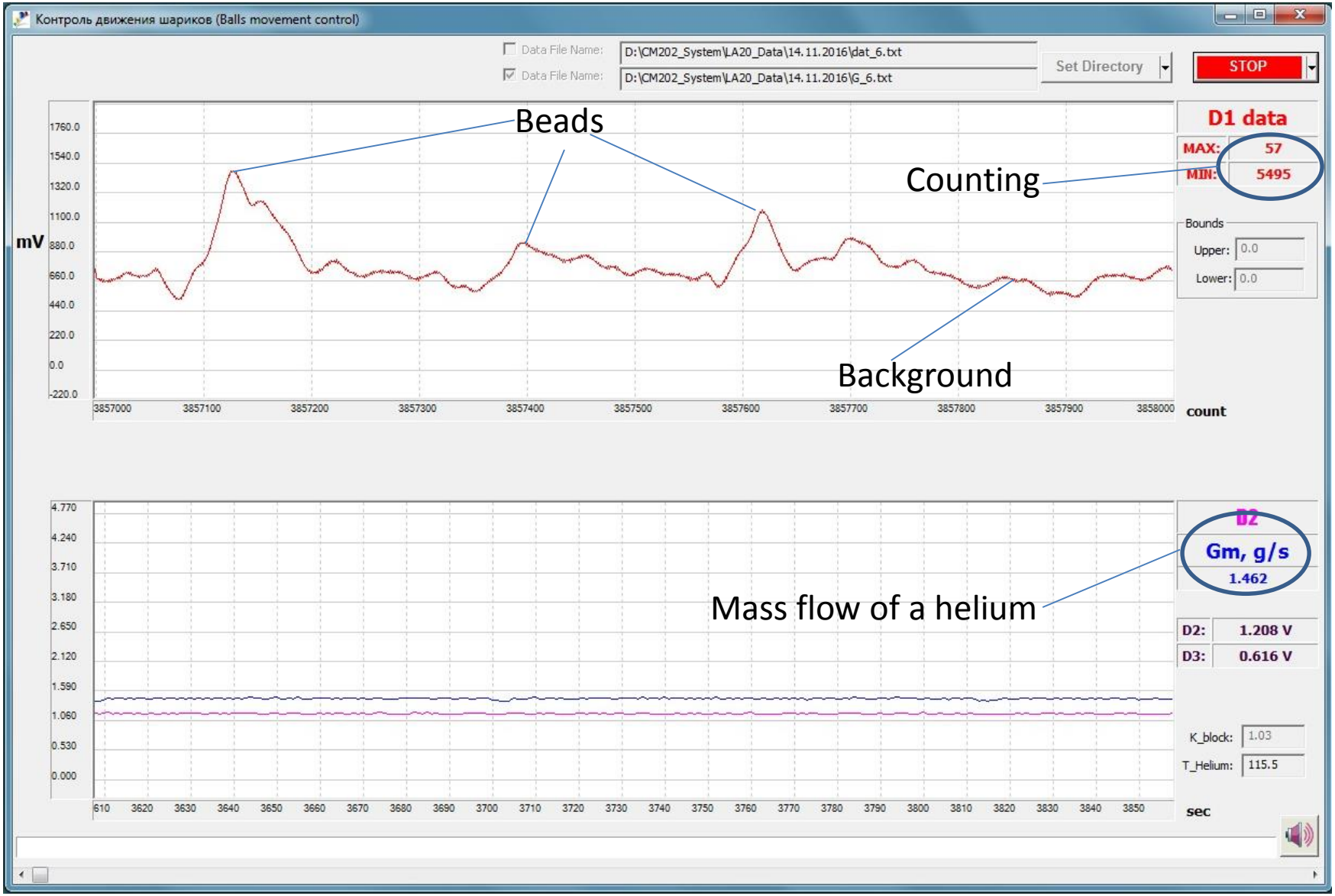
Gas dynamic beads' movement sensors



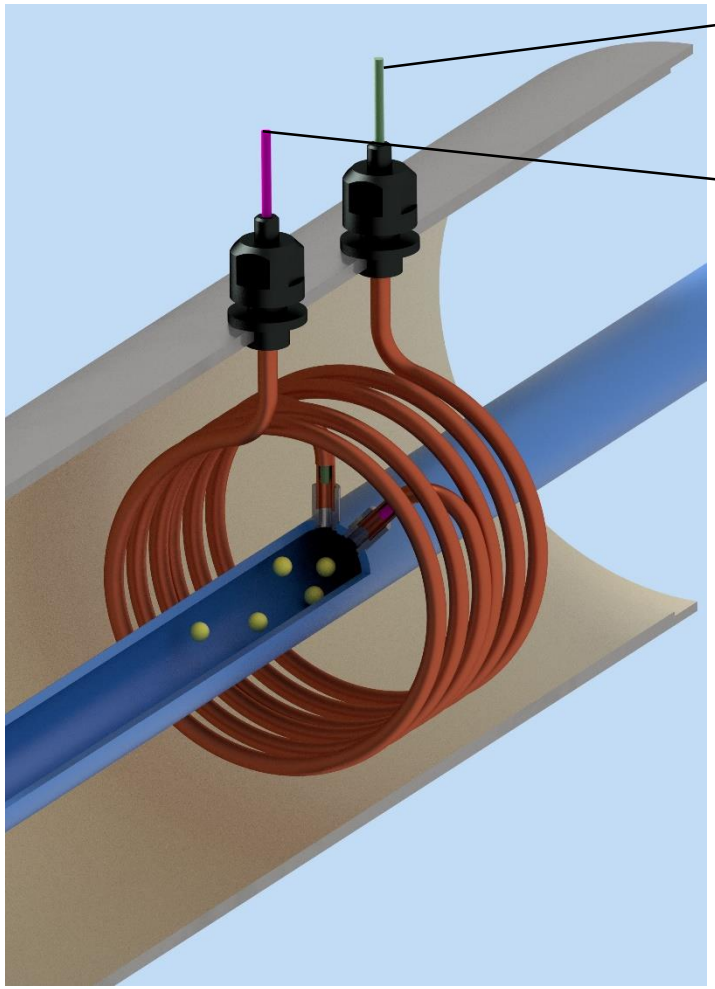
Gas dynamic beads’ movement sensors

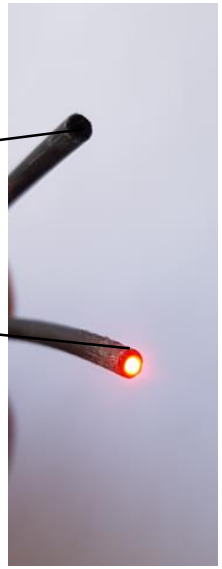


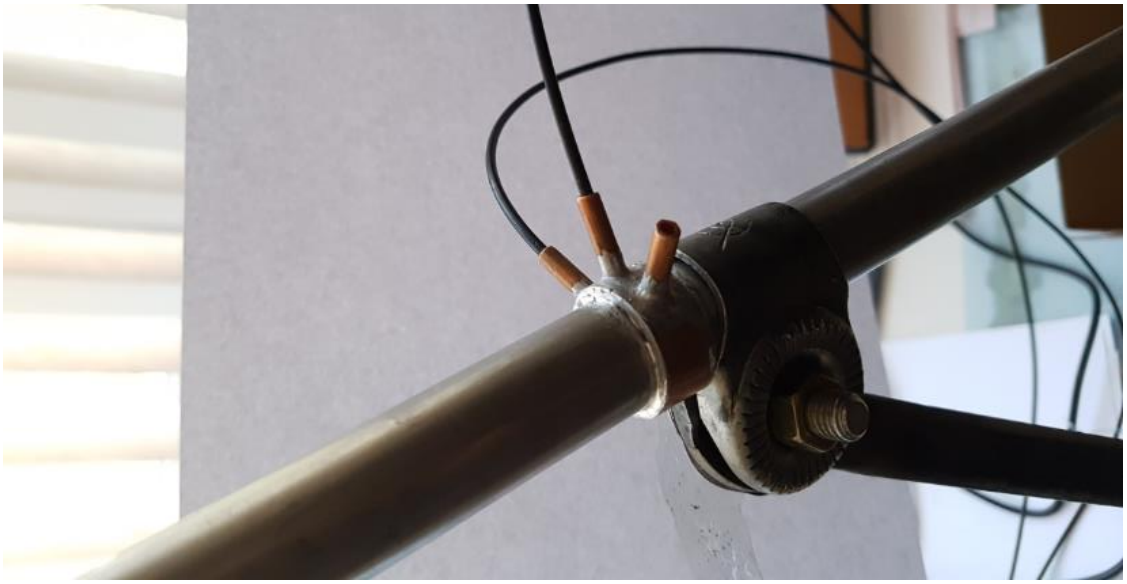
Gas dynamic beads' movement sensors



Optical sensor







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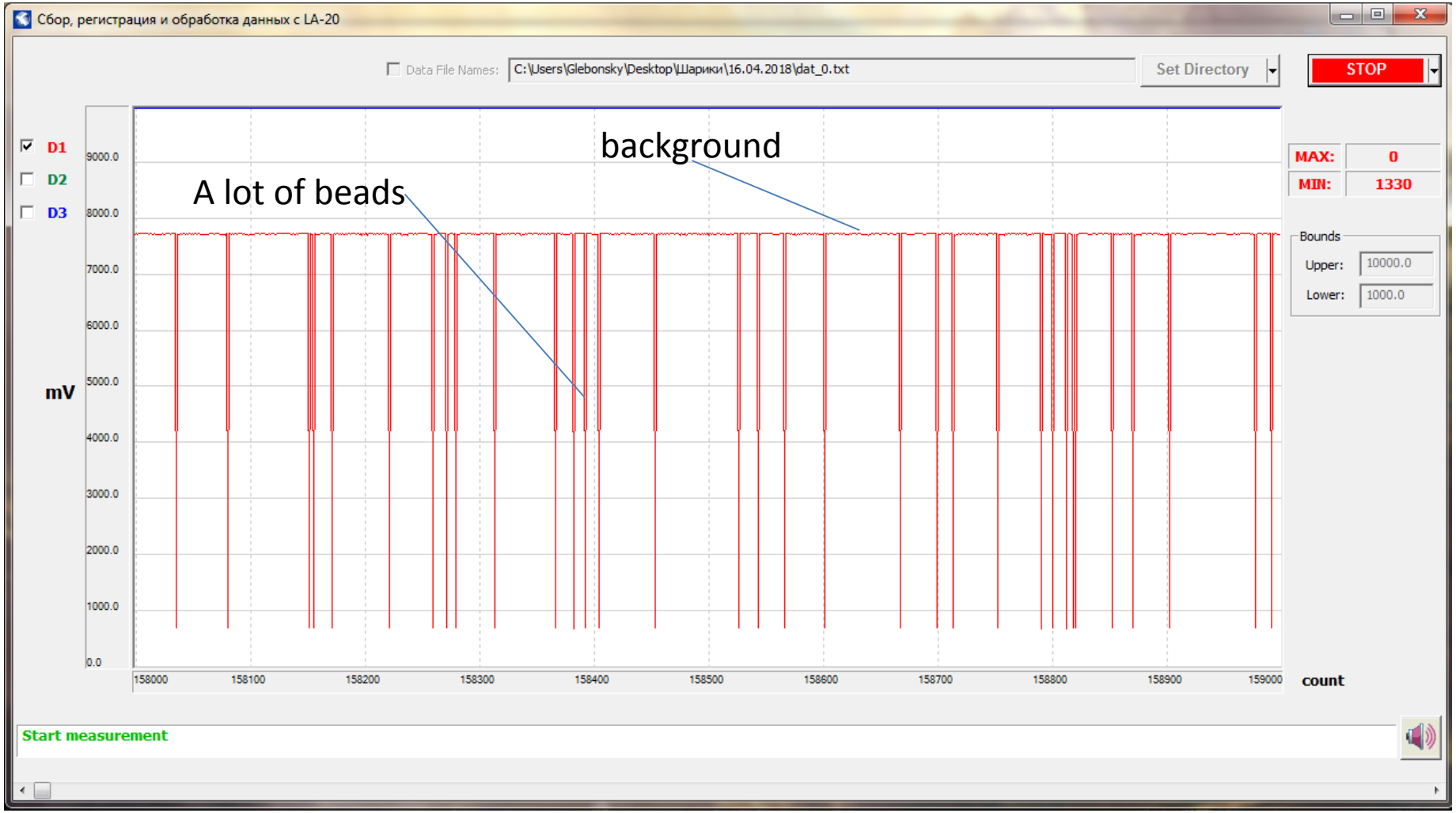
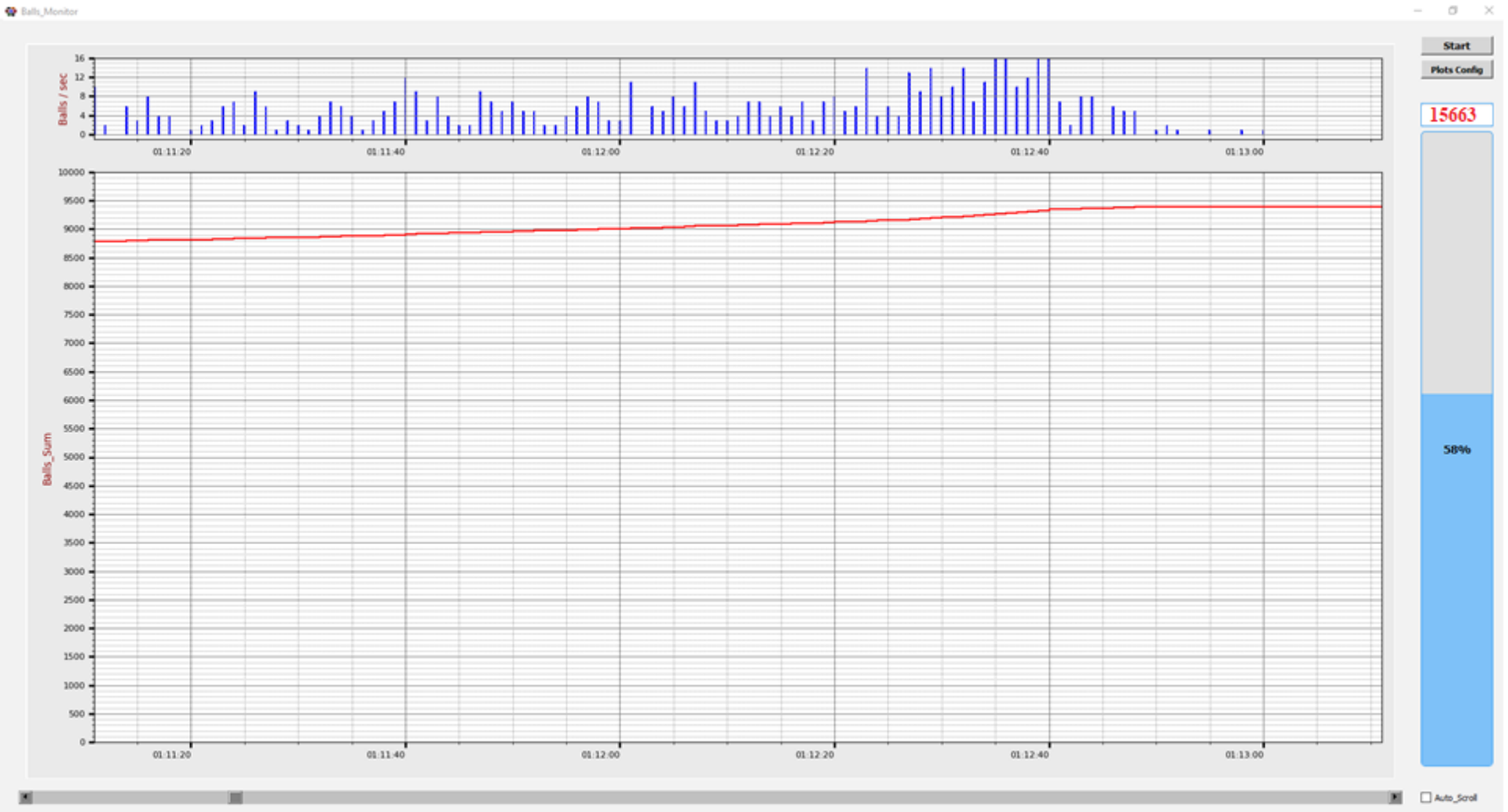
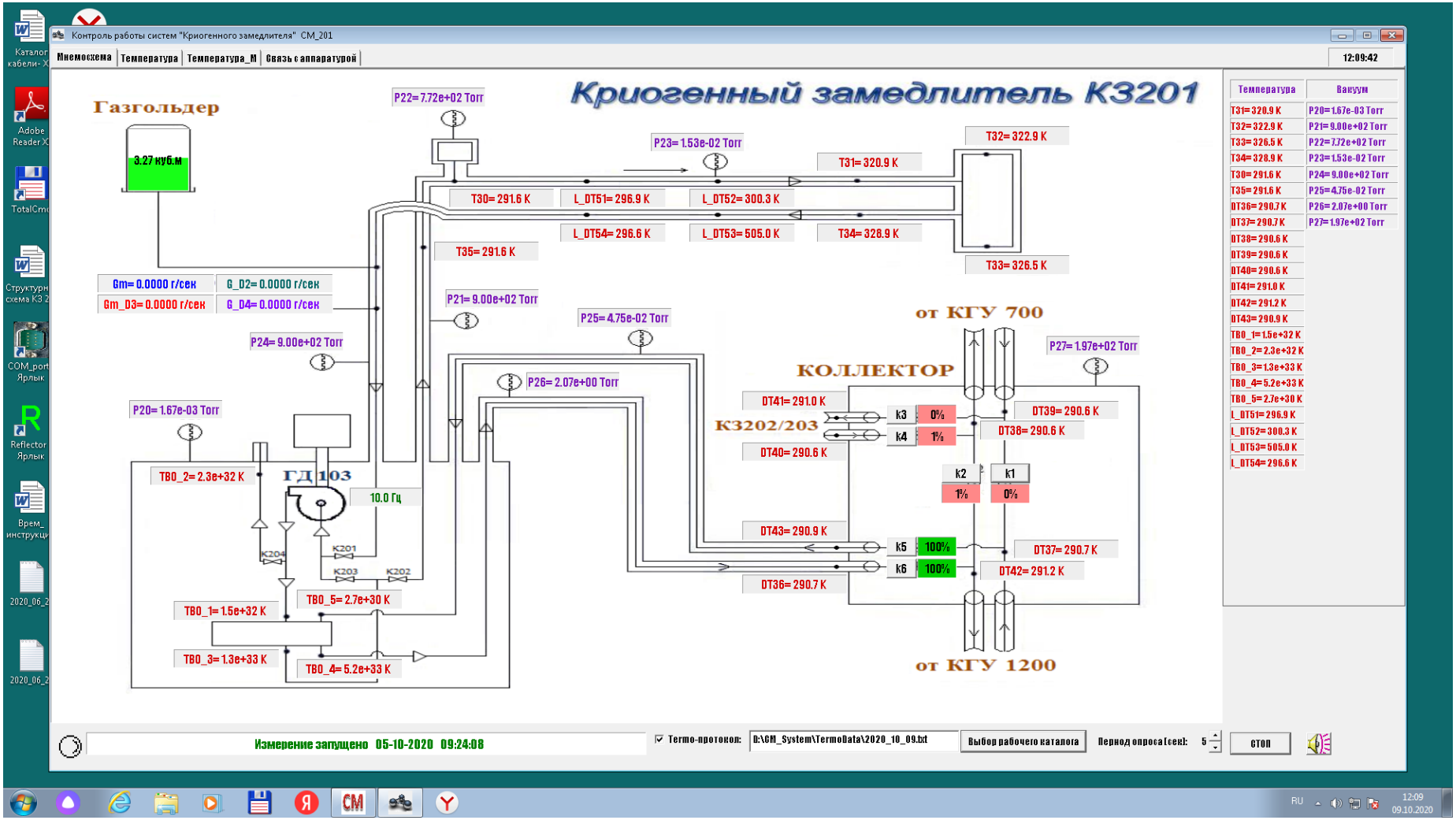


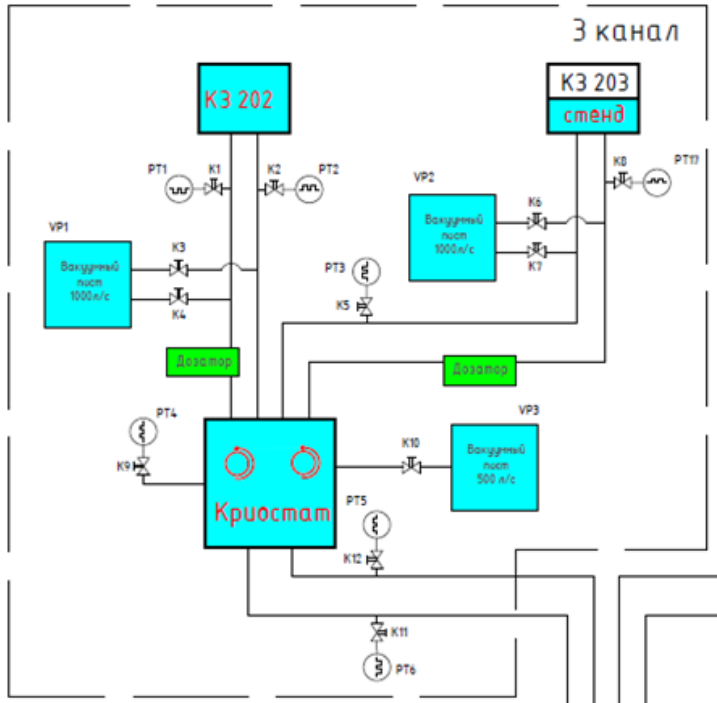
Optical sensor

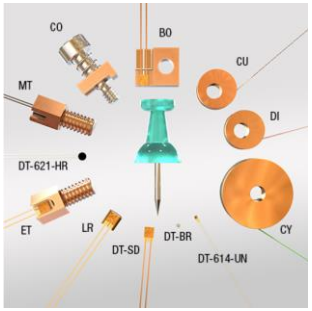


Management and control system



Cryogenic system



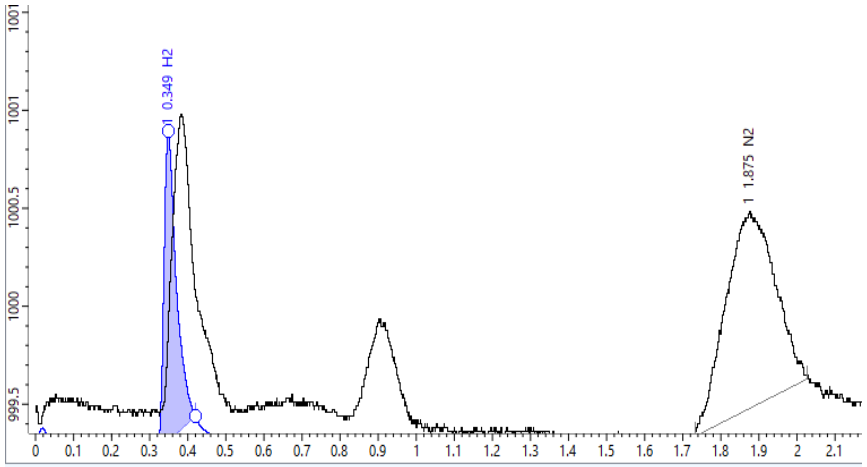


Cryogenic system

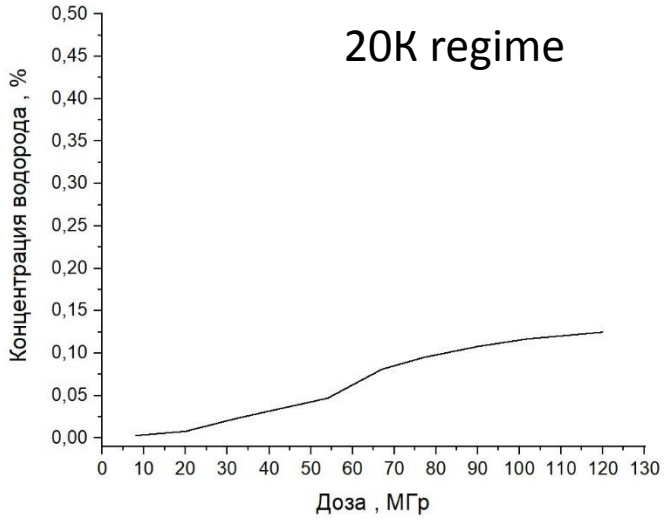
Cryogenic system

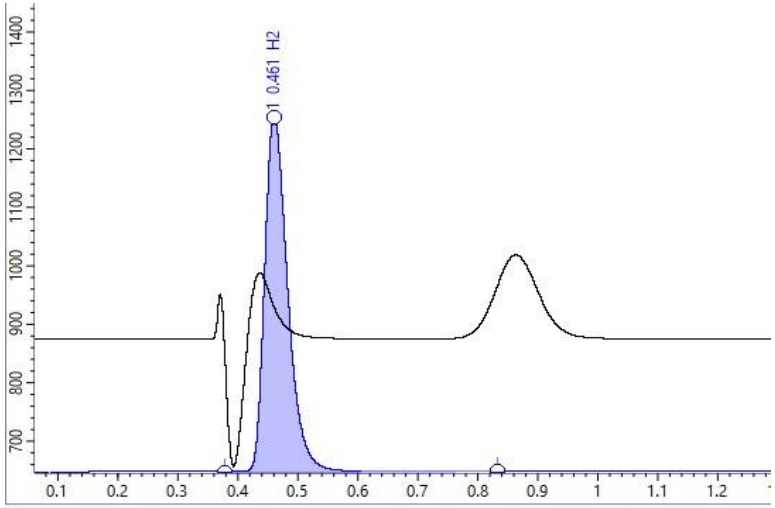
Cryogenic system

Radiolitic hydrogen

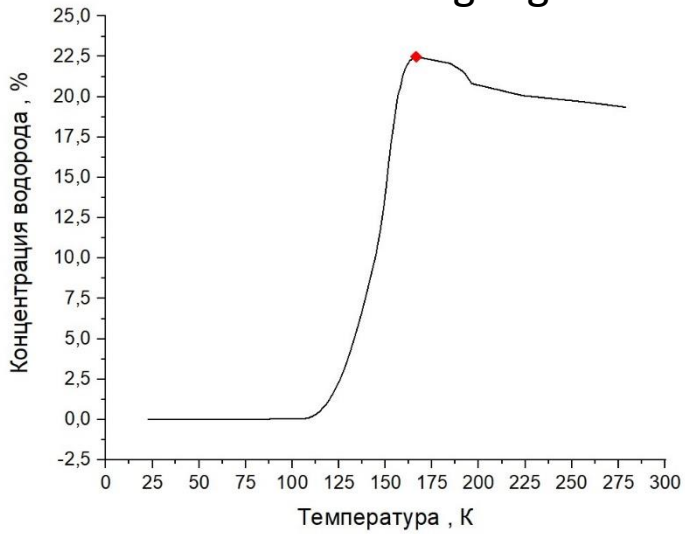


Название	Группа	Время, мин	Детектор	Концентрация	Ед. измерения	Площадь	Высота
N2		1.875	ДТП-1	0.002079		9.071	1.007
• H2		0.349	ДТХ-1	0.1229		20.281	8.991

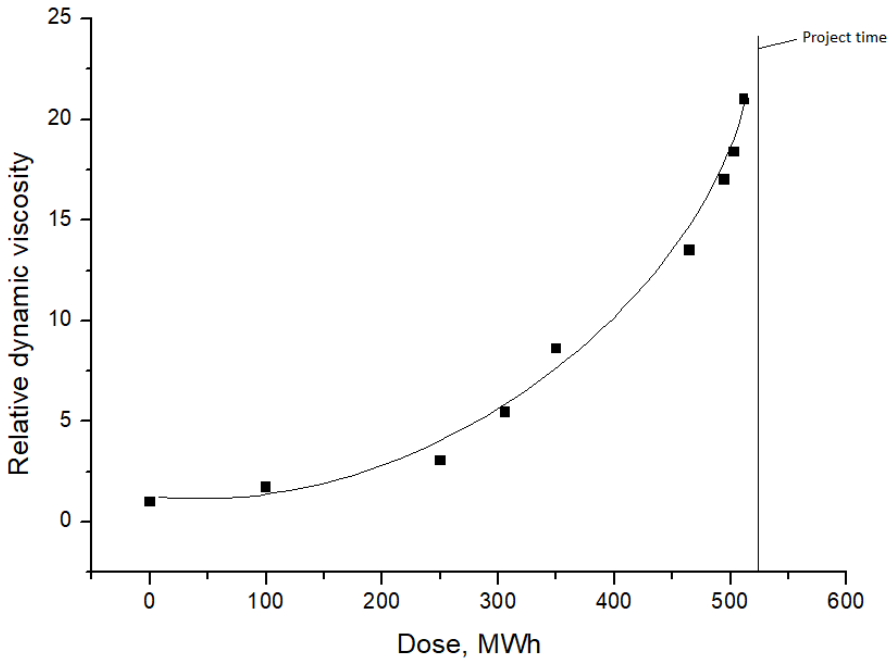




Название	Группа	Время, мин	Детектор	Концентрация	Ед. измерения	Площадь	Высота
N2		1.840	ДТП-1	1.010	моль. %	3903.646	382.417
• H2		0.461	ДТХ-1	22.498	моль. %	47462.597	17616.620

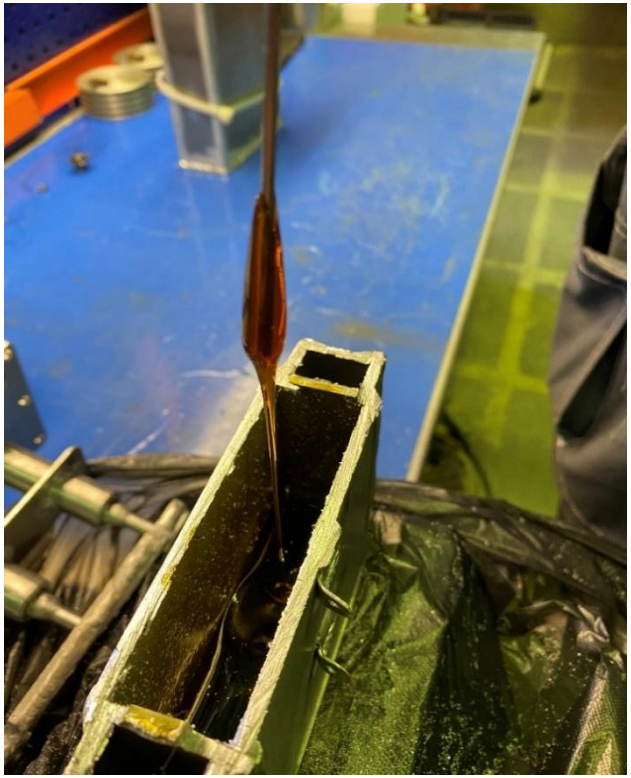


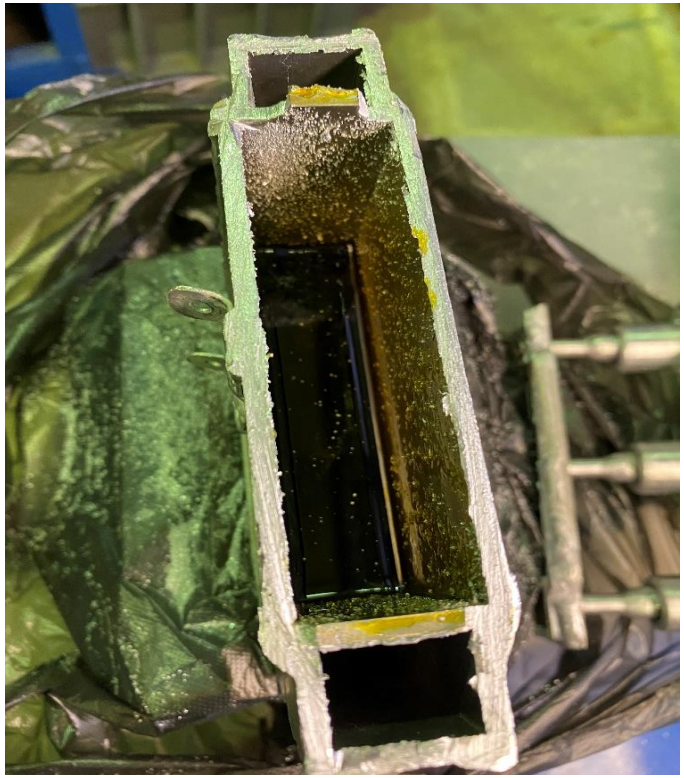
Irradiated mesitylene



	До облучения, масс. %	После облучения с дозой 120 МГр, масс. %
Мезитилен (1,3,5-триметилбензол)	82,6	0
Метаксилол (1,3-диметилбензол)	16,7	0
Псевдокумол (1,2,4-триметилбензол)	0,45	35
3-этилтолуол (1-метил-3-этилбензол)	0,25	0
Параксилол (1,4-диметилбензол)	0	15
Прочие, в т.ч. неидентифицированные химические вещества	0	50

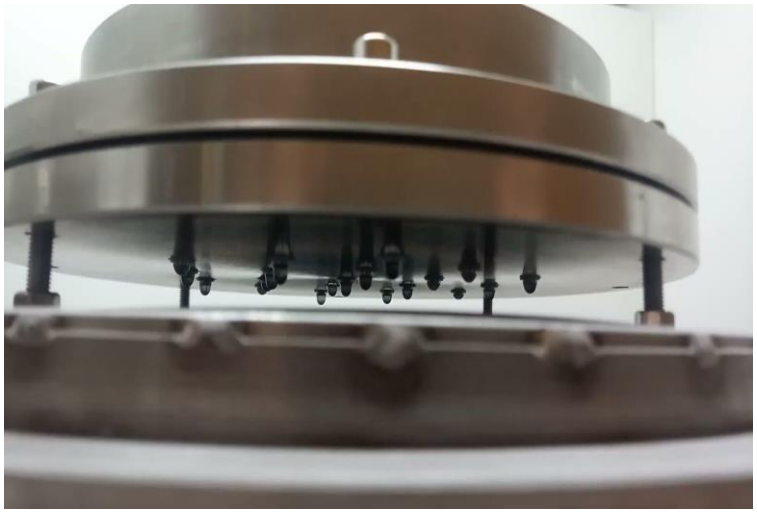
Irradiated mesitylene

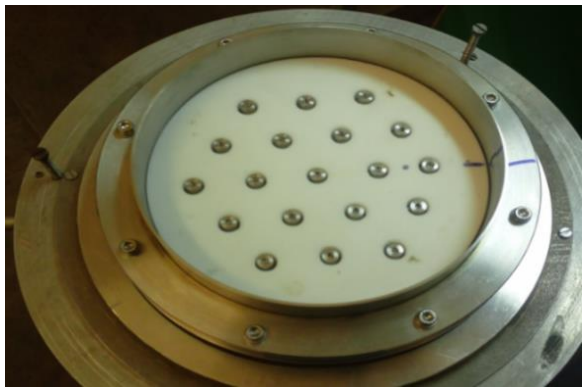


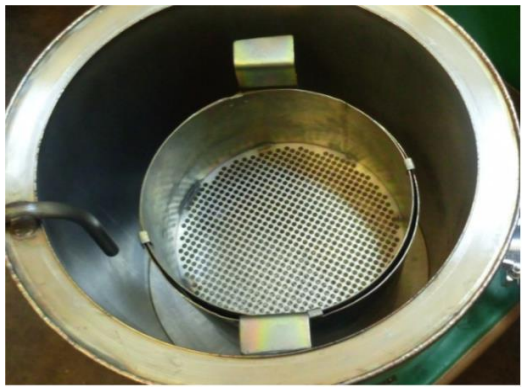


Producing of frozen beads from mesitylene

50 ml/h

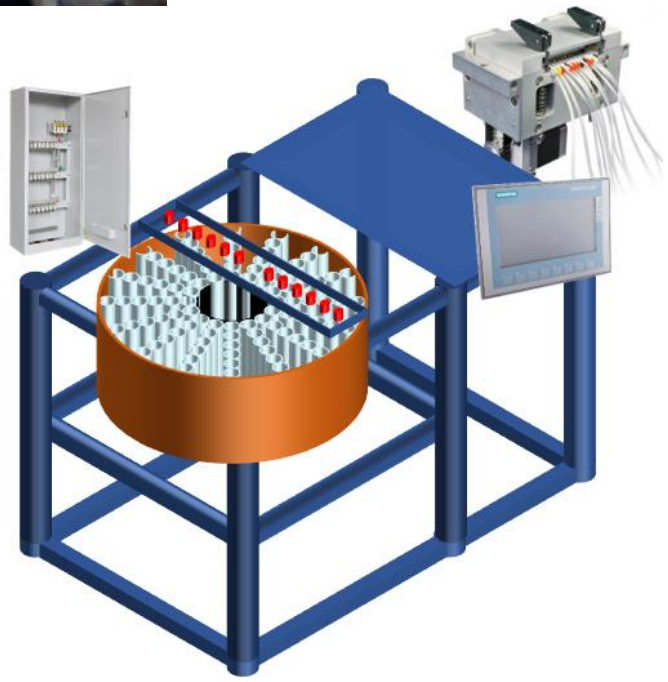




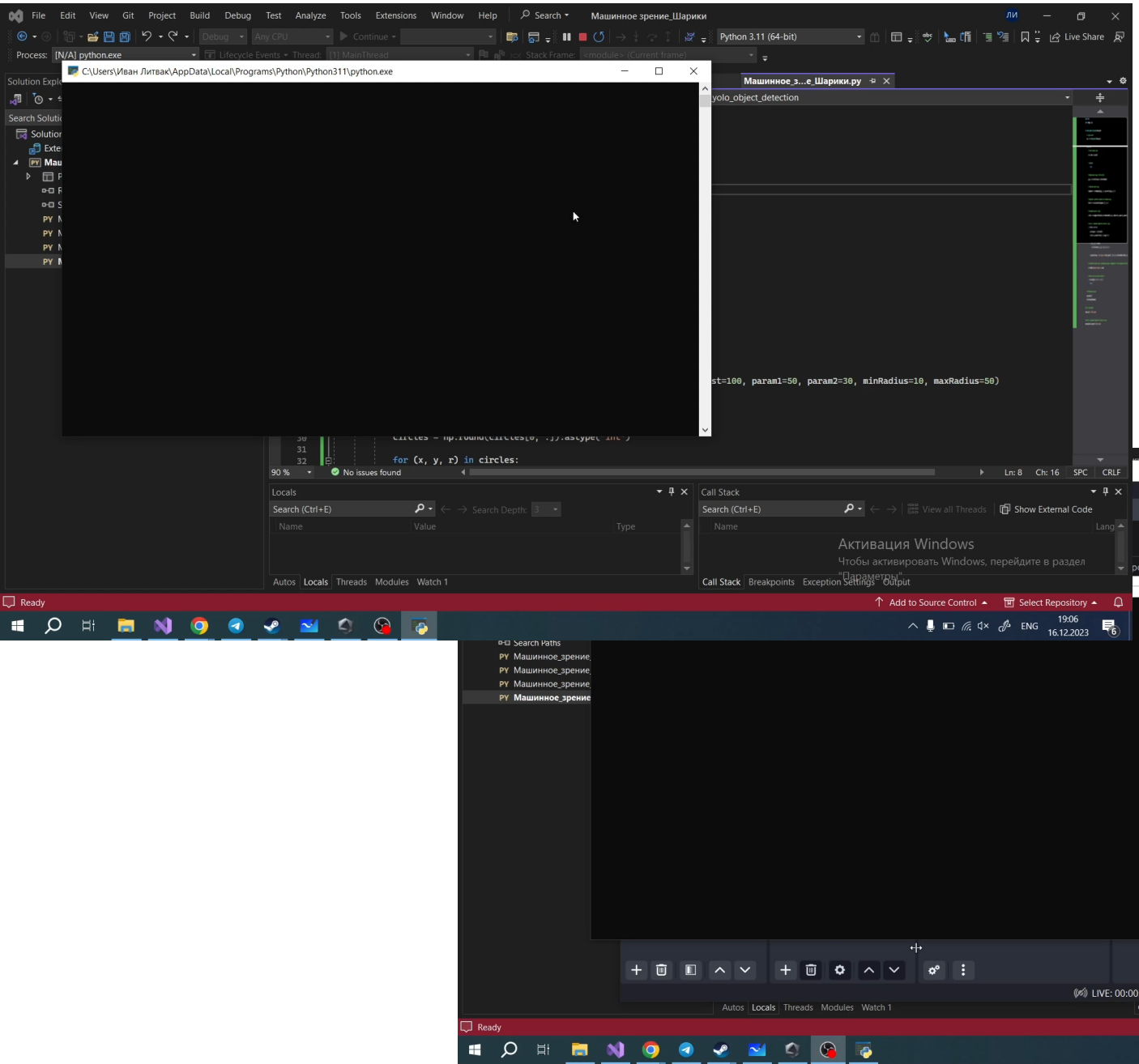


Producing of frozen beads from mesitylene

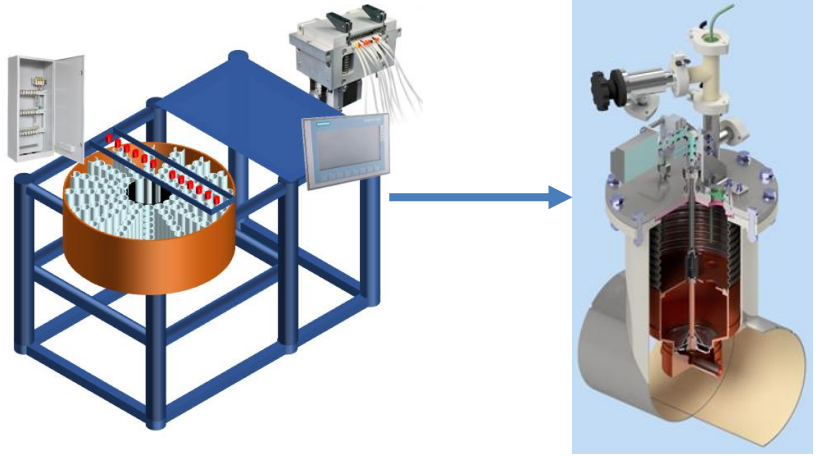
1,3 l/h

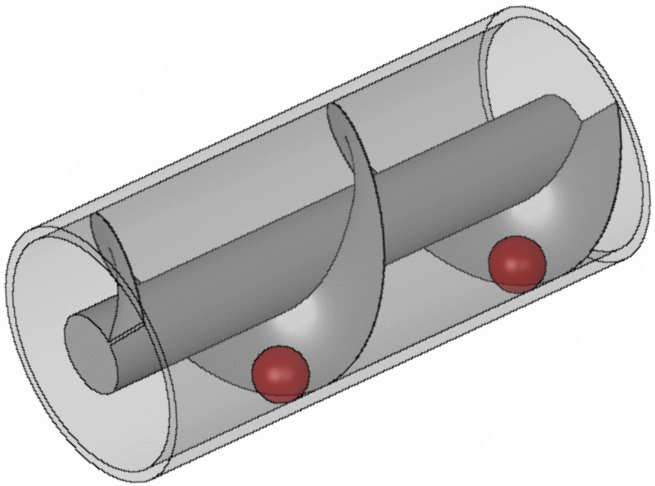


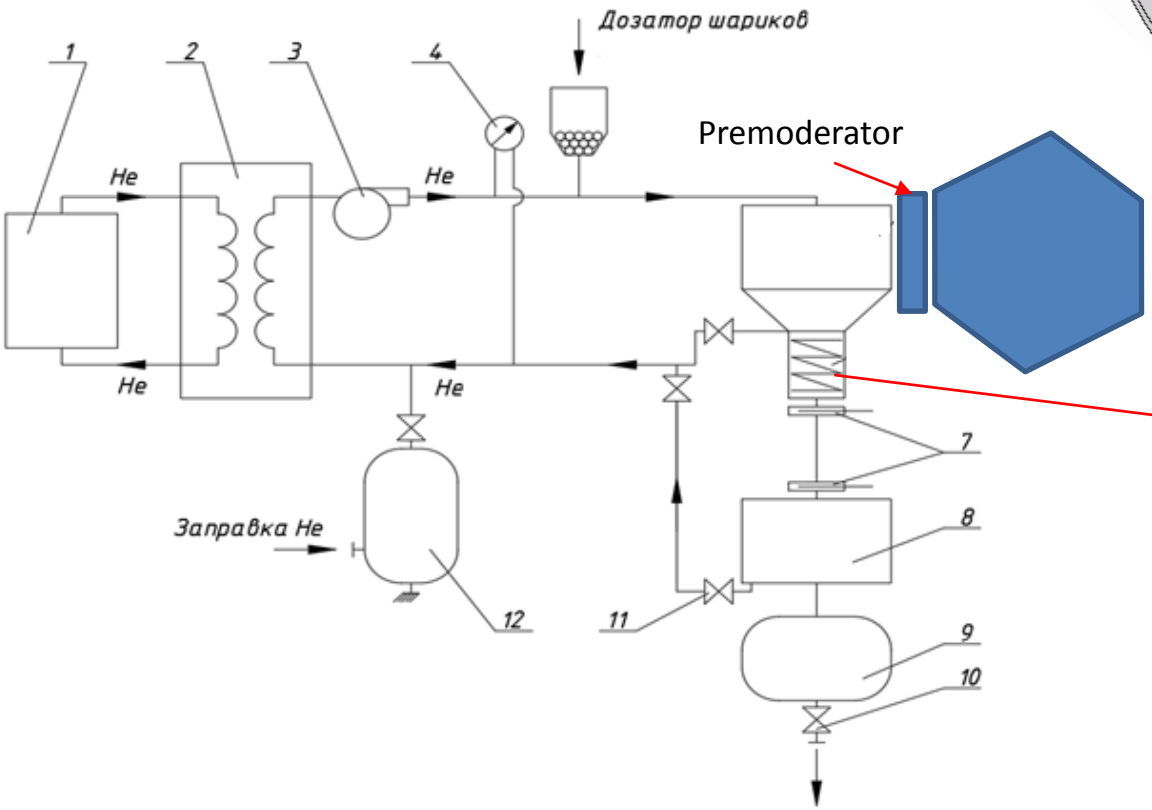
Producing of frozen beads from mesitylene

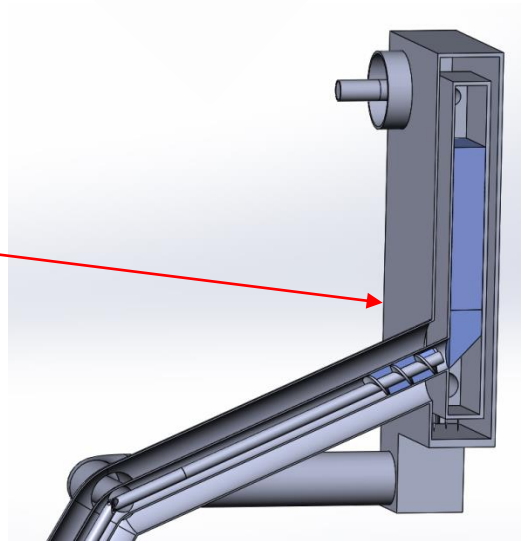


System of fast charging and discharging of beads

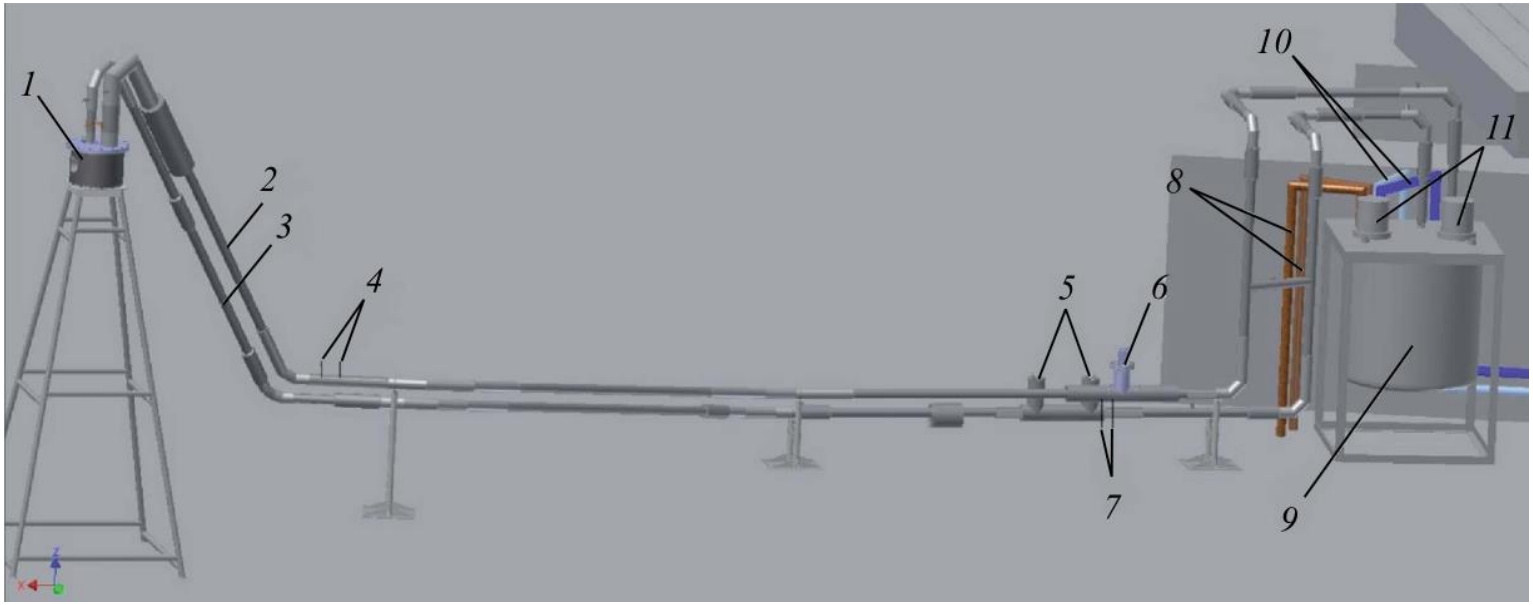


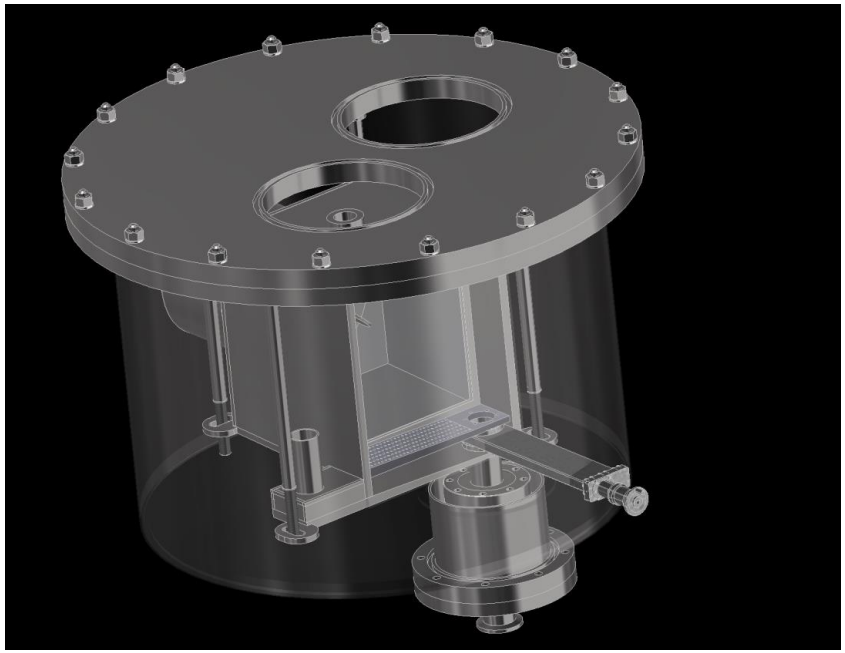




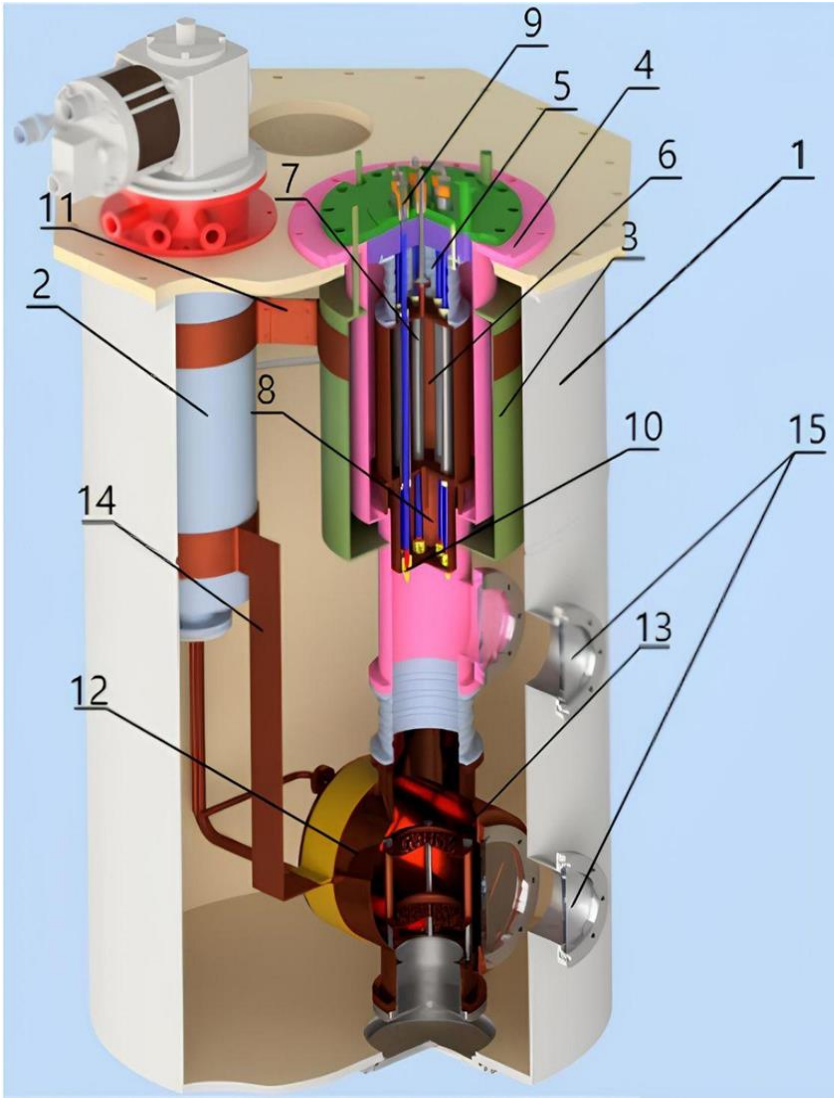


System of fast charging and discharging of beads



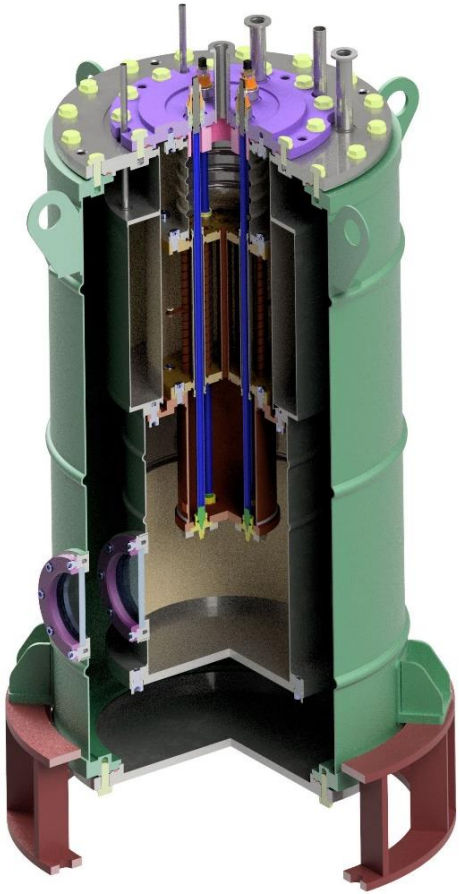


Producing of methane beads: concept

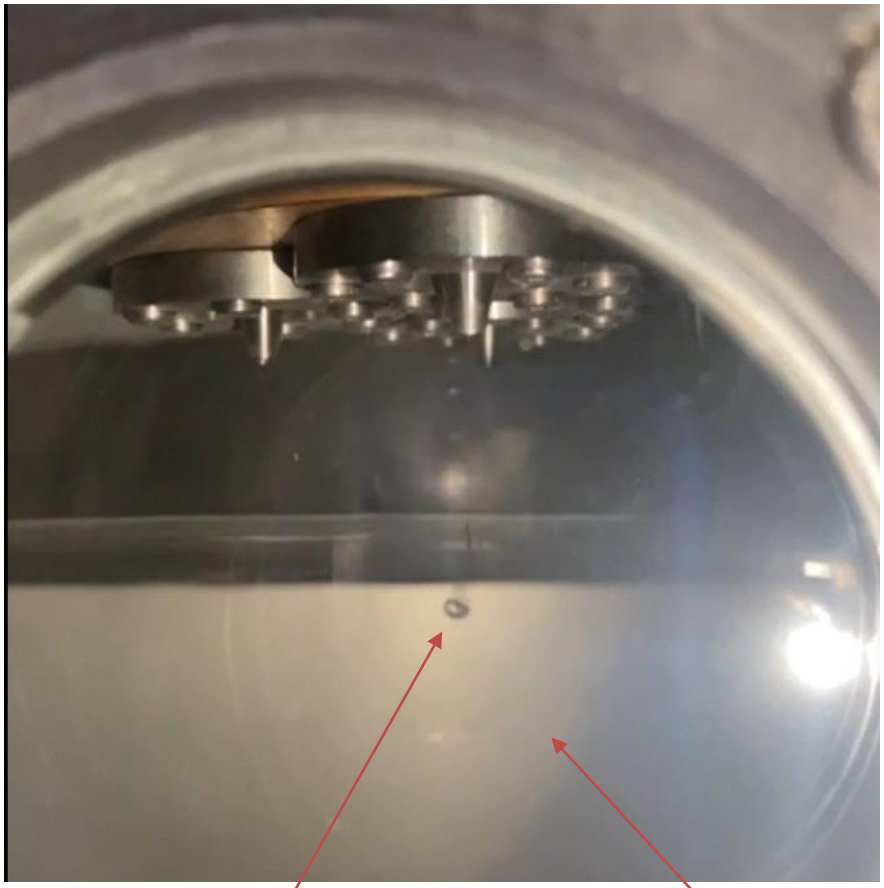


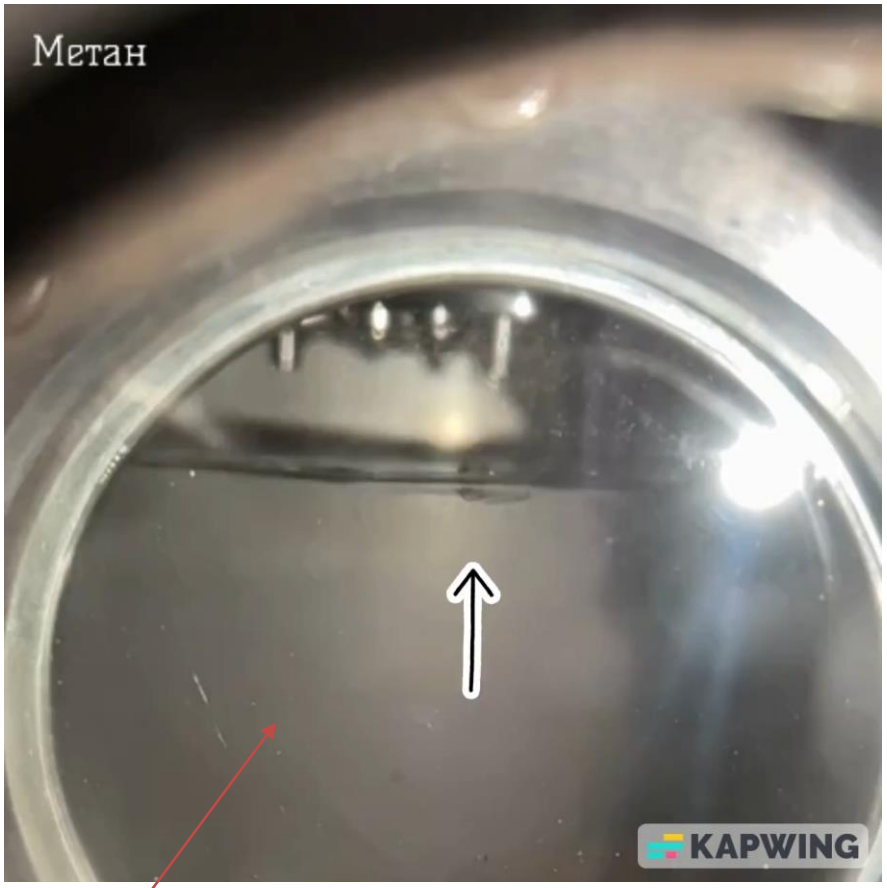
1. Криостат с вакуумом
2. Криогенная установка
3. Полость с жидким азотом
4. Полость с вакуумом
5. Полость с метаном
6. Полость с вакуумом
7. Медные трубки, оплетённые нихромовыми нитями
8. Полость с жидким метаном
9. Регулирующие болты
10. Каплеобразователи
11. Первый контур криогенной установки
12. Полость с жидким гелием
13. Сепаратор
14. Второй контур Криогенной установки
15. Стекло для наблюдений

Producing of methane beads: I stage



Producing of methane beads: first experiments



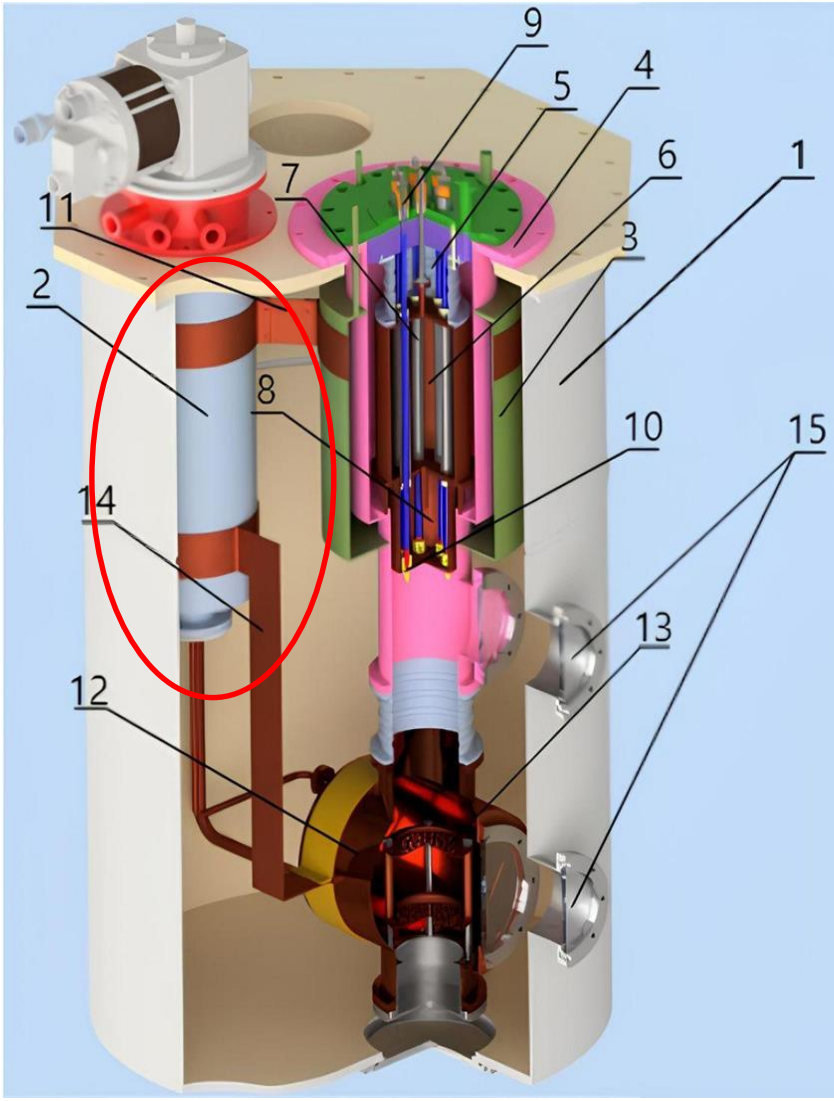


Argon bead

Liquid nitrogen

Methane bead

Producing of methane beads: II stage



1. Криостат с вакуумом
2. Криогенная установка
3. Полость с жидким азотом
4. Полость с вакуумом
5. Полость с метаном
6. Полость с вакуумом
7. Медные трубки, оплетённые нихромовыми нитями
8. Полость с жидким метаном
9. Регулирующие болты
10. Каплеобразователи
11. Первый контур криогенной установки
12. Полость с жидким гелием
13. Сепаратор
14. Второй контур Криогенной установки
15. Стекло для наблюдений

Thank you for your attention!