



ИНСТИТУТ КАТАЛИЗА
ИМ. Г.К. БОРЕСКОВА



Fast Processes beamline (1-3)

<http://ancient.hydro.nsc.ru/skif>

rubtsov@hydro.nsc.ru

Lavrentyev Institute of Hydrodynamics SB RAS

E.R. Pruel, K.A. Ten, I.A. Rubtsov, A.O. Kashkarov, V.M. Titov

Institute of Solid State Chemistry and Mechanochemistry SB RAS

B.P. Tolochko, A.I. Ancharov, N.I. Razumov

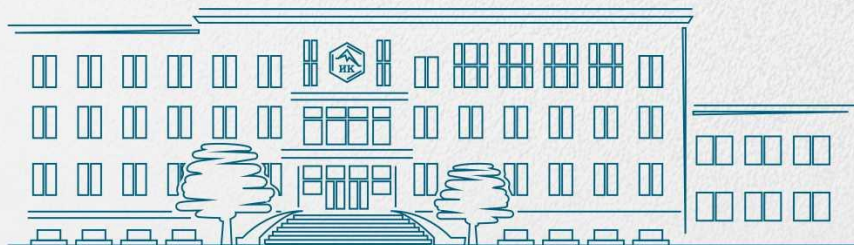
Budker Institute of Nuclear Physics

A.S. Arakcheev, Ya.V. Rakshun, L.I. Shekhtman, V.V. Zhulanov, V.M. Aulchenko,

N.A. Mezentsev, V.A. Shkaruba, A.E. Trebushinin, Yu.V. Khomyakov

Boreskov Institute of Catalysis SB RAS

Ya.V. Zubavichus



Fast Processes beamline

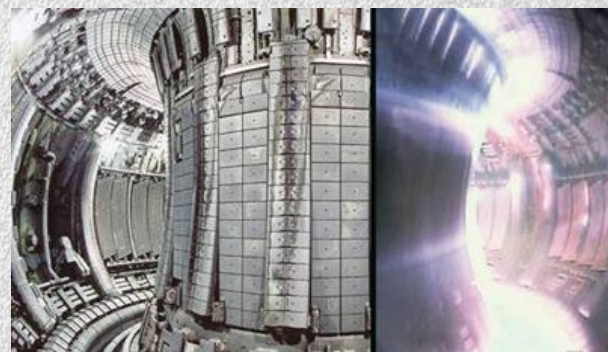
Dynamic processes sector

The properties of energetic materials, the structure of the shock and detonation fronts, the equation of state, phase transitions under compression, chemical reactions, the dynamic formation of nanostructures, high-speed deformation and fracture of materials.

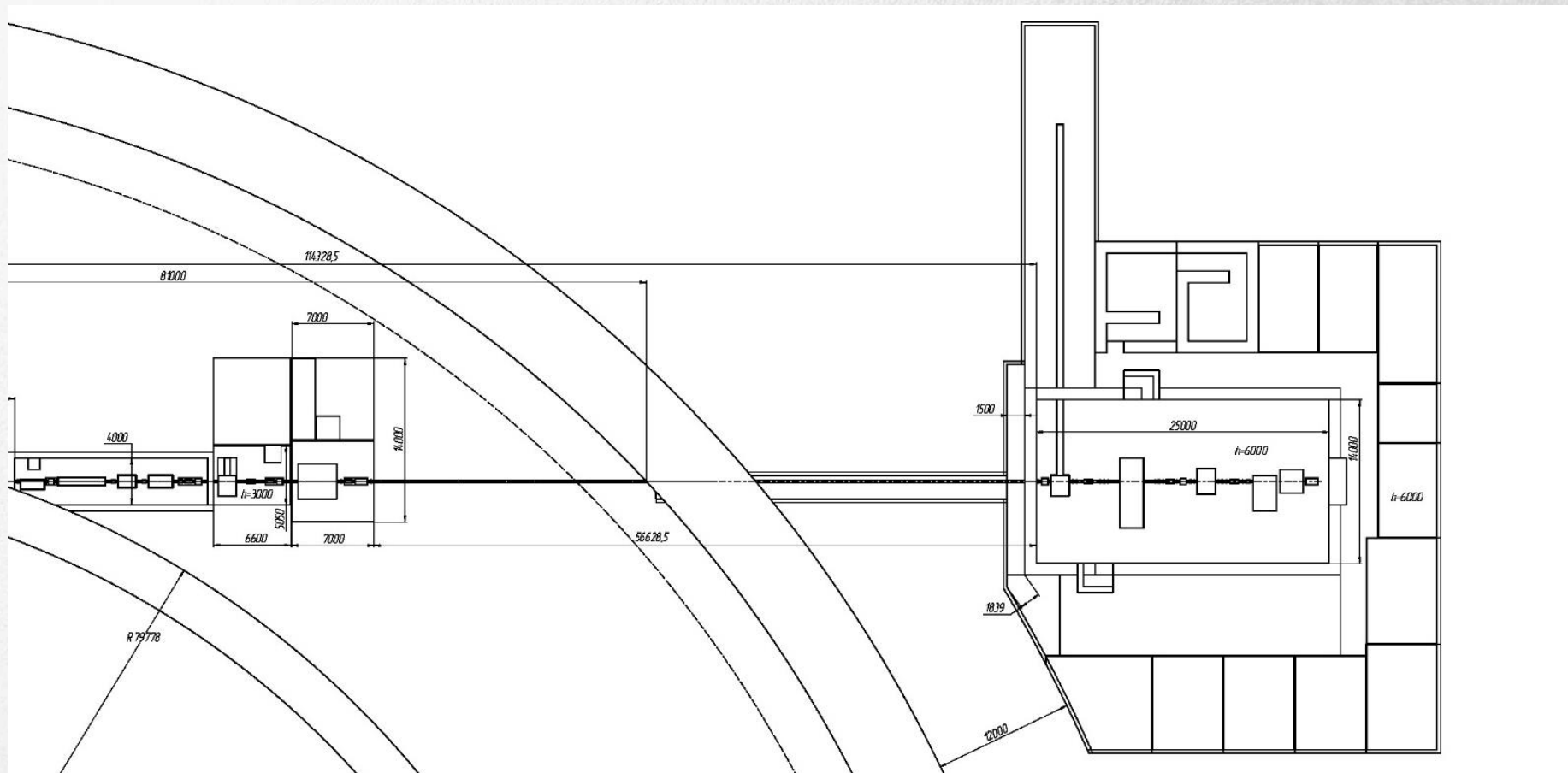


Plasma sector

Investigation of the effects of high temperature and plasma on materials in a fusion reactor. Using diffraction techniques, the change in the crystal structure of the samples and the deformations arising in them will be investigated.



General scheme of the Fast Processes beamline



SR beam requirements at the Station

Time between bunches	Perimeter distribution	Accelerator current, mA	Number of bunches
2.86 ns	Uniform filling	400	0.4 A (510 bunches) T=1600 ns Accelerator main mode
11.44 ns	Train	≈350	≈70 bunches
22.88 ns	Uniform filling	350	70 bunches
50 ns	Uniform filling	160	32 bunches
133 ns	Uniform filling	60	12 bunches

The station's methods are aimed at studies requiring a high temporal resolution (up to one bunch).

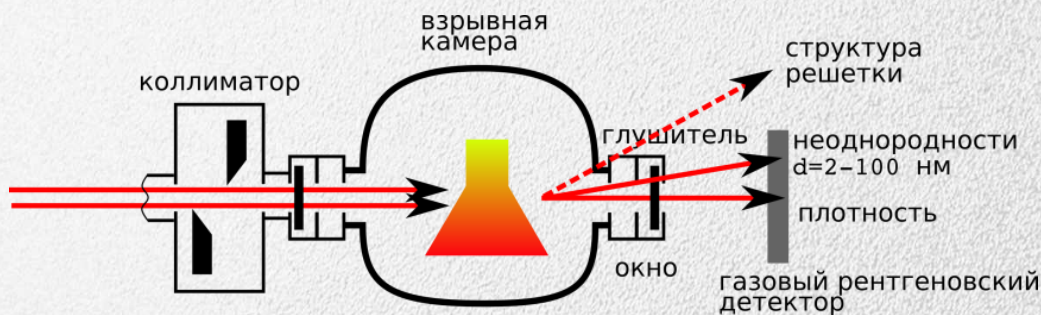
Dynamic processes sector

Properties of high-energy materials

Studying of dynamic characteristics (combustion, detonation, initiation) of industrially used and promising new high-energy materials.

Dynamic behavior of materials and structural elements under shock loading

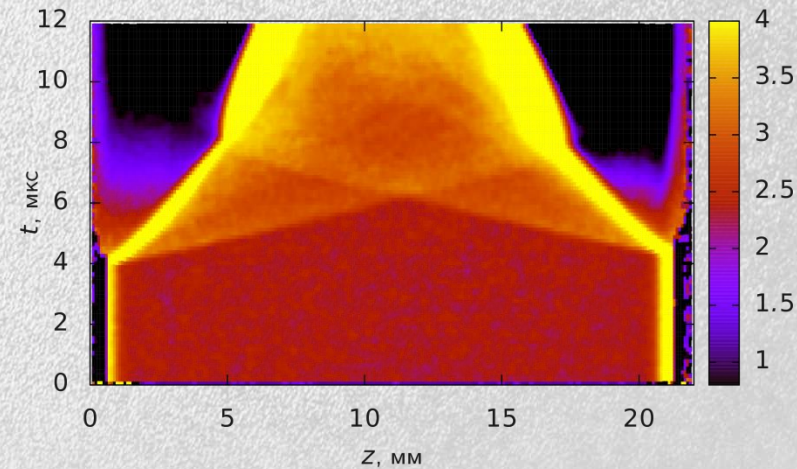
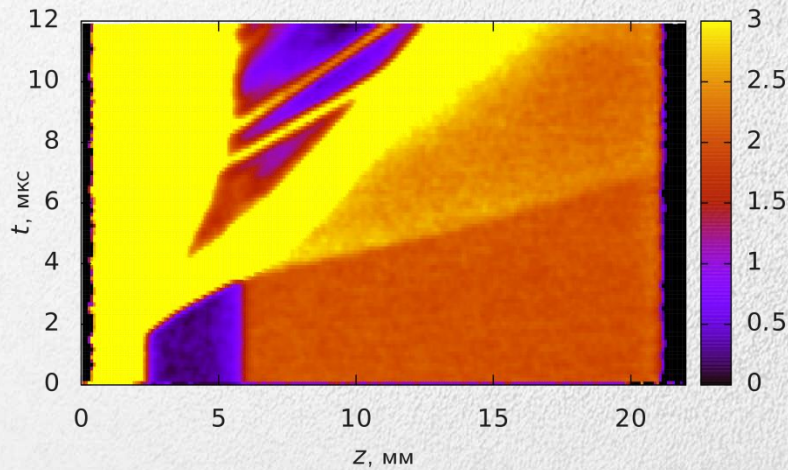
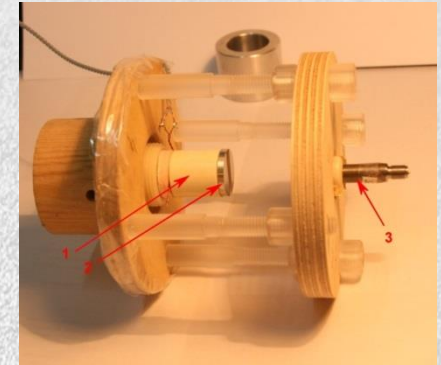
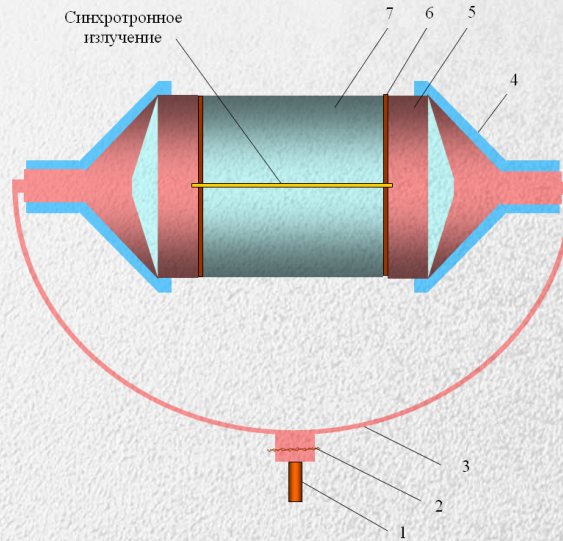
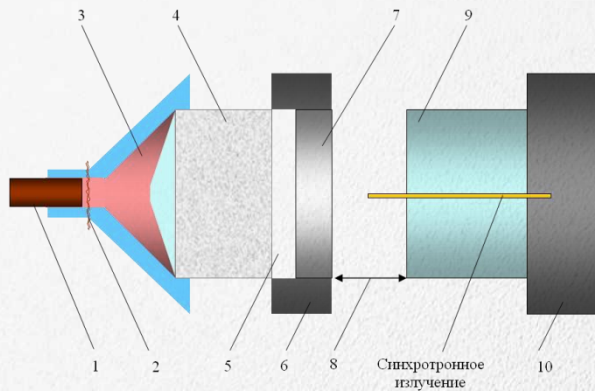
The scope includes: the structure of the shock wave front, the equation of state, phase transitions under compression, chemical reactions, high-speed deformation and fracture of materials, the dynamic formation of nanostructures.



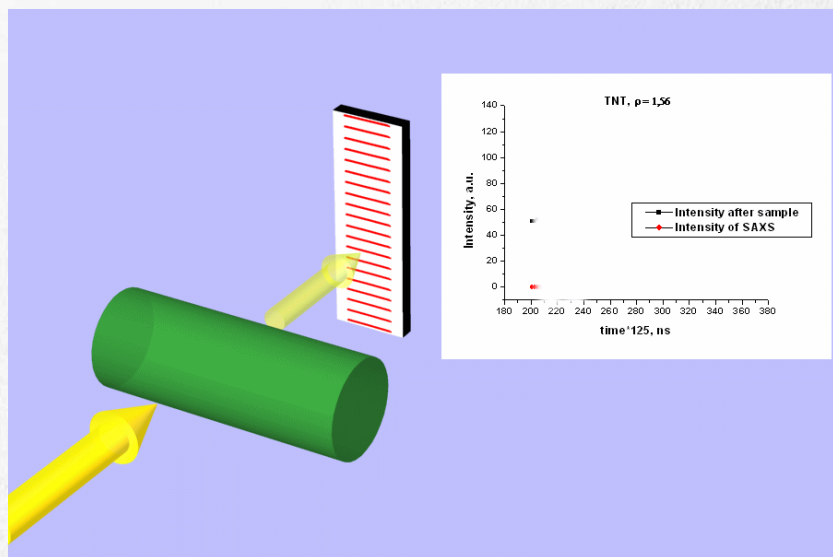
Experiment design



High-speed radiography (t down to 1 ps)



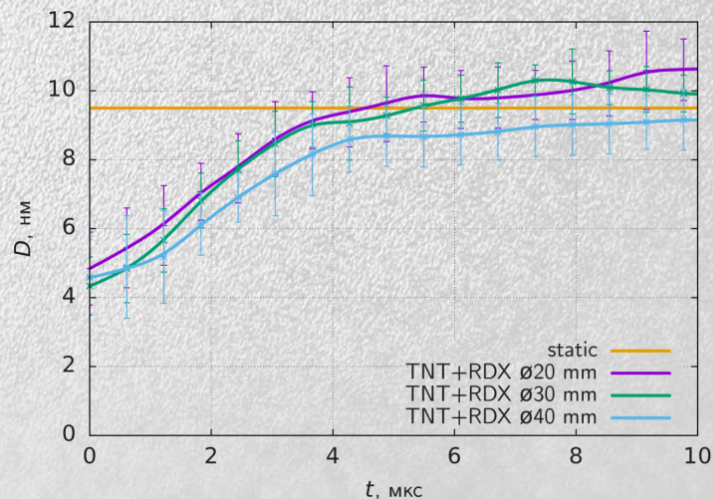
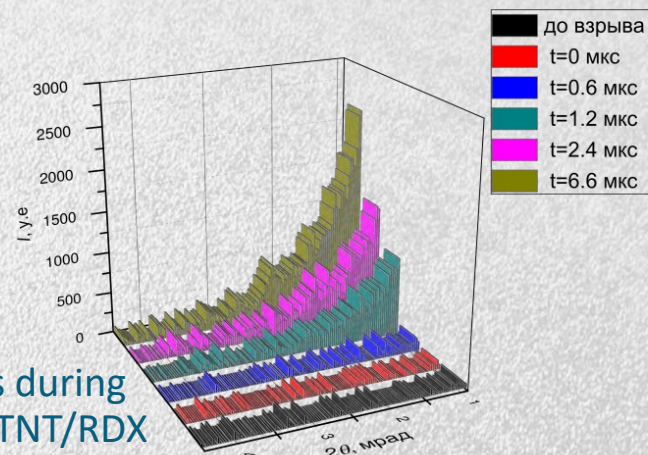
Time-Resolved Small-angle X-ray scattering ($t \approx 10$ ns)



The yellow arrow is the incident SR beam, and the purple cone is X-ray scattering by carbon nanoparticles.

The dynamics of carbon particles growth during detonation of TNT/RDX charges of different diameters.

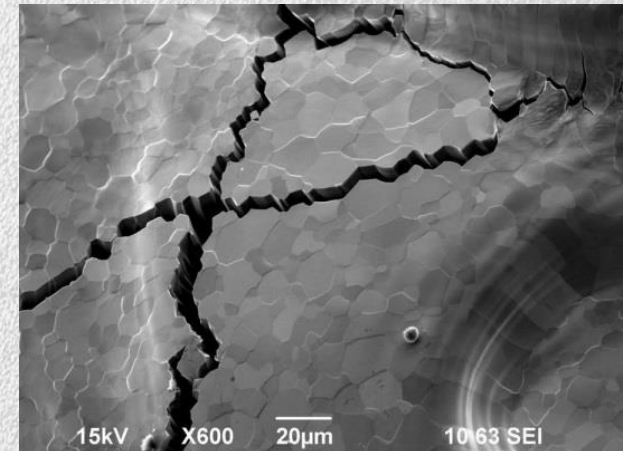
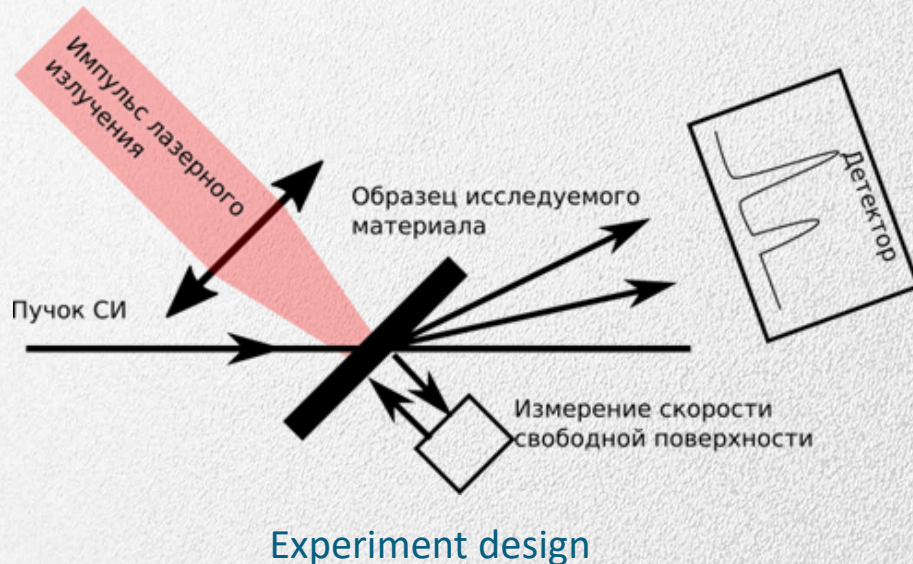
SAXS dynamics during detonation of TNT/RDX charge.



Plasma sector

Investigation of the effects of high-power pulsed heating and plasma on materials simulating a fusion reactor. The behavior of the structure of the material under the influence of pulsed heat load, deformation of the material at significant temperature gradients, the effect of plasma on the material.

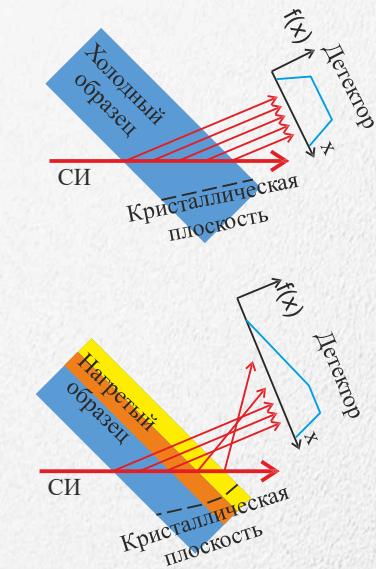
Study of the impact of pulsed laser radiation (terawatt) on the substance. Generation of super-strong (hundreds of GPa) shock waves. The equation of state under these conditions.



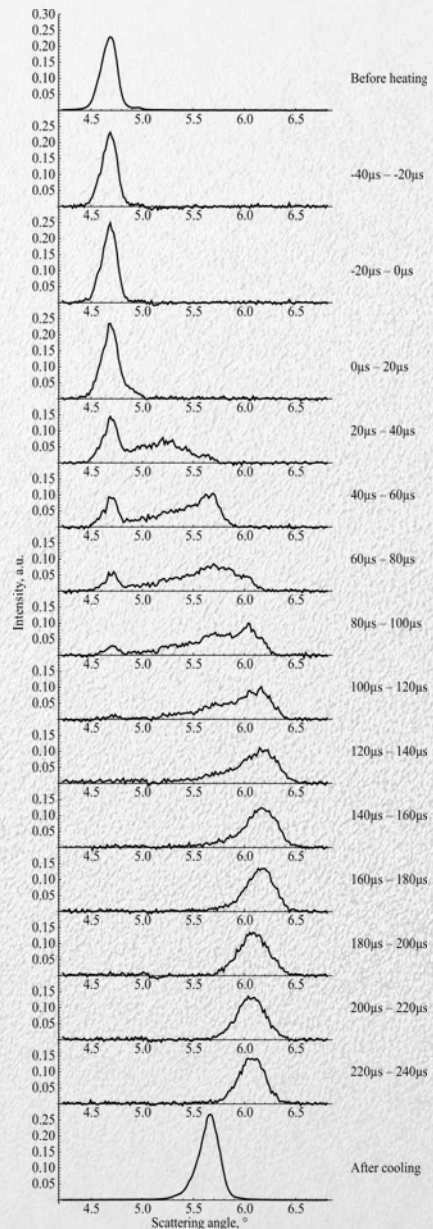
Emergence of cracks in a tungsten single crystal after a laser pulse



High-speed diffractometry ($t \approx 10 \mu\text{s}$)



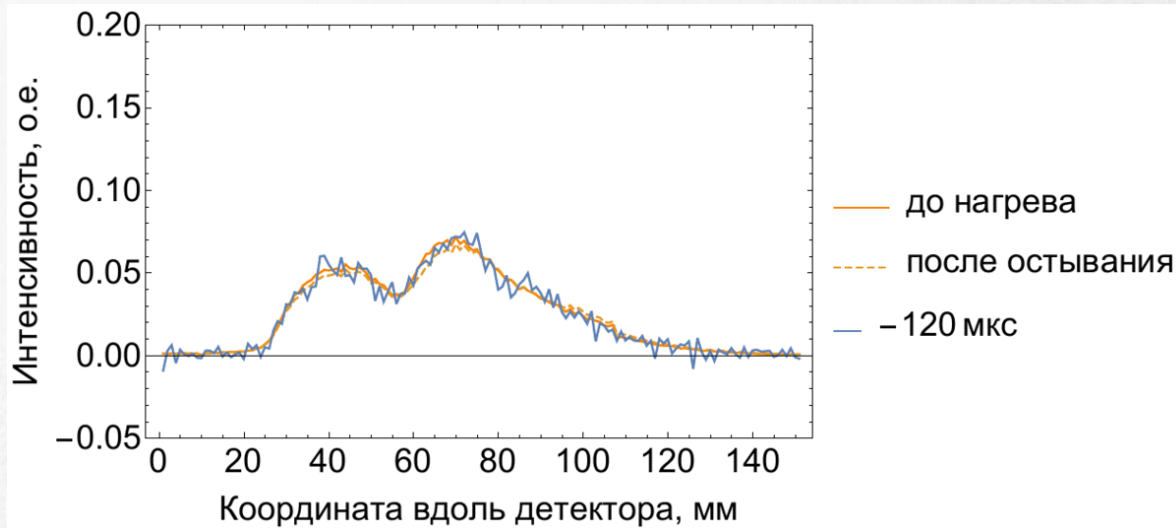
Pulse heating
diffraction pattern



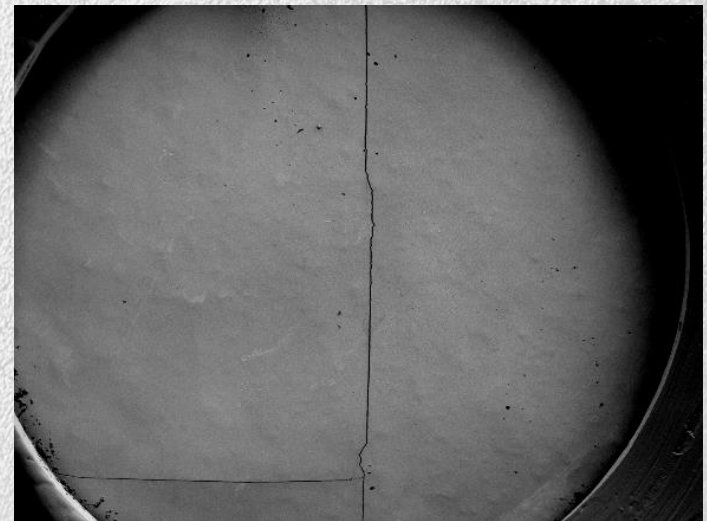
Plasma station at the SSTRC (VEPP-4)

- Measurement of strains parameters inside the material,
- Measurements with spatial resolution in depth below the surface,
- Dynamic measurements with a temporal resolution of the order of $10 \mu\text{s}$.

High-speed diffractometry ($t \approx 10 \mu\text{s}$)



Observation of coalescence of the sides of the crack during pulsed heating



Cracked specimen

Primary Detecting Equipment





*Thank you
for your attention!*

Partners and interested organizations:



РОСАТОМ



РФЯЦ-ВНИИТФ



РФЯЦ
ВНИИЭФ



Пермский
моторный завод
ОДК



ФНПЦ "АЛТАЙ"



ИПХФ
РАН



ИСМАН



N* Новосибирский
государственный
университет
***НАСТОЯЩАЯ НАУКА**



НГТУ



АлГТУ