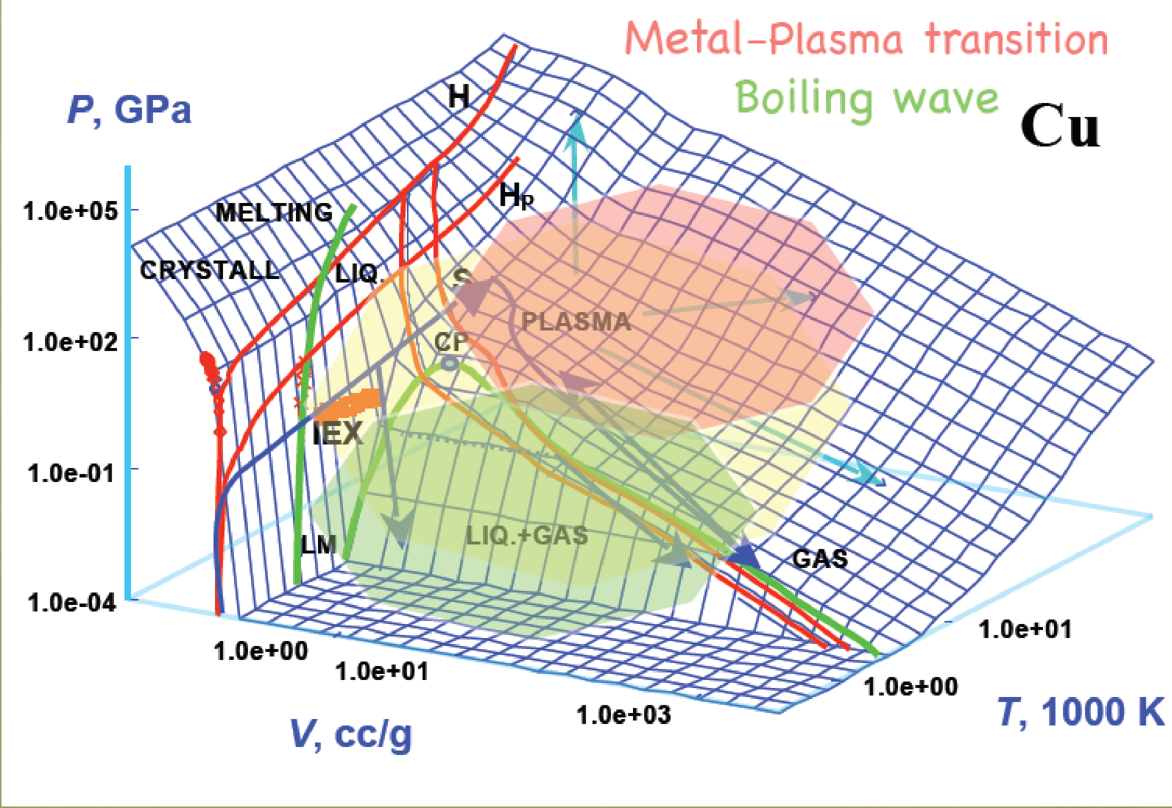
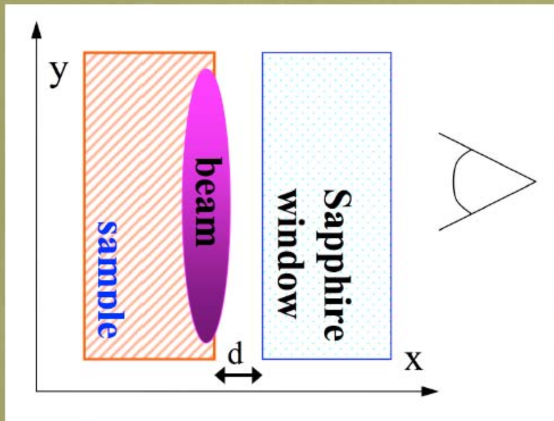
New version of scientific investigation

Study of Near-Critical States of Refractory Materials by Intense Heavy Ion Beams

Experiment proposal **S396**
Spokesperson: Vladimir Ternovoi
GSI contacts: Dmitry Varentsov

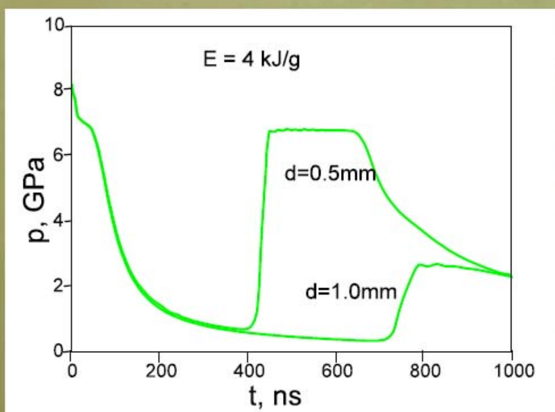


Geometry of the proposed experiment

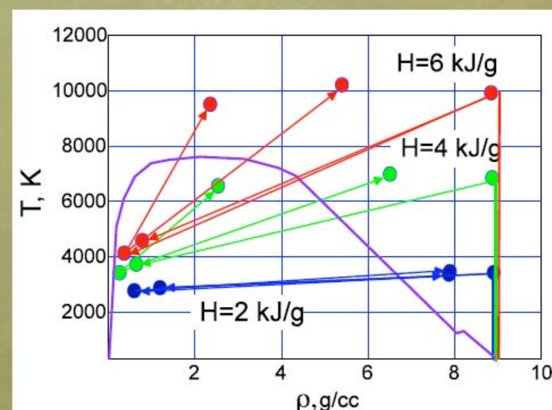


Beam parameters:

- 350 MeV/u uranium ions
- focal spot 0.4 x 0.8 mm (FWHM)
- pulse duration 100 - 200 ns (FWHM)
- intensity $2 \cdot 10^9$ $7 \cdot 10^9$ ions per pulse



Pressure profile at free surface of copper sample

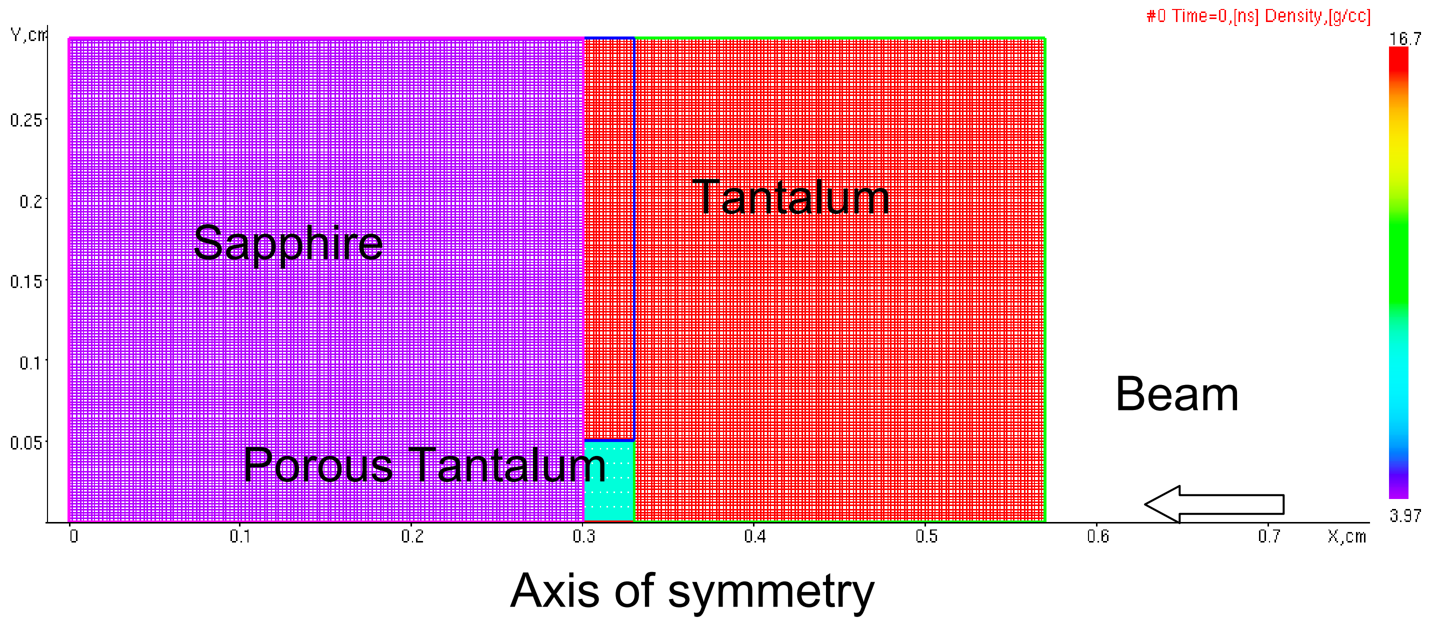


T-V diagram of copper near critical point of liquid-vapor transition states

New parameters

	Ion	Max. energy, AGeV	Max. intensity, per pulse	Focal spot size, (2*σ) mm	Pulse duration, ns	Comments
1	U28+	0.2	3e10	1.3	100	
2	U39+	0.35	3e10	1.2	100	exclusive mode with a stripper foil in the UNILAC

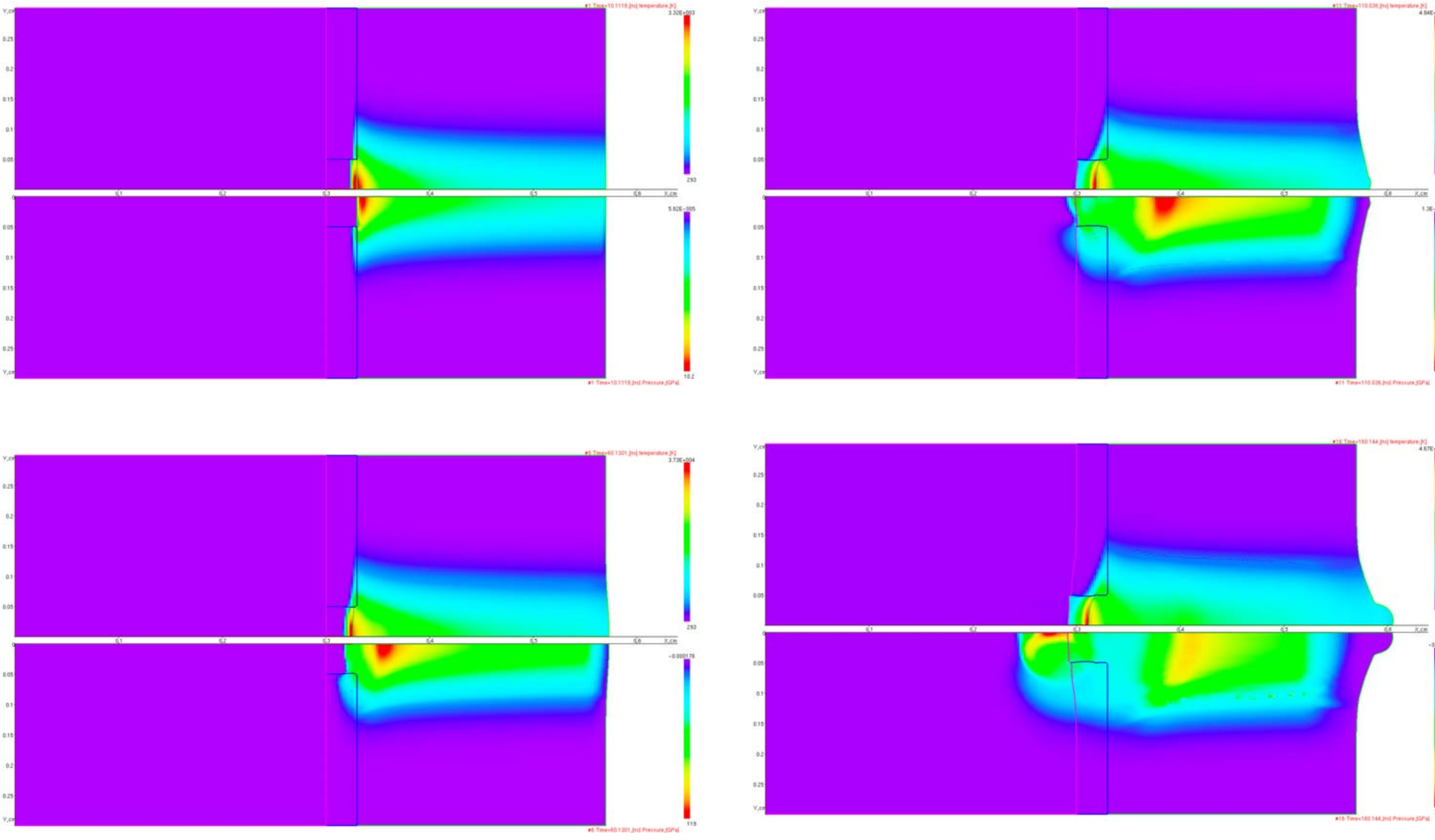
New geometry of experiments. A.V. Shutov simulation



Beam parameters for calculations: Uranium Beam. The intensity 3e10. The pulse duration 100 ns. Parabolic shape of the beam intensity in time. Parallel beam with intensity distribution by Gauss function along radius. The focal spot size FWHM=1.2mm. Energy of the beam ions is 0.35 AGeV

1. The Bragg peak is located at 1/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.5.
2. The Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.3.
3. Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.75.

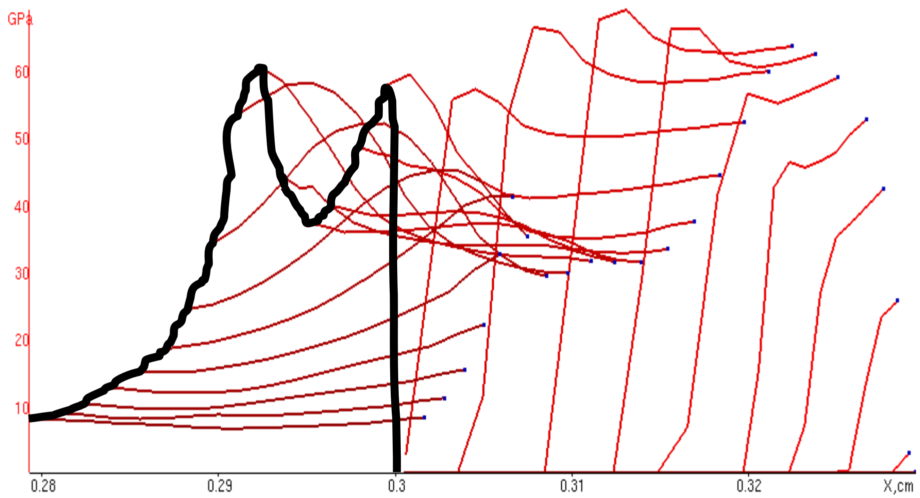
The Bragg peak is located at 1/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.5.

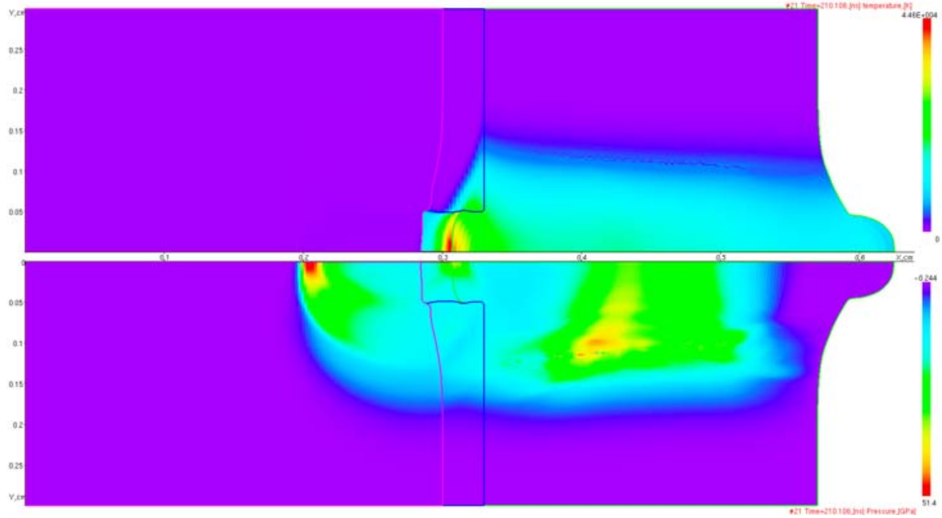


The numerical simulation results

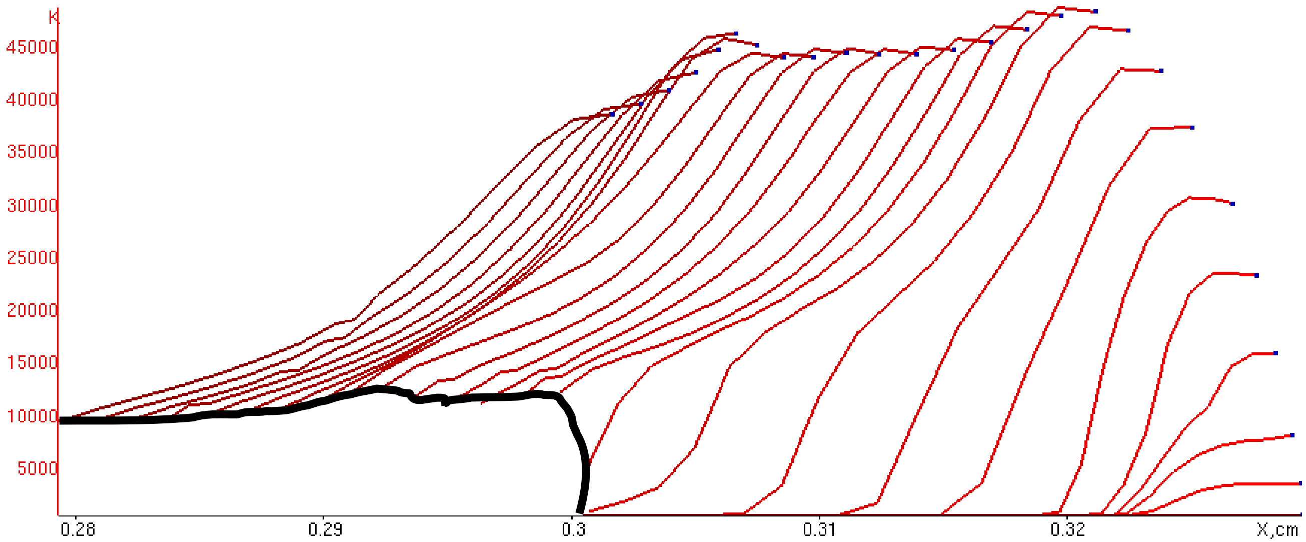
Field of temperature and pressure in successive moments of time every 50 ns

The Bragg peak is located at 1/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.5.



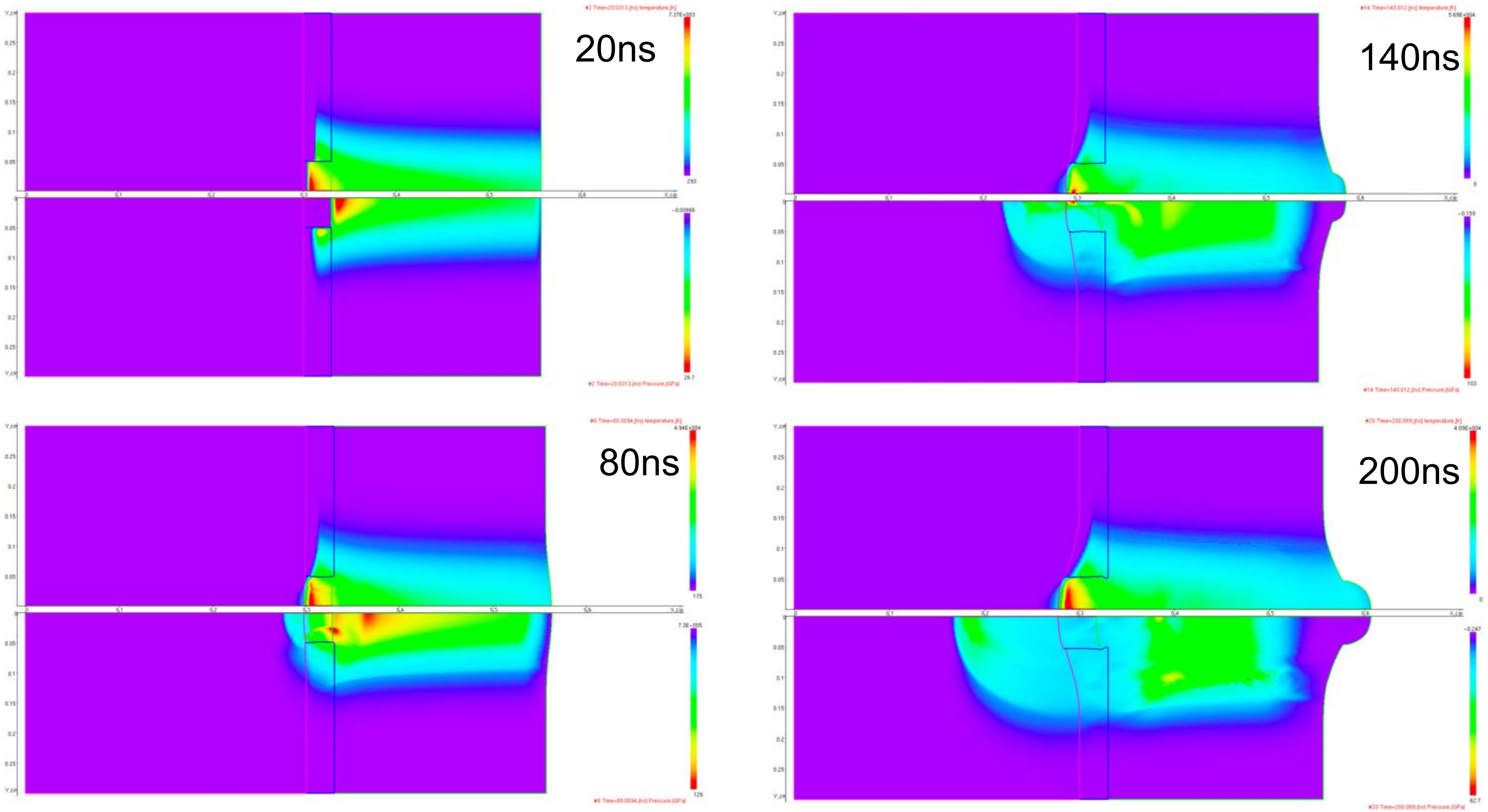


pressure profiles along axis of symmetry every 10 ns



temperature profiles along axis of symmetry every 10 ns

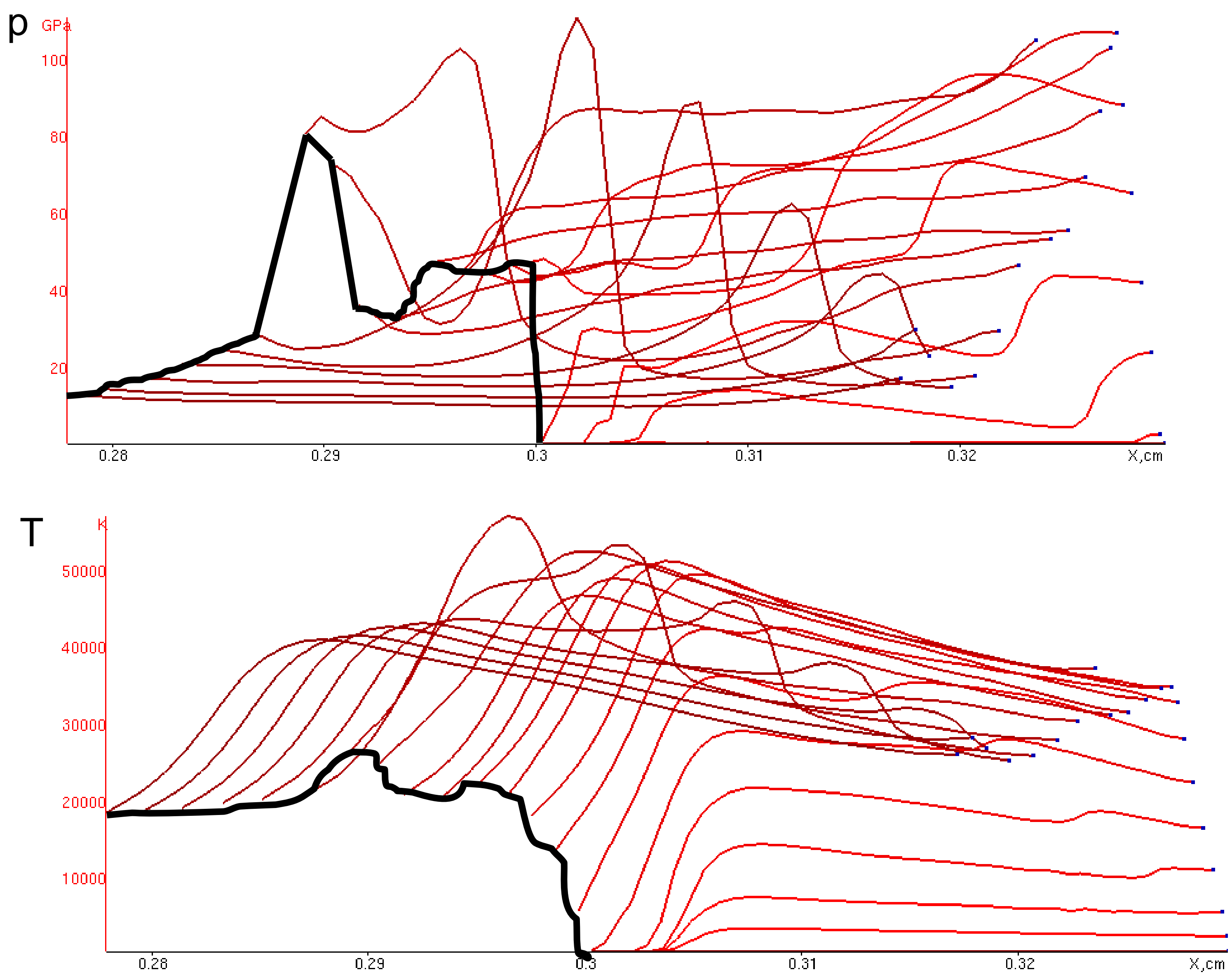
The Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.3.



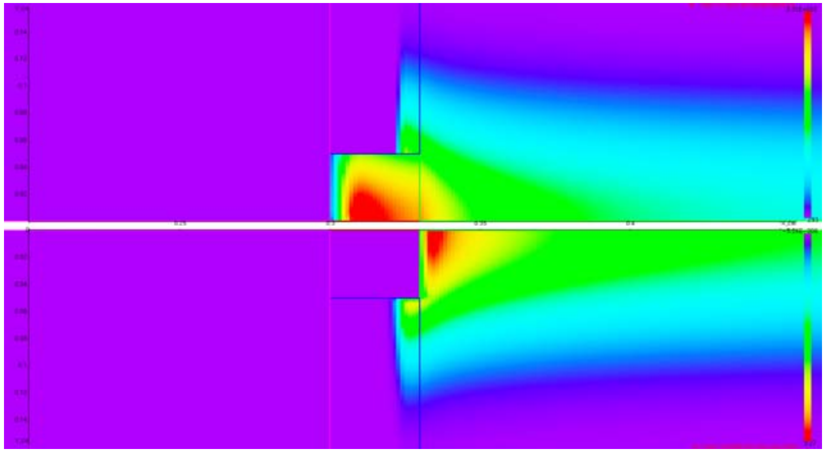
The numerical simulation results

Field of temperature and pressure in successive moments of time every 60 ns

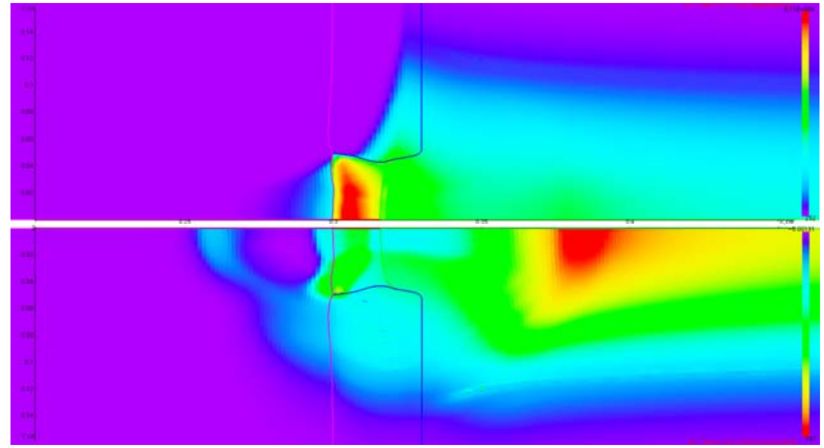
The Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.3.



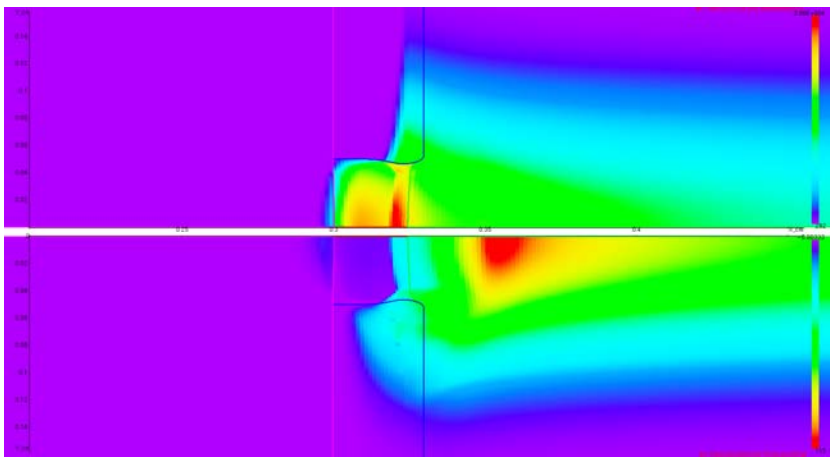
Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.75.



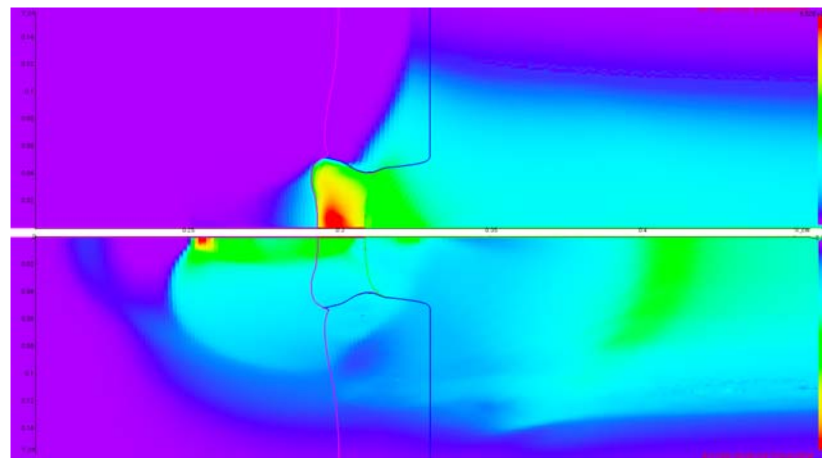
10ns



110ns

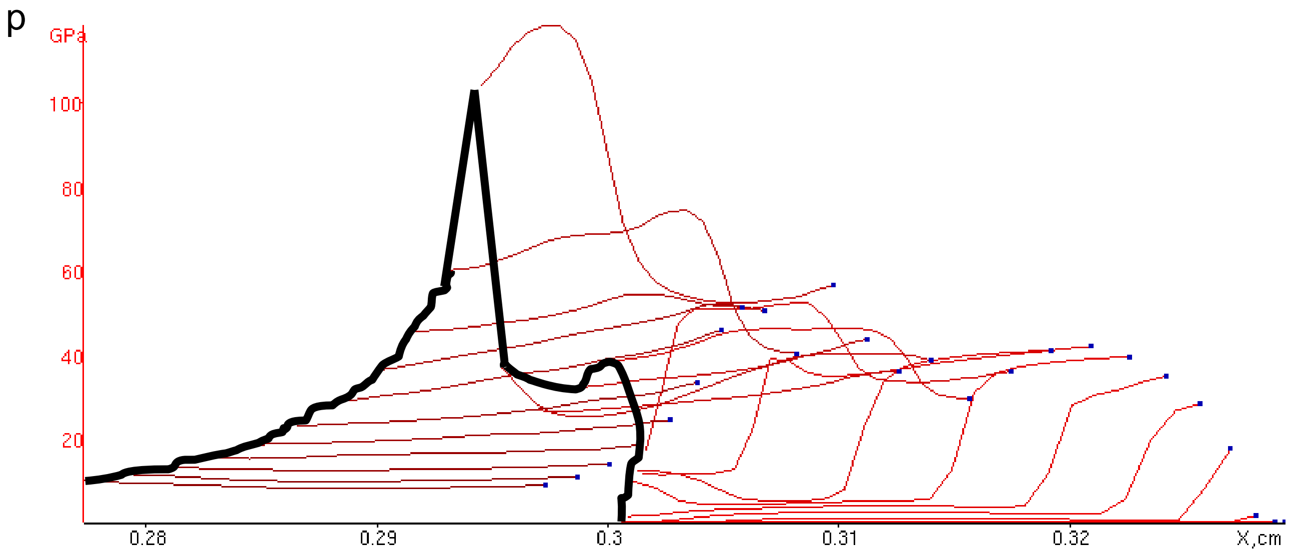


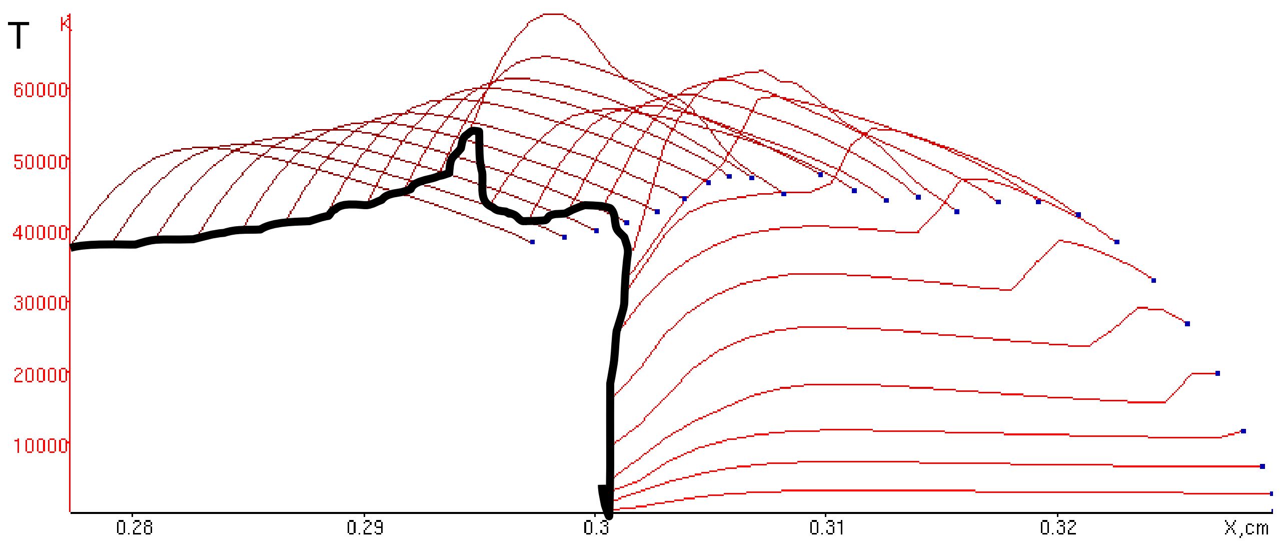
60ns



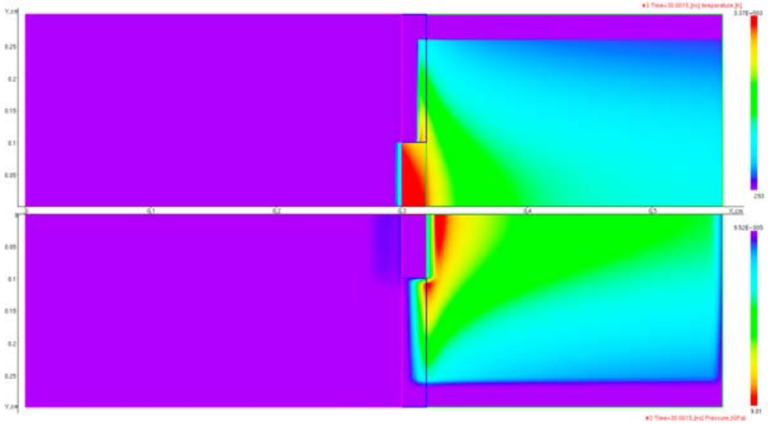
160ns

Bragg peak is located at 3/4 of the porous target depth. Porous Tantalum has porosity coefficient 0.75.

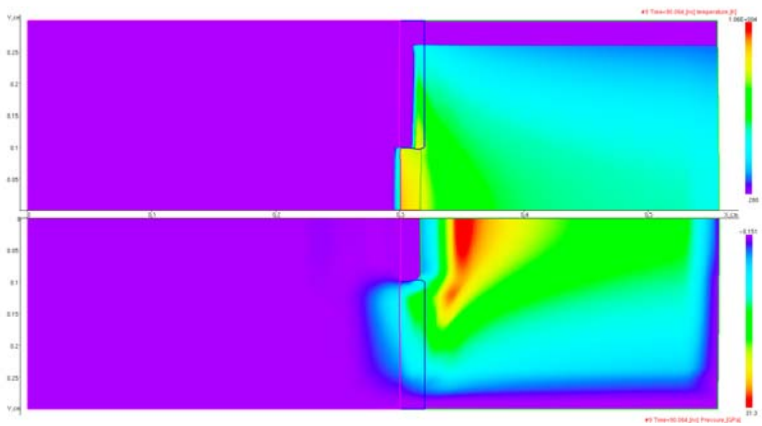




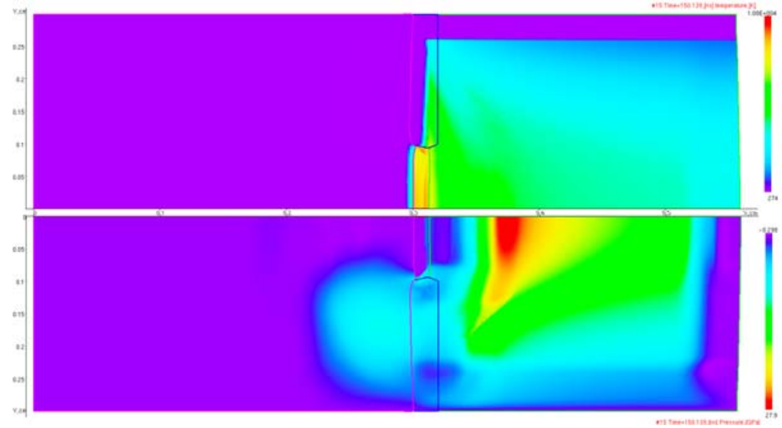
Varinat4: The Bragg peak is located at 3/4 of the porous target depth.
Porous Tantalum has porosity coefficient 0.75.
The focal spot size FWHM=3.6mm. The cavity radius 1 mm, thickness 0.2mm



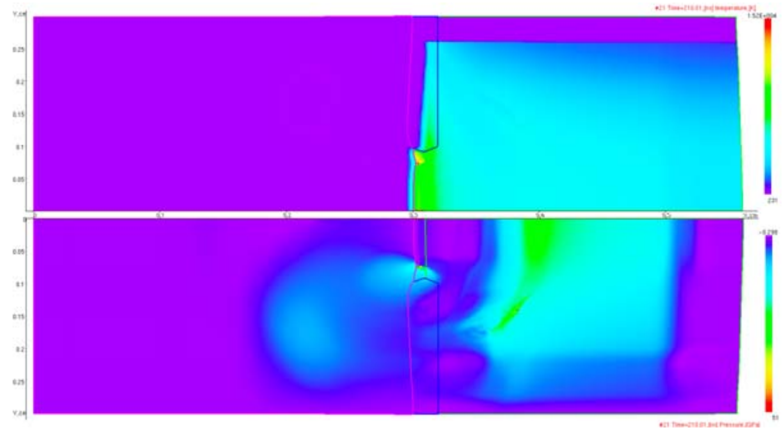
30ns



90ns

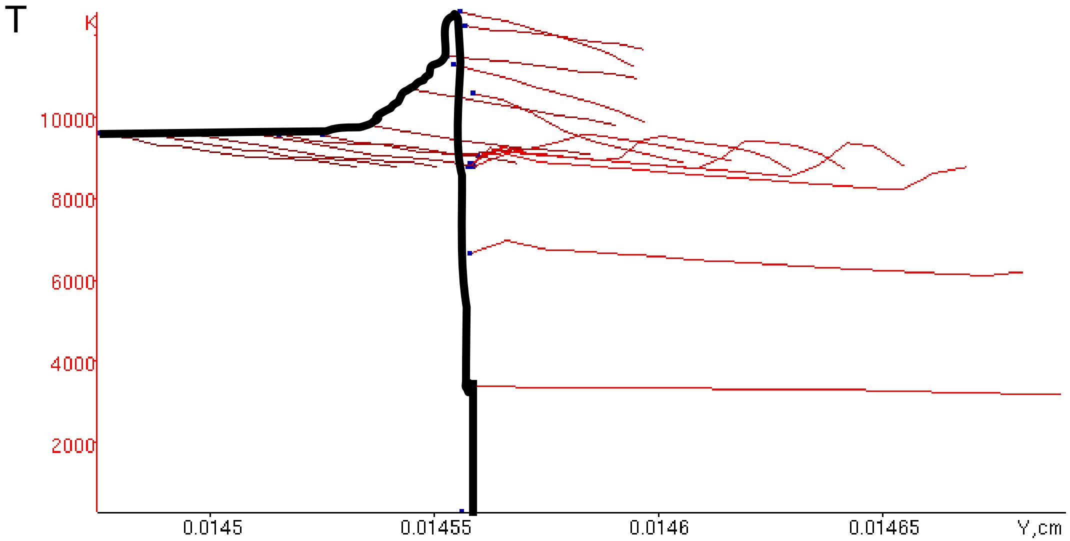


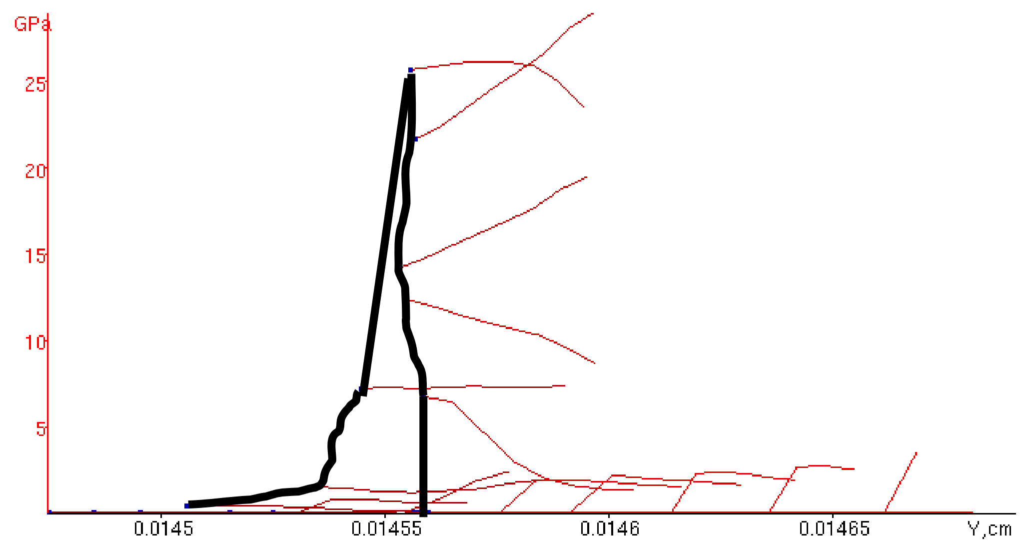
150ns



210ns

Varinat4: The Bragg peak is located at 3/4 of the porous target depth.
Porous Tantalum has porosity coefficient 0.75.
The focal spot size FWHM=3.6mm. The cavity radius 1 mm, thickness 0.2mm





Summary

We propose to study thermodynamic properties of various elements and materials, including refractory metals and alumina at elevated temperatures and pressures – 2-40 kK and 0.01-10 GPa – employing an intense heavy ion beam of SIS-18 synchrotron as driver. New plane experimental assembly will be used.
We propose to investigate by optical methods processes of material heating, evaporation, and compression under impact with window, ceramics disintegration and metal-dense plasma transition. These processes realized under beam action and following material expansion and compression between window and expanding metal liquid.
New thermodynamic experimental data will be obtained for refractory materials in poorly explored domain of it phase diagram.