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X-ray emission and absorption spectroscopy to study laser-initiated WDM.

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Warm dense matter generated due to the interaction of high contrast sub-PW ps laser pulses of (0.5-5)e20 W/cm2 laser intensities with solid matter is investigated experimentally.

The methods to determine the temperature of laser-generated warm dense matter created in relativistic laser plasma are introduced. The features in highly-resolved K-shell X-ray emission and absorption spectra of WDM are under discussion. Recent results obtained at Vulcan PW and Phelix facilities are discussed. X-ray absorption spectroscopy method was developed and applied in experiments with flat silicon foils i. The electron temperature of warm dense matter created at rear side of the target was estimated to be in the range of 140-300 eV.

The use of thin metal wires as a target allowed to trace the isochoric heating of a matter deep into the target. The temperature measured by means of K-shell X-ray emission spectroscopy obtained with spatial resolution along the wire axis and compared with the spectra simulation by collisional-radiative SCRAM code. For the first time, it becomes possible to distinguish surface target regions heated by the laser and mixed plasma mechanisms from those heated only by the hot electrons that generate warm dense matter with temperatures up to 50 eV, 800 mm deep into the matter. Additionally, for such targets with reduced cross dimensions, a strong electrostatic sheath fields confine the electrons to the target which efficiently and homogeneously heat it to high energy densities. Detailed simulations were performed to reproduce the hot-electron source and heating inside the target. They unravel an efficient confinement of the electron current, causing a substantial increase of energy deposition both from resistive and from collisional effects, when compared with the common foil-target geometry.