

**Study of Warm Dense Plasmas with Ultrafast X-rays**

Byoung-ick Cho

Department of Physics and Photon Science, GIST, Korea
Center for Relativistic Laser Science, IBS, Korea

Under extreme temperature and pressure conditions, normal matters behave abnormally and open regulates physical processes in the stars and large planets, inertial confinement fusion as well as the applied processes of laser machining and ablation. As an example of such extreme conditions, the warm dense plasma (WDP) or warm dense matter (WDM) regime represent the state between condensed matter and plasma, where the thermal energy is comparable to the Fermi energy and the ions are strongly coupled. This regime bridges the gap between plasma physics and condensed matter physics. In this talk, I will present a series of x-ray spectroscopy experiments for warm dense matters. Utilizing a high-power laser, a synchrotron, and an x-ray free electron laser, x-ray absorption and emission spectra of several materials, such as Cu, SiO₂ and Al under WDM conditions are measured at different time scales. Various properties of WDMs, such as electronic structure, electron temperature, heat capacities, and electron-ion relaxation rates will be discussed based on the x-ray measurement.

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