L-O2

1st Asia-Pacific Conference on Plasma Physics, 18-23, 09.2017, Chengdu, China

Experimental Study of K-shell Absorption Spectra in Dense Plasma at Shenguang II Laser Facility

Yang Zhao*, Zhiyu Zhang, Bo Qing, Jiamin Yang, Jiyan Zhang, Minxi Wei, Guohong Yang, Tianming Song, Gang Xiong, Min Lv, Zhimin Hu

Laser Fusion Research Center, China Academy of Engineering Physics
P. O. Box 919-986, Mianyang 621900, China

* E-mail: edwardszy@yahoo.com

Understanding the properties of highly compressed Warm Dense Matter and Hot Dense Plasma is important in the research field of planetary interiors and inertial confinement fusion. With the advent of the high-power laser facility, x-ray radiation-driven shocks were adopted to generate the dense plasma under high pressure [1-3].

Compared with WDM research of reflectivity and conductivity, X-ray absorption can provide direct information about the density, temperature, electronic, and ionic structures of dense matter. Thus, creating in a laboratory highly compressed matter and obtaining detailed measurements of x-ray absorption spectra, especially near the absorption edge of highly compressed matter, is very appealing. In this WDM experiment, colliding shocks driven by laser-converted radiation is used to compress aluminum / Silicon over two times solid density and low temperature below 1.0eV, an unattained state of high ion-ion coupling parameter in the laboratory. And a comparison of the measured K-shell edge with quantum molecular dynamics calculations is made.

In the hot dense plasma experiment, the aluminum sample was heated by M-band emission and compressed by radiation-driven shocks. By adopting a long laser (2ns) for backlighter and an x-ray streak crystal spectrometer, continuous variations of K-shell absorption spectra were obtained in one shot. The Pre-edge structure and XANES were studied during the preheating process. The time-resolved 1s-2p absorption features from F-like to C-like ions were observed in series with the radiation ablating.

This work shows the progress of the experimental study of H/WDM at ShenGuang II Laser Facility, and the K-shell absorption can provide a unique capability to probe matter at extreme conditions.

References：

【1】 J. Y. Zhang, H. Li, Y. Zhao, et al., Phys. Plasmas 19, 113302 (2012)

【2】 Y. Zhao, J. M. Yang, J. Y. Zhang, et. al., Phys. Rev. Lett. 111, 155003 (2013).

【3】 Y. Zhao, Z. Y. Zhang, B. Qing, et. al., Euro. Phys. Lett. 117, 65001 (2017).