Progress of ICF Diagnostic techniques and experimental results based on Shenguang laser facility in China

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Abstract: At present, Inertial Confinement Fusion (ICF) diagnosis technology has made a lot of progress in the field of optics, X-ray, particle diagnosis, and established the second largest experimental platform in the world. This report will focus on recent progress of universal X-ray framing camera, high sensitivity X-ray framing camera and pulse broadening X-ray framing camera on ShenGuang laser facilities. The spatial resolution X-ray detector (SRXRD), which can be used to measure the special position flux in Hohlraum, will be introduced. The key technologies of pulse width X-ray framing camera are introduced. The advantages and disadvantages of drift tube with hybrid complementary metal oxide semiconductor（hCMOS) and micro-channel plate (MCP) are analyzed. At the same time, the calibration and experimental results of Kirkpatrick-Baez (KB) microscope are introduced. The key technologies of Wolter microscope are analyzed, and the problems affecting imaging resolution and depth of field are analyzed in detail. At the same time, a new transmission bandpass technology is introduced. The advantages of the technology are introduced from the basic principles, calibration results and experimental results.

In recent years, a large number of experimental results have been achieved with the diagnostic system developed by us on Shenguang laser facility. Hohlraum and implosion experiments have been performed extensively on Shenguang series laser facilities in the context of laser indirect-drive inertial confinement fusion. Multiple aspects about the hohlraum energetics, drive symmetry and plasma condition are studied by a variety of methods resolving different photon ranges and multiple viewing areas. To improve the experimental uncertainty, several diagnostics are optimized and calibrated, also the power balance and pointing accuracy of laser beams are evaluated and improved. These works lead a rapid progress on hohlraum and implosion experimental capabilities and a series of successful experimental campaigns. In order to further optimize the hohlraum performance, other hohlraum geometry and hohlraum wall material (depleted Uranium and foam Au) are explored as well. Hohlraum experiments and modeling on Shenguang series laser facilities demonstrated quantitative understanding of the laser conversion, x-ray ablation and plasma motion in different regions.

Keywords: Inertial confinement fusion; High power laser; diagnostics technique; hohlraum physics, implosion