Progress of high spatial and temporal resolution diagnosis for inertial confinement fusion experiments In ShengGuang 100KJ laser facility

Feng Wang, Xing Zhang, Yulong Li, Bolin Chen, Yudong Pu, Li Yao, Zanyang Guan, Ao Sun, Yunsong Dong, Dong Yang, Jiamin Yang, Yuqiu Gu, Zongqing Zhao，Baohan Zhang

Laser Fusion Research center, China Academy of Engineering Physics, Mianyang 621900, China

In the laser driven inertial confinement fusion (ICF) experiment, it is necessary to compress the mm scale hollow target more than 30 times in a spherically symmetric and low entropy manner, forming a core of about 50μm high temperature and high density plasma hot spot, and then ablate the peripheral fusion fuel to support combustion. ICF implosion compression and fusion combustion are in a physical process of rapid contraction of space scale and accelerated evolution of time scale. However, due to driving symmetry, mixing of shell interface and hot spot caused by fluid instability growth, high-order mode of hot spot interface, asymmetry of hot spot and other factors, implosion performance is often significantly lower than theoretical design expectation, and it is necessary to develop high time-space resolution diagnostic technology and diagnostic instruments, The state evolution of ICF target in each stage of the implosion process in the experiment is precisely characterized to judge the physical and engineering factors affecting the implosion performance. In the implosion loading stage, factors such as the loading symmetry of the shock wave and the flatness of the wave front will become the seeds of the growth of the implosion compression symmetry and fluid instability. The research team has developed the three-axis velocity interferometer system for any reflector (VISAR) technology to characterize the driving symmetry of the multi angle shock wave, and has developed the 2ps resolution two-dimension VISAR to diagnose the non-uniformity of the wave front velocity field, At present, compressed ultrafast photography (CUP) VISAR technology is being developed and it is expected to realize the time evolution measurement of shock wave front with more than 50 frames. In the internal protection retardation and combustion stage, recently, a variety of high spatial and temporal resolution imaging diagnostic technologies have been developed mainly around the mode of retardation hot spot and hybrid analysis. The research team has established an ultra-high spatial and temporal resolution X-ray microscopic imaging method based on Wolter like microscopic imaging and magnetic drift time broadening camera, which can achieve 3μm space resolution and 10ps time resolution X-ray imaging in the 8keV energy region is expected to realize the imaging analysis of the eighth order mode and the following high mode of the hot spot interface; Developed a resolution of 6 μ M's toroidal curved crystal imaging technology, and the fluorescence imaging diagnosis method of missing elements has been established, and the diagnosis of fluid disturbance growth caused by isolated defects such as gas filled tubes has been carried out; The design of multi energy point KB imaging microscope and the diagnosis method of spatial distribution of hot spot bremsstrahlung intensity are proposed, which are used to measure the spatial distribution of hot spot electron temperature and diagnose the spatial distribution of mixing zone; A new method of variable cone curved crystal spectrum measurement is designed, which can increase the X spectrum sensitivity by more than 100 times in the energy range of 1-10 keV, and realize the high signal noise ratio measurement of the emission spectrum of trace mixed elements.