

Using laser-driven magnetized hohlraum to make a high temperature symmetrical clean X-ray radiation source

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Strong magnetic fields in high power laser laboratories play a prominent role in high energy density physics, while interaction of high power laser with high Z hohlraum is one effective way of converting laser energy to high temperature X-ray radiation source. To obtain high temperature symmetrical clean radiation source, capacitor-hohlraum target was designed based on capacitor-coil target, so megagauss axial magnetic field can be generated in hohlraum by the interaction of high power laser with the capacitor part. Then, interaction of laser with the magnetized hohlraum can be studied. Firstly, compared with the traditional hohlraum, the strong magnetic field in magnetized hohlraum can limit the plasma electron heat conduction in the laser channels, increase the plasma temperature, and reduce scattering laser. Secondly, magnetic pressure can suppress the hohlraum wall plasma motion, provide channels for laser injection, and avoid plasma filling and large-scale laser-plasma interactions. Lastly, strong magnetic field can guide hot electron out of hohlraum along the magnetic field lines, which provide clean hohlraum radiation. These are of great significance in hohlraum energetics and laser interaction with magnetized plasma.

500-700 T magnetic field was generated in a cylindrical hohlraum by the interaction of 1.8 kJ-1.0 ns-1064 nm laser with capacitor-coil target on SG-II laser facility, which was proven by B-dot probe. Magnetic field suppressed plasma filling, forming a hollow region of the plasma corona in the vacuum hohlraum, which was observed by an x-ray framing camera. Therefore, strong magnetic field is proven to effectively suppress the plasma filling in vacuum hohlraum instead of gas, providing an important potential way for hohlraum design in the laser indirect-drive inertial confinement fusion.

References

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