Progress of inertial confinement fusion study with spherical hohlraum

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In the report we present progresses of inertial confinement fusion (ICF) study, including experimental and theoretical study on novel octahedral spherical hohlraum[1-5], and study on novel implosion scheme of wedged-peak-pulse design[6], as well as ion-electron non-equilibrium model[7] for relaxing the hot-spot ignition conditions in ICF, and a new robust and efficient fusion neutron generation scheme by laser-driven spherically convergent plasma (SCPF)[8], etc.

From our theoretical study, the octahedral hohlraums[1-5] with 6 laser entrance holes (LEHs) have robust high symmetry throughout implosion and high energy coupling efficiency. We gave a design with optimum laser arrangement for ignition octahedral spherical hohlraum[2], and proposed a novel octahedral hohlraum with cylindrical LEHs[9] and LEH shields[10] to mitigate the influence of the wall blowoff on laser transport and to increase the laser coupling efficiency and improve the capsule symmetry. We also verify the robustness of the symmetry the octahedral spherical hohlraums by studying its sensitivity to random errors[4]. We have successfully carried out three spherical hohlraum experiments on ShengGuang laser facilities since 2014, including improvement of laser propagation by using the cylindrical LEHs[10] for the spherical hohlraum, and spherical hohlraum energetics experiment on the SGIII prototype laser facility[11], also comparison of LPI between the spherical hohlraums and the cylindrical hohlraums[12] on the SGIII laser facility which shows very low level of LPIs in spherical hohlraums. The wedged-peak-pulse design can raise the drive pressure and implosion velocity without significantly raising the fuel adiabat[7], thus can balance the energy requirement and hydrodynamic instabilities control at interfaces. Our analysis of the ion-electron non-equilibrium model[8] shows that the ignition condition can be greatly relaxed as compared with commonly used equilibrium model, and such non-equilibrium condition can be created with shocks induced in the wedged-peak-pulse design. Finally, We propose and realize a new scheme for robust and efficient fusion neutron generation by laser-driven spherically convergent plasma (SCPF)[8], etc.

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