8th Asia-Pacific Conference on Plasma Physics, 3-8 Nov, 2024 at Malacca

Recent results of the double cone ignition campaigns

Zhe Zhang[1], Yutong Li[2] and Jie Zhang[1,2,3]
[1] Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China
[2] Collaborative Innovation Center of IFSA (CICIFSA), Shanghai Jiao Tong University, Shanghai 200240, China
[3] MoE Key Laboratory for Laser Plasmas and School of Physics, Shanghai Jiao Tong University, Shanghai 200240, China
e-mail (speaker):zzhang@iphy.ac.cn

The double-cone ignition (DCI) scheme has been proposed as one of the alternative approaches to inertial confinement fusion, based on direct-drive and fast-ignition, in order to reduce the requirement for the driver energy. We have carried out several experimental campaigns since 2018, to study the basic physical processes, such as the LPIs, the colliding process, the stagnation before heating, the total energy transfer efficiency and so on.

The quantitatively measurements of scattering light have indicated that 89%–96% of the laser energy was absorbed by the target, with moderate stimulated Raman scatterings. The side scattering has dominated the LPI.[1]

To optimize the colliding process of the plasma jets formed by the shells embedded in the gold cones, an x-ray streak camera was used to capture the spontaneous x-ray emission from the plasma jets. High-density plasma jets with a velocity of 220 km/s are observed to collide and stagnate, forming an isochoric plasma with sharp ends. During the head-on colliding process, the self-emission intensity nonlinearly increases because of the rapid increase in the density and temperature of the plasma jets. [2]

The high-speed plasma jets from the cone tips collide and form a stagnating plasma with a higher density during the stagnation stage, preheating the plasma by the Coulomb potential. The preheated plasma is then rapidly heated up further to the ignition temperature by fast electrons generated by a powerful laser pulse of 10 ps. The stagnation period was found to be about 300 ps, the temperature of the core area of the stagnated plasma was between 340 and 390 eV, while the aspect ratio of the colliding plasma was about 0.78. [3]

Anyhow, only 2%–6% of the laser energy was coupled into the plasma jets ejected from the cone tips, which was mainly restricted by the mass reductions during the implosions inside the cones. [4]

References
[1]K. Glize *et al*, Phys. Plasmas **30**(12), 122706 (2023).
[2]Z. Liu *et al*, Phys. Plasmas **31**(4), 042704 (2024).
[3]K. Fang *et al*, Phys Plasmas 30(4), 042705 (2023).
[4]Y. Zhang *et al*, Phys. Rev. E **109**(3), 035205 (2024).

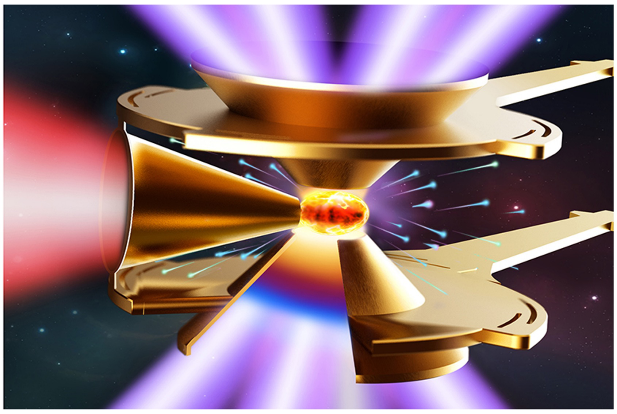

Figure 1. The scheme of Double-cone ignition.