OPTIMIZATION DESIGN OF THE LASER PARAMETERS FOR THE DOUBLE-CONE IGNITION SCHEME ENPOWERD BY ARTIFICIAL INTELEGENCE

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ABSTRACT

Laser fusion has a potential to provide humanity with an ultimate energy with low-carbon release. In 2022, the Lawrence Livermore National Laboratory achieved the fusion ignition target with a fusion energy gain greater than unit for the first time by using a 2.05 MJ laser energy. Double-cone ignition (DCI) scheme is one of the promising fast-ignition schemes for high-gain laser driven fusion energy [1-3]. DCI scheme employs two head-on gold cones to guide the nanosecond laser driven implosion to obtain high-density colliding plasmas with sharp edges, for the injection of relativistic electrons generated by PW picosecond ignition laser pulses. The exist of implosion gold cones make it necessary to optimize the plasma implosion with two-dimensional hydrodynamic codes. In this report, we present AI powered optimization design of the plasma implosions of the DCI scheme with the MULTI-2D simulations [4,5]. The laser beams are modulated by special CPPs (Continuous Phase Plates) to achieve quasi-uniform irradiation. Both the gold cones and laser screens are included in the simulations. It is found that compressed colliding plasmas with densities higher than 100 g/cc can be achieved on the SG-II Upgraded laser facility.

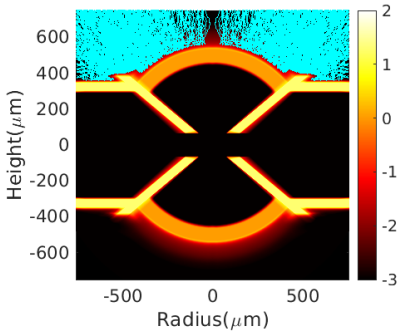

Fig. 1 Simulation setup for the laser driven implosion of the double-cone ignition (DCI) scheme

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