PROBING HOT ELECTRON PREHEAT AND HOT SPOT ASYMMETRIES IN ICF IMPLOSIONS

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In direct-drive inertial confinement fusion, a laser directly irradiates a spherical capsule of cryogenic deuterium and tritium (DT) enclosed by a plastic ablator. The DT capsule needs to be compressed on a low adiabat to achieve high compression upon convergence. The final compression is degraded if the capsule is either preheated by hot electrons generated by the two-plasmon decay (TPD) instability or the central hot spot is highly distorted. Hot electrons are measured by the hard x-rays they emit as they are stopped in the ablator material and the DT fuel. Although hot electrons are certainly present in the system, there is not enough experimental data to determine the amount of hot electron energy deposited in the DT fuel. In this work, we present the first measurements of the fraction of hot electrons absorbed by the DT fuel. The TPD source primarily depends on the conditions in the corona. It follows that if plastic shell with the same mass and outer diameter as a companion cryogenic target is irradiated with the same laser pulse, then the hot electron source will be the same for both capsules. The resulting difference in the hard x-ray signals provides the necessary information to infer the fraction of the hot electron energy deposited in the DT fuel. As the hot spot is compressed by the imploding shell, the temporal evolution of the bremsstrahlung emission is strongly affected by the hot spot asymmetries. In a uniform hot spot, the self-emission volume exhibits a minimum at the time of peak compression while in a distorted hot spot, the x-ray emitting volume decreases monotonically. Therefore by measuring the temporal evolution of the emitting volume one can infer the degree of non-uniformities in the hot spot.

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