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Integrated Simulations of Hot-Electron Transport and Ignition for Direct-Drive, Fast-Ignition Targets

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A thorough understanding of future integrated fast-ignition experiments combining compression and heating for high-density thermonuclear fuel require hybrid (fluid+particle) simulations of the implosion and ignition process. Very different spatial and temporal scales need to be resolved to model the entire fast-ignition experiment. The 2-D axisymmetric hydrocode *DRACO*[1] and the 2-D/3-D hybrid-PIC code *LSP*[2] have been integrated to simulate the implosion and heating of direct-drive fast-ignition fusion targets. *DRACO* includes the physics required to simulate compression, ignition, and burn of fast-ignition targets. *LSP* simulates the transport of hot electrons from the place where they are generated by a petawatt laser pulse to the dense fuel core where their energy is absorbed. The results of integrated simulations of optimized spherically symmetric and cone-in-shell DT, high-gain, fast-ignition targets[3] will be presented. The minimum energy required for ignition is found for hot electrons with a realistic angular spread and Maxwellian energy-distribution function.[4] The results from simulations of cone-in-shell plastic targets designed for fast-ignition experiments on OMEGA EP will be presented. Target heating and neutron yield are computed. Resistive Weibel instability is found to break the hot-electron beam into filaments. The global self-generated resistive magnetic field of the beam is found to collimate the hot electrons. The self-generated field increases the coupling efficiency of hot electrons with the target core and reduces the minimum energy required for ignition. This work was supported by the U.S. Department of Energy under Cooperative Agreement Nos. DE-FC02-04ER54789 and DE-FC52-08NA28302. Contributors: K.S. Anderson, R. Betti, V. Gotcheva, J.F. Myatt, J.A. Delettrez, S. Skupsky.

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