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Fast ignitor target studies for HiPER[1]

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Recently, a European collaboration has proposed the HiPER facility [1], aimed at the demonstration of laser driven inertial fusion fast ignition. According to the present design, HiPER will have a 3ω, multi-beam, multi-ns-pulse of about 250 kJ and a 2ω or 3ω ignition beam delivering 70 kJ in about 15 ps. In this talk, we present studies on fast-ignitor targets directly driven by 100-300 kJ compression pulses, followed by 70-100 kJ ignition pulses. First, we discuss ignition and compression requirements, and present gain curves, based on a model including ablative drive, compression, ignition and burn, and taking the coupling efficiency η_{ig} of the igniting beam as a parameter. It turns out that ignition and moderate gain (up to 100) can be achieved, provided that adiabat shaping is used in the compression and the efficiency η_{ig} exceeds 20%. According to present understanding, a 2ω ignition beam is required to make the hot-electron range comparable to the desired size of the hot spot. A reference target family is then presented, based on 1-D fluid simulation of compression, and 2-D fluid and hybrid simulations of fast electron transport, ignition and burn. The sensitivity to compression pulse shape, as well as to hot-electron source location, hot electron range and beam divergence is also discussed. Models and perturbation codes have been used to study the Rayleigh-Taylor instability. Crucial issues that have so far not been studied in detail include high convergence cone-guided implosions, the generation of the hot electron beam and its transport in low-to-moderate density plasmas. However, we have begun studying the hydrodynamics of cone-guided targets with model hydrodynamics simulations and we are tackling aspects of intense laser interaction, hot electron generation and transport with PIC codes. [1] M. Dunne, Nature Phys., **2**, 2 (2006); HiPER Technical Design Report: http://www.hiper-laser.org/overview/TDR/tdr.asp

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