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Robustness studies of NIF ignition targets in two dimensions[1]

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Inertial confinement fusion capsules are critically dependent on the integrity of their hot spots to ignite. At the time of ignition, only a certain fractional perturbation of the nominally spherical hot spot boundary can be tolerated and the capsule still achieve ignition. The degree to which the expected hot spot perturbation in any given capsule design is less than this maximum tolerable perturbation is a measure of the ignition margin or robustness of that design. Moreover, since there will inevitably be uncertainties in the initial character and implosion dynamics of any given capsule, all of which can contribute to the eventual hot spot perturbation, quantifying the robustness of that capsule against a range of parameter variations is an important consideration in the capsule design. Here, the robustness of the 300 eV indirect drive target design for the National Ignition Facility (NIF) [J. D. Lindl, *et. al.*, Phys. Plasmas **11**, 339 (2004)] is studied in the parameter space of inner ice roughness, implosion velocity, and capsule scale. A suite of two thousand two-dimensional simulations, run with the radiation hydrodynamics code Lasnex, is used as the data base for the study. For each scale, an ignition region in the two remaining variables is identified and the “ignition cliff” is mapped. In accordance with the theoretical arguments of W. K. Levedahl and J. D. Lindl [Nucl. Fusion **37**, 165 (1997)] and R. Kishony and D. Shvarts [Phys. Plasmas **8**, 4925 (2001)], the location of this cliff is fitted to a power law of the capsule implosion velocity and scale. It is found that the cliff can be quite well represented in this power law form, and, using this scaling law, an assessment of the overall (one- and two-dimensional) ignition margin of the design can be made. The effect on the ignition margin of an increase or decrease in the density of the target fill gas is also assessed.

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