ICF CAPSULE IMPLOSION SCALINGS AND SENSITIVITIES

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The computationally derived scaling of capsule velocity, mass remaining, shock timing, core shape, and hydroinstability growth with key laser and target parameters were compared to simple analytic models [1,2] to gain further insight into the physics and sensitivities of various ignition capsule surrogates used to optimize implosion performance [3,4]. We will present an update of this work, encompassing all phases of the implosion, from shock strength, shock merge time, and Richtmyer-Meshkov (RM) growth through foot asymmetry, Rayleigh-Taylor (RT) growth and ending with peak velocity and burnwidth sensitivity. In particular, the scalings with respect to radiation temperature, foot pulse shape, ablator thickness and material (CH, HDC, Be) are examined as part of comparing the merits of evolving ICF design options.

For shock timing, we have added the effects of rarefactions from the ablator/fuel interface and prior shock overtakes, providing improved matches to simulation sensitivities [5]. A simplified treatment of the RM growth phase [6] is used to extract differences in ablator perturbation growth behavior as function of foot pulse shape, ablator thickness and ablator material. The sensitivity of surrogate capsules (backlit foamballs and thinshells [7] is reexamined in light of measuring the pulse-dependent foot drive symmetry [8]. A simple model for RT growth sensitivity will be presented, including evaluating effects of low mode growth on fuel areal density asymmetries [9] and residual kinetic energy [10]. The sensitivity of peak implosion velocity [11-13] to initial capsule thickness is refined using realistic rates of rise of peak drive. Finally, we will end with some intriguing hypotheses for differences in x-ray vs nuclear burnwidths as functions of hot spot x-ray power [14].

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[1] O.L. Landen *et. al.*, Phys. Plasmas 18 (2011) 051002.
[2] J.D. Lindl *et. al.*, Phys Plasmas 21 (2014) 020501.
[3] S.W. Haan *et. al.*, Phys. Plasmas 18 (2011) 051001.
[4] M.J. Edwards *et. al.*, Phys. Plasmas 18 (2011) 051003.
[5] H.S. Robey *et. al.*, Phys. Rev. Lett. 108 (2012) 215004.
[6] J.L. Peterson, D.S. Clark, L.P. Masse, and L.J. Suter, Phys. Plasmas 21 (2014) 092710.
[7] S.M. Pollaine *et. al.*, Phys, Plasmas 8 (2001) 2357; P.A. Amendt *et. al.*, ibid. 2908.
[8] R.P.J. Town *et. al.*, Phys. Plasmas 21 (2014) 056313.
[9] J. Gu *et. al.*, Phys. Plasmas 21 (2014) 012704.
[10] A. Kritcher *et. al.*, Phys Plasmas 21 (2014) 042708.
[11] D.A. Callahan *et. al.*, Phys Plasmas 19 (2012) 056305.
[12] N.B. Meezan *et. al.*, Phys Plasmas 20 (2013) 056311.
[13] Y. Saillard, Nucl. Fusion 46 (2006) 1017.
[14] T. Ma *et. al.*, Rev. Sci. Instrum. 83 (2012) 10E115.