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A Classical Mechanics Piston-Model for Understanding the Impact of Asymmetry on ICF Implosions[1] O.A. HURRICANE, D.T. CASEY, O. LANDEN, A.L. KRITCHER, R. NORA, P.K. PATEL, J.A. GAFFNEY, K.D. HUMBIRD, J.E. FIELD, M.K.G. KRUSE, J.L PETERSON, B.K. SPEARS, Lawrence Livermore Natl Lab — Low mode asymmetry in ICF implosions has been recognized as a potential performance limiting factor. Recently a non-linear, but solvable, theory based upon the simple picture of a pair of asymmetric pistons has generated new insights and provides some practical formulae for estimating the degradation of an implosion due to mode-1 asymmetry and there are hints the model naturally extends to mode-2. Asymmetry of the implosion shell, as opposed to asymmetry of the hot-spot, is key to the model. By including time-dependent swing in the model, it is shown that a key variable in the model is the shell asymmetry fraction at stagnation, f, which interconnects DSR asymmetry measured by nuclear diagnostics, the neutron-time-of-flight measured hot-spot velocity, and the concept of RKE. The theory yields explicit expressions for the impact of asymmetry upon hot-spot diameter, stagnation pressure, hot-spot energy, inertial confinement-time, Lawson parameter, hot-spot temperature, fusion yield, and yield amplification. Agreement is found between the scalings coming from the theory and ICF implosion data from the NIF and to large ensembles of detailed simulations, making the theory handy for interpreting data.

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