

GENERALIZED LAWSON CRITERIA FOR INERTIAL CONFINEMENT FUSION*

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The Lawson Criterion was proposed by John D. Lawson in 1955 as a general measure of the conditions necessary for a magnetic fusion device to reach thermonuclear ignition^[1]. Over the years, similar ignition criteria have been proposed which would be suitable for Inertial Confinement Fusion (ICF) designs^{[2][3][4]}. This paper will compare and contrast several ICF ignition criteria based on Lawson's original ideas. Both analytical and numerical results will be presented which will demonstrate that although the various criteria differ in some details, they are closely related and perform similarly as ignition criteria. A simple approximation will also be presented which allows the inference of each ignition parameter directly from the measured data taken on most shots fired at the National Ignition Facility (NIF) with a minimum reliance on computer simulations. Evidence will be presented which indicates that the experimentally inferred ignition parameters on the best NIF shots are very close to the ignition threshold.

- [1] J. D. Lawson, "Some Criteria for a Power producing thermonuclear reactor", (Technical Report). Atomic Energy Research Establishment, Harwell Bershire, U.K.A.E.R.E. GP/R 1807 (December 1955).
- [2] Ricardo Betti, et al, "Thermonuclear ignition in inertial confinement fusion and comparison with magnetic fusion", *Plasma of Physics* **17**, 058102 (2010).
- [3] Baolian Cheng, Thomas J. T. Kwan, Yi-Ming Wang & Steven Batha, "On the thermonuclear ignition criterion at the National Ignition Facility", LA-UR-14-24110, August 5, 2014.
- [4] John Lindl, Otto Landen, John Edwards, Ed Moses, "Review of the National Ignition Campaign 2009-2012", *Physics of Plasmas* **21**, 020501 (2014).

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