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Inertial Confinement Fusion: progress through close coupling of theory and experiment[1]

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It has been nearly 50 years since the first approach to Inertial Confinement Fusion (ICF) was discussed and 36 years since the first publication appeared. For DT plasmas, the ignition (Lawson) criterion can be simply stated as (pressure * time) > 10 atmosphere-seconds. In ICF, plasma confinement times are set by the plasma inertia to a few 10's of picoseconds. Therefore, an igniting ICF plasma needs pressures > 100 billion atmospheres. Achieving these extreme conditions requires a temporally precise, intense field (the equivalent of >200 TW/cm^2) that symmetrically (~1%) drives the fusion target. Over the past three decades the goal of achieving these extreme conditions has led to tremendous advances in plasma physics, computational tools, diagnostics, precision targets, and experimental facilities. Close coupling of simulations and experiments have led the way to a detailed understanding of the requirements for achieving ignition, enabled by driver energies that have gone from kilojoules to Megajoules and simulations that will soon exceed a Petaflop. ICF research in the United States is entering an exciting new phase with the recent completion of the Sandia Z-Refurbishment Project and the LLE Omega Extended Performance Project. The LLNL National Ignition Facility (NIF) Project will be completed in 2009, and the National Ignition Campaign (NIC) will perform the first ignition attempts on the NIF soon thereafter. This talk will briefly review highlights of the history of ICF with particular attention to the close coupling of theory and experiment, which has been a hallmark of ICF research.

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