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Ushering in A New Era in Lasers: The National Ignition Facility¹

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The world's largest ultraviolet laser, the National Ignition Facility (NIF), under construction at Lawrence Livermore National Laboratory, is scheduled to be complete by March 2009. NIF focuses on three main missions: support of stockpile stewardship to ensure a safe and reliable nuclear stockpile, demonstrating the feasibility of inertial confinement fusion (ICF) as a clean source of energy, and enabling high-energy-density (HED) science to help understand the physical processes that drive the cosmos. These three missions share the need to study materials at extreme conditions: temperatures up to 108 K, densities approaching 1000 grams per cc, and pressures up to 10^{10} megapascals. Moreover, in fusion events NIF will produce, for a short time, a neutron density up to 10^{21} cm⁻³. These conditions occur only in the interiors of stars, during thermonuclear burn, and in supernova events. NIF's next set of experiments, to study the systematics of ICF, is scheduled to begin in 2008 with the goal of conducting a credible ignition experiment by 2010. NIF will also conduct a variety of basic science experiments that will include laser-plasma interactions; solids at extremely high pressure leading to information about planetary interiors; hydrodynamic instabilities; and nuclear astrophysics. By 2010, NIF will be managed as a national user facility to best exploit its scientific potential. Users of NIF will include researchers from the Department of Energy national laboratories, scientists from academia, and other national and international users. Nuckolls, Wood, and Thiessen proposed ICF half a century ago, within weeks of the first demonstration of a working laser. Successive generations of lasers were built with the goal of achieving self-sustaining nuclear fusion and energy gain in the laboratory for more than half a century. With the completion of NIF that long-sought goal will be much closer to realization. The talk will focus on NIF technical capabilities and the exciting ICF and science campaigns that will be enabled by NIF.

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