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OMEGA Experiments on the Shock-Ignition ICF Concept

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Shock ignition[1] is an ICF concept that assembles thermonuclear fuel to high areal densities and then ignites it by launching a strong shock wave into the compressed fuel. The low-adiabat fuel assembly implodes with a velocity that is less than that required for hot-spot ignition. An intensity spike at the end of the main drive pulse generates a strong shock that is timed to meet the return shock bouncing back from the capsule center in the hot spot. The resulting fuel assembly is non-isobaric and will ignite with less energy than a conventional isobaric implosion.[1] Experiments to study the shock-ignition concept were performed on the OMEGA Laser System using 40-μm-thick, 0.9-mm-diam plastic shells filled with D_2 gas. The targets were driven by a relaxation adiabat-shaping laser pulse with a short picket pulse[2] and a high-intensity spike. The implosion was optimized by measuring the fuel assembly performance as a function of the timing of the picket pulse and the spike. Neutron-averaged areal densities of $\sim$200 mg/cm^2 were measured. The shock-generated implosion showed fusion product yields enhanced by a factor of $\sim$4 compared to an implosion without the spike. The measured neutron yield for a 25-atm fill, an adiabat of 1.6, and 17 kJ of laser energy was $\sim$10% of the 1-D simulation prediction. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreements DE-FC52-92SF19460 and DE-FC02-04ER54789. Contributors: R. Betti,* C. Stoeckl, K.S. Anderson,* J.A. Delettrez, V.Yu. Glebov, F.J. Marshall, D.N. Maywar, R.L. McCrory, D.D. Meyerhofer, P.B. Radha, T.C. Sangster, V.A. Smalyuk, A.A. Solodov,* B. Yaakobi, and C.D. Zhou, *UR/LLE*; J.A. Frenje, C.K. Li, R.D. Petrasso, and F.H. Séguin, *MIT-PSFC*; L.J. Perkins, *LLNL*; D. Shvarts, *NRCN (Israel).* *Also at the Fusion Science Center for Extreme States of Matter and Fast Ignition.

[1]R. Betti *et al.*, Phys. Rev. Lett. **98**, 155001 (2007).
[2]K. Anderson and R. Betti, Phys. Plasmas **11**, 5 (2004).