Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Burning DT Plasmas with Ultrafast Soft X-Ray Pulses S.X. HU, V.N. GONCHAROV, S. SKUPSKY, Laboratory for Laser Energetics, U. of Rochester — Fast ignition with narrowband, coherent ultrafast soft x-ray pulses[1] has been investigated for cryogenic deuterium–tritium (DT) plasma conditions achieved on the OMEGA Laser System. In contrast to using hard x-rays ($h\nu = 3$ to 6 keV) proposed in the original x-ray fast-ignition proposal, we find that soft x-ray sources with $h\nu \approx 500$-eV photons can be more suitable for igniting the dense DT plasmas. Two-dimensional radiation–hydrodynamics simulations have identified the breakeven conditions for realizing such a "hybrid" ignition scheme (direct-drive compression with soft x-ray heating) with 50-μm-offset targets: an $\sim$10-ps soft x-ray pulse ($h\nu \approx 500$ eV) with a total energy of 500 to 1000 J to be focused into a 10-μm spot size. A variety of x-ray pulse parameters have also been investigated for optimization. It is noted that an order of magnitude increase in neutron yield has been predicted even with x-ray energy as low as $\sim$50 J. Scaling this idea to a 1-MJ large-scale NIF target, a gain above $\sim$30 can be reached with the same soft x-ray pulse at 1.65-kJ energy. Even though such energetic x-ray sources do not currently exist, we hope that the proposed ignition scheme may stimulate efforts on generating powerful soft x-ray sources in future. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC52-08NA28302.

[1]S. X. Hu, V. N. Goncharov, and S. Skupsky, "Burning Plasmas with Ultrashort Soft-X-Ray Flashing," to be published in Physics of Plasmas.

S.X. Hu
Laboratory for Laser Energetics, U. of Rochester

Date submitted: 11 Jul 2012 Electronic form version 1.4