LASER SCIENCE AND TECHNOLOGY PROGRESS TOWARD POLAR DIRECT DRIVE AT THE NATIONAL IGNITION FACILITY

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Polar direct drive (PDD) makes it possible to carry out direct-drive–ignition experiments at the National Ignition Facility (NIF) without extensive reconfiguration by using the indirect-drive beam configuration with beams repointed toward the equator of the target. A joint LLNL–LLE working group is developing new PDD laser capabilities and optics for the NIF that are required for direct-drive implosions.

One-dimensional smoothing by spectral dispersion with multifrequency modulation (multi-FM 1-D SSD) and optimized on-target beam profiles are required to achieve the required irradiation uniformity. Multi-FM 1-D SSD has been demonstrated on an OMEGA EP beamline and plans are set to implement it on a quad of NIF beams for validation experiments. Continuous phase plates (CPP's) have been designed for initial PDD implosion experiments and prototype manufacturing is scheduled. High-resolution laser pulse shapes with multiple picket pulses are needed to provide adiabat shaping for shell stability. High-temporal-resolution pulse-shaping technology developed for the OMEGA Laser System can be implemented in a future upgrade to the NIF Master Oscillator Room. Hemispheric wavelength detuning is required to mitigate cross-beam energy transfer. System analysis and experiments are underway to quantify technical challenges posed by increasing the NIF center wavelength tuning capability to ±6 Å (UV). Single-beam polarization smoothing can be achieved using patterned UV birefringent coatings in the final optics assembly using glancing-angle deposition (GLAD). Research and development is advancing GLAD technology to achieve the required damage threshold, low-scatter performance, and near-field spatial beam contrast.

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