

ENABLING SUSTAINABLE HIGH PERFORMANCE OPERATIONS ON NIF*

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The National Ignition Facility (NIF) laser consists of a 192 beam laser system capable of delivering up to 1.8 MJ energy in shaped pulses of up to 500 TW peak power in the third harmonic (351 nm) of the fundamental infrared wavelength of 1053 nm. Since its completion in 2009, NIF has performed over 1000 target shots in supporting a diverse set of missions (Inertial Confinement Fusion, High-energy Density Physics, Fundamental Discovery Science, and National Security applications). NIF solicits and supports experimental campaigns from a variety of national and international users. Supporting these experiments requires an assessment of the experiment configurations for potential risk to the facility as well as adjustments to the laser performance needed to meet the goals of the experiment.

Risks to the facility include optical component damage from both incident laser light and that scattered from target structures. In addition, damage to optics and diagnostics from disassembly of the target can occur. In order to lower the optical component damage risk from the incident laser light, we are improving the beam flatness by using a programmable spatial shaper in the front end. Initial data show a ~30% reduction (from 10% to about 7% with beam flattening) in the beam contrast at low energies and a similar contrast reduction at high energies (from ~7.5% to about 5%). A new main laser amplifier configuration is being commissioned to lower the damage risk to the front end by reducing the gain of the counter-propagating unconverted light. Light backscattered from the targets is regularly monitored using the existing UV laser diagnostics.

Laser performance adjustments are sometimes necessary to meet exacting requirements for power accuracy and power balance for high contrast pulses. Examples of such measures include shot specific model adjustments to improve the delivered pulse shape and energy, and periodic laser calibrations and consequent model updates as necessary.

The process of risk and performance assessment will be described together with examples that illustrate the performance capabilities of NIF. Actions taken to simplify the experiment setup process, reduce facility risks from experiments, and enhance the efficiency of risk assessments to support an increasing shot rate, will also be described.

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