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Planar Laser–Plasma Interaction Experiments at Direct-Drive Ignition-Relevant Scale Lengths at the National Ignition Facility M.J. ROSENBERG, A.A. SOLODOV, W. SEKA, J.F. MYATT, S.P. REGAN, M. HOHENBERGER, R. EPSTEIN, D.H. FROULA, P.B. RADHA, Laboratory for Laser Energetics, U. of Rochester, P.A. MICHEL, J.D. MOODY, L. MASSE, C. GOYON, D.P. TURNBULL, M.A. BARRIOS, LLNL, J.W. BATES, A.J. SCHMITT, NRL —
The first experiments at the National Ignition Facility to probe laser–plasma interactions and the hot electron production at scale lengths relevant to direct-drive ignition are reported. The irradiation on one side of planar CH foils generated a plasma at the quarter-critical surface with predicted density scale lengths of $L_{\mathrm{n}} \sim 600\,\mu\mathrm{m}$, measured electron temperatures of $T_{\mathrm{e}} \sim 3.5$ to 4.0 keV, and overlapped laser intensities of $I \sim 6$ to $15 \times 10^{14}\,\mathrm{W/cm^2}$. Optical emission from stimulated Raman scattering (SRS) and at $\omega/2$ are correlated with the time-dependent hard x-ray signal. The fraction of laser energy converted to hot electrons increased from $\sim 0.5\%$ to $\sim 2.3\%$ as the laser intensity increased from ~ 6 to $15 \times 10^{14}\,\mathrm{W/cm^2}$, while the hot electron temperature was nearly constant around 40 to 50 keV. Only a sharp redshifted feature is observed around $\omega/2$, and both refracted and sidescattered SRS are detected, suggesting that multibeam SRS contributes to, and may even dominate, hot-electron production. These results imply a diminished presence of two-plasmon decay relative to SRS at these conditions, which has implications for hot-electron preheat mitigation strategies for direct-drive ignition. This work is supported by the DOE NNSA under Award Number DE-NA0001944.

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