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Two-dimensional non-equilibrium plasma model for dual-pulse laser ignition. RAJIB MAHAMUD, ALBINA A. TROPINA, Texas AM University, MIKHAIL N. SHNEIDER, Princeton University, RICHARD B. MILES, Texas AM University — Dual-pulse laser ignition mechanism uses an ultraviolet (UV) pulse with low pulse energy to create initial ionization and a subsequent deposition of energy by a near-infrared (NIR) pulse that allows avoiding any optical breakdown and minimization of energy requirements. Decoupling of the UV preionization (without breakdown) pulse from the second energy deposition pulse allows tailoring the laser plasma parameters such as electron number density and temperature, ion number density and size of the initial ignition kernel. In this study a two dimensional mathematical model is presented for dual-pulse laser ignition technique that self-consistently integrates Navier-stokes, three energy states (electronic, vibrational, and neutral), Poisson equation, plasma species and GRI-Mech 3.0 mechanism. The two-dimensional multiphysics model allows to understand the role of chemistry and energy exchange mechanisms on the hydrodynamics of dual-pulse laser ignition and flame propagation. The results also suggest that the initial flame kernel growth and ignition delay time are affected by the energy exchange mechanism between internal degrees of freedom, the laser intensity and initial electron density from the first UV pulse.

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