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Vorticity generation and jetting caused by a laser-induced optical breakdown JONATHAN WANG, DAVID BUCHTA, JONATHAN FREUND, Univ of Illinois - Urbana — A focused laser can cause optical breakdown of a gas that absorbs energy and can seed ignition. The local hydrodynamics are complex. The breakdown is observed to produce vorticity that subsequently collects into a jetting flow towards the laser source. The strength and the very direction of the jet is observed to be sensitive to the plasma kernel geometry. We use detailed numerical simulations to examine the short-time ($< 1\,\mu$s) dynamics leading to this vorticity and jetting. The simulation employs a two-temperature model, free-electron generation by multi-photon ionization, absorption of laser energy by inverse *Bremsstrahlung*, and 11 charged and neutral species for air. We quantify the early-time contributions of different thermodynamic and gas-dynamic effects to the baroclinic torque. It is found that the breakdown produces compression waves within the plasma kernel, and that the mismatch in their strengths precipitates the involution of the plasma remnants and yields the net vorticity that ultimately develops into the jet. We also quantify the temperature distribution and local strain rates and demonstrate their importance in seeding ignition in non-homogeneous hydrogen/air mixtures.

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