Characterizing Gas and Plasma Densities in Ultrafast Laser-Plasma Interactions Using Shadowgraphy, Schlieren, and Interferometry

Priyanshu Dasgupta[1], Elise Kretschmer[1], Ava Qin[1], Michelle Wang[1], Arunava Das[1], Isabelle Tigges-Green[1], Matthew Mason[1], Anatoli Morozov[1], Tolga Gurcan[1], Matthew Edwards[2], Jason Fleischer[1], Julia Mikhailova[1]

[1] *Princeton University, Princeton, New Jersey, 08544*

[2] *Stanford University, Stanford, CA 94305*

Abstract – 10.01

The primary goal of this research is to use lasers to visualize and study the density gradients and flow in gases and plasma. We compare and contrast three methods of laser imaging to measure density gradients and flow in gases and plasma: (1) shadowgraphy, (2) knife-edge schlieren, and (3) two-color interferometry. The first, being the simplest, utilizes a method to visualize the density gradients sans spatial filters or reference beams. Shadowgraphy only records the spatial second derivative or Laplacian of the refractive index field, making the method largely qualitative. The second is sensitive to density gradients, but only in one direction at a time. Lastly, two-wavelength interferometry employs one wavelength which is more sensitive in the plasma while the other is more sensitive to the neutral gas, to further study, distinguish, and quantify the refractive index changes between plasma and neutral gas. Taken together, these three techniques provide a holistic insight into the flow mechanics of plasma and gases.