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Electron density measurements for plasma adaptive optics

Neiswander, Brian, bneiswan@nd.edu; Matlis, Eric; Corke, Thomas, University of Notre Dame, United States

ABSTRACT

This study investigates the feasibility of using plasma as an adaptive optical medium for applications such as beam steering, wavefront control, and adaptive filtering. The optical path length of light propagating through plasma depends on the plasma electron density, which may be controlled via the prescribed voltage, frequency, pressure, gas, and electrode geometry. Accurate control of the optical path length requires characterization of the electron density over all operating conditions. Experimental measurements of plasma electron density were obtained using a dielectric barrier discharge at various voltage and pressure conditions. The plasma was contained in a low-pressure, hollow glass cylinder with flat optical glass at each end. The electron density of the plasma was measured using a dual-wavelength Michelson interferometer setup. Probing the plasma with two distinct wavelengths (0.633 μm and 3.39 μm) allowed for simultaneous determination of the plasma electron density and background gas heating. Results from the experiment provided critical data for assessing plasma as a medium for adaptive optics.