Abstract Submitted
for the DPP19 Meeting of
The American Physical Society

Time-resolved dispersion interferometry for measuring low density air plasmas.[1] ERIC WELCH, SERGEI TOCHITSKY, DANIEL MATTEO, CHAN JOSHI, UCLA — Many electrical phenomena in the atmosphere result in either full or partial local ionization of air. Such plasmas are unique from many laboratory plasmas due to the large concentration of neutral particles that can strongly affect the dynamics. One interesting active area of research is that of laser filamentation in air. Here, a laser beam with power above the critical power for Kerr self-focusing tends to collapse until it is arrested by generation of free electrons through field-ionization. A dynamic balance between Kerr self-focusing and plasma defocusing allows for guiding of an intense laser beam over multiple Rayleigh lengths. We have recently shown that a picosecond, terawatt CO_2 laser self-guided through air forms a centimeter-scale diameter channel with a very low density plasma in the range of 10^{13} – 10^{16} cm^{-3} [1]. The measured laser intensity in the channel of 10^{12} W/cm^2 is significantly below the tunnel ionization threshold for oxygen and nitrogen. Simulations show that free electrons are generated by a combination of many-body Coulombic interactions and avalanche ionization. To experimentally measure such a low density, we tested a dispersion interferometer on a 1 cm long plasma produced by 10 m optical breakdown. Results suggest that we can measure 10^{13} cm^{-3} plasma density in a channel by probing nearly collinearly over ~50 cm. The diagnostic design and initial measurements will be presented.

1. S. Tochitsky et al, Nature Photonics 13, 41-46 (2019).

[1]Office of Naval Research MURI grant no. N00014-17-1-2705

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Date submitted: 03 Jul 2019 Electronic form version 1.4