Filament Propagation Through the Atmosphere in Nonlinear Regimes

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Recent fundamental science and applications studies made in high intensity laser filamentation in the atmosphere. These allow a perspective of future developments we might expect in this field in the near term.

Research activities in high intensity laser light propagation at UCF are concentrating on studies and innovations that will extend the range of laser light beams operating in the linear and non-linear propagation regimes, and the usefulness of a number of specific applications. Experimental studies are performed with two 10 TW NIR laser systems, one in the LPL laboratories at UCF, the other on the TISTEF Laser Range on Merritt Island, where also an ultrashort pulse, 1 ps LWIR system is also being assembled. Theoretical studies are performed with a number of propagation codes, some taking account of turbulence, altitude and atmospheric conditions, and a suite of laser-target interaction codes to model beam target effects.

Significant advances have been made in the propagation of temporally and spatially structured beams propagating in both the linear and non-linear regimes. Over 30 sequential high-intensity ultrafast pulses have been stitched temporally into a single beam of ~ 20 ns duration in the laboratory with an accuracy of a few microns, and similar results have recently been recorded over 250 m in the field. Spatially engineered arrays of filaments have been demonstrated over similar distances. These pulse paradigms have been utilized in a number of laser target interaction investigations examining white-light and supercontinuum generation, ablation, shockwave and RF emission in a number of different regimes.

This presentation will also point to new and continuing investigations of ultrafast laser light propagation, and those applications that will steer the development of the next generations of ultrafast laser systems.