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Remote sensing with femtosecond laser pulses

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Abstract

Femtosecond laser pulses find widespread use in standoff spectroscopy. Various scenarios have been considered, including for example remote generation of a backward-propagating laser beam, or filament - induced breakdown spectroscopy (FIBS). Femtosecond laser filamentation starts when Kerr-induced self-focusing overcomes beam diffraction. When a threshold power is reached, the transverse intensity profile of the laser beam decreases until nonlinear defocusing mechanisms come into play, due to for example production of plasma or multi-photon excitation of conduction-band electrons. The balance between self-focusing and defocusing processes results in formation of a filament that can propagate over distances orders of magnitude longer than the Rayleigh range corresponding to their transverse dimensions. In our experiment we have used filaments for sub-diffraction-limited imaging of remote objects. Controlled production and manipulation of laser filaments will enable further applications to remote detection and sensing. In my talk I will review the latest ideas and the most recent experimental results from our work toward this goal.

Biography

Alexei Sokolov obtained an M.S. from Moscow Institute of Physics and Technology (1994), and a Physics Ph.D. from Stanford University (2001). Currently at Texas A&M University, Sokolov holds a Professor position in Physics and Astronomy, and a Stephen Harris Professorship in Quantum Optics. His overall expertise is in the field of laser physics, nonlinear optics, ultrafast science and spectroscopy. His research interest centers around applications of molecular coherence to quantum optics, ultrafast laser science and technology, including generation of sub-cycle optical pulses with prescribed temporal shape and studies of ultrafast atomic, molecular, and nuclear processes, as well as applications of quantum coherence in biological and defense-oriented areas. Sokolov is an OSA Fellow; his awards include the Lomb Medal (OSA, 2003), the Hyer Award (TX section APS, 2007), and the Treat Award (Texas A & M Research Foundation, 2011).