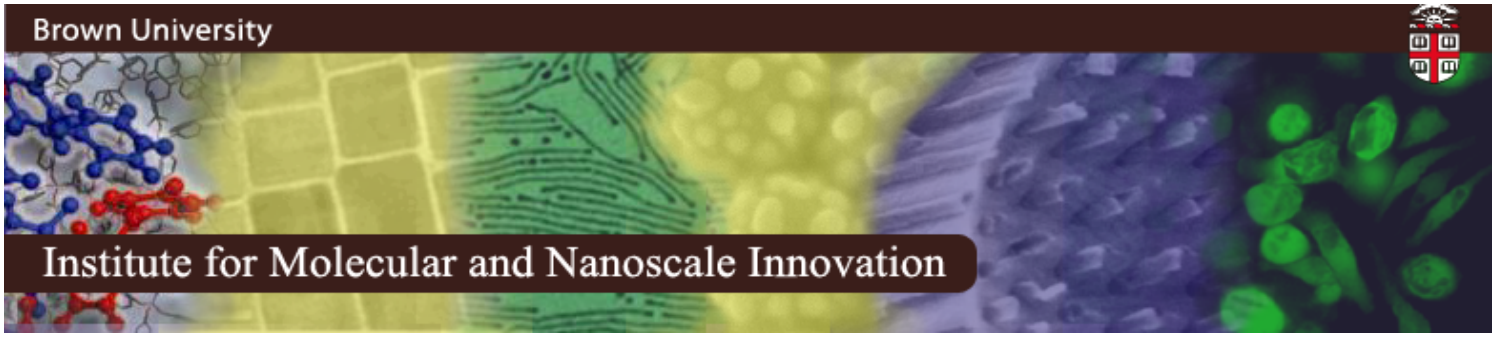
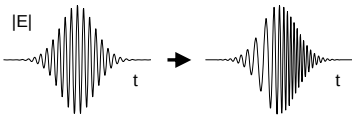


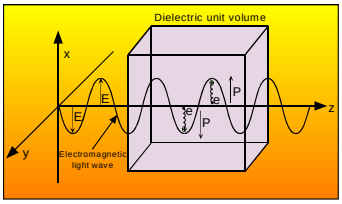
JOINT INSTITUTE FOR MOLECULAR AND NANOSCALE INNOVATION (IMNI)
AND DIVISION OF ENGINEERING

"Control of nonlinear optics at the few-cycle limit for access to new optical science"

Jeffrey Moses, Ph.D.
Research Laboratory of Electronics
Optics and Quantum Electronics Group
Massachusetts Institute of Technology

April 3, 2009
Barus & Holley, Room 190
10:30 AM





Abstract

In recent years, laser technology has widened the field of light-matter interaction physics to those involving intense light pulses lasting only a few periods of the electromagnetic wave oscillation. In ordinary dielectric materials, the propagation of these light pulses can trigger multiple, competitive, nonlinear effects. In gases, they provide a way to control electron ionization, acceleration and recombination with half-cycle precision, allowing generation of bursts of coherent extreme-ultraviolet and soft-X-ray radiation and attosecond-duration (<10^-15 s) pulses, and new sources of information on the nanometer scale and the time scale of electron dynamics.

I will report on recent investigations into the interplay of nonlinear propagation effects triggered by these pulses in dielectric media, uncovering some new optical phenomena. These include self-defocusing nonlinear phase shifts usable for generating high-energy few-cycle pulses in the context of pulse self-compression, controllable pulse self-steepening, optical shock-front formation without simultaneous phase modulation, and pulse propagation governed by an integrable derivative nonlinear Schrödinger equation studied for the first time in any physical setting. These investigations provide a starting point for new studies in nonlinear wave physics as well as some new means of controlling and generating intense, few-cycle pulses for applications in many physical settings.

Host: Robert Hurt
Administrative Contact: Lisa Mildner, Lisa_Mildner@brown.edu, 863-1386