Electro-Optics Seminar
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Ultra-intense Lasers and Laser Matter Interaction

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Abstract

The OSU SCARLET laser has a peak power exceeding 300 TW and generates intensities over 1021 Wcm^{-2}. It will soon exceed 500 TW and 1022 Wcm^{-2} to become one of the brightest light sources in our galaxy. This system was completed in July, 2012 [1], and it produces >10 J pulses with pulse duration of 30 fs at a 1 shot/min repetition rate. I will discuss the technological challenges encountered and how they were overcome during the design and construction of this laser. Of particular note is femtosecond laser damage of optical components, which heavily impact laser design in terms of cost, size, and reliability.

One of our key thrusts has been studying femtosecond laser-matter interaction in the mid IR, due to enhancement of electron ponderomotive energy at longer wavelengths, and its promise to generate XUV attosecond pulses efficiently. For traditional insulators, the reduced individual photon energies at mid IR should exhibit a transition from multiphoton to tunneling ionization, when compared to similar interactions with UV-VIS-near IR femtosecond pulses. Semiconductors like Si and Ge become transparent 'high band gap' semiconductor at mid IR. With fluence near damage threshold, when sufficient electron population transfer into conduction band occurs and all insulators become metal-like, mid IR frequencies present and interesting paradigm, i.e. much larger ponderomotive energies of electrons (compared with near IR) which may be very sensitive to alignment of laser polarization direction along different lattice axes of symmetry.

Biography

Dr. Enam Chowdhury, Research Assistant Professor, OSU Physics, is a leading expert in the field of short pulse lasers, ultra-intense and high energy density laser matter interaction. He led the design and construction of the 500 TW SCARLET laser system at the OSU High Energy Density Physics (HEDP) Laboratory in conjunction with a team of scientists, engineers and graduate students. SCARLET was completed in 2012 and since then our team has moved into a very active phase of research using what is currently one of the most intense lasers in the world. Our experimental campaign currently focuses on particle acceleration, both for cancer treatment and for the activation and detection of nuclear materials. In 2013, he began construction of a new Femtosecond Solid Dynamics (FSD) Lab with short pulses of lasers operating with wavelengths from 200 – 10,000 nm and pulsewidth from 5 – 300,000 femtoseconds. This lab is dedicated to studying the fundamental mechanisms of damage caused to materials exposed to ultra-high intensity femtosecond laser light.