Wright State University

Physics Department Seminar – Faculty Candidate

Monday, March 13th, 2017

3:25 pm, Medical Science Building 145

"High and ultra-high intensity laser matter interaction"

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Since the invention of the laser over 50 years ago, laser matter interaction has been a topic of intense interest both from fundamental science and applications point of view. On the one side, super intense lasers are used to explore relativistic laser plasma effects, ushering a new regime of compact particle accelerators; on the other side, high intensity lasers are used as the finest 'scalpels' of the universe to perform eye surgery, and opened pathways for surface engineering (e.g. super-hydrophobic surfaces) and machining not possible before. At the heart of these phenomena is the femtosecond laser induced damage (fs-LID) of solids. Although experimental, theoretical and computational efforts on this topic have been ongoing for over two decades, large gaps in fundamental understanding remain to this day. In Femtosecond Solid Dynamics program on laser damage at OSU, we are experimentally identify the gaps we believe to be the most crucial and we are developing tools to address them, e.g. how is fs-LID affected by bandgap, photon energy, band structure, electron-lattice coupling, and using these understandings, is it feasible to predict macroscopic observations like crater geometry, from fundamental principles, without fitting parameters? Our primary objective is to develop a comprehensive, fundamental understanding of intense field laser damage in the femtosecond regime by combining experimental, theoretical and computational efforts that will inform and be benchmarked against one another. On the second part of my talk, I'll explore a high repetition rate ultra-high intensity program that I helped develop at the Extreme Light Lab at the Air Force Research Laboratory, Dayton, where we explore light matter interaction at relativistic fields with liquid targets. Although demonstrations of up to 4 GeV electrons and ~100 MeV protons have been achieved in the past, all of these are not feasible as future accelerators, due to their slow duty cycle (usually single shot, rarely 1 Hz). There are many challenges to increasing the duty cycle, where laser technology, target technology, damage to system, target alignment, high repetition rate sub-micron plasma diagnostics provides nearly insurmountable obstacles. In this program, we developed ways to accelerate MeV electrons and ions at kHz repetition rate, by developing a combination of suitable laser system, diagnostic system, target system and experimental data collection system capable of handling the high duty cycle.

A leading expert in the field of high power short pulse lasers, ultra-intense and high energy density laser matter interaction, Research Assistant Professor at OSU Physics, Dr. Enam Chowdhury currently leads Femtosecond Solid Dynamics Laboratory, a program dedicated to studying fundamentals of laser solid interactions near material damage threshold, including ionization, ablation, multi-pulse effects, laser induced periodic surface structures. He led the design and construction of the 500 TW SCARLET laser system at the Ohio State University, which is one of the most intense lasers operational in the world studying high energy density physics and its various applications, such as laser plasma based MeV electron and ion acceleration. Dr. Chowdhury won many grants from various agencies, including AFOSR, DARPA, NSF and DoE and authored over 50 articles in peer reviewed journals and conference proceedings in physics and engineering.