mipse
Michigan Institute for Plasma Science and Engineering

Prof. Matthew Edwards

Stanford University

Plasma and Gas Optics for Ultra-Intense Lasers

Wednesday
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3:10 pm
Room 1003 EECS

Our ability to build lasers of higher peak power into higher-intensity regimes of laser science is fundamentally limited by the optical damage thresholds of the dielectric coatings, glass, and metal that make up modern optics. Although we would like to have lasers capable of probing Schwinger-limit fields or accelerating large plasma volumes to relativistic speeds, current laser technology cannot be scaled much beyond the ten-petawatt level without prohibitive cost. Plasma physics offers a solution: plasma can tolerate light intensities far beyond the damage thresholds of solid-state optics. In principle, the use of plasmas as optics allows the construction of compact ultra-high-power lasers, but a range of plasma physics and engineering problems must first be solved. We will discuss how gases and plasmas can be shaped into precision optics suitable for our most powerful and energetic lasers, providing ultra-high damage thresholds and resistance to the neutron and debris fluxes that would be present in an inertial fusion plant. We will show experimental, computational, and analytic results on the performance of gas and plasma diffraction gratings and lenses, including demonstrations of efficiency and stability comparable to standard solid-state optics. We will then discuss designs for plasma-based laser systems and how plasma optics could enable compact lasers with multi-petawatt to exawatt peak powers.

About the Speaker: Matthew Edwards is an Assistant Professor of Mechanical Engineering at Stanford University. He received BSE, MA, and PhD degrees from Princeton University in Mechanical and Aerospace Engineering. From 2019 to 2022 he was a Lawrence Fellow in the National Ignition Facility and Photon Science Directorate at Lawrence Livermore National Laboratory. His research applies high-power lasers to the development of optical diagnostics for fluids and plasmas, the study of intense light-matter interactions, and the construction of compact light and particle sources, combining adaptive high-repetition-rate experiments and large-scale simulations to explore new regimes in fluid mechanics, thermodynamics, materials science, and plasma physics.