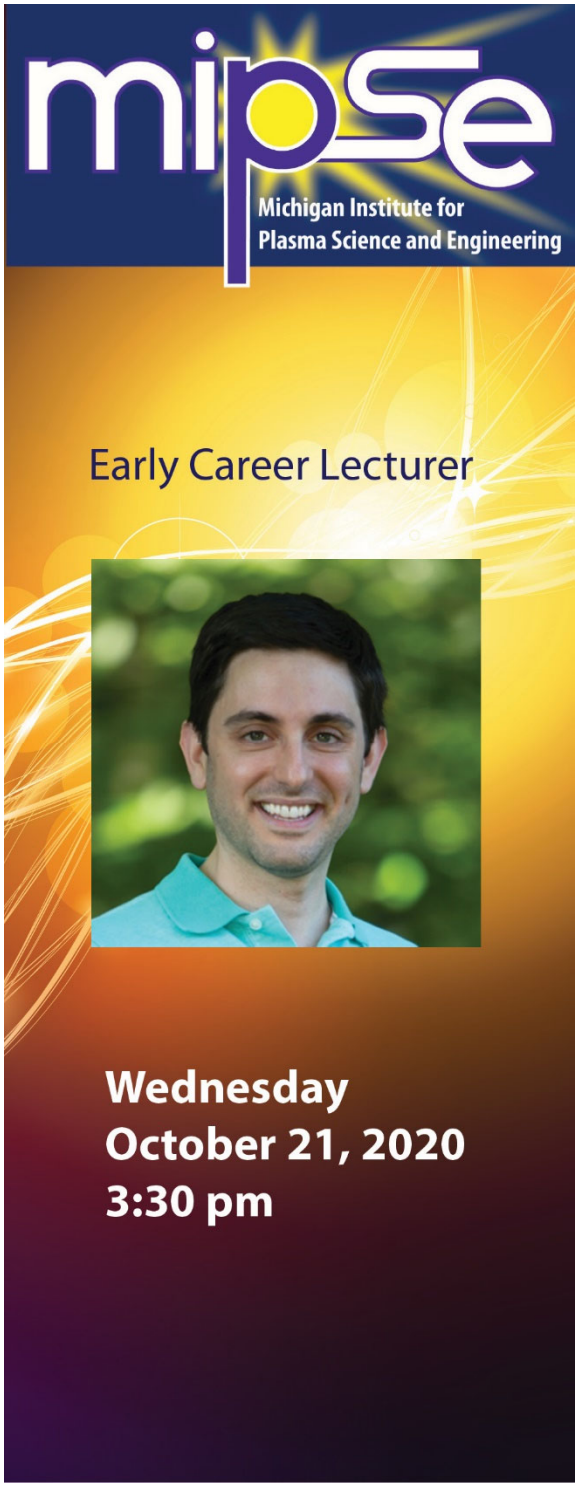

Dr. Derek Schaeffer

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Bringing Cosmic Shock Waves Down to Earth

As a fundamental process for converting kinetic to thermal energy, collisionless shocks are ubiquitous throughout the heliosphere and astrophysical systems, from Earth's magnetosphere to supernova remnants. While these shocks have been studied for decades by spacecraft, telescopes, and numerical simulations, there remain key open questions in shock physics, such as: How do shocks accelerate particles to extremely high energies? or How are particles heated across a shock? Laboratory experiments thus provide a significant opportunity to both complement spacecraft and remote sensing observations with well-controlled and well-diagnosed datasets, and to help benchmark numerical simulations that bridge laboratory and astrophysical systems.

In this talk, I will discuss recent results from experiments and simulations on the formation and evolution of collisionless shocks created through the interaction of a supersonic laser-driven magnetic piston and magnetized ambient plasma. Through advanced diagnostics a fast, high-Mach-number shock is observed. Direct probing of particle velocity distributions reveals the coupling between the piston and ambient plasmas that is a key step in forming magnetized collisionless shocks. Particle-in-cell simulations further detail the shock formation process, the role of collisionality, and the dynamics of multi-ion-species ambient plasmas. I will also discuss how this experimental platform complements spacecraft missions and can allow novel investigations of shock heating and particle acceleration.

About the Speaker: Dr. Schaeffer is an Associate Research Scholar in the Department of Astrophysical Sciences at Princeton University. He received his BA in Physics at Cornell University and his PhD in Physics from UCLA, and did his postdoctoral work at Princeton in high-energy-density laboratory astrophysics. Dr. Schaeffer has extensive experience in experiments involving magnetized laser plasmas, collisionless shocks, and magnetic reconnection, and a keen interest in bridging laboratory and astronomical observations. He also has expertise in a wide range of diagnostics, including Thomson scattering, refractive imaging, proton radiography, and x-ray imaging. He has authored dozens of papers and has presented at numerous conferences around the world.