Department of Electrical and Computer Engineering

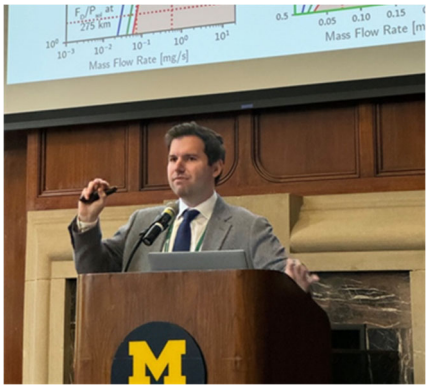
TEXAS TECH UNIVERSITY
Edward E. Whitacre Jr.
College *of* Engineering™

Fall 2024 Seminar Series

Seminar Title: ***Probing Microwave-Plasma Interactions using Ultrafast Terahertz Spectroscopy***

Time: 3:00-3:50 PM, Monday, Nov 4, 2024
Location: Holden Hall 104

Speaker:
Tom Underwood
The University of Texas at Austin



Abstract:
This talk will describe how the dispersion characteristics of plasmas can be leveraged to change and control the propagation of microwaves. Our approach extends ideas that have focused on optimizing bulk (i.e., scales greater than wavelengths) wave-particle interactions to explore how the dielectric properties of plasmas can be changed locally (i.e., scales less than wavelengths). To understand this interaction, and how plasmas form in high power microwave systems, an ultrafast chirped terahertz time-domain spectroscopy diagnostic will be presented to probe the properties of plasmas in microwave systems. The diagnostic measures the index of refraction of plasma environments, including the free electron density and absorption features of rotational features of molecules, simultaneously. The diagnostic leverages chirped pulse spectral encoding to scan broad spectral regions spanning ~ 100 GHz - 2 THz all in a single shot from a femtosecond laser. This enables the diagnostic to achieve temporal resolutions < 10^{-12} s during a single snapshot or view dynamics of microwave breakdown at the repetition rate of the laser. We deploy this diagnostic to measure the properties of plasmas over timescales that can capture electron transport (~10^{-9} s), ion transport (~10^{-6} s), and collisional energy exchange between neutral molecules (~10^{-6} s – 10^{-3} s) in microwave systems.

Speaker Bio:
Dr. Tom Underwood is an Assistant Professor in the Department of Aerospace Engineering and Engineering Mechanics at The University of Texas at Austin. He received his Ph.D. in Mechanical Engineering from Stanford University and was a postdoctoral fellow in chemistry at Harvard University. His research lies at the intersection of plasma physics, microwaves, fluid mechanics, and chemistry. He is interested in understanding how the chemistry and dynamics of plasmas and reactive flows can be leveraged to address challenges in space, propulsion, directed energy, and the synthesis of clean and environmentally sustainable fuels. He is a recipient of numerous distinctions including the AFOSR Young Investigator Award.