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Michigan Institute for Plasma Science and Engineering

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3:10 pm
Room 1003 EECS

Prof. Thomas White

University of Nevada-Reno

Direct and Model-Independent Temperature Measurements in Extreme States of Matter

Temperature is a cornerstone of thermodynamics, yet its measurement in high-pressure solids, dense opaque plasmas, and highly ionized systems remains one of the greatest challenges in extreme physics. Accurate temperature diagnostics are essential for understanding material behavior under such conditions, but traditional methods are often hindered by opacity and limited sensitivity. Using high-resolution inelastic X-ray scattering (IXS) at facilities like the Linac Coherent Light Source and European X-ray Free Electron Laser, we developed an advanced diagnostic capable of directly probing bulk ion temperatures. This technique leverages the exceptional resolution and narrow bandwidth of IXS to detect small energy shifts and broadenings in scattered X-ray spectra, offering unprecedented insights into the ion dynamics of matter in extreme states. In this talk, I will highlight how IXS has been utilized to address: (1) Electron-ion equilibration rates in warm dense matter, (2) superheating of solids to temperatures far exceeding their theoretical stability limits, (3) bond hardening under non-equilibrium conditions, and (4) Ion-acoustic wave propagation. The ability to directly measure ion temperatures and dynamics not only advances understanding of fundamental physics but also opens pathways for experimental research in HED science and beyond.

About the Speaker: Thomas White is an Associate Professor of Physics at the University of Nevada-Reno. He earned the MS in physics from the Univ. of Bath (2005) and Ph.D. in Atomic and Laser Physics from Univ. of Oxford (2015), where his dissertation earned the Culham Thesis Prize. Before joining UNR in 2017, he was a post-doc at Imperial College London and Univ. of Oxford. White's research focuses on the behavior of matter under extreme conditions, using high-power optical and X-ray free-electron lasers to replicate environments found in planetary interiors and fusion plasmas. His work combines experiments at facilities such as the NIF and the European X-ray Free Electron Laser with advanced quantum-mechanical simulations. His research is supported by the Department of Energy, National Nuclear Security Administration, and National Science Foundation. In 2021, White received the NSF CAREER Award and UNR's Mousel-Feltner Excellence in Research Award. He currently serves as Chair of the Jupiter Laser Facility Executive Committee and Deputy Chair of the High Energy Density Science Association.