

Institute for Shock Physics Lecture Series

TUESDAY, JULY 21

10:00 – 11:00 a.m.

Shock Physics Building, Room 201

MARCUS KNUDSON

Sandia National Laboratories, Albuquerque, NM

Direct Observation of an Abrupt Insulator-to-Metal Transition in Dense Liquid Deuterium

Recently a so-called shock-ramp platform has been developed on the Sandia Z Accelerator to access off-Hugoniot states in liquids. The accelerator delivers a two-step current pulse; the first accelerates the electrode to a reasonably constant velocity, which upon impact with the sample cell creates a well-defined shock, the subsequent current rise produces ramp compression from the initially shocked state. This technique generates relatively cool (~1-2 kK), high pressure (>300 GPa), high compression states (~10-15 fold compression) states, allowing experimental access to the region of phase space where hydrogen is predicted to undergo a first-order phase transition from an insulating molecular-like liquid to a conducting atomic-like liquid. In this talk we will discuss the experimental platform, survey the various theoretical predictions for the liquid-liquid, insulator-to-metal transition in hydrogen, and present the results of experiments that clearly show an abrupt transition to a metallic state. Our results will also be discussed in the context of previous dynamic compression experiments aimed at investigating the metallization of hydrogen at higher temperatures and lower densities. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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