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Dynamic compression experiments on liquid deuterium above the melt boundary to investigate the insulator-to-metal transition

MARCUS KNUDSON, Sandia National Laboratories

Recently we have been exploring various pulsed power experimental concepts to access off-Hugoniot states in liquids at the Sandia Z Accelerator. One very promising technique utilizes a so-called shock-ramp platform. Here a relatively small gap is introduced between the ramp compression load electrode and a liquid sample cell. The accelerator is configured to deliver a two-step current pulse; the first step accelerates the electrode to a reasonably constant velocity, which upon impact with the sample cell creates a well-defined shock, while the subsequent current rise produces ramp compression from the initially shocked state. This technique makes it possible to achieve relatively cool ($\sim$ 1000-2000 K), high pressure (>300 GPa), high compression states ($\sim$ 10-15 fold compression), 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 fluid. In this talk we will discuss the development of the liquid shock-ramp platform, survey the various theoretical predictions for the liquid-liquid transition in hydrogen, and present the results of initial experiments performed that access this region of phase space. 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.