Shock Compression Seminar Series
APS GSCCM Announcement

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Coupling the Sandia Z Machine and Condensed Matter Theory to Understand Extreme Dynamic Compression Experiments

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Over the past two decades, a large, interdisciplinary team at Sandia National Laboratories has been refining the Z Machine (20+ MA and 10+ MGauss) into a mature, robust, and precise platform for dynamic compression experiments in the multi-Mbar pressure regime. In particular, significant effort has gone into effectively coupling condensed matter theory, magneto-hydrodynamic simulation, and electromagnetic modeling to produce a fully self-consistent simulation capability able to very accurately predict the performance of the Z machine and various experimental load configurations. This capability has been instrumental in the ability to develop experimental platforms to routinely perform magnetic ramp compression experiments to over 5 Mbar, magnetically accelerate flyer plates to over 40 km/s, creating over 20 Mbar impact pressures, and combined shock-ramp loading, which greatly expands the region of phase space accessible through dynamic compression experiments. Additionally, a strong tie has been developed between the condensed matter theory group and the experimental program. This coupling has proven time and again to be extremely fruitful, with the capability of both theory and experiment being challenged and advanced through this close interrelationship. This talk will provide a brief overview of these dynamic compression platforms and discuss examples of the use of Z to perform extreme dynamic compression studies with unprecedented accuracy in support of basic science, planetary astrophysics, inertial confinement fusion, and high energy density laboratory physics. Specific examples will include: evaluation of exchange-correlation (xc) functionals at the molecular-to-atomic (MA) transition in deuterium along the Principal Hugoniot at high temperature and relatively low density; direct observation of an abrupt liquid-liquid, insulator-to-metal transition in relatively cool (~1-2 kK), dense (~2 g/cc) liquid deuterium, just above the melt boundary; and evaluation of xc functionals with multiple-shock electrical conductivity measurements which probed the MA transition at intermediate temperatures and densities.

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For more information, or to recommend future speakers contact Seminar Organizer, Tracy Vogler at tjvogl@sandia.gov. Or, GSCCM Secretary/Treasurer, Matt Lane at jlane@sandia.gov.