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Recent Advances in Conductivity and EOS Modeling for High Energy Density Physics Simulations Near the Metal-Insulator Transition*

M. P. Desjarlais, S. E. Rosenthal
Sandia National Laboratories

K. Cochrane
Ktech Corporation

Many present day high energy density physics experiments, such as wire-array Z pinches, imploding liners, and exploding wires, evolve through complex conductivity and equation of state regimes, starting from solid density and rapidly transitioning through liquid and vapor to plasma. Of particular importance for the accurate computer simulation of the early time evolution of these experiments is the phase space in the vicinity of the metal-insulator transition and the solid-liquid-vapor transitions. The commonly used Lee-More and Rinker (SESAME) conductivities, primarily developed for higher density and temperature regimes, are inaccurate at these lower temperatures and densities, often differing with experimental data by several orders of magnitude. A recently developed set of modifications [1] to the Lee-More algorithm provide greatly improved agreement with experimental data and have permitted significant improvements to the correspondence between simulations and experiments. We have extensively studied the Cornell exploding wire experiments with particular emphasis on the role of the conductivity model and the equation of state in the wire evolution. Simulations from the Mach II and ALEGRA codes, with elaborate phase space diagnostics, have helped identify critical regions in phase space and have suggested directions for further improvement in the transport and EOS modeling.

References:

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Footnotes:

[1] M. P. Desjarlais, "Practical Improvements to the Lee-More Conductivity Near the Metal-Insulator Transition", Contrib. Plasma Phys., to be published (2001).