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2P24 - Hybrid Quantum-Hydrodynamics/Kinetics Model for Dense Plasma Mixtures

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Fusion energy promises nearly unlimited, clean energy. One approach to fusion energy production is by means of inertial confinement fusion experiments where a fuel boundary exists (e.g., fuel-liner or fuel-ablator). Unfortunately, in the presence of a wide variety of energy loss mechanisms, obtaining a net gain in energy remains a challenge. The mixing of cooler materials into hot regions can spoil the production of fusion energy. Two ways that cooling occurs is from the mixing of two ion species, or by conduction from the electron species. An existing kinetic model for studying the mixing of ions, is the multi-component BGK (McBGK) equation which describes the ionic heat transfer. One way to add the effects of heat conduction from the electrons is by solving a kinetic equation which is not a computationally tractable approach due to the considerable difference in timescales for the electron and ion species. Instead, hydrodynamic equations of motion for the electron species are derived directly from the McBGK equation and are used to determine how the electrons transfer heat to the ion species. We plan to use our model to aid in the design and interpretation of experiments at Sandia National Laboratories that are being performed on the Z Machine, a large pulsed-power facility.
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