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On the Addition of Electron Inertia to the Computational Modeling of the Ion Acoustic Shock[1] ROBERT LILLY, ROBERT MARTIN, Air Force Research Lab - Edwards AFB — The ion-acoustic shock serves as an excellent benchmark for comparing various kinetic and particle plasma algorithms. AFRL/RQRS comparisons between fluid, Vlasov, and PIC plasma models have made use of the Boltzmann equilibrium for the electrons, thereby avoiding the need to capture electron timescales. Though internally consistent, the validity of assumptions inherent in the Boltzmann equilibrium model have not been rigorously explored in RQRS test cases. This work first reintroduces steady state electron inertia into the electron equilibrium model to enable study of high electron drift as found in hall thrusters. This equilibrium is then used to compare two approaches to the problem. In the first, the ion fluids are advanced using Euler equations, but the electron densities are determined using a Poisson-Boltzmann solve to determine both the scalar electric potential and the electron density that are self-consistent with the derived equilibrium. These results are compared to a full two Euler fluid simulation, where both the electron and ion plasma fluid species are modeled using Euler equations, and are coupled via a direct Poisson solve for the scalar electric potential. It is observed that the match between the two models is excellent, with and without the electron drift.

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