Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

A Generalized Hydrodynamics Model for Strongly Coupled Plasmas[1] ABDOURAHMANE DIAW, New Mexico Consortium, MICHAEL SEAN MURILLO, Los Alamos National Laboratory — Starting with the equations of the Bogoliubov-Born-Green-Kirkwood-Yvon hierarchy, we obtain the density, momentum and stress tensor-moment equations. The closure proceeds in two steps. The first that guarantees an equilibrium state is given by density functional theory. It ensures self consistency in the equation-of-state properties of the plasma. The second involves modifying the two-body distribution function to include collisions in the relaxation of the stress tensor. The resulting generalized hydrodynamics thus includes all impacts of Coulomb coupling, viscous damping, and the high-frequency response. We compare our results with those of several known models, including generalized hydrodynamic theory and models obtained using the Singwi-Tosi-Land-Sjolander approximation and the quasi-localized charge approximation. We find that the viscoelastic response, including both the high-frequency elastic generalization and viscous wave damping, is important for correctly describing ion-acoustic waves. We illustrate this result by considering three very different systems: ultracold plasmas, dusty plasmas, and dense plasmas. The new model is validated by comparing its results with those obtained from molecular-dynamics simulations of Yukawa plasmas, and the agreement is excellent.

[1]This work was supported by the Air Force Office of Scientific Research (Grant No. FA9550-12-1-0344).

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Date submitted: 23 Jul 2015 Electronic form version 1.4