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How to Relax When You Are Dense and Degenerate: A New Kinetic Theory for Electron-Ion Relaxation Processes in Warm Dense Matter SHANE RIGHTLEY, SCOTT BAALRUD, University of Iowa — Temperature and momentum relaxation have proven difficult to compute in systems subject to both strong Coulomb coupling and electron degeneracy. Recent measurements of relaxation under these conditions are providing for the first time an experimental means of validating theoretical and computational methods. We present the application of a mean-force quantum kinetic theory to electron-ion relaxation near equilibrium in a regime where electrons transition between quantum and classical behavior and ions between weak and strong coupling. Using a new closure of the BBGKY hierarchy for the Wigner function, we obtain a kinetic equation in which the collision integral takes the form of the quantum Boltzmann equation of Uehling and Uhlenbeck, but where the binary scattering interactions occur via the equilibrium potential of mean force. The kinetic equation also contains new terms associated with the non-ideal equation of state. Correlations are accounted for to all orders and are computed via established equilibrium methods. We outline the challenges of incorporating degeneracy into mean force kinetic theory and how these are overcome for electron-ion transport. Furthermore, we compare our calculations with recent experimental measurements. Supported by US DOE Grant No. DE-SC0016159.

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