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Density Effects in the Collision and Reaction Rate Coefficients of Atmospheric Pressure Plasmas[1] SCOTT BAALRUD, University of Iowa — Computation of collision and reaction rate coefficients are usually based on a dilute gas concept in which cross sections for binary interactions (either computed or measured) are used in a Boltzmann kinetic description to obtain the relevant rates. However, partially ionized plasmas at atmospheric and elevated pressures are sufficiently dense that the concept of binary collisions can break down. Interactions in this regime can be described as strongly correlated because the potential energy is comparable to the kinetic energy. Many-body effects become important in this regime. This presentation describes a new generalization of the Boltzmann equation that is suitable for these conditions, modeling interactions of neutrals, charge-neutral interactions and Coulomb collisions. The kinetic theory is derived from a new closure of the BBGKY hierarchy that expands about equilibrium instead of in terms of the strength of interactions. The result shows that particles interact via a mean force that includes many-body correlations. Validation of the theory has been obtained by comparison with experiments and molecular dynamics simulations for Coulomb collisions. Progress toward application to charge-neutral interactions in partially ionized plasmas will also be discussed.

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