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Moment Theory of Ion Motion in Devices with Fields that Depend Upon Time and Space[1]

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Recent work has extended the momentum-transfer theory of drift tubes to ion traps and similar devices where the external fields vary with both position and time. Four such extentions will be discussed: two-temperature (2T) and multi-temperature (MT) theories for atomic ion-atom systems, and spherical basis and Cartesian basis theories for molecular systems. In first approximation, the various theories give sets of differential equations with collision frequencies that vary with the effective temperature(s) characterizing the relative kinetic energy of the ion-neutral collisions. Solutions of the sets of equations provide the ion number density, average velocities, average energies and average temperatures as functions of time and of position in the apparatus. Such solutions will be discussed for the Maxwell model, for rigid spheres, and for general ion-neutral interactions. Emphasis will be placed on two new predictions obtained by using the 2T and MT theories to consider non-ideal quadrupole ion traps.

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