Testing theoretical ion-atom interaction potentials by precise measurements of gas-phase ionic mobilities

RAINER JOHNSEN, University of Pittsburgh, LARRY VIEHLAND, Chatham University, TIMOTHY WRIGHT, University of Nottingham — In a collaborative effort, we have recently tested ab-initio interaction potentials for the ion-atom pairs O$^+$-He, O$^+$-Ne, O$^+$-Ar, He$^+$-Ne, and Ne$^+$-He by comparing experimental ionic mobilities to those derived from the computed potentials (T. Wright and co-workers) in conjunction with ion transport theory (L. A. Viehland and co-workers). The computed mobilities were then compared to selected-ion drift-tube measurements carried out in the lab of R. Johnsen. Generally, the magnitude and E/n dependences of the calculated mobilities agree with their measured values sufficiently well (within a few percent) to be used with confidence in applications such as discharge modeling, but more accurate mobility measurements (at the 1% or better level) are needed to test for finer details of the interaction, e.g. effects arising from spin-orbit coupling, curve crossings, and the spin state of the ion. Improvements in the experimental apparatus are in progress. We will also present preliminary results on the He$^+$-Ar ion-atom pair, for which no previous mobility measurements are available.

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