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Separation of binary gas mixtures flowing through small orifices
RAINER JOHNSEN, University of Pittsburgh, BARUN K. CHATTERJEE, Bose Institute — Many atomic collision experiments rely on sampling of atoms, molecules or ions from a differentially-pumped gas cell via a small orifice into a separate analysis chamber. In such experiments the question arises if and to what extent the composition of a gas mixture is altered by the differential outflow of gases through the orifice, which is often in the transition regime between molecular and hydrodynamic flow. Somewhat surprisingly, gas separation effects of this kind are poorly understood and many experimenters seem to be unaware of them, even though ignoring them can cause serious errors. In this poster, we report results of drift-tube measurements, in which we used ion-molecule reactions to determine the variation of the number density of a minority molecular gas in the presence of a lighter or heavier rare gas. We find that the concentration of a heavier minority gas is far more strongly suppressed than one might estimate on the basis of simple mean-free-path arguments. While we have not succeeded in devising a theory of the effect (which may be amenable only to computer simulations), we show that a simple semi-empirical formula reproduces observations reasonably well.

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