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Kinetics of ion-ion mutual neutralization¹ THOMAS M. MILLER, JUSTIN P. WIENS, NICHOLAS S. SHUMAN, ALBERT A. VIGGIANO, Air Force Research Laboratory — We have measured rate coefficients for 87 mutual neutralization reactions between thermal energy anions and cations, a number of them as a function of temperature. In addition, in two cases we have observed a transfer ionization channel in which there is enough energy for the anion reactant to be doubly ionized, yielding a cation product rather than neutralization. We will summarize these results and note correlations, namely: (1) binary neutralization rate coefficients are primarily a function of the chemical nature of the system for atom-atom ionic pairs (with a wide range of rate coefficients), but quickly become dominated by physical aspects (i.e., relative velocity) as the number of atoms in the system increases. (2) Rate coefficients for atom-atom ionic pairs are well fit at 300 K by k $= 3 \times 10^{-4} R_x^{-3.15}$, where R_x is the curve crossing radius given by $R_x = 27.2/\Delta E$, with ΔE being the electron transfer energy released in the reaction. (ΔE in eV, R_x in Bohr, and k in cm³/s.) (3) Rate coefficients for systems of more than 4 or 5 atoms are well described by $k = 2.7 \times 10^{-7} (T/300)^{-0.9} \mu^{-0.5}$. (T in K, and the reduced mass μ in amu.) (4) Triatomic systems have rate coefficients smaller than given by the expression in (3).

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