Rate Coefficients for $\mathbf{D}(1s) + \mathbf{H}^+ \leftrightarrow \mathbf{D}^+ + \mathbf{H}(1s)$ Charge Transfer and Some Astrophysical Implications

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We have calculated the rate coefficients for $\mathrm{D}(1s) + \mathrm{H}^+ \leftrightarrow \mathrm{D}^+ + \mathrm{H}(1s)$ using recently published theoretical cross sections. We present results for temperatures T from 1 K to 2×10^5 K and provide fits to our data for use in plasma modeling. Our calculations are in good agreement with previously published rate coefficients for $25 \leq T \leq 300$ K, which covers most of the limited range for which those results were given. Our new rate coefficients for $T \gtrsim 100$ K are significantly larger than the values most commonly used for modeling the chemistry of the early universe and of molecular clouds. This may have important implications for the predicted HD abundance in these environments. Using our results, we have modeled the ionization balance in high redshift QSO absorbers. We find that the new rate coefficients decrease the inferred D/H ratio by $\lesssim 0.4\%$. This is a factor of $\gtrsim 25$ smaller than the current $\gtrsim 10\%$ uncertainties in QSO absorber D/H measurements.

References:

Savin, D. W. 2002, *ApJ* in press

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