The reaction of O+ with HD at low temperatures

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The reaction of O+ with HD has two channels

\[ O^+ + HD \xrightarrow{k_{OH}} OH^+ + D, \]
\[ k_{OD} \xrightarrow{OD^+ + H}. \]

The total reaction rate coefficient is the sum of rate coefficients of both channels \( k = k_{OH} + k_{OD} \) reaction. \( k \) and the isotopic branching ratio \( k_{OH}/k \) have been measured as a function of temperature using a 22-pole ion trap apparatus [1]. The apparatus allows measuring reaction rate coefficients in the temperature range 15 – 300 K. The systematic uncertainty of measurement is 20%. First results are shown in the figure. Our measurements will be compared with previous studies, where the lowest measuring temperature is 93 K [2,3,4].

Figure: Example of time evolution of numbers of O⁺ (■), OH⁺ (●), OD⁺ and OH₂⁺ (▲), OHD⁺ and OH₃⁺ (▼) ions at low temperatures in the trap. Ions of the same mass cannot be distinguished from each other. Ions OHD⁺, OH₃⁺ and other products OD₂⁺, ODH₂⁺ and H⁺ are not involved in fit model. (a) Measurement with high number density of HD. The rate of reaction is too fast to observe production of OH⁺ and OD⁺. However, by fitting a decay of O⁺ we can get the total reaction rate coefficient \( k \). (b) Measurement with low number density of HD. \( k \) and also \( k_{OH}/k_{OD} \) can be determined.

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References