The reaction of O^+ with HD at low temperatures

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The reaction of O^+ with HD has two channels

$$O^+ + HD \xrightarrow{k_{OH}} OH^+ + D, \quad (1)$$

$$\xrightarrow{k_{OD}} OD^+ + H. \quad (2)$$

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].

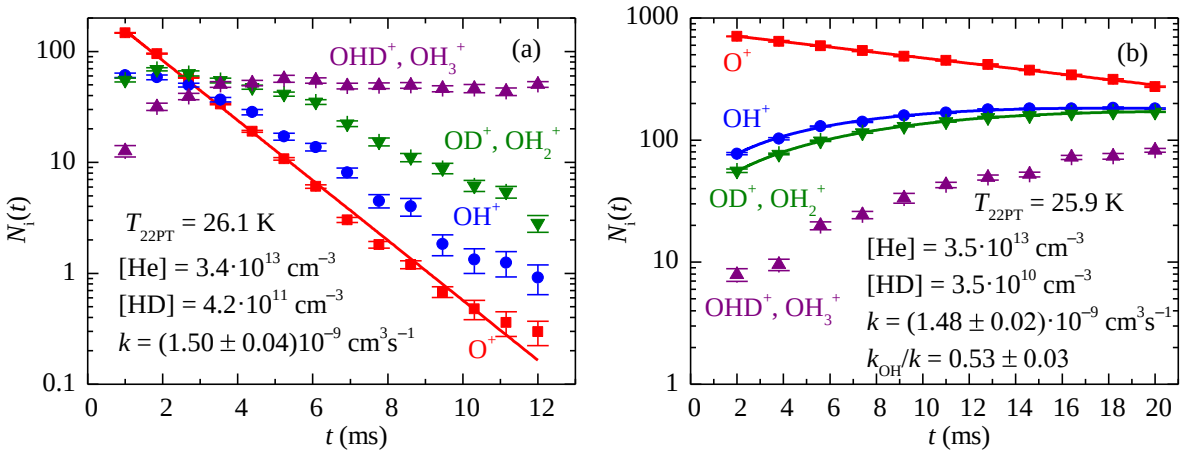

Figure: Example of time evolution of numbers of O^+ (■), OH^+ (●), OD^+ and OH_2^+ (▲), OHD^+ and OH_3^+ (▼) ions at low temperatures in the trap. Ions of the same mass cannot be distinguished from each other. Ions OHD^+, OH_3^+ and other products OD_2^+, ODH_2^+ and H^+ are not involved in fit model. (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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