INFLUENCE OF THE COLLISION ENERGY ON THE REACTION RATE OF THE D_2^+ + H_2O ION-MOLECULE REACTION NEAR 0 K

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Ion-molecule reactions are important reactions in atmospheric chemistry, astrophysics, and plasma physics.[1] Reliable values for the reaction rates are key to modelling the relevant reaction networks. This poster focusses on the reactions of water with D_2^+ at the low temperatures in the range of 0-50 K of interstellar molecular clouds.[1,2] For technical reasons D_2^+ is used instead of H_2^+.

Because ions are easily accelerated by (stray) electric fields, high Rydberg states ($n \approx 30$, $v^+ = 0$, $N^+ = 0$) are utilised as proxies for the ionic reaction partner, because the Rydberg-electron does not significantly affect the reaction but shields it from electric fields.[3,4] We use a merged-beam approach featuring a Rydberg-Stark deflector and decelerator to access the collision-energy range below $k_B \cdot 10\,\mathrm{K}$. The molecular beam of water is characterised.

The reaction rates are modelled with an adiabatic capture model inspired by earlier work in Refs. [5,6,7] which is constructed by modifying the Langevin model with the rotational-state-specific energy of the neutral molecules in the field of the ion.[5,6,7,8] For Maxwell-Boltzmann rotational-state distributions below 100 K the model predicts an increase of the reaction-rate constant at low collision energies.

[1] doi:10.1038/s42254-020-0198-0, B. A. McGuire, O. Asvany, S. Brünken, S. Schlemmer, *Nat. Rev. Phys.*, **2**, 402-410, (2020).

[2] doi:10.1146/annurev.pc.46.100195.000331, E. Herbst, *Annu. Rev. Phys. Chem.*, **46**, 27-53, (1995).

[3] doi:10.1103/PhysRevA.90.043403, P. Allmendinger, J. Deiglmayr, J. A. Agner, H. Schmutz, F. Merkt, *Phys. Rev. A*, **90**, 043403, (2014).

[4] doi:10.1088/1367-2630/ac231d, F. B. V. Martins, V. Zhelyazkova, C. Seiler, F. Merkt, *New J. Phys.*, **23**, 095011, (2021).

[5] doi:10.1063/1.453701, J. Troe, *Chem. Phys.*, **87**, 2773-2780, (1987).

[6] doi:10.1080/00268978500100461, D. C. Clary, *Mol. Phys.*, **54**, 605-618, (1985).

[7] doi:10.1063/1.472479, J. Troe, *J. Chem. Phys.*, **105**, 6249-6262, (1996).

[8] doi:10.1039/D1CP03116C, V. Zhelyazkova, F. B. V. Martins, J. A. Agner, H. Schmutz, F. Merkt, *Phys. Chem. Chem. Phys.*

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