ÉCOLE DE PHYSIQUE DES HOUCHES

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Towards inelastic collision rate coefficients of OH+ with He via photodissociation

Content

Cooling internal degrees of freedom by inelastic collisions is a widely applied method in cold molecule physics, especially for species that lack the possibility of laser cooling. [1] Despite this, the state specific rate coefficients are commonly unknown. Experimental data for ions at low temperatures, of the order of a few Kelvin, is particularly sparse. Our group has previously reported rotational state-to-state rate coefficients for the hydroxyl anion, OH-, in collisions with helium, He. [2] The Langevin capture rate which is commonly used as an estimate in ion-neutral collisions was found to overestimate the rates by an order of magnitude, demonstrating the elasticity of the system.

We now aim to measure the inelastic collision rate coefficients for trapped hydroxyl cations, OH+, with He buffer gas using photodissociation as a state-specific probe.

OH+ has been observed in numerous regions in space and is of special astrophysical interest because it could function as a tracer for cosmic and X-ray ionization rates besides serving as an initiator in the oxygen chemistry. [3] The photodissociation of OH+ also plays an important role in astrochemistry [4] and has interesting dynamics by itself. For excited vibrational levels in the A state, dissociation can occur via coupling between bound and dissociative excited electronic states or by tunnelling, and dissociation into both of the quasi degenerate channels O++H and O+H+ has been observed. The cross section and the branching ratio were found to be highly state specific. [5, 6]

Our experimental studies, in combination with quantum chemical theory [3, 7] , aim to give a fundamental understanding of collisions including quantum effects which can have a significant contribution when low masses collide at low temperatures. Open shell species like the OH+, are particularly interesting as collisions can induce changes in the electronic spin as well as the nuclear rotation.

References

[1]
A. K. Hansen, et al., „Efficient rotational cooling of Coulomb-crystallized molecular ions by a helium buffer gas," Nature, Bd. 508, pp. 76-79, 2014.

D. Hauser et al., „Rotational state-changing cold collisions of hydroxyl ions with helium," Nat. Phys., Bd. 11, pp. 467-470, 6, 2015.

S. Gómez-Carrasco et al., „OH^+ in Astrophysical Media: State-to-state Formation Rates, Einstein Coefficients and Inelastic Collision Rates with He," ApJ, Bd. 794, p. 33, 2014.

Heays, A. N., „Photodissociation and photoionisation of atoms and molecules of astrophysical interest," A&A, Bd. 602, p. A105, 2017.

J. Levin et al., „Photodissociation spectroscopy of OH^+ molecular ions at the TSR storage ring," Hyperfine Interact., Bd. 127, pp. 267-270, 01 8, 2000.

H. Helm, et al., „Photofragment spectroscopy of shape resonances in OH^+," Phys. Rev. A, Bd. 30, Nr. 2, pp. 851-857, 8, 1984.

E. Bodo and F. A. Gianturco, „Collisional quenching of molecular ro-vibrational energy by He buffer loading at ultralow energies," Int. Rev. Phys. Chem., Bd. 25, pp. 313-351, 2006.

Summary

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