Collision and reaction dynamics of radical anions

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Similar to neutral radical reactions, open-shell negative ions can be expected to give rise to a higher reactivity than closed-shell anions. To investigate this, we have studied the reaction dynamics of O^- anions with CH_3I using crossed-beam ion-molecule reactive scattering [1].We have found several unexpected product channels in the differential scattering data. These data provide evidence for fast and direct dynamics when comparing with scattering information for closed-shell F^- and Cl^- anions that react with the same neutral reactant [2].

In a different series of experiments we have studied the radical anion C_2^-. This dimer anion possesses two electronic excited states below the detachment threshold and is thus open to resonant optical excitation. Using a novel cryogenic wire ion trap [3], we have carried out high resolution optical spectroscopy on the B ← X transition and improved the accuracy of the transition frequency for rotational ground state anions to 20 MHz or $7\text{x}10^{-3}$ cm^{-1}. We could also improve measurements of the spin-rotation coupling. Using optical pumping we have then studied collisions and reactions of vibrationally excited C_2^- with cold hydrogen molecules and determined an absolute value for the inelastic quenching rate coefficient that can be compared to quantum scattering calculations [4].

[1] J. Meyer, R. Wester, Annu. Rev. Phys. Chem. 68, 333 (2017)

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[3] K. Geistlinger, M. Fischer, S. Spieler, L. Remmers, F. Duensing, F. Dahlmann, E. Endres, R. Wester, Rev. Sci. Instrum. 92, 023204 (2021)

[4] M. Nötzold *et al.*, in preparation