Colloquium

SFB 956

Conditions and Impact of Star Formation

16 Dec 2016 | supplementary colloquium

Friday 9:15 am

Physikalische Institute Köln

Seminarraum II

Zülpicher Straße 77 | 50937 Köln

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Cold, Controlled Reactions between Molecular Ions and Radicals

Radicals and ions frequently play an important role in gaseous media such as the interstellar medium, the upper atmosphere or flames and plasmas. Unfortunately, experimental measurements of the reaction rates and particularly the dynamics of reactions between ions and radicals are very few and far between. This is a direct consequence of the typical low densities of these species formed under experimental conditions in the laboratory. Most radical-ion reactions are predicted to be barrierless, thus can still occur rapidly at low temperatures. Therefore, measurements of such reactions under controlled conditions allow studying reaction pathways relevant for interstellar medium chemistry. At the same time it is possible to explore molecular spectroscopy and chemical reaction dynamics in a qualitatively new regime, e.g. at temperatures < 1 K.

For sensitively probe radical-ion reactions, we designed a new experimental system combining two cold molecule techniques: The free radicals are derived from a Stark decelerator, which produces not only molecules in a very limited number of quantum states, but also with a controllable collision energy from ~0.1 to 200 cm^{-1}. Molecular ions are stored in a linear quadrupole ion trap and sympathetically cooled with co-trapped, laser-cooled Ca^+. Thereby the ions are translationally cooled with temperatures < 1 K and have lifetimes of several hours. The combination of these two experimental approaches allows to probe chemical reactions with controllable energies in selected quantum states.

In this talk I will present the design of this experiment, showing its capabilities. Additionally I will report on the measurement of the quantum-state controlled reaction of $Ca^+ + NO$. Furthermore planned experiments and upgrades to the present setup will be presented.