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Institut für Ionenphysik
und Angewandte Physik

Institutsseminar

Towards Chemistry at Absolute Zero

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A diversity of experimental techniques has been developed over the last 25 years or more to create samples of molecular gases at temperatures close to the Absolute Zero - from 10s of Kelvin ('cold') down to 100s or even 10s of nanoKelvin ('ultracold'). One motivation for this work is to be able to study the kinetics and dynamics of chemical reactions in this novel physical regime, where quantum effects may come to the fore. A range of experiments can potentially be conducted that utilize the high levels of control achievable over the properties of the molecules, including their internal quantum states and translational motion. In some cases, control and observation of reactions at a single-molecule level is achievable. In this talk, I will give a perspective on the emerging themes of the 'cold and ultracold chemistry' field to date, with examples from my interests in the field of cold ion-molecule collisions, and from the work of others. Many of these examples are 'barrier-free' exothermic reactions controlled by long-range forces, but I will highlight examples where the properties of the short-range reaction complex, formed on collision, determine the outcomes of the chemical reaction.

Heazlewood, B.R., Softley, T.P. Towards chemistry at absolute zero. *Nat. Rev. Chem.* **5**, 125–140 (2021), DOI: 10.1038/s41570-020-00239-0
Softley T. P. Cold and ultracold molecules in the twenties *Proc. R. Soc. A.* **479**, 20220806 (2023), DOI: 10.1098/rspa.2022.0806

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