CFEL SCIENCE

SEMINAR

31st January 2019 - 10:00 h

CFEL – Building 99, seminar room I+II (ground floor)

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Stereodynamics of chemical reactions near absolute zero

I will present our work on fundamental aspects of low-energy gas-phase chemical reactions. In the past years we have developed a method that allows us to merge two neutral supersonic expansions using inhomogeneous electric and/or magnetic fields.[1] We obtain state-purified samples of polarized atoms or molecules with well-defined velocities, which in turn offers highly controlled conditions for scattering experiments. In particular, the merged beam technique currently is the only way to reach relative reactant velocities in molecular beams that correspond to collision energies under 1 K, opening doors towards the investigation of fundamental quantum mechanical effects in chemistry that are not visible at room temperature.

We recently combined the merged beam technique with methods to orient reactants[2,3] and studied, for the first time, sub-Kelvin stereodynamics in a prototypical energy transfer reaction, namely between metastable $Ne(^3P_2)$ and ground state Ar atoms.[4] This reaction can proceed along two pathways, one producing $Ne(^1S)+Ar^+ + e^-$ (called Penning ionization), the other one producing $NeAr^+ + e^-$ (associative ionization). At high energies the branching ratio between these channels can be controlled through the orientation of the $Ne(^3P_2)$ atom, but this ability is lost at low energies due to a reorientation of the reactants.

[1] A. Osterwalder, *EPJ Techniques and Instrumentation* **2**, 10 (2015).
[2] J. Zou, S.D.S. Gordon, S. Tanteri, and A. Osterwalder, *J. Chem. Phys.* **148**, 164310 (2018).
[3] S.D.S. Gordon, J. Zou, S. Tanteri, J. Jankunas, and A. Osterwalder, *Phys. Rev. Lett.* **119**, 053001 (2017).
[4] S.D.S. Gordon, J.J. Omiste, J. Zou, S. Tanteri, P. Brumer, and A. Osterwalder, *Nature Chemistry* **43**, 7279 (2018).

Host: Terry Mullins / CFEL Molecular Physics Seminar