Towards controlled reactive collisions

Content

One of the important goals in physical chemistry is to get a complete understanding of chemical reactions and the underlying dynamics on the molecular level. We therefore investigate collisions and reactions between individual molecules and atoms in high detail, using the powerful combination of Zeeman deceleration and Velocity Map Imaging in a crossed molecular beam setup [1]. The decelerator allows for precise control over paramagnetic species, while Velocity Map Imaging in combination with near-threshold ionization enables us to accurately probe the velocity vectors of the scattered products. This powerful combination of techniques enables scattering experiments with extraordinary resolution, thereby unveiling intimate details of molecular collisions, such as diffraction oscillations and scattering resonances.

So far, we used this experimental approach to investigate inelastic collisions, for instance between carbon atoms and helium atoms [2] or hydrogen molecules. Recently, we started examining reactive scattering processes. We aim to measure the collision-energy dependence of state-to-state differential cross sections in order to provide an extremely sensitive test for potential energy surfaces and scattering calculations used to describe the molecular reaction dynamics.

References:

[1] V. Plomp et al., "High-resolution imaging of molecular collisions using a Zeeman decelerator", J. Chem. Phys. 152, 091103 (2020).

[2] V. Plomp et al., "High-Resolution Imaging of C + He Collisions using Zeeman Deceleration and Vacuum-Ultraviolet Detection", J. Phys. Chem. Lett. 12, 12210 (2021).

Primary author: ONVLEE, Jolijn (Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands)

Co-authors: WANG, X.-D. (1Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands); TSOUKALA, A. (1Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands); PLOMP, V. (Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands); VAN DE MEERAKKER, S.Y.T. (Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands); LIQUE, F. (Institut de Physique de Rennes, Université de Rennes, 263 Avenue du Général Leclerc, Rennes 35042 CEDEX, France); KLOS, J. (Department of Physics, Joint Quantum Institute, University of Maryland, College Park, Maryland 20742, United States of America)

Presenter: ONVLEE, Jolijn (Institute for Molecules and Materials, Radboud University, Heijendaalseweg 135, 6525 AJ Nijmegen, the Netherlands)

Contribution Type: Invited talk