

Institutsseminar

Cold ion chemistry within a Rydberg-electron orbit

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In recent studies of cold ion–molecule reactions, we experimentally demonstrated that the partial-charge distribution in the neutral molecule dictates how the reaction rate coefficients vary with the collision energy (E_{coll}) near zero, confirming theoretical predictions made almost forty years ago. We use a merged-beam approach and study these reactions within the orbit of an excited Rydberg electron, which allows us to reach collision energies between 200 mK and 40 K. We found that, for polar molecules, the rate coefficients $k(E_{\text{coll}})$ increase as E_{coll} approaches zero, whereas, for molecules with a negative quadrupole moment, $k(E_{\text{coll}})$ decreases. These effects occur because the molecular rotational levels experience different Stark shifts in the field of the approaching ion, which gives rise to rotational-state-specific long-range potentials and reaction rate coefficients. I will show how this state specificity can be exploited to control the reaction rates by coherently driving population between different rotational states using mm-wave radiation. I will also present an interpretation of our results in the realm of an adiabatic-channel capture model.

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15:30 Uhr

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