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Quantum defect theory for reactive collisions of ultracold polar molecules

Recent experiments succeeded in making ultracold molecules in their stable vibrational and rotational ground electronic state by associating them from ultracold atoms. Cold molecules open up many new opportunities in comparison to ultracold atoms since they have more complex internal structure and different long range potentials. In this talk I will present theoretical models describing reactive collisions of ultracold molecules. The models are formulated in the framework of quantum defect theory and are based on some key simplifying assumptions regarding the short range molecular dynamics. In particular, when the short range chemical reactivity is high, molecular collisions exhibit universal elastic and inelastic collision properties that depend only on the long range potential. Predictions of universal theory is in very good agreement with experiments on reactive molecules such as KRb. In contrast, non-universal molecules that are weakly or non reactive are expected to exhibit scattering resonances dependent on the details of the short range molecular dynamics. In the last part of my talk, I will show how the theory can be adapted to describe charge transfer process in ion-atom collisions and Penning ionization in metastable atom collisions.

7. Juni 2013, 14:00 Uhr

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