Resonant processes and their impact in many-body dynamics

Prof. Dr. Robin Côté

Department of Physics, University of Connecticut

Resonant exchange is a general process playing a key role in many-body dynamics and transport phenomena, such as spin, charge, or excitation diffusion. The underlying process is described by the resonant exchange cross section. A prime example is the diffusion of an ion A+ in its parent neutral gas A. In fact, the charge actually behaves as a hole (h) at ultralow temperatures, hopping from atom to atom instead of staying on its heavy center (the ion). We have predicted a faster diffusion for the hole than if the charge was diffusing via collision. Here, we show that the exchange symmetry for identical (homonuclear) atom-ion system leads to special outcomes for ion transport in ultracold experiments, in particular in Li. We show that the charge hopping and collisional diffusion compete, leading to charge trapping in regions of high atomic density gradient. We also review how the locking of s-wave phase shifts could be used to explain this behavior, and we illustrate for resonant charge-transfer in ion-atom collisions for various isotopes of Yb. Finally, we also discuss charge exchange in very large identical molecules.