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Reactive processes in ion-atom hybrid systems

The recent development of experiments for the combined trapping of cold ions and cold neutral atoms has paved the way for studying interactions between these species at extremely low energies [1]. Such cold ion-atom hybrid systems display a rich chemistry including charge exchange and the formation of molecular ions by radiative association. In the talk, we will review recent results on the characterization of these reactive processes. We will also discuss their systematics across different systems and explore their underlying dynamics [2].

In the second part of the talk, we will highlight a range of new developments in hybrid trapping technology. First, we will discuss the combination of cold molecular ions with ultracold atoms in order to study molecular effects in cold ion-atom interactions [3]. Second, we will present a new “dynamic” hybrid trap which enables the study of ion-neutral collisions with a significantly improved energy resolution. Third, we will report on progress towards realizing a completely “molecular” hybrid trap by combining traps for cold neutral molecules and cold molecular ions.

[1] A. Härter, J. Hecker Denschlag, *Contemp. Phys.* 55, 33 (2014); S. Willitsch, *Int. Rev. Phys. Chem.* 31, 175 (2012); S. Willitsch, arXiv 1401.1699; C. Sias and M. Köhl, p.267 ff. in *Quantum Gas Experiments*, ed. P. Törmä and K. Sengstock, World Scientific 2014. [2] F.H.J. Hall et al., *Phys. Rev. Lett.* 107, 243202 (2011); *Mol. Phys.* 111, 2020 (2013); *Mol. Phys.* 111, 1683 (2013). [3] F.H.J. Hall et al., *Phys. Rev. Lett.* 109, 233202 (2012).

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