Kolloquium

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Experiments with Ultracold Dimer Molecules and Evidence for Efimov Trimer States

This talk will be divided into two parts: In the first part I will report on our experiments with trapped samples of ultracold Cs dimer molecules. These molecules are initially associated on so-called Feshbach resonances at temperatures in the nanokelvin range. By following and/or jumping avoided crossings various other molecular states can be populated with near 100% efficiency. The molecular density is sufficiently high so that collisional properties can be mapped out as a function of an externally applied magnetic field. In particular, we observe various collisional resonances, i.e. molecular Feshbach resonances on which two dimers are expected to couple to a tetramer state . Currently, we are mapping out the binding energy and the collisional properties of the weakly bound s-state which is responsible for the peculiar scattering properties of Cs.

This weakly bound s-state is the link to the second part of my presentation. For resonant two-body interactions, i.e. for sufficiently small binding energies of the two-body bound state, a family of three-body bound states appears, the family of so-called Efimov states . Surprisingly, these states even exist in the absence of the corresponding two-body bound state, and their precise nature is largely independent of the concrete type of the two-body interaction potential. Their appearance has a strong effect on the three-body collisional physics, leading to strong loss resonances in the range of large negative two-body scattering lengths as a result of the coupling of three free atoms to an Efimov trimer. We have observed such giant three-body recombination loss when the strength of the two-body interaction is varied as a result of an atomic Feshbach resonance . The observed resonance develops into a continuum resonance at non-zero collision energies, and we have detected a shift of the resonance position as a function of temperature. To our surprise, we have also found a minimum in the recombination loss for positive scattering lengths, indicating destructive interference of decay pathways in three-body loss.

[1] C. Chin, T. Kraemer, M. Mark, J. Herbig, P. Waldburger, H.-C. Nägerl, R. Grimm, Phys. Rev. Lett. **94**, 123201 (2005).
[1] V. Efimov, Phys. Lett. **33B**, 563 (1970).
[1] T. Kraemer, M. Mark, P. Waldburger, J. G. Danzl, C. Chin, B. Engeser, A. D. Lange, K. Pilch, A. Jaakkola, H.-C. Nägerl, R. Grimm, Nature **440**, 315 (2006).

Wann? Freitag 03.11.2006, 14:00 Uhr

Wo? Universität Ulm, Raum H14/N24