CO.CO.MAT

Leticia Tarruell

(ICFO -The Institute of Photonic Sciences, Barcelona)

Quantum droplets in attractive Bose-Bose mixtures

In the presence of attractive interactions, a Bose-Bose mixture has been predicted to host a novel type of ultra-dilute liquid-like phase, a quantum droplet [1]. This is a macroscopic self-bound object where the attractive interactions between the particles are exactly compensated by repulsive forces originating purely from quantum fluctuations. Thus, droplets cannot be described in a simple mean-field picture, and their existence is a striking quantum many-body effect. Analogous physics has been experimentally explored in the context of dipolar quantum gases [2-5]. In my talk, I will present experimental studies of quantum droplets using an attractive spin mixture of two 39K Bose-Einstein condensates. In a cigar trap, two types of self-bound states exist: solitons, stabilized by quantum pressure, and droplets, stabilized by quantum fluctuations. Depending on the atom number and interaction strength, they are separated either by an abrupt transition or by a smooth crossover, a situation that we explore experimentally. For a gas confined exclusively along one direction, no self-bound solutions exist at the mean-field level. However, we observe that, in stark contrast with a single component BEC, the effective attractive mean-field interaction does not lead to a collapse of the system, but instead to the stabilization of a self-bound droplet for sufficiently large atom numbers.

[1] D. S. Petrov, Phys. Rev. Lett. 115, 155302 (2015).
[2] H. Kadau, M. Schmitt, M. Wenzel, C. Wink, T. Maier, I. Ferrier-Barbut and T. Pfau , Nature 530 ,194 (2016).
[3] I. Ferrier-Barbut, H. Kadau, M. Schmitt, M. Wenzel, and T. Pfau, Phys. Rev. Lett. 116, 215301 (2016).
[4] L. Chomaz, S. Baier, D. Petter, M.J. Mark, F. Wächtler, L. Santos and F. Ferlaino, Phys. Rev. X 6, 041039 (2016). [5] M. Schmitt, M. Wenzel, F. Böttcher, I. Ferrier-Barbut and T. Pfau, Nature 539, 259 (2016).

2. Juni 2017, 15:30 Uhr

Universität Stuttgart, NWZII, Raum 2.136
Pfaffenwaldring 57, 70569 Stuttgart