SFB/TRR 21 - Seminar

25. April 2016, Stuttgart

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Observation of quantum depletion

Degenerate quantum Bose gases feature relatively weak interactions. At zero temperature these systems can be represented by a single macroscopic wavefunction shared by almost all the atoms, the Bose-Einstein condensate (BEC). The fraction of atoms that is not captured by this macroscopic wavefunction is the so called quantum depletion.
In my talk, I will report on the observation of the quantum depletion in a cloud of metastable Helium atoms He* [1]. The high internal energy of He* allows for single-particle detection in 3 dimensions after a long time of free expansion and with a high resolution, permitting detailed investigations of momentum-space density [2]. In particular the momentum distribution associated with the quantum depletion of the BEC is expected to exhibit characteristic momentum tails that our detector is capable of measuring. In addition finite temperature contributions, which may prevent the observation of quantum depletion [3], can be unambigously identifed in momentum space from their scaling. We have first investigated the quantum depletion in a trapped BEC. Secondly we have used 3 dimensional optical lattices [4] to tune the depleted fraction and study its dependency with the amplitude of the lattice.
[1] Q. Bouton et al., Phys. Rev. A 91 061402(R) (2015) [2] F. Nogrette et al., Rev. Scienti. Instrum. 86 113105 (2015). [3] S. Utsunomiya et al., Nature Physics 4, 700-703 (2008). [4] K. Xu et al., Physical Review Letters 96, 180405 (2006)

25. April 2016, 12:30 Uhr

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