PHYSIK

Kolloquium des SFB/TR 49
gemeinsam mit Theoretisch-Physikalischem Kolloquium

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Fundamental fluctuations and quantum simulation with Bose-Einstein condensates

Prof. Dr. Jan Arlt*
Institut for Fysik og Astronomi, Aarhus Universitet, 8000 Aarhus C, Denmark.

Ultracold atomic gases offer the opportunity of addressing problems from numerous areas of physics. The resulting field of quantum simulation has led to progress in the theoretical understanding of numerous open problems e.g. from solid state physics. Nonetheless some fundamental aspects of Bose-Einstein condensation (BEC) have not yet been addressed experimentally, since the technology in use has not reached the required maturity and precision so far.

In particular the reliable production of cold atomic clouds with well-defined properties is a notoriously difficult task. Variations in the atom number and temperature typically arise due to unpredictable fluctuations in the experimental sequence. We show that non-destructive measurements of the ensemble properties within the experimental sequence allow for an on-line adjustment of the cooling procedure. Thus we can demonstrate sub-per mille run to run stability of the final atom number at the shot noise limit. This is the basis for our current investigation of the fluctuations in a BEC which, despite considerable theoretical interest, has not been observed.

In the second part of the talk I will discuss the use of two spin components of a ^{39}K BEC to investigate the Bose polaron [1]. Radio frequency spectroscopy shows the existence of a well-defined quasiparticle state for an impurity interacting with the BEC, and allows for a measurement of its energy for attractive and repulsive interactions. Our results show that the spectral response consists of a well-defined quasiparticle peak at weak coupling which is strongly broadened for increasing interaction strengths. This opens up intriguing prospects for studying mobile impurities in a bosonic environment, as well as strongly interacting Bose systems in general.

* arlt@phys.au.dk

[1] N. B. Jørgensen, L. Wacker, K. T. Skalmstang, M. M. Parish, J. Levinsen, R. S. Christensen, G. M. Bruun, and J. J. Arlt, Phys. Rev. Lett. 117, 055302 (2016).

Gäste sind herzlich willkommen.

Die Dozenten der Theoretischen Physik

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