Institut für Angewandte Physik

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COLLOQUIUM „OPTICS AND CONDENSED MATTER“

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Investigating two-body physics in a Bose gas: The spectroscopic way

The thermodynamic equilibrium of any homogeneous fluid is characterized by its equation of state. This equation gives the variations of a thermodynamic potential, e.g. the internal energy E, with respect to a set of variables such as the number of particles, their temperature and their interaction strength. Regarding this latter variable, the relevant thermodynamic quantity for an ultra-cold gas is the so-called Tan's contact [1], which unifies many different properties from the momentum distribution to the spatial two-body correlation function.

In this talk, I will explain how one can use a Ramsey interferometric scheme between the two hyperfine clock states of rubidium atoms to map out the variations of Tan's contact in a two-dimensional Bose gas, from the strongly degenerate superfluid case to the non-degenerate case [2]. I will also show a somewhat surprising result, revealed by this precise microwave spectroscopy in a two-dimensional fluid: In spite of the fact that each clock state is non-magnetic, a mixture of the two states still displays a magnetic dipole-dipole interaction comparable to the one expected for the other (magnetic) Zeeman states [3].

[1] S. Tan, Annals of Physics 323, 2971 (2008).

[2] Y.-Q. Zou, B. Bakkali-Hassani, C. Maury, É. Le Cerf, S. Nascimbene, J. Dalibard, J. Beugnon, Nature Communications 12, 760 (2021).

[3] Y.-Q. Zou, B. Bakkali-Hassani, C. Maury, É. Le Cerf, S. Nascimbene, J. Dalibard, J. Beugnon, Phys. Rev. Lett. 125, 233604 (2020).

May 3rd, starting with discussion at 16:30 h, talk at 17:15 h, live IAP lecture hall and via Zoom

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