Effect of disorder in two-dimensional Bose gases

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We study the effects of disorder in ultracold 2D gases, well controlled systems where many parameters can be tuned. In particular, we analyze two different situations. First the expansion of non-interacting particles is quantitatively studied [1]. Diffusion and Anderson effects can be observed. Second, we focus on the physics of interacting bosons.

Interacting 2D Bose gases undergo a thermal phase transition to a superfluid phase at low temperature. It is a Berezinskii-Kosterlitz-Thouless type transition in which the interactions between particles are playing a crucial role. We study this transition through the emergence of phase coherence in the momentum distribution [2].

The influence of disorder on the 2D superfluid transition is an important open problem in condensed matter physics. It is relevant to a variety of systems such as helium films, thin metallic films, or even high temperature superconductors. Experimentally we study how microscopically correlated disorder changes the coherence properties of the 2D Bose gas close to the superfluid transition as a function of both temperature and disorder strength [3]. Our study is an experimental realization of the dirty boson problem in a well controlled atomic system suitable for quantitative analysis.

References

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