Experiments of quantum turbulence in trapped atomic superfluid

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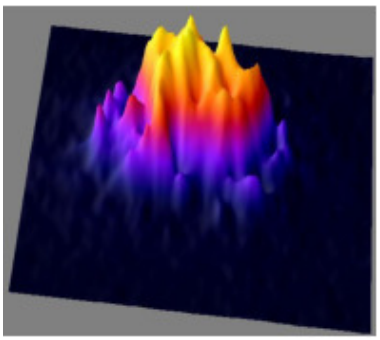
In these two lectures we will introduce, describe and verify the current state of investigation for the state of turbulence in atomic superfluid composed of Bose-Einstein condensates kept in traps.

Lecture 1: Exciting the superfluid and producing turbulence – The ways to start with a superfluid in equilibrium in such a way that its temporal evolution reaches the state of turbulence will be described. The generation of vortices or density perturbations can lead to the formation of a turbulence based on the reaction of the vortices or the interaction of waves. The consequences and macroscopic properties and how to measure them will be presented both for a non-homogeneous condensate (trapping in harmonic trap) and for a homogeneous condensate (box-type trap) in a tutorial way. Situations, where spontaneous generation of turbulence occurs, will also be considered. The main characteristics of the system such as momentum distribution, energy flow and entropy will be presented.

Lecture 2: Applications of a turbulent superfluid atomic cloud – Once the turbulent cloud is produced and characterized, this constitutes an excellent system for investigating various physical phenomena. The expanding cloud can be characterized as speckles of matter waves. The system is also an example of an out-of-equilibrium quantum system, where pre-thermalization and the presence of non-thermal fixed points can occur. Quantification of non-equilibrium as well as scalability measurements will be presented. Perspectives for experimental studies of out-of-equilibrium quantum systems will be considered.



Turbulent BEC of Rb