Out of equilibrium BEC: The quantum turbulence and characteristics

Vanderlei S. Bagnato

IFSC-University of São Paulo, Av. Trabalhador São Carlense, 400, São Carlos, Brazil

The notion of turbulence in the quantum world was conceived long ago, but the occurrence of turbulence in ultracold gases has been studied in the laboratory only very recently. The topic offers new pathways and perspectives on the problem of turbulence. The finite size effects create specific characteristics observed. In this presentation, we review the general properties of quantum gases at ultralow temperatures paying particular attention to vortices, their dynamics and turbulent behavior. Measurement of the energy spectrum using two techniques will be discussed and related to the present understanding of the theory. Identification of turbulence type based on energy spectrum determination will be explained. Applications of the turbulent cloud, when in an expansion, with the creation of a matter wave speckle field will be demonstrated. The appearance of exponential velocity distribution, as indicative of non-thermalization effect, will be interpreted in different views. Work supported by FAPESP - program CEPID and CNPq - program INCT. Work with contribution from P. Tavares, G. Telles, E. M. Gutierrez, K. Magalhaes, G. Roati, A. Orozco, P. Mazo, G. Neto, A. Marino, M. Miotti, M. Hemmerling, E. Santos, M. Caracanhas and L. Madeira. Recommended papers: http://cepof.ifsc.usp.br