

Investigation with atomic superfluids

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FAPESP:

Assunto(s): [Magnetismo](#) [Superfluidez](#) [Vórtices dos fluídos](#)

Resumo

This is a cooperative research involving MIT and USP to investigate in Brazil different aspects of quantum Turbulence in samples of BEG, while at MIT we shall cooperate in the investigation of magnetism in samples of quantum fluids of bosons and fermions. The study of vortices in quantum fluids started with the studies of superfluid liquid helium. Those studies has geneerted an incredible amount of physics. The study of vortices in condensates has never suffered for lack of interest. Over the years, studies involving new aspects of both the formation and the dynamics of vortices were performed as well as the development of new techniques of vortex nucleation. Recently, vortices were observed in our laboratory by means of a new technique that consists of introducing off-axis oscillations in the condensate. Besides vortices we also produce antivortices. The existence of vortices and antivortices in the same sample and their mutual interaction and annihilation are new topics never studied before experimentally. This system composed by vortices and anti-vortices evolves in an interesting way in relation to the frequency and amplitude of the excitation. Eventually, these excitations lead the system to a regime called quantum turbulence, where there are tangled vortices in each direction of space. The study of quantum turbulent systems also started with liquid helium. The study of quantum turbulence became interesting as a prototype for the understanding of the statistics as well as the dynamics of the nucleation of vortices in these regimes and possibly extension to classical regimes. Unfortunately, helium is not a good system for the observation and quantitative measurement of features due to the experimental difficulties in the control of the parameters as well as the generation of turbulence. In contrast, Bose-Einstein condensates, where the experimental parameters can be precisely tuned and the addition of angular momentum can be done in a controlled way are the perfect samples for this kind of study. Nevertheless, experimentally and theoretically there have been few studies in this regime until now. Recently, a series of theoretical papers demonstrated several aspects related to quantum turbulence in BEGs. In this project we shall develop experiments to investigate the influence of the temperature on the relaxation of the trubulent state. The transference of vorticity from one specie to a second one will be accomplished in a double specie experiment. Stabilization of a high charged vortex will be investigated using a mixture of two superfluids. Theoretical studies involving turbulence and its control will also be part of this program. While in Brazill we shall investigate quantum turbulence, at MIT we will collaborate with their programs of quantum magnetism which has many aspects. (AU)

Matéria(s) publicada(s) na Agência FAPESP sobre o auxílio:

[Cientista brasileiro e Nobel de Física pesquisam superfluidos](#)

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