Proposta de minicurso para pós-graduação:

Credits: 1

Quantum turbulence: principles and future possibilities

Vanderlei S. Bagnato, Monica Caracanhas and Lucas Madeira

Overall Description

Turbulence in quantum systems despite being an area that has existed for some time, only now with Bose-Einstein condensates, has taken a different direction and with perspectives that go beyond the study of turbulence itself. Being an excellent system for investigating out-of-equilibrium quantum systems, the topic has resurfaced with a lot of interest. We at IFSC are pioneers in demonstrating Turbulence in condensates and have made significant contributions in the area. Having the presence of four world experts in theory on this topic is an important opportunity to put together a mini course for our Postgraduate students. The topic comes at a good time, where the effervescence of quantum technologies is taking on an appreciated volume.

Data do proposto Curso: 24/04/2024 até 06/05/2024 – 2 semanas e 6 aulas

Avaliação: Um trabalho de final de curso.

Professors:

Sergey Nazarenko – Nice University – France

Ying Zhu – Nice University – France

Jason Laurie – Aston University - UK

Jonathan Skipp – Aston University - UK

Lectures and distributions

Six lectures distributed during the period- 1h20min each

Opening (Vanderlei): The importance of turbulence in the quantum world

L1 (Laurie): Intro to classical and quantum turbulence. Cascades and spectra. Quantized vortices and Vortex tangles. Reconnections, absence of dissipation at the inter vortex

scale. Intro about transition to Kelvin wave turbulence, bottleneck, acoustic dissipation at very small scales.

L2 (Laurie): Theory and numeric of Kelvin wave turbulence. Bio-Savart and GPE. Relevance to BEC experiment and possible future implementation in laboratories

L3: (Nazarenko): Introduction to Wave Turbulence with BEC as a master example. Matter waves, sound waves, Kelvin waves.

L4: (Nazarenko): Theoretical predictions for universal scaling states in BEC wave turbulence. Direct and inverse KZ spectra. Self-similar evolving states. Relevance to BEC experiment and possible future implementation in Vanderlei's group, or other groups with emphasis on the inverse KZ cascade and self-similar evolution (non-thermal fixed points).

L5 (Jonathan): Wave turbulence in self-gravitating BEC and optical systems. Dark matter turbulence.

L6 (Zhu): Numerical results for the universal scaling states in BEC wave turbulence. Direct and inverse KZ spectra. Self-similar evolving states.

The course will be presential and online: presential for the students registered for credit and broadcast live for general students. We shall announce it to everyone.

Notes will be distributed to the students in presential mode.

Evaluation: Final course text.