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BIOS AND ABSTRACTS

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Scientific session 3

QUANTUM TECHNOLOGIES

Speaker

PATRICIA MARQUES CASTILHO

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Patricia Christina Marques Castilho did her education in Brazil. She is an experimental physicist with bachelor's degree from the Universidade de São Carlos (2009) and master (2012) and PhD (2017) in Physics from the Instituto de Física de São Carlos of the Universidade de São Paulo (IFSC-USP), having defended a work on the production of Bose-Einstein condensates of two atomic species to study quantum turbulence, under the supervision of Vanderlei S. Bagnato. In 2017, she joined the group of Jean Dalibard, in Paris, as a postdoctoral fellow at the Laboratoire Kastler Brossel, where she developed studies related to the properties of degenerate two-dimensional Bose gases. Since 2019, she is an associated professor at IFSC-USP, in São Carlos, where she studies the superfluid properties of two- and three-dimensional atomic clouds. In 2024, she has became a grantee of the Instituto Serrapilheira in their 7th Call for research.

Ultracold atoms as a quantum simulation platform for 2D many-body systems

Quantum effects are fundamental in the development of new technologies. However, predicting the behavior of a quantum many-body system is still quite challenging and limited to a small number of constituents when performing numerical simulations in usual classical computers. While quantum computers are not fully operational, ultracold quantum gases have been established over the past twenty years as a quantum simulation platform with excellent controllability and refined detection techniques [1].
In this direction, low dimensional systems can be easily created using laser light to shape the atomic cloud by strongly compressing it in one or two directions of space and freezing all dynamics [2] and interactions can be tuned by means of Feshbach resonances [3]. In this talk, I will introduce a new experimental system being developed in Brazil which will allow to study the many-body dynamics of two-dimensional (2D) Bose gases [2] under different conditions. In particular, we will explore the onset and evolution of quantum hydrodynamic instabilities (e.g. Rayleigh-Taylor [4] and Kelvin-Helmholtz instabilities [5]) and the dynamical behavior of quantum vortices in the dimensional crossover 3D-2D [6].

[1] Nature Physics 8, 267 (2012).
[2] Rvista del nuovo cimento 34, 389 (2011).
[3] Rev. Mod. Phys. 82, 1225 (2010).
[4] PRA 80, 063611 (2009).
[5] PRA 82, 063604 (2010).
[6] PRL 124, 134501 (2020).