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Two-dimensional quantum turbulence and vortex dynamics in BECs[1]

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One of the most challenging problems in the study of turbulence is to understand how statistical flow characteristics, such as energy and velocity distributions, relate to and depend upon microscopic attributes of turbulent flows, such as vortex distributions and dynamics. Due to the quantization of circulation, prospects for tackling this problem within the rapidly developing field of two-dimensional quantum turbulence (2DQT) are now emerging. In 2DQT, a disordered distribution of quantized vortices evolves within a nominally 2D superfluid; the vortices are thus constrained to move within the superfluid without bending or tilting with respect to the plane of the superfluid. Recent experiments have demonstrated methods that permit the generation and study of 2DQT in highly oblate Bose-Einstein condensates, and new vortex detection and manipulation techniques may soon aid in obtaining a better understanding of 2DQT vortex dynamics in these systems. Additionally, analytical and numerical efforts are identifying new regimes of 2DQT vortex dynamics and corresponding statistical characteristics of the superfluid flows that should be experimentally observable in BECs. This talk will introduce the field of 2DQT, then focus on our recent progress and immediate goals in the investigation of 2DQT and vortices in highly oblate BECs.

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