

Stability and dynamics of matter-wave vortices in the presence of collisional inhomogeneities and dissipative perturbations

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Abstract

The spectral properties of singly-charged vortices and vortex dipoles in a Bose-Einstein condensate confined in a highly anisotropic (disk-shaped) harmonic trap are investigated. Special emphasis is given on the analysis of the so-called anomalous (negative energy) mode of the Bogoliubov spectrum. We use analytical and numerical techniques to illustrate the connection of the anomalous mode to the precession dynamics of the vortices in the trap. Effects due to inhomogeneous interatomic interactions and dissipative perturbations motivated by finite temperature considerations are explored. We find that both of these effects may give rise to oscillatory instabilities of the vortices, which are suitably diagnosed through the perturbation-induced evolution of the anomalous mode, and being monitored by direct numerical simulations.

Keywords: BEC, matter-wave, vortices, GPE, collisional inhomogeneity

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