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Dynamics of the Center of Mass in Rotating Bose-Einstein Condensates[1]

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Abstract

In this paper, we derive the analytical solution for a second-order ordinary differential system which governs the motion of the center of mass in the dynamics of a stationary state with its center shifted. A leap-frog Fourier pseudospectral (LFFP) method is presented for efficient and accurate numerical simulations of the Gross-Pitaevskii equation (GPE) with an angular momentum rotation term. Different motion patterns for the center of mass are observed and classified from the analytical solution and confirmed by directly simulating the GPE. To show the effectiveness of the LFFP method, the dynamics of vortex lattices are studied, and the numerical results demonstrate the efficiency and extremely high resolution of our method.

Keywords: rotating Bose-Einstein condensate; Gross-Pitaevkii equation; stationary state; angular momentum rotation; center of mass; quantized vortex lattice.

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