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Vortex Dynamics in Bose-Einstein Condensate in a Rotating Double-well Trap Potential and Co-rotating Optical Lattice

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Abstract:

We study vortex dynamics in Bose-Einstein condensate in a rotating double-well trap potential and co-rotating optical lattice. We derive analytically the expression for the surface mode frequency using time-dependent variational analysis. We also derive analytically the Feynman rule for the number of vortices in Bose-Einstein condensate in rotating double-well trap potential. From the numerical simulations of the two-dimensional Gross-Pitaevskii equation we show that the double-well potential gives rise to hidden vortices in addition to the usual visible vortices. It is shown that analytical formula for Feynman rule for number of vortices matches with the sum of these two types of vortices. We show that, unlike the isotropic case, the vortex number do not diverge at $\Omega = 1$ for the anisotropic case. The vortex lattice structure in a rotating triple-well potential shows interesting features. It shows a linear chain vortex lattice formation in the central well and the usual Abrikosov lattice structure in the neighboring two wells. In the presence of triangular pinning potential, alternative vortices in the linear chain of vortices gets pinned, where as for the square pinning potential all the vortices in the linear chain gets pinned.