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Stability analysis of two-dimensional Bose-Einstein condensates in the presence of a Gaussian potential MASAYA KUNIMI, YUSUKE KATO, Department of Basic Science, The University of Tokyo — Breakdown of superfluidity due to the nucleation of vortices has been investigated by many researchers [1,2]. However, the underlying mechanism of the instability of the nucleation of vortices is not clear. We investigate the stability of superflow states in two-dimensional Bose-Einstein condensates in the presence of a Gaussian potential by solving the Gross-Pitaevskii (GP) equation and the Bogoliubov equation. Although the system does not exhibit the Landau instability and dynamical instability, we find that the excitation energy of the first excited state in a finite system decreases rapidly toward zero near the critical velocity and the dynamical density fluctuations due to the low-lying normal mode increase. These results suggest that the breakdown of superfluidity can be regarded as dynamical critical phenomena. We discuss the relation between the breakdown of the superfluidity and the bifurcation structure of the stationary solution of the GP equation [3].

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