Short-time Effective Action Approach for Numerical Studies of Rotating Ideal BECs

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Abstract

Recently, we have developed an efficient recursive approach for analytically calculating the short-time expansion of the propagator to extremely high orders for a general many-body quantum system [1]. Here we apply this technique for numerical study of thermodynamical properties of a rotating ideal Bose gas of ^{87}Rb atoms in an anharmonic trap [2]. First, the energy spectrum of the system is obtained by the exact diagonalization of the discretized short-time propagator. Then the condensation temperature, ground-state occupancy, density profiles and the time-of-flight absorption pictures are calculated for varying rotation frequencies, including the critical and over-critical regime. The obtained results improve previous semiclassical calculations and agree well with Path Integral Monte Carlo simulations.

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[2] V. Bretin, S. Stock, Y. Seurin, J. Dalibard, *PRL* **92**, 050403 (2004)