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A new approach to number-conserving Bogoliubov approximation for Bose-Einstein condensates ZHANG JIANG, CARLTON CAVES, University of New Mexico, CENTER FOR QUANTUM INFORMATION AND CONTROL TEAM — We consider a BEC of N ultra-cold atoms in a trapping potential. The many-body wave function of the BEC is "encoded" in the N-particle sector of an extended catalytic state, coherent state for the condensate mode and a state for the orthogonal modes. Using a time-dependent interaction picture, we move the coherent state to the vacuum, where all the field operators are small compared to $N^{1/2}$. The resulting Hamiltonian can then be organized by powers of $N^{-1/2}$. Requiring the terms of order $N^{1/2}$ to vanish, we get the GP equation for the condensate wave function. Going to the next order, N^0, we are able to derive equations equivalent to those found by Castin and Dum [Phys. Rev. A **57**, 3008 (1998)] for a number-conserving Bogoliubov approximation. In contrast to other approaches, ours allows one to calculate the state evolution in the Schrödinger picture, and it also has advantages in discussing higher-order corrections and multi-component cases.

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