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An Improved Many-Body Ansatz for a Hypervectorial Description of Bose-Einstein Condensates[1] HYUNWOO LEE, CHRIS GREENE, Purdue Univ — We present results on moving beyond the K-Harmonic approximation for the adiabatic hypervectorial surface of a Bose-Einstein condensate, which intuitively describes the longitudinal and transverse sizes of the collective system. The K-Harmonic approximation freezes the hyperangular behavior of the many-body wavefunction to be that of the non-interacting state. Previous works show that the approximation describes the ground-state and the first excitation frequency reasonably well but qualitatively differs from the Bogoliubov theory for most other collective modes. Therefore, we develop a method for using the stationary state of the Gross-Pitaevskii equation as an alternative ansatz for the dominant hyperangular behavior. Of importance are the Thomas-Fermi regime and the quasi-one-dimensional bright soliton, where the order parameter deviates significantly from a gaussian. In particular, for the bright soliton, the K-Harmonic approximation predicts that the many-body spectrum should comprise of different Rydberg series of very large effective angular momentum, converging to thresholds defined by the transverse trap eigenstates. We discuss how the new method modifies the simple analytic behavior of K-Harmonic surfaces, in comparison with the Bogoliubov theory.

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