Generic Phase Diagram for Bose-Einstein Condensation of Weakly Interacting Symmetric Bosonic Mixtures

A.B. KUKLOV, CSI, CUNY, T. BLANCHARD, ENS, Cachan, France, B.V. SVISTUNOV, UMASS, Amherst, USA, and Kurchatov Institute, Russia — Weakly interacting Bose gas represents strongly correlated classical field within a domain (determined by the gas parameter \( \xi \)) of its Bose-Einstein condensation (BEC) temperature \( T = T_c \). Thus, \( N \)-component weakly interacting mixtures representing some symmetry can potentially exhibit rich phase diagram (PD). In particular, it can feature quasi-molecular phases preceding actual formation of the ODLRO in the vicinity of \( T_c \). However, realization of a specific part of the PD depends on details of interactions. As examples, we consider mixtures characterized by \( O(2) \times O(2) \) symmetry \( (N = 2) \) and spin \( S = 1 \) with the symmetry reduced to \( U(1) \times U(1) \) \( (N = 3) \). Monte Carlo simulations of these systems find a single line of the respective two- and three-component BEC transitions which has tricritical point separating II and I order transitions. No quasi-molecular phases have been found despite that naïve mean field (with one loop correction) predicts it. We discuss how such phases can emerge above the actual \( N \)-component BEC transition. One suggestion relies on Feschbach resonance detuned into negative inter-specie scattering length even when the gas parameter remains small. We acknowledge support from NSF grants PHY 0653135, 0653183 and CUNY grant 80209-0914.

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