

Some Typical Delusions in the Theory of Bose-Einstein Condensation

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Despite long history of the theory of Bose-Einstein condensation, there exist till nowadays some slippery points that are often misunderstood and result in confusion. The report touches some of these points, explaining the following statements: Ideal Bose-condensed gas is not stable. There is no any grand canonical catastrophe. Gauge symmetry breaking is the necessary and sufficient condition for the existence of Bose-Einstein condensate. Representative statistical ensembles are equivalent. Anomalous averages cannot be neglected. The so-called "Popov approximation", ascribed to Popov, suggesting to neglect anomalous averages, is neither an approximation nor has anything to do with Popov. There are no anomalous non-thermodynamic fluctuations in stable equilibrium systems. The phase operator in the Dirac-type form is not well defined. Mean kinetic energy cannot be found from the Landau-Lifshitz relation, when potential energy depends on particle mass.