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A nonextensive approach to Bose-Einstein condensation of trapped interacting boson gas

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Abstract

In the Bose-Einstein condensation of interacting atoms or molecules such as 87Rb, 23Na and 7Li, the theoretical understanding of the transition temperature is not always obvious due to the interactions or zero point energy which cannot be exactly taken into account. The S-wave collision model fails sometimes to account for the condensation temperatures. In this work, we look at the problem within the nonextensive statistics which is considered as a possible theory describing interacting systems. The generalized energy U q and the particle number N q of boson gas are given in terms of the nonextensive parameter q.q >1 (q <1) implies repulsive (attractive) interaction with respect to the perfect gas. The generalized condensation temperature T cq is derived versus T c given by the perfect gas theory. Thanks to the observed condensation temperatures, we find q 0.1 for 87Rb atomic gas, q ≈ 0.95 for 7Li and q ≈ 0.62 for 23Na. It is concluded that the effective interactions are essentially attractive for the three considered atoms, which is consistent with the observed temperatures higher than those predicted by the conventional theory. © Springer Science+Business Media, LLC 2007.

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Keywords

Cold atom Bose systems, Interaction bosons, Nonextensive statistics