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Thermodynamic properties of an interacting boson system

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We consider the thermodynamical properties of an interacting boson system at finite temperatures and zero chemical potential within the framework of the Skyrme-like mean-field model. Self-consistency relations between the mean field and thermodynamic functions are derived. For illustration of our approach the thermodynamic properties of a π-meson system are investigated. We numerically solved the self-consistent equation for a particle density and derived all thermodynamical functions as functions of the temperature for different values of an attractive constant of coupling κ. It is shown that for some values of κ this system develops a first-order phase transition via formation of the Bose condensate at non-zero temperatures. Phase diagrams and the pressure p/T^4, energy density ϵ/T^4, entropy density s/T^3, trace anomaly $(\epsilon - 3p)/T^4$, specific heat C_V/T^3, and the speed of sound c_s^2 are calculated in the liquid-gas and condensed phases.

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