DYNAMICS OF A DILUTE FERMI-BOSE CONDENSED GAS MIXTURE

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The main object of our interest is a Bose gas with small admixture of Fermi gas at temperature below the temperature of Bose-Einstein condensation. In such mixture two fermionic atoms can attract each other by exchanging condensate-noncondensate and noncondensate-noncondensate particles. In lowest order in interaction between particles we derive the effective potential for fermion-fermion interaction due to the presence of Bose medium. The effective attraction reveals a posibility for a BCS-like superfluid transition in the Fermi subsystem. In a nonideal Bose gas there are two types of particles, condensate and noncondensate ones. One type of the indirect interaction, inherent in Bose gas, is associated with the exchange of condensate-noncondensate particles. This results in the short-range Yukawa-like interaction potential. The second type, associated with the exchange of noncondensate-noncondensate particles, exists also in the normal noncondensed state. Compared with the first one, the contribuion from the second type is weaker but has a long-range character, slowly decaying at infinity. The temperature of superfluid transition is calculated, and the properties of effective potential for fermion-fermion interaction are investigated.

The experimental realization of Bose-Einstein condensation in atomic vapors has allowed to observe a great variety of macroscopic quantum effects. In particular, there arises a considerable interest to the study of the Josephson effect in the Bose-condensed gases as one of intriguing possibilities to explore the macroscopic quantum effects related directly to the broken symmetry in the quantum systems. The dynamics of the Josephson effect is governed by the difference between the phases of the condensates, playing a role of macroscopic quantum variable. The theoretical treatment of the Josephson effect includes both the internal effect for atoms of a gas in the different hyperfine states and the case of the Bose-condensates spatially separated with a potential barrier which acts as a tunneling junction. The latter case due to its direct analogy with superconductors seems to be attractive. The dissipative dynamics of a Josephson junction in the Bose-gases (Bose-Bose mixture as well) is considered within the framework of the model of a tunneling Hamiltonian. The effective action which describes the dynamics of the phase difference across the junction is derived using functional integration method.