Berezinskii-Kosterlitz-Thouless Phase Transition with Rabi Coupled Bosons

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We theoretically investigate the superfluid–normal-state Berezinskii-Kosterlitz-Thouless transition in a binary mixture of bosonic atoms with Rabi coupling under balanced densities [1]. We find the non-monotonic behavior of the transition temperature with respect to the intercomponent coupling and amplification of the transition temperature for finite values of Rabi coupling, but for small intracomponent couplings [1]. We develop the Nelson-Kosterlitz renormalization-group equations in the two-component Bose mixture and obtain the Nelson-Kosterlitz criterion modified by a fractional parameter, which is responsible for half-integer vortices, and by Rabi coupling [1]. Adopting the renormalization-group approach, we clarify the dependence of the Berezinskii-Kosterlitz-Thouless transition temperature on the Rabi coupling and the intercomponent coupling [1]. Analysis of the first and second sound velocities also reveals the suppression of quasicrossing of the two sound modes with a finite Rabi coupling in the low-temperature regime [1]. Our results for a two-dimensional binary Bose superfluid contribute to the understanding of a broad range of multicomponent quantum systems such as two-dimensional multiband superconductors.

References

[1] K Furutani, A Perali and L Salasnich, Phys. Rev. A **107**, L041302 (2023)