Spatial Adiabatic Passage and Josephson Effect for Bose-Einstein Condensate in a Double-Well Trap

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The analogy between controlled spatial adiabatic passage (SAP) and dc Josephson effect in BEC [1,2] in analyzed. As a relevant example, the transport of the repulsive BEC in a double-well trap is considered [2] using the 3D time-dependent Gross-Pitaevskii equation. The population transfer is driven by a time-dependent shift of the barrier separating the left and right wells. The evolution of the main characteristics (currents, population imbalance, phase difference, chemical potential) is inspected. It is shown that the repulsive interaction supports SAP and leads to a wider interval of the eligible barrier velocity. SAP in the interacting BEC can be three orders of magnitude faster than in the ideal BEC. It is shown that SAP can be treated as the dc Josephson effect. The dual origin of the critical barrier velocity (break of the adiabatic following and dc/ac transition) is discussed. Following the calculations, the robustness of the SAP (dc Josephson) crucially depends on the interaction and profile of the barrier velocity. Perspectives of further studies of dc Josephson effect (production of topological phases, application in the synthetic spin-orbit BEC, toroidal traps, ...) are discussed.

References

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