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Emergence of Topological and Strongly Correlated Ground States in Rashba Spin-Orbit Coupled Bose Gases[1] B. RAMACHANDHRAN, Rice University, Houston, TX 77005, USA, HUI HU, Swinburne University of Technology, Melbourne 3122, Australia, HAN PU, Rice University, Houston, TX 77005, USA —
We theoretically study an interacting few-body system of two-component Bose gases with isotropic Rashba spin-orbit coupling in a 2D isotropic harmonic trap. We show that the Hamiltonian is gauge-equivalent to particles subject to a pure non-abelian vector potential preserving time-reversal symmetry. We use Exact Diagonalization scheme to obtain the low-energy states of the system with large Rashba spin-orbit coupling strength for a range of interatomic interaction strengths. At small particle numbers, we observe that the bosons condense to an array of topological ground states that have $n + 1/2$ -quantum angular momentum vortex configuration, with $n = 0, 1, 2, 3$. At relatively large particle numbers, we observe two distinct regimes: (a) at weak interaction strengths (mean-field regime), we observe ground states with topological and symmetry properties that are also obtained via mean-field theory computations. (b) at intermediate to strong interaction strengths (beyond mean-field regime), we report the emergence of strongly correlated ground states. We analyze ground state properties using various techniques: energy spectrum, density distribution, pair-correlation function, conditional wavefunction, entanglement spectrum, and entanglement entropy.

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