Stability of topological excitations under the phase transition in spinor BECs

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We investigate the stability of topological excitations under symmetry breaking or recovering phase transition in a Bose-Einstein condensate with spin degree of freedoms (spinor BEC). Topological excitations are characterized by $\pi_n(G/H)$, where G is the full symmetry of the system and H is the symmetry of the condensed phase. In the case when the symmetry H is reduced to H' in the phase transition, a topological excitation is stable if the element of $\pi_n(G/H)$ which corresponds to the topological excitation is mapped to a nontrivial element of $\pi_n(G/H')$ in the phase transition.

Here, we use relative homotopy theory. In the relative homotopy theory, nth homotopy group $\pi_n(H/H')$ gives a relation between $\pi_n(G/H)$ and $\pi_n(G/H')$, where H/H' describes the broken or recovered symmetry in the phase transition. Thus, the stability of topological excitation can be investigating by calculating $\pi_n(H/H')$ [1,2].

We apply relative homotopy theory to spinor BECs and study a topological stability in case a spatially or temporally symmetry changing. We show some examples in spinor BECs.

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