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Persistent Currents in Bosonic Mixtures in the Ring Geometry[1]
ZHIGANG WU, EUGENE ZAREMBA, Queen's University, Canada — We investigate the possibility of bosonic mixtures supporting persistent currents in the ring geometry. Our analysis is based on an approach developed by F. Bloch which focuses on the ground state energy of the condensate as a function of its angular momentum L, the so-called yrast spectrum. According to this approach, persistent currents are stable if the energy exhibits a local minimum at some non-zero angular momentum. We extend Bloch's analysis to a two-component mixture containing N_A atoms of species A and N_B atoms of species B, with masses M_A and M_B, respectively. For the special case of $M_A = M_B$ and equal interaction strengths between all the species, we use analytic soliton solutions of a two-component Bose gas in the ring geometry to analyze the mean-field yrast spectrum of the system. We find that the spectrum exhibits a surprisingly rich structure as a result of an intricate interplay of interparticle interactions and population imbalance. We discuss the implication of these results in regard to the possibility of persistent currents at higher angular momenta.

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