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Order by Disorder in Spin-Orbit Coupled Bose-Einstein Condensates RYAN BARNETT, STEPHEN POWELL, Joint Quantum Institute and Condensed Matter Theory Center, University of Maryland, TOBIAS GRASS, ICREA-Institucio Catalana de Recerca i Estudis Avancats, MACIEJ LEWENSTEIN, ICREA-Institucio Catalana de Recerca i Estudis Avancats and ICFO, SANKAR DAS SARMA, Joint Quantum Institute and Condensed Matter Theory Center, University of Maryland — Motivated by recent experiments, we investigate the system of isotropically-interacting bosons with Rashba spin-orbit coupling. At the non-interacting level, there is a macroscopic ground-state degeneracy due to the many ways bosons can occupy the Rashba spectrum. Interactions treated at the mean-field level restrict the possible ground-state configurations, but there remains an accidental degeneracy not corresponding to any symmetry of the Hamiltonian, indicating the importance of fluctuations. By finding analytical expressions for the collective excitations in the long-wavelength limit and through numerical solution of the full Bogoliubov- de Gennes equations, we show that the system condenses into a single momentum state of the Rashba spectrum via the mechanism of order by disorder. We show that in 3D the quantum depletion for this system is small, while the thermal depletion has an infrared logarithmic divergence, which is removed for finite-size systems. In 2D, on the other hand, thermal fluctuations destabilize the system. This work is supported in part by JQI-PFC.

Ryan Barnett
Joint Quantum Institute and Condensed Matter Theory Center,
University of Maryland

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