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Finite-temperature energy landscapes in rotating ring BECs[1]
BRENNAN COHELEACH, CLAYTON HELLER, MARK EDWARDS, Georgia Southern Univ, STEVE ECKEL, AVINASH KUMAR, CHARLES CLARK, GRETCHEN CAMPBELL, Joint Quantum Institute — In a recent experiment conducted at NIST a ring Bose–Einstein condensate (BEC) was prepared in a unit angular momentum circulation state. A barrier was then slowly raised and left on for a variable hold time and then turned off. The final circulation of the BEC was studied as a function of hold time and barrier energy height. This procedure was carried out for several well–characterized non–zero temperatures. We have studied the energetics of this process under the assumption that a vortex is initially present in the center of the ring BEC and then travels out of the ring through the density notch created by the barrier. We have computed the energy per particle of the condensate system for a variable location of the vortex by solving the time–dependent Generalized Gross–Pitaevskii (GGP) equation in imaginary time. To account for finite–temperature we solved self–consistently for the condensate fraction as a function of temperature in thermal equilibrium for fixed total particle number. This yielded the non–condensate density which appears in the GGP affecting the energy of the vortex. We also modeled the dynamics of the vortex using the ZNG formalism.

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