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Expansion Dynamics of a Ring Bose–Einstein Condensate[1]
MARK EDWARDS, Georgia Southern University and NIST, HADAYAT SEDDIQI, MICHAEL KRYGIER, BRANDON BENTON, Georgia Southern University, CHARLES CLARK, Joint Quantum Institute and NIST — We studied the dynamics of BECs when released from a ring trap under conditions similar to those that obtained in a recent experiment done at NIST. In that experiment a ring–shaped BEC was formed in an all–optical trap created by intersecting a horizontal light sheet and a vertical Laguerre-Gaussian beam. Condensates were created in these traps and then "stirred" by applying Raman pulses having orbital angular momentum (OAM). We modeled the dynamics of condensates formed under these conditions by first solving the 2D time–dependent Gross–Pitaevskii equation (GPE) in imaginary time to obtain the initial condensate shape. We accounted for the OAM by applying a phase imprint to this wave function and then propagated it using the GPE in real time with the trap off. We found that, after release, the condensate expands both inward and outward. When no OAM was applied, this inward expansion causes the hole in the ring to close up entirely in turn causing a buildup of atom density there. Inflow and outflow of atoms from the center caused expanding interference rings to form. With non-zero applied initial OAM similar behavior was observed except that the central hole never closes with hole size increasing with increasing initial OAM. We compare our results with the NIST experiment.

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