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Finite temperature and density depletion effects on persistent current state transitions and critical velocity of a toroidal Bose-Einstein condensate AVINASH KUMAR, STEPHEN ECKEL, FRED JENDRZEJEWSKI[1], Joint Quantum Institute, University of Maryland, GRETCHEN CAMPBELL, Joint Quantum Institute, University of Maryland, NIST — We study the decay of a persistent, quantized current state in a toroidal geometry. Our experiment involves trapping neutral ^{23}Na atoms in an all optical "target trap" shaped potential. This potential consists of a disc surrounded by an annular potential. A current in a superfluid can be sustained only below a critical current. This critical current can be tuned by introducing a density perturbation which depletes the local density. The decay time of a persistent current state can also be controlled by enhancing fluctuations of the system thermally. We study the decay at four different temperatures between 30 nK and 190 nK. For each temperature we record the decay at four different perturbation strengths. We find that increasing the magnitude of the density depletion or the temperature leads to a faster decay, and have seen the decay constant change by over two orders of magnitude. We also studied the size of hysteresis loop between different current states as a function of temperature, allowing us to extract a critical velocity. We find that the discrepancies between the experimentally extracted critical velocity and theoretically calculated critical velocity (using local-density approximation) decreases as the temperature is decreased.

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