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Minimally destructive Doppler measurement of a quantized, superfluid flow NEIL ANDERSON, AVINASH KUMAR, STEPHEN ECKEL, Joint Quantum Institute (NIST/UMD), SANDRO STRINGARI, Universit di Trento, GRETCHEN CAMPBELL, Joint Quantum Institute (NIST/UMD) — Ring shaped Bose-Einstein condensates are of interest because they support the existence of quantized, persistent currents. These currents arise because in a ring trap, the wavefunction of the condensate must be single valued, and thus the azimuthal velocity is quantized. Previously, these persistent current states have only been measured in a destructive fashion via either interference with a phase reference or using the size of a central vortex-like structure that appears in time of flight. Here, we demonstrate a minimally destructive, in-situ measurement of the winding number of a ring shaped BEC. We excite a standing wave of phonon modes in the ring BEC using a perturbation. If the condensate is in a nonzero circulation state, then the frequency of these phonon modes are Doppler shifted, causing the standing wave to precess about the ring. From the direction and velocity of this precession, we can infer the winding number of the flow. For certain parameters, this technique can detect individual winding numbers with approximately 90% fidelity.

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