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Superfluid Hall effect in a Bose-Einstein condensate LINDSAY J. LEBLANC, KARINA JIMENEZ-GARCIA, ROSS A. WILLIAMS, MATTHEW C. BEELER, ABIGAIL R. PERRY, WILLIAM D. PHILLIPS, IAN B. SPIELMAN, Joint Quantum Institute, NIST and University of Maryland — In condensed matter physics, measurement techniques exploiting the Hall effect are widely used to explore the internal properties of solids, ranging from charge-carrier concentrations in semiconductors to the quantum Hall effects in two-dimensional electron gases. While Hall physics is generally associated with the reaction of charged particles to a magnetic field, we observed a superfluid Hall effect in a BEC of neutral ^{87}Rb atoms subjected to an artificial magnetic field B^*. To probe the BEC's properties, we generated an alternating atomic current and measured the cloud's dynamics as a function of B^*. When the artificial field is present, an effective Lorentz force acts on the atoms and the current is deflected in the direction transverse to the usual hydrodynamic flow, indicating a Hall effect. The good quantitative agreement between our measurements and a superfluid hydrodynamic model indicates that this Hall effect is associated with the BEC's irrotational superfluidity. By extending the Hall measurement technique to the realm of neutral-atom experiments, we establish this tool as a valuable probe for exploring the internal or many-body properties of ultracold gas systems.

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