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Topology of a quantum gas with Rashba spin-orbit coupling ANA VALDES-CURIEL, University of Maryland, College Park, DIMITRIS TRYPOGEORGOS, INO-CNR BEC Center and Dipartimento di Fisica, Universit di Trento, QI-YU LIANG, University of Maryland, College Park, RUSSELL ANDERSON, La Trobe University, IAN SPIELMAN, University of Maryland, College Park — Topological order can be found in a wide range of physical systems, from crystalline solids and even atmospheric waves to optomechanic, acoustic, and atomic systems. Topological systems are a robust foundation for creating quantized channels for transporting electrical current, light, and atmospheric disturbances. These topological effects are quantified in terms of integer-valued 'invariants', such as the Chern number. We engineered Rashba spin-orbit coupling for a cold atomic gas giving non-trivial topology, without the underlying crystalline structure that conventionally yields integer Chern numbers. We validated our procedure by spectroscopically measuring both branches of the Rashba dispersion relation which touch at a single Dirac point. We then measured the quantum geometry underlying the dispersion relation and using matter-wave interferometry to implement a form of quantum state tomography, giving a Berry's phase with magnitude π. When the Dirac point is opened, both resulting dispersions (bands) have a half-integer Chern number. This is in contrast to crystalline materials, where topological indices take on integer values, potentially implying new forms of topological transport.

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