

Abstract Submitted
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Topological invariants measured for Abelian and non-Abelian monopole fields SEIJI SUGAWA, FRANCISCO SALCES CARCOBA, Joint Quantum Institute, NIST and the University of Maryland, ABIGAIL PERRY, NIST-Boulder, YUCHEN YUE, ANDIKA PUTRA, IAN SPIELMAN, Joint Quantum Institute, NIST and the University of Maryland — Understanding the topological nature of physical systems is an important topic in contemporary physics, ranging from condensed matter to high energy. In this talk, I will present experiments measuring the 1st and 2nd Chern number in a four-level quantum system both with degenerate and non-degenerate energies. We engineered the system's Hamiltonian by coupling hyperfine ground states of rubidium-87 Bose-Einstein condensates with rf and microwave fields. We non-adiabatically drove the system and measured the linear response to obtain the local (non-Abelian) Berry curvatures. Then, the Chern numbers were evaluated on (hyper-)spherical manifolds in parameter space. We obtain Chern numbers close to unity for both the 1st and the 2nd Chern numbers. The non-zero Chern number can be interpreted as monopole residing inside the manifold. For our system, the monopoles correspond to a Dirac monopole for non-degenerate spectra and a Yang monopole for our degenerate case. We also show how the dynamical evolution under non-Abelian gauge field emerged in degenerate quantum system is different from non-degenerate case by showing path-dependent acquisition of non-Abelian geometric phase and Wilson loops.

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