Nontrivial Topology Through Quantum Evolution in a 1D Optical Lattice

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We realized the 1D bipartite Rice-Mele (RM) lattice using a highly tunable optical lattice and ultracold ^{87}Rb and used a form of quantum state tomography to measure the full pseudospin state throughout the Brillouin zone (BZ). We used this control and measurement capability for two experiments. In the first, we followed the evolution of the Zak phase and chiral winding number after changing the lattice configuration, observing continuous time evolution of the Zak phase and discontinuous changes in the winding number. In the second, we periodically changed the lattice configuration, resulting in a topological Floquet system with a linear (Dirac) dispersion and measured the underlying Floquet winding number from the time-resolved pseudospin micromotion (figure 1).

https://arxiv.org/abs/2203.07448

https://arxiv.org/abs/2202.05033

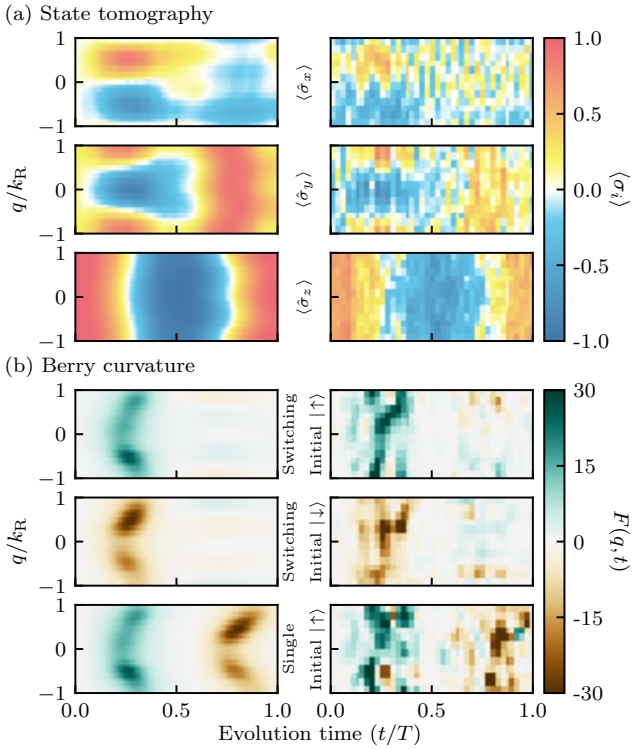

Figure 1: Crystal momentum resolved pseudospin state measured using quantum tomography in a 1D optical lattice (a), and corresponding Berry curvature (b) giving a Floquet winding number of ± 1 or 0 depending on the protocol and initial state