CMP Seminar

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Probe of Band Structure Singularities with a Lattice-Trapped Quantum Gas

The band structure of a crystal may have points where two or more bands are degenerate in energy, which may reflect singularities in the geometry of the Bloch state manifold with consequences for material and transport properties. To date, ultracold atoms in optical lattices have been used to characterize such points only indirectly, for example, by detection of an Abelian Berry phase. These studies have only investigated singularities with linear dispersion (Dirac points). In this work, we probe band-structure singularities through the non-Abelian transformation produced by transport directly through the singular points. We prepare atoms in one Bloch band, accelerate them along a quasi-momentum trajectory that enters the singularity along a ray, turns by a variable angle, exits on a different ray, and then we measure the final band populations. We apply this technique to both linear and quadratic band-touching points of a honeycomb lattice, and we observe band population variations that identify the winding numbers of these singularities to be 1 and 2, respectively.

Zoom Link: https://msu.zoom.us/j/96442051971

Zoom Password: 306844

Monday, March 28th, 2022, at 4:10 p.m.
Host: Xianglin Ke