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Title: Non-Abelian Bloch oscillations in higher-order topological insulators

Abstract: Bloch oscillations (BOs) are a fundamental phenomenon by which a wave packet undergoes a periodic motion in a lattice when subjected to a force. Observed in a wide range of synthetic systems, BOs are intrinsically related to geometric and topological properties of the underlying band structure. This has established BOs as a prominent tool for the detection of Berry-phase effects, including those described by non-Abelian gauge fields. In this work, we unveil a unique topological effect that manifests in the BOs of higher-order topological insulators through the interplay of non-Abelian Berry curvature and quantized Wilson loops. It is characterized by an oscillating Hall drift synchronized with a topologically-protected inter-band beating and a multiplied Bloch period. We elucidate that the origin of this synchronization mechanism relies on the periodic quantum dynamics of Wannier centers. Our work paves the way to the experimental detection of non-Abelian topological properties through the measurement of Berry phases and center-of-mass displacements.

Ref: Nature Communications 11, 5942 (2020)