A
FIZIKAI INTÉZET
és az
ATOMKI
közös
SZEMINÁRIUMA

ASBÓTH JÁNOS
(MTA WIGNER FK SZFI, KVANTUMOPTIKAI ÉS KVANTUMINFORMATIKAI OSZTÁLY)

The Hofstadter butterfly takes flight in quantum walks

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BEFEKTETÉS A JÖVŐBE

Asbóth János
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The Hofstadter butterfly takes flight in quantum walks

The Hofstadter butterfly [1] is the intricate self-similar structure of subgaps that the single energy band of a charged particle hopping on a 2-dimensional lattice develops as a magnetic field perpendicular to the lattice is turned on. It has inspired physicists for 40 years (e.g., an important role in the exploration of the quantum Hall effect), and now enjoys a renewed interest as experiments might finally be close to observing it. In case the charged particle has several internal states, the spectrum as a function of magnetic field is a multiband Hofstadter butterfly, where each energy band develops a set of subgaps. We show [2] that besides developing subgaps, the bands of topologically nontrivial (e.g., Chern) insulators must also flow in energy as the magnetic field is tuned, because eigenstates flow across topological gaps at a steady rate. We thus connect the global topology of multiband Hofstadter butterflies, i.e., the pattern in which bands flow into each other, with the topological invariants of the underlying lattice Hamiltonians. Our results also apply to quantum walks, and other periodically driven systems, where we obtain a simple formula for the Rudner topological invariant [3], which has potential to be directly measured.

[1]: D. R. Hofstadter, Phys. Rev. B 14, 2239–2249 (1976)
[2]: Janos K. Asboth and Andrea Alberti, Phys. Rev. Lett. 118, 216801 (2017)
[3]: M. S. Rudner et al, Phys. Rev. X 3, 031005 (2013)

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