Generating synthetic gauge potentials by split driving of an optical lattice

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Ultracold atoms held in optical lattice potentials provide an almost ideal arena for the study of coherent quantum phenomena. We describe here a method to generate synthetic gauge potentials using the effect termed "coherent destruction of tunneling" to renormalise the value of the intersite tunneling [1]. Inspired by the well-known split-operator scheme used in quantum simulation, our approach uses two quickly alternating signals to engineer the appropriate Aharonov-Bohm phases, and permits the simulation of a uniform tunable magnetic field [2]. We explicitly demonstrate that our split-driving scheme reproduces the behavior of a charged quantum particle in a magnetic field over the complete range of field strengths, and produces the Hofstadter butterfly band-structure for the Floquet quasienergies.

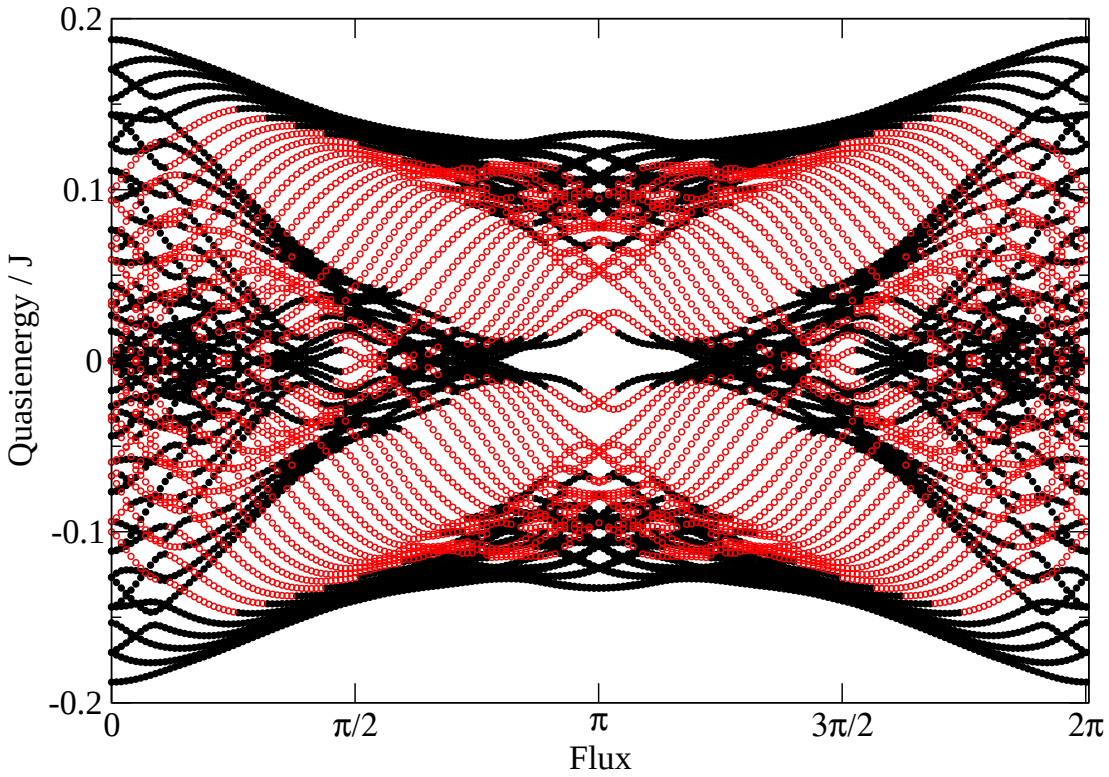

Figure 1: *Floquet quasienergies for the split-driven system, showing the formation of the Hofstadter butterfly structure. Black (filled) circles show the bulk states, the red (unfilled) symbols the chiral transporting edge states.*

References

[1] C.E. Creffield and F. Sols, Phys. Rev. A **84**, 023630 (2011)

[2] C.E. Creffield and F. Sols, `http://arxiv.org/abs/1403.5915`