Contribution ID: **172** Type: **Poster**

Dissipative preparation of a Floquet topological insulator in an optical lattice via bath engineering

Sunday, 10 September 2023 22:40 (20 minutes)

Floquet engineering is an important tool for realizing topologically nontrivial band structures for charge-neutral atoms in optical lattices. However, the preparation of a topological-band-insulator-type state of fermions, with one nontrivial quasi-energy band filled completely and the others empty, is challenging as a result of both driving induced heating as well as imperfect adiabatic state preparation (with the latter induced by the unavoidable gap closing when passing the topological transition). An alternative procedure that has been proposed is to prepare such states dissipatively, i.e. as a steady state that emerges when coupling the system to reservoirs. Here we discuss a concrete scheme that couples the system to a weakly interacting Bose-condensate given by second atomic species acting as a heat bath. Our strategy relies on the engineering of the potential for the bath particles, so that they occupy weakly coupled tubes perpendicular to the two-dimensional system. Using Floquet-Born-Markov theory, we show that the resulting nonequilibrium steady state of the driven-dissipative system approximates a topological insulator. We even find indications for the approximate stabilization of an anomalous Floquet topological insulator, a state that is impossible to realize in equilibrium.

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Session Classification: Poster Session I

Track Classification: Open Quantum Systems