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Floquet-engineering topological and spin-dependent bands with interacting ultracold fermions GREGOR JOTZU, ETH Zurich, MICHAEL MESSER, FREDERIK GÖRG, DANIEL GREIF, MARTIN LEBRAT, THOMAS UEHLINGER, RÉMI DESBUQUOIS, TILMAN ESSLINGER, Institute for Quantum Electronics, ETH Zurich, 8093 Zurich, Switzerland — Periodically driven quantum systems, when observed on time-scales longer than one modulation period, can be described by effective Floquet Hamiltonians that show qualitatively new features. Using a magnetic field gradient, we apply an oscillating force to ultracold fermions in an optical lattice. The resulting effective energy bands then become spin dependent, allowing for a tunable ratio of the effective mass for each internal state, also giving access to the regime where one spin is completely localized whilst the other remains itinerant. In a honeycomb lattice, circular modulation leads to the appearance of complex next-nearest neighbour tunnelling. This corresponds to a staggered magnetic flux in the lattice, allowing for the realisation of Haldane's model of a topological Chern insulator. When spin dependence is included, time-reversal symmetry can be restored giving rise to the Kane-Mele model. A crucial question is whether Floquet engineering can be extended to interacting systems, how the resulting Hamiltonians are modified, and whether the system thermalizes to a steady state. In particular, we study how heating in the system depends on the modulation and interaction parameters and identify regimes where it becomes negligible.

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