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Topology by Dissipation in Atomic Fermion Systems

SEBASTIAN DIEHL, TU Dresden

Controlled dissipation can be used as a resource to drive a many-body system into quantum mechanically ordered states from an arbitrary initial one. We discuss this concept in the context of atomic fermions, highlighting a dissipatively induced pairing mechanism, which is operative in the absence of attractive forces. We show how this targeted cooling can be utilized to cool atomic fermions into topologically non-trivial states in one dimension by quasi-local dissipative operations, and point out a possible physical implementation. This realizes a dissipative analog of the ground state of Kitaev's quantum wire. In higher dimensions, the analogy to Hamiltonian ground states breaks down due to a fundamental incompatibility of topology and locality. We present a new quasi-local dissipative mechanism for the preparation of Chern insulators, which bypasses these obstacles by making use of the intrinsic open system character of the preparation process, with no Hamiltonian counterpart. This greatly extends the scope of efficiently attainable topological symmetry classes via tailored dissipation.