

Emerging quantum many-body macroscopic coherence with non-trivial topology

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The topological nature of the electronic bands of materials is becoming a necessary part of the characterization of the electronic structure. This is not only due to the need for a more complete understanding of electronic structure, but also because of its inherent connection to stability, which results in long lifetimes for excitations possessing non-trivial topology. In addition to non-trivial topology of single-electron states, states of interacting electrons where robust, stable, and long-lived behavior emerges is in certain quantum many-body phenomena, like superconductivity, quantum magnetism, and more generally collective states of electrons which appear as a consequence of macroscopic quantum coherence. Here, we discuss electronic states which exhibit both macroscopic quantum coherence and at the same time non-trivial topological character. As examples, we focus in the cases of topological superconductivity, topological quantum magnetism and topological excitonic condensation, where the topology is specifically of Weyl character. Additional enhancement in stability and longevity of the elementary excitations should be expected when such non-trivial topology and quantum many-body coherence coexist.