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Characterising the topological superradiant state J S PAN, Key Laboratory of Quantum Information, Univ of Sci Tech of China, X J LIU, International Center for Quantum Materials, School of Physics, Peking University, W ZHANG, Department of Physics, Renmin University of China, X Z QIU, W YI, Key Laboratory of Quantum Information, Univ of Sci Tech of China, WEI YI'S TEAM TEAM, WEI ZHANG COLLABORATION, XIONG JUN LIU COLLABORATION
— Coherently driven atomic gases inside optical cavities hold great promises in generating rich dynamics and exotic states of matter. Recently, it has been shown that a novel topological superradiant state exists in a two-component degenerate Fermi gas coupled to a cavity, where local order parameters coexist with global topological invariants. In this work, we characterise in detail various properties of this exotic state, focusing on the feedback interactions between the atoms and the cavity field. In particular, we demonstrate that the cavity-induced inter-band couplings play a crucial role in inducing the topological phase transition between the conventional and the topological superradiant state. Furthermore, we analyse how the closing and reopening of the atomic bulk gap across the topological phase boundary leaves interesting signatures in the cavity field. We also discuss the robustness of the topological superradiant state by investigating the steady-state phase diagram under various circumstances. Our work provides many valuable insights into the unique atom-cavity hybrid system under study, and is helpful for future experimental exploration of the topological superradiant state.

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