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Berry curvature and spin-one color superconductivity

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We explore the interplay between Berry curvature and topological properties in single-flavor color superconductors, where quarks form spin-one Cooper pairs. By deriving a new relation, we connect the topological nodal structure of the gap function in momentum space to the (non-Abelian) Berry flux associated with paired quarks. This generalizes the early work by Li and Haldane [1] to systems with additional internal quantum numbers, such as color. In the ultra-relativistic limit, we uncover rich topological structures driven by the interplay of spin, chirality, and color. Specifically, we identify chirality-induced topological nodes in the transverse (opposite chirality pairing) polar and A-phases. In contrast, the color-spin-locking phase lacks these nodes due to a non-trivial color Berry flux, which in turn induces gapless excitations with total Berry monopole charges of ±3/2–differing from conventional Weyl fermions. Our findings can be potentially extended to other fermionic systems carrying additional internal degrees of freedom. This work has been published in Physical Review Letters [2].

[1] Y. Li and F. Haldane, Phys. Rev. Lett. **120**, 067003 (2018).
[2] N. Sogabe and Y. Yin, Phys. Rev. Lett. **134**, 171903 (2025).

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