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Berry monopole and topology of color superconductivity

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The color superconducting phase with single flavor pairing can be relevant at environments inside the core of neutron stars. In this case, the ground state is described by the BCS pairing between quarks with opposite chirality. Very recently, Li and Haldane argue that the Cooper pair inherits a non-trivial topological structure from the underlying single-particle Berry monopole for superconducting Wely semi-metal. In this work, we generalize Li-Haldane argument to the single flavor color super-conductor and uncover novel topological properties of this phase, which have been overlooked for decades. Depending on the color-spin structure, we find that either the gap function acquires topological nodal structure, as is the case for planar phase, or the gapless quasi-particle excitations carry non-zero Berry monopole. We present the evidence that the latter possibility, which Li-Haldane do not discuss, is energetically favored and is realized in the so-called color-spin locking phase, the ground state. We discuss the relevance of our findings to quark-hadron continuity, anomaly matching, and topological phase transition in Baryon-rich matter.

[1] Yi Li and F. D. M. Haldane, "Topological nodal Cooper pairing in doped Weyl metals,"Phys. Rev. Lett. 120, 067003 (2018).

[2] N. Sogabe and Yi Yin, in preparation.

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