ABSTRACT

Chiral Superconductivity on a Silicon Surface

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Chiral superconductors represent an exotic and heavily pursued state of matter where the angular momentum state of the Cooper pairs is ‘unconventional’ and time-reversal symmetry is broken [1]. While there are several candidates for the realization of chiral superconductors, conclusive evidence for the existence of chiral superconductivity has yet to be established. Here, I present experimental and theoretical evidence indicating the presence of a chiral d-wave superconducting ground state in a dilute monatomic Sn layer on the Si(111) surface [2]. This triangular single-band Mott insulator becomes superconducting upon hole doping with a critical temperature reaching 9 K. With a coverage of only 1/3 monolayer of Sn, this represents the thinnest and most dilute superconductor known to date. Importantly, quasi-particle interference spectra below the superconducting Tc indicate that time-reversal symmetry is broken, while scanning tunneling spectroscopy data recorded along the edges of the superconductive domains are consistent with the calculated edge states for a chiral d-wave order parameter. Whereas most candidates for chiral superconductivity are complex materials, the simplicity and experimental control of this (and related) surface-science platforms provides a powerful testbed for theoretical models and discovery of elusive phases of quantum matter.

[1] C. Kallin and J. Berlinsky, Rep. Prog. Phys 79, 054502 (2016).
[2] F. Ming, X. Wu, C. Chen, K. D. Wang, P. Mai, T. A. Maier, J. Strockoz, J. W. F. Venderbos, C. González, J. Ortega, S. Johnston and H. H. Weitering, Nat. Phys. 19, 500 (2023).