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Topological Superconductivity in an atomic Sn layer on a semiconductor substrate

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A third monolayer of tin atoms on the semiconductor substrate Si(111) has been shown to become superconducting upon six to ten percent hole doping. Experiments have reported promising results hinting at a superconducting chiral d-wave order parameter [1]. Here we examine Sn/Si(111) by combining most recent ab initio results, quasi-particle interference calculations, state-of-the-art truncated-unity functional renormalization group simulations and Bogoliubov-de Gennes analysis. We show remarkable agreement between experimental and theoretical quasi-particle interference data both in the metallic and superconducting regimes. The interacting phase diagram reveals that the superconductivity is indeed chiral d-wave with Chern number C=4. Surprisingly, magnetically ordered phases are absent, instead we find charge density wave order as seen in related compounds. We extend our analysis to the related compounds Pb/Si(111), Sn/SiC(0001) and Pb/SiC(0001), which exhibit different strengths of spin-orbit coupling and different interaction strength. Our results suggest that also these materials are promising candidate materials for chiral topological superconductivity.

[1] F.Ming, *et int.*, H.H. Weitering, Nat. Phys. **19**, 500 (2023).

Field of Condensed Matter

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