Observation of non-trivial superconductivity on surface of type II Weyl semimetal

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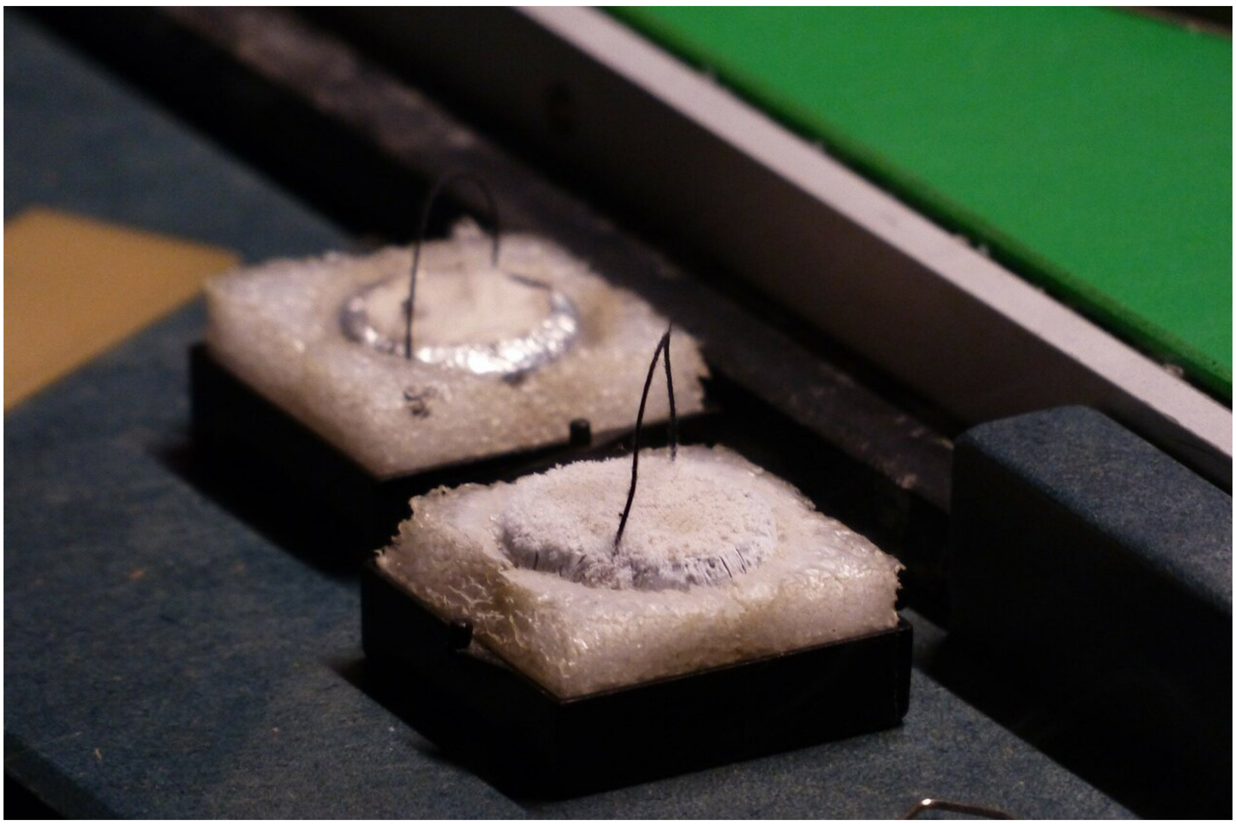

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Topological superconductors, with bulk superconducting gap and Majorana fermion states on the surface or edge, are one of the most sought after quantum materials. Topological superconductivity is of fundamental importance with potentially powerful applications in topological quantum computation. The discovery of Weyl semimetals—in which the conduction and valence bands contact only at Weyl points in the Brillouin zone protected against gap formation by crystalline symmetry or time reversal symmetry—has stimulated great enthusiasm for exploring topological superconductivity in these materials. Especially, the superconductivity from the topological non-trivial surface state of Weyl semimetals could be very attractive but has not been reported yet.

The noncentrosymmetric orthorhombic $TaIrTe_4$, has been considered as a time-reversal invariant Weyl semimetal with the minimal 4 Weyl points. Recently, Prof. Jian Wang and Xiong-Jun Liu at Peking University in collaboration with Minghu Pan at Huazhong University of Science and Technology and others reported the experimental evidences for the unconventional superconductivity generated by the surface states in $TaIrTe_4$ from both scanning tunneling microscopy/ spectroscopy (STM/STS) and electrical transport measurements. They demonstrated the superconductivity of $TaIrTe_4$ by both the superconducting gap from STS and the consistent resistance drop from electrical transport. The thickness-independent of ultralow critical current and angular dependence of upper critical field (Bc2) indicate that the superconductivity occurs only in the surface states. Furthermore, the temperature dependence of Bc2 behavior, the in-plane angle-dependent critical field and the stability of the superconductivity against the magnetization together support the p-wave-like topological nature of the quasi-1D superconductivity.

This discovery of quasi-1D surface superconductivity in Weyl semimetals offers a novel platform for exploring topological superconductors and may contribute to the rapidly developing field of topological quantum computation.

More information: Ying Xing et al, Surface superconductivity in the type II Weyl semimetal TaIrTe4, *National Science Review* (2019). DOI: 10.1093/nsr/nwz204

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