Basic Research

$S_{\pm}$-pairing Symmetry Defining High-order Topological Superconductor

The field of topological phases of matter and high-T_c superconductivity, as important and vibrant as they are individually, have almost had no overlap until very recently. Due to the discovery of intrinsic topological properties in iron-based superconductors, the two fields have begun to interact. Iron-based superconductors have become a high-temperature platform for realizing topological superconductivity and Majorana modes, attracting enormous interests from fundamental science such as topological quantum computation. However, the unique property, the unconventional pairing in these high-T_c superconductors has not been targeted. Recently, Prof. HU Jiangping at the Institute of Physics (IOP), Chinese Academy of Sciences (CAS), together with his collaborators, propose a new class of topological superconductors (TSCs) which are induced by the unconventional pairing.

This new class of TSCs represents a boundary-obstructed higher-order topological state of matter, which can only be formed by sign-changed unconventional pairing, the promising $s_{\pm}$-wave pairing in iron pnictides. They predict the 112-family of iron pnictides, which contains an intrinsic topological insulator/high-T_c superconductor heterostructure, to be the material candidate for our proposal. Because of the boundary-obstruction, the topologically non-trivial feature of the 112 pnictides does not reveal itself in a bulk-only torus band analysis without boundaries. The main is sketched in Figure 1.

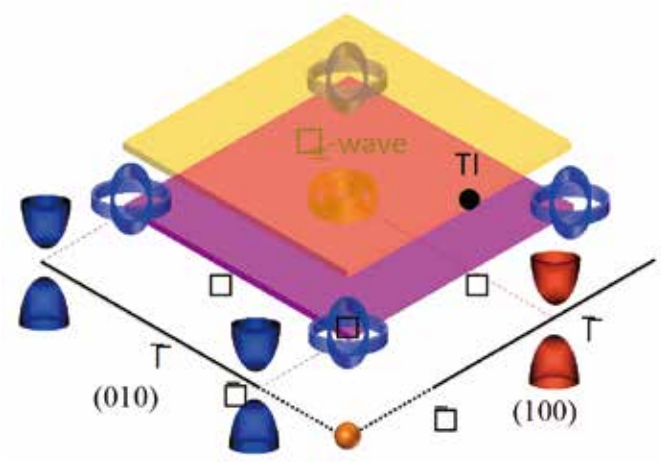

Figure 1: The sketch of Fermi surfaces, $s_{\pm}$-wave pairing and corner/hinge Majorana states.

This work significantly advances the understanding of TSCs and offers a promising high-temperature platform for Majorana modes. Most importantly, it provides a novel way to unambiguously identify the extended *s*-wave order in the iron pnictides, setting up a strong connection between topological phases of matter and unconventional superconductivity fields.

The work titled as "Boundary-Obstructed Topological High-T_c Superconductivity in Iron Pnictides" was published on *Physical Review X*, 10,041014 (2020). (Link: https://journals.aps.org/prx/abstract/10.1103/PhysRevX.10.041014)

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