Weekly Seminar

Recent topics in surface Andreev bound states

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Abstract

The study of Surface Andreev bound states (SABS) was activated more than twenty years before in the context of high Tc cuprate [1-3]. We have established a theory of tunneling spectroscopy of unconventional superconductors and clarified that the origin of zero bias conductance peak in high Tc cuprate is this SABS [2-3]. The flat band zero energy state has been recognized as a topological edge state where winding number defined in bulk Hamiltonian is responsible for the generation of SABS [4-5]. Up to now, there have been several types of SABSs stemming from their topological origins in two-dimensional unconventional superconductors [5]. It can be classified into i)dispersionless flat band type realized in cuprate, ii)linear dispersion type realized in chiral superconductor like Sr_2RuO_4, iii)helical dispersion type realized in non-centrosymmetric superconductor in quasi two-dimensional superconductors.

In three-dimensional superconductor, we can consider chiral superconductor where both line and point nodes exist. Recently, the topological stability of these SABS has been clarified, which behavior is clearly different from high-*Tc* cuprates and noncentrosymmetric superconductors[6].

We have also predicted new types of SABS in doped Topological insulator(TI) and Weyl semimetals. In these materials, there are surface state which can remain even in superconducting state without gap opening due to the strong spin-momentum locking [7]. In the case of superconducting doped TI, SBAS has a so called dispersion. SABSs have a structural transition in the energy dispersions. On the other hand, in superconducting doped Weyl semimetal, crossed flat bands in the superconducting state. We clarify the topological origin of the crossed dispersionless flat bands and the relevant symmetry that stabilizes the cross point [8].

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