MAR17-2016-002518

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Nematic superconductivity in $Cu_xBi_2Se_3$ revealed by field-angle-resolved calorimetry

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Unconventional superconductivity is characterized by the spontaneous symmetry breaking of the macroscopic superconducting wavefunction in addition to the ordinary gauge-symmetry breaking. In particular, superconductivity in which the wavefunction phase breaks rotational symmetry has been widely investigated and is now believed to be realized in various classes of materials such as high-T_c copper oxides. However, superconductivity with rotational-symmetry breaking in the gap amplitude, which can be termed "nematic" superconductivity in analogy to the nematic liquid-crystal phases, has not been reported previously. Here, by measuring the specific heat of the doped topological insulator $Cu_xBi_2Se_3$ ($T_c \sim 3$ K) under accurate magnetic-field-direction control, we observed clear two-fold-symmetric behavior in the in-plane field angle dependence of the specific heat and the upper critical field [1]. Considering the trigonal symmetry of the lattice, the observed two-fold behavior of bulk quantities indicate rotational symmetry breaking in the superconducting gap amplitude. Thus, this result provide the first thermodynamic evidence for nematic superconductivity, which actually belongs to a class of topological superconductivity in the case of this compound. This work has been performed under collaboration with K. Tajiri, S. Nakata, Y. Nagai, Z. Wang, K. Segawa, Y. Ando, and Y. Maeno.

[1] S. Yonezawa *et al.*, Nature Phys. doi:10.1038/nphys3907 (2016).