Rotational Symmetry Breaking in a Trigonal superconductor Nb-doped Bi₂Se₃

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The search for unconventional superconductivity has been focused on materials with strong spin-orbit coupling and unique crystal lattices. Doped bismuth selenide (Bi₂Se₃) is a strong candidate given the topological insulator nature of the parent compound and its triangular lattice. The coupling between the physical properties in the superconducting state and its underlying crystal symmetry is a crucial test for unconventional superconductivity. In this paper, we report direct evidence that the superconducting magnetic response couples strongly to the underlying trigonal crystal symmetry in the recently discovered superconductor with trigonal crystal structure, niobium (Nb)-doped bismuth selenide (Bi₂Se₃). As a result, the in-plane magnetic torque signal vanishes at every 60°. More importantly, we observed that the superconducting hysteresis loop amplitude is enhanced along one preferred direction spontaneously breaking the rotational symmetry. This observation confirms the breaking of the rotational symmetry and indicates the presence of nematic order in the superconducting ground state of Nb-doped Bi₂Se₃.

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