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In-plane spin-polarized supercurrent on the topological Josephson junction

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Abstract
In this work, we consider a topological Josephson junction that contains conventional superconductors and ferromagnet leads on the surface of three-dimensional topological insulators. We use Bogoliubov-deGennes formalism to show in-plane magnetization with a component perpendicular to the superconductor interface that alters the Andreev bound states and creates an Andreev zone. This effect reduces the magnitude of the supercurrent. Also, magnetization changes the spin arrangement of surface states and creates spin-polarized supercurrent. Because of strong spin-momentum interaction on topological insulators, the spin-polarized supercurrent has in-plane components with maximum value in m_x~Δ_0⁄2. On the other hand, the parallel component of in-plane magnetization creates an anomalous supercurrent that flows in the absence of a superconducting phase difference. The dissipation-less spin-polarized supercurrent has great importance from the application point of view in designing spintronics devices.

Keywords: Josephson junction, spin-polarized supercurrent, in-plane magnetization, anomalous supercurrent

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