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Theory for Spin Selective Andreev Re ection in Vortex Core of Topological Superconductor: Majorana Zero Modes on Spherical Surface and Application to Spin Polarized Scanning Tunneling Microscope Probe
FU-CHUN ZHANG, LUN-HUI HU, CHUANG LI, Zhejiang University, DONG-HUI XU, Hong Kong University of Science and Technology, YI ZHOU, Zhejiang University — Majorana zero modes (MZMs) have been predicted to exist in the topological insulator (TI)/superconductor (SC) heterostructure. Recent spin polarized scanning tunneling microscope(STM) experiment has observed spin-polarization dependence of the zero bias differential tunneling conductance at the center of vortex core. Here we consider a helical electron system described by a Rashba spin orbit coupling Hamiltonian on a spherical surface with a s-wave superconducting pairing due to proximity effect. We examine in-gap excitations of a pair of vortices with one at the north pole and the other at the south pole. While the MZM is not a spin eigenstate, the spin wavefunction of the MZM at the center of the vortex core, r = 0, is parallel to the magnetic field, and the local Andreev reflection of the MZM is spin selective, namely occurs only when the STM tip has the spin polarization parallel to the magnetic field, similar to the case in 1-dimensional nanowire. The total local differential tunneling conductance consists of the normal term proportional to the local density of states and an additional term arising from the Andreev reflection. We apply our theory to examine the recently reported spin-polarized STM experiments and show good agreement with the experiments

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