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Tunneling spectroscopy and Majorana modes emergent from topological gapless phases in high-T_c cuprate superconductors[1] CHUNG-YU MOU, JUN-TING KAO, Department of Physics, National Tsing Hua University,Taiwan, SHIN-MING HUANG, Graphene Research Centre and Department of Physics, National University of Singapore, Singapore, CHANG C. TSUEI, IBM Thomas J. Watson Research Center, Yorktown Heights, NY 10598, U.S.A. — We explore possible signatures for observing Majorana Fermions in the tunneling spectroscopy of high-Tc cuprate superconductors. We find that as long as the Rashba spin orbit interaction is in presence either through the proximity effect due to an electrode made by heavy metal or by the intrinsic nature of cuprates, in addition to the Heisenberg spin exchange interaction, the Dzyaloshinskii-Moriya and spin dipole-dipole interactions are induced. As a result, p-wave superconductivity is induced with the gap function d-vector being not aligned with the internal magnetic field of the spin-orbit interaction. Most importantly, the ground state goes through transitions into gapless phases with split nodal points. The split nodal structure always results in Majorana modes for any interfaces that are not exactly in (100) or (010) directions. Hence for general interfaces, existence of Majorana bound states is a robust feature. Our results indicate that these Majorana modes would result in a small plateau in tunneling spectrum near zero bias peak and in 4 π periodicity in typical SIS' junctions. As a result, it is easy for a π-ring in tricrystal experiments to hold Majorana Ferimions and exhibit periods of two flux quanta in external magnetic fields.

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