

Surface Andreev Bound State of Superfluid ^3He and Majorana Fermion

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A Majorana fermion state is an exotic state in which a particle and an antiparticle are equivalent. Such a fermion has not been identified so far in the elementary particle physics. However, recent theoretical studies anticipate its existence in some exotic condensed matter systems. The surface Andreev bound state of superfluid ^3He -B is drawing attention as one of its accessible candidates. The shear mode resonance of the wall immersed in the superfluid ^3He was strongly affected by quasi-particles scattering, which enabled us to investigate the surface bound state in a spectroscopic way. We have succeeded in observing the state by this method to find interesting properties concerning to the Majorana state. The fantastic point of ^3He experiment is that we can change the boundary condition of quasi-particles from diffusive to specular limit by coating the wall with superfluid ^4He film. The systematic measurement clearly revealed that the spectral density at $E=0$ (Fermi energy) was decreased, and enhanced at higher energy towards specular limit, and strongly suggested the realization of the Majorana cone in the Andreev bound state¹. Further experiments to search for more direct evidences is undergoing.

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