Quasiparticle bound states of vortices in superfluid ^{3}He-B phase

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Superfluid ^{3}He-B phase is known as a topological superfluid, which has zero energy Majorana quasiparticle at an interface between the ^{3}He-B phase and the vacuum[1]. On the other hand, low energy quasiparticle states can be bound at a vortex core, since the order of the ^{3}He-B phase locally disappears.
In the case of the ^{3}He-B phase, the vortex core filled by another superfluid phase of ^{3}He is more stable than the normal core vortex, since they can reduce the condensation energy[2]. For example, so-called v-vortex is stable in the high pressure and the high temperature region, whose vortex core is filled by coexisting phase of the A- and β-phase. The double-core vortex filled by coexisting phase of the planar and polar phase is the ground state at the low pressure and low temperature region.
In this presentation, we will discuss the quantized low energy quasiparticle bound states of the different vortex states of the ^{3}He-B phase on the basis of the numerical solution of the Bogoliubov-de Gennes equation. In this calculations, we use the order parameters obtained by the quasiclassical theory. Finally we clarify that the bound states near the vortex core of the ^{3}He-B phase can be understood as an Andreev bound state of the interface between the vortex core state and the bulk superfluid B-phase.

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