On Intrinsic Angular Momentum due to Edge Mass Current for Superfluid ^{3}He A-Phase

Y. Tsutsumi, T. Mizushima, M. Ichioka, and K. Machida

Department of Physics, Okayama University, Okayama, Japan

Majorana fermions and edge mass current exist in the superfluid ^{3}He A-phase, which is a topological superfluid phase. When the superfluid ^{3}He A-phase is confined in a thin slab, the Andreev bound state appears at the edge of the slab. The bound quasiparticles behave as Majorana fermions and they are accompanied with mass current along the edge.

We calculate the edge mass current by the quasiclassical Eilenberger theory quantitatively.[1] Numerical calculations are performed in finite temperatures, and an analytical calculation of Riccati equations is carried out at a low temperature limit $T \to 0$. Then, the so-called intrinsic angular momentum by the edge mass current is evaluated. Contributions to the angular momentum can be divided into those from the bound state and from the continuum state above the superfluid gap in a bulk. As a result, the angular momentum is found to be of the order of $N\hbar$, where N is the total number of ^{3}He atoms in the slab. Therefore, the angular momentum by the edge mass current relates to intrinsic angular momentum.

[1]Y. Tsutsumi, T. Mizushima, M. Ichioka, and K. Machida, J. Phys. Soc. Jpn. **79**, 113601 (2010); Y. Tsutsumi, M. Ichioka, and K. Machida, Phys. Rev. B **83**, 094510 (2011).