Mass Current at a Domain Wall in Superfluid ^{3}He A-Phase

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At a surface of the superfluid ^{3}He A-phase, the surface Andreev bound state accompanied with edge mass current emerges due to a topological phase transition. The direction of the edge mass current is fixed by the direction of l-vector, namely, angular momentum of Cooper pairs. When the surface is specular, angular momentum by the edge mass current points to the direction of l-vector and its amplitude is $N\hbar/2$,[1,2] which is the same with expected value as macroscopic intrinsic angular momentum, where N is number of ^{3}He atoms in a disk system. According to this result, the topological edge mass current seems to relate to the intrinsic angular momentum. Mass current by a topological phase transition also flows at a domain wall in the A-phase, namely, an interface between the A-phases with the opposite direction of l-vector. At the energetically favorable domain wall, we show that the amplitude of the mass current is almost the same with that at the specular surface; however, the mass current flows toward the opposite direction by angular momentum of Cooper pairs. Therefore, we conclude that topological mass current has no relation to intrinsic angular momentum.

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Section: QF - Quantum Fluids

Keywords: superfluid ^{3}He, topological current, intrinsic angular momentum