MAGNETIC RELAXATION IN VORTICES OF SUPERFLUID 3He-B

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When placed in a rotating vessel, superfluid ^{3}He cannot rotate as a whole. Instead, a lattice of quantised vortices is formed. Two types of vortices are observed in ^{3}He-B. Based on numerical calculations [1, 2], these have been identified as an axisymmetric A-phase-core vortex and a non-axisymmetric double-core vortex.

Nuclear magnetic resonance (NMR) is the main tool in experimental research of superfluid ^{3}He. Two distinct NMR modes are used to study vortices in rotating ^{3}He-B. If the magnetisation is slightly perturbed from the equilibrium, one can study the effect of vortices on the texture based on the frequency shifts. A more sensitive method, unique to ^{3}He-B, is the homogeneously precessing domain (HPD) [3]. Here the spins within the domain precess uniformly with a large tipping angle. The measured quantity is the absorbed energy.

We have studied theoretically how a single isolated vortex causes dissipation in HPD. One mechanism studied [4] is the so called Leggett-Takagi relaxation, which arises from the non-equilibrium between the superfluid component and the normal component. A more dominant mechanism arises from the dynamics of the vortex. It turns out that the precessing magnetisation causes the vortex to oscillate. This in turn gives rise to waves of magnetisation, or spin waves. These waves carry energy out of the system, causing dissipation. The calculated energy absorption is in a qualitative agreement with the experiment [3].

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