Propagation of Quasiparticles in a Cluster of Vortices in Superfluid ^{3}He-B

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The rotatory flow associated with quantized vortices can constrain the trajectories of thermal excitations in ^{3}He-B. An excitation propagating through the superfluid flow field created by vortices may not find a forward-propagating state and therefore retraces its trajectory and changes flavor from quasiparticle to quasihole. This mechanism is called Andreev reflection.
We describe the first measurement on Andreev scattering of thermal excitations from a vortex configuration with known density, spatial extent, and orientations in ^{3}He-B superfluid[1]. This configuration is created by rotating the ^{3}He-B sample at constant angular velocity. We use two quartz tuning fork resonators embedded inside a blackbody radiator. One resonator creates a controllable density of excitations at 0.2 T_c base temperature and the other records the thermal response. The results are compared to numerical simulations of ballistic propagation of thermal quasiparticles through a cluster of rectilinear vortices with taking into account the exact experimental geometry. Our studies suggest that the current understanding of Andreev reflection is correct and it can be used as a quantitative tool to visualize vortices in the low temperature limit. In particular, possible applications for studying Kelvin-wave excitations of vortex lines are discussed.

1. J.J. Hosio *et al.*, arXiv:1103.2633 (2011).