Anomalous spin relaxation and quasiparticle damping in superfluid 3He-B at very low temperatures

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The excitation density in superfluid 3He-B determines many of the low temperature transport properties as well as directly measurable quantities such as the bulk relaxation rate of spin precession, as measured by the lifetime of coherent spin precession modes in NMR experiments, and the damping of mechanical resonators. In T $\rightarrow$ 0 limit, one might expect that the life time of coherent spin modes will grow and the damping of resonators will fall exponentially on cooling. However, the presence of a surface can significantly change the behavior. The surface violates the symmetry of the superfluid by suppressing Cooper pairs having orbital momentum perpendicular to the surface normal. This leads to an energy gap distortion within a distance of order the coherence length from the surface. The distorted gap allows the creation of the Andreev bound excitations, the density of which depends on the surface quality. Here we present NMR measurements of coherent spin precession at low temperatures which reveal an extra dissipation mechanism in the presence of a nearby surface. This leads to anomalous, temperature independent, spin relaxation at the lowest temperatures. We also discuss the influence of Andreev bound excitations on the damping of mechanical resonators at very low temperatures.