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Study of the two-domain processing structure in the superfluid ^{3}He-B

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Abstract. The systematic experimental and theoretical investigation of the longlived induction signal, known to exist in the ^{3}He-B, has shown that even very small nonuniformity of a steady magnetic field H_0 changes qualitatively the precession pattern arising in the pulsed NMR experiments after tipping of the magnetization. The spin supercurrents redistribute magnetization within the experimental cell to produce the precessing structure, consisting of two domains. In one-domain, situated in the higher field region, magnetization M has its equilibrium value and is parallel to H_0. In the other domain the angle between M and H_0 is slightly larger than $\theta_0 = \arccos(-\frac{1}{4})$. The structure precesses with frequency, equal to the Larmor frequency at the site of the wall, separating the domains. The relaxation of this structure goes via the growth of the equilibrium domain at the expense of the precessing domain; therefore in the course of the relaxation the frequency of the precession has to decrease with time. The calculated rate decrease agrees with the observed value. Experiments were carried out directly demonstrating the existence of the two-domain structure.

After the formation of the two-domain structure, as well as after a perturbation of the structure by short r.f. pulses, low frequency (~ 200 Hz) modulation of the induction signal is observed due to vibration of the structure. These vibrations are the standing spin waves in the precessing domain, their frequency being proportional to the size of the domain. The observed dependence of the frequency on other parameters is in agreement with theoretical calculations.

The analysis of the data on the vibration and relaxation of the two-domain structure enables us to find the spin wave velocity and the spin diffusion coefficient in ^{3}He-B.

Further investigation of the two-domain structure enables the study of spin supercurrents in ^{3}He-B.

Keywords. Two-domain structure; helium.

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