Gravity waves on the surface of topological superfluid ^{3}He-B

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Waves on the surface of a fluid in a gravitational field are among the most ubiquitous phenomena in nature. We report the first observation of the gravity waves on the surface of superfluid ^{3}He-B at temperatures below $0.2\,T_c$ in the ballistic regime of quasiparticle motion [1]. At higher temperatures the gravity waves are damped by the large viscosity of the normal component, and only the third sound waves in a thin film have been observed. We excite the waves by vibrating vertical cylindrical container filled partially with ^{3}He-B. The oscillating free surface is coupled to the magnon Bose-Einstein condensate in a magneto-textural trap [2]. In the magnon BEC the magnetization of ^{3}He precesses with coherent phase and common frequency, which is determined by the trapping potential. The oscillating surface modifies the trap shape and modulates the frequency. By measuring the precession frequency of magnetization we have identified the two lowest surface wave modes of our system. Our measurements show that the damping of the waves decreases with temperature linearly with the density of the normal component and extrapolates to a finite value at zero temperature. We have also observed enhancement of relaxation rate of the trapped magnon condensate when the surface waves modulate the trap, whereas the similar modulation of the trap with the magnetic field does not affect the relaxation. We discuss the possibility that both the finite damping at $T = 0$ and the enhanced magnon relaxation could be related to the surface-bound Majorana states expected to exist at the free surface of topological superfluid ^{3}He-B.

1. V. B. Eltsov *et al.*, arXiv:1302.0764.
2. S. Autti *et al.*, PRL **108**, 145303 (2012).

Section: QF - Quantum Fluids

Keywords: superfluid ^{3}He, gravity waves, magnon BEC