Spontaneous formation of magnon Q-ball in superfluid ^{3}He-B

V. V. Zavjalov[a], S. Autti[a], V. V. Dmitriev[b], V. B. Eltsov[a], and P. J. Heikkinen[a]

[a]O. V. Lounasmaa Laboratory, Aalto University, P.O. Box 15100, FI-00076 AALTO, Finland
[b]Kapitza Institute for Physical Problems, Kosygin str. 2, Moscow 119334, Russia

Long-living coherent magnetic states can be created by NMR techniques in the ^{3}He-B. These states can be described in terms of Bose-Einstein condensation of magnon quasiparticles. At temperatures below 0.2 T_c magnon condensate can be formed in a pre-defined potential trap created by external magnetic field and inhomogeneous texture of ^{3}He-B order parameter [1]. Unlike Bose-Einstein condensates of cold atoms, magnon BEC in ^{3}He-B is able to modify its trapping potential since the order-parameter texture depends on the magnon density. This property makes the magnon condensate analogous to a so-called Q-ball [2]. A Q-ball in field theories is a soliton of self-localized charge in the scalar field with attractive interaction. In the case of the magnon BEC in ^{3}He-B, the magnon number plays role of the charge and the spin-orbit interaction provides the self-localization. We have observed that the condensate with large enough number of magnons moves from the pre-existing trap to another location forming a new potential trap. This trap exists only while the condensate is localized inside it and thus displays the soliton nature of a "true" Q-ball. We have also observed two coexisting spatially separated magnon condensates in the self-supported and original traps.

1. S. Autti *et al.*, Phys. Rev. Lett. **108**, 145303 (2012).
2. Yu. M. Bunkov, G. E. Volovik, Phys. Rev. Lett. **98**, 265302 (2007).

Section: QF - Quantum Fluids

Keywords: superfluid ^{3}He, magnon BEC