DISSIPATION AND DYNAMICS OF QUANTIZED VORTICES IN FERMIONIC SUPERFLUID ^{3}He-B IN THE ZERO TEMPERATURE LIMIT

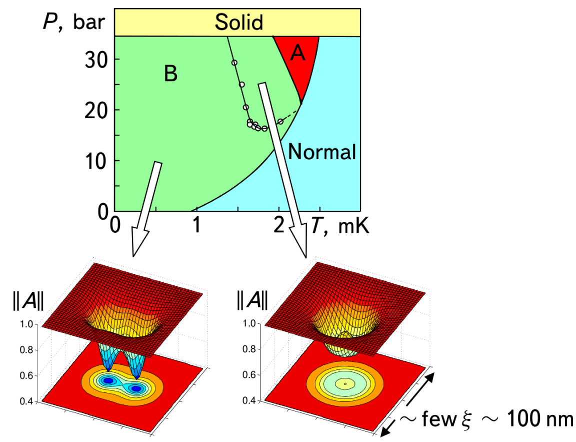
J. T. Mäkinen,[1] V. B. Eltsov,[1] and M. Silaev[2]

[1]Low Temparetures Laboratory, Department of Applied Physics, Aalto University, FI-00076 AALTO, Finland
[2]Department of Theoretical Physics and Center for Quantum Materials, KTH-Royal Institute of Technology, Stockholm, SE-10691, Sweden
email: jere.makinen@aalto.fi

Quantized vortices are topological defects, observed in various quantum systems, such as superconductors, superfluids, and ultra-cold atom condensates (BEC and fermionic). ^{3}He undergoes a transition into superfluid phases at low temperatures and, compared to ultra-cold gases, has a uniform density and a lifetime limited only by the cooling capacity of the experimental setup. The multi-component order parameter allows the existence of multiple different superfluid phases and vortex structures. In the pseudo-isotropic B-phase the cross section of vortex cores breaks from axially symmetric as a function of pressure P and temperature T, as shown in the phase diagram of liquid ^{3}He below. The vortex dynamics are dominated by interactions between the bulk thermal excitations and the vortex-core-bound fermions [1].

We study the dissipation mechanisms and dynamics of quantized vortices in the zero temperature limit, where the density of thermal excitations in the bulk of the fluid vanishes exponentially. What is surprising is that we observe finite dissipation when our results are extrapolated to absolute zero temperature, where the bulk thermal excitations are absent.

While the conclusive proof is yet missing, we rule out the possibility of surface friction and centrifugal motion of a precessing vortex cluster as possible mechanisms. Instead, the dissipation could be caused by overheated vortex cores, a mechanism related to accelerating motion caused by high frequency wave excitations on individual vortex lines, called Kelvin waves (KW) [2]. The KWs are induced when a vortex moves while it is weakly pinned on the container walls at its ends.



[1] T. D. C. Bevan *et al.*, J. of Low Temp. Phys. **109**, 423 (1997).
[2] M. Silaev, Phys. Rev. Lett. **108**, 045303 (2012).