Vortex Front in Rotating ^{3}He-B in the Zero-Temperature Limit

V.B Eltsov[a], R. de Graaf[a], J.J. Hosio[a], P.J. Heikkinen[a], M. Krusius[a], R. Hänninen[a], V.S. L'vov[b], and G.E. Volovik[a,c]

[a]Low Temperature Laboratory, Aalto University, FI-00076 AALTO, Finland
[b]The Weizmann Institute of Science, Rehovot 76100, Israel
[c]Landau Institute for Theoretical Physics, 119334 Moscow, Russia

The propagating vortex front is studied in superfluid ^{3}He-B at low temperatures. The turbulent front[1] moves axially along a rotating cylindrical container of ^{3}He-B and replaces vortex-free flow with vortex lines at constant density. At temperatures above $0.3\,T_c$, the vortex density behind the front approaches the equilibrium value. We present the first measurements on the thermal signal from dissipation as a function of time, recorded during the motion of the front and the subsequent relaxation to the equilibrium vortex state.[2] The time dependence, measured at $0.2\,T_c$ with sensitivity better than 0.1 pW, allows us to conclude that the density of vortices behind the front falls well below the equilibrium value. Similar behavior is observed in our numerical simulations of the vortex front. We present an interpretation based on the decoupling of the vortex dynamics from the container reference frame in the limit of vanishing mutual friction, when $T \to 0$. This interpretation allows us also to explain two different functional dependencies of the front velocity on the angular velocity of the container, which are observed in the coupled and decoupled regimes.

[1]V.B. Eltsov *et al.*, Phys. Rev. Lett. **99**, 265301 (2007). [2]V.B. Eltsov *et al.*, preprint arXiv:1102.4284.