Spin-Down of the Superfluid Component of ^{3}He-B in Different Geometries

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The spin-down of classical fluids from rotation is generally unstable. In superfluids the flow of quantized vortices is also expected to become turbulent when the temperature is low enough and the dissipation from mutual friction becomes negligible. This impression comes mostly from ^{4}He experiments where the pinning of vortices to the container walls is important. In superfluid ^{3}He-B pinning is weak and it is expected to behave like an ideal superfluid. We can therefore compare its responses to calculations with the vortex filament model. Here we numerically study the behavior of the superfluid component after a sudden stop of rotation (spin-down). Similar to experiments, we find that in cylindrically symmetric containers the decay of vorticity remains laminar down to $T = 0.20T_c$, which corresponds to a superfluid Reynold number $\mathrm{Re}_\alpha \sim 10^3$. Most of the reconnections occur within a thin boundary layer, whose thickness slowly increases as the temperature drops[1]. Future simulations will hopefully show, whether the thickness of the boundary layer remains finite or not, as $T \rightarrow 0$. A controllable perturbation to the initial state can be introduced by tilting the cylinder with respect to the rotation axis. By increasing the tilt, we observe a transition from laminar to turbulent decay. Similar turbulent responses are also displayed by our calculations on a cubic container. Even if the overall decay is turbulent, the tangle is inhomogeneous and partly polarized along the direction of the initial rotation.

[1]V.B. Eltsov *et al.*, Phys. Rev. Lett. **105**, 125301 (2010).