Dissipation enhancement from a single reconnection event in superfluid helium

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We investigate a single vortex reconnection event in superfluid helium at finite temperatures using the vortex filament model [1]. The reconnection induces Kelvin waves which strongly increase energy dissipation. We evaluate the mutual friction dissipation from the reconnection and show that the dissipation power has universal form which is seen by scaling both time (measured from the reconnection event) and power by the mutual friction parameter α. This observation allows us to conclude that the Kelvin-wave cascade is not important in the energy dissipation process within the range $\alpha \gtrsim 10^{-3}$. Rather the energy is directly transferred from Kelvin waves to the normal component. Moreover, while the excited Kelvin waves greatly enhance energy dissipation, no similar change is seen in angular momentum from the reconnection event. This result is in accordance with recent measurements on the propagating vortex front [2] and might also explain the laminar decay after a sudden stop of rotation (spin-down) in ^{3}He-B [3], where pinning can be neglected. Similarly, our results confirm another earlier observation that the minimum distance between vortices scales approximately as $d = C\sqrt{|t - t_{\mathrm{rec}}|}$, both before and after the reconnection event. The prefactor C is almost temperature independent and has ten times larger value after the reconnection than before. This is due to larger curvatures induced by the reconnection event.

1. R. Hänninen, arXiv:1303.6852 (2013).
2. J.J. Hosio, *et al.*, Nat. Commun. **4**, 1614 (2013).
3. V.B. Eltsov, *et al.*, Phys. Rev. Lett. **105**, 125301 (2010).

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