Quantum phase slips of trapped superfluid Bose gases in one dimension

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We study transport of trapped one-dimensional superfluids in connection with quantum phase slips.[1] We specifically consider damping of dipole oscillations induced by sudden displacement of the trapping potential, which has been investigated in previous experiments. We find a broad parameter region in which the damping rate of the oscillation is proportional to the nucleation rate of a quantum phase slip divided by the flow velocity and exhibits a power-law behavior with respect to the flow velocity. From this relation and simulations with the exact time-evolving block decimation method, we argue that the suppression of the 1D transport observed in the experiments is mainly due to quantum phase slips. We suggest that the damping rate at a finite temperature exhibits a universal crossover behavior upon changing the flow velocity.

1. Danshita, I. (2013), "Universal damping behavior of dipole oscillations of one-dimensional ultracold gases induced by quantum phase slips". arXiv:1303.1616v1.

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