Dissipative and coherent dynamics in a Josephson junction between fermionic superfluids

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I will report on the emergence of dissipation in an atomic Josephson junction between two weakly-coupled superfluid Fermi gases [1]. In the experiment, we create the analogous of a Josephson junction by bisecting BEC-BCS crossover superfluids with a thin optical barrier [2]. For all the interactions regimes, we find that vortex-induced phase slippage is the dominant microscopic source of dissipation. For intermediate bias potentials, the dynamics exhibits coexisting coherent oscillations and resistive flow. We link the junction transport properties to the phase-slippage mechanism, finding that vortex nucleation is primarily responsible for the observed trends of conductance and critical current. We also enter the regime of strong dissipation when the junction operation is irreversibly affected by vortex proliferation, causing the loss of coherence between the superfluid reservoirs. Our work opens new directions for investigating the interplay between dissipative and superfluid transport in strongly-correlated fermionic systems.