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Decay of Josephson Superflow via Vortex-Ring Emission[1] NICK PROUKAKIS, KLEJDJA XHANI, KEAN LOON LEE, LUCA GALANTUCCI, Joint Quantum Centre (JQC) Durham-Newcastle, Newcastle Univ., UK, ANDREA TROMBETTONI, CNR-IOM and SISSA, Italy, GIACOMO VALTOLINA, FRANCESCO SCAZZA, ANDREA AMICO, CHIARA FORT, MATTEO ZACCANTI, ALESSIA BURCHIANTI, GIACOMO ROATI, INO-CNR and LENS, Italy
— Josephson oscillations in fermionic superfluids across the BEC-BCS crossover (Valtolina et al., Science 350, 15050 (2015)) have been recently experimentally observed to decay through the emission of vortical excitations at the barrier connecting the two parts of the superfluid in a double-well trap. By performing full 3D numerical simulations in the molecular BEC regime at both zero and finite temperatures, we explicitly demonstrate the generated structures to be excited vortex rings, and study their propagation, dynamical instability and subsequent decay, shedding more light into this nonlinear process, the role of interactions of vortex rings with other rings and background sound, and the effect of gradually removing the barrier (experimental step undertaken before time-of-flight imaging). By self-consistently coupling the Gross-Pitaevskii equation to a quantum Boltzmann equation (ZNG model) we also discuss the role of finite temperature in damping both Josephson oscillations and macroscopic quantum self-trapping.

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