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Vortex-Induced Dissipation across a Josephson Junction. KLEJDJA XHANI, Joint Quantum Centre (JQC) Durham-Newcastle, Newcastle Univ., UK, ELETTRA NERI, MATTEO ZACCANTI, INO-CNR and LENS, Italy, KEAN LOON LEE, LUCA GALANTUCCI, Joint Quantum Centre (JQC) Durham-Newcastle, Newcastle Univ., UK, ANDREA TROMBETTONI, CNR-IOM and SISSA, Italy, FRANCESCO SCAZZA, ALESSIA BURCHIANTI, GIACOMO ROATI, INO-CNR and LENS, Italy, NIKOLAOS PROUKAKIS, Joint Quantum Centre (JQC) Durham-Newcastle, Newcastle Univ., UK, JQC TEAM, LENS TEAM — The transition from Josephson oscillations to a dissipative regime was experimentally observed (Science 350,1505(2015)), due to the generation of vortices inside a thin barrier coupling two parts of a superfluid from the BEC to the BCS limit. We model this experiment in the molecular BEC regime by performing 3D numerical simulations at both zero and finite temperatures. The onset of the dissipative regime depends on the barrier height and it is characterised in terms of the critical initial population imbalance between the two wells and the maximum superfluid current. We show that the vortices generated inside the barrier are vortex rings (VR) and give a full characterisation of their dynamics (position, radius, and shape oscillations). For the first VR we show the dependence of its lifetime and velocity on the initial population imbalance z_0. Experimentally the VRs are observed in time of flight images after gradually removing the barrier. We consider this effect and show that the barrier removal strongly enhances the VR stability, thus facilitating its experimental observation, even in the presence of a small thermal cloud.

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