Damping of Josephson oscillations in strongly correlated one-dimensional atomic gases

J. Polo[a*], V. Ahufinger,[b], F. W. J. Hekking[a], and A. Minguzzi[a]

a. Univ. Grenoble Alpes, CNRS, LPMMC, F-38000 Grenoble, France
b. Departament de Física, Universitat Autònoma de Barcelona, E-08193 Bellaterra, Spain

∗ juan.polo@lpmmc.cnrs.fr

We study the Josephson oscillations of two strongly correlated one-dimensional bosonic clouds separated by a localized barrier. Using a quantum-Langevin approach and the exact Tonks-Girardeau solution in the impenetrable-boson limit, we determine the dynamical evolution of the particle-number imbalance, displaying an effective damping of the Josephson oscillations which depends on barrier height, interaction strength and temperature. We show that the damping originates from the quantum and thermal fluctuations intrinsically present in the strongly correlated gas. Thanks to the density-phase duality of the model, the same results apply to particle-current oscillations in a one-dimensional ring where a weak barrier couples different angular momentum states.