Probing supercurrent decay in a toroidal Bose-Einstein condensate at $T=0$ with bosonic multi-configurational time-dependent Hartree theory

STORM WEINER, University of California, Berkeley, AXEL LODE, Technische Universitt Wien, JONATHAN DUBOIS, Lawrence Livermore National Lab, BIRGITTA WHALEY, University of California, Berkeley — Several experiments in the past decade have observed the step-wise decay of quantized circulation in toroidally trapped Bose-Einstein condensates of ultracold atomic gases, raising questions about the nature and stability of mesoscopic superfluidity in these systems. We investigate the role of quantum fluctuations in $T = 0$ current decay of states of flow in toroidally trapped BECs using a many-body simulation with the multi-configurational time-dependent Hartree for bosons. The method allows calculation of the local current density, single-shot statistics of the k-space density, and eigenvalues of the reduced one-body density matrix. Comparison is made with recent simulations using Gross-Pitaevskii mean-field equations and the truncated Wigner approximation.

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Storm Weiner
University of California, Berkeley

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