Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Experimental characterization of a first order dissipative phase transition in a many-body quantum system. JENS BENARY, MARVIN RÖHRLE, JIAN JIANG, Department of Physics and OPTIMAS research center, TU Kaiserslautern, CHRISTIAN BAALS, Department of Physics and OPTIMAS research center, TU Kaiserslautern / Graduate School Materials Science in Mainz, HERWIG OTT, Department of Physics and OPTIMAS research center, TU Kaiserslautern — We experimentally investigate a driven-dissipative Josephson junction array, realized with a weakly interacting Bose-Einstein condensate loaded in a 1-D optical lattice. Tunneling from the neighboring sites makes up the driving force. Engineered losses on one site act as a local dissipative process. The source of these losses is an electron beam, which we also use to image the system (SEM) and monitor the losses. Decreasing the tunnel coupling or increasing the dissipation strength makes the system cross from a superfluid to a resistive state. For intermediate values, the system shows bistable behavior, with coexistence of a superfluid and an incoherent branch. Studying single experimental runs, we see the filling of the lossy site change from the resistive to the superfluid state within a few tunneling times. We explore the hysteresis of the system as a function of sweep time, temperature and initial atom number. Studying the dynamics towards a steady state averaged over many experimental runs, we find a critical slowing down accompanied by large-scale quantum fluctuations. Our results reveal the presence of a first order dissipative phase transition in the system.

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Date submitted: 03 Feb 2020 Electronic form version 1.4