Dipartimento di Fisica e Astronomia Galileo Galilei

800 ANNI 1222·2022

Università degli Studi di Padova

November 26, 2024 - 16:30 aula "Voci"

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Dissipative dynamics and quantum phase transition in an atomic Josephson junction

A resistively shunted Josephson junction (RSJJ) is a widely used platform to study quantum dissipation caused by a resistor and also offers applications to quantum technology. In this talk, instead of the superconducting junction, we reveal the dissipative nature of an atomic Bose Josephson junction (BJJ) in a head-to-tail configuration. The dissipation originates from the intrinsic momentum coupling between the coherent Josephson mode and the incoherent excitation modes, which leads to damped Langevin dynamics in the Josephson mode even without any synthetic dissipation in contrast to the RSJJ. The intrinsic momentum coupling results in giant phase fluctuations compared to fluctuations in the population imbalance. Moreover, we find that the intrinsic momentum coupling yields a dissipative quantum phase transition (DQPT). The DQPT between a superconducting state and an insulating state was originally predicted in the RSJJ by Schmid and Bulgadaev 40 years ago, but the experimental verification has been yet challenging. We propose that the BJJ offers an alternative platform to observe the DQPT, which is robust against nonperturbative effects suppressing the insulating state, by controlling the interatomic interaction.

Seminar organized by the Group of Condensed Matter Theory