Dissipation and Fluctuations in Josephson Junctions

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In the first part of the talk, we discuss the dynamics of bosonic atoms in elongated Josephson junctions. We find that these systems are characterized by an intrinsic coupling between the Josephson mode of macroscopic quantum tunnelling and the sound modes. This coupling of Josephson and sound modes gives rise to a damped and stochastic Langevin dynamics for the Josephson degree of freedom. From a microscopic Lagrangian, we deduce and investigate the damping coefficient and the stochastic noise, which includes thermal and quantum fluctuations. Finally, we study the time evolution of relative-phase and population-imbalance fluctuations of the Josephson mode and their oscillating thermalization to equilibrium.

In the second part of the talk, we consider the phase and voltage correlation dynamics under a current noise, including thermal and quantum fluctuations in a resistively and capacitively shunted Josephson (RCSJ) junction. Within the linear regime, an external current is found to shift and intensify the deterministic contributions in phase and voltage. In addition to the deterministic contribution, we observe the relaxation of autocorrelation functions of phase and voltage to finite values due to the current noise. We also find an earlier decay of coherence at a higher temperature in which thermal fluctuations dominate over quantum ones.