Non-Markovian effects in the dynamics of entanglement in the high temperature limit

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Abstract

In the past years, some quantum phenomena have been observed at macroscopic scales. In particular, superconductivity, coherent superpositions of Bose-Einstein condensates and interference patterns in fullerenes have been detected. This fact has made that the border between the quantum and classical realms become more diffuse and intricate, although, more interesting, than before.

However, in order to observe these quantum features, one needs to reach the low temperature regime, $\hbar\omega/k_{\mathrm{B}}T \gg 1$, where $\hbar\omega$ denotes a characteristic system energy-scale and $k_{\mathrm{B}}T$ the thermal energy. Therefore, some delicate and elaborate cooling processes have been developed.

Our work aims to show that, even in the the high temperature regime, some quantum features such entanglement can be present, if the system is placed out from equilibrium. In particular, we study the non-Markovian dynamic of two different harmonic oscillators coupled to different baths at different temperatures and with different coupling-to-the-bath-strengths. We found that, despite the absence of symmetries in the parameters space, entanglement between the oscillators can be created and maintained in the long-time regime. We also discuss the implementation of our setup for studying the influence of the non-Markovian dynamics in the optimal sideband cooling of nano-mechanical resonators.

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