Fluctuations driven coupled oscillators as a quantum simulator

L. Bernazzani, G. Burkard

Department of Physics, University of Konstanz, D-78457 Konstanz.

We investigate a system composed of two coupled oscillators subject to stochastic fluctuations in its internal parameters. The goal would be to further extend the well-known classical analogy of the quantum dynamics of two level systems (TLS) described by Schrödinger's equation, provided by coupled oscillators [1-2]. This analogy has been already tested in multiple experimental setups. Examples of systems exploited on the experimental test-beds are given by coupled nanomechanical string resonators or optically levitated particles [3-5]. Notwithstanding, a result of this classical analogy is that the Bloch's vector (BV) dynamics, arising from the classical coupled oscillators problem, leads to the same relaxation time for all the components of the BV $T_1 = T_2$, which is in contrast with the general case of quantum TLS. At the present time our project deals with the description of such classical systems with the addition of noise. Our aim is to show that this fundamentally quantum feature, i.e. $T_1 \neq T_2$, can be implemented as well in the aforementioned classical systems by adding stochastic fluctuations in their internal parameters. Moreover, these stochastic contributions might be easily engineered in the control apparatus of those systems. A better understanding of such fundamental features of the quantum-classical analogy in these kinds of systems could lead to further proposals for hybrid mechanical systems as simulators of quantum systems made of coupled spins.

References:

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