Thermally generated autonomous coherence of subsystems

Michal Kolář and Radim Filip

Palacký University Olomouc, 17. listopadu 1192/12, Olomouc, 771 46, Czech Republic

Quantum superposition of energy eigenstates can appear autonomously in a quantum system coupled to a thermal bath, if such coupling is of the composite nature [1]. Here, we discuss an analogous situation where similar type of composite interaction describes the coupling between two subsystems of a total system in turn weakly coupled to a thermal bath at temperature T. We perform a case-study analyzing the properties of thermally induced steady-state coherence on mutually-interacting subsystems of a compound system. We quantify the local coherence [2] of the subsystems in each respective case and specify the system parameters optimal for reaching high coherence. We complement our study by analysis of mutual coherence [3] of the system, describing the local versus global distribution of coherence in the system. One of our findings is the fact that the best regime for coherence generation on subsystems is generally the low temperature region, where the system is close to its ground state. Therefore, we characterize each case from a thermodynamic perspective [4] by the rate of coherence generation, if the system is cooled down towards its ground state. Our analysis can be beneficial for proposing more autonomous Quantum information protocols employing quantum coherence as an important resource.

[1] Guarnieri, G., Kolář, M., and Filip, R., Steady-state Coherence by Composite system-Bath Interactions, PRL 070401 (2018).

[2] Baumgratz, T., Cramer, M., Plenio, M.B., Quantifying Coherence, PRL 113, 140401 (2014).

[3] Gumberidze, M., Kolář, M., and Filip, R., Pairwise-Measurement-Induced Synthesis of Quantum Coherence, PRA 105, 012401 (2022).

[4] Greiner, W., Neise, L., and Stocker, H., Thermodynamics and Statistical Mechanics (Springer, 1997).