QUANTUM HYBRID SYSTEM'S DYNAMICS via ENVIRONMENTAL THERMOSTAT

Victor Ceban, Elena Cecoi, Sergiu Cârlig, and Mihai A. Macovei,
Institute of Applied Physics, Moldova State University,
Academiei str. 5, MD-2028 Chișinău, Moldova

Hybrid quantum systems attracted a lot of attention nowadays, especially, in connections to quantum technologies. In this respect, here, we shall present our recent investigations on quantum dynamics in hybrid quantum systems mediated by the environmental quantum thermostat. Particularly, we will discuss the quantum efficiency of a quantum heat engine consisting from many three-level quantum emitters collectively interacting with the cold and the hot baths, respectively. We have found that the quantum performance may be enhanced considerably in a three-level ensemble, depending on the level's configuration [1]. Then, we turn to a hybrid quantum optomechanical setup, where we demonstrate enhanced effective phonon lifetimes [2] and multi-phonon effects in dispersive regimes of interaction. These regimes can be achieved involving few-level emitters as well [3]. The entanglement creation in a pair of laser pumped two-level qubits and its relationship with cooling effect of the boson mode which is coupled to them shall be reported as well. We demonstrate that the entanglement occurs even for resonance laser-qubit interaction - an effect arising due to the presence of the dipole-dipole interaction among the two-level qubits [4].

The study was supported by the Project «***Non-linear Quantum Optics in high-frequency intense electromagnetic fields***» no. 011205.

References

1. M. A. Macovei, Phys. Rev. A **105**, 043708 (2002). https://doi.org/10.1103/PhysRevA.105.043708.
2. V. Ceban, and M. A. Macovei, Journal of the Optical Society of America B **41**, 216 (2024). https://doi.org/10.1364/JOSAB.506974.
3. A. Mirzac, S. Carlig, and M. A. Macovei, Phys. Rev. A 103, 043719 (2021). https://doi.org/10.1103/PhysRevA.103.043719.
4. E. Cecoi, V. Ciornea, A. Isar, and M. A. Macovei, J. Phys. B: At. Mol. Opt. Phys. 53, 065501 (2020). https://doi.org/10.1088/1361-6455/ab5d8e

Corresponding author: Dr. habil. Mihai A. Macovei
Institute of Applied Physics, Moldova State University
Academiei 5, MD-2028 Chișinău, Moldova
e-mail: mihai.macovei@ifa.usm.md
ORCID: 0000-0003-2679-3283