

# STEADY-STATE DYNAMICS OF A QUANTUM OSCILLATOR COUPLED WITH A THREE-LEVEL EMITTER

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**Abstract:** A laser-pumped three-level  $\Lambda$ -type system the upper state of which is being coupled with a quantum oscillator characterized by a single quantized leaking mode has been investigated. Two distinct situations leading to cooling or lasing effects of the quantum oscillator's degrees of freedom have been identified and the mechanisms behind them have been described. Particularly, the interplay between single- or two-quanta processes accompanied by quantum interference effects among the induced emitter's dressed-states responsible for flexible lasing or deeper cooling effects has been proved, respectively.

**Keywords:** quantum, dynamics,  $\Lambda$  – type system.

We have researched out the quantum dynamics of a quantum oscillator coupled with the most upper state of a three-level  $\Lambda$ -type system. The two transitions of the three-level emitter are coherently pumped with a single or two electromagnetic field sources, respectively possessing orthogonal dipole moments. Certain ranges for flexible lasing or cooling phenomena referring to the quantum oscillator's degrees of freedom were found out. Appropriate system may be a nanomechanical resonator coupled with the most excited state of the three-level emitter fixed on it. On the other hand, if the upper state of the  $\Lambda$ -type system possesses a permanent dipole then it can couple with a cavity electromagnetic field mode which can be in the terahertz domain, for instance. Here, we have explored two distinct situations leading to cooling or lasing effects of the quantum oscillator's degrees of freedom and have described the mechanisms behind them. Remarkably, we have proved that interaction involving single- or two-quanta processes accompanied by quantum interference effects among the induced emitter's dressed-states are responsible for flexible lasing or deeper cooling effects, respectively. Mutual influences between the quantum oscillator's dynamics where shown to occur as well [1].

## References

1. A. Mirzac, M. A. Macovei, Dynamics of a quantum oscillator coupled with a three-level Lambda-type emitter, [arXiv:1810.09264v1](https://arxiv.org/abs/1810.09264v1)