

# **Thermodynamic uncertainty relation in degenerate and non degenerate maser heat engine**

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In this work, we investigate the thermodynamic uncertainty relation, which represents a trade-off between entropy production rate and relative power fluctuations, for non-degenerate three-level and degenerate four-level maser heat engines. For the non-degenerate case, we study two slightly different configurations of three-level maser engine and compare degree of violation of thermodynamic uncertainty relation in both models. We also show that the thermodynamic uncertainty relation remains invariant when we scale the matter-field coupling constant and system-bath coupling constants by the same factor. Further, for the degenerate four-level engine, we study the effects of noise-induced coherence on the thermodynamic uncertainty relation. We show that depending on the parametric regime of operation, the phenomenon of noise-induced coherence can either enhance or suppress the relative power fluctuations.