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POS-5 - Generating Squeezed Thermal States via Parametric Down Conversion in Lossy Cavities

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Squeezed states have recently attracted attention for use in quantum information as continuous variable entangled systems[1]. Such states can potentially be created in microring resonators and photonic crystal cavities. However, scattering leakage in these nanoscopic systems leads to loss, as it is an inherent feature of these devices. In this work, we show that the states created in lossy cavities via parametric down conversion are squeezed thermal states and we examine the effects of the loss on the squeezing parameter and thermal photon number as a function of time and pump intensity.

We consider a cavity with one leaky signal mode and pump this mode at twice signal-mode frequency. As such, this problem reduces to determining the photon dynamics of an optical parametric oscillator (OPO), where the pump light is treated classically. Although this problem can be solved by employing the Heisenberg-Langevin equations [2] or numerical methods [3], using our approach, we show that the exact solution to the Lindblad master equation for an OPO is the density matrix of a squeezed thermal state: $\rho(t) = S(u, \phi)\rho_{th}(n_{th})S^{\dagger}(u, \phi)$. The problem is therefore reduced to solving the three coupled differential equations for u, ϕ, and n_{th}, which are respectively, the squeezing amplitude, squeezing phase, and the thermal photon number in the thermal state that is being squeezed. We solve these equations to yield the time-dependent and steady-state solutions for the quadrature noise, thermal photon number, squeezing parameter, total photon number and second order correlation function under different pumping regimes.

References

[1] J. Fiurášek, "Continuous-variable quantum process tomography with squeezed-state probes," Phys. Rev. A. 92, 022101 (2015)
[2] M. O. Scully and M. S. Zubairy, Quantum optics (Cambridge university press, 1997).
[3] J. Johansson, P. Nation, and F. Nori, Computer Physics Communications 184, 1234 (2013).

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