Cavity Resonances Dominating the Photon Statistics in the Non-Equilibrium Steady State

F Rueting\textsuperscript{1} and C Weiss\textsuperscript{2}

\textsuperscript{1} Departamento de Física Teórica de la Materia Condensada, Universidad Autónoma de Madrid, Madrid, Spain
\textsuperscript{2} Joint Quantum Centre (JQC) Durham-Newcastle, Department of Physics, Durham University, Durham, UK
Contact Email: christoph.weiss@durham.ac.uk

The non-equilibrium-steady state (NEST) for photons in a cavity is investigated theoretically. The NEST is caused by different parts of the cavity being at distinct temperatures or by temperature gradients. By using a rate equation based on the Lindblad equation, we derive an analytic expression for the steady-state distribution of the photon spectrum. We predict differences between the non-equilibrium steady state and a fit to the black-body spectrum calculated via Planck’s law with an effective temperature. For two bodies of similar size at two temperatures which differ by a factor of two, the difference would be more than 10%. We also show that cavity resonances have a particularly large influence on the resulting non-equilibrium steady state of the photons. The investigation of thermal spectra in the presence of more than one temperature can be important for high-precision atomic clocks.

References