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Non-equilibrium atom-surface interactions: the failure of the Markov and of other common approximations

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Abstract

Like ordinary friction, the quantum friction describes a force acting on an object moving near another one. Unlike the classical case, however, quantum friction is mediated by the interaction with the electromagnetic field at zero temperature.
Using general theoretical arguments, we show that common approximations used in quantum optics (e.g. the Markov and the local thermal equilibrium approximations) can lead to erroneous predictions on such a phenomenon with regard to both strength and functional dependencies on system parameters. Our findings highlight the importance of non-equilibrium and of non-Markovian effects in dispersion interactions.