Exact Solution of Quantum Dynamics of a Cantilever Coupling to aSingle Trapped Ultracold Ion

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Abstract: The quantum behavior of a precooled cantilever can be probed highly efficiently by electrostatically coupling to a trapped ultracold ion, in which a fast cooling of the cantilever down to the ground vibrational state is possible. Within a simple model with an ultracold ion coupled to a cantilever with only few vibrational quanta, we solve the dynamics of the coupling system by a squeezed-state expansion technique, and can in principle obtain the exact solution of the time-evolution of the coupling system in the absence of the rotating-wave approximation. Comparing to the treatment under the rotating-wave approximation, we present a more accurate description of the quantum behavior of the cantilever.

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