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Negative Wigner function by decaying interaction from equilibrium

Bosonic systems with negative Wigner function superposition states are fundamentally witnessing nonlinear quantum dynamics beyond linearized systems and,recently, have become essential resources of quantum technology with many applications. Typically, they appear due to sophisticated combination of external drives,nonlinear control, measurements or strong nonlinear dissipation of subsystems to an environment. Here, we propose a conceptually different and more autonomous way to obtain such states, avoiding these ingredients, using purely sudden interaction decay in the paradigmatic interacting qubit-oscillator system weakly coupled to bath at thermal equilibrium in a low temperature limit. We demonstrate simultaneously detectable unconditional negative Wigner function and quantum coherence and their qualitative enhancement employing more qubits. Our results underline the fact that energy manipulation on a quantum level, here e.g. in the form of work injection, can redistribute the energy inside the complex quantum system in a way causing emergence of purely quantum states and phenomena.

Theme

Theme 2. Quantum effects in energy processes and materials

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