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Poster: ENGINEERING ORGANIC MOLECULES WITH LONG-LIVED QUANTUM COHERENCE

Single organic molecules in the solid-state are one of the promising optical platforms for realizing quantum networks owing to their remarkable coherent properties and flexibility in their chemical synthesis. However, the molecular excited states associated with the strong Fourier-limited zero-phonon lines of these systems decay within nanoseconds, posing a challenge for practical applications in quantum technologies.

In this theoretical work, we propose a new molecular system with quantum coherences up to millisecond time scales. Here, we exploit the inherent optomechanical character of organic molecules in a solid organic crystal. The proposed scheme consists of a single organic molecule in a host matrix with a structured phononic environment. By suppressing phononic decay channels, we realize and exploit long optomechanical coherence times up to milliseconds for storing and retrieving information. We show that the resulting long-lived vibrational states facilitate reaching the strong optomechanical regime at the single photon level. The proposed system shows the promise of organic molecules for achieving unexplored optomechanical phenomena and long-lived quantum memories.

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