

Entanglement of two qubits mediated by a TeraHertz channel

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Entanglement generation in open quantum systems is a cornerstone of robust quantum technologies, and extending these capabilities to the terahertz (THz) regime would provide a key resource for emerging THz quantum platforms. In this work, we theoretically demonstrate the dissipative stabilization of near-maximal entanglement between qubits mediated by THz channel via a Purcell-enhanced mechanism. While previous studies have independently explored dissipation-induced entanglement [1] and optically controlled emitters [2], our approach bridges these directions by exploiting driven-dissipative dynamics to stabilize an entangled steady state. By embedding two polar quantum emitters in a lossy THz cavity and driving them coherently at optical frequencies, we engineer effective interactions and common dissipation channels that stabilize the entangled antisymmetric state. Our approach relies on a double-dressing scheme, where an optical drive and a sideband field detuned by THz to its carrier sequentially dress the emitters, giving rise to an effective driven-dissipative Liouvillian whose dark state is a Bell state [3]. Optimizing the dressing parameters under experimentally realistic constraints, we obtain stationary concurrence values approaching $C \approx 0.9$ over a broad range of cavity frequencies and loss rates, demonstrating robustness against parameter imperfections. Finally, we propose an experimentally feasible quantum state tomography protocol based on classical shadows [4], relying solely on optical control and

readout, and demonstrate high-fidelity state reconstruction under finite detection efficiency. These results establish a viable route toward robust entanglement generation and verification in the THz regime.

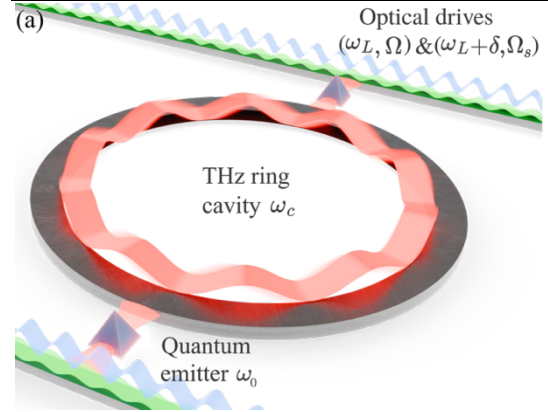


Figure 1: Schematic of the entanglement generation setup, featuring two quantum emitters coupled to a generalized medium (cavity or waveguide).

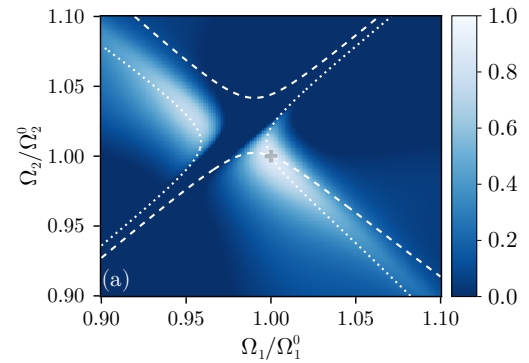


Figure 2: Stationary concurrence as a function of variation of the coherent drive amplitudes Ω_1/Ω_1^0 and Ω_2/Ω_2^0 . Dashed and dotted lines correspond to the angle and coated eigenfrequency conditions, respectively

References

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