Thermodynamics and Symmetry of Driven Open Quantum Systems

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The light-matter interaction has been pushed to the strong coupling regime in several experimental platforms, including superconducting qubits, NV centers, cold atoms in optical lattices, and molecules in cavities. This opens up new possibilities of quantum control, but also presents new theoretical challenges. To address this, we have systematically developed Floquet response theory for open quantum systems driven by a strong but periodic driving field and perturbed by a weak but arbitrary probe field. (i) Non-equilibrium stationary states of periodically-driven open quantum systems can strongly deviate from the Floquet-Gibbs distribution and exhibit exotic non-analytic behavior. [1] (ii) Dynamical symmetries of the stationary states lead to spectroscopic signatures including symmetry-protected dark states and Floquet-band selection rules. [2] (iii) Floquet response theory predicts the generation of squeezed and entangled light using a sequence of coupled strongly-driven quantum systems. [3]

[1] Phys. Rev. Lett. 123, 120602 (2019) G. Engelhardt, G. Platero, and J. Cao

[2] Phys. Rev. Lett. 126, 090601 (2021) G. Engelhardt and J. Cao

[3] G. Engelhardt and J. Cao (manuscripts in preparation)