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Non-thermal electron-photon steady-states, superconductivity and charge density waves in open cavity-quantum-materials

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Abstract

Coupling a system to two different baths can lead to novel phenomena escaping the constraints of thermal equilibrium. In quantum materials inside optical cavities, this feature can be exploited as electrons and cavity-photons are easily pulled away from their mutual equilibrium, even in the steady state. This offers new routes for a non-invasive control of material properties and functionalities. We show that the absence of thermal equilibrium between electrons and photons leads to reduced symmetries of the steady-state electronic distribution function. Furthermore, I will mention our recent results to extend the theory of the Eliashberg effect, originally developed for superconducting phases, to charge-density-wave phases in the presence of a cavity.

[1] R. Flores-Calderón, M.M. Islam, M. Pini, F. Piazza, Phys. Rev. Research 7, 013073

[2] M.M. Islam, M. Pini, R. Flores-Calderón, F. Piazza, https://arxiv.org/abs/2509.07865