Dissipative realisation of η-pairing in multimode cavity QED

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Markovian dissipation has been predicted to lead to steady states with off-diagonal long-range η-pairing order in the Hubbard model [1, 2]. Building on this idea, we propose a concrete implementation using a Fermi gas confined in a two-dimensional optical lattice and coupled to a near-confocal, multimode cavity. This configuration enables site-resolved spin–photon coupling while suppressing photon-mediated long-range interactions characteristic of conventional cavity-QED systems [3]. I will discuss how the proposed quadruple-Λ Raman coupling scheme can realise effective dissipation for the matter degrees of freedom and explore how multimode-mediated interactions can be tuned to access both Markovian and non-Markovian regimes of the dynamics. This work bridges theoretical advances in driven-dissipative quantum many-body physics with functionalities offered by the multimode cavity-QED platform, paving the way toward experimental realisations of a dissipatively stabilised long-range η-pairing order.

References

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