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Harvesting light with polaritons

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When placing an organic material inside an optical cavity, molecular and cavity mode excitations can hybridize into polaritons that provide the coupled system with new, sometimes enhanced, photochemical properties [1]. However, the mechanism by which the light-matter interaction changes the photochemistry of the molecules, remains unknown. Here, using molecular dynamics computer simulations, we demonstrate in atomic detail how collectively coupling a mixture of photoreactive and non-photoreactive molecules to a cavity can enhance artificial light harvesting in a way that resembles natural light-harvesting. Our results suggest that collective strong coupling not only enhances photon absorption but also provides a mechanism to transfer that photon into a photoreactive molecule and trigger the photochemical reaction that ultimately captures the energy in a chemical bond.

[1] F. J. Garcia-Vidal, C. Ciuti and T. Ebbesen. Manipulating matter by strong coupling to vacuum fields. Science, 373: eabd0336, 2021

Theme

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