# Superabsorption in an organic microcavity: towards a quantum battery

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The rate at which matter emits or absorbs light can be modified by its environment, as dramatically exemplified by the widely-studied phenomenon of superradiance. The reverse process, superabsorption, is harder to demonstrate due to the challenges of probing ultrafast processes, and has only been seen for small numbers of atoms. Its central idea—superextensive scaling of absorption meaning larger systems absorb faster—is also the key idea underpinning quantum batteries. Here we implement experimentally a paradigmatic model of a quantum battery, constructed of a microcavity enclosing a molecular dye. Ultrafast optical spectroscopy allows us to observe charging dynamics at femtosecond resolution to demonstrate superextensive charging rates and storage capacity, in agreement with our theoretical modelling. We find that decoherence plays an important role in stabilising energy storage, analogous to the role that dissipation plays in photosynthesis. Our work opens new opportunities for harnessing collective effects in light-matter coupling for nanoscale energy capture, storage, and transport technologies, including the enhancement of solar cell efficiencies.

[1] J. Q. Quach, K. E. McGhee, L. Ganzer, D. Rouse, B. W. Lovett, E. M. Gauger, J. Keeling, G. Cerullo, D. G. Lidzey, T. Virgili, Preprint arXiv:2012.06026 [quant-ph].