Guide-Slide Superabsorption with Condensed-matter Nanostructures

Author(s): William M. Brown & Erik M. Gauger
Institution(s): Institute of Photonics and Quantum Sciences
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Abstract: Inspired by natural photosynthetic complexes, we establish design principles for light-harvesting antennae whose energy capture scales superlinearly with system size. Controlling the absorber dipole orientations produces sets of “guide-slide” states that promote steady-state superabsorbing characteristics.

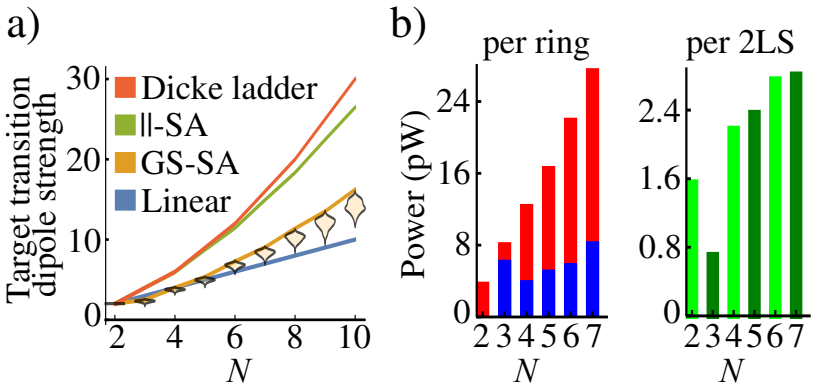
Schematic depiction of a guide-slide light harvesting ring antenna

Project Description

In this study, we tackle the challenge of overcoming the deleterious effect of (molecular and solvent) vibrations which tend to hamper the exploitation quantum-enhanced light-matter coupling in condensed matter settings.

We show that controlling the absorber dipole orientations in ring-like antennae produces sets of “guide-slide” states that promote steady-state superabsorbing characteristics , and that the effect proves to be robust to $\mathcal{O}(5\%)$ disorder simultaneously across for all relevant system parameters. This shows promise for experimental exploration in a broad range of platforms.

Key Results



a) Scaling of oscillator strength with system size, showing a super-linear increase for the superabsorbing ring antennae. **b)** Output (red) and input (blue) power for different system sizes. The green bars show the super-linear growth of net power per site.

Refs & links: *J. Phys. Chem. Lett.* 2019, 10, 15, 4323-4329. https://doi.org/10.1021/acs.jpclett.9b01349