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A model describing two-exciton effects in photosynthetic light-harvesting systems

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Abstract content
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In the light-harvesting apparatus of photosynthetic organisms, energy is transferred from captured photons to exciton states. These states, which are remarkably quantum in nature, are characterized by the sharing of an electronic excitation amongst different chromophore molecules. Energy can be passed coherently between two exciton states. Because of the presence of quantum coherence, energy can be transferred rapidly and very efficiently over large molecular distances; from the locus of photon capture to the reaction centre (where a spatial charge separation is achieved). In general, energy is transferred to the reaction centre so rapidly that only a single exciton exists in the light-harvesting system at a given time. Certain processes, however, like the annihilation of singlet excitation states by long-lasting triplet states, require a two-exciton description. We have set up a time-dependent, Redfield-type model that well-describes the time-evolution of single- and two-exciton states. This model will be discussed, as well as its application to real biological systems.

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