Superradiance at the localization-delocalization crossover in chlorosomes

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We study the effect of disorder on spectral properties of tubular chlorosomes, the main light-harvesting supramolecular structures in green sulfur bacteria. Employing a Frenkel-exciton Hamiltonian with diagonal and off-diagonal disorder consistent with spectral and structural studies, we analyze excitonic localization and spectral statistics of the chlorosomes. A size-dependent localization-delocalization crossover is found to occur as a function of the excitonic energy. The crossover energy region coincides with the more optically active states with maximized superradiance, and is, consequently, more conducive for energy transfer.