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Novel photo-protection mechanism in strongly coupled chlorophyll complexes: triplet excitons in chlorosomes and in artificial chlorophyll aggregates. SERGEI SAVIKHIN, HANYOUP KIM, Purdue University, HUI LI, JULIA MARESCA, DONALD BRYANT, The Pennsylvania State University — Bacteriochlorophyll (BChl) and chlorophyll (Chl) molecules are known to produce highly toxic singlet oxygen due to energy transfer from their excited triplet states to oxygen molecules. The monomeric (B)Chl molecules in a solution photodegrade within minutes under sunlight. In (B)Chl pigment-protein complexes of photosynthesis, a carotenoid is typically positioned within a distance of 4 Å of individual (B)Chl or antenna arrays, allowing rapid triplet energy transfer from (B)Chl to the carotenoid. Our time resolved and steady state optical experiments reveal that strongly coupled BChl arrays of pigments are inherently protected due to the formation of triplet excitonic states. According to model simulations, the energy of the triplet exciton is substantially lower than that of the triplet state of an individual BChl, dropping below that of singlet oxygen, and blocking the triplet energy transfer to both carotenoid and to oxygen. This effect is observed experimentally in photosynthetic chlorosomes and in artificial BChl complexes.

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