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Quantum Coherence in Photosynthetic Reaction Centers: A Quantum Heat Engine Perspective[1] ZIBO WANG, IMRAN MIRZA, Miami University, MACKLIN QUANTUM INFORMATION SCIENCES TEAM — Recent studies have suggested that the quantum effects can enhance the photosynthetic yield. In this work, we present a heat engine-based model of photosynthetic reaction centers. In our model, we consider three chlorophyll molecules, with two closely separated electron donor molecules and a single electron acceptor. In our heat engine, thermal light from the sun acts as a reservoir that promotes the excitation of the donor molecules. The electron transfer to the acceptor involves photon emission into a heat sink, while the useful work occurs during the deexcitation of the acceptor. Based on such a process, the reaction center can be configured as a five-level quantum system[2]. Recently, we have derived a master equation for our five-level system under the standard Born-Markov approximation. Next, we are planning to pay close attention to the quantum coherence terms in our master equation which can be held responsible for the enhancement of the photosynthetic yield.

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[2]K. E. Dorfman, D. V. Voronine, S. Mukamel, and M. O. Scully, "Photosynthetic reaction center as a quantum heat engine", PNAS, **110**, 2746-2751 (2013).

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