Lessons from nature about solar light harvesting and implications for energy harvesting

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Today, driven by the need for cheap and efficient solar power, we turn to photosynthetic organisms and their light-active supramolecular assemblies for bio-inspiration. In this talk I will explain what we have learned recently about the efficient and robust light-harvesting machinery of natural light-harvesting systems. Two-dimensional electronic spectroscopy experiments reveal the existence of coherence among vibronic levels in the initial response of light-harvesting proteins to femtosecond optical excitation. I will describe these recent experiments that reveal a potential role played by coherence, possibly quantum mechanical in nature, in light harvesting. Biological and chemical examples will be reported. While coherence effects may not profoundly change how efficiently light harvesting antenna systems gather excitation energy on average, they likely influence the underlying distribution of energy trapping times. Understanding and controlling these distributions may provide opportunities for quantum engineering in the design of artificial light-harvesting devices.