Shedding (Incoherent) Light on Natural Light-Induced Molecular Processes

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Molecular properties and molecule dynamics are often studied by time-dependent spectroscopies using ever-shorter laser pulses. Results from these studies are then used to describe light induced processes (e.g. radiationless transitions) under natural conditions. However, the molecular response to such coherent light pulses is dramatically different from that induced by natural incoherent sources such as sunlight. For example, processes induced by natural light (e.g. photosynthesis, vision) display complexities associated with molecular systems operating in steady state and coupled to both an irradiative bath as well as a thermal protein environment.

This talk will introduce computational tools and conceptual issues related to laboratory coherent vs. naturally-incoherent excitation of molecules relevant to energy transfer and to vision. Assorted problems associated with such systems, such as the presence or absence of stationary coherences, the generation of coherences under naturally slow turn-on of the radiation, rates of radiationless process under solar radiation, etc. will be discussed. The extent to which quantum mechanics is essential to these processes is introduced as an ongoing research challenge.