# From nano- to mesoscale quantum phenomenology in bioorganic materials

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Although many bioorganic systems and materials possess significantly disordered structures, they exhibit a remarkable capacity to facilitate processes in which the quantum properties of their constituent participants are manifest. Well-documented phenomena include electron [1, 2] and proton [3] tunneling, which is observed in many enzymatic catalytic processes. More contentious are proposals regarding coherent superpositions in various energy and electron transfer processes including: (1) excitonic states within biological photosynthetic antennae [4]; (2) superpositions within the singlet-triplet transition of cryptochrome proteins — a process sensitive to weak natural external magnetic fields [5]; (3) generation of delocalized excitonic states during energy dissipation in melanins [6]; (4) UV superradiance from tryptophane-containing biological architectures [7]. This lecture will have two parts. The first will review seminal experimental evidence that substantiates the occurrence of such quantum phenomena in biological systems. The second part will subsequently address contemporary questions concerning the emergence of quantum properties within complex systems [8]. It will also explore current and prospective applications that leverage the unique characteristics of living systems for the development of novel quantum materials [9, 10].

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