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Quantum Mechanisms of Electronic Signal Propagation Along a Microtubule[1] TRAVIS CRADDOCK, DOUGLAS FRIESEN, JACK TUSZYNSKI, University of Alberta — Evidence has been accumulating for the involvement of quantum coherence and entanglement in light harvesting photosynthetic complexes. This tests the adage that biological systems are too "warm and wet" to support quantum phenomena. Recent advancements in experiment and theory have allowed investigators to probe other warm systems for coherent phenomena including polymer chains, bacteriorhodopsin and ion channels. A debate has raged for over a decade regarding hypothetical quantum coherence/ entanglement in microtubules. Here we theoretically investigate coherent energy transfer in microtubules via dipole excitations coupled to the environment in networks of chromophoric amino acids. We present the spatial structure and Hamiltonian, containing localized site energies and couplings between aromatic amino acids, for the microtubule constituent protein tubulin. Energy transfer is discussed in terms of quantum walk formalism and energy transfer efficiency. Plausibility arguments are presented for the conditions favoring a quantum mechanism of electronic signal propagation along a microtubule.

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