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"Quantum Biology": How nature might be optimized to harness quantum mechanics

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Abstract

Accumulating experimental evidence suggests that quantum mechanical effects underlie how organisms function. "Quantum Biology" includes phenomena as varied as: magnetic field detection for animal navigation; metabolic and enzymatic regulation in cells; and optimal energy harvesting in photosynthesis. Unveiling such phenomena at all length scales (i.e., from the nanoscale to whole organisms) has remained a challenge, but can lead to the development of: biomimetic electromagnetic probes; room-temperature quantum computing architectures; improved photovoltaics; and novel therapeutics.

In this talk, I will review some of the evidence in support of these phenomena, besides discussing proposed underlying biophysical mechanisms and potential implications on human, plant and environmental biology. Can quantum mechanics be established – or refuted! – to account for physiologically relevant phenomena, and be manipulated to technological and therapeutic advantage? This is the exciting question that the field of "Quantum Biology" should aim to answer in the near future. I will argue that successful efforts in Quantum Biology will be contingent on interdisciplinarity, multi-scale approaches, and close theory-experiment collaboration.

Bio

Prof. Clarice D. Aiello is a quantum engineer interested in how quantum physics informs biology at the nanoscale. She is an expert on nanosensors harnessing room-temperature quantum effects in noisy environments. Aiello received her Ph.D. from MIT in Electrical Engineering and held postdoctoral appointments in Bioengineering at Stanford, and in Chemistry at Berkeley. She joined UCLA in 2019, where she leads the Quantum Biology Tech (QuBiT) Lab.