



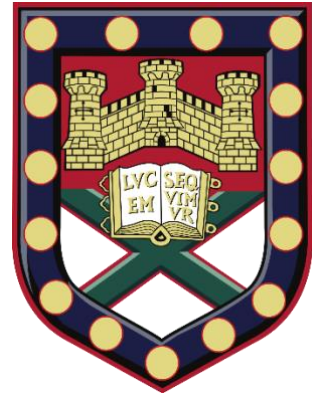
Quantum Biology of Magnetoreception

Nathan S. Babcock

N.S.Babcock@exeter.ac.uk

with Daniel Kattinig

Living Systems Institute / Department of Physics
College of Engineering, Mathematics, & Physical Sciences
University of Exeter, Devon, United Kingdom



Despite an established consensus that many forms of life can reliably detect the Earth's weak magnetic field, it is unclear how many complex organisms sense it [1]. Most prominent mechanistic proposals invoke a quantum-biological model [2], relying on the assumption that an excitonic “radical” electron pair [3] facilitates magnetoreception of the Earth's field (50 μ T).

Field-dependent decay products of this spin-crossing reaction are believed to constitute a decoherence channel to a signaling state that discriminates the field angle and inclination, yet essential details of the scheme are lacking. Comprehensive models of requisite activation [4-6], charge separation [7-8], chemical amplification [9-10], anisotropic response [11], coherence-preserving [12] and/or decoherence-limiting [13] steps are needed. Given the rich complexity of the biological *milieu* and lacking a consistent *in vitro* model, mechanistic features must be identified empirically in order to confirm a viable magnetic sense receptor.

In this seminar lecture, I review features of competing models of cryptochrome-based magnetoreception, in the context of existing theory and experiment. Seminar content will address recent conflicts [14-17] between evidences and conventional model proposals [18-19]. Implications of these conflicts will be explored in terms of an expanded model that involves the amplification of the spin-chemical effect—with an eye toward broad generalization of existing principles [20-23]. We assess criticism of models reliant on quantum entanglement in a dynamic environment at physiological temperature [24-28]. If time permits, we will discuss overall challenges facing a broad class of reaction schemes that depend upon coherent singlet-triplet interconversion to enable magnetoreception. In closing, we will consider how the engineering of biosynthetic systems [29] could enable new technologies with ramifications for metrology [30], magnetogenetics [31], and medicine [32].

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