Essential elements of photomagnetoreception in *Drosophila*

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Many animals can sense the Earth's magnetic field (MF) to aid with behaviours such as migration. It is proposed that MF can modulate the active concentration of the blue light photoreceptor, cryptochrome (CRY) [1]. In *Drosophila*, the active state of CRY correlates with the semiquinone radical of its flavin adenine dinucleotide (FAD) chromophore [2]. The canonical radical pair (RP) model of CRY-dependent magnetoreception involves magnetic effects on a spin correlated FAD / tryptophanyl RP following photoreduction of oxidised FAD following an electron transfer reaction within CRY [1]. Spectroscopic data from isolated animal CRY in solution suggest this RP is born in the singlet spin-state [3,4].

Despite numerous theoretical, spectroscopic and animal behaviour studies, several questions remain. What is the nature of the magnetically-sensitive RP *in vivo* and how is it made? How does a magnetic effect on a protein result in a behavioural response? What is the precise role of CRY? In contrast to migratory birds, the fruit fly, *Drosophila melanogaster*, represents a genetically-tractable *in vivo* model with which we can begin investigating such questions [5]. We have previously reported effects of MF on neuronal activity in *Drosophila* that are ostensibly CRY-dependent [6,7]. These studies suggest a critical role for the CRY C-terminal tail (CTT) in transducing the magnetic signal and the observed effects are most straightforwardly explained by a triplet-born RP. More recently, we have made the striking observation that the 52 C-terminal (CT) amino acids of CRY, which include the CTT but are missing the FAD binding domain, are sufficient to facilitate magnet responses at both the single neuron and organismal level [8]. These effects are enhanced by the addition of free FAD, but not riboflavin, which lacks the ability to autoreduce following intramolecular electron transfer.

I will discuss the implications of these findings on the possible nature of the RP, the signal transduction mechanism, and the likely role of CRY.

References

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