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Resonance effects indicate radical pair mechanism for avian magnetic compass

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Migratory birds possess a physiological magnetic compass that helps them to find north during their migratory flights, but the mechanism underlying this ability is not understood. In vitro experiments show that two types of mechanisms are in principle capable of detecting earth-strength magnetic fields in biological systems: the use of biological magnetic materials such as magnetite crystals, or magnetically sensitive chemical reactions. We have recently demonstrated that oscillating magnetic fields can provide a viable diagnostic test to identify the existence of a radical-pair mechanism as they will not affect the properties of magnetite-based sensors, but disrupt a radical-pair based mechanism through resonance effects. European robins, a species of migratory birds, were disoriented in a magnetic orientation test when a very weak (100 nT) oscillating field of 1.3 or 7 MHz was added to the geomagnetic field. Moreover, the effect of the oscillating field depended on the alignment of oscillating field with the geomagnetic field and showed an intensity dependence consistent with theoretical expectations from the radical pair mechanism, thereby providing evidence for the existence of a radical-pair mechanism in birds. We will discuss future avenues of research towards identifying not only the mechanism, but also the chemical nature of the receptors underlying magnetoreception, and in particular the photoreceptor chryptochrome, an emerging candidate for the long sought after magnetoreceptor.