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Spin Coherence in the Avian Magnetic Compass

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Abstract:

Most chemists and physicists would probably treat with scepticism the suggestion that a chemical reaction could respond to a magnetic field as weak as the Earth's. The energy of interaction of a molecule with a ~50 μT magnetic field is more than a million times smaller than the average thermal energy $k_B T$ at room temperature, which in turn is 10-100 times smaller than the strength of a chemical bond. It therefore seems inconceivable that the position of a chemical equilibrium or the rate of an activated chemical reaction could be significantly altered by such a minuscule perturbation. Nevertheless, it has been known since the 1970s that certain chemical reactions *are* magnetically sensitive. The key species are pairs of transient radicals whose electron-nuclear spin systems evolve coherently under the influence of internal and external magnetic interactions. I will discuss the hypothesis, for which there is growing support, that the quantum dynamics of radical pairs forms the basis of the magnetic compass sense of migratory birds.