Cavity-Enhanced Methods for Optical Detection of Magnetic Field Effects in Biological Systems

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The underlying physical mechanisms of magnetosensitivity in animals remain unclear, in part due to the lack of suitable techniques for detecting the tiny effects of magnetic fields on biological systems in solution. Experiments investigating magnetic field effects (MFEs) have traditionally used flash-photolysis transient absorption techniques to detect short-lived radical species which are hampered in their application to real biological systems by their requirement for large sample volumes (cm^3), high precursor concentrations (>μM), and high photolysis pulse energies, which lead to problems of photo-degradation. Here, we report on recent developments in our application of highly sensitive optical techniques to the detection of MFEs in solution. Two well-known cavity-based variants, Cavity Ring-Down Spectroscopy (CRDS) and Cavity Enhanced Absorption Spectroscopy (CEAS), have been adapted from their usual application in the gas phase and optimised for the study of condensed phase systems. In addition, a new instrument has been developed which harnesses the major advantages of both of these two powerful techniques. Optical Cavity-based Transient Absorption Spectroscopy (or OCTAS) combines the wide spectral coverage and high sensitivity of broadband-CEAS with microsecond time-resolution.