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Abstract – 2-Dimensional Electronic Spectroscopy (2DES) and ultrafast pump-probe spectroscopy on the light-dependent enzyme protochlorophyllide oxidoreductase (POR)

In photosynthesis, quantum coherence in light harvesting complexes could form the basis for the highly efficient propagation of excited states within the photosynthetic membranes of bacteria and plants. Additionally, recent work on Photosystem II reaction centres extends the possible relevance of electronic coherence to the photochemical steps of photosynthesis; it was shown that coherent states are sufficiently long-lived, at room temperature, to persist during the initial steps of electron transfer. This extension of quantum coherence, from the energy transfer to the energy trapping steps of photosynthesis, made it timely to find out if quantum coherence also plays a role in the formation of product states in enzyme catalysis. Given the short timescales involved it was necessary to study an enzyme where the catalytic cycle can be triggered by femtosecond light pulses, so protochlorophyllide (Pchlide) oxidoreductase (POR) was selected as an ideal model system. 2-dimensional electronic spectroscopy (2DES) was used to investigate the presence of quantum coherence in the intermediates of the light-dependent reduction of Pchlide to chlorophyllide (Chlide) catalysed by POR.