Coherent Control of Retinal Isomerization in Bacteriorhodopsin

R. J. Dwayne Miller
Institute for Optical Sciences
Departments of Chemistry and Physics
University of Toronto

Abstract: The primary processes of biological systems are best described within a quantum description that appropriately captures the wave properties of matter and importance thereof on the length scale of the reaction coordinate. It remains an intriguing question whether or not quantum coherence effects play a role in biological functions and to what degree. This question has been resolved to a certain degree by exploiting the pulse protocols of coherent control to essentially make a molecular interferometer on the molecular frame of reference to test the coherence properties of the reaction coordinate of retinal in bacteriorhodopsin. Not only have conserved coherence propagation been observed but the degree of intrinsic isomerization could be manipulated with shaped pulses using a genetic learning feedback. This finding is the first to fully demonstrate constructive and destructive interference pathways in biological systems and provides new fundamental insight into the transition state region of biological systems.