Quantum coherence in the dynamics of biomolecular excitons - revisited

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I will show how quantum coherence of biomolecular excitons is influenced by environmental noise stemming from polarization fluctuations of the solvent under ambient conditions and from the vibrational motion of the molecular backbone [1-4]. In particular, I will report recent theoretical and experimental results [5] on optical 2D photon echo spectra of the Fenna-Mathews-Olson complex at ambient temperature in aqueous solution. They do not provide evidence of any long-lived electronic nor strong vibronic quantum coherence, but confirm the orthodox view of rapidly decaying quantum coherence on a time scale of 60 fs under ambient conditions. Corresponding calculations at low temoerature yield a dephasing time of 120 fs at a temperature of 77 K. Our results can be considered as generic and give no hint that electronic quantum coherence plays any biofunctional role in real photoactive biomolecular complexes. Since this natural energy transfer complex is rather small and has a structurally well defined protein with the distances between bacteriochlorophylls being comparable to other light-harvesting complexes, we anticipate that this finding is general and directly applies to even larger photoactive biomolecular complexes.

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[5] Hong-Guang Duan, Valentyn I. Prokhorenko, Richard Cogdell, Khuram Ashraf, Amy L. Stevens, Michael Thorwart, and R. J. Dwayne Miller, Nature does not rely on long-lived electronic quantum coherence for photosynthetic energy transfer, submitted (2016), arXiv:1610.08425