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Indicators of quantum coherence in light-harvesting dynamics

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Characterizing quantum dynamics of electronic excitations in a variety of light-harvesting systems is currently of much interest [1]. In particular, it is important to identify measures that appropriately quantify the strength of coherent dynamics and its impact on different time scales of the light-harvesting process. In this talk I will discuss quantum transport performance measures that are defined based on the probability for the dynamics to successfully distinguish different initial photo-excitation conditions. I will also discuss how initial state distinguisability can provide information on spatially correlated phonon fluctuations as well as on the non-markovian character of the quantum dynamics. The prototype systems considered here are cryptophyte light-harvesting antennae isolated from marine algae [2, 3]. Experimental quantification of state distinguishability can be realized by monitoring the evolution of selected off-diagonal density matrix elements and therefore it could be achieved with current two-dimensional spectroscopy techniques.

[1] A. Olaya-Castro and G. D. Scholes, "Energy transfer from Förster-Dexter theory to quantum coherent light-harvesting", to appear in Int. Rev. Phys. Chem. (2010)
[2] E. Collini, C.Y. Wong, K.E. Wilk, P.M.G. Curmi, P. Brumer and G.D. Scholes, "Coherently wired light-harvesting in photosynthetic marine algae at ambient temperature" Nature, 463, 644-647 (2010)
[3] A. Kolli, A Nazir, F. Fassioli, R. Dinshaw, G D Scholes, and A Olaya-Castro, "Energy transfer dynamics in cryptophyte antennae proteins", submitted for publication (2010)