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Towards experimental verifications of the transport mechanisms in light-harvesting dynamics[1] F. CARUSO, S. MONTANGERO, T. CALARCO, S.F. HUELGA, M.B. PLENIO, Ulm Univ. — Recently, we identified the key mechanisms explaining the very- high efficiency and robustness of excitation energy transfer in bacterial photosynthesis, finding that dephasing noise may remarkably enhance the capability of transmitting energy (classical/quantum information) in light-harvesting systems (in communication complex networks [Caruso et al., PRL 2010]), by opening up additional transport pathways and suppressing the ineffective ones. To verify the relevance of such mechanisms in the actual bio-molecular systems, we propose how to gain control over the light-harvesting dynamics by using quantum optimal control tools. In this way, by means of optimally shaped and 'robust' laser pulses, we can: i) faithfully prepare the photosystem in some specific initial state (local site or coherent superposition, e.g. quasi-dark and -bright states), and ii) probe efficiently the dynamics, under realistic experimental conditions, i.e. sample of randomly oriented light-harvesting complexes and extra laser constraints related to an experiment in progress. These results could allow us to more easily discriminate the different transport pathways, to characterize the environmental properties, and so enhance our comprehension of coherent processes in biological complexes.

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