Motional effects on the efficiency of excitation transfer

Ali Asadian, Markus Tiersch, Gian Giacomo Guerreschi, Jianming Cai, Sandu Popescu, Hans J. Briegel

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Energy transfer plays a vital role in many natural and technological processes. In this work, we study the effects of mechanical motion on the excitation transfer through a chain of interacting molecules with application to the biological scenario of energy transfer in α-helices. Our investigation demonstrates that, for various types of mechanical oscillations, the transfer efficiency is significantly enhanced over that of comparable static configurations. This enhancement is a genuine quantum signature, and requires the collaborative interplay between the quantum-coherent evolution of the excitation and the mechanical motion of the molecules via their distance-dependent coupling; it has no analogue in the classical incoherent energy transfe This effect may not only occur naturally, but it could be exploited in artificially designed systems to optimize transport processes. As an application, we discuss simple and hence robust contro techniques.

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