QUENTRHEL- Quantum–coherent drive of energy transfer along helical structures by polarized light

Electronic energy transfer (EET) is a ubiquitous photophysical process that plays a crucial role in the light-harvesting capabilities of natural antenna complexes. Emerging experimental breakthroughs indicate that the dynamics of light harvesting is not fully described by a classical random-walk picture, but also quantum coherent transfer takes place. Interestingly, coherent EET processes were recently detected also in a conjugated polymer at room temperature, suggesting that coherent EET may play a key role in articial systems, as well. This suggests a new way to think about the design of future artificial photosynthetic systems and can potentially open a revolutionary avenue for the effective use of biological systems and conjugated polymers as quantum devices or resources for quantum information processing.
The main goal of the project is to give an important contribution in this breakthrough field, looking for a piece of information still missing: the possible presence of a relation between structure and coherent mechanisms. The main challenge is to develop new spectroscopic tools able to unveil the presence and the nature of vibrational modes acting during the energy migration and possibly driving coherent mechanisms. To this aim, a new 2D technique is proposed, which merges together the sensitivity of circular dichroism to structural deformations and the power of 2D photon echo in detecting coherent effects. Instead of natural light-harvesting antennae, the objects of this project will be model systems, more stable and easier to manipulate and modify ad hoc. The attention will be mainly focused on multichromophoric systems with helical arrangements because they mimic a ubiquitous motif that nature exploited to develop highly efficient EET. The helical core can act indeed as a wire, directionally driving the energy migration and, perhaps, preserving long-lived coherences.

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