



PhD Thesis Defense ROBERTO DE J. LEON-MONTIEL 'Quantum-Based Spectroscopy and Efficient Energy Transport with Biomolecules'

ROBERTO DE J. LEON-MONTIEL

September 30, 2014

Tuesday September 30, 12:00. ICFO Auditorium

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Quantum Engineering of Light

ICFO-The Institute of Photonic Sciences, SPAIN

For many years, the fields of quantum optics and biology have rarely shared a common path. In quantum optics, most of the concepts and techniques developed over the years stand for systems where only a few degrees of freedom are considered and, more importantly, where the systems under study are assumed to be completely isolated from their surrounding

environment. This situation is far from what we can find in nature. Biological complexes are, by definition, warm, wet and noisy systems subjected to environmental fluctuations, where quantum phenomena are unlikely to be observed. Notwithstanding, in recent years, this paradigm has begun to be questioned by several works where quantum-mechanical concepts have been introduced in order to describe the dynamics of important biological processes, such as energy transport in photosynthetic light-harvesting complexes.

The goal of this thesis is twofold. Firstly, we will investigate how ideas and techniques routinely used in quantum optics can be exploited in order to develop new quantum-based spectroscopy techniques and, secondly, we will examine to what extent microscopic quantum phenomena could impact on the efficient transport behavior of photosynthetic light-harvesting complexes. This problem is particularly relevant, because the understanding of the fundamental mechanisms that enable the highly efficient transport of energy in photosynthetic systems could lead us to the design of future quantum-inspired light-harvesting technologies, such as high-efficiency organic solar cells.

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Thesis Advisor: Prof. Juan Perez-Torres

