Contribution ID : **40** Type : **not specified**

From cooperativity in photosynthetic antenna systems to bio-mimetic sunlight pumped lasers

Quantum Biology is a research field that studies the role of Quantum Mechanics in biological systems, such as light-harvesting complexes (LHCs), and aims to develop quantum devices capable of operating at room temperature, such as photon sensors and bio-inspired sunlight-pumped lasers. Large-scale simulations of LHCs found in Green sulfur bacteria (GSB) and Purple bacteria (PB), which include more than 100000 bacteriochlorophyll molecules, have been performed. Using a non-Hermitian Hamiltonian approach, widely known in the field of Quantum Optics, we have analyzed LHCs of PB and GSB beyond the small-volume limit. These systems show the ability to support macroscopic coherent states, i.e. delocalized excitonic states coherently spread over many molecules even at room temperature. This macroscopic coherence emerges from the interplay between geometry and cooperativity (superradiance). Superradiance is crucial for an enhanced efficient energy transfer to the reaction center (RC), where charge separation occurs with almost 100% internal efficiency. Our findings offer deeper insights into natural photosynthetic processes and could inspire a new proposal of bio-inspired sunlight-pumped lasers. This new design could achieve the lasing condition even under natural sunlight and can be considered a significant step forward clean energy production.

Role

Master/PhD student

Primary author(s) : VALZELLI, Alessia (Università di Firenze)

Presenter(s) : VALZELLI, Alessia (Università di Firenze)