

# **Robustness of Collective Properties to Disorder: The Case of Superradiance. Applications to Light Harvesting Systems**

*Luca Celardo (Catholic University in Brescia, Italy)*

Open quantum systems are at the center of many research fields in condensed matter physics. We will introduce the non Hermitian Hamiltonian approach to open quantum systems, showing that this approach, in its simplest form, can be viewed as an extension of the Fermi Golden Rule. This approach allows to take into account the effect of the opening beyond the perturbation limit, where novel collective effects can arise. As an example of quantum collective property we consider here single excitation Superradiance. Among the many fascinating aspects of these properties, one important open question regards their robustness to the effects induced by the presence of an environment. This robustness might enable to exploit coherent quantum effects to build quantum devices for information technologies and basic energy science. Indeed, evidence of quantum coherent effects has been recently found in photosynthetic light-harvesting systems, and in other biological systems, even at room temperature. These findings raise many questions: how Nature can preserve quantum coherence in macromolecules in a wet and hot environment? What is the functional purpose of quantum coherence in Natural systems? We will investigate these questions using some realistic models of photosynthetic complexes.