Light Harvesting in Plants: Energy Transfer and Capture in Photosystem II

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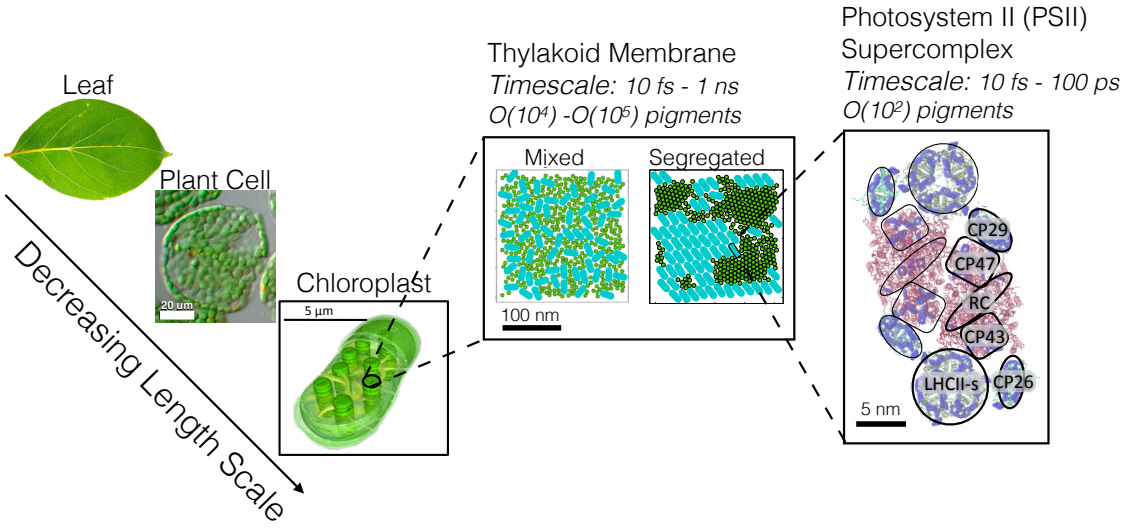

In this talk, we will present the first structure-based model of excitation energy transport (EET) within intact, photosystem II (PSII)-containing thylakoid membranes. As a result of the large number of pigments contained within the thylakoid membrane O(10^4), it is not feasible to simulate the EET using numerically exact methods, such as Hierarchical Equations of Motion. To address this challenge, we used the Modified Redfield/Generalized Forster method in combination with a novel approach for defining chlorophyll domains that optimizes the separation of timescales between intra- and inter-domain transport. Excitation dynamics can be coarse-grained at the domain level, resulting in a inhomogeneous-realization independent basis set for population transfer. We used this method to demonstrate, for the first time, that a single set of charge separation parameters and EET dynamics could simultaneously describe the fluorescence decay spectra for different PSII supercomplexes. We extended this framework to describe EET in the thylakoid membrane and revealed a diffusive picture of energy transfer. We will conclude by discussing the relevance of the resulting EET model for our understanding of the biological function of the thylakoid membrane in both its light harvesting and photoprotective states.