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Efficiency of excitation dynamics and regulation ability in photosynthetic light-harvesting

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In photosynthesis the light-harvesting complexes are responsible for efficient excitation delivery to reactions centers responsible for conversion of the absorbed energy into the trans-membrane potential. However, in plant photosynthesis, the light-harvesting antenna plays an additional role - to control the excitation density in oxygen evolving PSII. Indeed, this physiologically important strategy evolved by plants is responsible for a rapid regulation of excitation density at high light conditions known as the so-called non-photochemical quenching (NPQ) of excitations. Despite recent extensive discussions about the origin of the NPQ, a common agreement has not been achieved so far. The possible mechanisms caused by intermolecular resonance interaction between chlorophyll and carotenoid molecules and specificity of the excitation relaxation in the NPQ conditions will be considered. A special attention will be paid to the possible role of coherence in the intermolecular interaction between chlorophylls and carotenoids. The role of coherence in excitation dynamics and its influence on the efficiency of energy transfer and photo induced charge separation in molecular complexes is also intensively discussed during the last years. This discussion originates from two-dimensional (2D) coherent electronic spectroscopy data, which recently demonstrated the oscillatory behavior in the 2D spectra of various molecular systems. However, it still remains unclear what is actually being observed: Either excitonic and/or vibrational wavepacket motion. The possibility to distinguish between the excitonic or vibrational origin of these oscillations will be demonstrated. The experiments obtained for some photosynthetic light-harvesting complexes and reactions centers of photosystem II (PSII) from plants will be analyzed.

Biography

Leonas Valkunas has completed his PhD at the age of 27 years from Vilnius University. He is the Head of the Department of Theoretical Physics of Vilnius University and the Head of the Molecular Compounds Physics Department at the Center for Physical Sciences and Technology in Vilnius, Lithuania. He is the member of the Lithuanian Academy of Sciences. He has published more than 250 papers in reputed journals.

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