Femtosecond exciton dynamics in light-harvesting chromoproteins of cyanobacteria: energy transfer and quantum coherence

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Abstract: Phycobilisomes are antenna protein complexes in cyanobacteria and red algae. Energy transfer in phycobilisome is unidirectional with extremely high quantum efficiency close to unity. We investigate the constituent chromoproteins in phycobilisomes by two-dimensional electronic spectroscopy (2D-ES) to elucidate dynamics of efficient energy transfer. Both chromoproteins of allophycocyanin (APC) and C-phycocyanin (CPC) have similar adjacent pairs of pigments α84 and β84 which are excited to delocalized exciton states. However, the kinetics and coherence on energy transfer are significantly different between APC and CPC. In this presentation, quantum coherence in the biological system is glanced as an introduction. Then, the sub-10 fs visible laser system and the apparatus of 2D-ES in QST are explained. Subsequently, our recent results of dynamics (energy transfer and quantum coherence) in the proteins APC and CPC are shown with future perspectives.

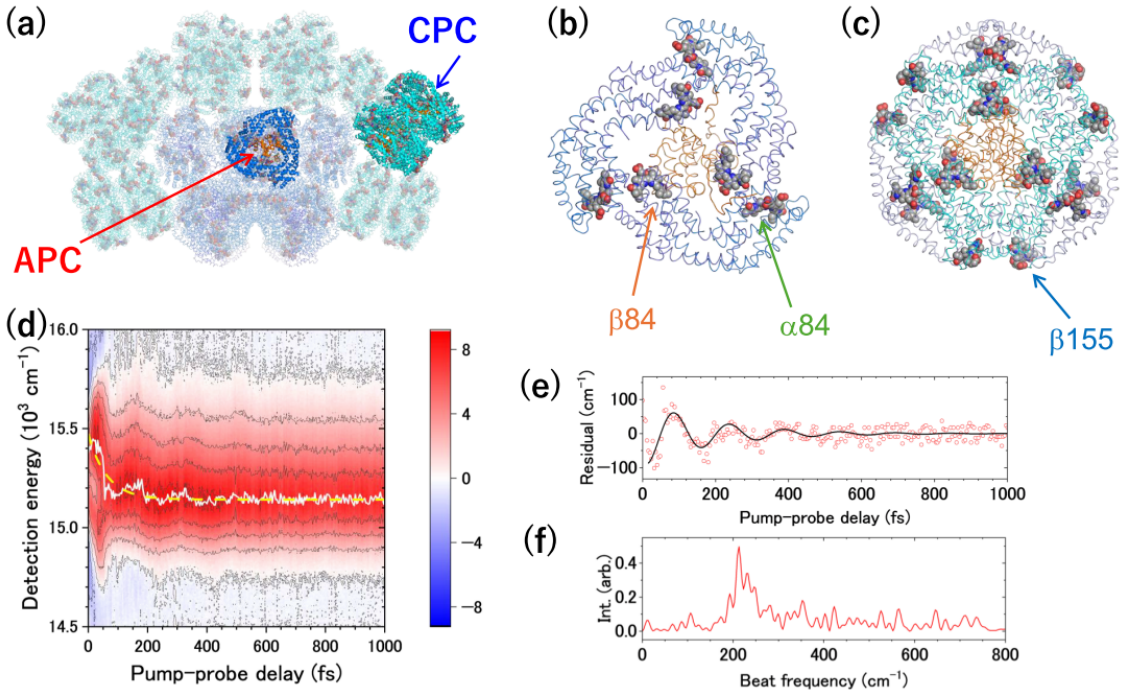

Figure 1. (a) Cryo-EM structure of Anabaena sp. PCC 7120 phycobilisome referred in this study. The APC and the CPC employed in this study are highlighted. (b) Structure of the APC trimer in which the pigments are shown by van der Waals representation. (c) Structure of the CPC hexamer. (d) Excitation energy selected time-resolved detection signal spectrum of APC at E_{ext} = 15500 cm^{-1}. (d) Oscillatory residual curve. (e) Fourier transformed spectrum of the residual time profile.