Revealing the lowest states in bacterial photosynthetic reaction centers

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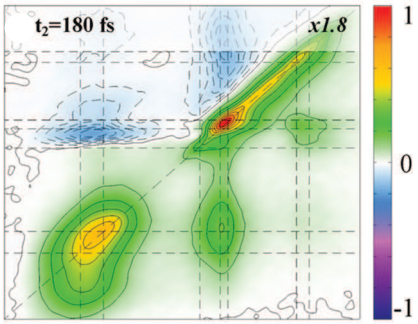
Photosynthetic reaction center (RC) is a protein-pigment complex where primary charge separation takes places. The general structural arrangement of RC is preserved throughout photosynthetic organisms. In all of the reaction centers the primary electron donor is the special pair of chlorophyll-type molecules. There are, however, uncertainties regarding the lowest energy states in bacterial RCs. It is tentatively assumed that the lowest state is an exciton state often coupled to a putative charge transfer state.



Absorptive 2D spectrum of purple bacteria RC at 77K.

Two-dimensional electronic spectroscopy (2DES) at cryogenic temperatures provides high spectral resolution of both excitation and detection frequencies. Unfolding spectral signatures in two dimensions and following their evolution in time enables unraveling otherwise congested transitions and excitation dynamics. We employed 2DES at 77 K to investigate the lowest states and their dynamics of the Q- type RC from purple non-sulfur bacteria [1] and FeS-type RC from green sulfur bacteria [2,3]. The picture that we uncover is more complex than what was thought before.

References:

[1] A. Vermeglio, G. Paillotin, BBA **681**, 32 (1982).

[2] G. Hauska, T. Schoedl, H. Remigy, G. Tsiotis, BBA **1507**, 260 (2001).

[3] J. Dostal, J. Psencik, D. Zigmantas, Natur. Chem. **8**, 705 (2016).