# SYMMETRY STRUCTURE OF THE ANTENNA SYSTEM IN PHOTOSYNTHESIS: COINCIDENCE OR CONSEQUENCE?

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The most important function of photosynthetic antenna is efficient light absorption and efficient energy transfer to a reaction center (RC) complex. The former is realized by a high molar extinction coefficient of pigments and/or a strong interaction between pigments, on the other hand, the latter, by an organized molecular structure and a vectorial energy flow to RC.

In the photosynthetic antenna system, a symmetric structure of pigment-protein complexes is frequently found. This structure insures enlargement of an optical cross section, however this structure does not insure a vectorial flow to a specific direction, thus a secondary modification or a new component is required for a directed flow.

In this study, we will discuss significance of the symmetry structure of antenna system in terms of necessity for function or consequence of phylogeny; we adopted phycobiliprotein as a model molecule and analyzed the dynamic structure by means of the normal mode analysis [1]. Phycobiliproteins are antenna of cyanobacteria and red-algae, and form the $C_3$ symmetry structure [2].

We estimated the correlative movement of individual amino acids and also displacement of those in the minimum energy conformation. On basis of the calculated correlative movement map, a dynamic structure of the proteins was extracted, which was very different from a static structure. Furthermore, it was shown that a specific (the N-terminal) part of the protein contributed to a stabilization of the whole structure and that a specific amino acid contributed to stabilization of the chromophore configuration and thus the optical properties of the pigment-protein complex. The N-terminal part also determined an angle for the $C_3$ symmetry. It is known that this part was introduced to the remaining part which keeps a globin fold. In this sense, addition of a specific part yielded a new protein which satisfied the symmetry structure and the optical properties necessary for a function.

On the basis of the above results and an evolutionary aspect of phycobiliproteins, a significance of the symmetry structure of the photosynthetic antenna systems will be discussed.

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