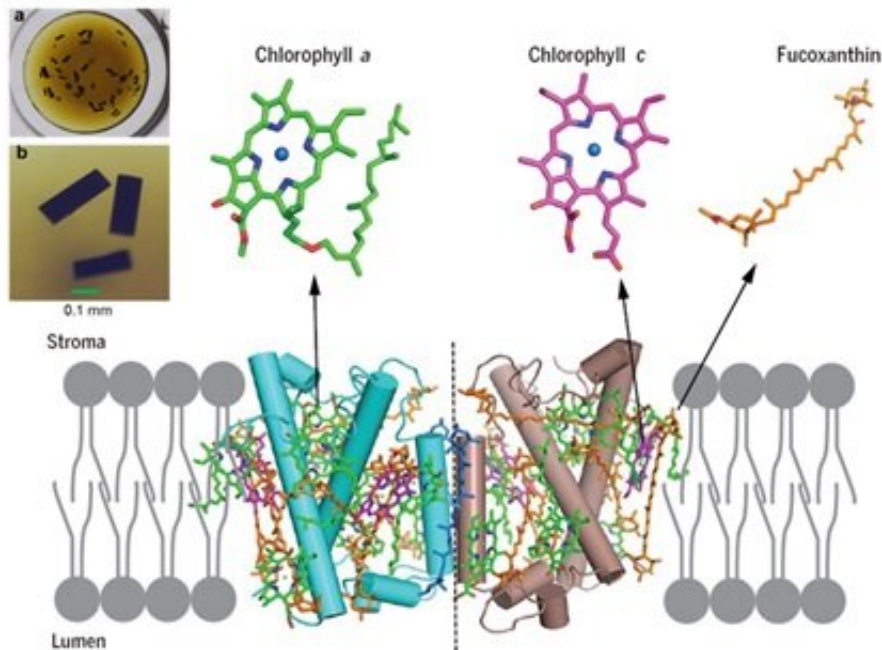


Basis of efficient blue-green light harvesting and photoprotection in diatoms revealed

February 12 2019



The crystals of FCP in an orange-brown color (left upside) and the structure of the FCP protein embedded in the thylakoid membrane of diatoms (middle)

Credit: SHEN Jianren

Diatoms are abundant photosynthetic organisms in aquatic environments; they contribute 20 percent of global primary productivity. Their fucoxanthin (Fx) chlorophyll (Chl) a/c-binding proteins (FCPs) have exceptional light harvesting and photoprotection capabilities. However, the structure of the FCP proteins and arrangement of pigments within

them remain unknown.

A research team from the Key Laboratory of Photobiology, Institute of Botany, Chinese Academy of Sciences, has solved the crystal structure of an FCP protein from a marine pennate [diatom](#) *Phaeodactylum tricornutum*. The study, titled "Structural basis for blue-green light harvesting and energy dissipation in diatoms," was published in *Science* on February 8, 2019.

The FCP membrane-protein was purified as a homodimer from *P. tricornutum* and crystallized. The structure was solved by X-ray diffraction at a resolution of 1.8 Å, which showed that each FCP monomer contains seven Chls a, two Chls c, seven Fxs, one diadinoxanthin (Ddx), two calcium cations and several lipid molecules.

Compared with light harvesting antennas from higher plants and [green algae](#), the number of Chls is much less, whereas that of Fxs is much larger in the FCP, resulting in a much higher Fx/Chl ratio. These features, together with the unique arrangement of pigments uncovered, indicates fast energy coupling of Chl c not only with Chl a but also with Fx.

Furthermore, each Fx is surrounded by one or more Chls, providing a basis for efficient energy transfer between them and also efficient dissipation of excess energy under high light conditions. The binding environment of the two end groups of each Fx showed different hydrophilicities within the protein scaffold, suggesting differences in their preferred absorption region of the blue-green light.

One Ddx molecule was assigned to a position close to the monomer-monomer interface with a weak electron density, suggesting its easy dissociation from the apoprotein and possible involvement in the Ddx-deepoxidation cycle that functions in excess [energy dissipation](#). "The

network of specific pigments demonstrated by the first and high-resolution FCP structure reveals a solid basis for blue-green light harvesting and super photochemical quenching in diatoms," said Professor Shen Jianren, a corresponding author of this study.

"This research provides a new model for theoretical simulations of photosynthetic [energy](#) trapping and transfer, and may also aid in designing photosynthetic organisms with enhanced [light](#)-harvesting and photoprotection capabilities," said Shen.

More information: Wenda Wang et al, Structural basis for blue-green light harvesting and energy dissipation in diatoms, *Science* (2019). [DOI: 10.1126/science.aav0365](https://doi.org/10.1126/science.aav0365)

Provided by Chinese Academy of Sciences

Citation: Basis of efficient blue-green light harvesting and photoprotection in diatoms revealed (2019, February 12) retrieved 26 April 2024 from <https://phys.org/news/2019-02-basis-efficient-blue-green-harvesting-photoprotection.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.