Phycobilisomes' secret life unravelled with single molecule spectroscopy

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1. Introduction

In many strains of cyanobacteria, phycobilisomes (PBs) absorb light and transfer excitations to the photosystems. In PBs from Synechocystis PCC6803, 396 identical pigments are bound to the protein subunits that differ in their optical properties due to various pigment-protein interactions. This tuning makes PBs efficient in transferring energy from the rods to the core and finally to the photosystems.

2. Results

Recently, single molecule spectroscopy has revealed the spectroscopic dynamics of PBs [1,2,3]. We performed our SMS measurements using physiologically relevant light intensities and discovered a novel type of photoprotective mechanism. This mechanism is light-activated and does not require interactions with other proteins. Switching between thermal energy dissipative and light-harvesting states involves a conformational change [1].

At the single-molecule level, we have also investigated the main cyanobacterial photoprotective mechanism, involving the orange carotenoid protein (OCP) [4]. By controlling the interaction between individual PBs and single OCPs, we revealed an intermediate state of energy quenching signifying the docking of OCP on a PB. In this intermediate state, some of the rods temporarily disconnect from the core and a hidden red state is exposed [4].

Not all hidden states of PBs are quenched [5]. The isolated rods of PBs can assume two different states, both of which are possibly involved in energy transfer to the photosystems. While one of these states fits the well-established model of energy transfer in PB, the other state is characterized by red-shifted emission and most likely involved with energy transfer to photosystem I [5].

3. References

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