**Exploring light-driven dynamics of phycobilisomes**

**Gonfa Tesfaye Assefa1, Michal Gwizdala1,2 and Tjaart P. J. Krüger1,2**

I Department of Physics, University of Pretoria, Lynnwood Road, Pretoria 0002, South Africa

2 Forestry and Agricultural Biotechnology Institute, University of Pretoria, Lynnwood Road, Pretoria 0002, South Africa

Email: tesfaye.gonfa@up.ac.za

1. **Introduction**

Phycobilisomes (PBs) are large (1-3 MDa) light-harvesting complexes in cyanobacteria and red algae. The PBs of *Synechocystis* PCC6803 bind exclusively phycocyanobilin pigments – 396 per complex. *Synechocystis’* PB has six cylindrical peripheral rods radiating from the tricylindrical core attached to the thylakoid membranes. Specialized pigments located in the basal cylinders of the core, called terminal emitters (TEs), collect the energy absorbed by the PBs and transfer it to Photosystems I and II. Most of the fluorescence emission from the isolated PBs comes from the TE pigments, emitting at ~680 nm.

1. **Results**

PBs regulate energy transfer upon illumination by switching between bright emissive unquenched states and dim quenched states [1]. The switching frequencies between quenched and unquenched states are affected by the intensity of excitation light. PBs tend to stay in their unquenched states at low-intensity light illumination, while at high energy influx, they are more likely to shift towards energy-dissipative, quenched states. In strongly quenched states, PBs dissipate up to 80% of the energy (unpublished work, Assefa *et al.*), and these states are related to quenching in TEs. A multi-state switching analysis of the fluorescence emission from individually complexes represents the total dynamics of the complexes. However, the fluorescence intensity dynamics involving strongly quenched states, which originate from the TE pigments, are best visualized using a two-state fluorescence intensity model [2]. In this work, two-state and multi-state models were applied to study the fluorescence emission dynamics of individually measured wild-type PBs (WT-PBs) and mutant PBs containing unpigmented ApcE subunits (C190S-ApcE-PBs). The results demonstrate a significant difference between the two-state emission dynamics of the two PBs. This can be explained by C190S-ApcE-PBs lacking the functionality of its unpigmented ApcE complex, thus reducing its dynamics. Multi-state dynamics of WT-PBs and C190S-ApcE-PBs were found to be the same. Our finding that the average dynamics of both PBs are identical is expected since C190S-ApcE-PBs lack only two ApcE pigments compared to a total of 396 pigments in fully assembled intact WT-PBs. Our results shed light on the important role of ApcE pigments in regulating the vital photoprotective function of PBs.

1. **References**

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