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Abstract

The bioenergetics of light-harvesting by photosynthetic antenna proteins in higher plants is well understood. However, investigation into the regulatory non-photochemical quenching (NPQ) mechanism, which dissipates excess energy in high light, has led to several conflicting models. It is generally accepted that the major photosystem II antenna protein, LHCII, is the site of NPQ, although the minor antenna complexes (CP24/26/29) are also proposed as alternative/additional NPQ sites. LHCII crystals were shown to exhibit the short excitation lifetime and several spectral signatures of the quenched state. Subsequent structure-based models showed that this quenching could be explained by slow energy trapping by the carotenoids, in line with one of the proposed models. Using Fluorescence Lifetime Imaging Microscopy (FLIM) we show that the crystal structure of CP29 corresponds to a strongly quenched conformation. Using a structure-based theoretical model we show that this quenching may be explained by the same slow, carotenoid-mediated quenching mechanism present in LHCII crystals.