qH-Energy Dissipation in Photosystem II Antennae

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Photoprotection includes several processes quenching chlorophyll fluorescence emission. Although short- or mid-term regulation is well-studied, we lack a detailed understanding of how photosynthesis acclimates to longer stress. The "sustained quenching" mechanism qH, for its induction and relaxation timescales of tens of minutes to hours, is independent of previously known regulatory proteins and triggers of energy dissipation. Its activation requires neither lumen acidification, nor xanthophyll pigments, or phosphorylation. Instead, several effectors have been described in Arabidopsis, whose exact role in qH remains to be characterized. These include the lumenal effector LCNP (LIPOCALIN IN THE PLASTID), SOQ1 (SUPPRESSOR OF QUENCHING 1), a membrane multi-domain protein that operates upstream of LCNP and prevents quenching, and ROQH1 (RELAXATION OF qH 1), a short-chain dehydrogenase-reductase.

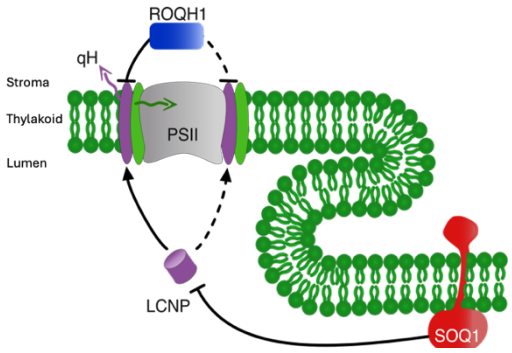

Figure 1: Schematic of qH working model. Green arrow, light harvesting; purple arrow, energy dissipation taking place in LHCII.

Recently, we have been investigating the targets and mechanism of qH combining genetics, biochemistry, and fluorescence studies, and showed that light harvesting complex II (LHCII) trimers, the major antenna of photosystem II (PSII), serve as a qH site. We now provide evidence that the minor, monomeric antennae of PSII can also be quenched in qH-active conditions and may represent a secondary target in cases of LHCII depletion or stress persistence.

Further, we aimed to characterize the qH-quenched state in LHCII antennae by combining structural biology, biophysical and biochemical approaches on isolated particles. The results exclude the occurrence of a substantial conformational change in qH-quenched particles. They rather point at a small, yet unidentified modification of a subpopulation of antennae affecting the environment of the neoxanthin pigment and surrounding cluster of chlorophylls, enhancing charge-transfer and blinking in the quenched particles.