Characterization of Steady-State P800 Oxidation Kinetics: Evidence that Heliobacterial Phototrophy is Light-Limited

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During constant illumination with orange light, spinach chloroplasts, cells of *Synechococcus sp. PCC 7002*, and cells of *Heliomicrobium modesticaldum* display a partial recovery after a large rapid absorbance change. Under constant illumination with red light, the recovery phase of spinach chloroplasts and *Synechococcus sp. PCC 7002* is lost while kinetics remain nearly constant *H. modesticaldum*.

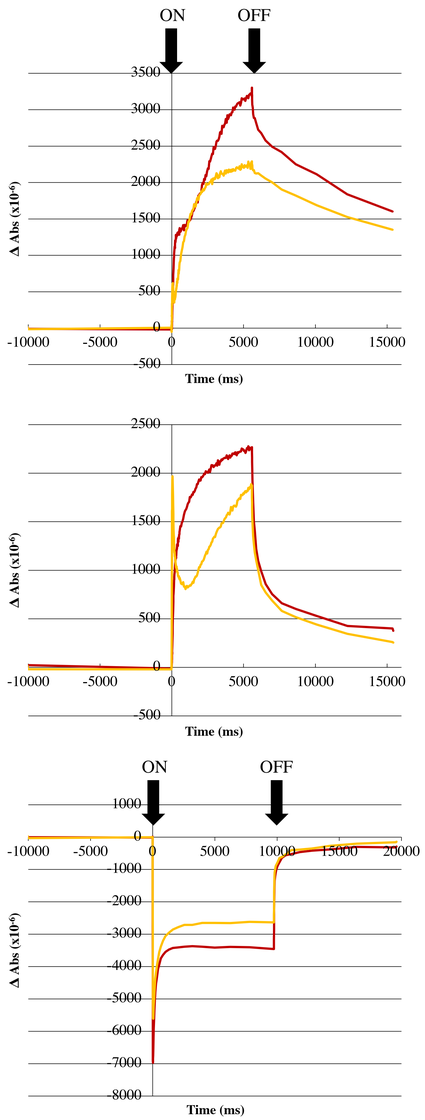
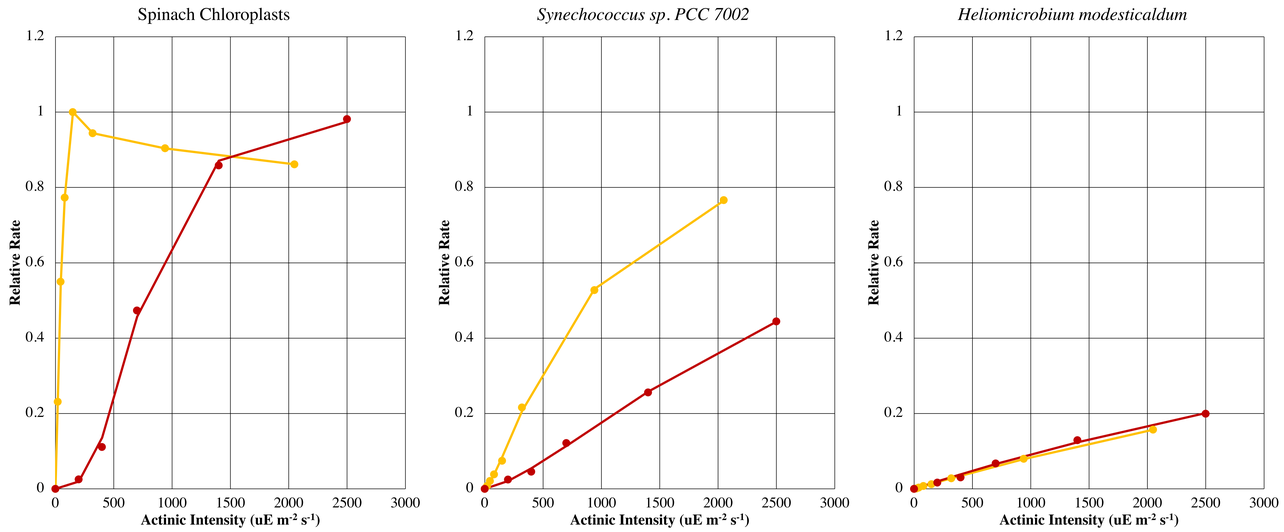


Figure 1. Light-induced absorbance changes of spinach chloroplasts *(top)*, *Synechococcus sp. PCC 7002* whole cells *(middle)*, *Heliomicrobium modesticaldum* whole cells *(bottom)*. Actinic illumination, provided by red LEDs centered at 720 nm *(red traces)* or orange LEDs centered at 630 nm *(orange traces)*, is indicated by the arrows. 10 µs detection pulses were emitted every 50 µs – 100 ms centered at 820 nm *(top, middle)* or at 800 nm *(bottom)*.

While all phototrophs possess complex steady-state primary donor oxidation kinetics, the extremely limited light saturation profile and the effects of simple charged redox reagents demonstrate that **the heliobacteria are the only group of light-limited photosynthetic organisms.**



During constant illumination, cells of *H. modesticaldum* display a partial recovery after a large rapid bleaching at 800 nm. Charged oxidants inhibit the partial recovery, whereas charged reductants enhance recovery.

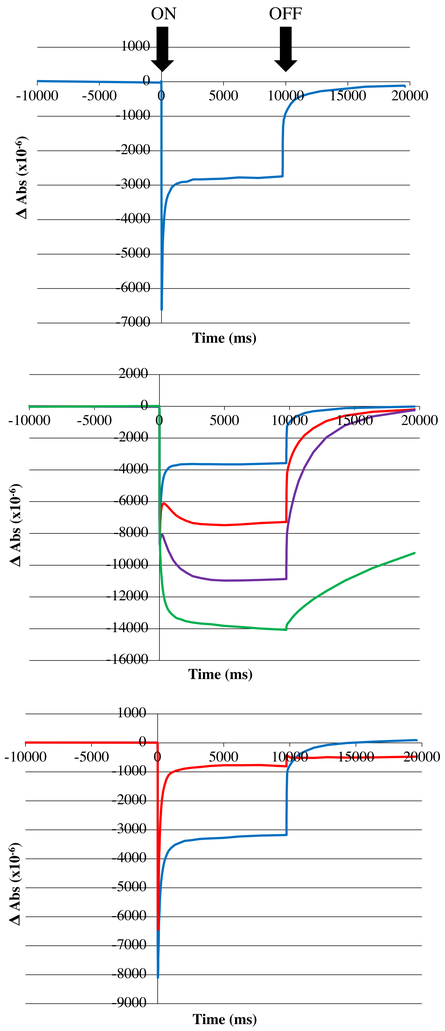


Figure 2. Light-induced absorbance changes of *H. modesticaldum* whole cells. Actinic illumination, provided by red LEDs centered at 720 nm, is indicated by the arrows. 10 µs detection pulses were emitted every 50 µs – 100 ms centered at 800 nm. *(Top)* Whole cells suspended in buffer alone. (*Middle)* Whole cells suspended in buffer (blue) supplemented with either 1.0 mM ferric nitrate (red), ferric ammonium citrate (purple), and cupric nitrate (green). *(Bottom)* Whole cells suspended in buffer (blue) supplemented with 1.0 mM sodium dithionite (red).