## Supplemental Information

This section contains (i) a graphical description of the multiple-LED set-up in Amsterdam, (ii) the SVD results of all experiments presented in the main text and (iii) the results obtained after analysis based upon our method for WT *Synechocystis* and the ΔPSI and ΔPSII mutants thereof both non-treated and in the presence of DCMU.

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| **A** | **B** |

Figure S 1 A) Schematic representation of the multiple-LED set-up in the LaserLab, in Amsterdam, The Netherlands. B) Spectra of the LEDs available. Key: *Gray:* White LED; *Blue:* 460 nm; *Orange:* 590 nm; *Red:* 640 nm; *Dark red solid:* White LED with a 695 nm filter; *Dark red thick:* White LED with a 715 nm filter; *Dark red dashed:* White LED with a 725 nm filter

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| Figure S 2 SVD of the time resolved spectrum of the WT *Synechocystis* cells during a saturation flash. a) first two left singular vectors u1(black) and u2 (red). b) first two right singular vectors v1(black) and v2 (red). c) scree plot |

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| Figure S 3 SVD of the time resolved spectrum of the ΔPSII mutant cells. a) first two left singular vectors u1(black) and u2 (red). b) first two right singular vectors v1(black) and v2 (red). c) scree plot. |



Figure S 4 SVD of the time resolved spectrum of the ΔPSI mutant cells. a) first two left singular vectors u1(black) and u2 (red). b) first two right singular vectors v1(black) and v2 (red). c) scree plot.



Figure S 5 SVD of the time resolved spectrum of the WT cells. a) first two left singular vectors u1(black) and u2 (red). b) first two right singular vectors v1(black) and v2 (red). c) scree plot.

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| **ΔPSII** **non-treated** |
| **ΔPSII** **DCMU** |
| Figure S 6 Full analysis of the time resolved fluorescence spectrum of **ΔPSII mutant** cells: non-treated (above), DCMU-treated (below); **A:** Estimated SAS1,ΔPSII (black) and SAS2,ΔPSII (red). **B:** the concentration profiles *c1* (black) and *c2* (red), the spikes are due to the saturation flashes; **C:** zoom into a region of **B**; **D:** the normalized difference spectrum between black and red SAS; **E:** sum of the concentrations **c**total; **F:** zoom into a region of **E**. See the main text for a detailed explanation of the non-treated panels. Transformation coefficients: non-treated: a12= 0.026, a21= 0.3 and a22= – 0.16 ; DCMU: a12= 0.026, a21= 0.3 and a22= – 0.16 |
| **ΔPSI** **non-treated** |
| **ΔPSI** **DCMU** |
| Figure S 7 Full analysis of the time resolved fluorescence spectrum of **ΔPSI mutant** cells: non-treated (above), DCMU-treated (below); **A:** Estimated SAS1,ΔPSI (black) and SAS2,ΔPSI (red); **B:** the concentration profiles *c1* (black) and *c2* (red); **C:** zoom into a region of **B**; **D:** the normalized difference spectrum between black and red; **E:** sum of the concentrations **c**total; **F:** zoom into a region of **E**. See the main text for a detailed explanation of the non-treated panels. Transformation coefficients: non-treated: a12= 0.055, a21= 0.32 and a22= – 0.45; DCMU: a12= 0.05, a21= 0.32 and a22= – 0.42 |

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| **WT****non-treated** |
| **WT** **DCMU** |
| Figure S 8 Full analysis of the time resolved fluorescence spectrum of **WT** **cells**: non-treated (above), DCMU-treated (below); **A:** Estimated SAS1,WT (black) and SAS2,WT (red); **B:** the concentration profiles *c1* (black) and *c2* (red), where, *c1*has been pulled to the front for better visibility of the first/last pulses; **C:** zoom into a region of **B**; **D:** the normalized difference spectrum between black and red; **E:** sum of the concentrations **c**total; **F:** zoom into a region of **E**. See the main text for a detailed explanation of the non-treated panels. Transformation coefficients: non-treated: a12=  0.16, a21= 0.51 and a22= –0.15; DCMU: a12= – 0.02, a21= 0.51 and a22= 0.33 |