Supporting Information

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SI Text

SI NPQ Calculation

NPQ is calculated using F_m, the fluorescence yield in the dark, and F'_m, the fluorescence yield after exposure to light:

$$NPQ = \frac{F_m - F'_m}{F'_m}. \quad \text{[S1]}$$

The fluorescence yield, F, is proportional to the integral of the time-resolved fluorescence, $F(t)$:

$$F \propto \int_0^\infty F(t)dt. \quad \text{[S2]}$$

Using the above definition for the fluorescence yield, and the definition for the average fluorescence lifetime (Eq. **2** in the main text), the amount of NPQ can be rewritten as follows:

$$NPQ = \frac{\tau_{avg,dark} - \tau_{avg,light}}{\tau_{avg,light}}. \quad \text{[S3]}$$

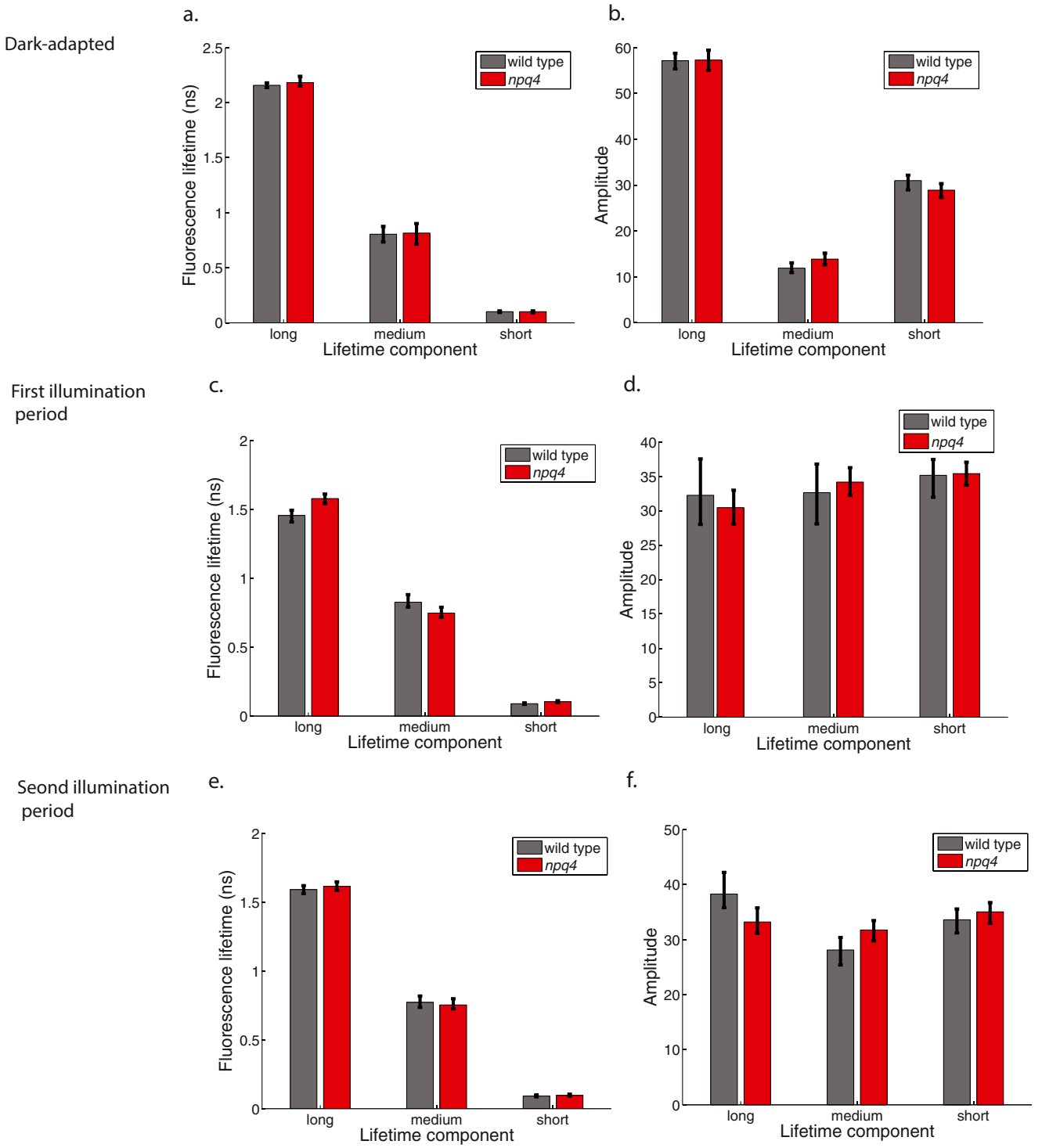

Fig. S1. The fitting parameters for fluorescence decay comparisons between wild type (gray) and *npq4* (red) are shown. The error bars reflect 1 SD. *A*, *C*, and *E* show the values for the long, medium, and short fluorescence lifetime decay components for comparisons between wild type and *npq4*, and *B*, *D*, and *F* show the associated amplitudes for the different fluorescence decay components. The comparisons between fitting parameters for dark-adapted leaves are shown in *A* and *B*. The comparisons between leaves during the first illumination period, after 30 s of illumination for wild type and 31.5 min of illumination for *npq4*, are shown in *C* and *D*. The comparisons between leaves during the second illumination period, after 3 s of illumination for wild type and 8 s of illumination for *npq4* are shown in *E* and *F*.

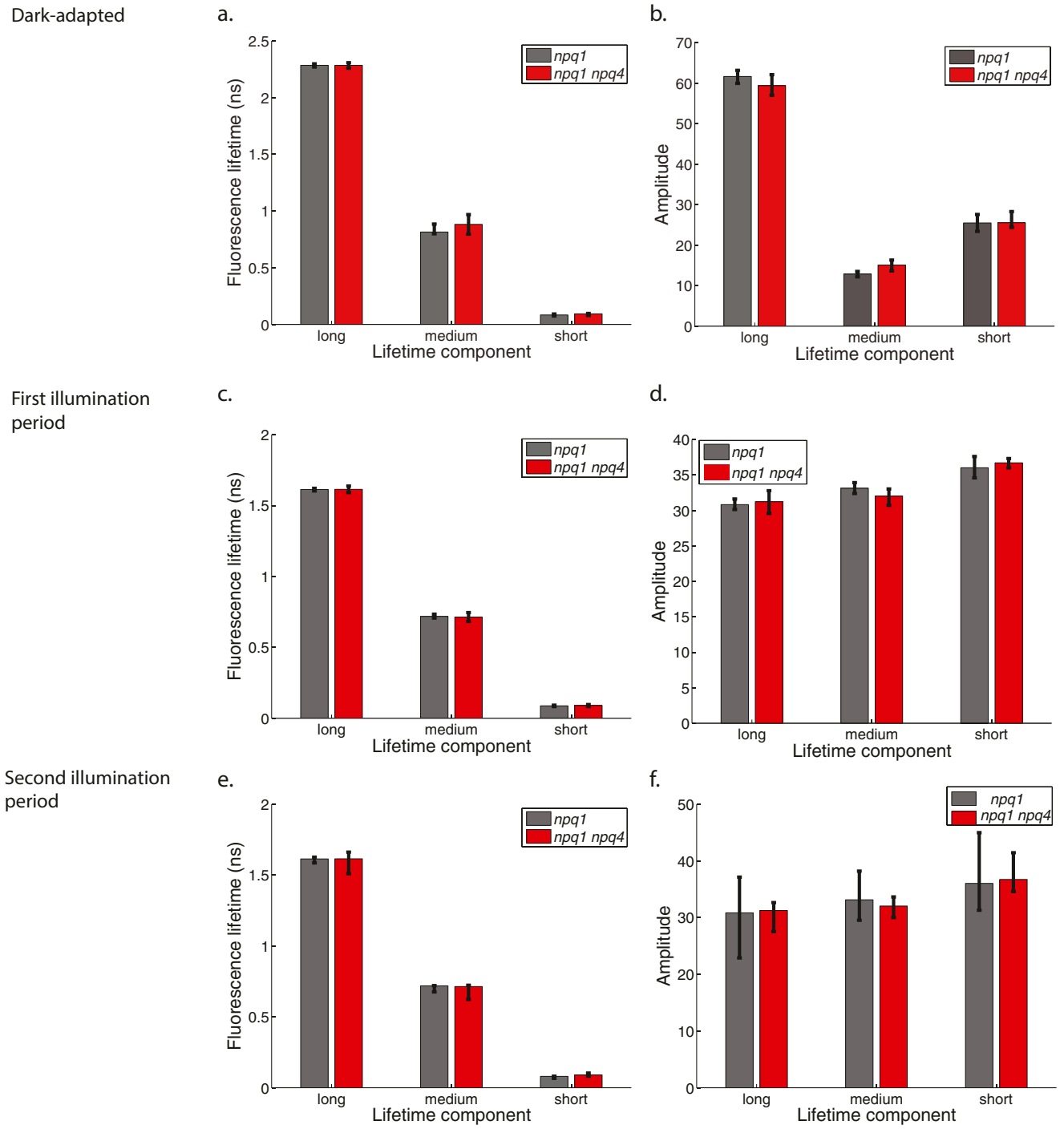

Fig. S2. The fitting parameters for fluorescence decay comparisons between *npq1* (gray) and *npq1 npq4* (red) are shown. The error bars reflect 1 SD. *A*, *C*, and *E* show the values for the long, medium, and short fluorescence lifetime decay components for comparisons between *npq1* and *npq1 npq4*. *B*, *D*, and *F* show the associated amplitudes for the different fluorescence decay components. The comparisons between fitting parameters for dark-adapted leaves are shown in *A* and *B*. The comparisons between leaves during the first illumination period, after 20.5 min of illumination, are shown in *C* and *D*. The comparisons between leaves during the second illumination period, after 2.5 min of illumination, are shown in *E* and *F*.

Table S1. Pigment analysis of wild type and *npq4*

Genotype	Light condition	Violaxanthin content, mmol per mol chl *a*	Antheraxanthin content, mmol per mol chl *a*	Zeaxanthin content, mmol per mol chl *a*
Wild type	Dark-adapted	48	0.8	0
	30 s of light	51	9.5	0
	30 min of light	20	9.1	21
npq4	Dark-adapted	54	2.7	0
	30 s of light	43	7.6	0
	30 min of light	20	13	21

Dark-adapted measurements are an average of two samples. Light-adapted measurements are from one sample.