

Supplementary Information

The role of mixed vibronic Q_y - Q_x states in green light absorption of light-harvesting complex II

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Supplementary Table 1. Fit Parameters for the peak amplitude dynamics provided in Fig. 2c, Fig 2f, and Fig. 3c

PA Component	$\omega_{det.} \text{ (cm}^{-1}\text{)}^a$	A_0	A_1	$\tau_1 \text{ (fs)}^b$	$\omega_1 \text{ (cm}^{-1}\text{)}^c$	$\varphi_1 \text{ (}\pi\text{)}^d$	A_2	$\tau_2 \text{ (fs)}^e$	$\omega_2 \text{ (cm}^{-1}\text{)}$	A_3	$\tau_3 \text{ (fs)}$
$\perp$	1690	0.42	--	--	--	--	--	--	--	--	--
$\parallel$		0.17	-0.01	140 $\pm$ 30	111 $\pm$ 7	0.7 $\pm$ 0.2	-0.001	--	240 $\pm$ 20	0.01	330 $\pm$ 120
$\perp$	1680	0.01	--	--	--	--	--	--	--	-0.01	600 $\pm$ 200
$\parallel$		0.19	-0.01	140 $\pm$ 30	90 $\pm$ 10	0.8 $\pm$ 0.3	--	--	--	--	--
$\perp$	1670	-0.93	--	--	--	--	--	--	--	-0.01	600 $\pm$ 200
$\parallel$		-0.56	-0.01	190 $\pm$ 30	106 $\pm$ 5	1.1 $\pm$ 0.2	-0.001	--	240 $\pm$ 10	--	--

^aExcitation frequency fixed at 17800 cm⁻¹.

^{b,c,d}Errors indicate 1 σ intervals.

^eDamping time unable to be fit precisely without smaller timesteps past 625 fs, but are likely >600 fs.

The fit function employed is given by:

$$f(t) = A_0 + A_1 \cos(2\pi\omega_1 t + \varphi_1) e^{-t/\tau_1} + A_2 \cos(2\pi\omega_2 t) e^{-t/\tau_2} + A_3 e^{-t/\tau_3}$$

convoluted with the instrument response function.

Supplementary Table 2. Fit Parameters for the frequency distribution dynamics along the excitation provided in Fig. 3g

PA Component	$\omega_{det.} \text{ (cm}^{-1}\text{)}$	$A_0 \text{ (cm}^{-1}\text{)}$	$A_1 \text{ (cm}^{-1}\text{)}$	$\tau_1 \text{ (fs)}^a$	$\omega_1 \text{ (cm}^{-1}\text{)}^b$	$\varphi_1 \text{ (}\pi\text{)}^c$	$A_2 \text{ (cm}^{-1}\text{)}$	$\tau_2 \text{ (fs)}^d$	$\omega_2 \text{ (cm}^{-1}\text{)}$
	1670	17821.70	-1.12	250±50	92±6	1.33±0.19	-0.14	--	240±20

^{a,b,c}Errors indicate 1 σ intervals.

^dDamping time unable to be fit precisely without smaller timesteps past 625 fs, but are likely >600 fs.

The fit function employed is given by:

$$f(t) = A_0 + A_1 \cos(2\pi\omega_1 t + \varphi_1) e^{-t/\tau_1} + A_2 \cos(2\pi\omega_2 t) e^{-t/\tau_2}.$$