Figure 1.

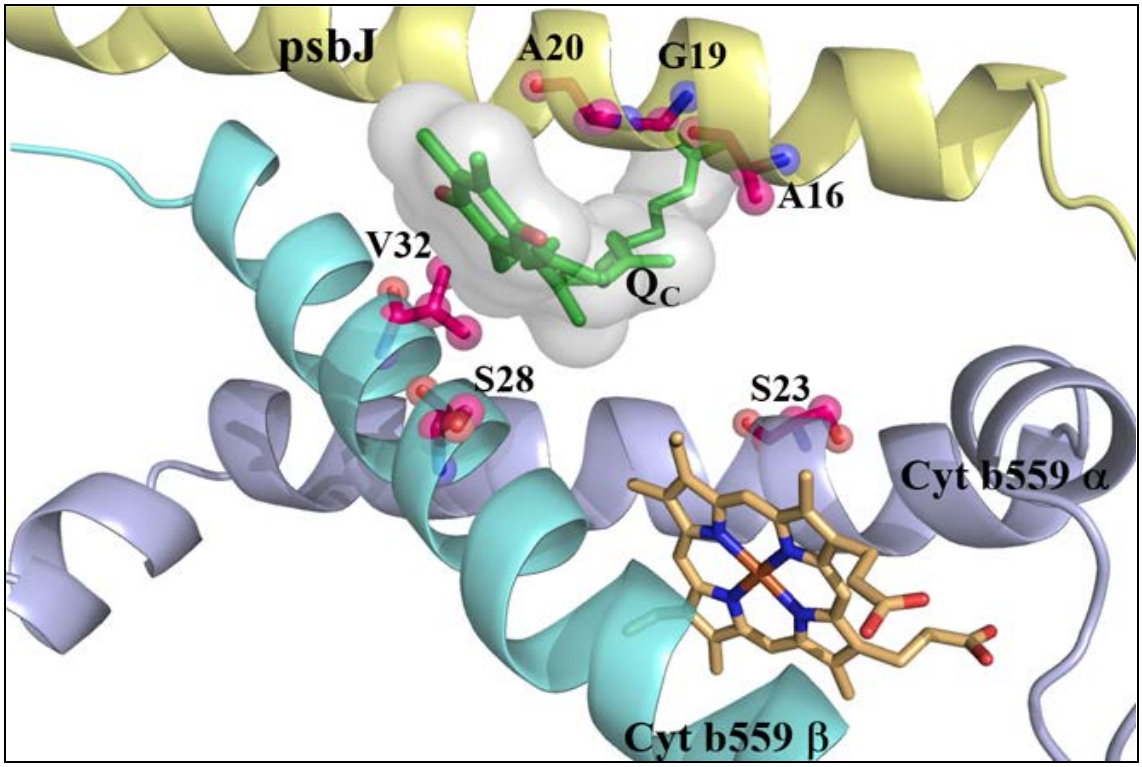


Figure 2.

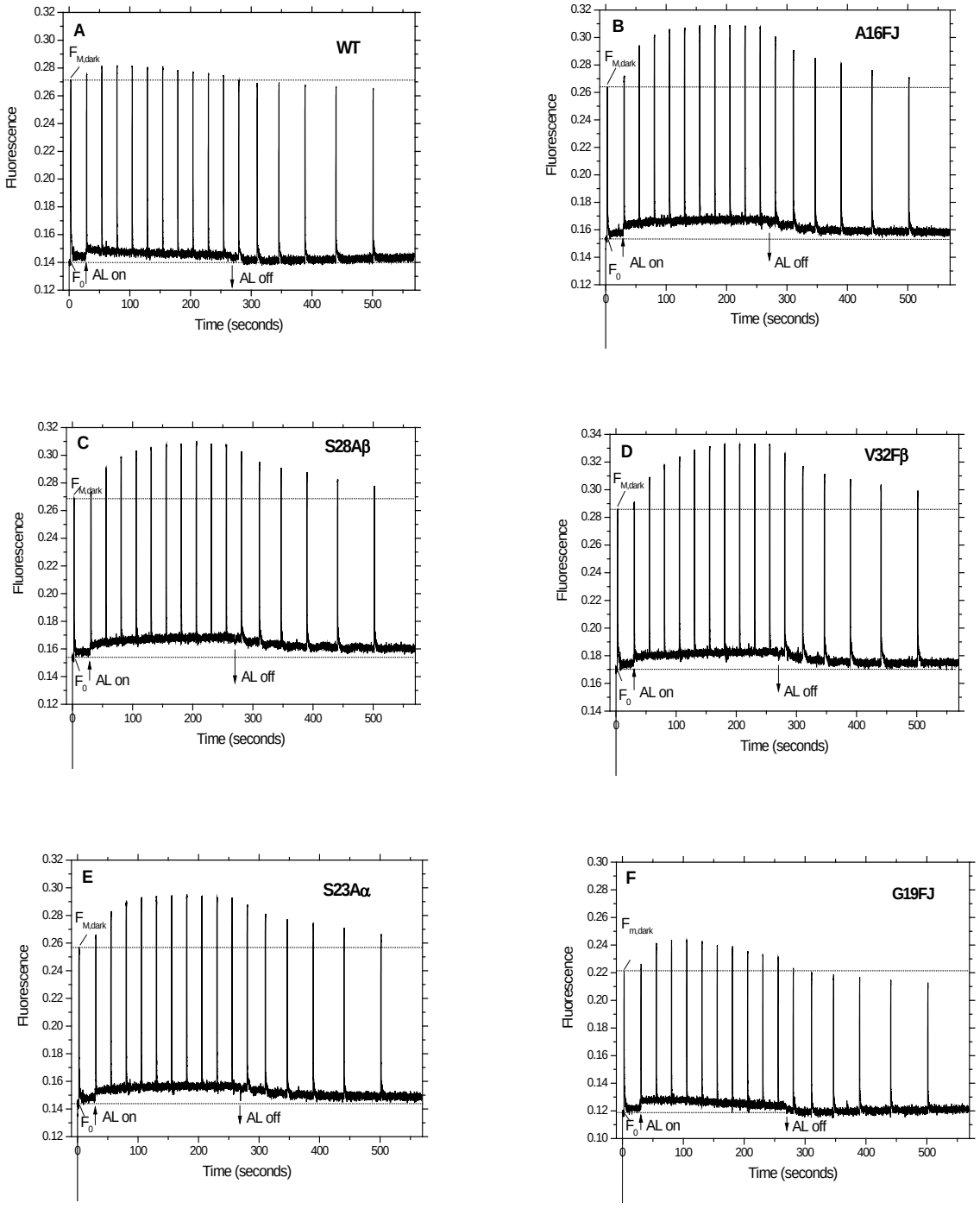

A
WT
B
A16FJ
C
S28Aβ
D
V32Fβ
E
S23Aα
F
G19FJ
Fluorescence
Time (seconds)
AL on
AL off

Figure 3

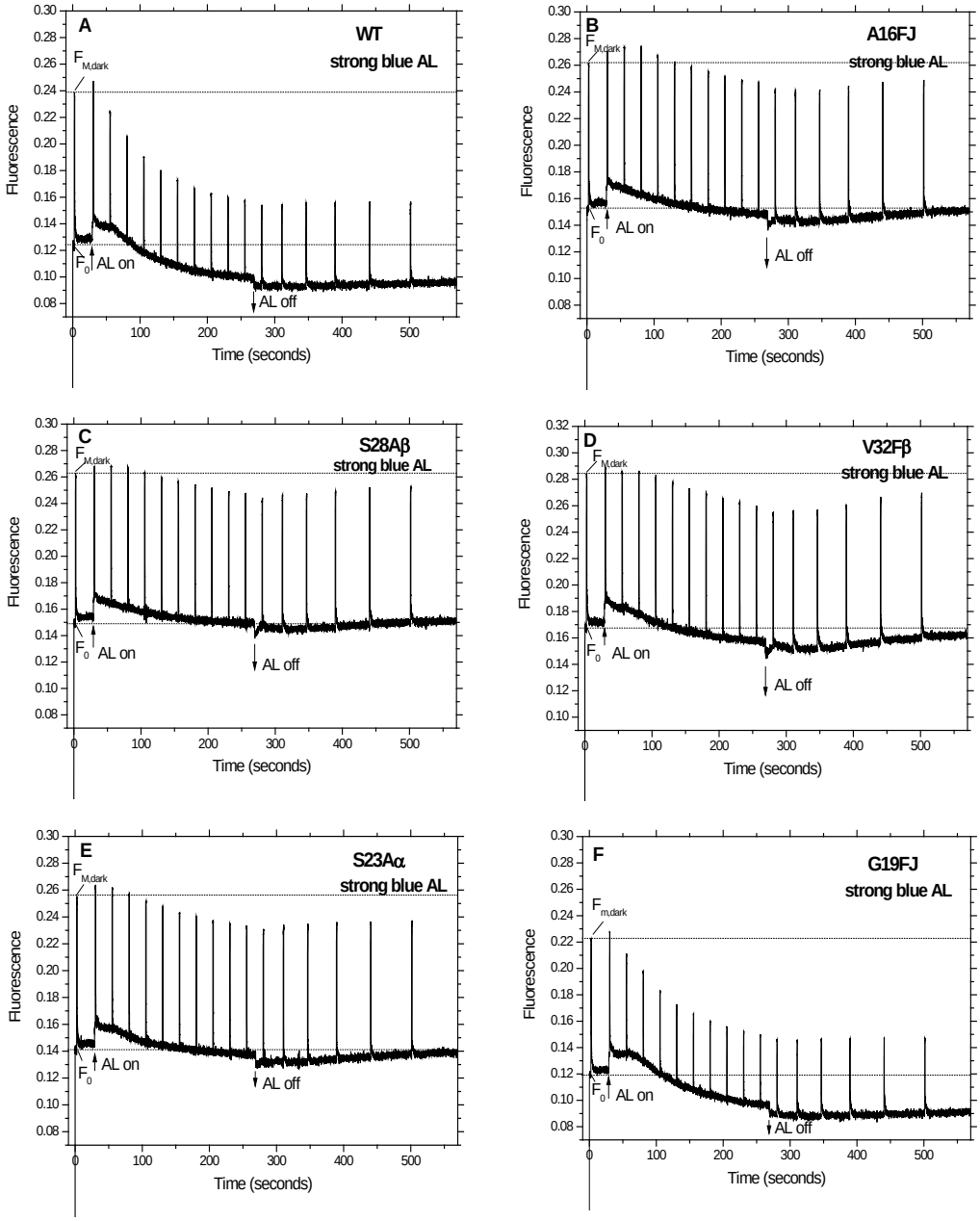

A
WT
strong blue AL
B
A16FJ
strong blue AL
C
S28Aβ
strong blue AL
D
V32Fβ
strong blue AL
E
S23Aα
strong blue AL
F
G19FJ
strong blue AL
Fluorescence
Time (seconds)
AL on
AL off

Figure 4

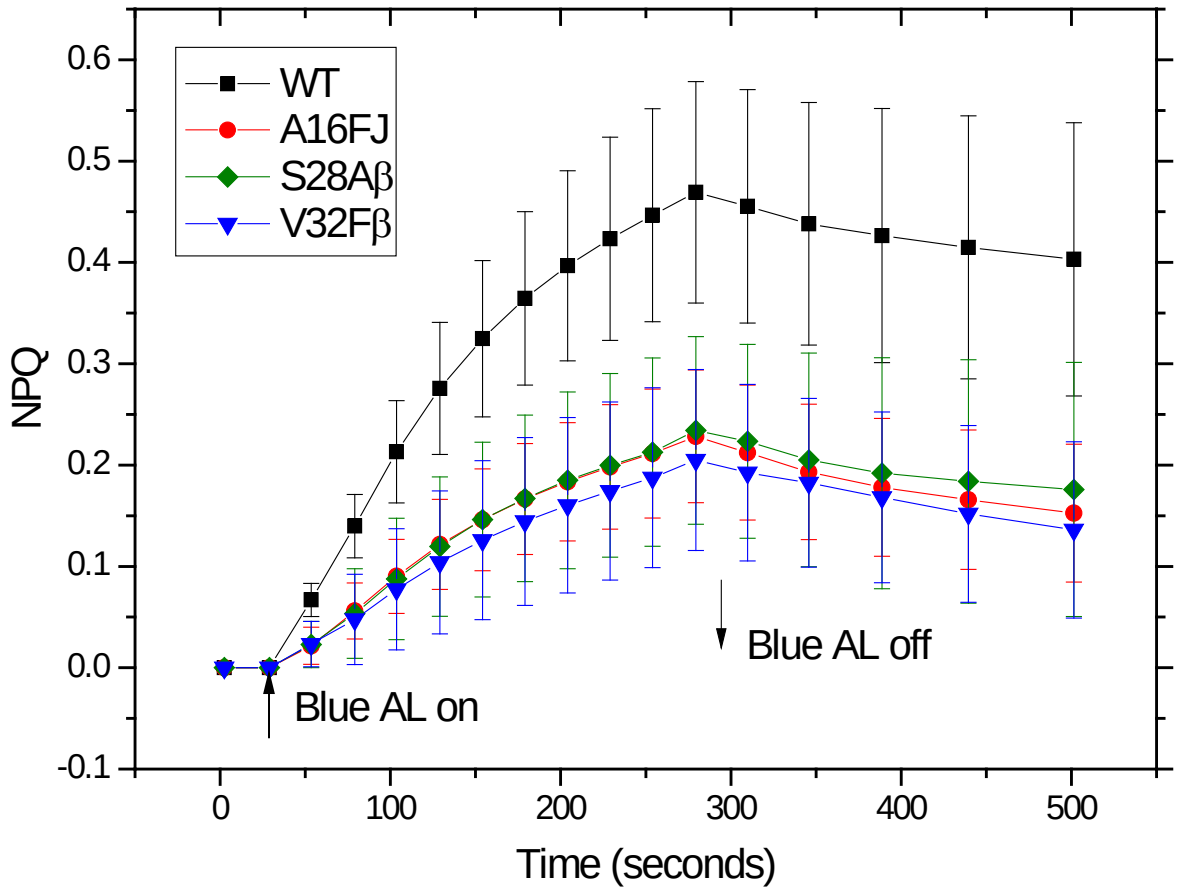

WT
A16FJ
S28Aβ
V32Fβ
NPQ
Time (seconds)
Blue AL on
Blue AL off
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0
100
200
300
400
500

Figure 5

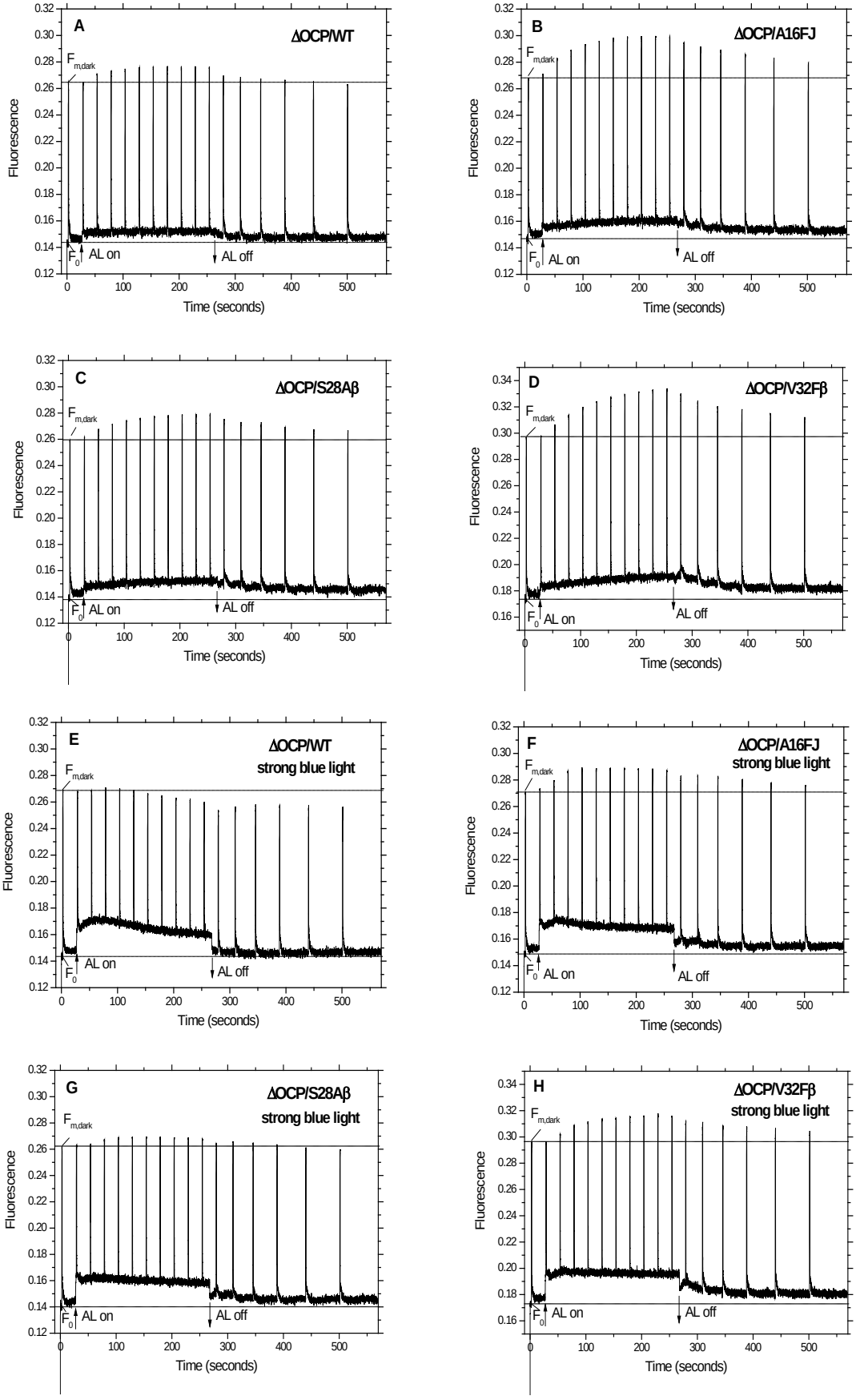

A
ΔOCP/WT
B
ΔOCP/A16FJ
C
ΔOCP/S28Aβ
D
ΔOCP/V32Fβ
E
ΔOCP/WT
strong blue light
F
ΔOCP/A16FJ
strong blue light
G
ΔOCP/S28Aβ
strong blue light
H
ΔOCP/V32Fβ
strong blue light
Fluorescence
Time (seconds)
F0
Fm,dark
AL on
AL off

Figure 6.

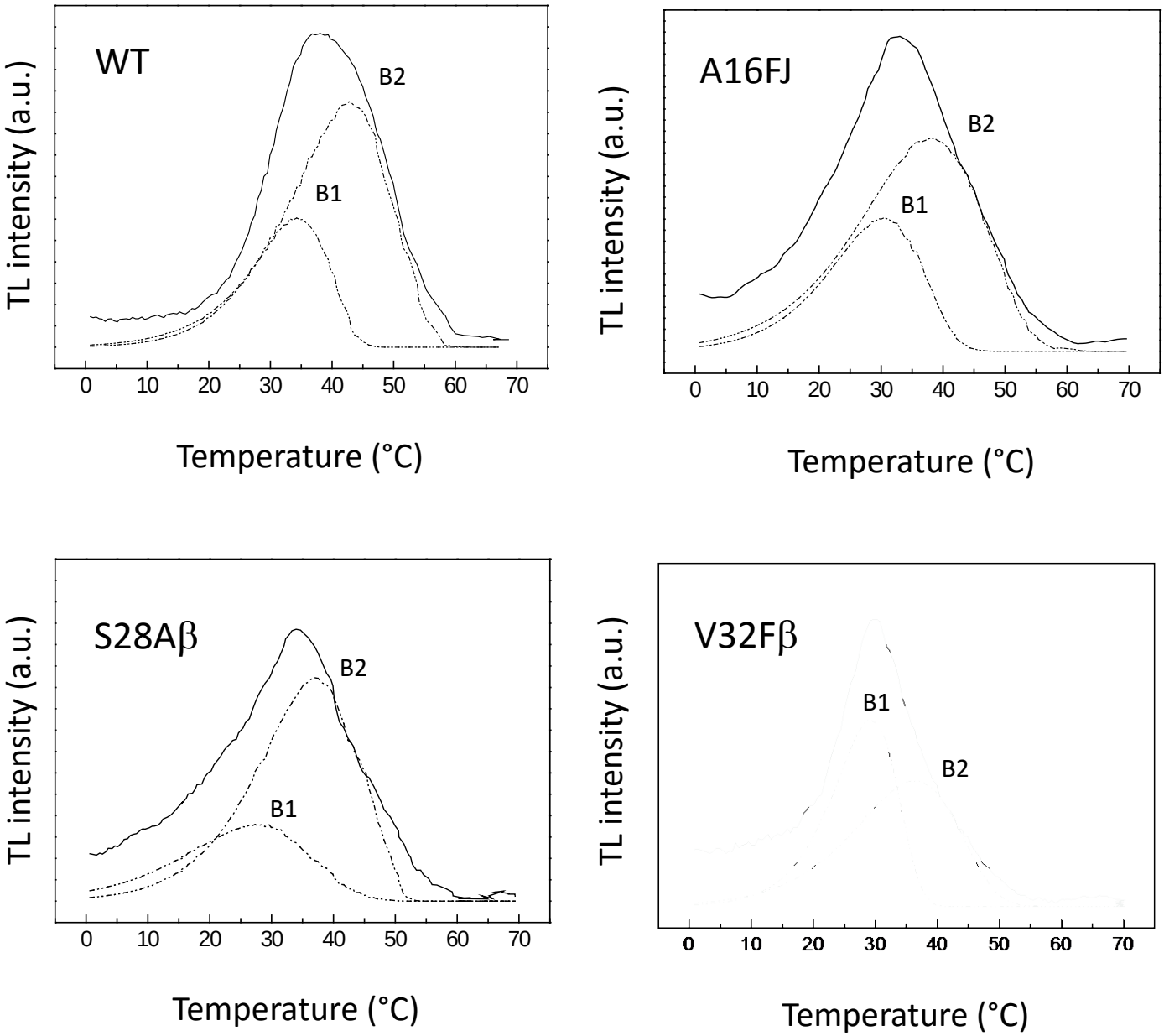

WT
B2
B1
TL intensity (a.u.)
0 10 20 30 40 50 60 70
Temperature (°C)
A16FJ
B2
B1
TL intensity (a.u.)
0 10 20 30 40 50 60 70
Temperature (°C)
S28Aβ
B2
B1
TL intensity (a.u.)
0 10 20 30 40 50 60 70
Temperature (°C)
V32Fβ
B1
B2
TL intensity (a.u.)
0 10 20 30 40 50 60 70
Temperature (°C)

Figure 7

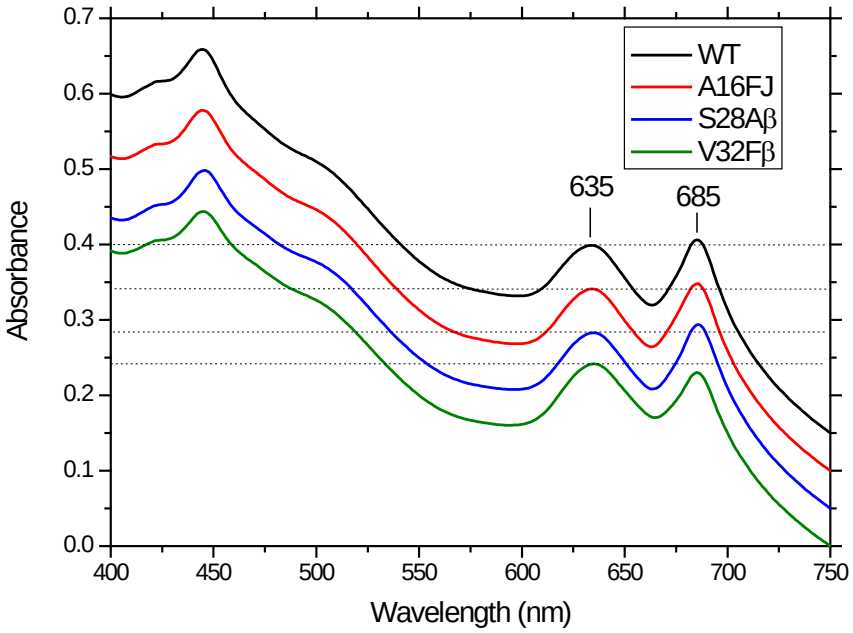
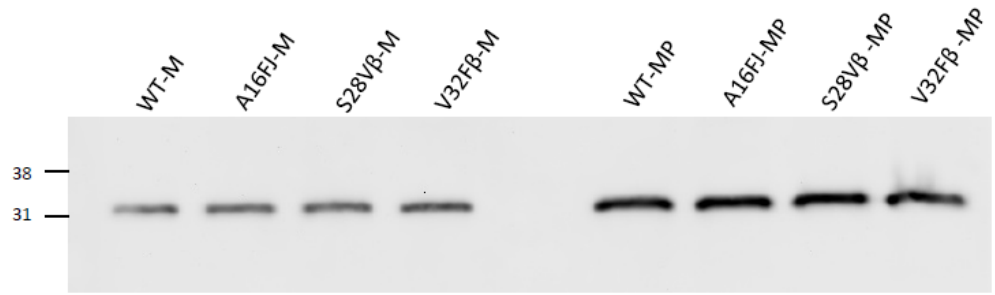

WT
A16FJ
S28Aβ
V32Fβ
635
685
Absorbance
Wavelength (nm)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
400
450
500
550
600
650
700
750

Figure 8.



Strains	Density of Bands (% of wild type)
WT-M	100
A16FJ-M	114±20
S28Vβ-M	105±12
V32Fβ-M	147±11
WT-MP	100
A16FJ-MP	110±1
S28Vβ-MP	101±11
V32Fβ-MP	91±13

Figure 9.

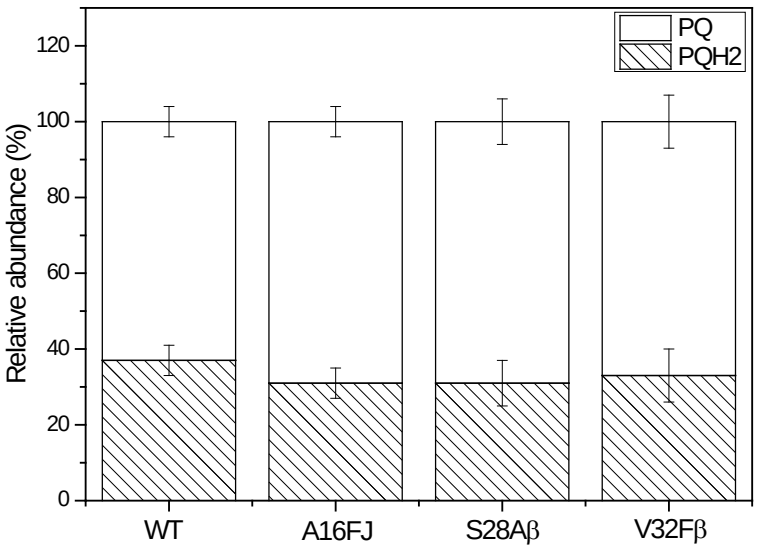
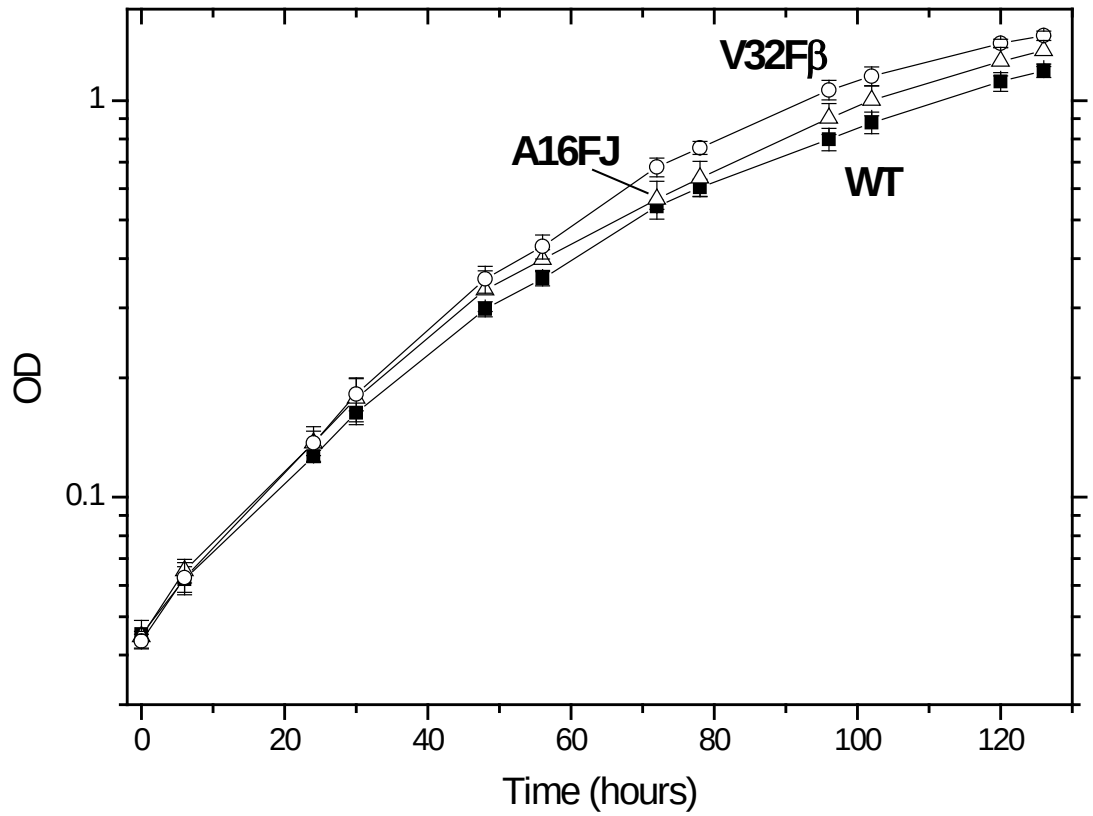
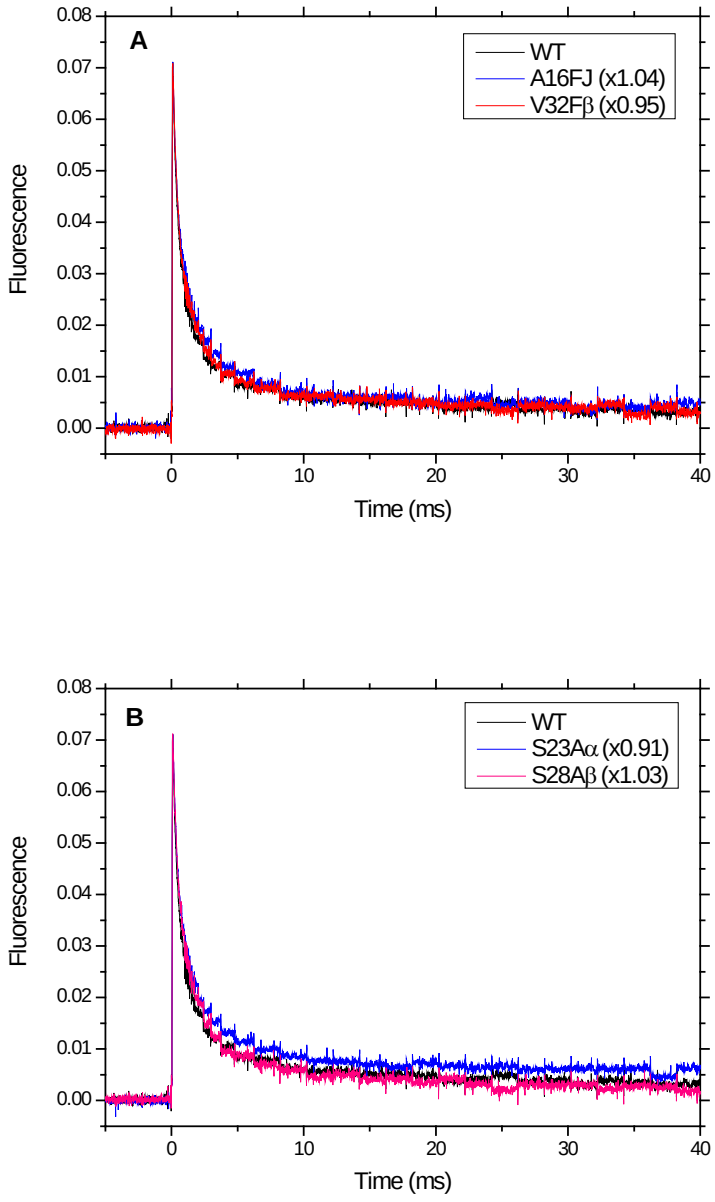

PQ
PQH2
Relative abundance (%)
120
100
80
60
40
20
0
WT
A16FJ
S28Aβ
V32Fβ

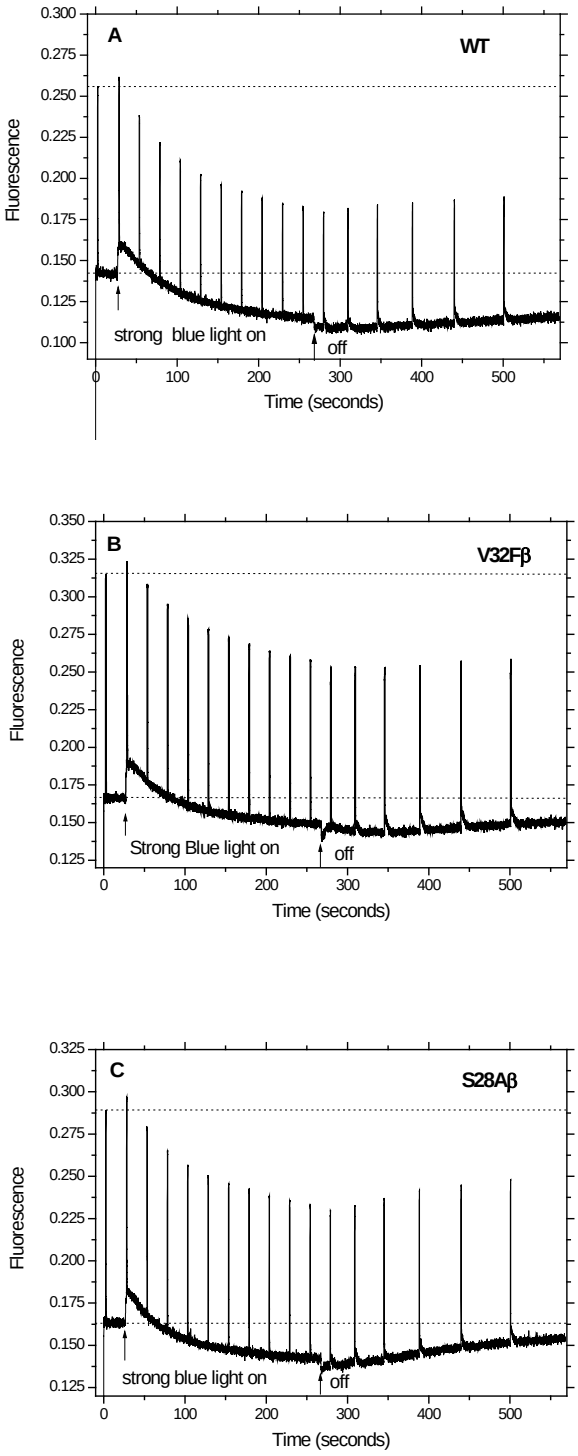
Figure 10.



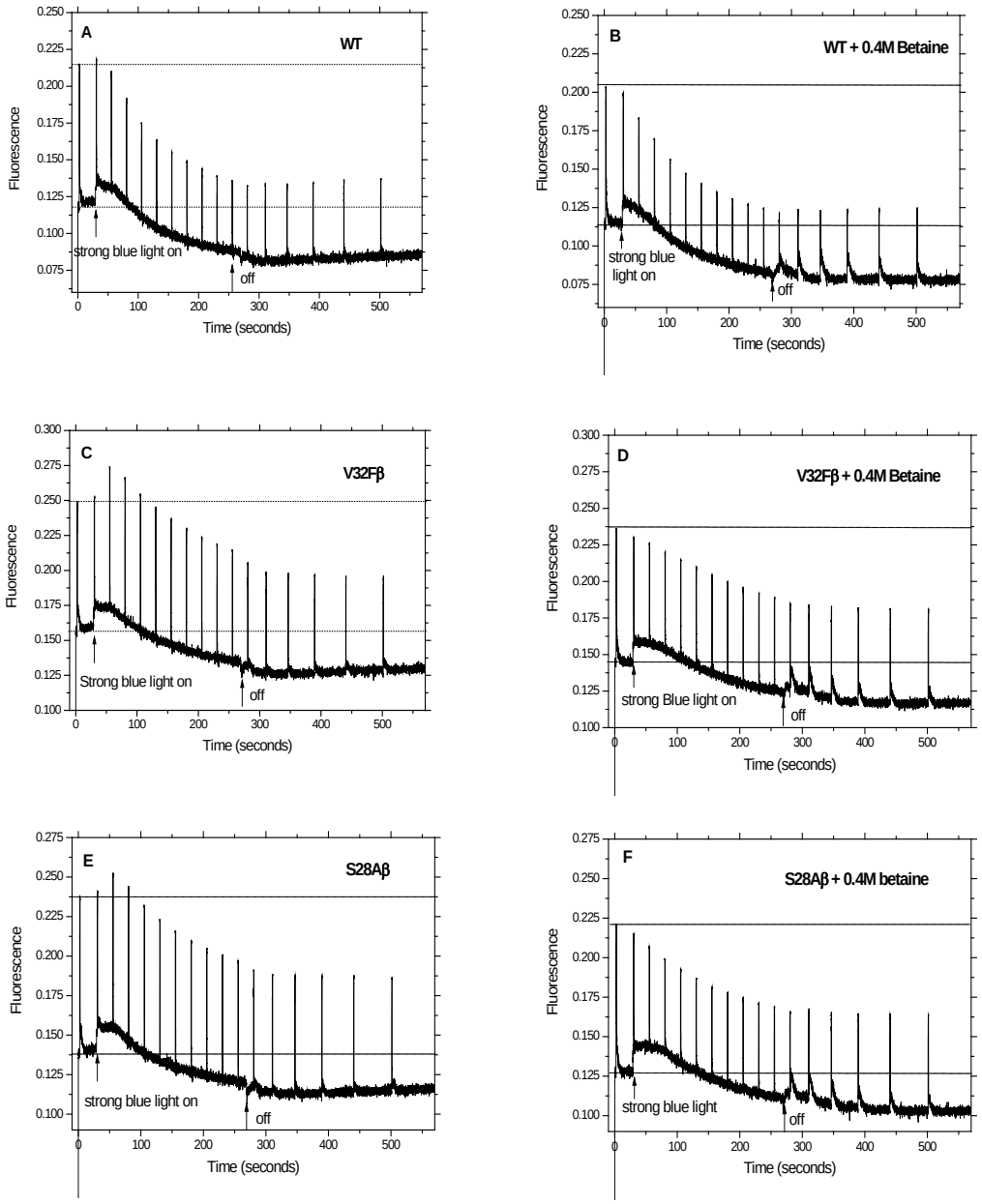
Supplemental Data.



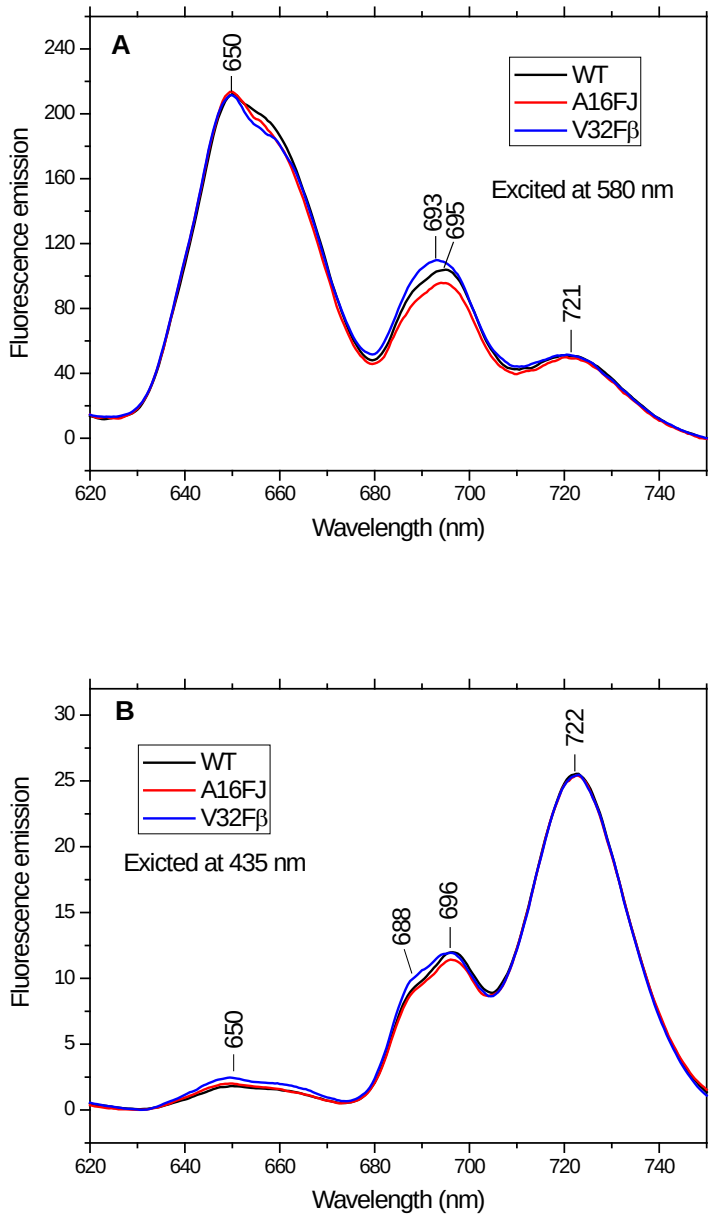
Supplemental Figure S1. Kinetics of electron transfer from Q_A^- to Q_B and Q_B^- in response to a saturating flash given to (A) WT (black trace), A16FJ (blue trace), and V32Fβ mutant cells (green trace) and (B) WT (black trace), S23Aα (blue trace), and S28Aβ Cyt b_{559} mutant cells (red trace). Conditions: 20 μg chlorophyll samples in 2 mL BG-11 medium. Samples were incubated in darkness for 1 min. The levels of F_o and F_m were normalized.



Supplemental Figure S2. Time-dependent, flash-induced PSII fluorescence yield for (A) WT, (B) V32Fβ, and (C) S28Aβ mutant cells [pre-illuminated with medium blue light (~50 μE m^{-2} s^{-1}) for 2 min] with and without strong blue actinic light. The intensity of strong blue light was ~400 μE m^{-2} s^{-1}.



Supplemental Figure S3. Time-dependent, flash-induced PSII fluorescence yield for (A, B) WT, (C, D) V32Fβ, and (E, F) S28Aβ mutant cells with and without strong blue actinic light. The intensity of strong blue light was ~400 μE m^{-2} s^{-1}. (B), (D) and (F) were treated with 0.4M betaine to inhibit state transition. The cells were grown under light conditions with intensity 80-90 μE m^{-2} s^{-1}.



Supplemental Figure S4. 77 K-fluorescence emission spectra for WT, A16FJ and V32Fβ mutant cells. (A) Excited phycobilisomes at 580 nm (excitation bandwidth 3 nm; emission bandwidth 1 nm; spectra were normalized at 650 nm). (B) Excited chlorophyll at 435 nm (excitation bandwidth 5 nm; emission bandwidth 1 nm; spectra were normalized at 722 nm). All measurements were carried out at 77 K, with cell suspensions at chlorophyll concentration 20 μg mL^{-1}.

Table S1. The DNA sequence of synthetic mutagenic oligonucleotides

A16FJf:	5- GTG GTG GGT GTA GTG **TT**C GGT ATT GGC GCC ATT -3
A16FJr:	5- AAT GGC GCC AAT ACC G**AA** CAC TAC ACC CAC CAC -3
A16LJf:	5- GTG GTG GGT GTA GTG **CT**C GGT ATT GGC GCC ATT -3
A16LJr:	5- AAT GGC GCC AAT ACC G**AG** CAC TAC ACC CAC CAC -3
A16SJf:	5- GTG GTG GGT GTA GTG **T**CC GGT ATT GGC GCC ATT -3
A16SJr:	5- AAT GGC GCC AAT ACC GG**A** CAC TAC ACC CAC CAC -3
G19FJf:	5- GTA GTG GCC GGT ATT **TT**C GCC ATT GGT GTT CTA -3
G19FJr:	5- TAG AAC ACC AAT GGC G**AA** AAT ACC GGC CAC TAC -3
A20FJf:	5- GTG GCC GGT ATT GGC **TT**C ATT GGT GTT CTA GGG -3
A20FJr:	5- CCC TAG AAC ACC AAT G**AA** GCC AAT ACC GGC CAC -3
S23Aαf:	5- TAC TGG GTG ATC CAC **GC**C ATC ACC ATC CCG ATG -3
S23Aαr:	5- CAT CGG GAT GGT GAT G**GC** GTG GAT CAC CCA GTA -3
S28Aβf:	5- ACC CTG GCG GTG CCC **GC**C GTC TTC TTT GTC GGG -3
S28Aβr:	5- CCC GAC AAA GAA GAC G**GC** GGG CAC CGC CAG GGT-3
S28Vβf:	5- ACC CTG GCG GTG CCC **GT**T GTC TTC TTT GTC GGG -3
S28Vβr:	5- CCC GAC AAA GAA GAC A**AC** GGG CAC CGC CAG GGT-3
V32Fβf:	5- CCC TCT GTC TTC TTT **T**TC GGG GCG ATC GCC GCG -3
V32Fβr:	5- CGC GGC GAT CGC CCC GA**A** AAA GAA GAC AGA GGG -3

f: forward; r: reverse. Mutations were marked with red color and underlined.