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†Electronic Supplementary Information (ESI) available:

Comparison of ground state recovery trace between *640 and* 650 nm components in intact PBS

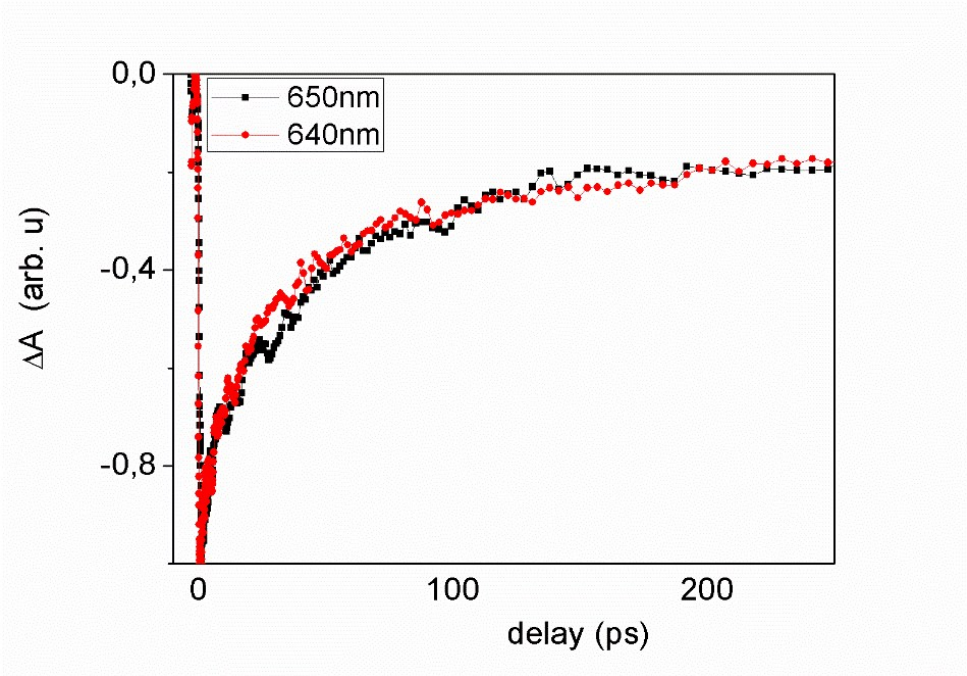

Figure S1: Comparison of ground state recovery trace between 640 and 650 nm components in intact PBS.

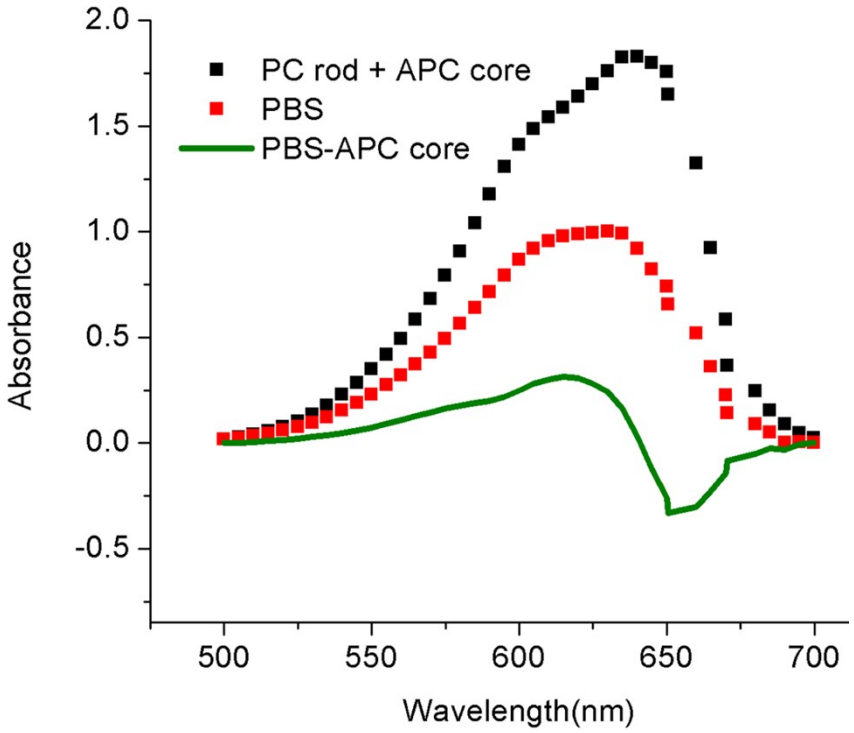

Figure S2: Comparison of the absorbance of PBS of *T. vulcanus (*normalized to 1) and the sum of absorbance of PC rod and APC core normalized to 1 respectively.

If we add the normalized spectrum of APC core (OD=1) and PC rod (OD=1) we obtain an optical density of 1.85 at 635 nm and 1.65 at 620 nm, which is far beyond the PBS OD=1. This indicates that the absorption of APC core is lower than that of the PC rod in PBS. Furthermore, the increase in absorption of OD= 0.65 at 620 nm can be related to 35 % the excitation light that can perhaps be absorbed by APC when the excitation is applied at 620nm. Admitting that APC can significantly absorb less than PC rod, the residual absorption by APC will be at the high-energy exciton band of APC. The work of Ref. 19, shows that the obtained kinetic of APC direct excitation was 70 fs, which is far beyond our instrumentation resolution. In Figure 5a, we have analysed the kinetic trace at 620 nm, we found 876 fs, which is consistent with the kinetic obtained with Ref.18 in isolated PC hexamer. For this reason the kinetic we monitor cannot be originated from APC.

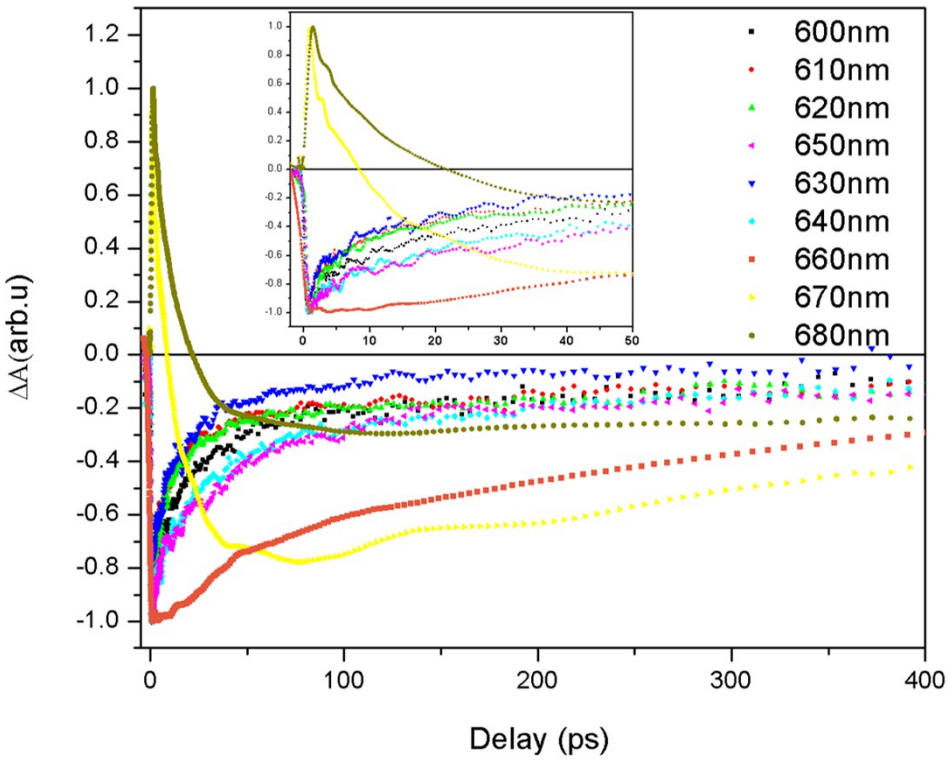

Figure S3: Comparison of ground state recovery trace from 600 to 680 nm components in intact PBS of *T. vulcanus* after 620 nm excitation. Inset Figure show the earlier 50 ps.

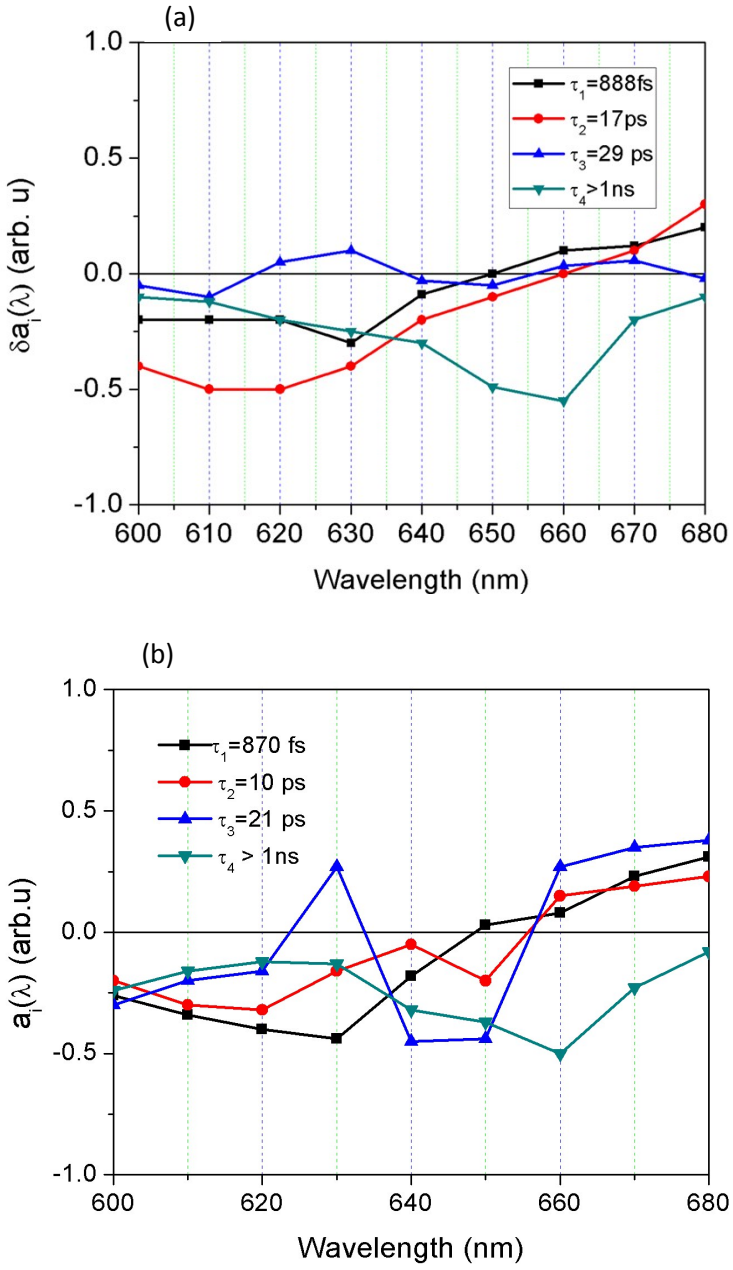

Figure S4: Decay analysis spectra of 4 EET components gathered by global analysis of the photo-induced absorption change in the PBS of *T. vulcanus* containing linker proteins in high phosphate: where (a) represents a system where all, then two and lastly one components are fixed. After fixing all components, the system exhibit an additional kinetic component τ3= 29 ps, which vanishes and has a fluctuating amplitude close to zero such that its statically average is zero. When components are progressively fixed from two to three, namely 888 fs and 17 ps components to then 888 fs, 17 ps and > 1ns components, the results remain the same. This suggests that the excited state of PC and APC in intact PBS with Linkers is not consistent with 4 kinetic components; and (b) is the decay analysis spectra of 4 EET components gathered by global analysis with all the parameter set free. The behavior of the 21 ps component observed is similar to those obtained with fixed parameters in (a). This suggests that the intact PBS dynamics cannot be described with 4 kinetic components of EET. Furthermore, the fast component kinetic decreases from 888 to 870 fs while the 17 ps decreased to 10 ps. These changes in kinetic component are attributed to the system dynamic refusing to accept additional component, and the weighting population of each component is affected by the fluctuation of the 21 ps.

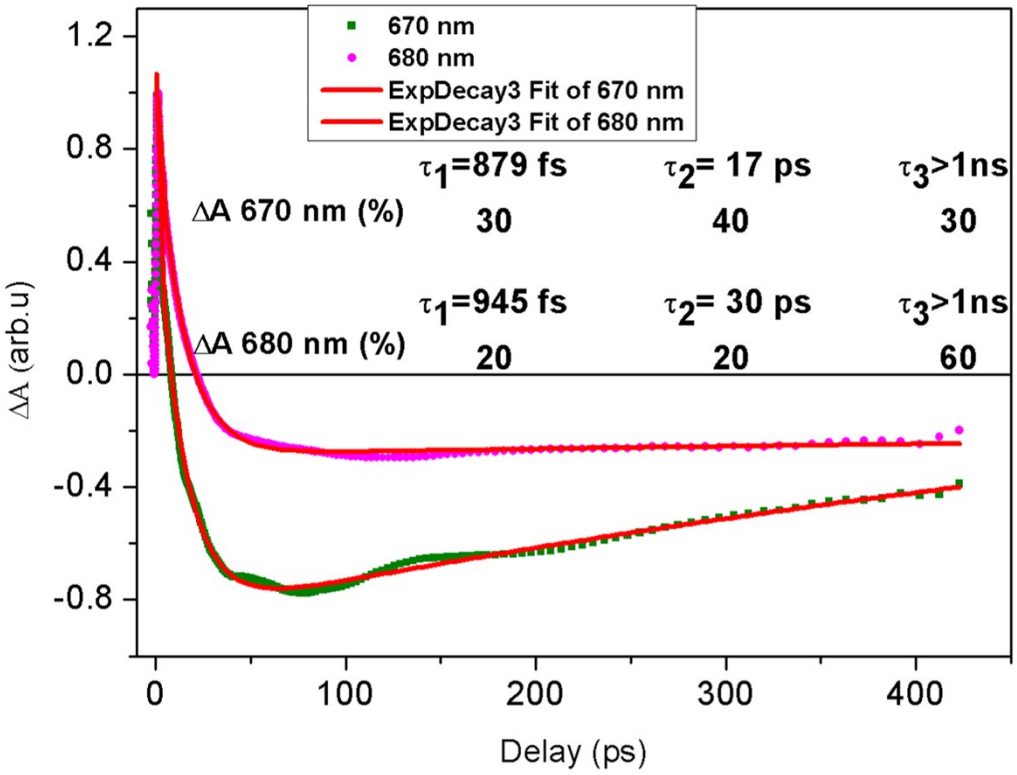

Figure S5: Absorption changes at 670 and 680 nm (the L_{CM}). The kinetic was consistent with 3 kinetic components all free parameters as global analysis of DASG. The fast component appears to be originated of the ESA of PC with a kinetic like the component found in PC620 or PC612 (Figure 5a). The delayed bleaching is apparent and displays a clear different profile than that of the positive ESA. This delayed bleaching appears to be the origin of the 17 ps obtained in the DAS. The 30 ps in 680 nm may be due to the contribution of the disruption system as the kinetic above 1ns may be the lifetime of the L_{CM}, which is beyond our instrumental resolution.

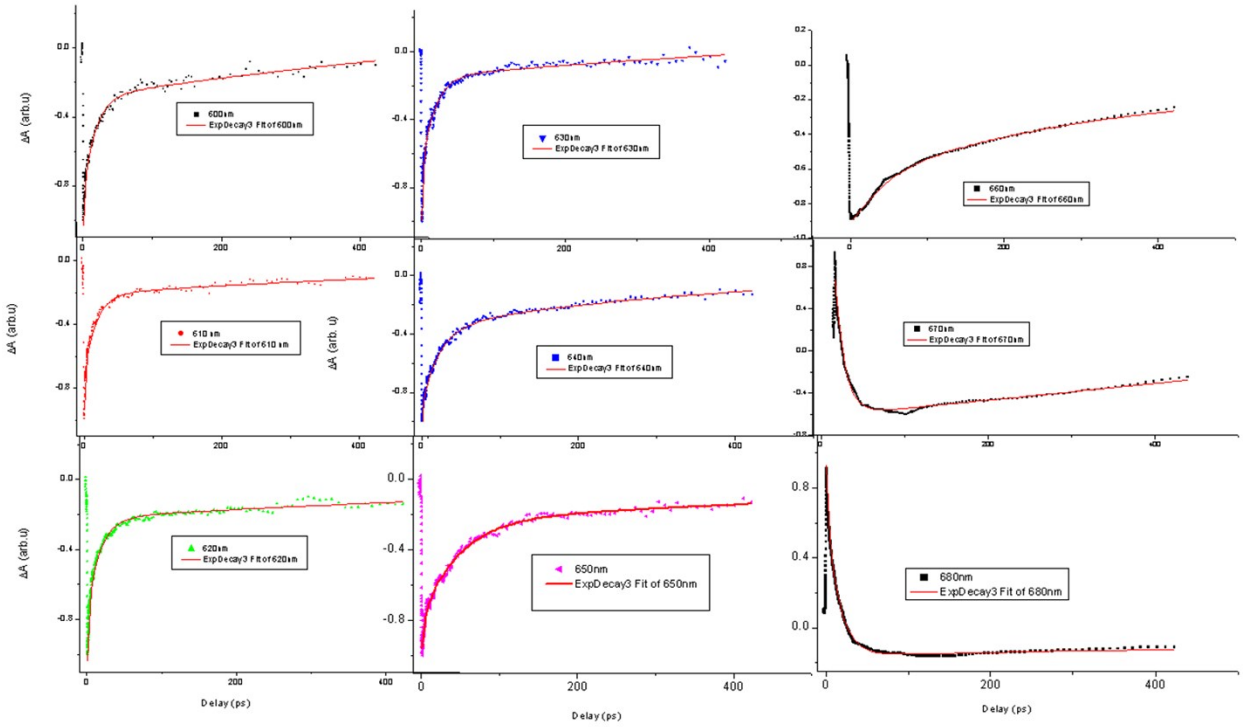

Figure S6: Global fit of spectra (in Figure 2) of PBS of *T. vulcanus*

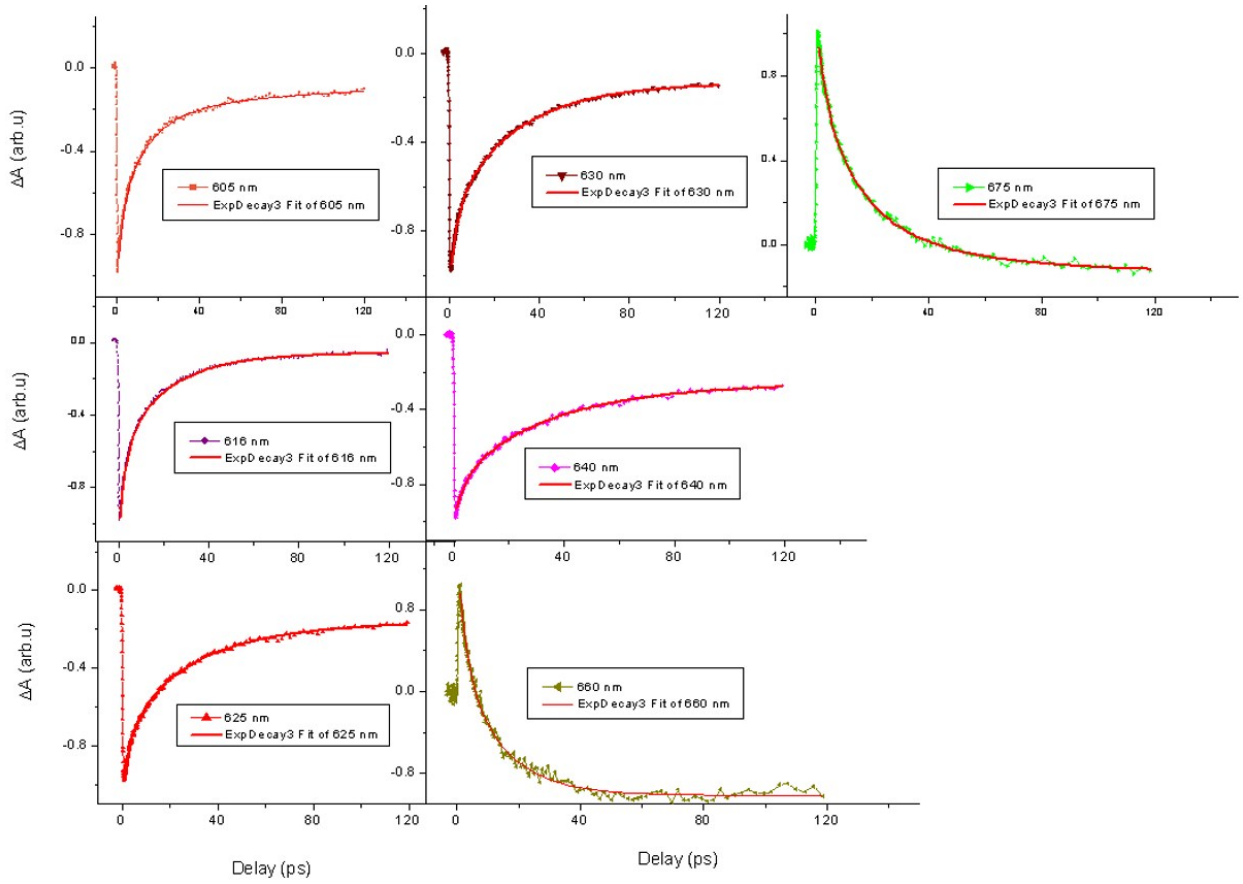

Figure S7: Global fit of spectra (in Figure 2) of PBS *A. marina*. The fit is super-imposed on each spectrum

References

18. J. M. Womick and A. M. Moran, *J. Phys. Chem. B*, 2009, **113**, 15771-15782.
19. J. M. Womick and A. M. Moran, *Journal of Physical Chemistry B*, 2009, **113**, 15747-15759.