SUPPLEMENTARY INFORMATION

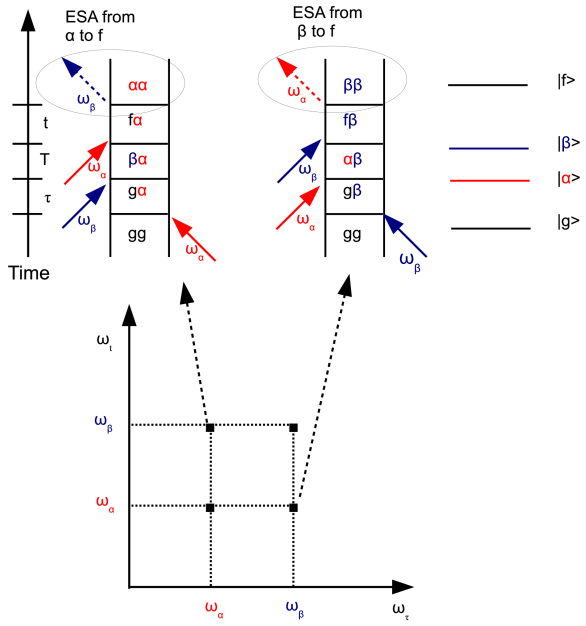

Fig 1. The Feynman diagrams can be used for assign certain properties to specific locations in the 2D spectrum. In this example it is shown that the excited state absorption (ESA) from α to f produces the above diagonal peak, whereas the ESA from β to f the below diagonal peak. Therefore the specific ESA band can be calculated without spectral deconvolution, differently from transient absorption where all the contributions to the signal (ESA, GSB and SE) are superimposed.

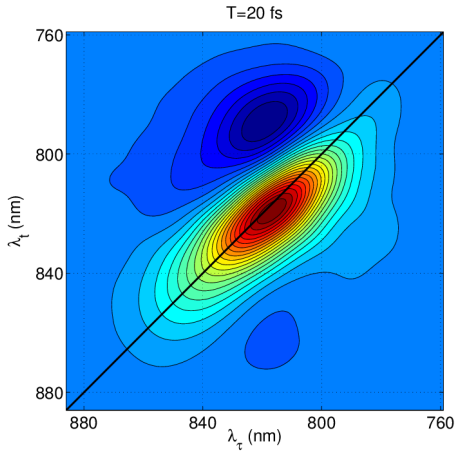

Fig. 2 Total real 2D spectrum at population time of 20 fs. The negative above diagonal peak is due to excited state absorption.