How does a protein achieve functionality?

and

Third harmonic generation imaging enables fast, label-free characterization of human brain tumors

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Two questions at the forefront of biophysical sciences are biological sensing and energy conversion. Photoactive Yellow Protein is at the cross point of these two topics as it converts light energy into a structural change, in the process of biological light sensing. This bacterial photosensor is an excellent model system to study how a protein achieves such a function as it is relatively small and very stable. In this contribution I will present results from visible pump/midinfrared probe studies on the femtosecond to microsecond timescale focused on the initial ultrafast events in PYP: The formation of a stable isomerized ground state of the pCa chromophore, the role of the amino acid residues near pCa in this process, and how they modulate the reaction via hydrogen bond interactions and localized charges.

In the second half of my talk I will discuss how we can obtain label-free images with sub-cellular resolution in deep tissue using higher harmonic generation. Especially optical third-harmonic generation (THG) provides high-contrast imaging of live brain tissue without the need for fluorescent probes. We exploit the specific geometry and lipid content of brain tissue at the cellular level to achieve partial phase matching of THG. I will present new results on how THG imaging enables fast characterization of increased cellularity in human brain tumor tissue.