Putting the pieces together - UV-Vis spectroscopy and reaction path calculations in ThDP-dependent enzymes

Ricardo A. Mata[1]

[1] *Institut für Physikalische Chemie, Georg-August-Universität Göttingen, Tammannstr. 6, D-37077 Göttingen, Germany*

The identification of reaction intermediates in enzymatic systems is a continuing challenge, both for theoretical and experimental approaches. UV-vis and circular dichroism spectra are commonly used to follow the progression and the appearance of such intermediates. However, the unequivocal assignment of a band to a particular compound can be a daunting task. Electronic structure methods can be invaluable in this context, but only when an adequate description of the environment effects and the chromophore itself are available.

The thiamin diphosphate (ThDP) coenzyme participates in a multitude of enzymatic reactions and their progression is commonly followed by absorption spectra.[1] We take a look at ThDP-dependent enzymes, and demonstrate the usefulness and limits of different approaches to describe environment effects, ranging from cluster calculations, to continuum solvent and QM/MM methodologies. Excitation energies are computed through time-dependent density functional theory calculations, as well as our own low-order scaling incremental Coupled Cluster approach.[2] In combination with reaction path studies and novel high-resolution crystal structure data, we move closer to understanding the rich chemistry of ThDP catalysis.

[1] H. Patel, N. S. Nemeria, F. H. Andrews, M. J. McLeish, F. Jordan, *Biochemistry* **53** (2014) 2145.

[2] R. A. Mata, H. Stoll, *J. Chem. Phys.* **134** (2011) 034122.