Temporal aspect of chirality : a photoionisation study from the femtosecond to the attosecond scale

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Life has found an extra parameter to store durably information: chirality. This asymmetry property appears at the molecular level when two molecules have the same chemical composition and structure but cannot be superimposed on each other. These two mirror images are called enantiomers. Enantiomers are able to regulate different biological mechanisms through their handedness. This chiral recognition is the key element for biological receptors, in particular, it dictates the perception of odor and taste and is also of major importance in many mechanisms of drug action. Chirality is as such, one of the most subtle examples of broken symmetry with a huge impact in chemistry, pharmacology and biochemistry and even the origin of life.

Most of the spectroscopic investigations based on circular dichroism are structural investigations on static molecules. Weak signal/noise ratios often prevent the extension to time-domain spectroscopy with evolving molecules. However, when randomly-oriented pure enantiomers are ionized by circularly polarized light, an asymmetry on the emitted photoelectrons is observed along the photon propagation axis, with an amplitude reaching several percents. This asymmetry, called PhotoElectron Circular Dichroism (PECD) reverses with the handedness of the enantiomer or the helicity of the light polarization. In this talk, time-resolved PECD[1] and PhotoeXcitation Circular Dichroism (PXCD)[2] will be presented, as well as a self-referenced attosecond photoelectron interferometry that allows one to measure the temporal profile of the forward and backward electron wave packets produced by combining a kind of RABITT measurement with chiral femtosecond pulses, that we called CHABITT [3].

References

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