From Static to time-resolved Photoelectron circular dichroism (PECD) in the photoionization of gas phase chiral systems

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Chiral molecules exist as two enantiomers, which cannot be superimposed but are mirror images of each other. They reveal their chiral nature when interacting with another chiral object such as Circularly Polarized Light (CPL) leading to enantio-specific photon/matter interactions such as the well-known circular dichroism (CD) in absorption.

Since 15 years, a new type of chiroptical effect has been the subject of a large array of both theoretical and experimental studies: Photoelectron Circular Dichroism (PECD) in the angular distribution of photoelectrons produced by CPL-ionization of pure enantiomers in the gas phase observed as a very intense (up to 35 %) forward/backward asymmetry with respect to the photon axis and which reveals the chirality of the molecule.

PECD happens to be an orbital-specific, photon energy dependent effect and is a very subtle probe of the molecular potential being very sensitive to static molecular structures such as conformers, chemical substitution, clusters, as well as to vibrational motion, much more so than other observables in photoionization such as the cross section or the β asymmetry parameter (for a recent review see [1]). Therefore PECD studies have both a fundamental interest as well and analytical interest, especially since chiral species are ubiquitous in the biosphere, food and medical industry. This last aspect is probably the driving force for the recent extension of PECD studies by the laser community, in the UV via REMPI schemes [2,3].

After an introduction to chirality and the PECD process itself, I'll show an example of static one-photon VUV PECD (ie frequency-resolved PECD from a ground state molecules) underlying the sensitivity to isomerism [4]. Then opportunities for time-resolved PECD opened by the recent first performance of PECD with fs HHG pulses [5] and REMPI time-resolved PECD [6] will presented.

[1] L. Nahon *et al.* 2015 *J. Elec. Spec. Rel. Phen.* **204**, 322
[2] C. Lux *et al.* 2012 *Angew. Chem.-Int. Edit.* **51**, 5001
[3] C. S. Lehmann 2013 *J Chem Phys* **139**, 234307
[4] L. Nahon *et al.* 2016 *Phys Chem Chem Phys* **18**, 12696
[5] A. Ferré *et al.* 2015 Nature Photonics **9**, 93
[6] A. Comby *et al.* 2016 *J. Phys. Chem. Lett* **7**, 4514