Chiral Recognition in the Gas Phase investigated Using Femtosecond Photoelectron Circular Dichroism

Alexander Kastner[1], Tom Ring[1], Christian Lux[1], Tim Schäfer[2], G. Barratt Park[2], Stefanie Züllighoven[1], Cristian Sarpe[1], Hendrike Braun[1], Arne Senftleben[1], Anton N. Artemyev[1], Philipp V. Demekhin[1] and Thomas Baumert[1]

1) Institute for Physics, University of Kassel (Germany)
2) Institute for Physical Chemistry, Georg-August-University Göttingen (Germany)
Alexander.Kastner@physik.uni-kassel.de

The asymmetry of photoelectron angular distributions from randomly oriented enantiomers of chiral molecules in the ionization with circularly polarized light arises in forward/backward direction with respect to the light propagation direction. This effect was termed Photoelectron Circular Dichroism (PECD) and can be investigated using synchrotron radiation[1] or multi-photon ionization.[2, 3] Highly structured asymmetries in the range of ± 10 % on bicyclic Ketones have been observed[2, 3, 4] and dependency on enantiomeric purity[5] and excitation wavelength[6] has been studied. A continuous wavelength scan allows to study the impact of photoelectron kinetic energy, when ionization can proceed through different intermediate states. The dependence of PECD on photoelectron energy is found to be different for single-photon[7] and multi-photon studies.[6] In addition, the influence of electronic character of intermediate state is found to have strong influence on observed PECD for fenchone.[6]

In the second part of the talk, experiments with a bichromatic field (400/800 nm) will be presented. For linear and mutually orthogonal polarization, a Lissajous-type field (∞) is generated, which can evoke a chiral response. Recently developed theory sheds light on the underlying mechanism, where the rotational sense of the field is transformed into translational motion of the photoelectron along the light propagation direction by a chiral target.[8]

[1] L. Nahon, G. A. Garcia, and I. Powis. *Journal of Electron Spectroscopy and Related Phenomena*, 204:322–334, 2015.

[2] C. Lux, M. Wollenhaupt, T. Bolze, Q. Liang, J. Köhler, C. Sarpe, and T. Baumert. *Angewandte Chemie Int. Ed.*, 51:5001–5005, 2012.

[3] C. S. Lehmann, N. Bhargava Ram, I. Powis, and M. H. M. Janssen. *The Journal of Chemical Physics*, 139:234307, 2013.

[4] C. Lux, M. Wollenhaupt, C. Sarpe, and T. Baumert. *Chem. Phys. Chem*, 16:115–137, 2015.

[5] A. Kastner, C. Lux, T. Ring, S. Züllighoven, C. Sarpe, A. Senftleben, and T. Baumert. *Chem. Phys. Chem*, 17:1119–1122, 2016.

[6] A. Kastner, T. Ring, B. C. Krüger, G. B. Park, T. Schäfer, A. Senftleben, and T. Baumert. *The Journal of Chemical Physics*, 147:013926, 2017.

[7] L. Nahon, L. Nag, G. A. Garcia, I. Myrgorodska, U. Meierhenrich, S. Beaulieu, V. Wanie, V. Blanchet, R. Géneaux, and I. Powis. *Phys. Chem. Chem. Phys.*, 18:12696–12706, 2016.

[8] P. V. Demekhin, A. N. Artemyev, A. Kastner, and T. Baumert. *submitted, preprint at arXiv:1807.01097*, 2018.