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# Laser-based sensing and driving of molecular chirality

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Exploiting an electric dipole effect in ionization [1], photoelectron circular dichroism (PECD) is a highly sensitive enantioselective spectroscopy for studying chiral molecules in the gas phase using either single-photon ionization [2] or multiphoton ionization [3]. In the latter case, resonance-enhanced multiphoton ionization (REMPI) gives access to neutral electronic excited states. The PECD sensitivity opens the door to study control of enantiomers' coupled electron and nuclear motion. A prerequisite is a detailed understanding of PECD in REMPI schemes. In this contribution, I will report on our investigations on PECD with coherent light sources whose pulse durations span from femtoseconds to nanoseconds [4]. By this, we address impulsive excitation on the femtosecond time scale to highly vibrational state selective excitation in mixtures with the help of high-resolution nanosecond laser techniques [5]. Subcycle control of PECD in bichromatic fields will be discussed [6], as well as coherent control of the ion yield [7] and handedness.

[01] Ritchie, B. Theory of the angular distribution of photoelectrons ejected from optically active molecules and molecular negative ions. Phys. Rev. A 13, 1411–1415 (1976).
[02] Böwering, N., Lischke, T., Schmidtke, B., Müller, N., Khalil, T. & Heinzmann, U. Asymmetry in Photoelectron Emission from Chiral Molecules Induced by Circularly Polarized Light. Phys. Rev. Lett. 86, 1187 (2001).
[03] Lux, C., Wollenhaupt, M., Bolze, T., Liang, Q., Köhler, J., Sarpe, C. & Baumert, T. Circular dichroism in the photoelectron angular distributions of camphor and fenchone from multiphoton ionization with femtosecond laser pulses. Angew. Chem. Int. Ed. 51, 5001–5005 (2012).
[04] Lee, H., Ranecky, S. T., Vasudevan, S., Ladda, N., Rosen, T., Das, S., Ghosh, J., Braun, H., Reich, D. M., Senftleben, A. & Baumert, T. Pulse length dependence of photoelectron circular dichroism. Physical chemistry chemical physics : PCCP 24, 27483–27494 (2022).
[05] Ranecky, S. T., Park, G. B., Samartzis, P. C., Giannakidis, I. C., Schwarzer, D., Senftleben, A., Baumert, T. & Schäfer, T. Detecting chirality in mixtures using nanosecond photoelectron circular dichroism. Phys. Chem. Chem. Phys. 24, 2758–2761 (2022).
[06] Demekhin, P. V., Artemyev, A. N., Kastner, A. & Baumert, T. Photoelectron Circular Dichroism with Two Overlapping Laser Pulses of Carrier Frequencies ω and 2ω Linearly Polarized in Two Mutually Orthogonal Directions. Phys. Rev. Lett. 121, 253201 (2018).
[07] Das, S., Ghosh, J., Sudheendran, V., Ranecky, S., Rosen, T., Ladda, N., Lee, H., Stehling, T.-J., Westmeier, F., Mikosch, J., Senftleben, A., Baumert, T. & Braun, H. Control of circular dichroism in ion yield of 3-methyl cyclopentanone with femtosecond laser pulses. Physical chemistry chemical physics : PCCP, (2025).

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