Attosecond Interferometry

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Attosecond science is a young field of research that has rapidly evolved over the past decade. The progress in this field opened a door into a new area of research that allows one to observe multi-electron dynamics in in atoms, molecules and solids. One of the most exciting advances in atto-science is high harmonic generation (HHG) spectroscopy. It allows one to combine sub-Angstrom spatial with attosecond temporal resolution, holding the potential of resolving the structure of electronic wavefunctions as they evolve in time.

An important aspect of HHG spectroscopy lies in its coherent nature. The strong field interaction directly transfers the coherence of the strong laser field into the coherent properties of the electronic wavefunction, and then back into the optical properties of the emitted harmonics. Resolving the internal coherent is one of the primary challenges in HHG spectroscopy – serving as the key step in our ability to reconstruct the internal dynamics.

As in many other branches in Physics, coherence is resolved via interferometry. In the talk I will describe advanced schemes in attosecond spectroscopy where the interferometric measurement is induced *during the interaction itself*. When the strong field interaction is driven by two, or several synchronized fields, it induces an internal interferometer, composed of several quantum paths [1]. Furthermore, this scheme provides a direct insight into the multidimensional nature of the interaction, thus revealing its complexity. In an alternative approach we demonstrate how the HHG coherence can be directly resolved via an all-optical approach. In this case, we replace the internal interferometer, by an external optical one, and obtain a direct insight into the photoionization mechanism [2].

[1] O. Pedatzur et al 2015 *Nature Physics* **11,** 811 (2015).
[2] D. Azoury et al 2019 *Nature Photonics* **13**, 54-59 (2019).