Probing electronic decoherence with high-resolution attosecond photoelectron interferometry

SND-ID: 2022-53-1. **Version**: 1. **DOI**: https://doi.org/10.5878/mtfm-b338

Download data

delay.txt *(658 bytes)*

spectrogram.txt *(452.96 KB)*

TOF.txt *(78.14 KB)*

Associated documentation

Documentation.txt *(1.69 KB)*

Download all files

2022-53-1-1.zip *(~533.43 KB)*

Citation

Busto, D., Zhong, S., Arnold, C., Gisselbrecht, M., & L'Huillier, A. (2022) Probing electronic decoherence with high-resolution attosecond photoelectron interferometry (Version 1) [Data set]. Lund University. Available at: https://doi.org/10.5878/mtfm-b338

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Description

We investigate the photoionization of helium atoms by attosecond pulse trains generated via high-order harmonic generation in neon gas. In the frequency domain these attosecond pulse trains correspond to a comb of odd harmonics. The wavelength of the infrared field used for high harmonic generation is chosen so that the 39th harmonic is resonant with the 2s2p resonance in helium situated at 60.147 eV. The attosecond pulse trains are overlapped spatially and temporally with a delayed infrared probe pulse with 10 nm bandwidth and a central wavelength of 800nm. Both pulses are focused on an effusive helium gas jet using a toroidal mirror. The resulting photoelectron spectrum is measured using a 2-meter long magnetic bottle electron spectrometer. The experiments consist in measuring the photoelectron spectrum as a function of the delay between the attosecond pulse train and the infrared probe pulse.

The photoelectron spectra exhibit small photoelectron peaks (sidebands) originating from the interference of two photon transitions. These peaks oscillate as a function of the delay between the attosecond pulse train and the infrared field at twice the angular frequency of the probe pulse. We

extract the amplitude and phase of the sideband oscillations adjacent to the resonant harmonic. We observe a different amplitude and phase variation in the two sidebands that we interprete as signature of decoherence in the upper harmonic due to coupling to the 2p2 state.

The data is acquired using a 2m-long magnetic bottle electron spectrometer. An acceleration voltage of 2V is applied on the permanent magnet and the gas needle and a retarding potential of 34V is applied at the entrance of the flight tube. The design of the MBES is based on the following publication: J. H. Eland et al., Phys. Rev. Lett. 90, 053003 (2003).

The experiments consist in measuring time-of-flight spectra as a function of the delay between the attosecond pulse train and the IR probe field.

spectrogram.txt is a matrix (41x5001), where each row corresponds to the time of flight spectrum of the photoelectron for a given delay. The values in this matrix correspond to the number of electrons detected for a given delay (rows) and time-of-flight (columns).
delay.txt is a vector containing 41 entries corresponding the values of the delay in femtoseconds.
TOF.txt is a vector containing 5001 entries corresponding to the values of the electron time of flight in nanoseconds.

Data contains personal data

No

Language

English

Data format / data structure

Numeric

Responsible department/unit

Department of Physics

Funding 1

- Funding agency: Knut and Alice Wallenberg Foundation
- Funding agency's reference number: 2017.0104
- Project name on the application: Attosecond chronoscopy of electron wave-packets probing entanglement and time-ordering of quantum processes

Funding 2

- Funding agency: European Research Council
- Funding agency's reference number: 339253
- Project name on the application: Physics of Atoms with Attosecond Light Pulses

Funding 3

- Funding agency: Swedish Research Council
- Funding agency's reference number: 2013-08185
- Project name on the application: Ansökan: Lunds attosekundvetenskapscentrum

Research area

Atom and molecular physics and optics (Standard för svensk indelning av forskningsämnen 2011)

Keywords

Interferometry, Quantum entanglement, Autoionization, Photoionization, Photoelectron interferometry, Decoherence

Publications

Busto et al., Probing electronic decoherence with high-resolution attosecond photoelectron interferometry, arXiv:2111.12037
DOI: https://doi.org/10.48550/arXiv.2111.12037

Busto, D., Laurell, H., Finkelstein-Shapiro, D., Alexandridi, C., Isinger, M., Nandi, S., Squibb, R. J., Turconi, M., Zhong, S., Arnold, C. L., Feifel, R., Gisselbrecht, M., Salières, P., Pullerits, T., Martín, F., Argenti, L., & L'Huillier, A. (2022). Probing electronic decoherence with high-resolution attosecond photoelectron interferometry. In European Physical Journal D (No. 112; Vol. 76, Issue 7).
DOI: https://doi.org/10.1140/epjd/s10053-022-00438-y

If you have published anything based on these data, please notify us with a reference to your publication(s). If you are responsible for the catalogue entry, you can update the metadata/data description in DORIS.

Accessibility level

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Versions

Version 1. 2022-03-25

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DataCite

DDI 2.5

DDI 3.3

DCAT-AP-SE 2.0

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Citation (CLS)

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