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Ultra-stable and high spectral resolution attosecond beamline for photoelectron interferometry

We present an ultra-stable and high spectral resolution attosecond pump-probe setup for photoelectron interferometry. Our system, based on a Mach-Zehnder interferometer, uses active stabilization of the interferometer arm lengths obtained directly from the phase relation of the pump and probe femtosecond laser pulses. With this technique, the system is stable to within 14 attosecond root-mean-square error over several hours.

With a 2 m long, high spectral resolution ($\approx$ 80 meV), magnetic-bottle electron spectrometer we use the rainbow RABBIT (Reconstruction of Attosecond Beating By Interference of two-photon Transitions) technique to measure the spectral phase across the spin-orbit resolved $3s^1 3p^6 4p$ Fano resonance in argon. By using a narrow bandwidth (10 nm) probe, we further improve the spectral phase resolution of our measurement by reducing the effects of spectral phase variations in the probe pulse, and mixing of different frequencies of the photoelectron wavepacket. This allows us to measure, for the first time, a 2π phase shift across the resonance. We propose a theoretical interpretation of the results.

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