Core-resonance line-shape analysis of atoms undergoing strong-field ionization

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Attosecond transient absorption spectroscopy (ATAS) is well suited for the time-resolved investigation of strong-field ionization (SFI) since the all-optical approach probes the system while it is being ionised. Using XUV spectrometers with high spectral resolution, absorption lines can be investigated not only with respect to their energy and line/oscillator strength, but also their specific shape. The continuous transition from a symmetric Lorentzian to an asymmetric Fano line is the result of a change in the phase of the underlying dipole [1].

In this contribution, we perform a systematic analysis of the line shape of an ionic core-to-valence transition in xenon using ATAS at different NIR pump intensities [2]. We extract the dipole phase from the measured/simulated line-shape and identify an indirect ionization pathway. Strong-field ionization of neutral xenon from an XUV core-excited virtual state interferes with the direct pathway of valence-shell strong-field ionization. This interference leads to delay-dependent asymmetry changes of a xenon ion XUV absorption line shape. More specifically, we observe delay-dependent NIR-half-cycle oscillations of the line-shape asymmetry whose amplitude decreases with increasing NIR pump intensity. We attribute this effect to the depletion of the neutral ground state, and hence a weakening of the interfering virtual pathway, which is confirmed by calculating the remaining neutral Xe population.

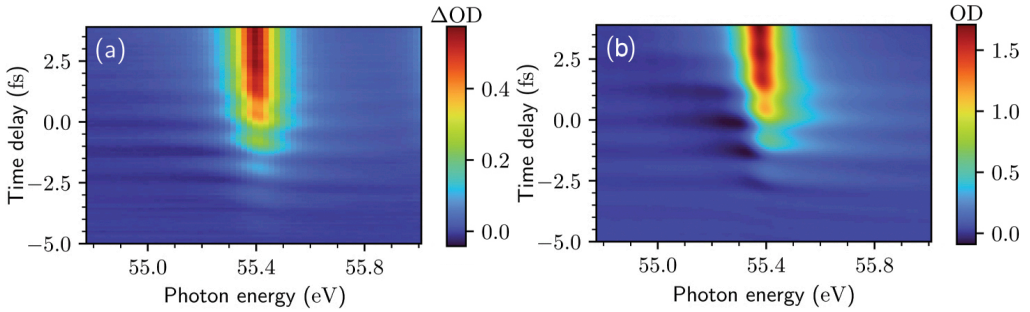

Figure 1: ATAS scan centered on the $5p_{3/2}^{-1} \rightarrow 4d_{5/2}^{-1}$ transition in the time-delay overlap region. (a) Measured and (b) simulated optical density, computed with the *ab initio* RMT approach [3].

References

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