

Analytical model for the calculation of the attosecond transient absorption spectrum of argon

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Synopsis We present a finite-pulse perturbative model that is able to describe resonant attosecond transient absorption spectra of atoms for arbitrary polarization of a moderately intense dressing pulse.

Recent advances in ultrafast laser technology have allowed the probing of electron dynamics of highly excited, quasi-bound atomic states that ionize on a femtosecond timescale [1, 2, 3]. These experiments give insight into the correlated nature of shortly-lived autoionizing resonances, and provide a stringent test for the analytical methods used to describe laser-assisted autoionization processes. Recently, a finite-pulse, multi-photon perturbative model, developed with the contribution of one of us (L.A. [1, 4]), was shown to reproduce accurately attosecond photoelectron spectra of atoms in the vicinity of autoionizing states. Here, we present an extension of this model to the fourth order, which is able to predict the attosecond transient absorption spectrum (ATAS) of atoms above the ionization threshold. We use this model, in conjunction with *ab initio* structure calculations [5], to reproduce the ATAS spectrum of the argon atom near its lowest autoioniz-

ing terms, as a function of the polarization vectors of and the time delay between the linearly polarized extreme ultraviolet and infrared fields that are typically employed in attosecond interferometric pump-probe spectroscopy. We show how changing the frequency and polarization of the dressing pulse it is possible to alter the relative strength of the coupling between neighboring autoionizing states, and hence to control the effective lineshape parameters of selected resonances.

References

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