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Controlling electronic couplings with tunable long wavelength pulses: Study of Autler-Townes splitting and XUV emission spectra[1]
NATHAN HARKEMA, CHEN-TING LIAO, ARVINDER SANDHU, University of Arizona — Attosecond transient absorption spectroscopy (ATAS) enables the study of excited electron dynamics with unprecedented temporal and energy resolution. Many ATAS experiments use an extreme ultraviolet (XUV) pump pulse and a near-infrared (NIR) probe fixed at the fundamental laser frequency ($\sim$ 800 nm) to study the light induced effects on electronic structure of atoms and molecules. We extend the technique by using an optical parametric amplifier in one arm of our setup, which allows us to independently tune the frequency of the probe pulse from 1200 to 1800 nm. These long-wavelength pulses allow us to explore a new regime, where we can control the couplings between nearby electronic states to alter the transient absorption lineshapes in atoms. We use this technique to investigate the 4p-3s detuning dependent Autler-Townes splitting of the 4p state in Helium. Light induced Floquet structures extending into the continuum are observed in our study. We demonstrate new tunable XUV emission channels from four-wave mixing processes, and the efficiency of these emissions can be strongly enhanced through resonant couplings. The tunable IR induced electronic couplings are also used to influence the autoionization dynamics in Argon.

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