Multi-Wave Mixing in the High Harmonic Regime: Monitoring Electronic Dynamics

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It has been demonstrated that electronic coherences across many eV can be detected in pump-probe experiments involving high harmonic sources. An additional degree of control over the phase matching can be employed by investigating a more general class of multi-wave mixing. Non-collinear multi-wave mixing of high harmonics with energy $q_1\omega_1 + q_2\omega_2$ can be selectively detected along the direction of $q_1\mathbf{k}_1 + q_2\mathbf{k}_2$. Simulations based on a recently developed semi-perturbative approach show that only the specific harmonic signals with $q_1\omega_1$ close to the energy difference between ground state and excited states are observable when the two input pulses are well separated in time. The coherent dynamics between different states can be selectively tracked by detecting the time-delay dependent signals with different $q_1\mathbf{k}_1$, which can overcome the potential spectral congestion in real experiments. Additionally, such non-collinear geometry can be used to separate the dephasing induced decay and collision induced recovery behaviors of pump-probe high harmonic signal typically observed in the time-resolved high harmonic pump-probe signals.

References

[1] K E Dorfman, P Wei, J Liu,and R. Li, Opt. Express **27**, 7147 (2019)

[2] S Jiang and K E Dorfman, Proc. Natl. Acad. Sci. **117**, 9776 (2020)

[3] S Jiang, M Kowalewski and K E Dorfman, Opt. Express **29**, 4746 (2021)