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High Harmonic Generation and XUV Free Induction Decay From Electronic Wavepackets

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In High-order Harmonic Generation (HHG), the electron that tunnel ionize from a given electronic state generally photorecombine onto the same state. We have demonstrated that during a few cycle laser pulse, several Rydberg states can be populated and open a new channels for HHG : the tunnel ionization from excited states and photorecombination onto the ground state. Using the attosecond lighthouse technique to spectro-temporally map the emission, we showed that the high harmonic emission from Rydberg states is temporally delayed by few-femtosecond compared to the usual non-resonant HHG [1].

Moreover, when the laser pulse is over, the coherence between the ground state and the Rydberg states created during the laser pulse leads to narrowband XUV emission at the Rydberg states field-free energies, due to Free Induction Decay (FID). Using a time-delayed IR pulse, this FID emission is probed and controlled, both in amplitude and phase. We directly measure the laser-induced phase on the FID emission by using a simple heterodyne dectection scheme based on two-source interferometry [2]. This technique provides rich information about the interplay between the laser field and the Coulombic potential on the excited electron dynamics.

[1] S. Beaulieu et al., Phys. Rev. Lett. 117, 203001 (2016)

[2] S. Beaulieu et al., arXiv: 1701.06352v1 [physics.atom-ph] (2017)

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