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Sub-Cycle Dynamics of High Harmonic Generation of He Atoms Excited by Attosecond Pulses and Driven by Near-Infrared Laser Fields: A Self-Interaction-Free TDDFT Theoretical Approach[1] JOHN HESLAR, National Taiwan University, Taiwan, DMITRY A. TELNOV, St. Petersburg State University, Russia, SHIH-I CHU, University of Kansas — In the framework of the *self-interaction-free* time-dependent density functional theory, we have performed 3D *ab initio* calculations of He atoms in near-infrared (NIR) laser fields subject to excitation by a single extreme ultraviolet (XUV) attosecond pulse (SAP). We have explored the novel dynamical behavior of the sub-cycle high harmonic generation (HHG) for transitions from the excited states to the ground state and found oscillation structures with respect to the time delay between the SAP and NIR fields. The oscillatory pattern in the photon emission spectra has a period of 1.3 fs which is half of the NIR laser optical cycle, similar to that recently measured in the experiments on transient absorption of He (M. Chini *et al.*, Sci. Rep. **3**, 1105 (2013)). We present the photon emission spectra from 1s2p, 1s3p, 1s4p, 1s5p, and 1s6p excited states as functions of the time delay. We explore the sub-cycle Stark shift phenomenon in NIR fields and its influence on the photon emission process. Our analysis reveals several new features of the sub-cycle HHG dynamics and we identify the mechanisms responsible for the observed peak splitting in the photon emission spectra.

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