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Subcycle dynamics of high harmonic generation in valence-shell and virtual states of Ar 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, USA — In the framework of the self-interaction-free time-dependent density functional theory (TDDFT), we have performed an ab initio all-electron study of subcycle structure, dynamics, and spectra of high harmonic generation (HHG) processes of Ar atoms in the presence of extreme ultraviolet (XUV) attosecond pulses and near-infrared (NIR) laser fields. The TDDFT equations are solved accurately and efficiently via the time-dependent generalized pseudospectral (TDGPS) method. We focus on the subcycle (with respect to NIR field) temporal behavior of the level shift of the excited energy levels and related dynamics of harmonic photon emission. We observe and identify the subcycle shifts in the harmonic emission spectrum as a function of the time delay between the XUV and NIR pulses. We present and analyze the harmonic emission spectra from $3snp_0$, $3p_0ns$, $3p_1nd_1$, $3p_1np_1$, $3p_0nd_0$, $3p_0np_0$, and $3p_0ns$ excited states and the $3p_04p_0^-$ virtual state as functions of the time delay. In addition, we explore the subcycle a.c. Stark shift phenomenon in NIR fields and its influence on the harmonic emission process. Our analysis reveals several novel features of the subcycle HHG dynamics and spectra as well as temporal energy level shift.

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