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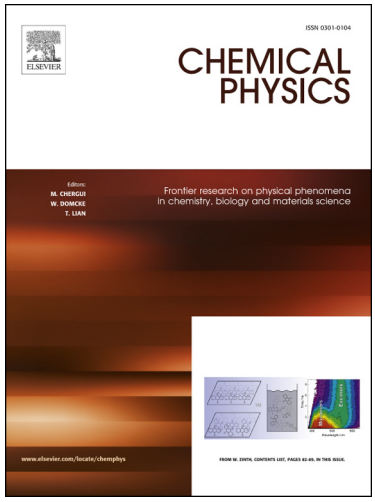

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Wavelength dependence of high-harmonic yield in stretched molecules

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Abstract

We study the wavelength dependence of harmonic yield in stretched molecules. It is found that when the laser field is perpendicular to the molecular axis, the harmonic yield has a slow scaling $\lambda^{-4.27}$ as the increase of the laser wavelength for the stretched molecule H_2^+ with the internuclear distance of 7 a.u. compared with $\lambda^{-5.11}$ for H_2^+ at the equilibrium position. Further analysis shows that the narrower width of the initial wave-function in the momentum space is in charge of the slow wavelength scaling of the stretched molecule since it can make the wave-function spreading less during propagation. Moreover, a higher enhancement and a better wavelength scaling of harmonic yield both can be achieved at the optimal internuclear distance of 7 a.u..

Keywords: High-order harmonic generation, wavelength dependence, stretched molecules, wave-packet spreading

PACS: 42.65.Ky, 33.80.Fb, 32.80.Rm

1. Introduction

Many interesting strong field phenomena will take place [1–5], when the intense laser pulse interacts with atoms or molecules. One of the most attractive phenomena is high-order harmonic generation (HHG) [6–11]. It supplies an important and effective avenue to generate extreme-ultraviolet radiation [12, 13] and an isolated attosecond source [14], which has significant applications in attosecond science [15, 16]. Because wider harmonic spectra can provide a way to generate shorter attosecond pulses which can be used for ultrafast measurement with higher resolution [17], improving the cutoff energy of high-order harmonic generation has attracted much attention in recent years [18–24].

The underlying physics of HHG can be well understood by the three-step model [1, 25]: ionization, acceleration, and recombination, followed by harmonic emission. The maximal energy of photon emitted in the HHG process is

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