High Harmonic Generation from Oriented Asymmetric Molecules in the Presence of Static Electric Field

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It is well known that the interaction of an intense laser pulse with a gaseous medium leads to the generation of high harmonics of the laser pulse [1]. The mechanism of high harmonic generation (HHG) is well understood in terms of the "three-step" model [2]: the electron is first ionized, then accelerated in the laser field, and finally recombined on the parent ion with the emission of an energetic photon. This process occurs periodically in each half cycle of the driving field; hence, for the isotropic gas medium, only odd harmonics are generated. The use of oriented asymmetric molecules breaks the symmetry of the ionization process in consecutive half laser cycles, and the HHG spectrum contains both odd and even harmonic numbers [3].

In this paper, we investigate the HHG during the interaction of the femtosecond laser field with oriented asymmetric molecules in the presence of an external static electric field. Based on the numerical solution of the time-dependent Schrödinger equation for the model one-electron system [3], we calculate the HHG spectrum for different static field strengths, laser-pulse intensities, and wavelengths. We find the range of parameters that corresponds to the linear dependence of high harmonic intensities on the static field strength. It is demonstrated that this range of parameters is attractive for implementing sampling methods of measuring the waveforms of low-frequency (terahertz or mid-infrared) radiation based on the HHG of probe laser pulse with variable time delay related to the low-frequency field.

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References

[1] F Krausz and M Ivanov, Rev. Mod. Phys. **81**, 163 (2009)

[2] P B Corkum, Phys. Rev. Lett. **71**, 1994 (1993)

[3] X B Bian, A D Bandrauk, Phys. Rev. Lett. **105**, 093903 (2010)