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Chapter 13

Interference Effects in High-Order Harmonic Generation in Solids

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13.1 Introduction

Interference effect is one of the most important phenomena in physical sciences. For high-order harmonic generation (HHG) in gases, there are various types of interference in HHG processes, such as interference between different atomic centers within molecular targets [1,2], interference between different orbits in molecules [3–5], and interference between long and short trajectories [6]. From 2011, HHG in solids has become a hot research direction [7]. Rich interference effects in crystal HHG have been revealed by theoretical and experimental studies recently. From the energy band theory [8], high-order harmonics mainly come from the interband polarization and intraband oscillation in crystals. In this chapter, we will review the multi-electron interference in intraband currents, the interference between long and short trajectories in interband currents, the interference

The simulation in Fig. 13.11 is also performed in the single-active electron approximation. It should be applicable to the real solid system since Zener tunneling occurs molstly around the Γ point. This interference model is also applicable in both the intraband and interband transitions. The modulation of harmonic yield as a function of laser intensity can be found in the experimental results in Refs. [25, 26]. Our model predicts that this kind of modulation will also be present in the driving laser wavelength scaling [24].

13.7 Discussion

The appearance of interference in HHG spectra sensitively depends on the laser conditions and band structures. When the driving laser wavelength is long, the intraband harmonics usually dominate the spectra, then one may observe the multi-electron interference in intraband transitions. At the same time, laser vector potential A_0 may be bigger than π/a, i.e., electrons and holes may travel beyond the edge of the first BZ, and then multichannel interference may occur. If the interband and intraband transitions are comparable, the interference between them may be measured. When the driving laser wavelength is short and the interband transtion dominates, the interference between long and short trajectories will be present. Subcycle interference requires a bigger dephasing time, and may exist in both the intraband and interband harmonics. These interference effects may be used to understand the origin of rich spectral structures in HHG, reconstruct band structure, and probe ultrafast electron-hole dynamics in solids.

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