High-Harmonic Generation in strongly correlated systems

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High-harmonic generation (HHG) is an intriguing nonlinear phenomenon indued by a strong electric field. It has been originally observed and studied in atomic and molecular gases, and is used in attosecond laser sources as well as spectroscopies. An observation of HHG in semiconductors expanded the scope of this field to condensed matters [1]. The HHG in condensed matters is attracting interests since it may be used as new laser sources and/or as powerful tools to detect band information such as the Berry curvatures.Recently, further exploration of the HHG in condensed matters are carried out in various other systems than semiconductors.

In this presentation we introduce our recent theoretical efforts on the HHG in strongly correlated systems [2,3,4]. In contract to semiconductors, the charge carriers are not normal fermions, which makes HHG in strongly correlated systems unclear. Using the dynamical-mean field theory and the infinite time-evolving block decimation for the Hubbard model, we reveal the HHG features in the Mott insulators. Firstly, we reveal that the origin of the HHG in the Mott insulator is the recombination of doublons (doubly occupied sites) and holons (no electron site)[2]. Then, we show that the HHG feature qualitatively changes depending on the field strength due to the change of mobility of charge carriers, and discuss that the HHG directly reflects the dynamics of many body elemental excitations, which the single particle spectrum may miss. These results indicate that the HHG in Mott systems may be used as a spectroscopic tool for many body elemental excitations [4]. We also discuss the effects of spin dynamics on the HHG, which is a unique feature in strongly correlated systems.

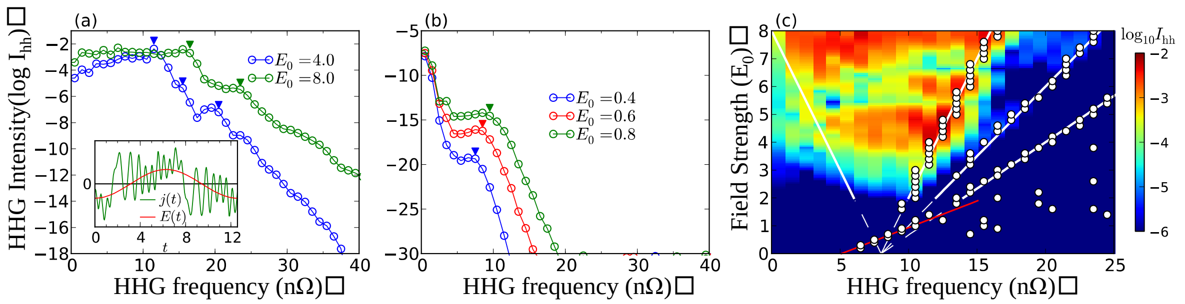

Figure 1: Results of the single-band Hubbard model [2]. (a) HHG spectra in the stronger-field regime, (b) HHG spectra in the weaker-field regime, and (c) HHG spectra as a function of the field strength (E_0) and the harmonic energy (nΩ). The arrows and the white circle markers show cutoff energies. The inset of panel (a) shows the current and electric field during one period for E_0 = 4.0.

Reference

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