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DC electric field-driven discretized excitation spectra in Mott insulators: an infinite matrix-product state approach

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Phenomena induced by dc electric fields in strongly correlated electron systems, such as Mott breakdown and field-induced magnetism, have been widely discussed both experimentally and theoretically. Recently, intense terahertz light pulses generated from synchrotron radiation have attracted particular attention as a method for observing these phenomena [1] since the energy of terahertz light is quite small compared to the energy gap of Mott insulators and it can be regarded as a low-frequency limit, i.e., almost a dc electric field. Using this terahertz light as the pump light and examining the dynamical response from the probe light, the properties of strongly correlated materials in a dc electric field can be clarified.

In this study, we investigate the optical conductivity and single-particle excitation spectra in one-dimensional Mott insulators under a dc electric field, employing an infinite matrix-product state approach [2,3]. In Mott insulators, the energy level of lower and upper Hubbard bands due to electronic correlations are discretized by the electric field, resulting in the multiple peaks in the spectra. Our results are associated with the Wannier-Stark ladder [4] in a tilted potential.

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