Spin-Charge Separation and Non-Linear Optical Response in One-Dimensional Cuprates

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The spin-charge separation is one of the key concepts in strongly correlated electron systems in one-dimension[1]. This also provides an opportunity for much debate on high temperature superconductivity. The Mott gap, i.e., the charge excitation gap in strongly correlated electron systems is in contrast to the energy gap in band insulators. Recent experiments have revealed that Mott inlsusulators in one-dimension exhibit the strikingly large non-linear optical response. Here, we theoretically examine the spin-charge separation and the linear and non-linear responses in one-dimensional Mott insulators and clarify the nature of the photo-excited states. In particular, we focus on the followings: (i) the linear absorption which is characterized by the odd-parity excited states, (ii) the two-photon absorption (TPA) which is characterized by the even-parity excited states, and (iii) the third-harmonic generation (THG). The theoretical results are compared with the experimental ones. We discuss the similarity and dissimilarity of the electronic and optical properties in one- and two-dimensional Mott insulators based on the spin-charge separation.

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[1] S. Maekawa et al. : “Physics of Transition Metal Oxides” (Springer, 2004)