

Conductivity of strongly correlated bosons in optical lattices in an Abelian synthetic magnetic field

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Topological phase engineering of neutral bosons loaded in an optical lattice opens a new window for manipulating of transport phenomena in such systems. Exploiting the Bose-Hubbard model and using the magnetic Kubo formula proposed in this paper we show that the optical conductivity abruptly changes for different flux densities in the Mott phase. Especially, when the frequency of the applied field corresponds to the on-site boson interaction energy, we observe insulator or metallic behavior for a given Hofstadter spectrum. We also prove that for different synthetic magnetic-field configurations the critical conductivity at the tip of the lobe is nonuniversal and depends on the energy minima of the spectrum. In the case of $1/2$ and $1/3$ flux per plaquette, our results are in good agreement with those of the previous Monte Carlo study. Moreover, we show that for half magnetic flux through the cell the critical conductivity suddenly changes in the presence of a superlattice potential with uniaxial periodicity.

References:

[1] A. S. Sajna, T. P. Polak, and R. Micnas, Phys. Rev. A 89, 023631 (2014).