

Violation of the Luttinger's theorem in fractional Chern insulators

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In this work, single-electron excitations in a fractional Chern insulator are investigated. The fractional insulator phase can be described in terms of weakly interacting fractionally charged quasiparticles. However, it was theoretically predicted [1] that the electron is a stable excitation in this strongly correlated liquid. Moreover, using the Luttinger theorem [2], one can show [3] how electronic correlations are related to the low-energy physics of the fractional quantum Hall effect. The focus of this study is to explore the physics of the fractional quantum Hall effect in lattice systems (fractional Chern insulators) using the Luttinger theorem [2].

In this study, we analytically and numerically demonstrated a violation of this theorem in the fractional quantum Hall phase, which is associated with the emergence of the Green's function zeros within the single-particle gap. In particular, this leads to a deviation of the many-particle Chern number C from the value N_3 , which is an invariant and works well in the integer quantum Hall effect.

[1] Jain J K and Peterson M R 2005 *Phys. Rev. Lett.* **94** 186808

[2] Luttinger J M 1960 *Phys. Rev.* **119** 1153

[3] Peralta Gavensky L, Sachdev S and Goldman N 2023 *Phys. Rev. Lett.* **131** 236601