

# Interaction-Induced Topological and Magnetic Phases in the Hofstadter-Hubbard Model

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Interaction effects have been a subject of contemporary interest in topological phases of matter. But in the presence of interactions, the accurate determination of topological invariants in their general form is difficult due to their dependence on multiple integrals containing Green's functions and their derivatives. Here we employ the recently proposed effective topological Hamiltonian [1] approach to explore interaction-induced topological phases in the time-reversal-invariant Hofstadter-Hubbard model. Within this approach, the zero frequency part of the self-energy is sufficient to determine the correct topological invariant.

We combine the topological Hamiltonian approach with the local self-energy approximation within Hartree-Fock and dynamical mean field theory (DMFT), and present the resulting phase diagram in the presence of many-body interactions. We investigate the emergence of quantum spin Hall (QSH) states for different interaction strengths by calculating the  $Z_2$  invariant. We also comment on the bulk-boundary correspondence at finite interactions [2]. The interplay of strong correlations and a staggered potential also induces magnetic long range order with an associated first order transition. We present results for the staggered magnetization ( $m_s$ ), staggered occupancy ( $n_s$ ) and double occupancy across the transition.

## References:

- [1] Z. Wang and S. C. Zhang, “*Simplified Topological Invariants for Interacting Insulators*”, Phys. Rev. X **2**, 031008 (2012)
- [2] M. Hohenadler and F. F. Assaad, “*Correlation effects in two-dimensional topological insulators*”, J. Phys.: Condens. Matter **25**, 143201 (2013)
- [3] P. Kumar, T. Mertz and W. Hofstetter, “*Interaction-Induced Topological and Magnetic Phases in the Hofstadter-Hubbard Model*”, arXiv:1606.09161