

Impurity-induced thermal crossover in fractional Chern insulators

Ke Huang¹

Xiao Li¹

¹*City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong SAR*

Khuang22-c@my.cityu.edu.hk

Abstract

The recent experimental observation of fractional quantum anomalous Hall (FQAH) states in rhombohedral multilayer graphene has attracted significant attention. One of the most intriguing observations is that the FQAH states at various fractional fillings give way to IQAH states as the temperature is lowered [1]. In this work [2], we propose a mechanism for the appearance of FQAH states within a finite temperature range in a toy model. The model consists of a flat Chern band and impurities, and we analyze the effects of impurities on the system's behavior at finite temperatures. We believe that the crossover may arise from the competition between the energy penalty for thermal excitations and the increase in entropy. We support our theoretical argument with numerical calculations using exact diagonalization. Our results suggest that impurities may play a crucial role in the crossover from the FQAH to IQAH states in rhombohedral pentalayer graphene.

References

- [1] Zhengguang Lu, Tonghang Han, Yuxuan Yao, Zach Hadjri, Jixiang Yang, Junseok Seo, Lihan Shi, Shenyong Ye, Kenji Watanabe, Takashi Taniguchi and Long Ju, *Nature*, 637 (2025) 1090-1095.
- [2] Ke Huang, Sankar Das Sarma, and Xiao Li, arXiv:2409.04349

Figures
