DISSERTATION

EMERGENT TOPOLOGICAL PHENOMENA IN LOW-D SYSTEMS INDUCED BY GAUGE POTENTIALS

Submitted by

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ABSTRACT

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Abstract goes here

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DEDICATION

I would like to dedicate this dissertation to my dog Zeta.

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Chapter 1

Introduction

EM gauge potential appears in electronic Hamiltonian in CM

1. Review Maxwell theory -> gauge potential
2. Minimal coupling $-i\hbar\nabla \to -i\hbar\nabla + q\mathbf{A}$ or $-i\partial_\mu \to -i\partial_\mu + qA_\mu$
3. TB Hamiltonian and Peierls phase

Topological phenomena in CM considered in thesis

1. (1) Majorana and TSC
   - i Kitaev chain (M— topological invariant). BdG?
   - ii Braiding (Application in TQC)
2. Landau Level and Hofstadter butterfly
   - i solve for LL in 2DEG — why it's topological, chern number, TKNN quantum Hall
   - ii square lattice — hofstadter butterfly (on other lattices, honeycomb)

STUFF

Chapter 2

Superconducting Triangular Islands as a Platform for Manipulating Majorana Zero Modes

1. Introduction
2. Formalism
    i. BdG — decide how much detail on derivation
    ii. Majorana Number
    iii. Many-Body Berry Phase
3. Model, results (uniform and non-uniform)
4. Discussion, future

Chapter 3

Floquet Landau Levels

1. Introduction (Tahir's intro is fine, maybe in my own words, Floquet engineering)
    i Time dependent, motivation—QAHE gap but not QHE gap
    ii Floquet Theorem— quasi-energy spectrum
2. Results
    i square + A(t) (Tahir's perturbative calc)
    ii honeycomb + A(t) (Tahir's perturbative calc)
3. Discussion and future

Chapter 4

Conclusion and Discussion

What makes gauge potential unique in creating/tuning/manipulating new topoglical systems

Applications

Appendix A

Suitable Name

1. Majorana Number derivation

2. Other derivations not included in introduction