Counterdiabatic, Better, Faster, Stronger:

Overcoming Losses in Quantum Processes

PhD Thesis

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Abstract

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Lay Summary

At the moment, this is full of quotes from Star Trek I'd like to use:

- "The slower you go, the more likely you'll get where you're going." - Stephen King, The Dark Tower

- "A library serves no purpose unless someone is using it." Mr. Atoz, "All Our Yesterdays"

- "Computers make excellent and efficient servants, but I have no wish to serve under them." Mr. Spock, "The Ultimate Computer"

- "Insufficient facts always invite danger." Mr. Spock, "Space Seed"

- "Change is the essential process of all existence." Mr. Spock, "Let That Be Your Last Battlefield"

- "Instruments register only through things they're designed to register. Space still contains infinite unknowns." Mr. Spock, "The Naked Time"

And now for some Terry Pratchett:

- "Sometimes scientists change their minds. New developments cause a rethink. If this bothers you, consider how much damage is being done to the world by people for whom new developments do not cause a rethink."

- "With magic, you can turn a frog into a prince. With science, you can turn a frog into a Ph.D and you still have the frog you started with."

Publications and manuscripts

The majority of this work is based on the following publications and manuscripts:

1. **Counterdiabatic Optimised Local Driving**, *Ieva Čepaitė, Anatoli Polkovnikov, Andrew J. Daley, Callum W. Duncan. PRX Quantum 4, 010309, 2023.* Eprint arxiv:2203.01948.

   There are a number of other articles which did not make it into the narrative of this thesis

Preface/Acknowledgements

I would like to acknowledge

Chapter 1

Introduction

Chapter 2

Preliminaries

2.1 Quantum Adiabaticity

Much of the motivation for the work presented in this thesis relies on a good understanding the idea of a quantum adiabatic process. While in classical thermodynamics, an adiabatic process i

Starting from the seminal work of Berry on the geometric phase [?], it was recognized that adiabaticity is intimately related to geometric aspects of the state space of a quantum system [?], and hence it is nowadays often presented with emphasis on a geometric angle.

2.1.1 The adiabatic gauge potential

2.1.2 Shortcuts to adiabaticity

2.1.3 Transitionless Driving

2.1.4 Variational counterdiabatic driving

2.2 Quantum Optimal Control

2.2.1 CRAB

2.2.2 GRAPE

Chapter 3

Counterdiabatic optimised local driving

Chapter 4

Conclusion

Appendix A

Stuff That Didn't Fit Anywhere Else

Appendix A. Stuff That Didn't Fit Anywhere Else