

Measuring of Entanglement Entropy in Valence Bond Quantum Monte Carlo Simulations

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

In this thesis we present methods for measuring entanglement entropy in spin-1/2 Heisenberg systems using quantum Monte Carlo in the valence bond basis. We first directly compare the recently proposed valence bond entanglement entropy to the standard definition of entanglement entropy: the von Neumann entanglement entropy. We find both cases in which SHUT UP, THESIS

We explain VB QMC techniques:

- single projector
- double projector
- loop algorithm

Look at VB EE compared to vN

Look at Renyi EE

Area Laws

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Chapter 1

Introduction

Explain entanglement
Explain measures of entanglement
Talk about entanglement entropy
Area Law
Corrections to Area Law

1.1 Entanglement

1.2 Measures of Entanglement

1.3 The von Neumann Entanglement Entropy

1.4 The Area Law

Chapter 2

Quantum Monte Carlo in the Valence Bond Basis

2.1 Single Projector

2.2 Double Projector

2.3 Loop Moves

Chapter 3

Valence Bond Entanglement Entropy

3.1 One Dimensional Systems

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Chapter 4

Measuring Rényi Entanglement Entropy

4.1 The Swap Operator

4.2 1D Results

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Chapter 5

Prospects for Future Research

Chapter 6

Conclusions

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