Thesis Title VB QMC... Entanglement...

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...

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Contents

Li	\mathbf{s}		vii			
List of Figures						
1	Intr	oduct	ion		1	
	1.1	Entan	nglement Entropy		1	
		1.1.1	The von Neumann Entanglement Entropy		1	
		1.1.2	The Area Law		1	
	1.2	somet	ching else to go in the introduction?		1	
		1.2.1	the VB QMC stuff?		1	
2	Qua	ntum	Monte Carlo in the Valence Bond Basis		2	
	2.1	Single	e Projector		2	
	2.2	Doubl	le Projector		2	
	2.3	Loop	Moves		2	
3 Valence Bond Entanglement Entropy		ence B	Bond Entanglement Entropy		3	
	3.1	One I	Dimension		3	
	3.2	Appro	oaching Two Dimensions		3	
	3 3	The A	Area Law		3	

4	Measuring Rényi Entanglement Entropy							
	4.1	The Swap Operator	4					
	4.2	1D Results	4					
	4.3	The Ratio Operator	4					
	4.4	2D Results	4					
	4.5	The Area Law	4					
5 Conclusions								
APPENDICES								
R	eferences 7							

List of Tables

List of Figures

Introduction

- 1.1 Entanglement Entropy
- 1.1.1 The von Neumann Entanglement Entropy
- 1.1.2 The Area Law
- 1.2 something else to go in the introduction?
- 1.2.1 the VB QMC stuff?

Quantum Monte Carlo in the Valence Bond Basis

- 2.1 Single Projector
- 2.2 Double Projector
- 2.3 Loop Moves

Valence Bond Entanglement Entropy

- 3.1 One Dimension
- 3.2 Approaching Two Dimensions
- 3.3 The Area Law

Measuring Rényi Entanglement Entropy

- 4.1 The Swap Operator
- 4.2 1D Results
- 4.3 The Ratio Operator
- 4.4 2D Results
- 4.5 The Area Law

Conclusions

APPENDICES

Bibliography

[1] Anders W. Sandvik. Ground state projection of quantum spin systems in the valence-bond basis. *Phys. Rev. Lett.*, 95(20):207203, Nov 2005.