aQa course 2021 - Miniproject

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June 2021

Contents

1. Theory

1.1. Strongly Correlated Systems

1.1.1. Exercise 1

(a) Let $a_i^\dagger$ be the creation operator on orbital i and a_i the annhilation operator. The canonical anticommutation relations are

$$\{a_i,\, a_j\} = \{a_i^\dagger,\, a_j^\dagger\} = 0 \tag{1.1}$$

$$\{a_i,\, a_j^\dagger\} = \delta_{i,\,j}\mathbb{1}. \tag{1.2}$$

(b) One transformation is

$$c_{i,0} = a_i + a_i^\dagger \tag{1.3}$$

$$c_{i,1} = \mathrm{i}(a_i - a_i^\dagger), \tag{1.4}$$

where i is the orbital index.

(c) Majorana fermions satisfy the following anticommutation relation

$$\{c_{i,\alpha} c_{i,\beta}\} = \delta_{i,j}\delta_{\alpha,\beta}\mathbb{1}. \tag{1.5}$$

1.1.2. Exercise 2

(a) Using the Jordan-Wigner transformation, a fermionic operator a_j or $a_j^\dagger$ becomes a j-local qubit operator, since it acts non trivially on j sites.

(b) Thanks to the fact of storing only partial sums of qubits occupation, a fermionic operator translates into a $O(\log(j))$-local qubit operator.

2. Project

More text ... Here I cite [1]

Bibliography

[1] A. Einstein. "Die Ursache der Mäanderbildung der Flußläufe und des sogenannten Baerschen Gesetzes". In: *Die Naturwissenschaften* 14.11 (Mar. 1926), pp. 223–224. DOI: 10.1007/bf01510300.

A. First appendix

Lots of cool stuff about being structured.

Todo list