Toponomic Quantum Computation

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Abstract

Holonomic quantum computation is a formalism of quantum computation where quantum gates are generated through non-abelian geometric phases obtained from suitable chosen quantum evolutions [1].

Recently we have shown [2] that for hamiltonians producing rotations, robust quantum gates can be produced by using the topological properties of a particular class of antisymmetric quantum states, known as anticoherent planes, which generalize anticoherent spin states [3], i.e. , states whose polarization vector vanishes.

This result generalizes a special topological property of anticoherent spin states when evolving under rotations [4]. This explains the origin of the word *toponomic* to describe this topologically robust way to perform holonomic quantum computation, extending the robustness against noise already presented in all schemes of holonomic quantum computation.

In this work, after a short presentation of the above model for holonomic quantum computation, we explicitly generate CNOT and TOFFOLI quantum gates using this formulation, in a way that allows for a generalization to a broader class of quantum gates of type CC…CNOT.

We also use the Majorana stellar representation of quantum spin states to find the suitable symmetry properties to get the target quantum gate. In Fig, 1 are presented the Majorana points of four different states used to find a CNOT gate.

References

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Figures

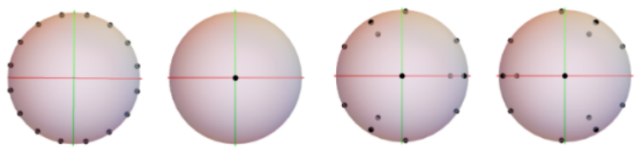

Figure 1: Geometric representation of four spin states used to the generation of topologically robust CNOT gates,