Adiabatic algorithms are implemented as follows:

1. Design a Hamiltonian where the ground state of the system encodes the solution to a trivial optimization problem
2. Prepare the known ground state of a simple Hamiltonian on a set of qubits
3. Adiabatically change the system to the desired Hamiltonian:
   \[ H(t) = f(t)H_1 + (1-f(t))H_0 \]
4. The system remains in ground state the final Hamiltonian and that will be the solution to the desired optimization problem

To study this problem, we can use a specific subclass of problems called gaussian free-fermion problems \[2\]. These models can be simulated scalably on classical computers.

**Motivation & Objective**

- Quantum adiabatic algorithms are of interest to quantum computing as an alternative to gate based quantum computing and are supposed to be more stable under errors , as method requires that qubits remain in their ground state the entire time\[1\].
- In this work we examine the error robustness of adiabatic quantum computing.

**Project Background**

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\[ \rho = \frac{e^{-\beta H}}{Z} \]

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**Results & Analysis: Error Scaling in Adiabatic Algorithms**

- Adiabatic errors depend on the number of qubits and the total adiabatic algorithm time
- Errors reduce as you increase the number of qubits and the adiabatic algorithm time
- Error scaling with the number of qubits in adiabatic and is similar to that in non-adiabatic algorithms

**Future Work, References, and Acknowledgments**

- Theoretical analysis of our proposed error quantifying scheme to verify the computational results.
- Simulating non-gaussian models
- Characterize the errors in quantum adiabatic algorithms using non-gaussian models

** ssh model**

- \[ H_{SSH} = \sum_{i=1}^{n} t_i a_i^+ a_i + H.c. \]
- The cases with the phase transition (at J=1) in the evolution require a larger T to stabilize because at J=1 the band gap collapses, making the thermal states more accessible.

**Methods: Quantifying Error**

**Adiabatic Algorithm**

- Initial Hamiltonian
- Intermediate Hamiltonian

**Gate Based (Non-Adiabatic) Quantum Algorithm**

- Ground State of Initial Hamiltonian
- Random Rotation (U)
- Reversed rotation (ground state, error perturbed)

**Results & Analysis: Error Scaling in Adiabatic Algorithms**

- Adiabatic and non-adiabatic errors in GS energies, for different values of n (number of qubits), with respect to T (the total adiabatic algorithm time).
- The cases with the phase transition (at J=1) in the evolution require a larger T to stabilize because at J=1 the band gap collapses, making the thermal states more accessible.