2020 Remote Summer Science Bi-Weekly Progress Report

Name of Student __Eesh Gupta___

Name of Faculty ___Stephen Schnetzer_____

Title of Project_ Calculation of molecular ground states using a quantum computer__

Department ____Physics & Asgonomy_____

1) Short introduction and objectives (Student to provide a brief statement about the objectives of the project)

In light of quantum computers being able to solve chemistry problems, our aim is to **benchmark recently proposed error mitigation techniques on the basis of types of noise they mitigate and their scalability with molecular systems.** The techniques we hope to explore are extrapolation, probabilistic error cancellation and quantum subspace expansion.

2) Accomplished work for specified period: From (June 1) To (June 12)

- **Notes**: Lindblad form of master equations in studying dynamics of open quantum systems.
- **Notes**: Richardson Extrapolation and its application on mitigating noise from quantum circuits
- **Experiment**: Amplifying noise by stretching pulses on a single qubit quantum circuit (with just the X gate) on the IBMQ-Armonk machine
- **Experiment**: Amplifying noise using Pauli-Twirling-and-Error-simulation technique on a 5 qubit quantum circuit on the IBMQ-Yorktown and IBMQ-London machines; Generate graphs for extrapolation

3) Continued Plan of Work (State clearly what the continued plan is; State what assistance is needed)

- **Experiment**: Amplifying noise via pulse stretching on larger circuits (in terms of gates and qubits)
- **Experiment**: Evaluating if extrapolation is a useful technique by applying it on a sample circuit from VQE simulation of hydrogen molecule, measuring error mitigated energy and comparing this result with ideal and noisy (un-mitigated) energies.
- **Notes and Experiment**: Exploring probabilistic error cancellation technique and comparing it with extrapolation through experiments.
- **Experiment** : Comparing the 2 noise amplifying techniques discussed in (2) – pulse stretching and twirling+simulation – on various noise models.

. **4) Any other comments:**

.

Student Name __Eesh Gupta__

Signature ____  _____

Date _6/11/2020__

Comments by Supervisors:

1) Name: Stephen Schnetzer Department: Physics & Astronomy

Comments: Eesh Gupta is making excellent progress

Signature:  Date: 6/11/2020