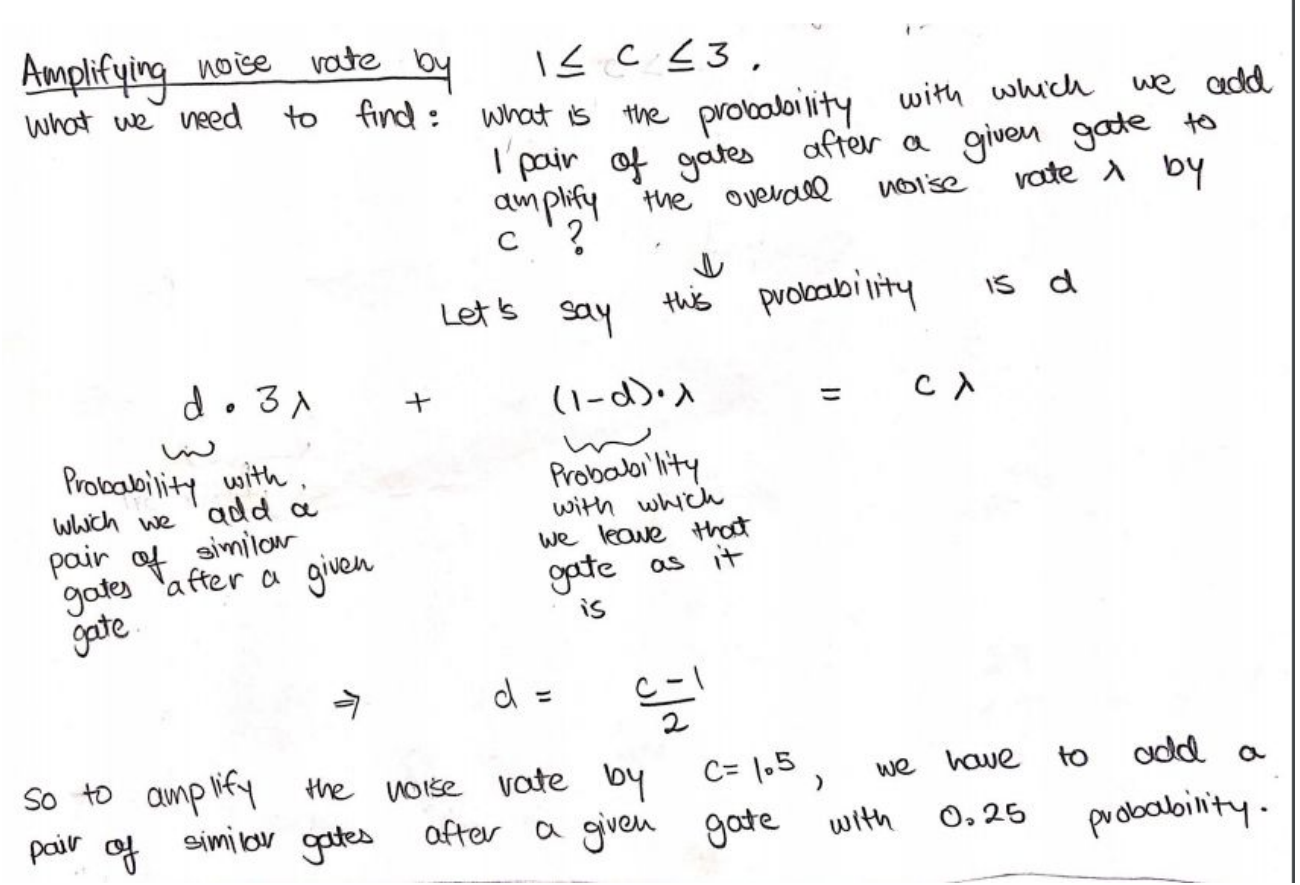
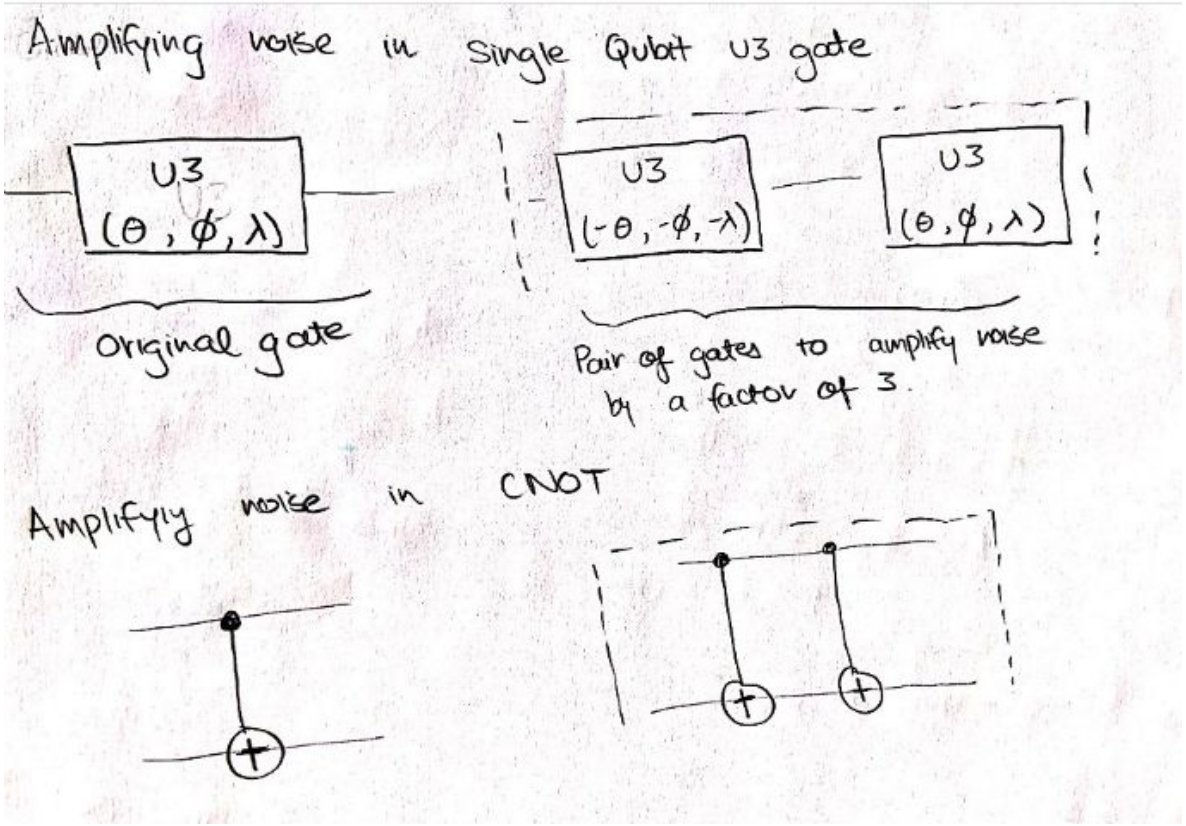
Amplifying Noise in VQE Optimized Circuit (4)

Meeting with Professor Schnetzer
August 3/4, 2020



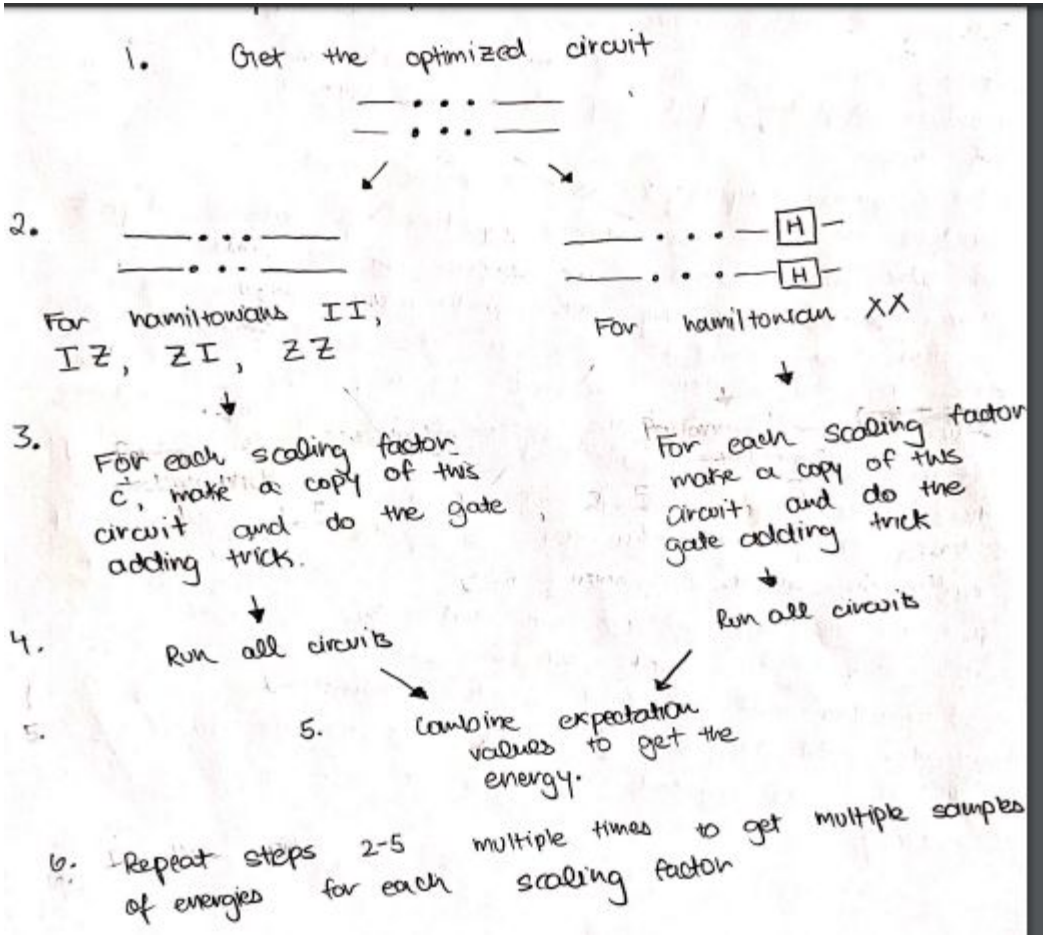
Noise Amplification Procedure

Note: *After adding any gate, we insert a barrier to prevent transpiler from making any changes to the noise amplified circuit.*

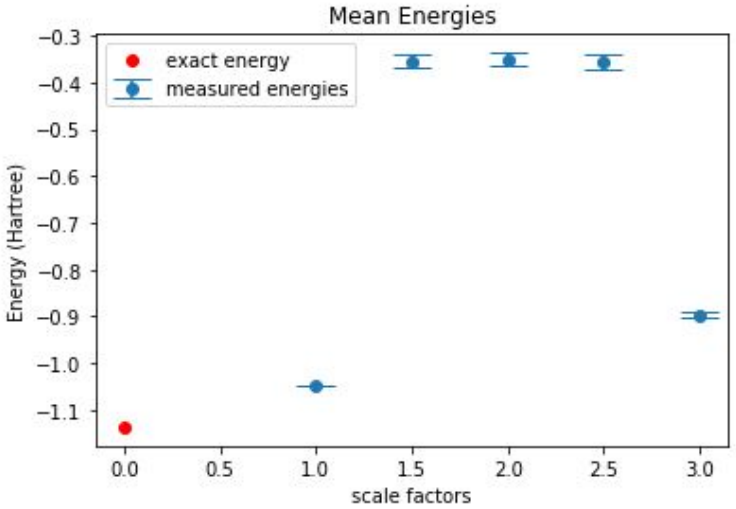


If a gate is chosen for noise amplification, how we add a pair of gates after it to triple the noise rate.

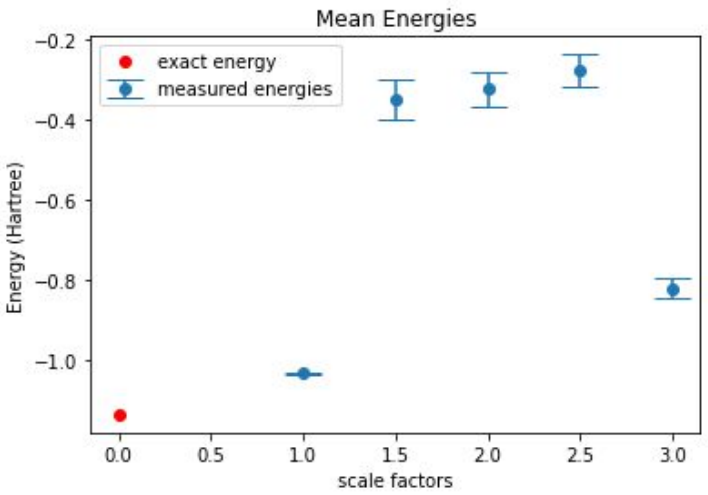
Amplifying Noise in Optimized VQE Circuit for Hydrogen Molecule at 0.74 ang separation.



Troubling Results!



London Noise Model Simulation (1000 samples)



London Quantum Computer (100 samples)

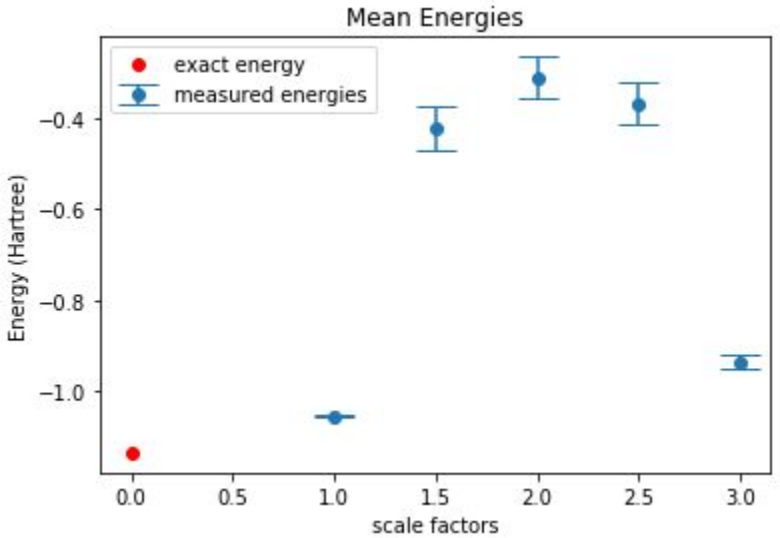
Looking Deeper

Repeating experiment in Slide 4:

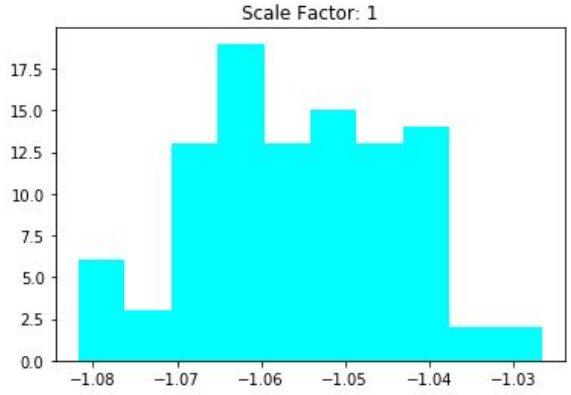
(100 samples on London Noise Model)

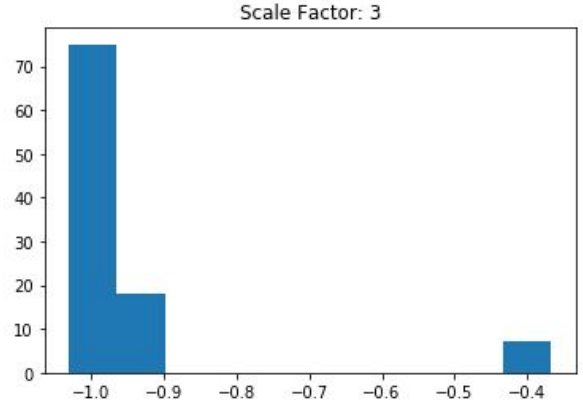
Why:

- Earlier versions showed that standard deviation was absurdly high (1 order of magnitude more than what's expected) for scale factors 1.5, 2 and 2.5.
- Need to verify that the spread is Gaussian and behaving as expected.



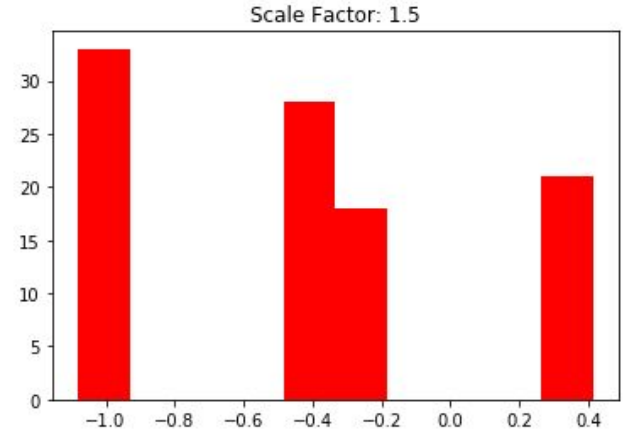
Results

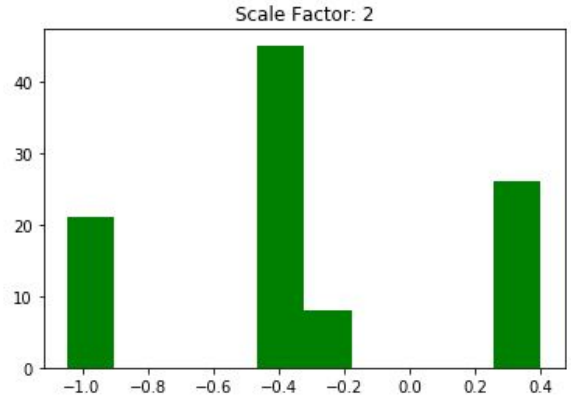


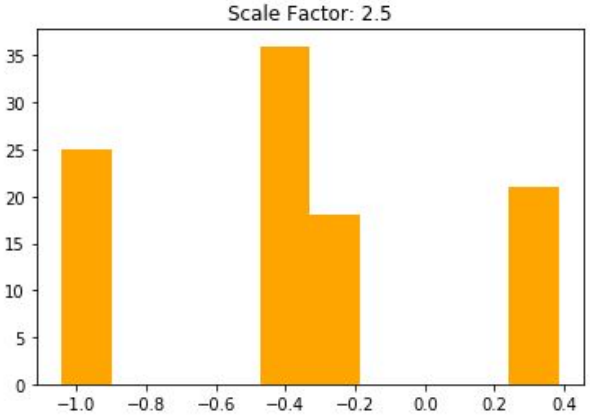


vs

X Axis: Energies (Hartree)
Y Axis: # of Samples





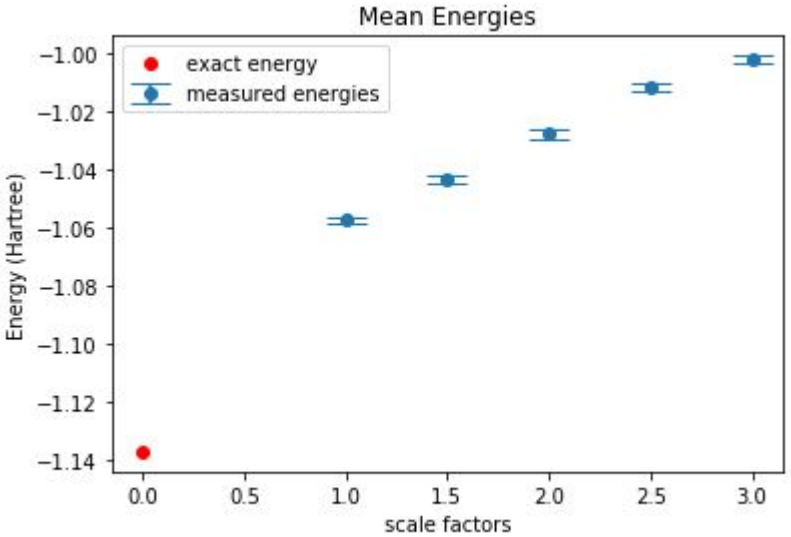


Looking Deeper

Histograms

- Data for 1 and 3 is concentrated in a very small range; not so for 1.5, 2 and 2.5
- Why are there 3 peaks, each of them separated by a considerable distance, for 1.5,2 and 2.5?
- Why do those 3 plots all look the same, as if noise amplifying doesn’t do anything?

Some Hope!



Isolating CNOT gates for noise amplification;

London Noise Model (100 samples)

- So results improve if we just amplify noise in CNOT gates. But we see that familiar jump from 0 to 1.
- To make sure these jumps were consistent (0 to 1 is same as 1 to 2), we chose to amplify noise in those single qubit U3 gates as well
- But as shown in slide 4, there is something going wrong there.
- Problem lies in how we are amplifying noise specifically in U3 gates.

Experiments Currently Running

Isolating U3 gates for noise amplification:

(100 samples on London Noise Model)

Why: If CNOT noise amplification is not an issue, then there must be something fishy going on with th U3 gates.