Updates on

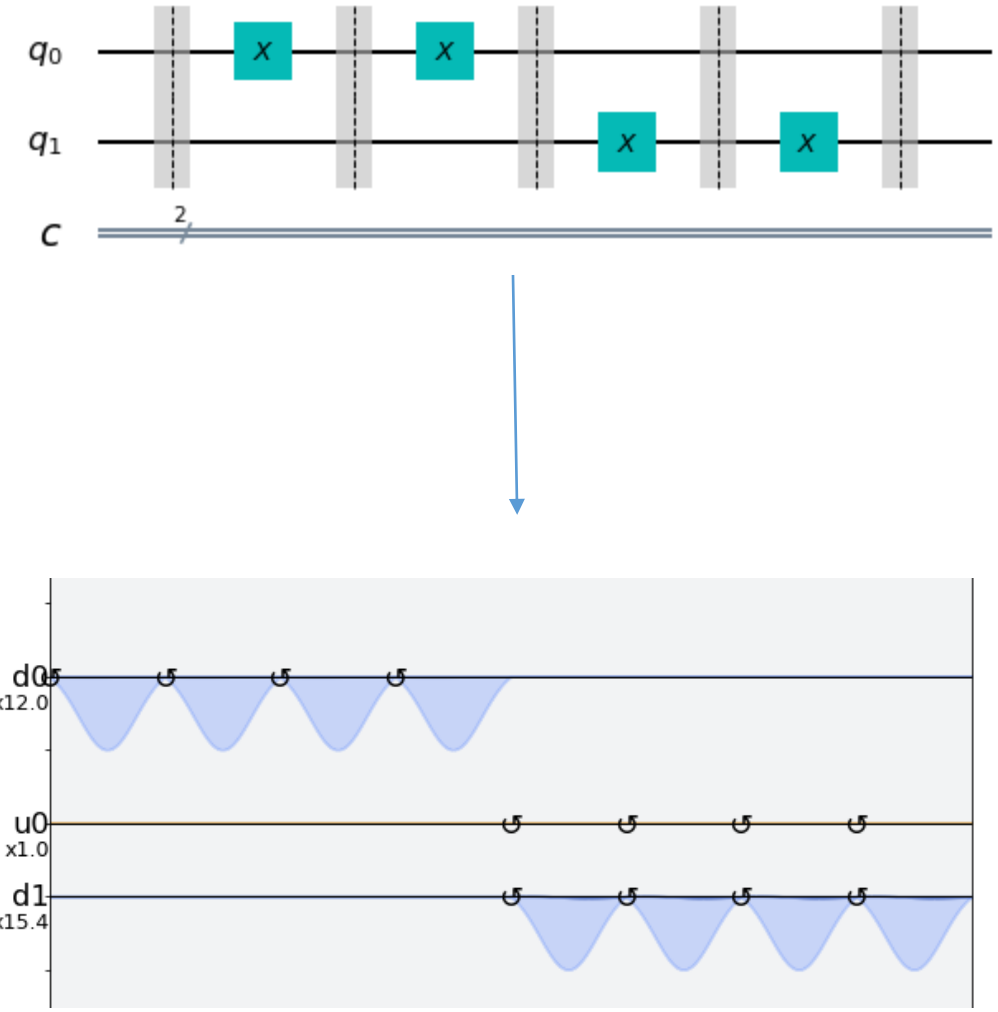
Pulse Stretching, Bigger Molecules and Errors

Meeting with Professor Schnetzer and Rikab

August 20, 2020

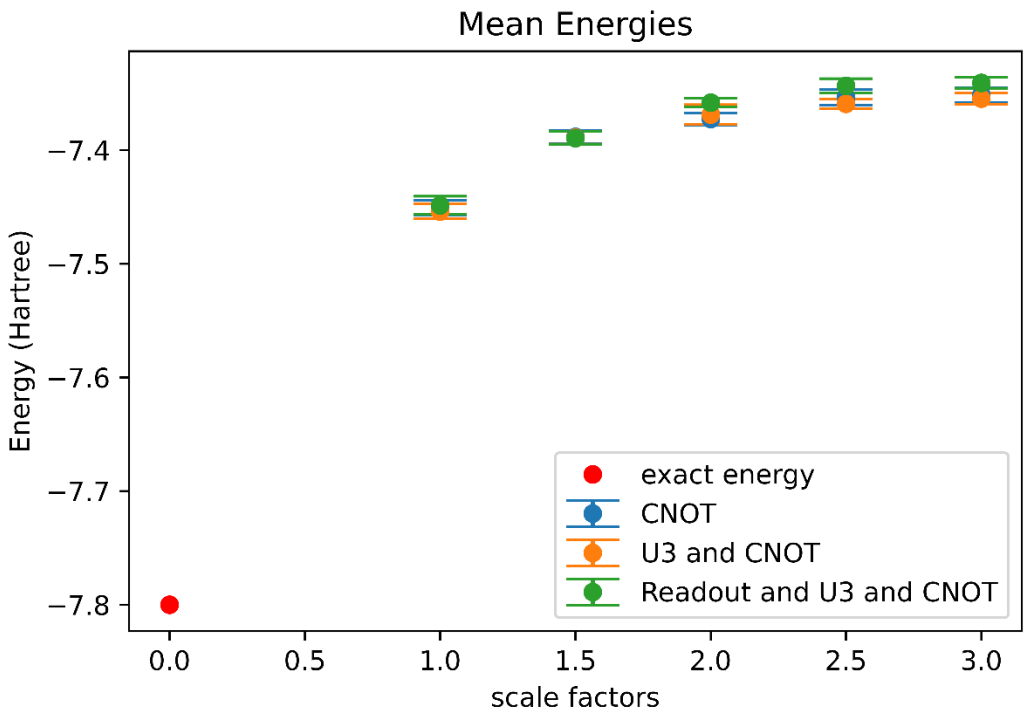
Pulse Stretching

- Done:
  - Given a quantum circuit, converting it to pulse form and stretching the pulses.
- Problem:
  - No way to implement noise in Qiskit's pulse simulators
  - Have to use external libraries like Qutip to make a simulator which supports noisy pulse experiments.



Experiment on Lithium Hydride

- Number of gates for UCCSD scale as $O(N^2\eta^2)$ where N is number of spin orbitals and η is number of electrons in the system.
- Lithium Hydride has 12 spin orbitals and 4 electrons --- around 2306 gates. Using some chemical approximations, reduced it to 500 gates.
- With ~100 CX gates and each one taking 300-400 ns, total gate time is exceeding T1, T2 time of the qubits.
- Hence adding in more gates to increase noise will not do much to the energies (since the qubit has already lost a lot of information due to decoherence)
- According to a some papers, using exponential functions for extrapolation might be more suitable for circuits with either lots of gates or lots of erros.
- For future, need to look at
  - Molecules such as H3 and H4
  - Other less "explosive" ansatz besides UCCSD



FakeLondon Noise Simulator, 30 samples

Issue of $E_{Thermal}$ and $E_{depolar}$

- When increasing noise by adding in more gates, we are already amplifying both $E_{Thermal}$ and $E_{depolar}$. No need for Scaling T_1 and T_2 then.
- Questions about noise:
  - Don't thermal relaxation errors cause depolarizing noise?
  - Are depolarizing and thermal relaxation errors enough for modeling noise in quantum computers?
  - Why aren't other forms of noise like amplitude damping, phase/bit flips taken into account as well?