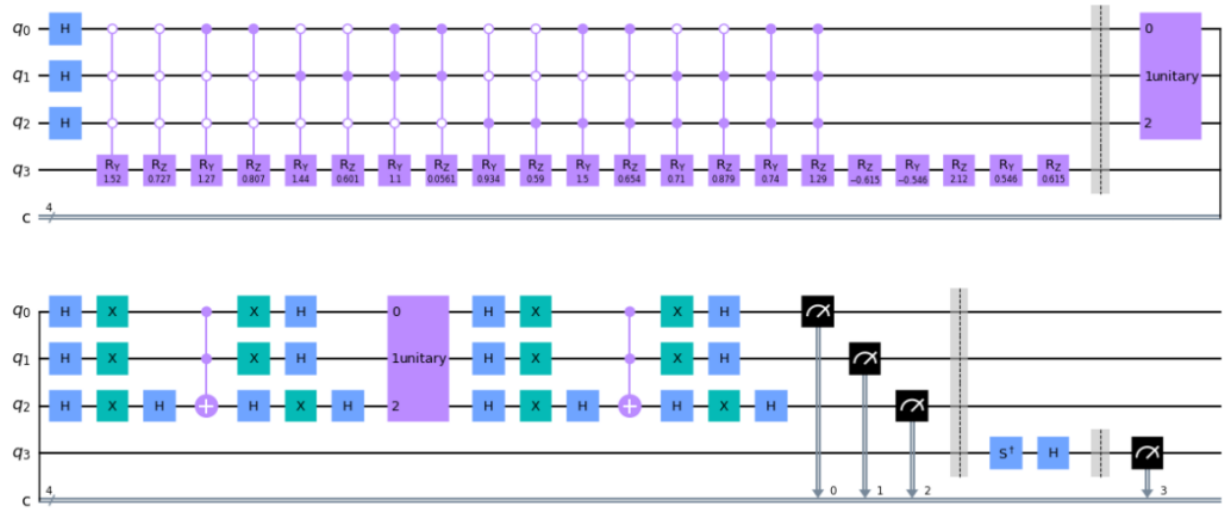
QAMP Second Checkpoint

Computing Rigid Body Rotations with Qiskit

A Circuit Approach

We are working on rotating multiple vectors resource-efficiently. To do this, we use conditioned rotation gates to prepare a single qubit into multiple initial vectors, each referenced by a basis state of n control qubits. Once all the initial vectors are stored in a single data qubit, we rotate this data qubit using a sequence of R_z and R_y gates. Since we have one vector for each basis state of the control qubits, we are able to rotate 2^n vectors using $n + 1$ qubits. Since the rotated vectors are stored in a single data qubit, we cannot extract all of them. Thus, the structure we propose can be used as a database from which a single vector can be extracted when required. To extract a vector, we need to collapse the control qubits to the index of said vector and then perform tomography on the data qubit. To ensure that the control qubits collapse to the state we want with high probability, we propose to perform a procedure similar to amplitude amplification on the control qubits with an oracle that marks the state we want. Then, we collapse the control qubits and perform normal tomography in the data qubit. We need to post-process the counts to make sure all instances where the control qubits did not collapse to the desired qubit are discarded before calculating the density matrix of the data qubit. After doing this, the conditional tomography calculations are performed and we are able to recover the rotated vector with high fidelity.



Tomography circuit measuring in Y basis