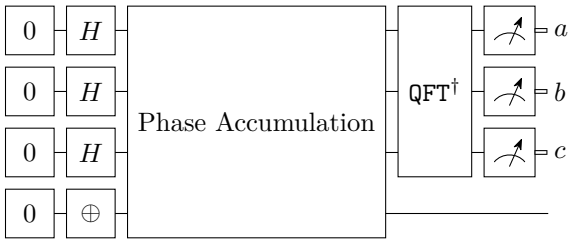
The QPE Ciricuit

- **Description.** Now that we know how phase accumulation works, and we know how to control the effect of the atmospheric pressure, we are now ready to implement the quantum phase estimation algorithm. We start by preparing the state $|1\rangle$ in the NV center so that we can accumulate the phase from the atmospheric pressure. We then perform the phase accumulation step, using three qubits in uniform superposition, so that for each binary number n represented in the uniform superposition, we apply U to the NV center exactly n-times. Next, we would like to extract the angle from the various phases we have accumulated. It turns out that there exists a quantum circuit, called the inverse quantum Fourier transform (QFT) which can take in these accumulated phases, and then return a representation of the angle (we will look at this representation in the next part). If we then measure these qubits, then we will recover the first three binary digits of the angle (with high probability). Putting, all of this together, we obtain the quantum phase estimation algorithm. Schematically, quantum phase estimation with three output qubits has the following structure where the estimate is encoded by $|abc\rangle$.



  Implementing the inverse QFT algorithm is quite tricky. Thankfully, we can use the built-in $\texttt{QFT}^\dagger$ gate in Quirk, which can extend to any number of qubits. This means that we can use the inverse QFT algorithm without knowing how to implement the inverse QFT algorithm. Your goal in this activity is to implement the quantum phase estimation for your NV center sensor, using the two circuits from the previous activities.

- **Submission.** A screenshot of the circuit and the Quirk file.