

Final Project

1. Implement the quantum teleportation algorithm and transport the state $(|0\rangle + |1\rangle)/\sqrt{2}$ from Alice to Bob on IMBQ, and perform the **quantum state tomography** to reconstruct the transported **density matrix**, ρ' , on IBMQ.
2. Estimate the fidelity $F(\rho, \rho') = (\text{Tr} \sqrt{\sqrt{\rho} \rho' \sqrt{\rho}})^2$ between the ideal, ρ , and the transported, ρ' , density matrices.
3. Verify that the state $(|00\rangle + |11\rangle)/\sqrt{2}$ violates the Bell's inequality $|\langle \hat{Q}\hat{S} \rangle + \langle \hat{R}\hat{S} \rangle + \langle \hat{R}\hat{T} \rangle - \langle \hat{Q}\hat{T} \rangle| \leq 2$ on IBMQ.

※ The report should be prepared with A4 pages and include the following relevant data:

- Layout of the quantum circuit.
- Which qubit? On which device?
- The date you collecting the data and the corresponding errors (single qubit gate error, C-NOT gate error, readout error).
- How many shots of the experiment?
- The output data for quantum state tomography and Bell's inequality.
- The density matrix (with specified ordering of basis) **constructed from the measured data**, and the negativity.

Deadline: Please hand in the report before the end of this semester (Jan. 8th, 2025) via
n96124365@gs.ncku.edu.tw (助教 黃川齊)