

Homework 02 - Quantum Teleportation

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Based on the lectures notes of our course, please compute the quantum teleportation protocol using the Bell state $|\beta_{02}\rangle$

$$|\beta_{02}\rangle = \frac{|01\rangle + |10\rangle}{\sqrt{2}}$$

and the state $|\psi\rangle$ to be teleported defined as

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$$

To visually follow the quantum teleportation protocol, please see Fig. (1).

- Please provide a full mathematical derivation of the following quantum states: $|\psi_0\rangle$, $|\psi_1\rangle$, $|\psi_2\rangle$, $|\psi_3\rangle$, and $|\psi_4\rangle$.
- Additionally, fully explain the strategy to be followed by Bob to transform his qubit to the state $|\psi\rangle$.

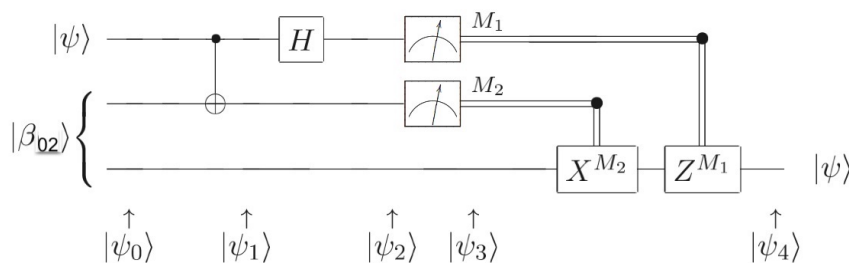


Figure 1.13. Quantum circuit for teleporting a qubit. The two top lines represent Alice's system, while the bottom line is Bob's system. The meters represent measurement, and the double lines coming out of them carry classical bits (recall that single lines denote qubits).

Figure 1: Quantum Teleportation Circuit (figure taken from [1]).

References

- [1] M.A. Nielsen and I.L. Chuang. Quantum Computation and Quantum Information. Cambridge University Press (2000)