

4.5 Dense Coding and Teleportation

1. Using an entangled pair (Bell state), one can send two binary bit information using one quantum bit.
2. Using an entangled pair (Bell state), one can use two classical bit information to transmit a qubit.

Dense Coding:

$$|0\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad |1\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

$$\alpha|0\rangle + \beta|1\rangle = \begin{pmatrix} \alpha \\ \beta \end{pmatrix} \in \mathbb{C}^2$$

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + |11\rangle) =$$

$$\frac{1}{\sqrt{2}} \left(\begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix} \right) \quad |\alpha|^2 + |\beta|^2 = 1$$

$$|x\rangle \otimes |y\rangle$$

Alice can use the method described in pp. 78-79

to transmit (00) (01) (10) or (11) safely to Bob

Quantum
Teleportation,

Alice
Sends

$$|\phi\rangle = \underline{a|0\rangle + b|1\rangle} \quad \text{to Bob}$$

For Teleportation, see the you-tube clips & the description
in the book