HW5

Sunday, February 12, 2023 10:32 AM

(1)

- Channel eff = 0.1
- Alice uses a 2 photon emitting soure
- Alice emits photons at P_2

(A) P_2 must be greater than 0.1 (10%) to garuntee security from a spy

→ this is so that we don't have a chance at losing photons greater than our efficiency

→ we need to guruntee our efficiency is at least 10% overall, or we could have been susceptible to a photon splitting attack

(3) a) Starting state: $|\psi_1\rangle \otimes |\psi_2\rangle$

⇓ lets check if two qubit bell basis is the same

$$= \frac{1}{2}\Big[(|00\rangle + |11\rangle) \otimes (|RR\rangle + |BB\rangle)$$
$$+ (|00\rangle - |11\rangle) \otimes (|RR\rangle - |BB\rangle)$$
$$+ (|01\rangle + |10\rangle) \otimes (|RB\rangle + |BR\rangle)$$
$$+ (|01\rangle - |10\rangle) \otimes (|RB\rangle - |BR\rangle)\Big]$$

$0 \to |0000\rangle$ (RR)

$3 \to |0011\rangle$ (BB)

$12 \to |1100\rangle$ (RR)

$15 \to |1111\rangle$ (BB)

$$= \frac{1}{4}\Big[|00RR\rangle + |00BB\rangle + |11RR\rangle + |11BB\rangle$$
$$+ |00RR\rangle - |00BB\rangle - |11RR\rangle + |11BB\rangle$$
$$+ |01RB\rangle + |01BR\rangle + |10RB\rangle + |10BR\rangle$$
$$+ |01RB\rangle - |01BR\rangle - |10RB\rangle + |10BR\rangle\Big]$$

$$\psi_{12} = \frac{1}{2}\Big[|00RR\rangle + |11BB\rangle + |01RB\rangle + |10BR\rangle\Big]$$

b) State of clock = $|\psi^-_{EM}\rangle = \frac{1}{\sqrt{2}}(|RB\rangle - |BR\rangle)$

projector: $|\psi^-_{EM}\rangle\langle\psi^-_{EM}|$

$$\langle\psi_{12}||\psi^-_{EM}\rangle\langle\psi^-_{EM}||\psi_{12}\rangle$$

$$\psi_{AB} = \frac{1}{2}\Big[|01\rangle + |10\rangle\Big] \Rightarrow$$ Projected state is entangled!

$$\rho_{AB} = |\psi_{AB}\rangle\langle\psi_{AB}|$$

$$Tr_B(\rho_{AB}) = |+\rangle\langle+|$$

$$VNE(|+\rangle\langle+|) = 0 \Rightarrow$$ We get a pure state from our traced out state. Therefor our Entanglement entropy is 0

pure state