

(9) Steering?**20 points**

In the week 7's final lecture we discussed the steering idea. There we saw that Alice cannot transfer any information to Bob by choosing her measurement directions since Bob's reduced state is independent of this choice. But she can determine whether the wave function on his side is in an eigenstate of the Pauli matrix σ_x or σ_z . This *steering* of the wave function is "magic" (in Schrödinger's words), as it forces Bob to believe that Alice can influence his particle from a distance. In the lecture Alice and Bob shared a maximally entangled state $|\Psi^\pm\rangle = (|00\rangle \pm |11\rangle)/\sqrt{2}$ (We only considered $|\Psi^+\rangle$ there). We say that Alice can use the state $|\Psi^+\rangle$ to steer Bob's conditional states.

- (a) Can Alice use the state $|\Phi^\pm\rangle = (|01\rangle \pm |10\rangle)/\sqrt{2}$ to steer Bob by local measurements on her side (Only show the answer for $|\Phi^+\rangle$ for now)? **10 points**
- (b) Can Alice use the state mixed state ρ to steer Bob by only local measurements on her side, where ρ is a uniform mixture of all four states $|\Psi^\pm\rangle$ and $|\Phi^\pm\rangle$: **10 points**

$$\rho = \frac{1}{4} \sum_{i=\pm} (|\Psi^i\rangle\langle\Psi^i| + |\Phi^i\rangle\langle\Phi^i|) ?$$