PH425 Spins Homework 3

Due 1/20/16 @ 4 pm

REQUIRED:

1. **I will give you some time on Tuesday in class to collect data for this problem, but it would be a good idea for you to think about what data you will need to collect ahead of time. A spin 1 system uses Stern-Gerlach devices with three exit ports instead of two. The component of angular momentum for particles that go up (through the top port) is $\hbar$. For particles that go straight (through the middle port) is 0, and for particles that go down (through the bottom port) is $-\hbar$.**

   Using the Spins simulation, choose the `Spin-1` case under the `Design` menu. Set up an experiment for two successive meaurements of spin projections.

   (a) Measure the probability that a state which starts out with z-component of spin equal to $\hbar$ ends up with z-component of spin equal to $\hbar$ after the z-component of spin is measured. Write your statement in bra-ket language.

   (b) Measure the probability that a state which starts out with z-component of spin equal to $\hbar$ ends up with z-component of spin equal to zero after the z-component of spin is measured. Write your statement in bra-ket language. What does this probability tell you about the z basis?

   (c) Measure the probability that a state which starts out with x-component of spin equal to zero ends up with z-component of spin equal to zero after the z-component of spin is measured. Write your statement in bra-ket language. What does this probability tell you about the x and z bases?

   (d) Use your simulation to find the value of $|\langle 1| -1\rangle_x|^2$. State in words what the measured quantity represents. Compare your "measured" value to a theoretical value computed from the Spin Reference Sheet.

2. **You only need to write up unknowns 3 and 4 for homework.**

   With the Spins simulation set for a spin 1/2 system, measure the probabilities of all the possible spin components for each of the unknown initial states $|\psi_i\rangle$ $(i = 1, 2, 3, 4)$.

   (a) Use your measured probabilities to find each of the unknown states as a linear superposition of the S_z-basis states $|+\rangle$ and $|-\rangle$.

   (b) Write a set of general instructions that would allow another student in next year's class to find an unknown state from measured probabilities.

   (c) Design an experiment that will allow you to test whether your prediction for each of the unknown states is correct. Describe your experiment here, clearly but succinctly, as if you were writing it up for a paper. Do the experiment and discuss your results.