Stuff for Thursday, April 12, 2012

- PS #5 due up front. Poll: New conflicts for May 1 midterm?
- Quiz tomorrow. *Anything* from the 1094 session is fair game, so please go through the answer key.
- 1094 Session 3 is returned up front (key is online).
  - Common error: forgetting that $|z|^2 = z^* z$ and not z^2.
  - Be careful not to mix up eigenvalues and the coefficients of eigenvectors (e.g., c_1 and c_2 vs. E_0 and $-E_0$ in the examples).
  - An eigenvector does not have to be an *energy* eigenvector. Consider a magnetic field in the $+x$ direction. In that case, only $|+x\rangle$ and $|-x\rangle$ are energy eigenvectors; the others (e.g., $|+z\rangle$ and $|-y\rangle$) are eigenvectors for spin-projection on the z-axis and y-axis but do not have definite energy.
  - Probability: *square* wave function $\psi(x)$ first, then add area.
  - Time dependence is important! (We'll review it today.)
- Quick warm-ups:
  - $|1+2i|^2 \stackrel{?}{=}$ $\qquad$ $|1-2i|^2 \stackrel{?}{=}$ $\qquad$ $|-i+2|^2 \stackrel{?}{=}$

Stages of learning quantum mechanics: Anger, denial, acceptance.

Six Rules that Quantons Live By

1. State vector $|\psi\rangle$ describes quanton state. Normalized: $\langle\psi|\psi\rangle = 1$.

$$|\psi\rangle = \begin{bmatrix} \psi_1 \\ \psi_2 \\ \vdots \end{bmatrix} \quad \langle\psi| = \begin{bmatrix} \psi_1^* \\ \psi_2^* \\ \vdots \end{bmatrix} \quad \langle\psi|\psi\rangle = \begin{bmatrix} \psi_1^* \\ \psi_2^* \\ \vdots \end{bmatrix} \begin{bmatrix} \psi_1 \\ \psi_2 \\ \vdots \end{bmatrix} = |\psi_1|^2 + |\psi_2|^2 + \cdots = 1$$

2. For each outcome (value), there is an eigenvalue and an eigenvector.
   E.g., S_x value $+s$ (eigenvalue) has $|+x\rangle = \begin{bmatrix} \sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}$ (eigenvector)

3. When an experiment determines an outcome a_n, the state vector becomes the corresponding eigenvector A_n. "Collapse!"

4. If $|\psi_0\rangle$ is the initial state, the probability that a measurement collapses it to A_n with value a_n is: $P(a_n) = |\langle\psi_0|A_n\rangle|^2$ where $|(a+bi)|^2 = a^2 + b^2$

5. Superposition: $|\psi_0\rangle = c_1|+y\rangle + c_2|-y\rangle = |+y\rangle\langle+y|\psi_0\rangle + |-y\rangle\langle-y|\psi_0\rangle$
   (Be able to derive 2nd equality.) The c_i's are *not* the eigenvalues!!!

6. Any $|\psi\rangle$ can be decomposed into energy eigenvectors (they "span" the space): $|\psi(t=0)\rangle = c_1|E_1\rangle + c_2|E_2\rangle + \cdots$
   At time t: $|\psi(t)\rangle = c_1 e^{-iE_1 t/\hbar}|E_1\rangle + c_2 e^{-iE_2 t/\hbar}|E_2\rangle + \cdots \quad (\hbar \equiv h/2\pi)$