Stuff for Friday, April 13, 2012

- Stop at 4pm today for Quiz 3 on Q5/Q6
  - Formulas for today's quiz:

$$v = \lambda f \qquad k = \frac{2\pi}{\lambda} \qquad \omega = 2\pi f \qquad \lambda = \frac{h}{p} \qquad \lambda = \frac{hc}{\sqrt{2(mc^2)K}}$$

$$E = hf = \frac{hc}{\lambda} \qquad K = hf - W \qquad \cos\theta = \tfrac{1}{2}\left(e^{i\theta} + e^{-i\theta}\right) \qquad i\sin\theta = \tfrac{1}{2}\left(e^{i\theta} - e^{-i\theta}\right)$$

$$|+x\rangle = \begin{bmatrix} \sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}, \quad |+y\rangle = \begin{bmatrix} \sqrt{1/2} \\ i\sqrt{1/2} \end{bmatrix}, \quad |+z\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$|-x\rangle = \begin{bmatrix} \sqrt{1/2} \\ -\sqrt{1/2} \end{bmatrix}, \quad |-y\rangle = \begin{bmatrix} i\sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}, \quad |-z\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

- Erratum for Q5S.3: For the special case of $\theta = 180^\circ$, there will be no output from the positive outlet of the SGθ device.
- Q6 loose ends
  - eigenvectors of position
  - probability calculations with wave functions
  - two-slit interference

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: $|\psi(t)\rangle = c_1 e^{-iE_1 t/\hbar}|E_1\rangle + c_2 e^{-iE_2 t/\hbar}|E_2\rangle + \cdots$ $(\hbar \equiv h/2\pi)$