# Announcements for Tuesday, April 10, 2012

- Sm1094 tomorrow at 2:30pm or 3:30pm. Be ready for Q6!
- Quiz 3 will be on Friday this week.
- Complex pretest returned up front; solution key online.
  - Imaginary part doesn't include the $i$
  - $|z|^2 = z^* z \geq 0$ always. Find $z^*$ by $i \leftrightarrow -i$. So $|re^{i\theta}|^2 = r^2$.
  - $\mathrm{Re}(\frac{1}{a+bi}) \neq \frac{1}{a}$ $\quad \mathrm{Re}(\frac{1}{a+bi}) = \mathrm{Re}(\frac{1}{a+bi} \cdot \frac{a-bi}{a-bi}) = \mathrm{Re}(\frac{a-bi}{a^2+b^2})$

Try Q5T.8. Other complex warm-ups (express as $a + bi$):

$a)\ [(1-i)i]^* \qquad b)\ |\frac{3}{4} + \frac{5}{4}i|^2 \qquad c)\ (2+i)^* \times (3-i) \qquad d)\ (e^{-i\pi})^*$

| Observable: | $S_x$ | $S_y$ | $S_z$ |
|---|---|---|---|
| value $+s$ | $\lvert +x\rangle = \begin{bmatrix} \sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}$ | $\lvert +y\rangle = \begin{bmatrix} \sqrt{1/2} \\ i\sqrt{1/2} \end{bmatrix}$ | $\lvert +z\rangle = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ |
| value $-s$ | $\lvert -x\rangle = \begin{bmatrix} \sqrt{1/2} \\ -\sqrt{1/2} \end{bmatrix}$ | $\lvert -y\rangle = \begin{bmatrix} i\sqrt{1/2} \\ \sqrt{1/2} \end{bmatrix}$ | $\lvert -z\rangle = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ |

"…a semblance of truth sufficient to procure for these shadows of imagination that willing suspension of disbelief …" (Coleridge)

# 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: $|\psi_0\rangle = c_+|+y\rangle + c_-|-y\rangle = |+y\rangle\langle+y|\psi_0\rangle + |-y\rangle\langle-y|\psi_0\rangle$

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