Recitation #5
Quantum 521

1. For the spinor state,
$$|\chi\rangle = A\big(\, 3i\,|{+}z\rangle + 4\,|{-}z\rangle\,\big)$$
Find the normalization constant A. Calculate $\langle \hat{S}_y \rangle$ and ΔS_y.

2. What are the projection operators $\hat{P}_\pm = |\pm z\rangle\langle \pm z|$ as matricies in the $+z$ basis? Knowing,
$$|\pm \mathrm{y}\rangle = \frac{1}{\sqrt{2}}\left[|{+}\mathrm{z}\rangle \pm \mathrm{i}\,|{-}\mathrm{z}\rangle\right]$$
write the matrix that transforms the spinor z-basis to the y-basis. Use this matrix to determine the these projection operators in the $+y$ basis. Working in the $+y$ basis, verify that $\hat{P}_+\,|{+}z\rangle = |{+}z\rangle$, $\hat{P}_-\,|{-}z\rangle = |{-}z\rangle$, $\hat{P}_+\,|{-}z\rangle = 0$ and $\hat{P}_-\,|{+}z\rangle = 0$. If you have time, also check that $\hat{P}_+^2 = \hat{P}_+$, $\hat{P}_-^2 = \hat{P}_-$, $\hat{P}_+\hat{P}_- = 0$ and $\hat{P}_-\hat{P}_+ = 0$.