

Homework #3

1. An electron is in the spin state $\chi = A \begin{bmatrix} 3i \\ 4 \end{bmatrix}$.
 - (a) Normalize χ to determine A .
 - (b) Determine $\langle S_x \rangle$, $\langle S_y \rangle$, and $\langle S_z \rangle$.
 - (c) Determine the uncertainties σ_{S_x} , σ_{S_y} , and σ_{S_z} . Don't confuse these with Pauli matrices!
 - (d) Confirm that your results are consistent with all three uncertainty principles ($\sigma_{S_x}\sigma_{S_y} \geq \frac{\hbar}{2}|\langle S_z \rangle|$ and its cyclic permutations).
2. For a generalized spinor, $\chi = a\chi_{+,z} + b\chi_{-,z}$, where $\chi_{+,z}$ is spin up and $\chi_{-,z}$ is spin down, compute $\langle S_x \rangle$, $\langle S_y \rangle$, $\langle S_z \rangle$, $\langle S_x^2 \rangle$, $\langle S_y^2 \rangle$, $\langle S_z^2 \rangle$. Check that $\langle S_x^2 \rangle + \langle S_y^2 \rangle + \langle S_z^2 \rangle = \langle S^2 \rangle$.