Quantum Mechanics: Wheeler: Physics 6210

Assignment 10

READ : Finish reading Chapter 3.

PROBLEMS :

- **S.3.14**: Just like c_+ in class.
- **S.3.15**: This is all clear enough. Part c) asks you to solve the Schrödinger equation backwards, from the answer to the equation.
- **S.3.16**: Hint: the semiclassical interpretation has to do with precession.
- **W1. Addition of angular momentum:**
  - a) Find the linear combinations of the direct product of two spin-$\frac{1}{2}$ states, $\left|\frac{1}{2}, m_1\right\rangle \otimes \left|\frac{1}{2}, m_2\right\rangle$ giving rise to states, $|j, m\rangle$, of definite total angular momentum,

$$\begin{aligned} \mathbf{J} &= \mathbf{J}_1 \otimes \mathbf{1} + \mathbf{1} \otimes \mathbf{J}_2 \\ &= \mathbf{J}_1 + \mathbf{J}_2 \end{aligned}$$

    as shown in class. You should find a singlet, $|0, 0\rangle$, and a triplet, $|1, m\rangle$.
  - b) Express the direct product of a spin-$\frac{3}{2}$ state with an $l = 1$ state of orbital angular momentum, $\left|\frac{3}{2}, m_1\right\rangle \otimes |1, m_2\rangle$ in terms of states of total angular momentum, $|j, m\rangle$.
  - c) Suppose you were going to solve the same problem for $\left|\frac{5}{2}, m_1\right\rangle \otimes \left|\frac{3}{2}, m_2\right\rangle$. What $|j, m\rangle$ states do you expect to find? Show that the total number of states balances between the initial product states and your answer.
- **S.3.24**
- **S.3.25**: Carefully carry out the indicated sum and it will look familiar. Remember that $d^{(j)}_{mm'}$ is defined as the matrix which produces a rotation by θ about the y - axis.
- **S.3.28**: The quadrupole transition is important in atomic physics.
- **S.3.29**: Don't be put off by the imposing appearance of this problem. It's not so bad, it's just put in physical terms. Take the time to do it carefully. The first part is simply to rearrange the terms; then you are to find some energy eigenkets of S operators. Nothing tough there!