

Homework #4 (due 11/1)
(Physics 115B, Fall 2017)

1. At time $t = 0$, a hydrogen atom is in the following state of coherent superposition:

$$\psi(\vec{r}, 0) = A[\psi_{100} + \sqrt{5}\psi_{210}]$$

(a) Normalize the wave function.

(b) What is the probability that a measurement of L^2 gives the value of $2\hbar^2$?

(c) What is the wavefunction at time t ?

(d) What is $\psi(\vec{r}, t)$ if the measurement L^2 at $t = 0$ gives $2\hbar^2$?

2. A particle in a spherically symmetric potential is in a state described by the wave packet

$$\psi(x, y, z) = C(xy + yz + zx)e^{-\alpha r^2}$$

What is the probability that a measurement of L^2 yields 0? What is the probability that it yields $6\hbar^2$? If the value of l is found to be 2, what are the relative probabilities for $m = 2, 1, 0, -1, -2$?

3. Construct matrix representations for the operators of L^2, L_+, L_-, L_z, L_x and L_y for the case of $l = 2$.

4. Consider an angular momentum 1 system, represented by the state vector

$$\psi = \frac{1}{\sqrt{26}} \begin{pmatrix} 1 \\ 4 \\ 3 \end{pmatrix}$$

What is the probability that a measurement of L_x yields the value 0?

5. Griffiths 4.19

6. Griffiths 4.20