

PHYS626 - HW 5

1) Numerically evaluate L_x , L_z , and L^2 in Cartesian coordinates for electrons in the 3d hydrogen orbital states with $m_l=2$ and $m_l=0$.

2) Show for $r \neq 0$ that

$$(S \cdot \nabla)(I \cdot \nabla) \frac{1}{r} = -\frac{1}{r^3} \left[S \cdot I - 3 \frac{(S \cdot r)(I \cdot r)}{r^2} \right]$$

Where S and I are the electron spin and nuclear spin, respectively.

3) Show that

$$L_x = yp_z - zp_y = -i\hbar \left(y \frac{\partial}{\partial z} - z \frac{\partial}{\partial y} \right) = i\hbar \left(\sin \phi \frac{\partial}{\partial \theta} + \cot \theta \cos \phi \frac{\partial}{\partial \phi} \right)$$

4) Find the M_{ik} matrix element (x,y,z components) for the 2p to 1s transition and the 3s to 1s transition.

5) Find the Einstein A, B coefficients for 4).