

Addition of angular momenta

Example used

⇒ hydrogen atom $\left[\overset{l=0}{\text{orbiting S-orbital } 1s^1} \right]$

What's inside the hydrogen atom

- 1) electron
 - 2) proton
 - 3) neutron
- ↓ fermions with spin $1/2$

⇒ hydrogen atom: (S-orbital)

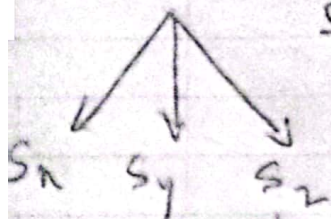
⊙ $l=0$

⊙ no orbital angular momentum

⇒ Add the spin value for electron and proton to get the angular momentum for hydrogen atom

⇒ $S = S_1 + S_2$

[Total spin] = electron spin + proton spin [or nuclear spin]

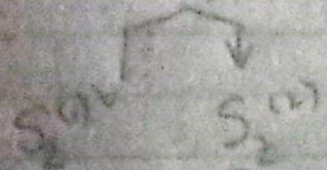


[you can go for S_x or S_y as each spin axis condemns one individual spin component]

S_z, m_s, m_s → proton spin state

↳ electron spin state

$$\Rightarrow S_z \chi_1 \chi_2 = (S_z^{(1)} + S_z^{(2)}) \chi_1 \chi_2$$



$$= (S_z^{(1)} \chi_1) \chi_2 + \chi_1 (S_z^{(2)} \chi_2)$$

[first
spin
state]

[second
spin
state]

Note: while you can write
 $(S_z^{(1)} \chi_1) \chi_2 + (S_z^{(2)} \chi_1) \chi_2$

its best to keep like states on one side
 the unlike states on the other side

$$\Rightarrow S_z = m\hbar$$

$$(S_z) \chi = (m\hbar) \chi$$

$$S = (m\hbar) \left[\text{eigen value} \right]$$

$$\Rightarrow S_z \chi_1 \chi_2 = m_1 \hbar \chi_1 \chi_2 + m_2 \hbar \chi_1 \chi_2$$

$$S_z \chi_1 \chi_2 = \hbar (\chi_1 \chi_2) [m_1 + m_2]$$

$$\Rightarrow m = m_1 + m_2$$