Addition of angular momenta

Example used

$l=0$

⇒ hydrogen atom [orbiting S-orbital $1s^1$]

what's inside the hydrogen atom

1) electron
2) proton

⇒ fermions with spin $1/2$

3) neutron

⇒ hydrogen atom :- ① S-orbital

① $l=0$

① 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]

S_x S_y S_z

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

$S_z \chi_1 \chi_2$ ⇒ proton spin state

↳ electron spin state

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

$S_z^{(1)}$ [first spin state] $S_z^{(2)}$ [second spin state]

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

Note:- while you can write
$(S_z^{(1)} \chi_1) \chi_2 + (S_z^{(2)} \chi_1) \chi_2)$
its best to keep like state on one side the unlike states on the other side

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

$S_{x/y/z} = (m\hbar)$ [eigen value]

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

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

* $m = m_1 + m_2$