

$$S_{-} \uparrow \downarrow = \hbar \uparrow \downarrow$$

$$S_{+} \uparrow \downarrow = \hbar \uparrow \downarrow$$

$$S_{+} \uparrow \uparrow = 0 \quad [\text{no other states higher than maximum state}]$$

$$S_{-} \uparrow \downarrow = 0 \quad [\text{no other states lower than the minimum state}]$$

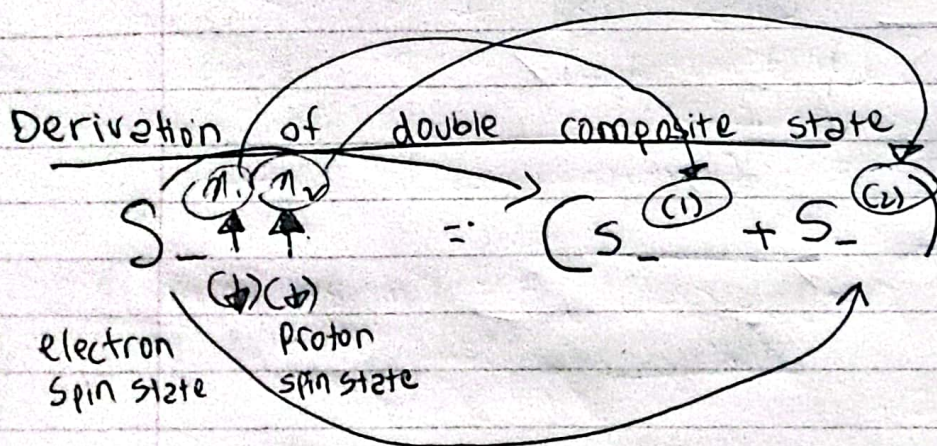
[these spin chi values are single component spin states]

m_1	m_2	m
$\frac{1}{2}$	$\frac{1}{2}$	1
$\frac{1}{2}$	$-\frac{1}{2}$	0
$-\frac{1}{2}$	$\frac{1}{2}$	0
$-\frac{1}{2}$	$-\frac{1}{2}$	-1

[Double component spin states :- m_1 has one spin state & m_2 has one spin state]

$$S_{\pm} |s, m\rangle$$

only m which derives the only spin state



Note: π_1 & π_2 are independent of each other so π_1 has no correlation with π_2 and π_2 has no correlation with π_1 .

from 38-1 derivation of $S_z \pi_1 \pi_2$

$$S_z \pi_1 \pi_2 = (S_z^{(1)} \pi_1) \pi_2 + \pi_1 (S_z^{(2)} \pi_2)$$

$$S_- \uparrow \uparrow = \underset{(\pi_1)(\pi_2)}{(S_-^{(1)} \uparrow)} \uparrow + \uparrow \underset{(\pi_1)}{(S_-^{(2)} \uparrow)} \underset{(\pi_2)}{}$$

$$S_z(\eta_1, \eta_2) = (S_z^{(1)} \eta_1) \eta_2 + \eta_1 (S_z^{(2)} \eta_2)$$

$$S_- (\uparrow \uparrow) = \underbrace{(S_-^{(1)} \uparrow)}_{(\eta_1)} \underbrace{\uparrow}_{(\eta_2)} + \uparrow \underbrace{(S_-^{(2)} \uparrow)}_{(2)}$$

$$= \boxed{\frac{1}{\hbar}} \downarrow \uparrow + \uparrow \boxed{\frac{1}{\hbar}} \downarrow$$

$$= \frac{1}{\hbar} (\downarrow \uparrow + \uparrow \downarrow)$$

[non normalized equation]

$$\frac{1}{\sqrt{2}}$$

∴ out of 4 states = 3 states $|S, m\rangle$

$$S=1, \boxed{m=1, 0, -1}$$

$$S \quad m$$

$$|1, 1\rangle = \uparrow \uparrow$$

$$|1, 0\rangle = \frac{1}{\sqrt{2}} (\uparrow \downarrow + \downarrow \uparrow)$$

$$|1, -1\rangle = \downarrow \downarrow$$

Spin $S=0 \quad m=0 : |0, 0\rangle$

$$|0, 0\rangle = \frac{1}{\sqrt{2}} (\uparrow \downarrow - \downarrow \uparrow) \quad \text{Singlet configuration}$$