

$$\begin{aligned}
 S_{-} \uparrow &= \pi \downarrow \\
 S_{+} \downarrow &= \pi \uparrow \\
 S_{+} \uparrow &= 0 \quad [\text{no other states higher than maximum state}] \\
 S_{-} \downarrow &= 0 \quad [\text{no other states lower than the minimum state}]
 \end{aligned}$$

[these spin chi values are single component]  
[spin states]

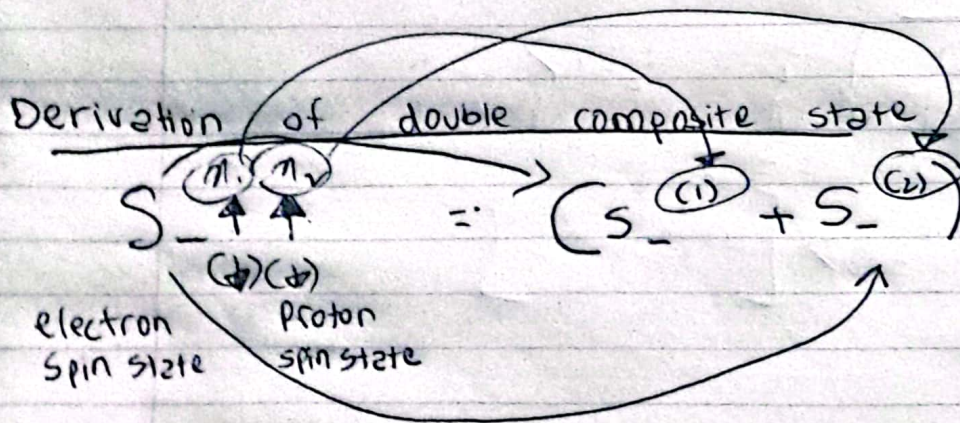


$m_1$	$m_2$	$m$
$\frac{1}{2}$	$\frac{1}{2}$	1
$\frac{1}{2}$	$-\frac{1}{2}$	0
$-\frac{1}{2}$	$\frac{1}{2}$	0
$-\frac{1}{2}$	$-\frac{1}{2}$	-1

[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:  $\pi_1$  &  $\pi_2$  are independent of each other so  $\pi_1$  has no correlation with  $\pi_2$  and  $\pi_2$  has no correlation with  $\pi_1$

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

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

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

$(\pi_1) (\pi_2)$        $(\pi_1)$        $(\pi_2)$



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

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

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

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

[non normalized equation]

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

∴ out of 4 states : 3 states  $|s, m\rangle$

$S, m$

$$S=1, m=1, 0, -1$$

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

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

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

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

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

*Kiboy*