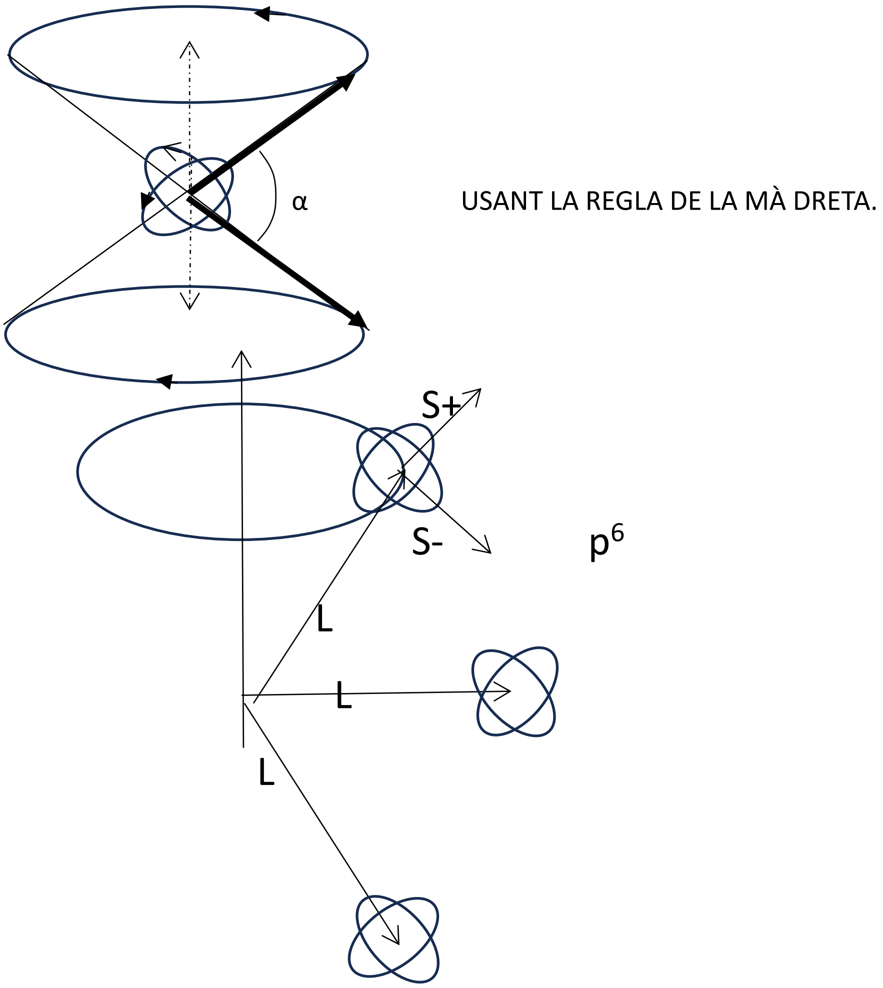
MOMENT D'SPIN:

Se representen com a S_x S_y S_z en 3-D.

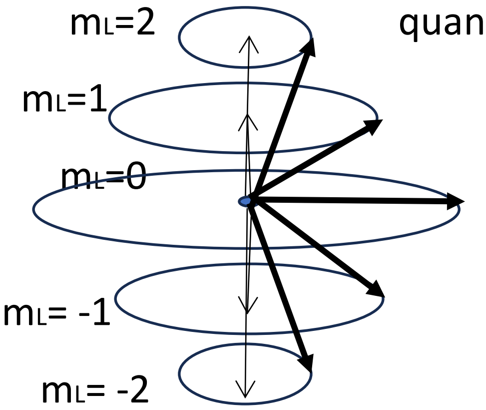


Sabent que quan el nº quàntic prpal. n= 1 dóna L= 1 i

m_L= -1, 0, 1 m_L= 2L+1

mentre que el nº quàntic d'spin: s= m_s= -½, +½.

Definim j= L+ s. Com que representen nivells d'energia cal multiplicar-los per la constant de Plank (nivel mínim d'energia): ħ.



quan L= 2 5 nivells i 10 e^-

d^{10}

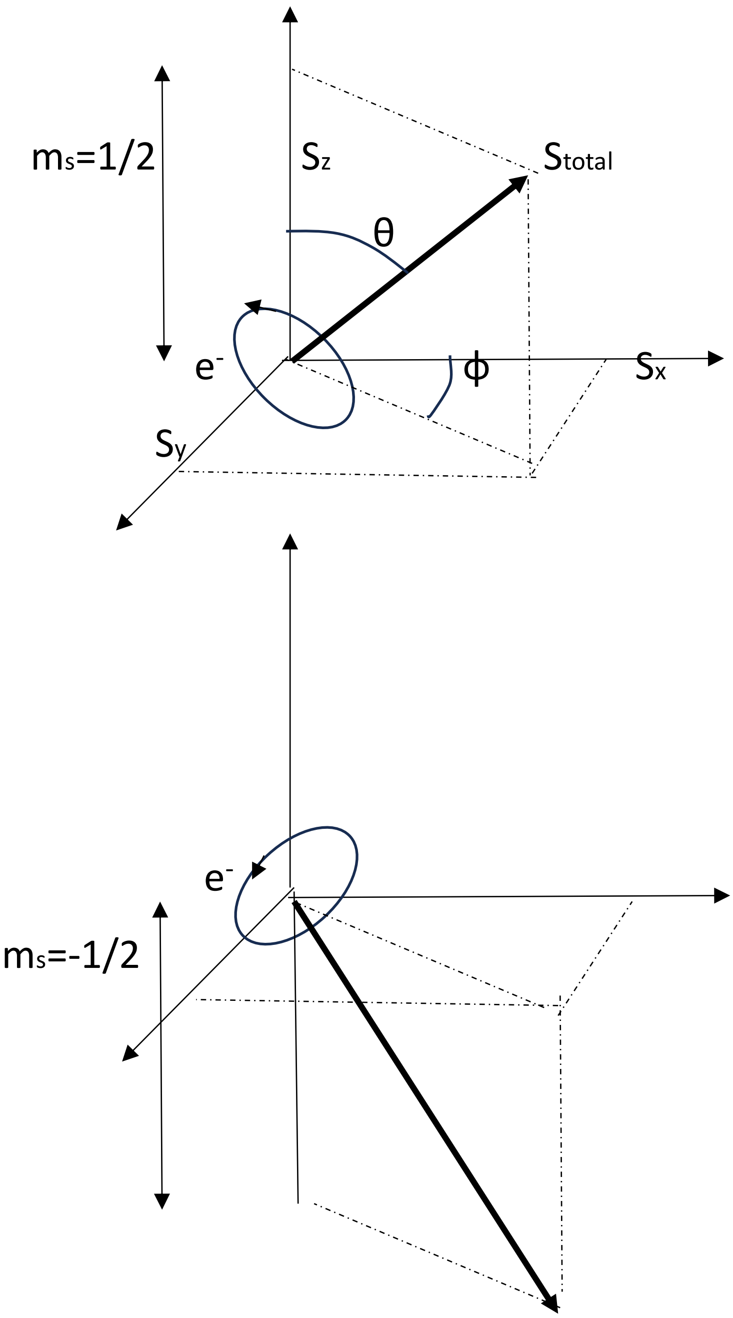
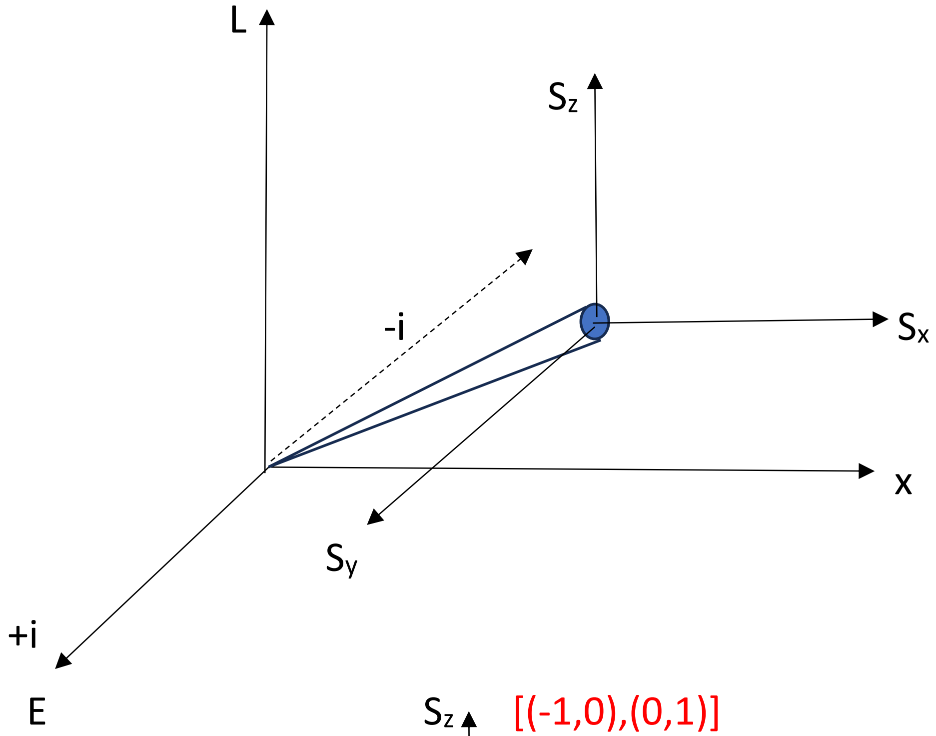
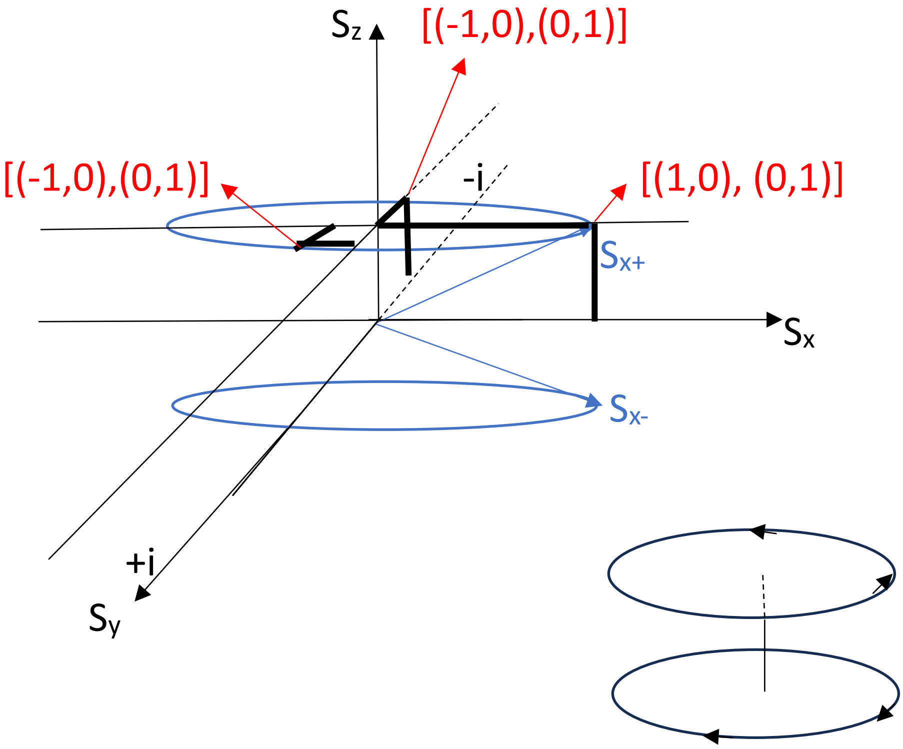


Figura 1

S_x , S_y i S_z són les components de S_{total}.

D’altra banda:





Així s’entén que $S_x = ½.(S_+ + S_-)$

mentre que $S_y = i.\ ½.(S_+ - S_-)$

E= Energia ($\propto$ velocitat); conté valors imaginaris

(+i , -i), entenent que la Energia pot ser 0$<\quad o \quad>$0. Segons Schrödinger:

- $\frac{\hbar^2}{2m}.\nabla^2\Psi + \cdots \rightarrow$ i^2 . i = -i , mentre que i^2.-i= i

Deduïnt que S_x= ½.(S_++ S_-)   i S_y= i.$\frac{1}{2}$.(S_+- S_-)

Suposo que S_+ i S_- no tenen perquè tenir α= 90º.

També cal tenir present que $\int_{-\infty}^{\infty}\Psi.\Psi^*dx = 1$= $(C_1.\Psi_1 + C_2.\Psi_2 + \cdots + C_n\Psi_n).(C_1^*.\Psi_1^* + C_2^*.\Psi_2^* +..+ C_n^*.\Psi_n^*)$=

=$C_1.C_1^* + C_2.C_2^* + \cdots + C_n.C_n^*$= 1   d'on se dedueïx que:

$$C_n = C_n^* = \frac{1}{\sqrt{n}}$$

Sabem que S_x= $\frac{\hbar}{2}.\sigma_x$ S_y= $\frac{\hbar}{2}.\sigma_y$ S_z= $\frac{\hbar}{2}.\sigma_z$

ja que ħ és el valor d'energia mínima valorada, i $\frac{1}{2}$ és el nº quàntic d'spin també vist com a m_s.

$\sigma_x, \sigma_y, \sigma_z$: matrius 2-D:

$\sigma_x = \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$ $\sigma_y = i.\begin{pmatrix}0 & -1\\ 1 & 0\end{pmatrix}$ i $\sigma_z = \begin{pmatrix}-1 & 0\\ 0 & 1\end{pmatrix}$

$|S_z,+\rangle = \frac{\hbar}{2}.\begin{pmatrix}-1 & 0\\ 0 & 1\end{pmatrix}\begin{pmatrix}-1\\ 0\end{pmatrix} = \begin{pmatrix}1\\ 0\end{pmatrix}$

i $|S_z,-\rangle = \frac{\hbar}{2}.\begin{pmatrix}-1 & 0\\ 0 & 1\end{pmatrix}\begin{pmatrix}0\\ 1\end{pmatrix} = \begin{pmatrix}0\\ 1\end{pmatrix}$

i per tant: $|S_x,+\rangle = \frac{1}{\sqrt{2}}.\ |S_z,+\rangle + \frac{1}{\sqrt{2}}.\ |S_z,-\rangle$

$|S_x,-\rangle = -\frac{1}{\sqrt{2}}.\ |S_z,+\rangle + \frac{1}{\sqrt{2}}.\ |S_z,-\rangle$

i: $|S_y,+\rangle = \frac{1}{\sqrt{2}}.\ |S_z,+\rangle + \frac{i}{\sqrt{2}}.\ |S_z,-\rangle$ (a)

$|S_y,-\rangle = \frac{i}{\sqrt{2}}.\ |S_z,+\rangle + \frac{1}{\sqrt{2}}.\ |S_z,-\rangle$ (b)

On veiem que (a) i (b) són expressions que encaixen:

$$|S_y,+\rangle = \frac{\hbar}{2}.\begin{pmatrix}0 & -i\\ i & 0\end{pmatrix}.\begin{pmatrix}1\\0\end{pmatrix} = \frac{\hbar}{2}.\begin{pmatrix}0\\i\end{pmatrix} = \frac{1}{\sqrt{2}}.\begin{pmatrix}1\\0\end{pmatrix} + \frac{i}{\sqrt{2}}.\begin{pmatrix}0\\1\end{pmatrix} =$$

$$= \begin{pmatrix}\frac{1}{\sqrt{2}}\\ \frac{i}{\sqrt{2}}\end{pmatrix}$$

$$|S_y,-\rangle = \frac{\hbar}{2}.\begin{pmatrix}0 & -i\\ i & 0\end{pmatrix}.\begin{pmatrix}0\\-1\end{pmatrix} = \frac{\hbar}{2}.\begin{pmatrix}i\\0\end{pmatrix} = \frac{i}{\sqrt{2}}.\begin{pmatrix}1\\0\end{pmatrix} + \frac{1}{\sqrt{2}}.\begin{pmatrix}0\\1\end{pmatrix} =$$

$$= \begin{pmatrix}\frac{i}{\sqrt{2}}\\ \frac{1}{\sqrt{2}}\end{pmatrix}$$