21|10

6)

$|P, m\rangle$

$|S\rangle$

$\rightsquigarrow$ $\boxed{|S\rangle + |P, 0\rangle}$

$|S\rangle + |P, \pm 1\rangle$

$$|\psi(t)\rangle = |S\rangle\, a(t) + |P, 1\rangle\, b(t)$$

$a(t)$
$b(t)$

$$|\psi(t)|^2$$

$$\langle j'm'|\check{\varepsilon}\cdot\bar{r}|jm\rangle$$

Base esférica:

$$\check{\varepsilon}_q = \left\{-\frac{\check{x}+i\check{y}}{\sqrt{2}},\ \check{z},\ \frac{\check{x}-i\check{y}}{\sqrt{2}}\right\}$$

$$\bar{r} = \sum_q \check{\varepsilon}_q^{*}\, r_q$$

$$\cdot\ \check{\varepsilon}_{q'}$$

$$\check{\varepsilon}_q\cdot\check{\varepsilon}_{q'} = \delta_{qq'}$$

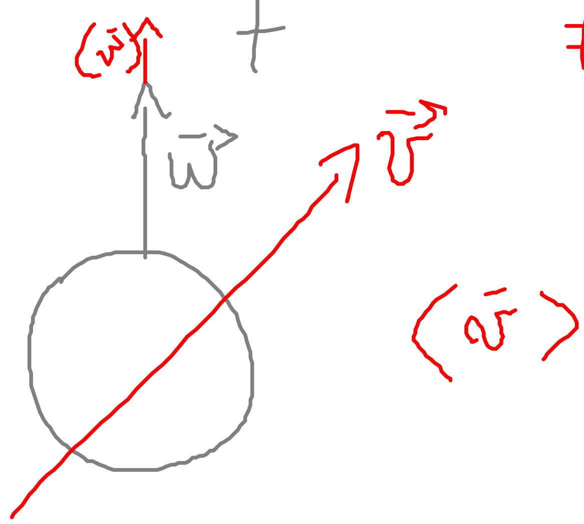
$$r_q = \left\{-\frac{x+iy}{\sqrt{2}},\ z,\ \frac{x-iy}{\sqrt{2}}\right\}$$

$$\langle j'm'|\check{\varepsilon}\cdot\bar{r}|jm\rangle =$$

$$= \sum_q \check{\varepsilon}\cdot\check{\varepsilon}_q^{*}\,\langle j'm'|r_q|jm\rangle$$

$$= \frac{\langle j'\|r\|j\rangle}{\sqrt{2j'+1}}\sum_q \check{\varepsilon}\cdot\check{\varepsilon}_q^{*}\,\underbrace{\langle jm\,1q|j'm'\rangle}_{\neq 0 \text{ sii } m+q=m'}$$

Analogía:



Base esférica y Polarización

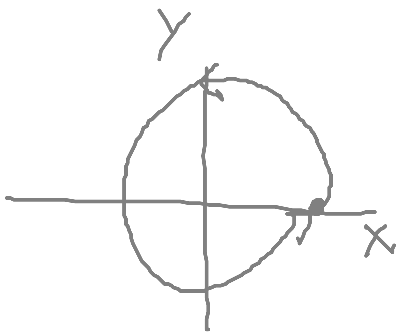
$$\vec{E} = E_0 \, \check{\varepsilon} \cdot e^{i\omega t}$$

- $\check{\varepsilon} = \check{\varepsilon}_0 = \check{z} \longrightarrow$ Pol. lineal

- $\check{\varepsilon} = \check{\varepsilon}_{-1} \Rightarrow$

$$\Rightarrow \bar{E} = E_0 \, \frac{\check{x} - i\check{y}}{\sqrt{2}} \, e^{i\omega t} =$$

$$= \frac{E_0}{\sqrt{2}} \left[\check{x} \, e^{i\omega t} + \check{y} \, e^{i(\omega t + \pi/2)} \right]$$

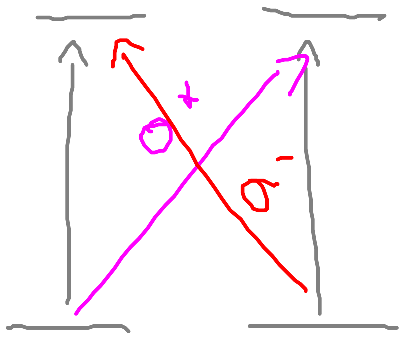


Pol circular R

$$\boxed{\begin{array}{l} \check{\varepsilon}_{-1} \rightsquigarrow R \\ \check{\varepsilon}_{+1} \rightsquigarrow L \end{array}}$$

$$\langle j'm' | \vec{r}\cdot\vec{\varepsilon} | jm \rangle =$$

$$= \frac{\langle \| r \| \rangle}{\sqrt{2j'+1}} \sum_q \vec{\varepsilon}_q^{\,*} \cdot \vec{\varepsilon} \, \langle jm\, 1k | j'm' \rangle$$



dir de onda

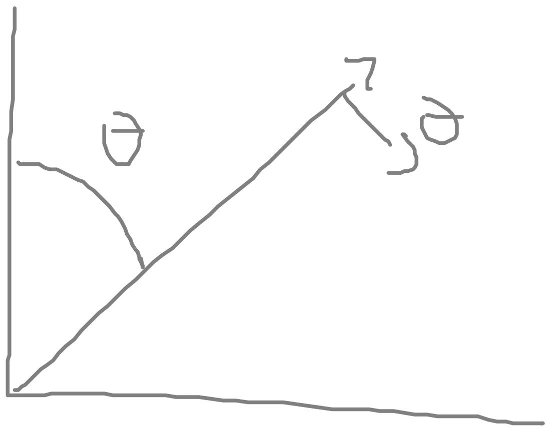
$\vec{z} = \vec{k}$

Pol		Δm
$\vec{\varepsilon}_0 = \vec{z}$	π	0
(L) $\vec{\varepsilon}_{+1}$	σ_+	$\Delta m = +1$
(R) $\vec{\varepsilon}_{-1}$	σ_-	$\Delta m = -1$

Radiación dipolar (Teo 1)

•) $\bar{p} = p_0 \cos(wt)\,\check{z}$

$$\bar{E} \propto \operatorname{Sen}\theta \frac{e^{i(kr-wt)}}{r} \check{\theta}$$



$\check{\theta} = \cos\theta\,\check{x} - \operatorname{Sen}\theta\,\check{y}$

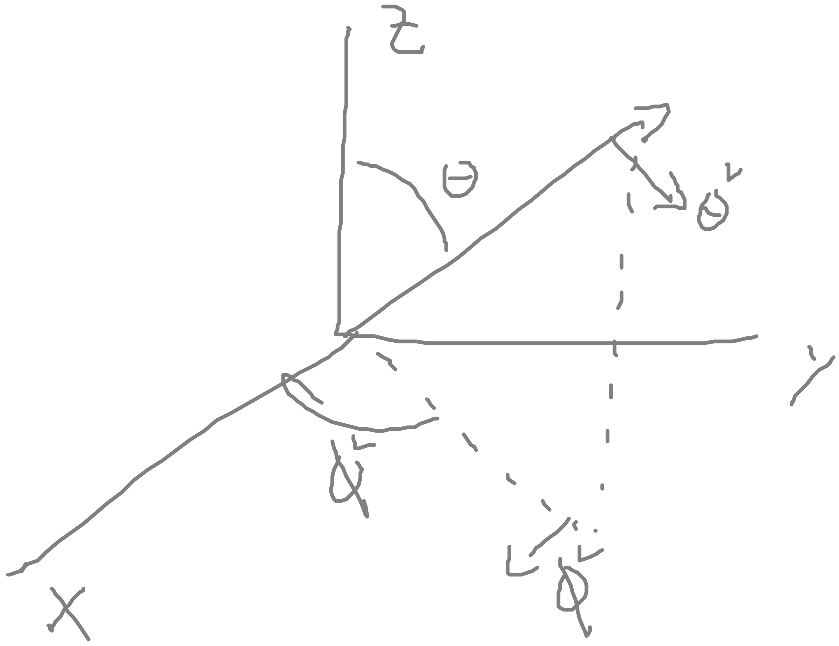
•) $\bar{p} = p_0 \left[\cos(wt)\,\check{x} + \operatorname{Sen}(wt)\,\check{y}\right]$

$$\bar{E} \propto \frac{e^{i(kr-wt)}}{r} \left[\cos\theta\,\check{\theta} + i\,\check{\phi}\right]$$

$\theta = \pi/2 \qquad \bar{E} \sim i\,\check{\phi} \qquad \theta = 0, \pi$

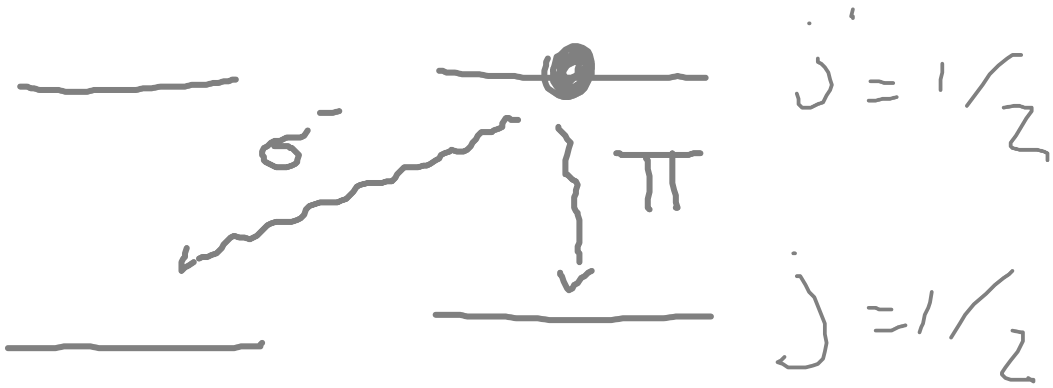
$\pi \to R$

$0 \to L$



$$\check{\phi} = -\cos\phi\,\check{y} + \text{sen}\,\phi\,\check{x}$$

Probleme 7:



$$A_{\check{\varepsilon}} \left\{ \langle 1/2\; m_j | \check{\varepsilon}\cdot\vec{r} | 1/2\; 1/2 \rangle \right.$$

$$\langle 1/2\ m_j | \check{\varepsilon} \cdot \vec{\Gamma} | 1/2\ 1/2 \rangle \qquad \underbrace{\bar{\Gamma} = \sum_q \varepsilon_q^{*} \Gamma_q}$$

$$a)\ A_{\check{\varepsilon}_0} \left\{ \langle 1/2\ 1/2 | \check{\varepsilon}_0 \cdot \bar{\Gamma} | 1/2\ 1/2 \rangle = \right.$$

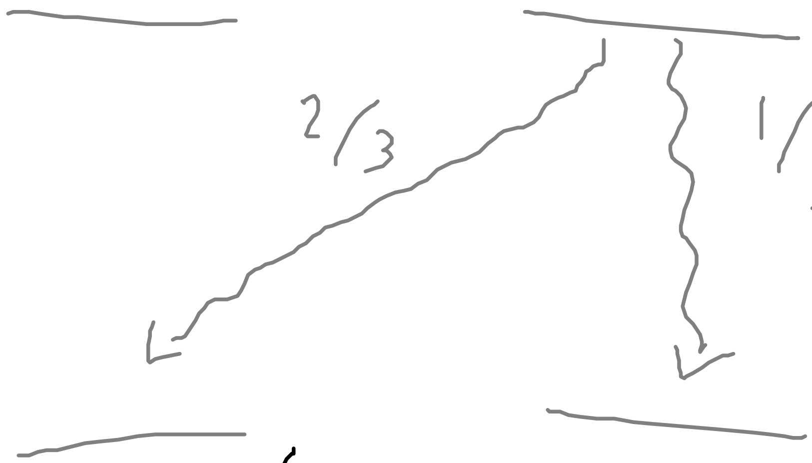
$$= \langle 1/2\ 1/2 | \Gamma_0 | 1/2\ 1/2 \rangle$$

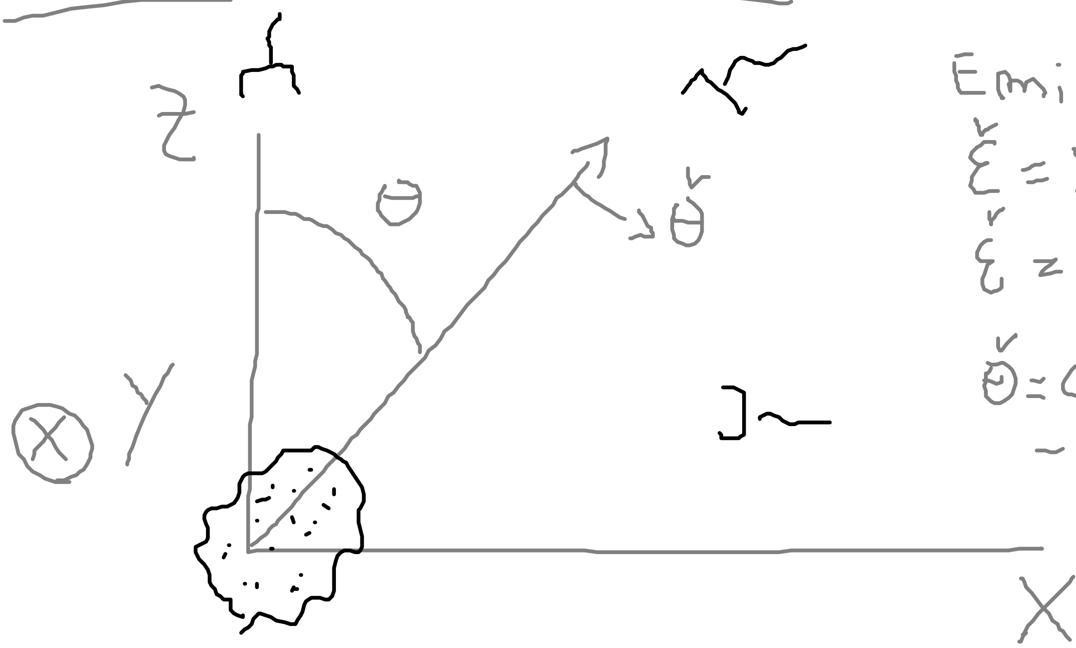
$$\overset{W-E}{=} \frac{\langle \| \Gamma \| \rangle}{\sqrt{2}} \langle 1/2\ 1/2, 1\ 0 | 1/2\ 1/2 \rangle$$

$$= \frac{\langle \| \Gamma \| \rangle}{\sqrt{2}} \frac{-1}{\sqrt{3}}$$

$$\langle 1/2\ -1/2 | \Gamma_{-1} | 1/2\ 1/2 \rangle = \frac{\langle \| \Gamma \| \rangle}{\sqrt{2}} \sqrt{\frac{2}{3}}$$

$$\langle \tfrac{1}{2}\, -\tfrac{1}{2} |\, \Gamma_{-1} \,| \tfrac{1}{2}\, \tfrac{1}{2} \rangle \underset{W-E}{=} \frac{\langle \| \Gamma \| \rangle}{\sqrt{2}} \underbrace{\langle \overset{j_1}{\tfrac{1}{2}}\, \overset{m_1}{\tfrac{1}{2}},\, \overset{j_2}{1}\, \overset{m_2}{-1} | \overset{J}{\tfrac{1}{2}}\, \overset{M}{-\tfrac{1}{2}} \rangle}_{= -\sqrt{\frac{2}{3}}}$$



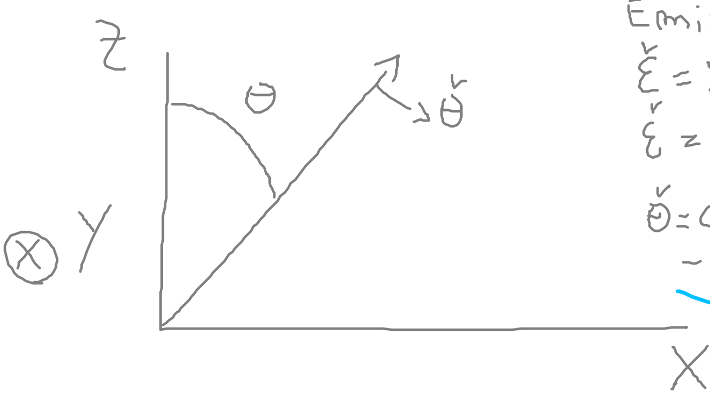


Emisión:

$\check{\varepsilon} = \check{y}$

$\check{\varepsilon} = \check{\theta}$

$\check{\theta} = \cos\theta\ \check{x} - \operatorname{sen}\theta\ \check{z}$



Emisión:

$\check{\varepsilon} = \check{y}$

$\check{\varepsilon} = \check{\theta}$

$\check{\theta} = \cos\theta\, \check{y} - \operatorname{sen}\theta\, \check{z}$

$$\pi : \check{\varepsilon} = \check{\varepsilon}_0 = \check{z}$$

$$I_y^{(\pi)} \propto \left| \check{z} \cdot \check{y} \right|^2 = 0$$

$$I_\theta^{(\pi)} \propto \left| \check{z} \cdot \check{\theta} \right| = \operatorname{sen}^2 \theta$$

$$I^{(\pi)} = 0 + \operatorname{sen}^2\theta = \operatorname{sen}^2\theta$$

$$\sigma^- : \check{\varepsilon} = \check{\varepsilon}_{-1}$$

$$\check{\varepsilon}_{-1} = \frac{\check{x} - i\check{y}}{\sqrt{2}}$$

$$I_y^{(\sigma-)} = \left| \check{y} \cdot \check{\varepsilon}_{-1} \right|^2 = 1/2$$

$$I_\theta^{(\sigma^-)} = \left| \check{\theta} \cdot \check{\varepsilon}_{-1} \right|^2 = \frac{\cos^2\theta}{2}$$

$$I(\theta)\ \{\ \frac{1}{3} I^{(\pi)}(\theta) + \frac{2}{3} I^{(\sigma_-)}(\theta) =$$

$$= \frac{\sin^2\theta}{3} + \frac{\cancel{2}}{3}\,\frac{1+\cos^2(\theta)}{\cancel{2}}$$

$$= \frac{2}{3}$$

Problema 8:

a) $\check{\Sigma} \longrightarrow \check{\mathcal{E}}_0 : |\Psi_{J'}\rangle = |J'=1, 0\rangle$

b) $\check{X} = \dfrac{\check{\mathcal{E}}_1 - \check{\mathcal{E}}_{-1}}{\sqrt{2}}$

Pert. dep. de t:

$H = H_0 + V(t) \qquad V(t) = E_0 \check{\mathcal{E}} e^{i\omega t}$

$|\Psi\rangle_0 = |\varphi_i\rangle$

$\rightsquigarrow |\Psi(t)\rangle = |\varphi_i\rangle + \sum_m C_m^{(1)}(t)|m\rangle$

$$C_m^{(1)}(t) = \frac{1}{2} \frac{\langle m|\check{\mathcal{E}}\cdot\bar{r}|\varphi_i\rangle}{i\hbar} t$$

Si $\omega_{mi} - \omega \ll 1/t$

b) $\check{X} = \frac{\check{\mathcal{E}}_{1} - \check{\mathcal{E}}_{-1}}{\sqrt{2}}$

$$|\Psi_{J'}\rangle \propto \sum_{m'=1,-1,0} \langle J'=1, m' | \check{X}\cdot\bar{r} | J=0,0\rangle \, |J'=1, m'\rangle$$

$$= \frac{\langle J' \| r \| J\rangle}{\sqrt{3}} \left[\frac{-|1\,1\rangle + |1\,-1\rangle}{\sqrt{2}} \right]$$

$$\check{X} = \frac{\check{\mathcal{E}}_{-1} - \check{\mathcal{E}}}{\sqrt{2}}$$

c) tarea

Problema 9:

Bombeo óptico