Intro Guía 2

$$\boxed{H = H_0 + V(t)}$$

$$\longrightarrow |\varphi_i\rangle \longrightarrow |\varphi_f\rangle$$

$$\boxed{\langle \varphi_f | V(t) | \varphi_i \rangle}$$

$\rho(\bar{x})$ aplico $\Phi(\bar{x})$ externo:

$$W = \int \rho(\bar{x})\, \Phi(\bar{x})\, d^3x$$

ρ

$$\Phi(\bar{x}) = \Phi(0) + \bar{x} \cdot \bar{\nabla}\Phi(0) + \frac{1}{2}\sum_{ij} x_i x_j \frac{\partial^2 \Phi}{\partial x_i \partial x_j}$$

$$\Rightarrow W \simeq q\Phi(0) - \vec{p} \cdot \vec{E} - \frac{1}{6}\sum_{ij} Q_{ij} \frac{\partial E_j}{\partial E_j}(0)$$

$$H = H_0 + \underbrace{H_{E1}}_{\text{dip elec}} + \underbrace{H_{M1}}_{\text{dip mag}} + \underbrace{H_{E2}}_{\text{cuadr elec}}$$

$$H_{E1} \sim -\vec{d} \cdot \vec{E}$$

$$H_{M1} \sim -\vec{\mu} \cdot \vec{B} \qquad \vec{\mu} \propto \bar{L} + 2\bar{S}$$

$$H_{E2} \sim Q_{ij} \frac{\partial E_i}{\partial E_j}$$

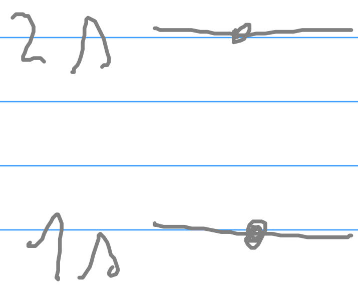
$$\langle f | \underbrace{H_{E1}}_{-\bar{d} \cdot \bar{E}} | i \rangle$$

Reglas de Selección

·) Paridad de $|\varphi_i\rangle \neq |\varphi_j\rangle$

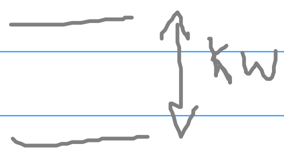
E1:

$$\langle 1s | H_{E1} | 2s \rangle = 0$$



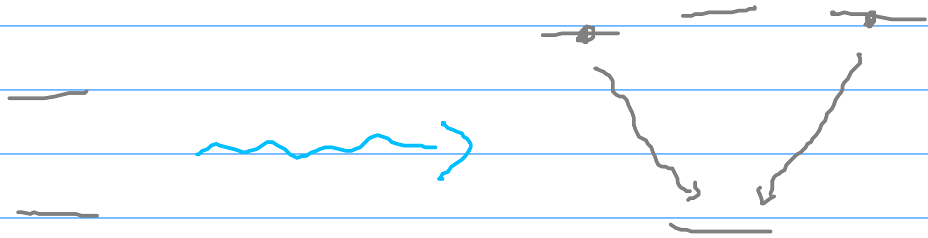
$\boxed{\text{Teórica + apunte en la página}}$

Pert armónica $V(t) = V_0 e^{i\omega t} + V_0^{+} e^{-i\omega t}$



$$W_{1\to2} = \frac{2\pi}{\hbar} \underbrace{|M_{12}|^2}_{M_{12} = \langle 2 | H_I | 1 \rangle} \delta(\hbar\omega)$$

$$A_{fi} \overset{\text{no deg!}}{=} \frac{\omega_{if}^3}{3\pi\varepsilon_0\hbar c^3}\left|\langle 2|\underbrace{-e\vec r}_{\vec d}|1\rangle\right|^2$$



Para el caso degenerado:

$$A_{fi} = \frac{e^2\omega_{fi}^3}{3\pi\varepsilon_0\hbar c^3}\sum_{m_f, m_i}\left|\langle \xi_f J_f m_f|\vec r|\xi_i J_i m_i\rangle\right|^2$$

$$= \frac{e^2\omega_{fi}^3}{3\pi\varepsilon_0\hbar c^3}\sum_{m_f, m_i}\left|\langle \xi_f J_f m_f|\vec r|\xi_i J_i m_i\rangle\right|^2$$

W-E: $T^{(k)}_q \qquad q = -k \dots +k$

$$\langle \xi' j' m' | T^{(k)}_q | \xi j m \rangle =$$

$$= \frac{\langle \xi' j' \| T^{(k)} \| \xi j \rangle}{\sqrt{2j'+1}}$$

$$\times \quad \langle j m , k q | j' m' \rangle$$

$T^{(k)}_q$: $\quad [J_z , T^{(k)}_q] = \hbar q T^{(k)}_q$

$$[J_\pm , T^{(k)}_q] = \hbar \sqrt{\qquad} \; T^{(k)}_{q\pm 1}$$

Op. Vectoriales:

$$\vec{V} = V_x \check{x} + V_y \check{y} + V_z \check{z}$$

$$[J_i, V_j] = i\hbar \varepsilon_{ijk} J_k$$

Base esférica:

$$\check{e}_1 = \frac{-1}{\sqrt{2}}(\check{x} + i\check{y}) \qquad \check{e}_0 = \check{z}$$

$$\check{e}_{-1} = 1/\sqrt{2}(\check{x} - i\check{y}) \qquad (\check{e}^*_q \, \check{e}_{q'}) = \delta_{qq'}$$

$$\bar{V} \longrightarrow \bar{V} = \sum_q \check{\varepsilon}^*_q V_q$$

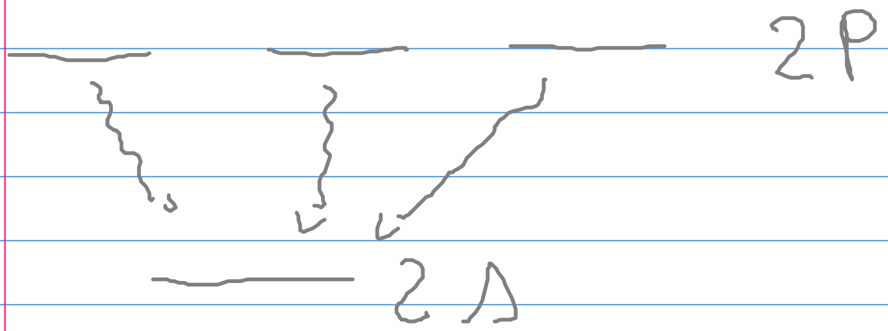
$$\boxed{V_q \longrightarrow \text{Forman un conj de } T_q^{(k=1)}}$$

$$\bar{V} = \sum_{q} \check{\varepsilon}^{*}_{q} \, V_{q}$$

$$V_{1} = -\frac{1}{\sqrt{2}}\left(\check{x} + i\check{y}\right) \qquad V_{0} = \check{z}$$

$$V_{-1} = \frac{1}{\sqrt{2}}\left(\check{x} - i\check{y}\right)$$

Vuelvo a A_{fi}:



(además no hay $\bar{L}\cdot\vec{S}$)

— — — 2P

— 2S

$$\sum_{m_i,\, q,\, m_F} \left| \langle 2\ 0\ 0 | \Gamma_q \varepsilon_q^{v*} | z_i\ j_i\ m_i \rangle \right|^2$$

$$\langle 2 0\ 0 | \Gamma_q | 2 1\ m \rangle$$

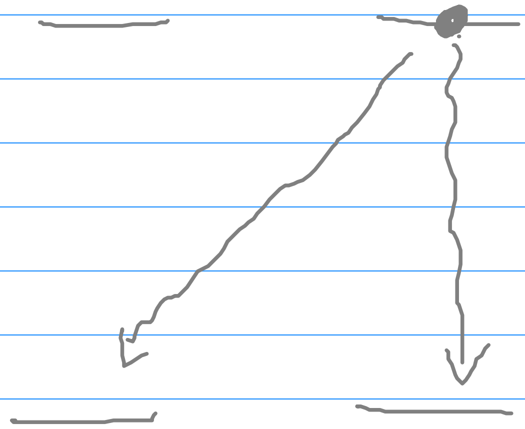
$$\underset{\text{WE}}{=} \frac{\langle 2 0 \| \Gamma^{(k=1)} \| 2 1 \rangle}{\sqrt{2 \cdot 0 + 1}}$$

$$\times \langle 1 m, 1 q | 0 0 \rangle$$

$$\boxed{0 = m + q} \Longrightarrow \underline{m = -q}$$

$$\Longrightarrow A_{Fi} = \frac{e^2 \omega_{iF}^3}{3\pi \varepsilon_0 \hbar c^3} \left| \langle 2 0 \| \Gamma^{(1)} \| 2 1 \rangle \right|^2 \times \sum_{q=-1}^{1} \left| \langle 1 -q, 1 q | 0 0 \rangle \right|^2$$

Por ejemplo:



$$\bar{E} \simeq E\,\underbrace{\check{z}}_{\Gamma_q^{(0)} = 0} \qquad \bar{E} = E\,\underbrace{(\check{x} + i\check{y})}_{\check{\varepsilon}_{-1}}$$

$$\boxed{m = m'}$$

Biblio: W-E en Sakurai

<u>Budker</u> Apendice F