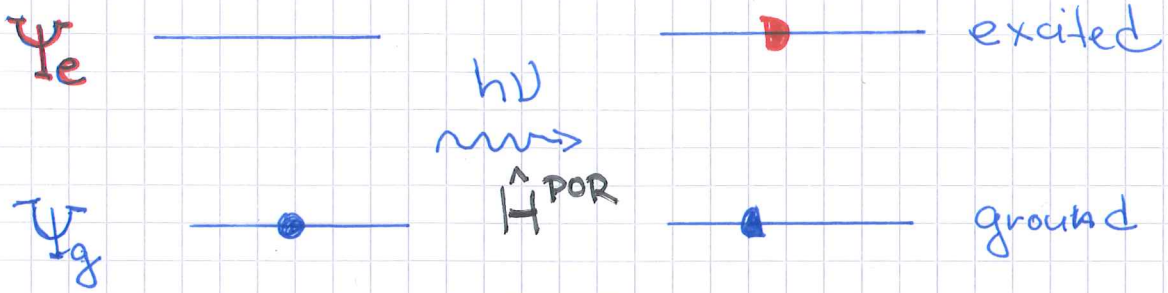
16/10/2014

2.4.1 TUHÝ ROTÁTOR [RIGID ROTOR]: VÝBĚROVÁ PRAVIDLA [SELECTION RULES]



operátor poruchy

$$P_{ge} \propto \int \Psi_e^* \hat{H}^{POR} \Psi_g \, d\tau$$

P_{ge} ↓ Pravděpodobnost přechodu ground → excited

$\propto$ ↓ je úměrná [is proportional]

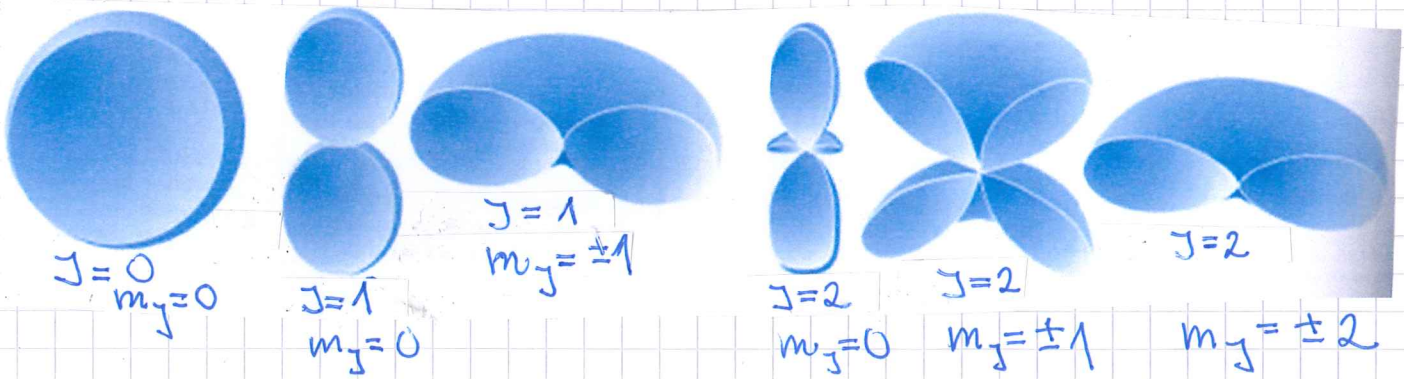
$\int \Psi_e^* \hat{H}^{POR} \Psi_g \, d\tau$ = μ_{eg} Tzv. Přechodový moment

[The probability of transition from the ground to the excited state]

[So-called Transition Moment]

Ψ_e, Ψ_g = vlastní funkce $\hat{J}^2$ a $\hat{J}_z$ = [eigenfunctions of $\hat{J}^2$ and $\hat{J}_z$]

= Sférické harmonické funkce $Y_J^{m_J}(\vartheta, \varphi)$ [spherical harmonics]

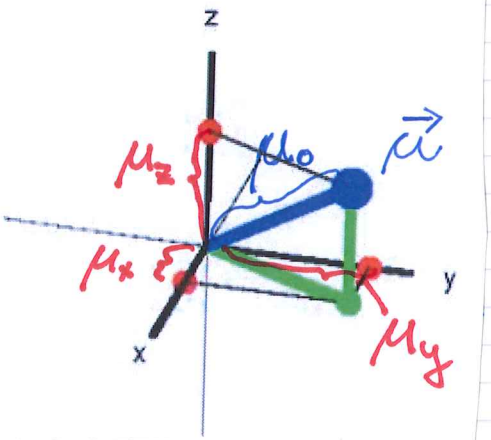


$\hat{H}^{POR} = \vec{\mu} \cdot \vec{E}$ → vektor elektrické složky EM pole [electric component vector of EM field]

$\vec{\mu}$ ↓ okamžitý el. dipól molekuly [instantaneous molecular electric dipole]

Pro rotační přechody jde o operátor ELEKTRICKÉHO DIPÓLOVÉHO MOMENTU.

[For rotational transitions, $\hat{H}^{POR}$ = ELECTRIC DIPOLE-MOMENT OPERATOR]



$$\mu_x = \mu_0 \cdot \underbrace{\sin\vartheta \cos\varphi}_{x}$$

$$\mu_y = \mu_0 \cdot \underbrace{\sin\vartheta \sin\varphi}_{y}$$

$$\mu_z = \mu_0 \cdot \underbrace{\cos\vartheta}_{z}$$

$$\mu_{eg} = \int Y_{J_e}^{-m_{Je}}(\vartheta,\varphi) \cdot \mu_0 \begin{pmatrix} \mu_x \\ \mu_y \\ \mu_z \end{pmatrix} \cdot \vec{E} \cdot Y_{J_g}^{m_{Jg}}(\vartheta,\varphi)\, d\tilde{\tau} =$$

$$= \mu_0 \vec{E} \int Y_{J_e}^{-m_{Je}}(\vartheta,\varphi) \begin{pmatrix} \sin\vartheta\cos\varphi \\ \sin\vartheta\sin\varphi \\ \cos\vartheta \end{pmatrix} Y_{J_g}^{m_{Jg}}(\vartheta,\varphi)\, \underbrace{d\tilde{\tau}}_{\sin\vartheta\, d\vartheta\, d\varphi}$$

Pro složku μ_z: (světlo polarizované ve směru osy z)

$$\mu_{eg,z} = \mu_0 \vec{E} \int_0^{\pi}\int_0^{2\pi} Y_{J_e}^{-m_{Je}}(\vartheta,\varphi) \cdot Y_{J_g}^{m_{Jg}}(\vartheta,\varphi) \cos\vartheta \sin\vartheta \, d\vartheta\, d\varphi$$

$\mu_0 \neq 0$

$m_{Je} = m_{Jg}$

$J_e = J_g \pm 1$

$\int_0^{2\pi} e^{i(m_{Jg} - m_{Je})\varphi} d\varphi \neq 0$