Lecture 1-QM_II-WS-00-01

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موضوعات درس
گروههای ترین
گروه ۱
گروه ۲
شنبه ها و ۷ لبدازظهر
یکشنبه ها و ۷ لبدازظهر
نماینده کلاس

اتم هیدروژن ساده

$$H = \frac{\vec{p}_1^{\,2}}{2m_1} + \frac{\vec{p}_2^{\,2}}{2m_2} + V(r) \qquad r = |\vec{x}_1 - \vec{x}_2|$$

$$\vec{x}_1 = (x_1, y_1, z_1)$$
$$\vec{x}_2 = (x_2, y_2, z_2)$$

$$\mu = \frac{m_1 m_2}{m_1 + m_2} \qquad m_1 + m_2 = M$$

$$\vec{x}_1 - \vec{x}_2 = \vec{x}_r \qquad \vec{x}_{CM} = \frac{m_1\vec{x}_1 + m_2\vec{x}_2}{m_1 + m_2}$$

$$H = \frac{\vec{p}_r^{\,2}}{2\mu} + \frac{\vec{p}_{CM}^{\,2}}{2M} + V(r) \qquad \vec{p}_{CM} = M\dot{\vec{x}}_{CM}$$

$$\vec{p}_r = \mu(\vec{v}_1 - \vec{v}_2)$$

$$H\,\psi(\vec{x}_{CM}, \vec{x}_r) = \tilde{E}\,\psi(\vec{x}_{CM}, \vec{x}_r)$$
$$\psi = \varphi(\vec{x}_{CM})\,\psi(\vec{x}_r)$$
$$\varphi(\vec{x}_{CM}) = e^{i\vec{k}_{CM}\cdot\vec{x}_{CM}} \qquad \vec{k}_{CM} = \frac{\vec{p}_{CM}}{\hbar}$$

$$\left(\frac{\vec{p}_r^{\,2}}{2\mu} + V(r)\right)\psi(\vec{x}_r) = E\,\psi(\vec{x}_r)$$

$$\tilde{E} = E + \frac{\hbar^2 k_{CM}^2}{2M}$$

$$\vec{x}_r = (r, \theta, \varphi) \qquad \vec{p}_r = \frac{\hbar}{i}\vec{\nabla}_r$$

$$\left(-\frac{\hbar^2}{2\mu}\vec{\nabla}_r^{\,2} + V(r)\right)\psi(\vec{x}_r) = E\,\psi(\vec{x}_r)$$

$$\psi(\vec{x}_r) = R(r)\,Y_{lm}(\theta, \varphi) \qquad \vec{L} = \vec{r}\times\vec{p}$$

$$\vec{L}^{\,2}\,Y_{lm_l}(\theta,\varphi) = \hbar^2 l(l+1)\,Y_{lm_l}(\theta,\varphi)$$
$$L_3\,Y_{lm_l}(\theta,\varphi) = \hbar\, m_l\, Y_{lm_l}(\theta,\varphi)$$

$$\left(\frac{-\hbar^2}{2\mu}\left(\frac{d^2}{dr^2} + \frac{2}{r}\frac{d}{dr}\right) + \frac{\hbar^2 l(l+1)}{2\mu r^2} - \frac{e^2 Z}{r}\right)R(r) = E\,R(r)$$

$$E_n = -|E_n| = -\frac{1}{2}\mu c^2 (Z\alpha)^2 \frac{1}{n^2}$$

$$\alpha = \frac{e^2}{\hbar c} \qquad n = n_r + l + 1$$

$$n = 1, 2, \ldots$$

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$l = 0, 1, \ldots n-1$

$-l \leq m_l \leq l$

$$D_n = 2 \sum_{l=0}^{n-1} (2l+1) = 2n^2$$

$\vec{B} \cdot \vec{L}$