Phys 261

The class

August 29, 2006

Abstract

Here are the notes from the class. They are written i realtime.

0.1 Third lecture 29.08.06

0.1.1 Atomic world construction

a_0 - radius, length $\Delta x \approx a_0$ $\Delta k \approx 1/a_0$ ($\hbar \Delta k = \Delta p$ wavenumber $\Delta E \approx \frac{(\Delta p)^2}{2m} = \frac{\hbar^2}{2ma_0^2} \approx \frac{\hbar^2}{ma_0^2}$ (kinetic energy T_0.) Potential energy V_0 $| - \frac{e^2}{a_0}$ $a_0 = 0,529$ Å$= \frac{\hbar^2}{e^2 m}$ Lenght unit Energy unit $\frac{e^2}{a_0} = \frac{\hbar}{ma_0^2} = 27,2$ eV

$< T_0 > = < V_0 >$ should be in the same order.

Atomic unit of time Atomic unit of velocity $p_0 = \hbar k_0 = \frac{\hbar}{a_0} v_0 = \frac{p_0}{m} = \frac{\hbar}{m} \frac{1}{a_0} = \frac{me^2}{\hbar^2} \frac{\hbar}{m} = \frac{e^2}{\hbar} \frac{v_0}{c} = \frac{e^2}{\hbar c} = \alpha = \frac{1}{137}$ $t_0 = \frac{a_0}{v_0} = (\frac{a_0}{e^2})\hbar = \frac{\hbar}{E_0}$ Alternative postulate $t_0 = \frac{\hbar}{E-O}$

(Statement a.u. $\longleftrightarrow e = m\hbar = 1$)

$\hbar = 0,66 \cdot 10^{-15}$ eVs $t_0 = \frac{0,66 \cdot 10^{-15}}{27,2}s=0,24 \cdot 10^{-15}$ (2 π for angular freq.) ν frequency — ω - angular frequency

$k_0 T$ is the "physical temperature". Room temperature is thus $\frac{1}{40}$eV or 25 meV

Atomic unit of energy $\longrightarrow$ VERY HOT

More about bound states in H

Ground state $-\frac{1}{2}$ a.u. States characterized by n, l (m - magnetic) In H energies given by $\frac{1}{n^2}(-\frac{1}{2})$a.u **Sett inn bilde av matrise og brnnpotensiale har bilder**

Ladi says its nonsens to talk about m as a quantum number.

Angular momentum $L = \omega\varphi$ $T_{rot} = \frac{1}{2}\frac{L^2}{g}$ $E = t + V$ is negativ

** bane bilde **

I_n QM it looks different 3-dim Schr.Eq. $\rightarrow$ Seperation of variables $x, y, z, \rightarrow r, \nu, \varphi | \frac{\delta^2}{\delta x^2} + \frac{\delta^2}{\delta y^2} + \frac{\delta^2}{\delta z^2} \longrightarrow T_r + \frac{L^2(\nu,\varphi)}{r^2}$

$T_r \longrightarrow \frac{1}{r}\frac{\delta}{\delta r}\frac{1}{r}\frac{\delta}{\delta r}$ L^2 is ugly (can be made very elegant) This is generally used in many fields.

Exercise: Look on the separation and how it's done.

(0)s-states, (1)p-states, (2)d-states, (3)f-states, ... there are more, but it is irrelevant here