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87(4): Charge Density from Fluctuating Zero-Point Radiative Corrections.

In papers 18, 85 and 86 the mean value of the radiative correction was used as follows:

$$g \rightarrow g\left(1 + \frac{\langle \alpha \rangle}{4\pi}\right)^2, \quad —(1)$$

$$\nabla^2 \rightarrow \nabla^2\left(1 + \frac{\langle \alpha \rangle}{4\pi}\right)^2 \quad —(2)$$

We now assume that the fluctuating electric and magnetic fields in the absence of photons can be expressed as:

$$\boxed{\alpha = \langle \alpha \rangle \left(1 + \cos(\kappa_r r)\right)} \quad —(3)$$

where r is the radial coordinate and κ_r a characteristic wavenumber. As a simple model the SE of atomic H is used to compute from eq. (3) the driving term of the Bernoulli / Euler equation ~~that~~ amplifies the radiative correction to the point at which the electron breaks free from the H atom

To first order in α:

$$\left(1 + \frac{\alpha}{4\pi}\right)^2 = 1 + \frac{\alpha}{2\pi} = 1 + \frac{\langle \alpha \rangle}{2\pi}\left(1 + \cos \kappa_r r\right)$$

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The SE is therefore:

$$-\frac{\hbar^2}{2m}\left(1+\frac{\langle\alpha\rangle}{2\pi}\left(1+\cos\kappa_{r}r\right)\right)\nabla^2\psi + V^{(0)}\psi = E\psi \quad -(5)$$

where: $$V^{(0)} = -\frac{e^2}{4\pi\epsilon_0 r} \quad -(6)$$

Eq. (5) is:

$$-\frac{\hbar^2}{2m}\left(1+\frac{\alpha}{2\pi}\right)\frac{d^2P}{dr^2} + V^{(0)}_{eff}P = EP \quad -(7)$$

where:

$$P = rR \quad -(8)$$

$$V^{(0)}_{eff} = -\frac{e^2}{4\pi\epsilon_0 r} + \frac{l(l+1)\hbar^2}{2mr^2} \quad -(9)$$

and where α is given by eq. (3).

Using the method of papers 85 and 86, eq. (7) is written as

$$-\frac{\hbar^2}{2m}\frac{d^2P}{dr^2} + V_{eff}P = EP \quad -(10)$$

where:

$$\bar{V}_{eff} = -\frac{e^2}{4\pi\epsilon_0 (r + r(vac))} + \frac{\ell(\ell+1)\hbar^2}{2m(r + r(vac))^2} \quad -(11)$$

Subtracting eq. (10) from eq. (7):

$$\boxed{-\frac{\hbar^2}{4\pi m} \alpha \frac{d^2 \rho}{dr^2} + \left(\bar{V}_{eff}^{(0)} - \bar{V}_{eff}\right) \rho = 0} \quad -(12)$$

Eq (12) is used to calculate the shift r(vac) due to α of eq (3). It is seen that r(vac) will have a cosinal dependence, which models <u>Zitterbewegung</u>, i.e. <u>jitterbugging</u>.

The next step is to calculate the effect of r(vac) on the charge density of the H atom, denoted ρ. The driving term of the Bernoulli Euler equation is $-\rho / \epsilon_0$. If this is cosinal, resonance amplification of ϕ, the initial Coulomb potential, will occur! In order to calculate the charge density, it is necessary to calculate the most probable distance

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of the electron from the proton. The probability of finding the electron in a volume element $d\tau$ at some point (r, θ, ϕ) is in general $|\psi(r,\theta,\phi)|^2$. The volume element in spherical polar coordinates is:

$$d\tau = r^2 dr \sin\theta \, d\theta \, d\phi \quad \text{— (13)}$$

The probability of finding the electron in a spherical shell of thickness dr and radius r is the sum of all of these probabilities as θ and ϕ move over all their values $(0 \leq \theta \leq \pi, \ 0 \leq \phi \leq 2\pi)$:

$$\text{prob} = \int_0^{\pi} \sin\theta \, d\theta \int_0^{2\pi} d\phi \, |\psi(r,\theta,\phi)|^2 r^2 dr$$

— (14)

However, the $\underline{f}$ wavefunction of eqs. (7) and (10) depends only on r. So:

$$\boxed{\text{prob} = 4\pi r^2 \underline{f}^2(r)} \quad \text{— (15)}$$

This is:

$$\boxed{\text{prob} = 4\pi r^4 R^2(r)} \quad \text{— (16)}$$

because

$$\underline{f} = r R(r) \quad \text{— (17)}$$

where $R(r)$ is the radial ... orbital

5) We now normalize this probability to be <u>unitless</u> by using r/a_0, where a_0 is the Bohr radius:

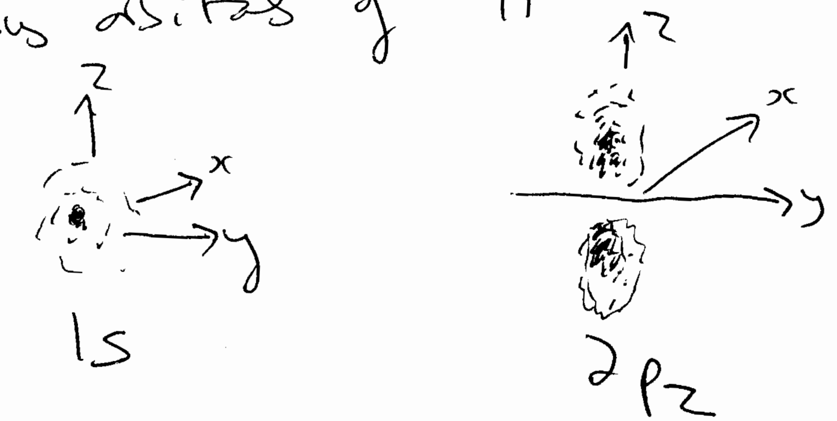
$$\text{prob(normalized)} := 4\pi\left(\frac{r}{a_0}\right)^4 R^2(r) \quad -(18)$$

The effect of $r(\text{vac})$ is:

$$\boxed{\text{prob(normalized)} = 4\pi\left(\frac{r+r(\text{vac})}{a_0}\right)^4 R^2(r)} \quad -(19)$$

because it has been assumed that $R(r)$ is hydrogenic to an excellent approximation.

Eq. (19) defines the <u>electron densities</u> (N) in various orbitals of H:



etc.

So:

$$\boxed{N = 4\pi\left(\frac{r+r(\text{vac})}{a_0}\right)^4 R^2(r)} \quad -(20)$$

Finally:

$$\rho = eN \quad -(21)$$

Therefore the Euler Bernoulli equation is:

$$\frac{d^2 \phi}{dr^2} + \frac{1}{r}\frac{d\phi}{dr} - \frac{1}{r^2}\phi = -\frac{\rho}{\epsilon_0} \quad -(22)$$

where:

$$\rho = 4\pi e \left(\frac{r + r(vac)}{a_0} \right)^4 R^2(r) \quad -(23)$$

In paper 63, eq. (22) was solved for:

$$\rho = \rho_0 \cos(\kappa_r r) \quad -(24)$$

using the Euler transformation ~~method~~. A circuit was found and three basic resonance frequencies isolated. This must now be repeated for eq. (23) as driving force.