311(4): Self Consistency of the Vacuum Force and Lamb Shift.

In order that m theory be self consistent with Lamb shift theory:

$$r_1 = \frac{r}{m(r)^{1/2}} = r + \delta r \quad -(1)$$

therefore the vacuum force of UFT 417

$$F(\text{vac}) = -\frac{mc^2}{2} \gamma \frac{dm(r)}{dr_1} \quad -(2)$$

becomes rigorously consistent with the Lamb shift through Eq. (1). The generalized γ factor becomes:

$$\gamma = \left(m(r) - \frac{1}{c^2} \underline{\dot{r}_1} \cdot \underline{\dot{r}_1} \right)^{-1/2} \quad -(3)$$

$$= \left(\left(\frac{r}{r + \delta r} \right)^2 - \frac{1}{c^2} \frac{d}{dt} \left(\underline{r} + \delta \underline{r} \right) \cdot \frac{d}{dt} \left(\underline{r} + \delta \underline{r} \right) \right)^{-1/2}$$

Eq. (3) is written as:

$$\gamma = \left(m(r) - \frac{1}{c^2} \frac{v_N^2}{m(r)} \right)^{-1/2} \quad -(4)$$

Here v_N is the Newtonian velocity. Therefore:

$$\gamma = \left(\left(\frac{r}{r+\delta r} \right)^2 - \left(\frac{r+\delta r}{r} \right)^2 \frac{v_N^2}{c^2} \right)^{-1/2} \quad -(5)$$

$$\boxed{\gamma = \left(\left(\frac{1}{1+\frac{\delta r}{r}} \right)^2 - \left(1 + \frac{\delta r}{r} \right)^2 \frac{v_N^2}{c^2} \right)^{-1/2}} \quad -(6)$$

2) This is the fluctuating Lorentz factor responsible for the Lamb shift:

In the limit:

$$\delta r \to 0 \quad -(7)$$

then

$$\gamma \to \left(1 - \frac{v_N^2}{c^2}\right)^{-1/2} \quad -(8)$$

which is the usual Lorentz factor Q.E.D.

The vacuum force accompanying the Lamb shift is:

$$F(\text{vac}) = -\frac{mc^2}{2} \gamma \frac{dm(r)}{dr_1} \quad -(9)$$

where γ is given by Eq. (6), and where:

$$\frac{dm(r)}{dr_1} = \frac{dm(r)}{dr} \frac{dr}{dr_1} \quad -(10)$$

From eq. (1):

$$\frac{dr_1}{dr} = 1 + \frac{d}{dr}(\delta r) \quad -(11)$$

and

$$m(r) = \left(\frac{r}{r + \delta r}\right)^2 \quad -(12)$$

$$= \left(\frac{1}{1 + \frac{\delta r}{r}}\right)^2$$

Therefore the vacuum force produced by the Lamb shift is:

$$F(\text{vac}) = -\frac{mc^2}{2} \gamma \frac{d}{dr} \left(\frac{1}{1 + \frac{\delta r}{r}}\right)^2 \left(1 + \frac{d}{dr}(\delta r)\right)^{-1}$$

$-(13)$

It is seen that:

$$F(vac) \xrightarrow[\delta r \to 0]{} 0 \quad -(14)$$

In eq (13):

$$\frac{d}{dr}\left(\frac{1}{1+\frac{\delta r}{r}}\right)^2 = \frac{d}{dr}\left(\frac{1}{1+2\frac{\delta r}{r}+\left(\frac{\delta r}{r}\right)^2}\right) \quad -(15)$$

$$= -\frac{\frac{d}{dr}\left(2\frac{\delta r}{r}+\left(\frac{\delta r}{r}\right)^2\right)}{\left(1+\frac{\delta r}{r}\right)^4}$$

Therefore the vacuum force is:

$$F(vac) = -\frac{mc^2}{2}\gamma \, \frac{\frac{d}{dr}\left(\frac{1}{1+\frac{\delta r}{r}}\right)^2}{1+\frac{d}{dr}\delta r} \quad -(16)$$

$$= -\frac{mc^2}{2}\gamma \, \frac{\frac{d}{dr}\left(\frac{1}{1+2\frac{\delta r}{r}+\left(\frac{\delta r}{r}\right)^2}\right)}{1+\frac{d}{dr}\delta r}$$

$$\boxed{F(vac) = \frac{mc^2}{2}\gamma \, \frac{\frac{d}{dr}\left(2\frac{\delta r}{r}+\left(\frac{\delta r}{r}\right)^2\right)}{\left(1+\frac{\delta r}{r}\right)^4\left(1+\frac{d}{dr}\delta r\right)}}$$

$-(17)$

4) This gives the Lamb shift to any precision in any atom or molecule. If

$$\delta r \rightarrow 0 \quad - (18)$$

then

$$F(\mathrm{vac}) \rightarrow 0 \quad - (19)$$