431(2): New Expression for Vacuum energy

Consider the hamiltonian in the format of recent papers:

$$H = T + U + E_0 \quad -(1)$$

where the kinetic energy is:

$$T = \frac{p^2}{m\left(\frac{\hbar\omega}{mc^2} + m(r)^{1/2}\right)} \quad -(2)$$

the potential energy is:

$$U = m(r)^{1/2} U_0 \quad -(3)$$

and the rest energy is:

$$E_0 = m(r)^{1/2} mc^2 \quad -(4)$$

Here p is particle momentum, m is particle mass, and $m(r)$ is the $m(r)$ function of m space.

The total relativistic energy is:

$$E = T + E_0 \quad -(5)$$

$$= \frac{p^2}{m\left(\frac{\hbar\omega}{mc^2} + m(r)^{1/2}\right)} + m(r)^{1/2} mc^2$$

$$= \hbar\omega$$

Now use: $E^2 = c^2 p^2 + m(r) m^2 c^4 \quad -(6)$

to find that: $p^2 = \frac{1}{c^2}\left(E^2 - m(r) m^2 c^4\right) \quad -(7)$

From Eqs. (5) and (7):

$$E = \frac{E^2 - m(r) m^2 c^4}{\hbar\omega + mc^2 m(r)^{1/2}} \quad -(8)$$

which is a quadratic in E:

$$E^2 - AE - B = 0 \quad -(9)$$

where:

$$A = \hbar\omega + m(r)^{1/2} mc^2 \quad -(10)$$

$$B = m(r) m^2 c^4 \quad -(11)$$

It follows that:

$$E = \hbar\omega = \frac{1}{2}\left(A \pm \left(A^2 + 4B\right)^{1/2}\right) - (12)$$

i.e.:

$$E = \hbar\omega = \frac{1}{2}\left(\hbar\omega + m(r)^{1/2} mc^2 \pm \left(\left(\hbar\omega + m(r)^{1/2} mc^2\right)^2 + 4m(r) m^2 c^4\right)^{1/2}\right) \quad -(13)$$

This equation can be solved for $m(r)$ in terms of $\hbar\omega$ and mc^2.

When considering the vacuum, E is the total relativistic energy of the vacuum particle of mass m. As in UFT338, the "missing mass" of the universe is described in terms of the mass of the vacuum particle.

Note that if:

$$m = 0 \quad -(14)$$

i.e. (13) then:

$$E = \hbar \omega \quad -(15)$$

taking the positive root of eq. (13).

The vacuum force is eq. (24) of Note 430(1):

$$F = \frac{dn(r)}{dr} \left(\frac{n(r)}{r\frac{dn(r)}{dr} - 2n(r)} \right)^{1/2} E \quad -(16)$$

where E, the vacuum energy, is given by Eq. (13).

From eq. (8) of Note 430:

$$n(r) = \left(\frac{m_1}{m} \right)^2 = \frac{\hbar}{mc} q_a^{\nu} \gamma^{\mu} \left(\Gamma^a_{\mu\nu} - \omega^a_{\mu\nu} \right) \quad -(17)$$

So $n(r)$ found from eq. (13) can be equated with $n(r)$ found from eq. (17).

Finally the mass m_1 of any elementary particle is given by eq. (17), where m is the mass of the particle in Minkowski space ($n(r) = 1$).

These equations apply to any particle, elementary or macroscopic.
