338(1): Development of the Minimal Prescription of ECE2

Consider the physical W^μ potential of ECE2:

$$W^\mu = \frac{\hbar}{e} \Omega^\mu \quad -(1)$$

here Ω^μ is the spin connection four vector:

$$\Omega^\mu = \left(\Omega^0, \underline{\Omega} \right) \quad -(2)$$

and where

$$W^\mu = \left(\frac{\phi_W}{c}, \underline{W} \right) \quad -(3)$$

If the minimal prescription is defined by:

$$p^\mu \rightarrow p^\mu - eW^\mu \quad -(4)$$

the Einstein field equation becomes:

$$\left(p^\mu - eW^\mu \right)\left(p_\mu - eW_\mu \right) = m^2 c^2 \quad -(5)$$

i.e.

$$\left(p^\mu - \hbar \Omega^\mu \right)\left(p_\mu - \hbar \Omega_\mu \right) = m^2 c^2 \quad -(6)$$

Here

$$p^\mu = \left(\frac{E}{c}, \underline{p} \right), \quad -(7)$$

where

$$E = \gamma m c^2 = \hbar \omega \quad -(8)$$

and

$$\underline{p} = \gamma m \underline{v} = \hbar \underline{\kappa} \quad -(9)$$

In the Aharonov Bohm vacuum the Maurer / Cartan structure equations are:

$$T = d \wedge q + \omega \wedge q = 0 \quad -(10)$$

and

$$R = d \wedge \Omega + \Omega \wedge \Omega = 0 \quad -(11)$$

... the torsion T and curvature R are both zero, but the tetrad q and spin connection Ω are non-zero. The ... potentials a material ... Aharonov Bohm effects are effects in regions where fields are excluded. These regions ... matter in regions where fields are excluded ... defined as Aharonov Bohm vacua, and it is considered that the Aharonov Bohm vacuum is responsible for the radiative corrections, energy from spacetime and low energy nuclear reactions.

The minimal prescription does not consider the fields of force, only potentials, so is ideal for the development of the above hypotheses. Furthermore, eq. (1) is a quantization of the spin connection, giving the overall result:

$$p^\mu = eW^\mu = \hbar \Omega^\mu \quad -(12)$$

The usual quantization procedure is:

$$p^\mu = \hbar \kappa^\mu \quad -(13)$$

so

$$\boxed{\Omega^\mu = \kappa^\mu} \quad -(14)$$

where

$$\kappa^\mu = \left(\frac{\omega}{c}, \underline{\kappa} \right) \quad -(15)$$

is the wave four-vector.

It follows that the spin connection four vector

) of the AB vacuum is the wave four-vector of quantized spacetime. Therefore eq. (6) is:

$$(p^\mu - \hbar\kappa^\mu)(p_\mu - \hbar\kappa_\mu) = m^2c^2 \quad -(16)$$

where

$$\kappa^\mu = \Omega^\mu \quad -(17)$$

In general there is summation over repeated indices in eq. (16), but for a particle, such as an electron, at rest:

$$p^\mu = \left(\frac{E_0}{c}, \underline{0}\right) \quad -(18)$$

and

$$\kappa^\mu = \left(\frac{\omega_0}{c}, \underline{0}\right) \quad -(19)$$

because there is no momentum:

$$\underline{p} = \hbar\underline{\kappa} = \underline{0}. \quad -(20)$$

The quantity ω_0 is known as the rest frequency. The de Broglie rest frequency equation is:

$$E_0 = mc^2 = \hbar\omega_0 \quad -(21)$$

Therefore for a particle at rest:

$$\mu = 0 \quad -(22)$$

in Eq. (16):

$$(p^0 - \hbar\kappa^0)(p_0 - \hbar\kappa_0) = m^2c^2 \quad -(23)$$

4) Eq. (23) can be written as:

$$\left(\frac{E_0}{c} - \frac{\hbar\omega_0}{c}\right)\left(\frac{E_0}{c} - \frac{\hbar\omega_0}{c}\right) = m^2c^2 \quad -(24)$$

i.e.

$$E_0 - \hbar\omega_0 = mc^2 \quad -(25)$$

or

$$\boxed{E_0 = mc^2 + \hbar\omega_0} \quad -(26)$$

Eq. (26) demonstrates the fact that the AB vacuum contributes an energy $\hbar\omega_0$ to the rest energy mc^2 of a particle of mass m such as an electron. The de Broglie equation for the AB vacuum is:

$$m(\text{vac})\, c^2 = \hbar\omega_0 \quad -(27)$$

where $m(\text{vac})$ is the mass of the vacuum particle. The vacuum contains a flux of such particles. Therefore the Einstein rest energy equation is

$$\boxed{E = (m + m(\text{vac}))\, c^2} \quad -(28)$$

What is actually measured experimentally is $m + m(\text{vac})$, because m is always in contact with the vacuum.

Spacetime in the universe is filled with particles of mass $m(\text{vac})$, even in regions

) where there is no mass m, i.e region of deep space. Therefore the mass of the universe is made up of particles of mass m(vac). In some cases these can be thought of as photons of mass m(vac). The mass is defined by:

$$m(\text{vac}) = \frac{\hbar \omega_0}{c^2} \quad -(29)$$

where ω_0 is the angular frequency of the quantized spacetime known as the Aharonov Bohm vacuum. This frequency is:

$$\boxed{\omega_0 = c\,\Omega^0} \quad -(30)$$

where Ω^0 is the scalar part of the spin connection four vector defined by eq. (2).

Therefore the mass of the vacuum particle is defined by:

$$\boxed{m(\text{vac}) = \frac{\hbar\,\Omega^0}{c}} \quad -(31)$$

The mass of the universe is therefore due to the scalar part of the spin connection.