337(4): Final Version of Note 337(3)

Consider the Einstein field equation:

$$p^\mu p_\mu = m^2 c^2 \quad -(1)$$

where

$$p^\mu = \left(\frac{E}{c}, \underline{p} \right) \quad -(2)$$

and

$$p_\mu = \left(\frac{E}{c}, -\underline{p} \right) \quad -(3)$$

Use the minimal prescription:

$$p_\mu \rightarrow p_\mu + eW_\mu \quad -(4)$$

and

$$p^\mu \rightarrow p^\mu + eW^\mu \quad -(5)$$

to describe the effect of Aharonov Bohm spacetime, whose geometry is:

$$T = d \wedge q + \Omega \wedge q = 0 \quad -(6)$$

$$R = d \wedge \Omega + \Omega \wedge \Omega = 0. \quad -(7)$$

Aharonov Bohm spacetime is a space in which there is no curvature R or torsion T, but in which the tetrad and spin connection are non-zero. In ECE and ECE2 there are potentials but no fields in an AB spacetime.

The effect of the AB spacetime on eq. (1) is:

$$(p^\mu + eW^\mu)(p_\mu + eW_\mu) = m^2 c^2 \quad -(8)$$

2) The positive sign is used for the minimal prescription:

$$p^\mu \rightarrow p^\mu + eW^\mu \quad -(9)$$

This is consistent with the definition of the elementary fluxon:

$$W^{(0)} = \frac{\hbar}{e} \text{ weber or } J s C^{-1} \quad -(10)$$

The fluxon is the quantum of magnetic flux (see "The Enigmatic Photon")

The W^μ four potential of ECE2 is defined in general by:

$$W^\mu = (W^0, \underline{W}) = \left(\frac{\phi_W}{c}, \underline{W}\right) \quad -(11)$$

By hypothesis:

$$W^\mu = W^{(0)}\Omega^\mu \quad -(12)$$
$$= \frac{\hbar}{e}\Omega^\mu$$

where the spin connection four vector is

$$\Omega^\mu = (\Omega^{(0)}, \underline{\Omega}) \quad -(13)$$

In general there is summation over repeated indices in eq. (8), but when considering a particle at rest:

$$p^\mu = \left(\frac{E}{c}, \underline{0}\right), \quad W^\mu = \frac{\hbar}{e}\left(\Omega^0, \underline{0}\right) \quad -(14)$$

In this case:

$$\left(\frac{E}{c}+\hbar\Omega^{(0)}\right)\left(\frac{E}{c}+\hbar\Omega^{(0)}\right)=m^2c^2 \quad -(15)$$

so
$$\left(E+\hbar\Omega^{(0)}c\right)\left(E+\hbar\Omega^{(0)}c\right)=m^2c^4 \quad -(16)$$

Define the angular frequency:

$$\omega_0 = c\Omega^{(0)} \quad -(17)$$

Then we obtain:

$$(E+\hbar\omega_0)(E+\hbar\omega_0)=m^2c^4 \quad -(18)$$

and it is clear that the rest frequency of a particle at rest is increased by:

$$E = mc^2 \rightarrow mc^2+\hbar\omega_0 \quad -(19)$$

where ω_0 is an angular frequency that is inherent in AB spacetime.