340(5): Development of ECE2 Theory of the Aharonov Bohm Vacuum

In minimal notation the Aharonov Bohm vacuum is defined by:

$$T = d \wedge q + \omega \wedge q = 0 \quad -(1)$$

and

$$R = d \wedge \omega + \omega \wedge \omega = 0 \quad -(2)$$

These equations are translated directly into field equations:

$$F = d \wedge A + \omega \wedge A = 0 \quad -(3)$$

from eq. (1), in the original ECE theory, and

$$F = d \wedge W + \omega \wedge W = 0 \quad -(4)$$

from eq. (2), in ECE2 theory.

In more detail:

$$\underline{B}^a = A^{(0)} \underline{T}^a(\text{spin}) \quad -(5)$$

$$\underline{B}^a{}_b = W^{(0)} \underline{R}^a{}_b(\text{spin}) \quad -(6)$$

$$\underline{E}^a = cA^{(0)} \underline{T}^a(\text{orb}) \quad -(7)$$

$$\underline{E}^a{}_b = cW^{(0)} \underline{R}^a{}_b(\text{orb}) \quad -(8)$$

The spin torsion is defined by:

$$\underline{T}^b(\text{spin}) = \underline{\nabla} \times \underline{q}^b - \underline{\omega}^b{}_c \times \underline{q}^c \quad -(9)$$

and the spin curvature by:

$$\underline{R}^a{}_b(\text{spin}) = \underline{\nabla} \times \underline{\omega}^a{}_b - \underline{\omega}^a{}_c \times \underline{\omega}^c{}_b \quad -(10)$$

Therefore the Aharonov Bohm vacuum is defined by:

2)

$$\underline{\nabla} \times \underline{q}^b = \underline{\omega}^b{}_c \times \underline{q}^c \quad -(11)$$

and

$$\underline{\nabla} \times \underline{\omega}^a{}_b = \underline{\omega}^a{}_c \times \underline{\omega}^c{}_b \quad -(12)$$

The $\underline{A}^a$ potential is defined by:

$$\underline{A}^a = A^{(0)} \underline{q}^a \quad -(13)$$

and the $\underline{W}^a{}_b$ potential by:

$$\underline{W}^a{}_b = W^{(0)} \underline{\omega}^a{}_b. \quad -(14)$$

The fundamental unit of $W^{(0)}$ is the fluxon:

$$W^{(0)} = \frac{\hbar}{e}, \quad -(15)$$

the quantum of magnetic flux in units of weber.

In the ECE2 series of papers, indices are removed by use of unit vectors, so for example:

$$\underline{B} = -e_a \underline{B}^a \quad -(16)$$

and

$$\underline{R}(\text{spin}) = e^b e_a \underline{R}^a{}_b(\text{spin}). \quad -(17)$$

However, the index removal (16) leads to:

$$\underline{B} = \underline{\nabla} \times \underline{W} \quad -(18)$$

~~and~~ but this is not sufficient to define the Aharonov Bohm vacuum, because if $\underline{B}$ is zero, $\underline{\nabla} \times \underline{W}$ is zero. Also, eq. (18) is a $U(1)$ type theory which cannot define the $\underline{B}^{(3)}$ field, and as shown in UFT 132 ff. the $U(1)$ theory collapses when antisymmetry is applied.

3) Therefore a self consistent description of the AB vacuum requires:

$$\underline{B}^a = \underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b = \underline{0} \quad -(19)$$

and

$$\underline{B}^a{}_b = \underline{\nabla} \times \underline{\overline{W}}^a{}_b - \underline{\omega}^a{}_c \times \underline{\overline{W}}^c{}_b \quad -(20)$$

Eqs. (19) and (20) can be shown to be the same using:

$$\boxed{\underline{A}^a = -e^b \underline{\overline{W}}^a{}_b} \quad -(21)$$

which is a new development of ECE2 theory. Since

$$\underline{\overline{W}}^a = -e^b \underline{\overline{W}}^a{}_b \quad -(22)$$

it follows that:

$$\boxed{\underline{\overline{W}}^a = \underline{A}^a}. \quad -(23)$$

The spin connection $\underline{\omega}^a{}_b$ can be reduced to a single index vector by the same procedure:

$$\underline{\omega}^a = -e^b \underline{\omega}^a{}_b \quad -(24)$$

It follows that:

$$\boxed{\underline{B}^a = \underline{\nabla} \times \underline{\overline{W}}^a - \underline{\omega}^a{}_b \times \underline{\overline{W}}^b}. \quad -(25)$$

In ECE:

$$\underline{B}^a = \underline{\nabla} \times \underline{A}^a - \underline{\omega}^a{}_b \times \underline{A}^b \quad -(26)$$

In these equations:

$$\underline{W}^a = \overline{W}^{(0)} \underline{R}^a \quad -(27)$$

$$\underline{A}^a = A^{(0)} \underline{T}^a \quad -(28)$$

From these equations:

$$\boxed{\overline{W}^{(0)} \underline{R}^a = A^{(0)} \underline{T}^a} \quad -(29)$$

i.e.

$$\underline{T}^a = \frac{\overline{W}^{(0)}}{A^{(0)}} \underline{R}^a \quad -(30)$$

and

$$\underline{R}^a = \frac{A^{(0)}}{\overline{W}^{(0)}} \underline{T}^a = \frac{eA^{(0)}}{\hbar} \underline{T}^a \quad -(31)$$

Therefore if curvature vanishes, torsion vanishes, and if torsion vanishes, curvature vanishes.

Q.E.D.