1)

SUMMARY OF THE AHARONOV BOHM EFFECTS

Experimentally, the Aharonov Bohm effects use two ~~intersect~~ boundaries:

Fig. (1)

The original Chambers experiment confined the magnetic field to the inner region enclosed by the inner boundary. Nevertheless the effect observed is due to a surface integral around the outer boundary. There have been many attempts to explain this using the standard model, but none are successful. In the Evans unified field theory all Aharonov Bohm (AB) effects are explained by the fundamental definition of the magnetic field:

$$F^a = D \wedge A^a = d \wedge A^a + \omega^a{}_b \wedge A^b \qquad -(1)$$

in which there appears the spin connection.

In the standard model the magnetic field is always defined by:

$$F = d \wedge A \qquad -(2)$$

2)

In the standard model the AB effect is proportional to the magnetic flux:

$$\Phi = \oint A \quad (\text{outer boundary}) \quad -(3)$$

This is observed experimentally as in the well known Chambers experiment. However, the magnetic field (i.e. flux density) is confined inside the inner boundary (the iron whisker):

$$F = d \wedge A \quad (\text{inner boundary}) \quad -(4)$$

and so:

$$\Phi = \oint A = \int_S F = \int_S d \wedge A \quad -(5)$$

inside the inner boundary.

From Stokes' Theorem and eqn. (3):

$$\Phi = \oint A = \int_S F = \int_S d \wedge A \quad -(6)$$

inside the outer boundary.

There is a contradiction between eqns (5) and (6) because the experimentally measured flux is given by eqn. (6) but the physical magnetic flux is given by eqn. (5). This contradiction is waved aside in the standard model by the attempted use of a gauge transformation:

3)

$$A \rightarrow A + d\chi \qquad -(7)$$

and the assertion that $d\chi$ exists in regions where A does not exist. The standard model argument is at best confused and at worst incorrect. The Poincaré Lemma shows that:

$$F = d \wedge d\chi = 0 \qquad -(8)$$

for all χ. It follows that

$$\Phi = \int_S F = \int_S d \wedge d\chi = \oint d\chi = 0 \qquad -(9)$$

for all χ. Despite this, the standard model asserts that the AB effect is due to $d\chi$, i.e. asserts that:

$$\oint d\chi \neq 0 \; ? \qquad -(10)$$

This contradicts the well known mathematical result - that the Stokes Theorem is valid in non-simply connected regions such as in Fig (1).

In the standard model therefore the AB effects cannot be explained without some very special pleading. In the Chambers experiment for example the basic equations used in the standard model are:

$$F = d \wedge A \qquad -(11)$$

$$d \wedge F = 0 \qquad -(12)$$

$$\kappa \rightarrow \kappa + \frac{e}{\hbar} A \qquad -(13)$$

4) The Chambers experiment observes a shift of type (13) in the wavefunction of an electron. It is an effect to first order in A. Eqn (12) is the homogeneous field equation of the standard model.

Evans Unified Field Theory

From eqn (1) magnetic flux in weber is, in general:

$$\boxed{\Phi^a = \int_S F^a = \oint A^a + \int_S \omega^a{}_b \wedge A^b} \quad -(14)$$

and is defined by the sum of two terms, one involving the spin connection $\omega^a{}_b$ of general relativity. It is $\omega^a{}_b$ that gives rise to the Aharonov Bohm effects. The reason is that the second term on the right hand side of eqn (14) exists in the outer region of Fig (1) even though the magnetic flux density is confined to the inner region. This is a fundamental result of geometry.

The homogeneous field equation of the Evans theory is:

$$d \wedge F^a = 0, \quad -(15)$$

and this implies that:

5)

$$\omega^a{}_b = -\kappa\, \epsilon^a{}_{bc}\, q^c \qquad -(16)$$

and in the complex circular basis:

$$\Phi^{(3)*} = \int_S F^{(3)*} = \oint A^{(3)*} - \frac{ie}{\hbar}\int_S A^{(1)} \wedge A^{(2)}$$

$$-(17)$$

From eqn (17) it is seen that $F^{(3)}$ and $A^{(3)}$ are confined to the iron whisker (being in the Z axis of the iron whisker perpendicular to the plane of the paper), but $A^{(1)}$ and $A^{(2)}$ exist outside the iron whisker (in the plane of the paper) and interact with the electron beams. The observed fringe shift is proportional to $\Phi^{(3)*}$ as is well known. The electron wavefunction's wavenumber is shifted by:

$$\cancel{\kappa_x \rightarrow \kappa + \frac{e\mathrm{Re}(A^{(1)})}{\hbar}}$$

$$\kappa \rightarrow \kappa + \frac{eA^{(0)}}{\hbar} \qquad -(18)$$

where:

$$A^{(0)} = -i\left(A^{(1)} \wedge A^{(2)}\right)^{1/2} \qquad -(19)$$

Here:

$$eA^{(0)} = \hbar\kappa. \qquad -(20)$$

Optical or Second Order AB Effect.

The existence of the inverse Faraday effect implies that there is an optical or second order AB effect. This is not a shift in the electron wave function, but is due to the magnetization caused in the electron by the $B^{(3)}$ field:

$$B^{(3)*} = -ig\, A^{(1)} \wedge A^{(2)} \quad -(21)$$

The $B^{(3)}$ field, the Evans spin field, is a manifestation of the fact that electromagnetism is spinning spacetime. The magnetization of the IFE can be expressed as the second order effect:

$$M^{(3)*} = -\frac{ig'}{\mu_0} A^{(1)} \wedge A^{(2)} \quad -(22)$$

and the optical AB effect is proportional to the flux:

$$\Phi^{(3)*} = \mu_0 \int_S M^{(3)*} \quad -(23)$$

where integration occurs around the outer surface in Fig (1). This has important implications for RADAR technology.