317(9): ECE2 Field Equations for Engineering Model
(Triple Checked)

Gauss Law of Magnetism

$$\underline{\nabla} \cdot \underline{B} = \underline{\kappa} \cdot \underline{B} \quad -(1)$$

Coulomb Law

$$\underline{\nabla} \cdot \underline{E} = \underline{\kappa} \cdot \underline{E} \quad -(2)$$

Faraday Law of Induction

$$\frac{\partial \underline{B}}{\partial t} + \underline{\nabla} \times \underline{E} = -\left(\kappa_0 c \underline{B} + \underline{\kappa} \times \underline{E} \right) \quad -(3)$$

Ampère Maxwell Law

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2} \frac{\partial \underline{E}}{\partial t} = \frac{\kappa_0}{c} \underline{E} + \underline{\kappa} \times \underline{B} \quad -(4)$$

Here:

$$\underline{\kappa} = 2 \left(\frac{\underline{v}}{r^{(0)}} - \underline{\omega} \right) \quad -(5)$$

Equations in the Absence of a Magnetic Monopole

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(6)$$

$$\underline{\nabla} \cdot \underline{E} = \underline{\kappa} \cdot \underline{E} \quad -(7)$$

$$\frac{\partial \underline{B}}{\partial t} + \underline{\nabla} \times \underline{E} = \underline{0} \quad -(8)$$

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2} \frac{\partial \underline{E}}{\partial t} = \underline{\kappa} \times \underline{B} \quad -(9)$$

2) In the absence of a magnetic monopole:

$$\kappa_0 = 2\left(\frac{q_0}{r^{(0)}} - \omega_0\right) = 0, \quad -(10)$$

and

$$\underline{B} \perp \underline{\kappa}, \quad -(11)$$

$$\underline{E} \parallel \underline{\kappa} \quad -(12)$$

Therefore in the absence of a magnetic monopole:

$$\underline{B} \perp \underline{E} \quad -(13)$$

Electric Charge Density

$$\rho = \epsilon_0 \underline{\kappa} \cdot \underline{E} \quad -(14)$$

Electric Current Density

$$\underline{J} = \frac{1}{\mu_0} \underline{\kappa} \times \underline{B} \quad -(15)$$

where

$$\epsilon_0 \mu_0 = \frac{1}{c^2} \quad -(16)$$

Charge Current Four Density

$$J^\mu = (c\rho, \underline{J}) = \frac{1}{\mu_0}\left(\frac{1}{c}\underline{\kappa} \cdot \underline{E}, \underline{\kappa} \times \underline{B}\right) \quad -(17)$$

in the absence of a magnetic monopole

Conservation of Charge Current Density

This follows from:

3)

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_0 \quad -(18)$$

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2} \frac{\partial \underline{E}}{\partial t} = \mu_0 \underline{J} \quad -(19)$$

So:

$$\mu_0 \underline{\nabla} \cdot \underline{J} = \underline{\nabla} \cdot \underline{\nabla} \times \underline{B} - \frac{1}{c^2} \underline{\nabla} \cdot \frac{\partial \underline{E}}{\partial t}$$

$$= -\frac{1}{c^2} \frac{\partial}{\partial t} \left(\underline{\nabla} \cdot \underline{E} \right) = -\frac{1}{c^2 \epsilon_0} \frac{\partial \rho}{\partial t} \quad -(20)$$

$$= -\frac{1}{\mu_0} \frac{\partial \rho}{\partial t}$$

So:

$$\frac{\partial \rho}{\partial t} + \underline{\nabla} \cdot \underline{J} = 0 \quad -(21)$$

i.e.

$$\partial_\mu J^\mu = 0 \quad -(22)$$

This means

$$\frac{\partial}{\partial t} \left(\underline{\kappa} \cdot \underline{E} \right) + c^2 \underline{\nabla} \cdot \left(\underline{\kappa} \times \underline{B} \right) = 0 \quad -(23)$$

in the absence of a magnetic monopole.

Therefore if $\underline{E}$ and $\underline{B}$ are known, $\underline{\kappa}$ can be found from eq. (23).

The overall structure of the ECE2 field equations is:

$$\underline{\nabla} \cdot \underline{B} = 0 \qquad -(24)$$

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_0 \qquad -(25)$$

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \qquad -(26)$$

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2}\frac{\partial \underline{E}}{\partial t} = \mu_0 \underline{J} \qquad -(27)$$

This is the same structure exactly as that of the Maxwell Heaviside (MH) field equations. So everything that is known about electrodynamics can be derived from the Cartan and Cartan Evans identities with basic axioms:

$$\underline{B}^a = A^{(0)} \underline{T}^a (\text{spin}) \qquad -(28)$$

$$\underline{E}^a = c A^{(0)} \underline{T}^a (\text{orbital}) \qquad -(29)$$

$$\underline{B}^a{}_b = W^{(0)} \underline{R}^a{}_b (\text{spin}) \qquad -(30)$$

$$\underline{E}^a{}_b = W^{(0)} c \underline{R}^a{}_b (\text{orbital}) \qquad -(31)$$

The fundamental philosophical difference is that ECE2 is a generally covariant unified field theory, whereas MH is special relativity. ECE2 has more information than MH, given by the relation between field and potential. These are given as follows:

5)

In ECE2:

$$\underline{B} = \underline{\nabla} \times \underline{A} + 2\,\underline{\omega} \times \underline{A} \quad -(32)$$

In MH:

$$\underline{B} = \underline{\nabla} \times \underline{A} \quad -(33)$$

In ECE2:

$$\underline{E} = -cA^{(0)}\underline{\nabla} q_0 - A^{(0)}\frac{\partial \underline{q}}{\partial t} - cA^{(0)}\omega_{0b}\underline{q}^b + cA^{(0)}q^b_0\,\underline{\omega}_b$$

$$= -c\underline{\nabla}A_0 - \frac{\partial \underline{A}}{\partial t} - c\omega_{0b}\underline{A}^b + cA^b_0\,\underline{\omega}_b$$

$$= -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} + 2\left(c\omega_0\underline{A} - \phi\,\underline{\omega}\right) \quad -(34)$$

where

$$A^\mu = (\phi, c\underline{A}) \quad -(35)$$

In MH:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} \quad -(36)$$

Here:

$$\omega^\mu = (\omega_0, \underline{\omega}) \quad -(37)$$

Here ϕ is the scalar potential and $\underline{A}$ the vector potential. The spin connection four vector is defined in Eq. (37), in which ω_0 is the

6) spin connection scalar and $\underline{\omega}$ the vector spin connection.

The spin connection is the key difference between ECE2 and MH. In UFT 311 it was proven experimentally that the spin connection can be found from a circuit designed by Ide.

As in ECE theory the spin connection can be used to describe many effects, such as spin connection resonance and the Aharonov Bohm effects.

In ECE2 there are new relations between the field and spin connections based on the vector format of the second Maurer Cartan structure equation:

$$\underline{R}^a{}_b(\text{spin}) = \underline{\nabla} \times \underline{\omega}^a{}_b - \underline{\omega}^a{}_c \times \underline{\omega}^c{}_b \quad -(38)$$

and

$$\underline{R}^a{}_b(\text{orb}) = -\underline{\nabla}\,\omega^a{}_{0b} - \frac{1}{c}\frac{\partial \underline{\omega}^a{}_b}{\partial t} - \omega^a{}_{0c}\,\underline{\omega}^c{}_b + \omega^c{}_{0b}\,\underline{\omega}^a{}_c \quad -(39)$$

Tangent indices are removed using:

$$\underline{R}(\text{spin}) = e^b e_a \underline{R}^a{}_b(\text{spin}) \quad -(40)$$

) and

$$\underline{R}(\mathrm{orb}) = e^{b} e_a \underline{R}^{a}{}_{b}(\mathrm{orb}). \quad -(41)$$

Therefore:

$$\underline{R}(\mathrm{spin}) = \underline{\nabla} \times \underline{\omega} - \underline{\omega}_c \times \underline{\omega}^c \quad -(42)$$

$$= \underline{\nabla} \times \underline{\omega}$$

and

$$\underline{R}(\mathrm{orb}) = -\underline{\nabla}\omega_0 - \frac{1}{c}\frac{\partial \underline{\omega}}{\partial t} - \omega_{0c}\underline{\omega}^c + \omega^c{}_0 \underline{\omega}_c$$

$$= -\underline{\nabla}\omega_0 - \frac{1}{c}\frac{\partial \underline{\omega}}{\partial t} \quad -(43)$$

This geometry is converted into electrodynamics using:

$$\underline{B} = A^{(0)} \underline{R}(\mathrm{spin}) \quad -(44)$$

$$\underline{E} = c A^{(0)} \underline{R}(\mathrm{orb}) \quad -(45)$$

and

$$W^{\mu} = W^{(0)} \omega^{\mu}, \quad -(46)$$

where $W^{(0)}$ has the units of weber = tesla m^2.

The original ECE hypothesis is:

$$A^{\mu} = A^{(0)} q^{\mu} \quad -(47)$$

so A^{μ} and W^{μ} have the same units of tesla metre.

Therefore it is found that:

8)

$$\underline{B} = \underline{\nabla} \times \underline{W} \quad -(48)$$

and

$$\underline{E} = -c\underline{\nabla} W_0 - \frac{\partial \underline{W}}{\partial t}$$
$$= -\underline{\nabla} \phi_W - \frac{\partial \underline{W}}{\partial t} \quad -(49)$$

where

$$W^\mu = (c\phi_W, \underline{W}) \quad -(50)$$

The overall result is: $\quad -(51)$

$$\underline{B} = \underline{\nabla} \times \underline{W} = \underline{\nabla} \times \underline{A} + 2\underline{\omega} \times \underline{A}.$$

and:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} + 2(c\omega_0 \underline{A} - \phi\underline{\omega}) \quad -(52)$$
$$= -\underline{\nabla}\phi_W - \frac{\partial \underline{W}}{\partial t}$$

A vast amount of new development is possible with these equations.