259(1): Electrostatics in ECE Theory

The equations of electrostatics in ECE theory are the Coulomb law:

$$\underline{\nabla} \cdot \underline{E}^a = \underline{\omega}^a{}_b \cdot \underline{E}^b - c \underline{A}^b \cdot \underline{R}^a{}_b \text{(ad)}, \quad -(1)$$

the Faraday law of induction in the absence of a magnetic field:

$$\underline{\nabla} \times \underline{E}^a = \underline{0} \quad -(2)$$

and the definition of the electric field:

$$\underline{E}^a = -c \underline{\nabla} A^a_0 - \frac{\partial \underline{A}^a}{\partial t} - c\, \omega^a{}_{0b} \underline{A}^b + c A^b_0 \underline{\omega}^a{}_b \quad -(3)$$

In electrostatics the Ampère Maxwell law reduces to:

$$\frac{\partial \underline{E}^a}{\partial t} = \underline{0}. \quad -(4)$$

In the absence of a magnetic field:

$$\underline{B}^a = 0, \quad \underline{A}^a = 0, \quad \underline{J}^a = \underline{0} \quad -(5)$$

are possible solutions. However the Aharonov Bohm effects are described in the absence of a magnetic flux density by:

$$\underline{\nabla} \times \underline{A}^a = \underline{\omega}^a{}_b \times \underline{A}^b \quad -(6)$$

where:

$$\underline{\nabla} \times \underline{A}^a = \kappa \underline{A}^a \quad -(7)$$

and:

2)

$$\underline{\nabla} \times \underline{\omega}^a{}_b = -\kappa\, \underline{\omega}^a{}_b \quad -(8)$$

The Aharonov Bohm effects are therefore described by:

$$\kappa \underline{A}^a = \underline{\omega}^a{}_b \times \underline{A}^b. \quad -(9)$$

The electric charge density and electric current density are described in ECE theory by:

$$\rho^a = \epsilon_0 \left(\underline{\omega}^a{}_b \cdot \underline{E}^b - c\, \underline{A}^b \cdot \underline{R}^a{}_b(\text{orb}) \right) \quad -(10)$$

and:

$$\underline{J}^a = \epsilon_0 c \Big(\omega^a{}_b\, \underline{E}^b - c\, A^b \circ \underline{R}^a{}_b(\text{orb}) \quad -(11)$$
$$+ c\, \underline{\omega}^a{}_b \times \underline{B}^b - c\, \underline{A}^b \times \underline{R}^a{}_b(\text{spin}) \Big)$$

The current S.I. units are:

$$E = V m^{-1} = J C^{-1} m^{-1}$$
$$A = J s C^{-1} m^{-1}$$
$$\epsilon_0 = J^{-1} C^2 m^{-1}$$
$$B = J s C^{-1} m^{-2} = \text{tesla}$$
$$\rho = C m^{-3}$$
$$\underline{J} = C m^{-2} s^{-1}$$
$$\omega = m^{-1}$$
$$R = m^{-2}$$

So it may be checked that the above equations

$\Rightarrow$ (2) and (3) have the right units.

In the absence of a vector potential:

$$\underline{\nabla} \cdot \underline{E}^a = \underline{\omega}^a{}_b \cdot \underline{E}^b \quad -(12)$$

and

$$\underline{J}^a = \underline{0} = \epsilon_0 c \left(\omega^a{}_{0b} \underline{E}^b - c A^b{}_0 \underline{R}^a{}_b (\text{orb}) \right) \quad -(13)$$

so

$$\omega^a{}_{0b} \underline{E}^b = c A^b{}_0 \underline{R}^a{}_b (\text{orb}) \quad -(14)$$

and

$$\underline{E}^a = -c \underline{\nabla} A^a{}_0 + c A^b{}_0 \underline{\omega}^a{}_b \quad -(15)$$

with:

$$\underline{\nabla} \times \underline{E}^a = \underline{0} \quad -(16)$$

From eqs. (15) and (16):

$$\underline{\nabla} \times \underline{E}^a = -c \underline{\nabla} \times \underline{\nabla} A^a{}_0 + c \underline{\nabla} \times (A^b{}_0 \underline{\omega}^a{}_b) \quad -(17)$$

so

$$\boxed{\underline{\nabla} \times (A^b{}_0 \underline{\omega}^a{}_b) = 0} \quad -(18)$$

in electrostatics. This is because:

$$\underline{\nabla} \times \underline{\nabla} A^a{}_0 = 0 \quad -(19)$$

4) Eq. (18) is:

$$\underline{\nabla} \times (A^b_0 \underline{\omega}^a{}_b) = A^b_0 \underline{\nabla} \times \underline{\omega}^a{}_b + (\underline{\nabla} A^b_0) \times \underline{\omega}^a{}_b$$

$$= 0 \quad -(20)$$

where

$$\phi^a = c A^a_0 \quad -(21)$$

is the scalar potential. So:

$$\phi^a \underline{\nabla} \times \underline{\omega}^a{}_b + (\underline{\nabla} \phi^b) \times \underline{\omega}^a{}_b = \underline{0} \quad -(22)$$

The magnetic charge density in ECE theory is given by:

$$\rho^a_{mag} = \epsilon_0 c \left(\underline{\omega}^a{}_b \cdot \underline{B}^b - \underline{A}^b \cdot \underline{R}^a{}_b(\text{spin}) \right) \quad -(23)$$

and the magnetic current density is:

$$\underline{J}^a_{mag} = \epsilon_0 \left(\underline{\omega}^a{}_b \times \underline{E}^b - c\,\omega^a_{0b} \underline{B}^a - c \left(\underline{A}^b \times \underline{R}^a{}_b(\text{orb}) - A^b_0 \underline{R}^a{}_b(\text{spin}) \right) \right) \quad -(24)$$

These are thought to vanish in the theory of electromagnetism. So:

6) A rich variety of phenomena come out of these equations.

The Coulomb Law

This may be expressed along the Z axis as:

$$\underline{E}^{(3)} = -\frac{e}{4\pi\epsilon_0 Z^2}\underline{e}^{(3)} \quad -(37)$$

where

$$\underline{E} = \underline{E}^{(3)} = E_Z \underline{k}, \quad -(38)$$

$$\underline{e}^{(3)} = \underline{k} \quad -(39)$$

So:

$$\underline{\nabla} \cdot \underline{E} = \frac{\partial E_Z}{\partial Z} = \frac{e}{2\pi\epsilon_0 Z^3} \quad -(40)$$

There is only one sense of polarization, so:

$$(a) = (b) = (3) \quad -(41)$$

and

$$\frac{\partial E_Z}{\partial Z} = \omega E_Z = \underline{\omega}^{(3)}{}_{Z(3)} \cdot \underline{E}^{(3)} \quad -(42)$$

where

$$\omega := \omega^{(3)}{}_{Z,(3)} \quad -(43)$$

$$E_Z = -\frac{e}{4\pi\epsilon_0 Z^2} \quad -(44)$$

therefore

$$\frac{e}{2\pi\epsilon_0 Z^3} = -\omega\frac{e}{4\pi\epsilon_0 Z^2} \quad -(45)$$

and

$$\boxed{\omega = -\frac{2}{Z}} \quad -(46)$$

5)

$$\underline{\omega}^a{}_b \cdot \underline{B}^b = \underline{A}^b \cdot \underline{R}^a{}_b(\text{spin}) \quad -(25)$$

and:

$$\underline{\omega}^a{}_b \times \underline{E}^b - c\,\omega^a{}_{0b}\,\underline{B}^a - c\,\underline{A}^b \times \underline{R}^a{}_b(\text{orb}) + A^b{}_0\,\underline{R}^a{}_b(\text{spin}) = \underline{0} \quad -(26)$$

in which:

$$\underline{\nabla} \times \underline{B}^a = \kappa\,\underline{B}^a \quad -(27)$$

$$\underline{\nabla} \times \underline{A}^a = \kappa\,\underline{A}^a \quad -(28)$$

In electrostatics, eq. (25) is true because:

$$\underline{B}^b = \underline{0} \quad -(29)$$

$$\underline{A}^b = \underline{0} \quad -(30)$$

In electrostatics eq. (26) becomes: $\quad -(31)$

$$\underline{\omega}^a{}_b \times \underline{E}^b + A^b{}_0\,\underline{R}^a{}_b(\text{spin}) = \underline{0}$$

Summary of Equations of Electrostatics

$$\underline{\nabla} \cdot \underline{E}^a = \underline{\omega}^a{}_b \cdot \underline{E}^b \quad -(32)$$

$$\omega^a{}_{0b}\,\underline{E}^b = \phi^b\,\underline{R}^a{}_b(\text{orb}) \quad -(33)$$

$$c\,\underline{\omega}^a{}_b \times \underline{E}^b + \phi^b\,\underline{R}^a{}_b(\text{spin}) = \underline{0} \quad -(34)$$

$$\phi^a\,\underline{\nabla} \times \underline{\omega}^a{}_b + (\underline{\nabla}\phi^b) \times \underline{\omega}^a{}_b = \underline{0} \quad -(35)$$

$$\underline{E}^a = -\underline{\nabla}\phi^a + \phi^b\,\underline{\omega}^a{}_b \quad -(36)$$

In general:

$$\underline{\nabla} \times \underline{\omega}^a{}_b = \kappa\, \underline{\omega}^a{}_b \quad -(47)$$

as derived in UFT 258, but if it is assumed that the only relevant spin connection is:

$$\underline{\omega} = \omega\, \underline{k} = -\frac{2}{Z}\, \underline{k} \quad -(48)$$

then:

$$\boxed{\underline{\nabla} \times \underline{\omega} = \underline{0}} \quad -(49)$$

This is a Beltrami equation of the type:

$$\boxed{\underline{\nabla} \times \underline{\omega} = 0\, \underline{\omega}} \quad -(50)$$

With the assumption (48) it follows that:

$$\underline{\omega} \times \underline{E} = \underline{0} \quad -(51)$$

so

$$\underline{R}\,(\text{spin}) = \underline{0} \quad -(52)$$

from eq. (33). Self consistently, from eq. (35):

$$(\underline{\nabla}\, \phi) \times \underline{\omega} = \underline{0} \quad -(53)$$

From eqs. (32) and (36):

$$\underline{\nabla} \cdot \underline{E} = -\nabla^2 \phi + \underline{\nabla} \cdot (\phi\, \underline{\omega}) \quad -(54)$$

$$= -\underline{\omega} \cdot \underline{\nabla}\, \phi + \phi\, \omega^2 = \frac{\rho}{\epsilon_0}$$

8) The charge density is:

$$\rho = \epsilon_0 \left(\phi \omega^2 - \omega \frac{\partial \phi}{\partial Z} \right) \quad -(55)$$

where

$$\phi = -\frac{e}{4\pi\epsilon_0} \frac{1}{Z} \quad -(56)$$

and

$$\omega = -\frac{2}{Z} \quad -(57)$$

So

$$\rho = \frac{\epsilon_0 e}{4\pi\epsilon_0} \left(-\frac{4}{Z^3} + \frac{2}{Z^3} \right) \quad -(57)$$

$$= -\frac{2e}{4\pi Z^3}$$

The volume occupied by the charge is:

$$V = 4\pi Z^3 \quad -(58)$$

As in previous work ~~spin~~ connection resonance energy from eq. (54) when the charge is oscillating. A finite charge density must be defined as follows:

$$\rho_0 = -\frac{2e}{4\pi Z_0^3} \quad -(59)$$

in a finite volume

$$V_0 = 4\pi Z_0^3 \quad -(60)$$

9) The correct way of doing this integral is to use the divergence theorem:

$$\oint \underset{\sim}{\alpha} \cdot \underline{n} \, dA = \int_{V} \underline{\nabla} \cdot \underline{\alpha} \, d^3x \quad -(61)$$

where $\underline{\alpha}(x)$ is any well defined vector field in a volume V surrounded by the closed surface S. Here $\underline{n}$ is the outwardly directed normal. The ECE Coulomb law is:

$$\underline{\nabla} \cdot \underline{E} = \underline{\omega} \cdot \underline{E} = \rho / \epsilon_0 \quad -(62)$$

Its integral form is:

$$\oint_S \underline{E} \cdot \underline{n} \, dA = 4\pi \int_V \rho(x) \, d^3x$$

$$= 4\pi\epsilon_0 \int_V \underline{\omega} \cdot \underline{E} \, d^3x \quad -(63)$$

i.e.

$$\boxed{\oint_S \underline{E} \cdot \underline{n} \, dA = 4\pi\epsilon_0 \int_V \underline{\omega} \cdot \underline{E} \, d^3x} \quad -(64)$$

These equations are satisfied by:

$$\boxed{\underline{n} = \frac{\underline{\omega}}{\omega}} \quad -(65)$$

10) from which it follows automatically that

$$\underline{\nabla} \cdot \underline{E} = \underline{\omega} \cdot \underline{E} \quad -(66)$$

Q.E.D.