388(2): The Complete Set of Equations for Circuit Vacuum Interaction

The fundamental definitions are:

$$\underline{E} = -\underline{\nabla}\phi + \underline{\omega}\phi = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(1)$$

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

Rewrite eq. (1) as:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} + \underline{\omega}\phi = -2\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(3)$$

for convenience of development.

The vector antisymmetry equations are:

$$\frac{\partial A_Z}{\partial Y} + \frac{\partial A_Y}{\partial Z} = \omega_Y A_Z + \omega_Z A_Y \quad -(4)$$

$$\frac{\partial A_X}{\partial Z} + \frac{\partial A_Z}{\partial X} = \omega_Z A_X + \omega_X A_Z \quad -(5)$$

$$\frac{\partial A_Y}{\partial X} + \frac{\partial A_X}{\partial Y} = \omega_X A_Y + \omega_Y A_X \quad -(6)$$

Violation of Antisymmetry by the Standard Model

If it is asserted that there is no spin connection:

$$\omega^\mu = \left(\frac{\omega_0}{c}, \underline{\omega} \right) =? \underline{0} \quad -(7)$$

then matter could exist in the absence of a vacuum, which violates geometry and the existence of the radiative corrections. Matter is always in contact with the vacuum, and the spin connection is always non-zero.

Eq. (7) implies that:

2)

$$\underline{E} = -\underline{\nabla}\phi = -\frac{\partial \underline{A}}{\partial t} \quad -(8)$$

$$\frac{\partial A_z}{\partial y} + \frac{\partial A_y}{\partial z} = 0 \quad -(9)$$

$$\frac{\partial A_x}{\partial z} + \frac{\partial A_z}{\partial x} = 0 \quad -(10)$$

$$\frac{\partial A_y}{\partial x} + \frac{\partial A_x}{\partial y} = 0 \quad -(11)$$

and eqs. (8) to (11) are not true in general. The Maxwell Heaviside theory violates antisymmetry.

Now realize that:

$$\underline{E}\,(\text{total}) = \underline{E} + \underline{E}_1 \quad -(12)$$

$$\underline{B}\,(\text{total}) = \underline{B} + \underline{B_1} \quad -(13)$$

Here:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} \quad -(14)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} \quad -(15)$$

and

$$\underline{E}_1 = \underline{\omega}\,\phi := -\underline{\nabla}\,\phi_1 - \frac{\partial \underline{A_1}}{\partial t} \quad -(16)$$

$$\underline{B_1} = -\underline{\omega} \times \underline{A} := \underline{\nabla} \times \underline{A_1} \quad -(17)$$

Here ϕ_1 and $\underline{A_1}$ are the scalar and vector potentials for circuit - vacuum interaction. It follows that:

$$A_1^{\mu} = \left(\frac{\phi_1}{c}, \underline{A_1} \right) \quad -(18)$$

It follows that:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t}$$

$$\underline{B} = \underline{\nabla} \times \underline{A}$$

$$\underline{\nabla} \cdot \underline{B} = 0$$

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0}$$

$$\underline{\nabla} \cdot \underline{E} = \rho / \epsilon_0$$

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

$$\underline{\nabla} \cdot \underline{J} + \frac{\partial \phi}{\partial t} = 0$$

using the Lorenz gauge:

$$\underline{\nabla} \cdot \underline{A} + \frac{1}{c^2}\frac{\partial \phi}{\partial t} = 0$$

and

$$A^\mu = \left(\frac{\phi}{c}, \underline{A}\right)$$

$$J^\mu = (c\rho, \underline{J})$$

it follows that:

$$\Box A^\mu = \mu_0 J^\mu$$

$$\Box \phi = \rho / \epsilon_0 .$$

$$\Box \underline{A} = \mu_0 \underline{J}$$

$$\Box = \frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \nabla^2$$

$$-(19)$$

$$\underline{E}_1 = -\underline{\nabla}\phi_1 - \frac{\partial A_1}{\partial t} = \underline{\omega}\,\phi$$

$$\underline{B}_1 = \underline{\nabla} \times \underline{A}_1 = -\underline{\omega} \times \underline{A}$$

$$\underline{\nabla} \cdot \underline{B}_1 = 0$$

$$\underline{\nabla} \times \underline{E}_1 + \frac{\partial \underline{B}_1}{\partial t} = \underline{0}$$

$$\underline{\nabla} \cdot \underline{E}_1 = \rho_1 / \epsilon_0$$

$$\underline{\nabla} \times \underline{B}_1 + \frac{1}{c^2}\frac{\partial \underline{E}_1}{\partial t} = \mu_0 \underline{J}_1$$

$$\underline{\nabla} \cdot \underline{J}_1 + \frac{\partial \phi_1}{\partial t} = 0 .$$

Using the Lorenz gauge:

$$\underline{\nabla} \cdot \underline{A}_1 + \frac{1}{c^2}\frac{\partial \phi_1}{\partial t} = 0$$

and

$$A_1^\mu = \left(\frac{\phi_1}{c}, \underline{A}_1\right)$$

$$J_1^\mu = (c\rho_1, \underline{J}_1)$$

it follows that:

$$\Box A_1^\mu = \mu_0 J_1^\mu$$

$$\Box \phi_1 = \rho_1 / \epsilon_0$$

$$\Box \underline{A}_1 = \mu_0 \underline{J}_1$$

$$\Box = \frac{1}{c^2}\frac{\partial^2}{\partial t^2} - \nabla^2$$

$$-(20)$$

4) The left hand column represents the old style Maxwell Heaviside (MH) theory and the right hand column gives the set of equations governing the interaction with the vacuum of matter or a circuit.

It is known that the radiative corrections are small, so it can be assumed that:

$$J^{\mu} >> J_1^{\mu} \quad - (21)$$

This assumption means that the charge current density measured in the circuit is dominated by the intrinsic contribution, i.e.

$$J^{\mu}(\text{measured}) = J^{\mu} + J_1^{\mu} \sim J^{\mu} \quad - (22)$$

Then ϕ is given by

$$\Box \phi = \rho / \epsilon_0 \quad - (23)$$

and $\mathbf{A}$ by

$$\Box \mathbf{A} = \mu_0 \mathbf{J} \quad - (24)$$

The spin connection $\boldsymbol{\omega}$ is found from eqs. (4) to (6) and the scalar spin connection ω_0 from eq. (1). The intrinsic $\mathbf{E}$ and $\mathbf{B}$ are given by:

$$\mathbf{E} = - \boldsymbol{\nabla} \phi - \frac{\partial \mathbf{A}}{\partial t} \quad - (25)$$

$$\mathbf{B} = \boldsymbol{\nabla} \times \mathbf{A} \quad - (26)$$

The interaction $\mathbf{E}_1$ and $\mathbf{B}_1$ are given by:

$$\mathbf{E}_1 = \boldsymbol{\omega} \phi \quad - (27)$$

$$\mathbf{B}_1 = - \boldsymbol{\omega} \times \mathbf{A} \quad - (28)$$

The interaction charge density is given by:

$$\underline{\nabla} \cdot \underline{E}_1 = \rho_1 / \epsilon_0 \quad -(29)$$

the interaction current density is given by:

$$\underline{\nabla} \times \underline{B}_1 + \frac{1}{c^2} \frac{\partial \underline{E}_1}{\partial t} = \mu_0 \underline{J}_1 \quad -(30)$$

i.e.

$$\rho_1 = \epsilon_0 \underline{\nabla} \cdot (\underline{\omega} \phi) \quad -(31)$$

$$\underline{J}_1 = \frac{1}{\mu_0} \left(\underline{\nabla} \cdot (-\underline{\omega} \times \underline{A}) + \frac{1}{c^2} \frac{\partial (\underline{\omega} \phi)}{\partial t} \right) \quad -(32)$$

The interaction scalar potential is found from:

$$\Box \phi_1 = \rho_1 / \epsilon_0 \quad -(33)$$

the interaction vector potential is found from:

$$\Box \underline{A}_1 = \mu_0 \underline{J}_1 \quad -(34)$$
