100(1): Some Important Results from Papers 93 – 99

Paper 100 is intended as a review of the most important results of ECE theory, and to standardize some of the notations and equations. A lot of progress has been made recently in papers 93 – 99, and computer algebra has been used to check the overall self-consistency of the main concepts. In this note the most important results of papers 93 – 99 are given and standardized.

Homogeneous Field Equation

$$\partial_\mu \tilde{F}^{\kappa\mu\nu} = 0 \quad -(1)$$

Inhomogeneous Field Equation

$$\partial_\mu F^{\kappa\mu\nu} = -A^{(0)} R^{\kappa}{}_{\mu}{}^{\mu\nu} \quad -(2)$$

Definition of the Vacuum

$$R^{\kappa}{}_{\mu}{}^{\mu\nu} = 0. \quad -(3)$$

This is a Ricci flat spacetime. Self-consistently the vacuum inhomogeneous equation is:

$$\partial_\mu F^{\kappa\mu\nu} = 0 \quad -(4)$$

i.e. the charge / current density in such a spacetime is zero, showing an internal ECE consistency between vacuum e/m and gravitation.

2) Coulomb Law

$$\partial_\mu F^{0\mu 0} = -\frac{A^{(0)}}{\mu_0}\left(R^0{}_1{}^{10} + R^0{}_2{}^{20} + R^0{}_3{}^{30}\right) \quad -(5)$$

i.e.

$$\underline{\nabla} \cdot \underline{E}^0 = -\phi\left(R^0{}_1{}^{10} + R^0{}_2{}^{20} + R^0{}_3{}^{30}\right) \quad -(6)$$

Ampère Maxwell Law

$$\partial_0 F^{\kappa 0 \nu} + \partial_2 F^{\kappa 2 \nu} + \partial_3 F^{\kappa 3 \nu} = -\frac{A^{(0)}}{\mu_0} R^{\kappa}{}_{\mu}{}^{\mu\nu}$$

$$\nu = 1, 2, 3 \quad -(7)$$

Vector Notation

Eq. (6) is:

$$\underline{\nabla} \cdot \underline{E} = \frac{\rho}{\epsilon_0} = -\phi\left(R^0{}_1{}^{10} + R^0{}_2{}^{20} + R^0{}_3{}^{30}\right) \quad -(8)$$

In spherical polar coordinates:

$$E_r = E^0{}_{10}, \quad E_\theta = E^0{}_{20}, \quad E_\phi = E^0{}_{30} \quad -(9)$$

Eq. (7) is:

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2}\frac{\partial \underline{E}}{\partial t} = \mu_0 \underline{J} \quad -(10)$$

$$\underline{J} = J_r \underline{e}_r + J_\theta \underline{e}_\theta + J_\phi \underline{e}_\phi \quad -(11)$$

3)

$$J_r = -\frac{A^{(0)}}{\mu_0}\left(R^{1}{}_{0}{}^{01} + R^{1}{}_{2}{}^{21} + R^{1}{}_{3}{}^{31}\right) \quad -(12)$$

$$J_\theta = -\frac{A^{(0)}}{\mu_0}\left(R^{2}{}_{0}{}^{02} + R^{2}{}_{1}{}^{12} + R^{2}{}_{3}{}^{32}\right) \quad -(13)$$

$$J_\phi = -\frac{A^{(0)}}{\mu_0}\left(R^{3}{}_{0}{}^{03} + R^{3}{}_{1}{}^{13} + R^{3}{}_{2}{}^{23}\right) \quad -(14)$$

The magnetic fields components are:

$$B_r = B^{1}{}_{23}, \quad B_\theta = B^{2}{}_{31}, \quad B_\phi = B^{3}{}_{12}. \quad -(15)$$

Therefore:

$$\underline{E} = E_r \, \underline{e}_r + E_\theta \, \underline{e}_\theta + E_\phi \, \underline{e}_\phi \quad -(16)$$

$$\underline{B} = B_r \, \underline{e}_r + B_\theta \, \underline{e}_\theta + B_\phi \, \underline{e}_\phi \quad -(17)$$

<u>Relation between Field and Potential</u>

$$F^{\kappa}{}_{\mu\nu} = \partial_\mu A^{\kappa}{}_{\nu} - \partial_\nu A^{\kappa}{}_{\mu} + \omega^{\kappa}{}_{\mu b} A^{b}{}_{\nu} - \omega^{\kappa}{}_{\nu b} A^{b}{}_{\mu} \quad -(18)$$

For example, for the magnetic field:

$$F^{1}{}_{23} = \partial_2 A^{1}{}_{3} - \partial_3 A^{1}{}_{2} + \omega^{1}{}_{2b} A^{b}{}_{3} - \omega^{\kappa}{}_{3b} A^{b}{}_{2} \quad -(19)$$

where in general: $b = 0, 1, 2, 3.$ $\quad -(20)$

This can be written as:

$$\underline{B} = \underline{\nabla} \times \underline{A} - \underline{\omega} \times \underline{A} \quad -(21)$$

4) following the convention of ECE theory (2003 to present).

For the electric field:

$$F^0{}_{i0} = \partial_i A^0{}_0 - \partial_0 A^0{}_i + \omega^0{}_{ib} A^b{}_0 - \omega^0{}_{0b} A^b{}_i \quad -(22)$$

$i = 1, 2, 3,$
$b = 0, 1, 2, 3$

This can be written as:

$$\underline{E} = -\underline{\nabla}\phi - \frac{\partial \underline{A}}{\partial t} - c\omega^0 \underline{A} + c\underline{\omega}\phi \quad -(23)$$

<u>Relation to Canonical Energy Momentum Density</u>

$$E_r = E^0{}_{01} = \frac{c^2}{e\omega} J^0{}_{01} \quad -(24)$$

$$E_\theta = E^0{}_{02} = \frac{c^2}{e\omega} J^0{}_{02} \quad -(25)$$

$$E_\phi = E^0{}_{03} = \frac{c^2}{e\omega} J^0{}_{03} \quad -(26)$$

$$B_r = B^1{}_{23} = \frac{c}{e\omega} J^1{}_{23} \quad -(27)$$

$$B_\theta = B^3{}_{12} = \frac{c}{e\omega} J^3{}_{12} \quad -(28)$$

$$B_\phi = B^2{}_{31} = \frac{c}{e\omega} J^2{}_{31} \quad -(29)$$