88(2): Reduction of ECE to New Theories of Electrodynamics

Reference:

B. Lehnert in M. W. Evans (ed.), "Advances in Chemical Physics", 119(2), (Wiley, 2001).

We start with the ECE wave equation, which is:

$$(\square + kT) A^a_\mu = 0 \quad - (1)$$

where:

$$R = -kT = \frac{1}{4} q^\lambda_a \partial^\mu \left(\Gamma^\nu_{\mu\lambda} q^a_\nu - \omega^a_{\mu b} q^b_\lambda \right) \quad - (2)$$

and

$$A^a_\mu = A^{(0)} q^a_\mu . \quad - (3)$$

When the electromagnetic field is free of all other fundamental fields, eq. (1) reduces to:

$$\left(\square + \left(\frac{mc}{\hbar} \right)^2 \right) A^a_\mu = 0 \quad - (4)$$

where m is the photon mass (Einstein 1905).

It was shown in the Einstein / Schrödinger / de Broglie / Vigier / Evans theory, reviewed by Lehnert, that:

2)

$$j^\mu = \frac{1}{\mu_0}\left(\frac{m_0 c}{\hbar}\right)^2 A^\mu, \quad -(5)$$

So the ECE wave equation can be expressed as:

$$\boxed{\Box A^a_\mu = -\mu_0 j^a_\mu} \quad -(6)$$

where:

$$j^a_\rho = \frac{kT}{\mu_0} A^a_\rho$$

$$= -\frac{A^{(0)}}{\mu_0}\left(\frac{1}{4} q^\lambda_c \partial^\mu \left(\Gamma^\nu_{\mu\lambda} q^c_\nu - \omega^c_{\mu b} q^b_\lambda\right) q^a_\rho\right)$$

So:

$$\boxed{j^a_\rho = -\frac{A^{(0)}}{\mu_0}\left(\frac{1}{4} q^\lambda_c \partial^\mu \left(\Gamma^\nu_{\mu\lambda} q^c_\nu - \omega^c_{\mu b} q^b_\lambda\right) q^a_\rho\right)}$$

$$-(7)$$

This is the fundamental expression for charge current density of <u>any kind</u> in ECE theory. <u>All the other theories of electrodynamics can be obtained from this theory</u>. Also, eq. (7) can be compared with the charge-current

3) densities of the ECE field equations:

$$d \wedge F^a = \mu_0 j^a \quad -(8)$$

$$d \wedge \tilde{F}^a = \mu_0 \tilde{j}^a \quad -(9)$$

where:

$$j^a = \frac{A^{(0)}}{\mu_0} \left(R^a{}_b \wedge q^b - \omega^a{}_b \wedge T^b \right) \quad -(10)$$

$$\tilde{j}^a = \frac{A^{(0)}}{\mu_0} \left(\tilde{R}^a{}_b \wedge q^b - \omega^a{}_b \wedge \tilde{T}^b \right) \quad -(11)$$

Eqs (8) - (11) are true under all circumstances, in the Lehnert theory, so allow for the existence of which:

$$j^\mu = \underset{(Cs^{-1}m^{-2})}{\epsilon_0 \underline{\nabla} \cdot \underline{E}} \left(c, i\underline{v} \right) \quad -(12)$$

<u>Units Check</u>

$$A = JsC^{-1}m^{-1}, \quad \mu_0 = Js^2C^{-2}m^{-1},$$

$$\Rightarrow \quad j^\mu = Cs^{-1}m^{-2} \quad -(13)$$

Thus
$$j^\mu = \frac{1}{\mu_0}\left(\frac{mc}{\hbar}\right)^2 A^\mu = \frac{JsC^{-1}m^{-1}m^{-2}}{Js^2C^{-2}m^{-1}}$$

$$= Cs^{-1}m^{-2} \quad \checkmark\checkmark \quad -(14)$$

4) <u>Reduction to Einstein / de Broglie / Schrödinger / Vigier / Evans</u>

In this case:

$$R = -kT = \frac{1}{4} q^{\lambda}_{c} j^{\mu} \left(\Gamma^{\nu}_{\mu\lambda} q^{c}_{\nu} - \omega^{c}_{\mu b} q^{b}_{\lambda} \right) \quad -(15)$$

$$j^{a}_{\rho} = \left(\frac{kT}{\mu_0} \right) A^{a}_{\rho}, \quad -(16)$$

and

$$kT = \left(\frac{mc}{\hbar} \right)^2. \quad -(17)$$

<u>Reduction to Lehnert</u>

$$j^{a}_{\rho} = \left(\frac{kT}{\mu_0} \right) A^{a}_{\rho} = \epsilon_0 \underline{\nabla} \cdot \underline{E}^{a} \left(c, i\underline{v} \right) \quad -(18)$$

where in the Lehnert theory, the index a is implied.

The reduction to Vigier / Roy vacuum conductivity theory is given by eqs. (15) to (17). To be fully self-consistent, the Lehnert theory needs a non-zero homogeneous current j^{μ}, which implies a non-zero $\tilde{j}^{\mu}$ without an electron.

5) Relation to the Radiative Correction

The radiative correction in ECE theory is given by papers 18, 85 and 86:

$$\square \rightarrow \square \left(1 + \frac{\alpha}{4\pi} \right)^2 \quad -(19)$$

This can be thought of as a current, because:

$$\square A_\mu^a \rightarrow \left(\square + kT \right) A_\mu^a \quad -(20)$$

where:

$$kT A_\mu^a = \mu_0 j_\mu^a = \left(\frac{\alpha}{2\pi} + \frac{\alpha^2}{16\pi^2} \right) \square A_\mu^a \quad -(21)$$

To first order in α:

$$j_\mu^a = \frac{\alpha}{2\pi\mu_0} \square A_\mu^a \quad -(22)$$

i.e.

$$\boxed{\square A_\mu^a = \frac{2\pi\mu_0}{\alpha} j_\mu^a} \quad -(23)$$

To first order in α the radiative correction gives:

$$\square \rightarrow \frac{\alpha}{2\pi} \square . \quad -(24)$$