Notes 59(2): Review of the ECE Field Equations and Resonance Equations: Vector Notation

The electric and magnetic fields are related to the potential field by:

$$\underline{E}^a = -\frac{\partial \underline{A}^a}{\partial t} - c\underline{\nabla} A^{0a} - c\omega^{0a}{}_b \underline{A}^b + c\underline{\omega}^a{}_b A^{0b} \quad -(1)$$

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

The field equations are as follows.

Gauss Law of Magnetism

$$\underline{\nabla} \cdot \underline{B}^a = \mu_0 \tilde{j}^{0a} \quad -(3)$$

Faraday Law of Induction

$$\underline{\nabla} \times \underline{E}^a + \frac{\partial \underline{B}^a}{\partial t} = \mu_0 \underline{\tilde{j}}^a \quad -(4)$$

Coulomb Law

$$\underline{\nabla} \cdot \underline{E}^a = c\mu_0 \tilde{J}^{0a} \quad -(5)$$

Ampère Maxwell Law

$$\underline{\nabla} \times \underline{B}^a - \frac{1}{c^2}\frac{\partial \underline{E}^a}{\partial t} = \frac{\mu_0}{c} \underline{\tilde{J}}^a \quad -(6)$$

The resonance equations are found by substituting

2) eqns. (1) and (2) into eqns. (3) to (6). This has been done in papers 52 and 53. The four currents are defined by:

$$\tilde{j}^{a\mu} = \left(\frac{1}{c} \tilde{j}^{a0}, \underline{\tilde{j}}^{a} \right) \quad -(7)$$

and its Hodge dual:

$$\tilde{J}^{a\mu} = \left(\frac{1}{c} \tilde{J}^{a0}, \underline{\tilde{J}}^{a} \right). \quad -(8)$$

<u>Standard Model</u>

The corresponding equations of the standard model are:

$$\underline{E} = -\frac{\partial \underline{A}}{\partial t} - c \underline{\nabla} A^0 \quad -(9)$$

$$\underline{B} = \underline{\nabla} \times \underline{A} \quad -(10)$$

<u>Gauss Law of Magnetism</u>

$$\underline{\nabla} \cdot \underline{B} = 0 \quad -(11)$$

<u>Faraday Law of Induction</u>

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \quad -(12)$$

<u>Coulomb Law</u>

$$\underline{\nabla} \cdot \underline{E} = c\mu_0 \tilde{J}^0 \quad -(13)$$

<u>Ampère Maxwell Law</u>

$$\underline{\nabla} \times \underline{B} - \frac{1}{c^2} \frac{\partial \underline{E}}{\partial t} = \frac{\mu_0}{c} \underline{\tilde{J}} \quad -(14)$$

3)

Resonance Phenomena

The Coulomb Law in generally covariant unified field theory is:

$$\boxed{\underline{\nabla} \cdot \underline{\nabla} A^{a0} + \frac{1}{c}\frac{\partial}{\partial t}\left(\underline{\nabla} \cdot \underline{A}^a\right) + \underline{\nabla} \cdot \left(\omega^{0a}{}_b \underline{A}^b\right) - \underline{\nabla} \cdot \left(\underline{\omega}^a{}_b A^{0b}\right) = -\mu_0 \tilde{J}^{0a}}$$

— (15)

obtained by substituting eq. (1) into eq. (5). This is the type of equation that can give rise to resonance. Here, the right hand side is a "driving force" obtained from spacetime. At resonance the potential is greatly amplified, giving rise to amplification of $\underline{E}^a$ through eq. (1). So a small ~~current~~ charge density $\tilde{J}^{0a}$ may give rise to a very large electric field $\underline{E}^a$ while conserving Noether's theorem.

The standard model equivalent of eq. (15) is:

$$\underline{\nabla} \cdot \left(\frac{\partial \underline{A}}{\partial t} + c \underline{\nabla} A^0\right) = -c\mu_0 \tilde{J}^0$$

— (16)

and does not give rise to resonance, so cannot explain the Mexican Group results.

4) The simplest type of resonance equation is:

$$\ddot{x} + 2\beta\dot{x} + \omega_0^2 x = A\cos\omega t \quad \text{— (17)}$$

Comparing eqns (15) and (17) it is found that there are double derivatives, first derivatives, and a linear term on the left hand sides, and a "driving force" on the right hand sides. So both eqns. are examples of the class of linear inhomogeneous differential equations. These have been known since 1743 to produce resonance. The resonance frequency from eq. (17) is:

$$\omega_R = (\omega_0^2 - 2\beta^2)^{1/2}. \quad \text{— (18)}$$

The quality factor of resonance is defined as:

$$Q = \frac{\omega_R}{2\beta}. \quad \text{— (19)}$$

The particular integral is:

$$x_p(t) = D\cos(\omega t - \delta) \quad \text{— (20)}$$

where:

$$\delta = \tan^{-1}\left(\frac{2\omega\beta}{\omega_0^2 - \omega^2}\right). \quad \text{— (21)}$$

At resonance:

$$\left.\frac{dD}{d\omega}\right|_{\omega = \omega_R} = 0. \quad \text{— (22)}$$

5)

From eq. (22) it is seen that resonance occurs when ω is tuned to ω_R. Under this condition enough energy may be generated (13.6 eV) to free the electron from the proton in the H atom. The free electron can then move in a wire or circuit to give an electric current. The source of this is the charge density $\tilde{J}^{oa}$ of eq (15), which plays the role of $A \cos \omega t$ in eq. (17), the small driving force.

Therefore eq (15) must be solved to give the resonance frequency, Q factor and so on for the H atom.

Conclusion

Given a small charge density $\tilde{J}^{oa}$ a resonance amplification of $\underline{E}^a$ may occur from eq (15). This is not possible in the standard model, eq. (16).