1)

Notes for Paper 47 Part Three

In these notes the Lorentzian field equation is expressed in terms of polarization and magnetization, and it is shown that the overall effect of EMG coupling is to polarize and magnetize spacetime.

The Lorentzian field equation is:

$$\underline{\nabla} \times \underline{E}^{a} + \frac{\partial \underline{B}^{a}}{\partial t} = \mu_0 \underline{\tilde{j}}^{a} \quad -(1)$$

The electric field strength $\underline{E}^{a}$ (volt m^{-1}) and magnetic flux density $\underline{B}^{a}$ (tesla) are related to the magnetization $\underline{M}^{a}$ and polarization $\underline{P}^{a}$ of ECE spacetime as follows:

$$\underline{P}^{a} = (\epsilon - \epsilon_0)\underline{E}^{a} \quad -(2)$$

$$\underline{M}^{a} = \left(\frac{1}{\mu_0} - \frac{1}{\mu}\right)\underline{B}^{a} \quad -(3)$$

where μ and ϵ are the permeability and permittivity of ECE spacetime and where μ_0 and ϵ_0 are the vacuum permeability and permittivity. In general:

$$\epsilon = \epsilon' + i\epsilon'' \quad -(4)$$

$$\mu = \mu' + i\mu''. \quad -(5)$$

From eqns (1) to (3):

$$\boxed{\frac{\partial \underline{M}^{a}}{\partial t} + \left(\frac{1}{\mu_0} - \frac{1}{\mu}\right)\left(\frac{1}{\epsilon - \epsilon_0}\right)\underline{\nabla} \times \underline{P}^{a} = \mu_0 \underline{\tilde{j}}^{a}} \quad -(6)$$

2)

Weak coupling Limit

In this limit:

$$\epsilon \rightarrow \epsilon_0 \qquad -(7)$$

$$\mu \rightarrow \mu_0 \qquad -(8)$$

and

$$\underline{\tilde{J}}^{a} \rightarrow \underline{0}. \qquad -(9)$$

This is the limit expected experimentally if the effect of gravitation or electromagnetism is weak. This is the situation encountered in the inverse square laws of Newton and Coulomb, for example, and in the Eddington effect for the solar system. In this limit:

$$\boxed{\frac{\partial \underline{M}^{a}}{\partial t} + \left(\frac{1}{\mu_0} - \frac{1}{\mu}\right)\left(\frac{1}{\epsilon - \epsilon_0}\right) \underline{\nabla} \times \underline{P}^{a} \sim 0} \qquad -(10)$$

When EMG coupling is completely absent:

$$\epsilon = \epsilon_0 \qquad -(11)$$

$$\mu = \mu_0 \qquad -(12)$$

$$\underline{P}^{a} = \underline{0} \qquad -(13)$$

$$\underline{M}^{a} = \underline{0}, \qquad -(14)$$

and

$$\underline{\nabla} \times \underline{E}^{a} + \frac{\partial \underline{B}^{a}}{\partial t} = \underline{0}. \qquad -(15)$$

3)

The refractive index of ECE spacetime caused by polarization and magnetization is:

$$n^2 = \frac{\mu\epsilon}{\mu_0\epsilon_0} \qquad -(16)$$

and is in general complex:

$$n = n' + in'' \qquad -(17)$$

It is seen from eqn. (10) that EM G coupling in the weak field limit produces a spectrum of refractive indices and power absorption coefficient:

$$\alpha(\omega) = \frac{\omega\,\epsilon''(\omega)}{n'(\omega)\,c} \qquad -(18)$$

This is a new type of spectrum which characterises the effect of gravitation on light or e/m radiation. The spectrum can be analysed. It may be blue or red shifts depending on the characteristics of the EM G coupling.
