59(1): The Complete Set of ECE2 Gravitational Equations

Field Equations

$$\underline{\nabla} \cdot \underline{\Omega} = 0 \quad -(1)$$

$$\underline{\nabla} \times \underline{g} + \frac{\partial \underline{\Omega}}{\partial t} = \underline{0} \quad -(2)$$

$$\underline{\nabla} \cdot \underline{g} = 4\pi G \rho_m \quad -(3)$$

$$\underline{\nabla} \times \underline{\Omega} - \frac{1}{c^2} \frac{\partial \underline{g}}{\partial t} = \frac{4\pi G}{c^2} \underline{J}_m \quad -(4)$$

Here: $\underline{\Omega}$ is the gravitomagnetic field with units of s^{-1}

$\underline{g}$ is the gravitational field in $m s^{-2}$

ρ_m is the mass density in $kg\, m^{-3}$

$\underline{J}_m$ is the current of mass density in $kg\, s^{-1} m^{-2}$

G is Newton's constant in $m^3 s^{-2} kg^{-1}$.

The gravitational four potential is:

$$Q^\mu = \left(\frac{\Phi}{c}, \underline{Q} \right) \quad -(5)$$

where the scalar potential Φ has units of $m^2 s^{-2}$, and the vector potential $\underline{Q}$ has units of $m s^{-1}$

The gravitational four current is:

$$J^\mu = \left(c\rho, \underline{J} \right) \quad -(6)$$

In these equations:

$$\epsilon_0 (e/m) \rightarrow \frac{1}{4\pi G} \text{(gravitation)} \quad -(7)$$

$$\mu_0 (e/m) \rightarrow \frac{4\pi G}{c^2} \text{(gravitation)} \quad -(8)$$

There are four field equations.

The Gravitational Wave Equation

This is obtained from the ECE wave equation and is:

$$\Box Q_\mu = \frac{4\pi G}{c^2} J_\mu \quad -(9)$$

So

$$\Box \Phi = 4\pi G \rho_m \quad -(10)$$

and

$$\Box \underline{Q} = \frac{4\pi G}{c^2} \underline{J}_m \quad -(11)$$

The Continuity Equation

This is

$$\frac{1}{c^2}\frac{\partial \Phi}{\partial t} + \underline{\nabla} \cdot \underline{Q} = 0 \quad -(12)$$

The Conservation of Antisymmetry

The conservation equations are:

$$\underline{g} = -\underline{\nabla}\Phi + \underline{\omega}\Phi = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} \quad -(13)$$

$$\underline{\Omega} = \underline{\nabla} \times \underline{Q} - \underline{\omega} \times \underline{Q} \quad -(14)$$

$$\frac{\partial Q_Z}{\partial Y} + \frac{\partial Q_Y}{\partial Z} = \omega_Y Q_Z + \omega_Z Q_Y \quad -(15)$$

$$\frac{\partial Q_X}{\partial Z} + \frac{\partial Q_Z}{\partial X} = \omega_Z Q_X + \omega_X Q_Z \quad -(16)$$

$$\frac{\partial Q_Y}{\partial X} + \frac{\partial Q_X}{\partial Y} = \omega_X Q_Y + \omega_Y Q_X \quad -(17)$$

$$\frac{1}{c^2}\left(\frac{\partial}{\partial t} + \omega_0\right)\Phi = \left(\underline{\nabla} - \underline{\omega}\right) \cdot \underline{Q} \quad -(18)$$

3) Eq. (18) is the trace antisymmetry equation for gravitation. This has not been considered before in ECE theory.

The units of $\underline{\Phi}$ are $m^2 s^{-2}$ and the units of $\underline{Q}$ are $m s^{-1}$.

The spin connection four vector is:

$$\omega^{\mu} = \left(\frac{\omega_0}{c}, \underline{\omega} \right) \quad -(19)$$

The units of $\underline{\omega}$ are m^{-1}, and the units of ω_0 are s^{-1}.

For any problem in gravitation the complete set of equations must be used. They contain several new fundamental laws of physics.
