318(1): Gravitational Field Equations of ECE2 Theory.

These are:

$$\underline{\nabla} \cdot \underline{g} = \underline{\kappa} \cdot \underline{g} = 4\pi G \rho_m \quad -(1)$$

$$\underline{\nabla} \times \underline{g} + \frac{\partial \underline{\Omega}}{\partial t} = -\left(c\kappa_0 \underline{g} + \underline{\kappa} \times \underline{\Omega} \right) = \frac{4\pi G}{c} \underline{J}_{mh} \quad -(2)$$

$$\underline{\nabla} \cdot \underline{\Omega} = \underline{\kappa} \cdot \underline{\Omega} = \frac{4\pi G}{c} \rho_{mh} \quad -(3)$$

$$\underline{\nabla} \times \underline{\Omega} - \frac{1}{c^2} \frac{\partial \underline{g}}{\partial t} = \frac{\kappa_0}{c} \underline{g} + \underline{\kappa} \times \underline{\Omega} = \frac{4\pi G}{c^2} \underline{J}_m \quad -(4)$$

Here $\underline{g}$ is the gravitational field, G is Newton's constant, ρ_m is the mass density, $\underline{\Omega}$ is the gravitomagnetic field, ρ_{mh} the gravitomagnetic mass density, $\underline{J}_{mh}$ the gravitomagnetic current density and where:

$$\underline{\kappa} = 2 \left(\frac{\underline{q}}{r^{(0)}} - \underline{\omega} \right) \quad -(5)$$

and

$$\kappa_0 = 2 \left(\frac{q_0}{r^{(0)}} - \omega_0 \right) \quad -(6)$$

The field potential relations are as follows:

$$\underline{g} = -\underline{\nabla}\Phi - \frac{\partial \underline{Q}}{\partial t} + 2\left(c\omega_0 \underline{Q} - \Phi\underline{\omega}\right) \quad -(7)$$

and

$$\underline{\Omega} = \underline{\nabla} \times \underline{Q} + 2\underline{\omega} \times \underline{Q} \quad -(8)$$

The mass/current density four vector is:

$$J_m^{\mu} = (c\rho_m, \underline{J}_m) \quad -(9)$$

where:

$$\rho_m = \frac{1}{4\pi G}\underline{\kappa}\cdot\underline{g}, \quad \underline{J}_m = \frac{c^2}{4\pi G}\underline{\kappa}\times\underline{\Omega}$$

$$-(10)$$

Eq. (10) is obtained in the limit when the gravitomagnetic mass and current densities vanish in the same type of assumption that magnetic charge/current density vanishes. In this limit:

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

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

$$\underline{\nabla}\cdot\underline{g} = \underline{\kappa}\cdot\underline{g} = 4\pi G\rho_m \quad -(13)$$

$$\underline{\nabla}\times\underline{\Omega} - \frac{1}{c^2}\frac{\partial \underline{g}}{\partial t} = \underline{\kappa}\times\underline{\Omega} = \frac{4\pi G}{c^2}\underline{J}_m \quad -(14)$$

In eqs. (7) and (8) Φ is the gravitational scalar potential and $\underline{Q}$ the vector potential.

3) The gravitational vector four potential is:

$$Q^{\mu} = (\Phi, c\underline{Q}) \quad -(15)$$

and the spin connection four vector is:

$$\omega^{\mu} = (\omega_0, \underline{\omega}). \quad -(16)$$

From eq. (14) and eq. (13):

$$\frac{4\pi G}{c^2} \underline{\nabla} \cdot \underline{J}_m = -\frac{1}{c^2} \frac{\partial}{\partial t}(\underline{\nabla} \cdot \underline{g}) = -\frac{4\pi G}{c^2} \frac{\partial \rho_m}{\partial t} \quad -(17)$$

so

$$\frac{\partial \rho_m}{\partial t} + \underline{\nabla} \cdot \underline{J}_m = 0 \quad -(18)$$

i.e

$$\partial_{\mu} J_m^{\mu} = 0 \quad -(19)$$

Eqs. (18) and (19) are fundamental conservation equations of mass current four density.

If it is assumed that:

$$\underline{g} = g_r \underline{e}_r = -\frac{mG}{r^2} \underline{e}_r \quad -(20)$$

then

$$\frac{\partial g_r}{\partial r} = \frac{2mG}{r^3} = 2 g_r \left(\frac{1}{r^{(0)}} q_r - \omega_r \right)$$

$$= -\frac{2mG}{r^2} \left(\frac{1}{r^{(0)}} g_r - \omega_r \right) \quad -(21)$$

So:

$$\left(\omega_r - \frac{1}{r^{(0)}} g_r \right) = \frac{1}{r} \quad -(22)$$

and

$$\kappa_r = -\frac{2}{r} \quad -(23)$$

In classical standard gravitational theory:

$$\underline{g} = -\underline{\nabla}\, \Phi \quad -(24)$$

and

$$\underline{\nabla} \cdot \underline{g} = 4\pi G \rho_m \quad -(25)$$

together with:

$$\underline{F} = m\underline{g} = -\frac{mMG}{r^2} \underline{e}_r \quad -(26)$$

and no other equations exist in standard classical gravitational theory. Eq. (26) is the Newtonian equivalence principle.

Therefore ECE2 is much richer and contains much more information. For example eq. (12) is the gravitational Faraday law of induction. The gravitational Ampère law is:

$$\underline{\nabla} \times \underline{\Omega} = \underline{\kappa} \times \underline{\Omega} = \frac{4\pi G}{c^2} \underline{J}_m \quad -(27)$$