190(3): Inconsistency of Newtonian Physics and Resolution with ECE2 Physics.

In Newtonian physics:

$$\Phi = -\frac{MG}{r} \quad - (1)$$

is the gravitational potential and:

$$\underline{g} = -\underline{\nabla}\Phi \quad - (2)$$

is the acceleration due to gravity. The orbit of m around M is a conic section:

$$r = \frac{\alpha}{1+\epsilon\cos\phi} \quad - (3)$$

and

$$\frac{dr}{dt} = \frac{dr}{d\phi}\frac{d\phi}{dt} = \frac{L}{mr^2}\frac{dr}{d\phi} \quad - (4)$$

where L is the conserved angular momentum. It follows that:

$$\frac{\partial\Phi}{\partial t} = \frac{\partial\Phi}{\partial r}\frac{dr}{dt} \neq 0 \quad - (5)$$

and

$$\boxed{\frac{1}{c^2}\frac{\partial^2\Phi}{\partial t^2} \neq 0} \quad - (6)$$

at the Newtonian level.

In ECE2 physics:

$$\Box\Phi = 4\pi G\rho_m \quad - (7)$$

where ρ_m is the mass density, and

$$\underline{g} = -\underline{\nabla}\Phi + \underline{\omega}\Phi \quad - (8)$$

where $\underline{\omega}$ is the spin connection. Also:

$$\underline{\nabla}\cdot\underline{g} = 4\pi G\rho_m \quad - (9)$$

2) From eqs. (8) and (9):

$$-\nabla^2 \Phi + \underline{\nabla} \cdot (\underline{\omega} \Phi) = 4\pi G \rho_m \quad -(10)$$

Eq. (7) is:

$$\frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} - \nabla^2 \Phi = 4\pi G \rho_m \quad -(11)$$

From eqs. (10) and (11):

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

in which:

$$\frac{\partial^2 \Phi}{\partial t^2} \neq 0 \quad -(13)$$

The inconsistency of Newtonian dynamics is shown from the fact that these dynamics are defined by:

$$\underline{\omega} = \underline{0} \quad -(14)$$

in which case

$$\frac{\partial^2 \Phi}{\partial t^2} = ? \; 0 \quad -(15)$$

from eq. (12). However, from eqs. (1) to (6),

$$\frac{\partial^2 \Phi}{\partial t^2} (\text{Newtonian}) \neq 0 \quad -(16)$$

Newtonian dynamics is described by the Poisson equation

$$-\nabla^2 \Phi = 4\pi G \rho_m \quad -(17)$$

whereas it should be described by the wave equation:

$$\Box \underline{\Phi} = \frac{1}{c^2}\frac{\partial^2 \underline{\Phi}}{\partial t^2} - \nabla^2 \underline{\Phi} = 4\pi G \rho_{\underline{m}} \quad - (18)$$

i.e. by the ECE wave equation (7).

Therefore there exist gravitational waves in both Newtonian and ECE2 physics:

$$\Box \underline{\Phi} = 4\pi G \rho_{\underline{m}} \quad - (19)$$

In ECE2 physics there also exists:

$$\Box \underline{Q} = \frac{4\pi G}{c^2} \underline{J}_{\underline{m}} \quad - (20)$$

where $\underline{Q}$ is the vector potential and $\underline{J}_{\underline{m}}$ is the current of mass density.