379(7): Equations Available for Gravitation, Part 1

The field potential equations are:

$$\underline{g} = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} - \underline{\nabla} \Phi + \Phi \underline{\omega} \quad -(1)$$

where the gravitational vector potential $\underline{Q}$ has the units of linear velocity $\underline{v}$. So:

$$\underline{g} = -\frac{\partial \underline{v}}{\partial t} - \omega_0 \underline{v} - \underline{\nabla} \Phi + \Phi \underline{\omega} \quad -(2)$$

The spin connection four vector:

$$\omega^\mu = \left(\frac{\omega_0}{c}, \underline{\omega} \right) \quad -(3)$$

and the momentum four vector:

$$p^\mu = m Q^\mu \quad -(4)$$

are properties of the vacuum or aether under certain conditions

In general:

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

where

$$\underline{v} = \underline{Q} \quad -(6)$$

By antisymmetry:

$$\underline{g} = -\underline{\nabla} \Phi + \Phi \underline{\omega} = -\frac{\partial \underline{v}}{\partial t} - \omega_0 \underline{v} \quad -(7)$$

i.e.

$$\underline{g} = -\left(\frac{\partial}{\partial t} + \omega_0 \right) \underline{v} \quad -(8)$$

$$= \left(-\underline{\nabla} + \underline{\omega} \right) \Phi \quad -(9)$$

Eqs (8) and (9) contain ECE2 covariant derivatives

In flat spacetime:

$$\omega^{\mu} = 0 \quad -(10)$$

so

$$\underline{g} = -\frac{\partial \underline{v}}{\partial t} = -\underline{\nabla}\,\underline{\Phi} \quad -(11)$$

which is the Newtonian equivalence principle if $\underline{v}$ is interpreted as a particle velocity.

Considering the orbit of m around M, the orbital equation is:

$$\underline{F} = m\underline{g} \quad -(12)$$

i.e.

$$-\left(\frac{\partial}{\partial t} + \omega_0\right)\underline{v} = \left(-\underline{\nabla} + \underline{\omega}\right)\underline{\Phi} \quad -(13)$$

In two dimensions and Cartesian coordinates:

$$-\ddot{X} - \omega_0 X = \left(-\frac{\partial}{\partial X} + \omega_x\right)\Phi \quad -(14)$$

$$-\ddot{Y} - \omega_0 Y = -\left(\frac{\partial}{\partial Y} + \omega_Y\right)\Phi \quad -(15)$$

If, in the first approximation, $\underline{\Phi}$ is the Hooke Newton gravitational potential:

$$\underline{\Phi} = -\frac{mG}{r} \quad -(16)$$

then

$$-\underline{\nabla}\,\underline{\Phi} = -mG\frac{\underline{r}}{r^3} \quad -(17)$$

so:

$$-\ddot{X} - \omega_0 X = -\frac{mG\ddot{X}}{(X^2+Y^2)^{3/2}} - \frac{mG\omega_x}{(X^2+Y^2)^{1/2}} \quad -(18)$$

3) $$-\ddot{Y} - \omega_0 Y = -\frac{mG\ddot{Y}}{(X^2+Y^2)^{3/2}} - \frac{mG\omega_Y}{(X^2+Y^2)^{1/2}} \quad -(19)$$

The orbit is obtained from simultaneous solution of eqs. (18) and (19). The spin connections can be obtained from input parameters to the code. It will be very interesting to see how the orbit behaves as ω_0, ω_X and ω_Y are varied.

In the limit of zero gravitation:

$$g = 0 \quad -(20)$$

so:

$$\left(\frac{\partial}{\partial t} + \omega_0\right) \underline{v} = 0 \quad -(21)$$

and

$$\left(-\underline{\nabla} + \underline{\omega}\right) \Phi = 0 \quad -(22)$$

so

$$\ddot{X} + \omega_0 \dot{X} = 0 \quad -(23)$$

$$\ddot{Y} + \omega_0 \dot{Y} = 0 \quad -(24)$$

and

$$\frac{-mG\ddot{X}}{(X^2+Y^2)^{3/2}} + \frac{mG\omega_X}{(X^2+Y^2)^{1/2}} = 0 \quad -(25)$$

$$\frac{-mG\ddot{Y}}{(X^2+Y^2)^{3/2}} - \frac{mG\omega_Y}{(X^2+Y^2)^{1/2}} = 0 \quad -(26)$$

Therefore the zero gravity orbit is defined by eqs. (23) to (26), i.e. by:

$$\omega_0 = -\frac{\ddot{X}}{X} = -\frac{\ddot{Y}}{Y} \quad -(27)$$

and

$$\omega_X = -\frac{X}{X^2+Y^2} \quad -(28)$$

$$\omega_Y = -\frac{Y}{X^2+Y^2} \quad -(29)$$

Under these conditions, $\underline{M}$ does not attract m..

For counter gravitation, the sign of g must change. Therefore ω_0 and $\underline{\omega}$ are varied until the sign of $\underline{g}$ for attraction changes.
