197(1): Force Law for Any Orbit.

From UFT 196 the force law for any orbit is:

$$-\frac{mF(r)r^2}{L^2} = \left(\frac{1}{1+\omega c t_g}\right)\left(\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right)+\frac{1}{r}\right)$$
$$+\frac{1}{2}ct_g r^2\left(\frac{\partial\omega}{\partial r}\right)\left(\frac{1}{(1+\omega c t_g)^2}\right)\left(\frac{1}{r^2}+\left(\frac{d}{d\theta}\left(\frac{1}{r}\right)\right)^2\right) \quad -(1)$$

in the notation of that paper.

In order to make a first investigation of this equation assume that:

$$\omega = -\frac{1}{r} \quad -(2)$$

as in some previous papers of the UFT series. Then:

$$\frac{\partial\omega}{\partial r} = \frac{1}{r^2} \quad -(3)$$

and:

$$-\frac{mF(r)r^2}{L^2} = \left(1-\frac{ct_g}{r}\right)^{-1}\left(\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right)+\frac{1}{r}\right)$$
$$+\frac{1}{2}ct_g\left(1-\frac{ct_g}{r}\right)^{-2}\left(\frac{1}{r^2}+\left(\frac{d}{d\theta}\left(\frac{1}{r}\right)\right)^2\right) \quad -(4)$$

If it is assumed further that:

$$ct_g / r \ll 1 \quad -(5)$$

and that the second term in eq. (4) is much smaller than the first term, then:

2) $$-\frac{m F(r)}{L^2} r^2 \left(1 - \frac{ct_g}{r}\right) \sim \frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} \quad -(6)$$

For a processing ellipse:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1 + \epsilon \cos(x\theta)\right) \quad -(7)$$

so

$$\frac{d}{d\theta}\left(\frac{1}{r}\right) = -\frac{x\epsilon}{\alpha} \sin(x\theta) \quad -(8)$$

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = -\frac{x^2\epsilon}{\alpha} \cos(x\theta). \quad -(9)$$

Therefore:

$$-\frac{m F(r) r^2}{L^2}\left(1 - \frac{ct_g}{r}\right) = -\frac{x^2\epsilon}{\alpha} \cos(x\theta) + \frac{1}{\alpha} + \frac{\epsilon \cos(x\theta)}{\alpha} \quad -(10)$$

so:

$$F(r) = \left(1 - \frac{ct_g}{r}\right)^{-1}\left[-\frac{mMG x^2}{r^2} + \frac{(x^2 - 1)L^2}{mr^3}\right] \quad -(11)$$

using

$$\alpha = \frac{L^2}{m^2 MG} \quad -(12)$$

It can be seen that the force law in eq. (11) is the same as that found in previous notes, but

) it is modified by $\left(1 - \frac{ct_f}{r}\right)^{-1}$.

A more complete treatment requires the complete eq. (4). If:

$$ct_f / r << 1 \quad -(13)$$

then:

$$F(r) \sim \left(1 + \frac{ct_f}{r}\right)\left[-\frac{mMGx^2}{r^2} + \frac{(x^2-1)L^2}{mr^3}\right] \quad -(14)$$

so it becomes a sum of inverse square, cube and fourth power terms.

As far as is known at present this is the only correct relativistic description of a precessing elliptical orbit. It depends on the characteristic time t_f which does not appear in the obsolete theory of general relativity.