193(7): Calculation of Gravitational Time Delay without the Use of General Relativity.

Consider the chain rule:

$$\frac{dr}{dt} = \frac{dr}{d\theta}\frac{d\theta}{dt} \quad -(1)$$

For a precessing ellipse:

$$\frac{dr}{d\theta} = \frac{x\epsilon}{\alpha} r^2 \sin(x\theta) \quad -(2)$$

where:

$$\sin(x\theta) = \frac{1}{\epsilon r}\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2} \quad -(3)$$

For any planar orbit:

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

where L is the constant angular momentum. So:

$$\frac{dr}{dt} = \left(\frac{L}{m}\frac{x\epsilon}{\alpha}\right)\sin(x\theta) \quad -(5)$$

$$= \left(\frac{Lx}{m\alpha}\right)\frac{1}{r}\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}$$

The result from general relativity (UFT 155) is:

$$\frac{dr}{dt} = cbm(r)\left(\frac{1}{b^2} - m(r)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right)^{1/2} \quad -(6)$$

The angular velocity from general relativity is:

$$\omega = \frac{d\theta}{dt} = \frac{cbm(r)}{r^2} \quad -(7)$$

) where

$$b = \frac{Lc}{E}, \quad a = \frac{L}{mc} \qquad -(8)$$

and where E is the total energy. So:

$$\omega = \left(\frac{Lc^2}{E}\right)\frac{m(r)}{r^2} \qquad -(9)$$

from general relativity, where:

$$E = m(r)\, mc^2\, dt/d\tau \qquad -(10)$$

$$L = mr^2\, d\theta/d\tau \qquad -(11)$$

The lagrangian result is eq. (4), and is the simpler theory. Without prejudice therefore, the lagrangian result is preferred to general relativity by Ockam's Razor.

In the lagrangian theory:

$$\frac{dt}{dr} = \left(\frac{m\alpha}{Lx}\right) r\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{-1/2} \qquad -(12)$$

which is derived from the precessing conic section:

$$r = \frac{\alpha}{1 + \epsilon\cos(x\theta)} \qquad -(13)$$

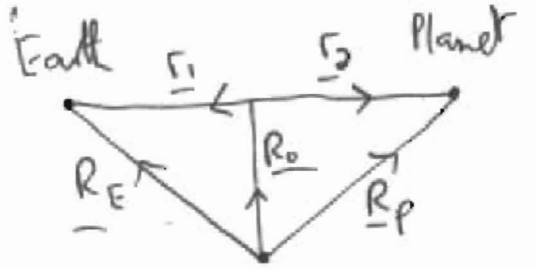
observed in astronomy in the solar system.

Therefore:

$$\boxed{t = \int \left(\frac{m\alpha}{Lx}\right) r\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{-1/2} dr}$$

$$-(14)$$

3)



Base line,
Fig (1)

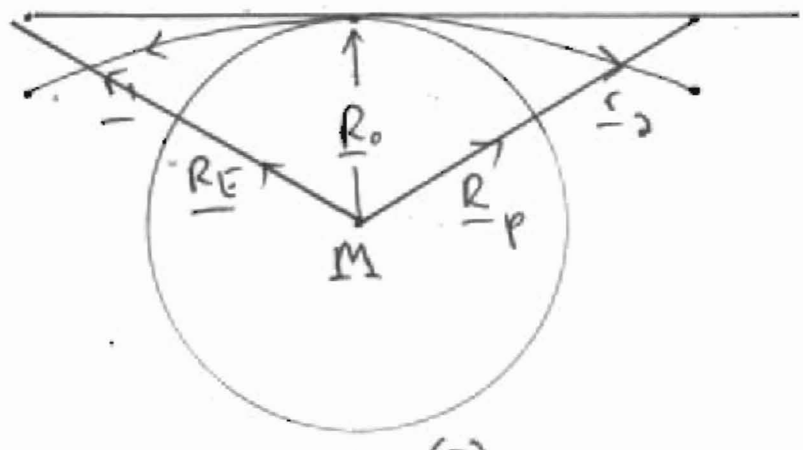


Fig (2)

With reference to the figures, and defining:

$$f(r) = \left(\frac{m\alpha}{Lx}\right) r \left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{-1/2} \quad -(15)$$

The gravitational time delay is:

$$\boxed{\Delta t = t_3 - t_0} \quad -(16)$$

where:

$$t_3 = \frac{2}{c}\left(\int_{R_0}^{R_E} f(r)\,dr + \int_{R_0}^{R_p} f(r)\,dr\right) \quad -(17)$$

and

$$t_0 = 2(t_1 + t_2) \quad -(18)$$

where

$$t_1 = \frac{1}{c}\int_{R_0}^{R_E}\left(1 - \frac{R_0^2}{r^2}\right)^{-1/2} dr = \frac{r_1}{c} \quad -(19)$$

$$t_2 = \frac{1}{c}\int_{R_0}^{R_p}\left(1 - \frac{R_0^2}{r^2}\right)^{-1/2} dr = \frac{r_2}{c} \quad -(20)$$

So eq. (16) can be worked out directly from the observed orbit (13) without any general relativity.

4) The result (16) for gravitational time delay must be consistent with the result for deflection due to gravitation:

$$\boxed{\Delta\theta = -\frac{2\alpha}{x}\int_{1/R_0}^{0}\left(\epsilon^2-(\alpha u-1)^2\right)^{-1/2} - \pi} \quad -(21)$$

also worked out directly from observation, eq. (13). So α, x and ϵ must be the same from eqs. (15) and (21), and must be the same as in eq. (13).

This is a severe test of the idea of photon mass, because both light deflection and gravitational time delay are solved a photon mass theory.

A much simpler test would be to measure the angular velocity of a photon in orbit around the sun. In the Lagrangian theory and GR respectively:

$$\boxed{\omega = \frac{L}{mr^2}\ (\text{Lagrangian}); \quad \omega = \frac{Lc^2}{E}\frac{m(r)}{r^2}\ (\text{GR})} \quad -(22)$$

If these two theories were to give the same result:

$$\boxed{m(r) = \frac{E}{mc^2}} \quad -(23)$$