319(4): Simplified Calculation of Light Deflection due to Gravitation.

The orbit of a photon around the sun is in general a precessing hyperbola:

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

but to an excellent approximation:

$$x \sim 1 \quad -(2)$$

so:

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

with a very large eccentricity ϵ. Due to the quasi Lorentz covariance of the field equations of ECE2 theory the orbit is governed by a quasi Minkowski metric:

$$c^2 d\tau^2 = (c^2 - v^2)\, dt^2 \quad -(4)$$

where

$$v^2 = \left(\frac{dr}{dt}\right)^2 + r^2 \left(\frac{d\theta}{dt}\right)^2 \quad -(5)$$

As in UFT 215 and UFT 216:

$$v^2 = \left(\frac{xL\epsilon}{\alpha m}\right)^2 \sin^2(x\theta) + \left(\frac{L}{mr}\right)^2 \quad -(6)$$

where

$$L = mr^2 \frac{d\theta}{dt} \quad -(7)$$

Here:

$$\sin^2(x\theta) = 1 - \frac{1}{\epsilon^2}\left(\frac{\alpha}{r} - 1\right)^2 \quad -(8)$$

So:

$$v^2 = \left(\frac{L}{m\alpha}\right)^2\left[\frac{2x^2\alpha}{r} - x^2(1-\epsilon^2) + \frac{\alpha^2}{r^2}(1-x^2)\right]. \quad -(9)$$

When

$$x = 1 \quad -(10)$$

$$v^2 = \left(\frac{L}{m\alpha}\right)^2\left[\frac{2\alpha}{r} - (1-\epsilon^2)\right] \quad -(11)$$

The orbit (3) is obtained from:

$$\underline{F} = m\underline{g} = -\frac{mMG}{r^2}\underline{e_r} \quad -(12).$$

if

$$L^2 = m^2 MG\alpha \quad -(13)$$

so

$$v^2 = \frac{MG}{\alpha}\left(\frac{2\alpha}{r} - (1-\epsilon^2)\right) - (14)$$

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

At closest approach:

$$r = R_0 = \frac{\alpha}{1+\epsilon} \quad -(15)$$

and by definition the semi major axis is:

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(16)$$

3)

So $$v^2 = mG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(17)$$

Also: $$v^2 = mG\left(\frac{2}{r} + \frac{(\epsilon+1)(\epsilon-1)}{\alpha}\right) \quad -(18)$$

$$= mG\left(\frac{2}{r} + \frac{(\epsilon-1)}{R_0}\right)$$

at closest approach. So
$$v^2 = mG\left(\frac{2}{R_0} + \frac{(\epsilon-1)}{R_0}\right) \quad -(19)$$

$$= \frac{mG}{R_0}\left(1+\epsilon\right)$$

The angle of deflection at closest approach is:
$$2\phi = \frac{2}{\epsilon} \quad -(20)$$

where $$\epsilon = \frac{R_0 v^2}{mG} - 1 \quad -(21)$$

$$\sim \frac{R_0 v^2}{mG}$$

if $$R_0 v^2 \gg mG \quad -(22)$$

In this approximation:

4)

$$2\phi = \frac{2MG}{R_0 v^2} \quad -(23)$$

The experimentally observed result is:

$$2\phi = \frac{4MG}{R_0 c^2} \quad -(24)$$

to high precision, so:

$$v^2 = \frac{1}{2} c^2 \quad -(25)$$

which is the same result as that observed in Note 319(3).

From eq. (4):

$$d\tau^2 = \left(1 - \frac{v^2}{c^2}\right) dt^2 \quad -(26)$$

an equation which defines the Lorentz factor:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} = \frac{dt}{d\tau} \quad -(27)$$

From eqs. (25) and (27) the Lorentz factor is

$$\gamma = 0.5^{-1/2} = \frac{1}{\sqrt{2}} = 0.707 \quad -(28)$$

The photon mass is given by:

$$\hbar\omega = \gamma m c^2 \quad -(29)$$

5) So

$$m = \frac{\hbar\omega}{\gamma c^2} = \left(\frac{\hbar}{\gamma c^2}\right)\omega \quad -(30)$$

Here

$$\hbar = 1.05459 \times 10^{-34}\ Js \quad -(31)$$

$$c = 2.997925 \times 10^{8}\ ms^{-1}$$

So

$$m = \left(\frac{\sqrt{2} \times 1.05459}{2.99792^2} \times 10^{-42}\right)\omega \quad -(32)$$

$$= 1.66 \times 10^{-43}\ \omega\ kg$$

This result is obtained from a one photon theory of light grazing the sun.

If the average energy of an oscillator is used:

$$\langle \hbar\omega \rangle = \frac{\hbar\omega}{e^{(\hbar\omega/kT)} - 1} \quad -(33)$$

So

$$m = \frac{\hbar\omega}{\gamma c^2}\left(\frac{1}{e^{((\hbar\omega)/kT)} - 1}\right) \quad -(34)$$