263(2): Explanation of Light Deflection Due to Gravitation

In the new theory the orbit is:

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

where

$$R = r + r_0 \quad -(2)$$

and

$$r_0 = \frac{3MG}{c^2}. \quad -(3)$$

Eq. (1) is that of a precessing orbit, where the angle of precession per rotation is:

$$\Delta\theta = \frac{3MG}{\epsilon\alpha c^2} \quad -(4)$$

as observed experimentally in the solar system. The force law that gives the orbit (1) is defined by:

$$\frac{d^2R}{dt^2} = -\frac{mMG}{R^2} + \frac{L^2}{mR^3}. \quad -(5)$$

At the turning point:

$$\frac{d^2R}{dt^2} = 0 \quad -(6)$$

so from eqs. (5) and (6):

$$R = \frac{L^2}{m^2MG} \quad -(7)$$

From eq. (1):

2)
$$R = \alpha \quad -(8)$$

if
$$\cos\theta = 0, \quad \theta = \frac{\pi}{2} \quad -(9)$$

The force law
$$\underline{F} = -\frac{mMG}{R^2}\,\underline{e}_r \quad -(10)$$

gives eq (1) if:
$$\alpha = \frac{L^2}{m^2 MG} \quad -(11)$$

and the turning point occurs at:
$$R = \alpha = r + r_0 \quad -(12)$$

i.e.
$$r = \alpha - r_0 \quad -(13)$$

The turning point of the precessing ellipse (1) is equivalent to the turning point of the static ellipse:
$$r = \frac{\alpha}{1 + \epsilon\cos\theta} \quad -(14)$$

if eq. (13) is true, so:
$$\alpha - r_0 = \frac{\alpha}{1 + \epsilon\cos\theta} \quad -(15)$$

which gives eq. (4) self consistently.

The turning point (13) is the one given by the Einstein theory:

3)

$$m\frac{d^2r}{dt^2} = -\frac{mMG}{r^2} - \frac{L^2}{mc^2r^4}r_0 + \frac{L^2}{mr^3} = 0 \quad -(16)$$

So eq. (1) gives the same precession angle as the Einstein ~~theory~~. It also gives the same angular momentum at the turning point:

$$\frac{L^2}{m^2MG} = \alpha = r + r_0 \quad -(17)$$

The observed orbital precession of planets in the solar system can be explained by replacing r by R wherever it occurs. This has the effect of changing the static Newtonian ellipse (14) to the precessing ellipse (1) as observed experimentally. The experimentally observed angle of precession per radian, eq. (4), is obtained from the force law (5), in which r is replaced by R. This force law is obtained from the orbital acceleration:

$$\underline{a} = \left(\ddot{R} - R\dot{\theta}^2\right)\underline{e}_r \quad -(18)$$

and the orbital velocity:

$$\underline{v} = \frac{dR}{dt}\underline{e}_r + R\dot{\theta}\,\underline{e}_\theta \quad -(19)$$

4) The simple replacement:

$$r \rightarrow r + r_0 \quad -(20)$$

is the true explanation of all orbital properties, not the incorrect Einstein theory.

The orbital velocity is given from eq. (19) by:

$$v^2 = \left(\frac{dR}{dt}\right)^2 + R^2\dot{\theta}^2 \quad -(21)$$

in which

$$\omega = \dot{\theta} = \frac{L}{mR^2} \quad -(22)$$

and

$$\frac{dR}{dt} = \frac{dR}{d\theta}\frac{d\theta}{dt} \quad -(23)$$

so

$$v^2 = \left(\frac{dR}{d\theta}\right)^2\left(\frac{d\theta}{dt}\right)^2 + \frac{L^2}{m^2R^2} \quad -(24)$$

$$= \frac{L^2}{m^2R^2}\left(1 + \frac{1}{R^2}\left(\frac{dR}{d\theta}\right)^2\right)$$

From eq. (1):

$$\left(\frac{dR}{d\theta}\right)^2 = \frac{\epsilon^2R^4}{\alpha^2}\left(1-\cos^2\theta\right) \quad -(25)$$

where

$$\cos^2\theta = \frac{1}{\epsilon^2}\left(\frac{\alpha}{R} - 1\right)^2 \quad -(26)$$

) So:

$$v^2 = \frac{L^2}{m^2}\left(\frac{1}{R^2} + \frac{\epsilon^2}{\alpha^2}\left(1 - \frac{1}{\epsilon^2}\left(\frac{\alpha}{R} - 1\right)^2\right)\right)$$

$$= \frac{L^2}{m^2\alpha}\left(\frac{(\epsilon^2 - 1)}{\alpha} + \frac{2}{R}\right)$$

$$= \frac{L^2}{m^2\alpha}\left(\frac{2}{R} - \frac{1}{a}\right) \qquad -(27)$$

where

$$a = \frac{\alpha}{1-\epsilon^2} \qquad -(28)$$

is the semi major axis.

Eq. (27) is the orbital linear velocity of an orbit precessing with the experimentally observed result (4).

If m orbits a mass M in a hyperbolic orbit the angle of deflection is, for small ϕ:

$$\Delta\phi = 2\phi = \frac{2}{\epsilon} \qquad -(29)$$

i.e

$$\phi = \frac{1}{\epsilon} \qquad -(30)$$

Using eq. (11), eq. (27) becomes:

$$v^2 = MG\left(\frac{2}{R} + \frac{(\epsilon^2 - 1)}{d}\right) \quad -(31)$$

where

$$d = r_{min}(1+\epsilon) \quad -(32)$$
$$= r_{max}(1-\epsilon)$$

with r_{min} denoting the perihelion and r_{max} the aphelion, the minimum and maximum distances of m from M.

So:

$$v^2 = MG\left(\frac{2}{R} + \frac{\epsilon - 1}{r_{min}}\right) \quad -(33)$$

for the precessing orbit (1). The corresponding result for the static orbit (14) is:

$$v^2 = MG\left(\frac{2}{r} + \frac{\epsilon - 1}{r_{min}}\right) \quad -(34)$$

Eq. (34) is the Newtonian result.

At closest approach:

$$r = r_{min} = R_0 \quad -(35)$$

so:

$$\epsilon + 1 = \frac{R_0 v^2}{MG} \quad -(36)$$

in the Newtonian theory.

7) For a photon grazing a mass M:

$$v \to c \quad -(37)$$

so
$$\epsilon = \frac{R_0 c^2}{MG} - 1 \sim \frac{R_0 c^2}{MG} \quad -(38)$$

and the deflection is:
$$\Delta\phi = 2\phi = \frac{2}{\epsilon} = \frac{2MG}{R_0 c^2} \quad -(39)$$

in the Newtonian theory.

The experimental result is:
$$\Delta\phi = 2\phi = \frac{2}{\epsilon} = \frac{4MG}{R_0 c^2} \quad -(40)$$

i.e.
$$\epsilon = \frac{R_0 c^2}{2MG} \quad -(41)$$

The eccentricity is defined by:
$$\epsilon = \frac{R_0 v^2}{MG} - 1 \quad -(42)$$

at closest approach R_0. So if ϕ is doubled, the eccentricity ϵ is halved, i.e.:
$$v = \frac{c}{\sqrt{2}} \quad -(43)$$

The replacement of r by R produces

) a change:

$$v^2 = MG\left(\frac{2}{r+r_0} + \frac{\epsilon - 1}{r_{min}}\right)$$

$$= \frac{2MG}{r}\left(1 + \frac{r_0}{r}\right)^{-1} + \frac{MG}{r_{min}}(\epsilon - 1)$$

So

$$\Delta v^2 \sim -\frac{2MG}{r}\frac{r_0}{r} = -\frac{2MG r_0}{r^2} \quad (44)$$

This is the change in the square of the orbital velocity needed to produce the observed precession (4) for a precessing elliptical orbit. It is very tiny and does not produce twice the Newtonian value for angle of deflection.

Eq. (43) however produces the observed experimental value by assuming that the photon has a mass m. The velocity of the photon is slowed to $1/\sqrt{2}$ of c as it grazes the mass M. Alternatively the velocity of the photon is c, and the spin connection method of UFT 261 can be used.