406(3): The de Sitter Precession of Planets.

The well known Einstein precession:

$$\Delta \phi_E = \frac{6\pi MG}{c^2 a(1-\epsilon^2)} \quad - (1)$$

is derived in the standard theory from a consideration of the now obsolete Schwarzschild line element. However, in the standard theory itself there is also present a precession that is derived from the rotation of the Schwarzschild line element - the de Sitter precession $\Delta \phi_g$, also known as the geodetic precession. There is also present the Lense Thirring precession ϕ_{LT}. So the true result of the standard theory is:

$$\Delta \phi = \Delta \phi_E + \Delta \phi_g + \Delta \phi_{LT} \quad - (2)$$

The de Sitter precession can be derived straightforwardly as follows, using the methods of the standard model itself. Consider the now obsolete Schwarzschild line element:

$$ds^2 = c^2 d\tau^2 = ac^2 dt^2 - \frac{1}{a} dr^2 - r^2 d\phi^2 \quad - (3)$$

in plane polar coordinates (r, ϕ). Here:

$$a = 1 - \frac{2MG}{rc^2} \quad - (4)$$

where M is the mass of an object about which orbits an object of mass m.

The de Sitter rotation is:

$$\phi \rightarrow \phi + \omega t \quad - (5)$$

where ω is the non relativistic angular velocity defined by

$$v = \omega r \quad - (6)$$

where v is the linear velocity of the rotation. The Thomas rotation is the same as Eq. (5) and for Thomas precession:

$$a = 1 \quad - (6)$$

From eqs (3) and (5):

$$ds^2 = ac^2dt^2 - r^2(d\phi^2 + 2\omega\, d\phi\, dt + \omega^2 dt^2) - \frac{dr^2}{a} \quad -(7)$$

Now use:

$$ac^2 - v^2 = \left(1 - \frac{2mG}{rc^2}\right)c^2 - v^2 \quad -(8)$$

$$= c^2 - v^2 - \frac{2mG}{r}$$

$$: c^2 - v_1^2$$

where

$$v_1^2 = v^2 + \frac{2mG}{r}. \quad -(9)$$

Also,

$$c^2 - v_1^2 = \left(1 - \frac{v_1^2}{c^2}\right)c^2 \quad -(10)$$

So

$$ds^2 = \left(1 - \frac{v_1^2}{c^2}\right)c^2dt^2 - 2r^2\omega\, d\phi\, dt - r^2 d\phi^2 - \frac{dr^2}{a} \quad -(11)$$

Now define the de Sitter angular velocity:

$$\Omega := \omega\left(1 - \frac{v_1^2}{c^2}\right)^{-1} \quad -(12)$$

So

$$ds^2 = \left(1 - \frac{v_1^2}{c^2}\right)\left(c^2dt^2 - 2r^2\Omega\, d\phi\, dt\right) - r^2 d\phi^2 - \frac{dr^2}{a} \quad -(13)$$

The de Sitter or geodetic precession is then:

$$\Delta\phi_g = \Omega\, d\tau - \omega\, dt \quad -(14)$$

where

$$d\tau = \left(1 - \frac{v_1^2}{c^2}\right)^{1/2} dt \quad -(15)$$

For one orbit of 2π radians:

$$\Delta \phi_g = 2\pi \left(\left(1 - \frac{v^2}{c^2} - \frac{2mG}{rc^2} \right)^{-1/2} - 1 \right) \quad -(16)$$

In comparison, the Thomas precession is:

$$\Delta \phi_T = 2\pi \left(\left(1 - \frac{v^2}{c^2} \right)^{-1/2} - 1 \right) \quad -(17)$$

(UFT110).

For small precessions such as those in the solar system the Newtonian approximation to v may be used:

$$v^2 = mG \left(\frac{2}{r} - \frac{1}{a} \right) \quad -(18)$$

where a is the semi major axis. So

$$v_1^2 = v^2 + \frac{2mG}{r} = mG \left(\frac{4}{r} - \frac{1}{a} \right) \quad -(19)$$

For nearly circular orbits such as those in the solar system:

$$r \sim a \quad -(20)$$

So

$$v_1^2 \sim \frac{3mG}{a} \quad -(21)$$

If

$$v_1 << c :$$

$$\Delta \phi_g = 2\pi \left(\left(1 - \frac{v_1^2}{c^2} \right)^{-1/2} - 1 \right)$$

$$\sim \pi \frac{v_1^2}{c^2} \quad -(22)$$

So

$$\boxed{\Delta \phi_g \sim \frac{6\pi mG}{2c^2 a}} \quad -(23)$$

The total precession is:

$$\Delta \phi = \Delta \phi_E + \Delta \phi_g + \Delta \phi_{LT} \quad -(24)$$

4) Assuming that the Lense Thirring precession is negligible (e.g. UFT344) then:

$$\boxed{\begin{aligned}\Delta\phi &= \Delta\phi_E + \Delta\phi_g \\ &= \frac{6\pi MG}{a}\left(\frac{1}{1-\epsilon^2}+\frac{1}{2}\right)\end{aligned}} \quad - (25)$$

This is the result of the standard model itself when the geodetic precession is correctly considered.

Eq. (25) can be worked out for all the planets, using data for a and ϵ. For Mars, Venus and Earth it is more than 50% larger than the experimental result, which is in itself obtained in a dubious way.

So EGR is completely refuted, Q.E.D.