SIMPLE CLASSICAL EXPLANATION OF PLANETARY PRECESSION WITH THREE DIMENSIONAL ORBIT THEORY: THOMAS PRECESSION THEORY

by

M. W. Evans and H. Eckardt,

Civil List, AIAS and UPITEC

(www.webarchive.org.uk, www.aias.us, www.upitec.org, www.atomicprecision.com, www.et3m.net)

ABSTRACT

Planetary precession in the solar system and elsewhere in the universe is explained straightforwardly on the classical level with three dimensional orbit theory. Within the approximations it is the ratio of the total angular momentum magnitude L to its Z component L_Z. Thomas precession theory is used to derive planetary precession from the rotated Minkowski metric in three dimensions. Precession of the Foucault pendulum, spin orbit coupling and the geodedic effect are derived in the same way. The incorrect Einstein field equation is nowhere used.

Keywords: ECE theory, x theory three dimensional orbit theory, Thomas precession theory.

UFT 276

1. INTRODUCTION

In recent papers of this series {1 - 10} three dimensional orbit theory has been developed straightforwardly by replacing the plane polar by the spherical polar coordinates in the definition of the kinetic energy. It has been shown that all orbits are in general three dimensional and that the conservation laws are obeyed in three dimensions. This simple but profound paradigm shift has led to many original results in immediately preceding papers of this series (UFT Section of www.aias.us). In Section 2 these results are applied to derive a simple expression for the precisely observable precession of all orbits as the ratio of the total angular momentum magnitude L to its Z component L_Z. In the four hundred year old two dimensional orbit theory only L_Z exists, and the Hooke Newton inverse square law of attraction produces a conic section. When the eccentricity is less than unity this is an ellipse which does not precess. This theory was known as universal gravitation, and Einstein's general relativity was applied to explain the precession of the perihelion of the ellipse. The precession is now known experimentally with great accuracy.

However, it is well known {1 - 10} that Einstein's theory was developed in an era when Cartan torsion was unknown, so the second Bianchi identity upon which Einstein based his field equation was fundamentally incorrect (UFT88, UFT99, UFT255). In this series {1 - 10} it has been shown that the correct geometry requires both torsion and curvature, and if torsion is missing, curvature and gravitation BOTH vanish. This series has developed a generally covariant unified field theory that replaces and updates the Einstein theory - the ECE theory (Einstein Cartan Evans theory). The ECE theory has generated unprecedented worldwide interest and has essentially replaced the Einstein theory in what was named by Alwyn van der Merwe as the "Post Einstein Paradigm Shift". The Einstein theory can no longer be accepted as an explanation of orbit precession and fails qualitatively in galaxies and other objects known to astronomy. Dark matter theory was an ad hoc attempt to bolster up the Einstein theory but dark matter theory has also been refuted experimentally.

All the phenomena attributed to the Einstein theory have been derived in a simpler way (1 - 10} using ECE theory: orbit precession, electromagnetic deflection due to gravitation, gravitational time delay, gravitational red shift, and in Section 2, de Sitter precession is derived from Thomas precession by rotating the Minkowski metric. It is shown in Section 2 that orbit precession is a straightforward consequence of three dimensional orbit theory and this result is recognized to be the classical limit of orbit precession derived from relativistic three dimensional Thomas precession. Cartan torsion is ubiquitous to all geometries, and can never be omitted from any geometry. It is well defined in the spherical polar coordinates so this theory is an example of ECE theory. Einstein's omission of torsion means that his field equation is entirely meaningless, and the correct version of the second Bianchi identity is the Cartan identity. The correct field equations of gravitation are given in the Engineering Model of ECE theory (www.aias.us). In Section 3 some results of Section 2 are graphed and analysed, revealing a rich structure that has been entirely unknown in the four hundred years since Kepler first analysed the orbit of Mars.

2. CLASSICAL EXPLANATION FOR ORBIT PRECESSION AND THOMAS PRECESSION OF SPECIAL RELATIVITY.

In immediately preceding papers of this series {1 - 10} it has been shown that that the three dimensional orbit corresponding to the Hooke Newton law of attraction is the beta conic section:

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

where:

$$\tan \beta = \frac{L}{L_Z} \tan \phi. \quad -(2)$$

Here α is the half right magnitude in three dimensions, ϵ is the ellipticity in three dimensions and where β is defined in terms of the spherical polar coordinate system (r, ϕ, θ) by:

$$\dot{\beta}^2 = \dot{\theta}^2 + \dot{\phi}^2 \sin^2\theta \quad -(3)$$

When the eccentricity is:

$$0 < \epsilon < 1 \quad -(4)$$

the beta conic section becomes the beta ellipse.

Now assume that:

$$\beta = x\phi \quad -(5)$$

to obtain the precessing ellipse:

$$r = \frac{\alpha}{1 + \epsilon \cos(x\phi)}. \quad -(6)$$

It is observed experimentally for all precessions and with great precision that:

$$x = 1 + \frac{3MG}{\alpha c^2} \quad -(7)$$

where M is the mass of an object that attracts a mass m, G is the Newton constant and where α is the half right latitude. From Eqs. (2) and (5):

$$\tan(x\phi) = \frac{L}{L_Z} \tan \phi \quad -(8)$$

so the precession constant is:

$$x = \frac{1}{\phi} \tan^{-1}\left(\frac{L}{L_Z} \tan\phi\right) = 1 + \frac{3mG}{\alpha c^2} \quad -(9)$$

where:

$$\alpha = \frac{L_Z^2}{m^2 MG} . \quad -(10)$$

In all observed precessions x is very close to unity:

$$x \sim 1 \quad -(11)$$

to high experimental precision. So for all x, the classical precession constant is the result of a very small change in the L_Z of the old planar theory to L of the three dimensional theory.

The effect of x is to change 2π to $2\pi + \Delta\phi$ in one complete orbit, where $\Delta\phi$ in radians is a very small quantity. In the solar system for example it is only a few arc seconds per revolution of 2π radians. The x needed for the angle $\Delta\phi$ is:

$$x = \frac{1}{\Delta\phi} \tan^{-1}\left(\frac{L}{L_Z} \tan(\Delta\phi)\right). \quad -(12)$$

Now consider the Maclaurin expansions:

$$\tan^{-1}x = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots, \quad |x| < 1 \quad -(13)$$

and:

$$\tan x = x + \frac{x^3}{3} + \frac{2}{15}x^5 + \cdots, \quad |x| < \frac{\pi}{2}. \quad -(14)$$

It follows that Eqs. (12) to (14) give:

$$x = \frac{1}{\Delta\phi}\left(\frac{L}{L_Z}\tan(\Delta\phi) - \frac{1}{3}\left(\frac{L}{L_Z}\tan(\Delta\phi)\right)^3 + \cdots\right) \quad -(15)$$

where:

$$\Delta\phi \lll 1. \quad -(16)$$

So:

$$\tan(\Delta\phi) \sim \Delta\phi \lll 1 \quad -(17)$$

and:

$$x = \frac{L}{L_Z}. \quad -(18)$$

This result can be obtained in a different way by using a Taylor expansion around:

$$\phi = 2\pi \quad -(19)$$

For small ϕ :

$$\tan\phi = \phi - 2\pi + \frac{1}{3}(\phi - 2\pi)^3 + \cdots \quad -(20)$$

$$\tan(\phi + 2\pi) \sim \phi \quad -(21)$$

so:

$$\tan^{-1}\left(\frac{L}{L_Z}\tan\phi\right) = \frac{L}{L_Z}\phi - \frac{1}{3}\left(\frac{L\phi}{L_Z}\right)^3 + \cdots \quad -(21)$$

giving Eq. (18) again Q.E.D.

All observed orbit precessions can be explained on the classical level using three dimensional orbit theory and the use of the spherical polar coordinates in the kinetic energy. This is a major advance in the theory of orbits because it means that all orbits are three dimensional. The three dimensional property manifests itself in a seemingly two dimensional precession within the approximations used.

In classical physics this is a necessary and sufficient explanation of precessing orbits. The observed x can always be expressed as the ratio:

$$x = \frac{L}{L_2} = 1 + \frac{3mG}{\alpha c^2}. \quad -(22)$$

In special relativity an explanation for the structure of x can be obtained from the Thomas precession (UFT265). The theory of UFT265 must be developed for self consistently into a three dimensional theory and the result (22) must be regarded as the classical limit of special relativity, in which the infinitesimal line element is {1 - 10}:

$$ds^2 = c^2 d\tau^2 = (c^2 - v^2) dt^2 = c^2 dt^2 - dr^2 - r^2 d\beta^2. \quad -(23)$$

where c is the speed of light, τ is the proper time (the time in the moving frame), and t the time in the fixed, observed frame. The velocity v is the classical velocity. The hamiltonian is:

$$H = (\gamma - 1) mc^2 + U(r) \quad -(24)$$

where γ is the Lorentz factor:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}. \quad -(25)$$

Sommerfeld showed in 1915 that the hamiltonian (24) leads to a precessing elliptical orbit in atoms {1 - 10} using an inverse square law for potential energy:

$$U(r) = -\frac{k}{r} \quad -(26)$$

which has the same format as the Hooke Newton inverse square law of orbits. So a Sommerfeld hamiltonian of special relativity would lead to precessing orbits.

In three dimensions the velocity is:

$$v^2 = \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\beta}{dt}\right)^2 \quad -(27)$$

and the relativistic kinetic energy is:

$$T = (\gamma - 1)mc^2 \quad -(28)$$

As shown in detail in Note 276(3), the beta ellipse leads to:

$$v^2 = \frac{L^2}{m^2\alpha^2}\left(1 + \epsilon^2 + 2\epsilon\cos\beta\right) \quad -(29)$$

where:

$$\cos\beta = \frac{\cos\phi}{\left(\cos^2\phi + \left(\frac{L}{L_Z}\right)^2 \sin^2\phi\right)^{1/2}} \quad -(30)$$

$$= \left(1 - \left(\frac{1}{1-\left(\frac{L_Z}{L}\right)^2}\right)\cos^2\theta\right)^{1/2}$$

and in Section 3 the properties of the velocity (29) and relativistic kinetic energy (28) are graphed in terms of ϕ, in terms of θ, and as a combination of ϕ and θ in three dimensional plots. There is a rich structure discussed in Section 3 that is entirely unknown in the two dimensional orbit theory.

The use of three dimensional Thomas precession as developed in Notes 276(4) to 276(6) accompanying UFT276 on www.ai ..us leads to orbit precession in a simpler way than use of the Sommerfeld hamiltonian. Consider the three dimensional metric of special relativity derived in Note 276(4):

$$ds^2 = c^2 d\tau^2 = c^2 dt^2 - r^2 d\beta^2 - dr^2 \quad -(31)$$

$$d\beta^2 = d\theta^2 + \sin^2\theta\, d\phi^2 \quad -(32)$$

The classical velocity is:

$$v^2 = r^2 \left(\frac{d\beta}{dt}\right)^2 = r^2 \left(\left(\frac{d\theta}{dt}\right)^2 + \sin^2\theta \left(\frac{d\phi}{dt}\right)^2 \right). \quad -(33)$$

Thomas precession in two dimensions is

$$\phi' = \phi + \omega t \quad -(34)$$

and in three dimensions this becomes:

$$\beta' = \beta + \omega t. \quad -(35)$$

As shown in UFT265 Eq. (34) results in:

$$ds^2 = \left(1 - \frac{6mG}{c^2 r}\right) c^2 dt^2 - v^2 dt^2 \quad -(36)$$

which can be rewritten as:

$$c^2 d\tau^2 \left(1 - \frac{6mG}{c^2 r}\right)^{-1} = c^2 dt^2 - v^2 \left(1 - \frac{6mG}{c^2 r}\right)^{-1}. \quad -(37)$$

Therefore the classical velocity is increased to:

$$v' = v\left(1 - \frac{6mG}{c^2 r}\right)^{-1/2} \sim v\left(1 + \frac{3mG}{c^2 r}\right) \quad -(38)$$

It can be seen immediately that this result is closely related to the experimentally observed

precession:

$$x = 1 + \frac{3mG}{c^2 \alpha} \quad -(39)$$

$$x = \frac{L}{L_z} = \left(1 + \frac{3mG}{c^2 r}\right)_{r=\alpha} \quad -(40)$$

The required:

$$r = \alpha \quad -(41)$$

occurs at the turning point, as shown in UFT265:

$$F = m\frac{d^2 r}{dt^2} = 0 \quad -(42)$$

which is the point at which there is no net force on m. So the particle behaves as if it is a free particle at this point, and this is consistent with the use of the free particle metric (31).

Therefore:

$$x = \frac{L}{L_z} = 1 + \frac{3mG}{c^2 \alpha} \quad -(43)$$

which is the experimental result to great precision.

Replacing v by xv means that the classical hamiltonian is changed to:

$$E = H = \frac{1}{2} m x^2 v^2 + U(r) \quad -(44)$$

and the classical lagrangian to:

$$\mathcal{L} = \frac{1}{2} m x^2 v^2 - U(r). \quad -(45)$$

As shown in Note 276(5) the classical angular momentum is increased to:

$$L \rightarrow x^2 L \quad -(46)$$

and the orbit becomes the precessing ellipse:

$$r = \frac{\alpha}{1+\epsilon\cos(x\phi)} \quad -(47)$$

provided that:

$$\alpha = x^4 L^2 / (mMG) \quad -(48)$$

$$\frac{\epsilon^2 - 1}{\alpha^2} = \frac{2mE}{x^4 L^2}, \quad xr \sim r. \quad -(49)$$

Since x is very close to unity these approximations are valid. So rotating the three dimensional infinitesimal line element (31) using:

$$\phi' = \phi + \omega t \quad -(50)$$

gives the experimentally observed precessing ellipse to great accuracy.

As shown in Note 276(6) the rotation:

$$\beta' = \beta + \omega t \quad -(51)$$

also produces the result (47) provided that the angular velocity is defined by:

$$\omega = \frac{d\beta}{dt} = \frac{v_\theta}{r}. \quad -(52)$$

The result of the rotation (50) can also be expressed as:

$$ds^2 = \left(1 - \frac{v_\theta^2}{c^2}\right)\left(c^2 dt^2 - 2r^2\Omega\, d\beta\, dt\right) - dr^2 - r^2 d\phi^2 \quad -(53)$$

as in UFT110 on www.aias.us. Now define the relativistic angular velocity as:

$$\Omega = \omega\left(1 - \frac{v_\theta^2}{c^2}\right)^{-1} \quad -(54)$$

and the relativistic time interval in the observer frame as:

$$t' = \left(1 - \frac{v_\theta^2}{c^2}\right)^{1/2} t. \quad -(55)$$

For a rotation of 2π radians:

$$\omega t = 2\pi \quad -(56)$$

and the phase shift due to the frame rotation (56) is:

$$\alpha = \Omega t' - \omega t = 2\pi\left(\left(1 - \frac{v_\theta^2}{c^2}\right)^{1/2} - 1\right). \quad -(57)$$

This has been observed experimentally (UFT110) in pendulum motion. The time shift (55)

is observed in spin orbit interaction in atoms and molecules.

Finally, geodedic precession can be obtained as in Note 276(6) by using:

$$\beta' = \beta + \frac{\omega}{\sqrt{2}} dt \quad -(58)$$

in the three dimensional metric (31), giving the result:

$$ds^2 = \left(1 - \frac{3mG}{c^2 r}\right) c^2 dt^2 - dr^2 - r^2 d\beta^2. \quad -(59)$$

Conventionally, the result (59) is obtained from the three dimensional "Schwarzschild

metric" by rotating the latter by:

$$\phi' = \phi + \omega t. \quad -(60)$$

The time shift:

$$dt^{2\prime} = \left(1 - \frac{2mG}{c^2 r}\right) dt^2 \quad -(61)$$

is the gravitational red shift and:

$$dt'^2 = \left(1 - \frac{mG}{c^2 r}\right) dt^2 \quad -(62)$$

is the conventional de Sitter precession or geodedic effect. Both of these effects are observed with great precision experimentally but are misattributed to the Einstein theory. As shown above they are the result of rotating the three dimensional Minkowski metric (31).

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REFERENCES

{1} M. W. Evans, H .Eckardt, D. W. Lindstrom and S. J. Crothers, "Principles of ECE Theory" (open source on www.aias.us in draft format).

{2} M .W. Evans, Ed., J. Found. Phys. Chem., (CISP, Cambridge International Science Publishing, www.cisp-publishing.com, 2011 and open source on www.aias.us).

{3} M .W. Evans, Ed. "Definitive Refutations of the Einsteinian General Relativity" (CISP, 2012 and open source on www.aias.us).

{4} M. W. Evans, S. J. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" (CISP 2011 and open source on www.aias.us).

{5} M. W. Evans, H. Eckardt and D. W. Lindstrom, "Generally Covariant Unified Field Theory" (Abramis Academic, 2005 to 2011 and open source on www.aias.us) in seven volumes.

{6} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, and open source on www.aias.us. Spanish translation by A. Hill, open source on www.aias.us).

{7} M. W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific 2001).

{8} M .W. Evans and S. Kielich, Eds., "Modern Nonlinear Optics" (Wiley Interscience, New York, 1992, 1993, 1997, 2001) in two editions and six volumes.

{9} M. W. Evans and J.- P. Vigier, "The Enigmatic Photon" (Kluwer 1994 to 2002) in five volumes each, hardback and softback.

{10} M. W. Evans and A. A. Hasanein, "The Photomagneton in Quantum Field Theory" (World Scientific, 1994).