TURNING POINT METHOD OF CALCULATING ORBITAL PRECESSION AND THE ECE ANTI SYMMETRY LAW.

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ABSTRACT

The turning point of a closed planar orbit is used to calculate the precession of the orbit straightforwardly, and applied with the ECE anti symmetry law to produce the observed precession of orbits in the solar system. It is shown that the Einstein theory is a vastly over complicated and incorrect attempt to produce a simple result. The observed precession of planets is described with the spin connection of ECE theory through a small adjustment of the angular velocity. The anti symmetry law is used to define the scalar and vector parts of the spin connection.

Keywords: ECE theory, anti symmetry law, turning point of orbits, orbital precession.

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1. INTRODUCTION

In previous papers of this series, and in books and articles on www.aias.us {1 - 10} a new cosmology has been developed which is based on correct geometry due to Cartan and co workers, notably Maurer, textbook geometry {11} known for ninety years. This is the post Einstein paradigm shift and the Einstein Cartan Evans (ECE) unified field theory. It improves Einstein's attempts at developing cosmology by using the basic building blocks of geometry, spacetime torsion and curvature. Einstein used the only entity of geometry known in his time, the curvature. As a result the torsion was incorrectly discarded. If the totality of available data are used, it has been obvious for almost sixty years that the Einstein theory appears to succeed in describing only a very small corner of the universe, the solar system, and then in a dubious way (UFT240 on www.aias.us) by using the precession of orbits. In whirlpool galaxies, Einstein fails completely, but ECE theory does not. In Section 2 of this paper the experimentally observed precession is described through a small adjustment in the Cartan spin connection, the angular velocity. Section 2 starts by proving that the spin connection of a planar orbit is the angular velocity. The fundamental kinematic expression for the orbital linear velocity is shown to be a well defined example of Cartan's covariant derivative. The Cartan spin connection of any planar orbit is the angular velocity, that includes the orbits of stars in a whirlpool galaxy.

The ECE anti symmetry law is used in Section 2 to prove the equivalence of gravitational and inertial mass and to provide expressions for the centrifugal force. The latter is due to the rotation of the plane polar system of coordinates and does not exist in the Newtonian theory. The existence of the centrifugal force allows the straightforward definition of the turning point of a planar orbit, and this method is used to reproduce the experimental data on orbital precession in the solar system. Thus ECE theory provides the geometrically correct method of describing orbital precession. In previous work {1 - 10} it has been shown that two entirely different force laws lead to a precessing elliptical orbit. The reason for this is found in Section 2. The Einstein theory is not only incorrect, but it is not unique, it has been criticised severely for a century, and its success is an unfortunate illusion. The idea of general relativity by Einstein is however a sound one, that physics is based on geometry. If the correct geometry is used, the corrected Einstein theory, ECE, succeeds remarkably well.

Section 3 is a graphical analysis of the vector and scalar spin connections found using the anti symmetry law.

2. TURNING POINT METHOD OF CALCULATING PRECESSIONS.

Consider the covariant derivative of the position vector in Cartan geometry:

$$D_\mu r^a = \partial_\mu r^a + \omega^a_{\ \mu b} r^b \quad -(1)$$

where $\omega^a_{\ \mu b}$ is the Cartan spin connection. It will be shown that the familiar definition of orbital linear velocity in plane polar coordinates:

$$\underline{v} = \frac{dr}{dt}\underline{e}_r + \omega r \underline{e}_\theta = \frac{dr}{dt}\underline{e}_r + \underline{\omega} \times \underline{r} \quad -(2)$$

is an example of Eq. (1), where the angular velocity vector:

$$\underline{\omega} = \frac{d\theta}{dt}\underline{k} \quad -(3)$$

is the vector part of the Cartan spin connection defined in units of radians per second:

$$\omega^a_{\ \mu b} = \left(\omega^a_{\ 0 b}, -\underline{\omega}^a_{\ b}\right). \quad -(4)$$

In Eq. (2), dr / dt is the Newtonian derivative expressed in static coordinates. So Eq. (2) means:

$$\frac{D\underline{r}}{dt} = \frac{d\underline{r}}{dt} + \underline{\omega} \times \underline{r} . \quad -(5)$$

The second term on the right hand side of Eq. (5) means that the rotation of the axes of the plane polar coordinates system produces the orbital linear velocity $\underline{\omega} \times \underline{r}$. This cross product is defined as:

$$\underline{\omega} \times \underline{r} = \begin{vmatrix} \underline{i} & \underline{j} & \underline{k} \\ \omega_1 & \omega_2 & \omega_3 \\ r_1 & r_2 & r_3 \end{vmatrix} . \quad -(6)$$

So the components of Eq. (5) are:

$$D_\mu r^1 = \partial_\mu r^1 + \omega^2_\mu r^3 - \omega^3_\mu r^2 \quad -(7)$$

$$D_\mu r^2 = \partial_\mu r^2 + \omega^3_\mu r^1 - \omega^1_\mu r^3 \quad -(8)$$

$$D_\mu r^3 = \partial_\mu r^3 + \omega^1_\mu r^2 - \omega^2_\mu r^1 \quad -(9)$$

in which

$$\mu = 0 \quad -(10)$$

and:

$$\underline{\omega} = \omega^1{}_0 \underline{i} + \omega^2{}_0 \underline{j} + \omega^3{}_0 \underline{k} \quad -(11)$$

$$\underline{r} = r^1 \underline{i} + r^2 \underline{j} + r^3 \underline{k} . \quad -(12)$$

Consider Eq. (7) and write:

$$\omega^1{}_{\mu 3} = \epsilon^{12}{}_3 \, \omega^2_\mu \quad -(13)$$

$$\omega^1{}_{\mu 2} = \epsilon^{13}{}_2 \, \omega^3_\mu \quad -(14)$$

where:

$$\epsilon^{12}{}_3 = -\epsilon^{13}{}_2 = 1 \quad -(15)$$

is the totally antisymmetric unit tensor in three space dimensions. So Eq. (7) becomes

$$D_0 r^1 = \partial_0 r^1 + \omega^1_{\ 03} r^3 + \omega^1_{\ 02} r^2 \quad -(16)$$

which is Eq. (1) with

$$\mu = 0, \quad a = 1, \quad b = 3 \text{ and } 2 \quad -(17)$$

Q.E.D.

Therefore Eq. (2) of all the textbooks is an example of general relativity based on Cartan geometry.

With this realization the relativistic force law can be developed from the definition of the Cartan torsion {1 - 11}:

$$T^a_{\ \mu\nu} = \partial_\mu q^a_{\ \nu} - \partial_\nu q^a_{\ \mu} + \omega^a_{\ \mu b} q^b_{\ \nu} - \omega^a_{\ \nu b} q^b_{\ \mu} \quad -(18)$$

where the Christoffel connection is defined as:

$$\Gamma^a_{\ \mu\nu} = \partial_\mu q^a_{\ \nu} + \omega^a_{\ \mu b} q^b_{\ \nu}. \quad -(19)$$

By the fundamental commutator theorem of geometry {1 - 11} the Christoffel connection must be anti symmetric:

$$\Gamma^a_{\ \mu\nu} = -\Gamma^a_{\ \nu\mu}. \quad -(20)$$

The commutator theorem produces the two Cartan structure equations in tensor notation, and without the anti symmetric connection, Riemann and Cartan geometry reduce to null torsion and null curvature, generated by a null commutator. Unfortunately this was the geometry used by Einstein in an era when torsion was unknown, so Einsteinian general relativity is meaningless, its apparent accuracy in describing perihelion precession is an obvious illusion, and this section gives the reason why.

From the antisymmetry of the connection, Eq. (20):

$$\partial_\mu q^a_{\ \nu} + \omega^a_{\ \mu b} q^b_{\ \nu} = -\left(\partial_\nu q^a_{\ \mu} + \omega^a_{\ \nu b} q^b_{\ \mu} \right). \quad -(21)$$

For example:

$$\partial_0 q^a_{\ 1} + \omega^a_{\ 0b} q^b_{\ 1} = -\left(\partial_1 q^a_{\ 0} + \omega^a_{\ 1b} q^b_{\ 0} \right). \quad -(22)$$

In vector notation, Eq. (22) is:

$$-\frac{1}{c}\frac{\partial \underline{q}^a}{\partial t} - \omega^a_{\ 0b}\underline{q}^b = -\underline{\nabla} q^a_{\ 0} + \underline{\omega}^a_{\ b} q^b_{\ 0}. \quad -(23)$$

With the definitions:

$$\omega^a_{\ \mu b} := \left(\frac{1}{c}\omega^a_{\ 0b}, -\underline{\omega}^a_{\ b} \right) \quad -(24)$$

and

$$\phi^a_{\ 0} = c q^a_{\ 0} \quad -(25)$$

$$p^a_{\ \mu} = \left(\frac{\phi^a_{\ 0}}{c}, -\underline{p}^a \right) - (26)$$

and using a single polarization model {1 - 10}:

$$-\frac{\partial \underline{p}}{\partial t} - \omega_0 \underline{p} = -\underline{\nabla}\phi + \underline{\omega}\phi. \quad -(27)$$

In the absence of a spin connection Eq. (27) becomes:

$$-\frac{\partial \underline{p}}{\partial t} = -\underline{\nabla}\phi \quad -(28)$$

which is the equivalence of gravitational and inertial mass, tested experimentally to one part in seventeen orders of magnitude. Therefore Eq. (27) is the generally covariant format of the equivalence theorem.

Therefore the familiar orbital velocity {12} of all the textbooks:

$$\underline{v} = \dot{r}\,\underline{e}_r + r\dot{\theta}\,\underline{e}_\theta \quad -(29)$$

and the orbital acceleration:

$$\underline{a} = \left(\ddot{r} - r\dot{\theta}^2\right)\underline{e}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\underline{e}_\theta \quad -(30)$$

are examples of ECE theory, which is based directly on Cartan's geometry {1 - 11}. Here $\underline{e}_r$ and $\underline{e}_\theta$ are the unit vectors of the plane polar system of coordinates {12}. The axes of the plane polar system are rotating, so there is present a geometrical connection as defined already. A geometrical connection means that these equations are equations of general relativity and are covariant under the general coordinate transformation because all equations of Cartan geometry are thus covariant. The fundamental origin of the centrifugal force is the spin connection generated by the rotation of axes. So the centrifugal force is missing from the Newton equations because the latter are defined with static axes. Newtonian dynamics has no centrifugal force to counter balance the inverse square law of attraction, actually discovered by Hooke and developed by Newton. Newtonian dynamics are therefore described by:

$$\underline{v} = \dot{r}\,\underline{e}_r, \quad -(31)$$

$$\underline{a} = \ddot{r}\,\underline{e}_r. \quad -(32)$$

In ECE theory the torsion gives two force equations in general, one due to orbital torsion, and one due to spin torsion:

$$\underline{F}(\text{orb}) = -\underline{\nabla}\phi - \frac{\partial \underline{p}}{\partial t} - \omega_0\,\underline{p} + \phi\,\underline{\omega} \quad -(33)$$

$$\underline{F}(\text{spin}) = \underline{\nabla} \times \underline{p} - \underline{\omega} \times \underline{p} \quad -(34)$$

Before proceeding to a general theory of planar orbital precession consider the radial vector in plane polar coordinates:

$$\underline{r} = r\,\underline{e}_r \quad -(35)$$

where the radial unit vector is defined as:

$$\underline{e}_r = \underline{i}\cos\theta + \underline{j}\sin\theta. \quad -(36)$$

The radial unit vector depends on the angle θ and rotates as θ changes. This is an important and fundamental point, a spin connection is generated by this rotation. The other unit vector of the plane polar system is defined by:

$$\underline{e}_\theta = -\underline{i}\sin\theta + \underline{j}\cos\theta \quad -(37)$$

and both unit vectors are time dependent, another fundamentally important point. So the Leibniz theorem must be used as follows:

$$\underline{v} = \frac{d\underline{r}}{dt} = \frac{dr}{dt}\underline{e}_r + r\frac{d\underline{e}_r}{dt}. \quad -(38)$$

From Eqs. (36) and (37):

$$\frac{d\underline{e}_r}{dt} = \frac{d\theta}{dt}\underline{e}_\theta = \omega\,\underline{e}_\theta \quad -(39)$$

where ω is the magnitude of the angular velocity in units of radians per second:

$$\omega = \frac{d\theta}{dt}. \quad -(40)$$

The angular velocity is a type of spin connection because it governs the rotation of $\underline{e}_r$ and $\underline{e}_\theta$. The orbital linear velocity is therefore:

$$\underline{v} = \frac{dr}{dt}\underline{e}_r + \omega r \underline{e}_\theta = \frac{dr}{dt}\underline{e}_r + \underline{\omega} \times \underline{r} = \frac{D\underline{r}}{dt} \quad -(41)$$

where D is an example of the Cartan covariant derivative as argued already. In vector notation the spin connection tem is $\underline{\omega}\times$.

Using the chain rule:

$$\frac{dr}{dt} = \frac{dr}{d\theta}\frac{d\theta}{dt} \quad -(42)$$

it is found that the velocity for any orbit is given by:

$$v^2 = \omega^2\left(\left(\frac{dr}{d\theta}\right)^2 + r^2\right) \quad -(43)$$

in which the angular momentum is a constant of motion {12}:

$$L = mr^2\omega \quad -(44)$$

So the magnitude of the spin connection is given by:

$$\omega = \frac{L}{mr^2} \quad -(45)$$

It follows that:

$$\left(\frac{dr}{d\theta}\right)^2 = \frac{v^2}{\omega^2} - r^2 \quad -(46)$$

and that the angular velocity and orbital linear velocity are related to the orbit dr / $d\theta$ by

$$\omega^2 = v^2\left(r^2 + \left(\frac{dr}{d\theta}\right)^2\right)^{-1}. \quad -(47)$$

This fundamental theory describes the main features of a whirlpool galaxy straightforwardly as follows, whereas it is well known that both Newton and Einstein fail completely to describe them. The all important property of the whirlpool galaxy was discovered in the late fifties. The orbital velocity of a star in the galaxy becomes constant as r becomes very large:

$$v \xrightarrow[r \to \infty]{} v_\infty \quad -(48)$$

where v_∞ denotes the constant observed velocity. In both the Newton and Einstein theories the orbital velocity falls to zero as r goes to infinity. This fact is sufficient to show that the Einstein theory fails to describe the totality of available data in astronomy. To claim that it succeeds in the solar system is empty, meaningless dogma. From Eq. (43):

$$v \xrightarrow[r \to \infty]{} \frac{L}{mr^2} \frac{dr}{d\theta} = v_\infty . \quad -(49)$$

Therefore:

$$\frac{d\theta}{dr} \xrightarrow[r \to \infty]{} \left(\frac{L}{m v_\infty} \right) \frac{1}{r^2} \quad -(50)$$

and

$$\theta \xrightarrow[r \to \infty]{} \frac{L}{m v_\infty} \int \frac{dr}{r^2} = -\left(\frac{L}{m v_\infty} \right) \frac{1}{r} \quad -(51)$$

which is the hyperbolic spiral orbit of the star as observed experimentally. It is concluded that any planar orbit in which the linear velocity becomes constant at infinite r must be a hyperbolic spiral, or Coats spiral, first investigated in the seventeenth century by Roger Coats.

The whirlpool galaxy is a dramatically visible manifestation of ECE dynamics, which reduces to the familiar kinematics of all the textbooks in the well defined circumstances discussed already. The whirlpool galaxy is a manifestation of spacetime torsion, as is instinctively apparent. Torsion is missing completely from the Einstein theory, which is why it fails completely to describe a whirlpool galaxy.

From Eqs. (46) and (50) as r becomes infinite:

$$\left(\frac{m v_\infty}{L}\right)^2 r^4 = \frac{v_\infty^2}{\omega^2} - r^2 \quad -(52)$$

so the spin connection magnitude (the angular velocity magnitude) becomes:

$$\omega \xrightarrow[r\to\infty]{} \frac{v_\infty}{r}\left(1 + \left(\frac{m v_\infty}{L}\right)^2 r^2\right)^{-1/2} \quad -(53)$$

However:

$$L = m r^2 \omega \quad -(54)$$

so:

$$\omega^2\left(1 + \left(\frac{v_\infty}{\omega r}\right)^2\right) \rightarrow \left(\frac{v_\infty}{r}\right)^2 \quad -(55)$$

i.e.

$$\omega \xrightarrow[r\to\infty]{} 0. \quad -(56)$$

The spin connection (i.e. angular velocity) goes to zero at infinite r for any planar orbit whose orbital velocity becomes constant at infinite r. This means that:

$$\underline{v} \rightarrow \underline{v}_\infty = \frac{dr}{dt}\,\underline{e}_r \quad -(57)$$

and the orbit becomes a straight line. This is again observed in astronomy, for example in photographs of a galaxy such as M51 as discussed in previous UFT papers.

The force law for the Coats spiral orbit of a star in a whirlpool galaxy in the infinite r limit may be obtained from the textbook Lagrangian {12}

$$\mathcal{L} = \frac{1}{2}m\left(\dot{r}^2 + r^2\dot{\theta}^2\right) - \phi(r) \quad -(58)$$

and the Euler Lagrange equations:

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\theta}} = \frac{\partial \mathcal{L}}{\partial \theta} = 0 \quad -(59)$$

and

$$\frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{r}} = \frac{\partial \mathcal{L}}{\partial r}. \quad -(60)$$

Eq. (2) gives conservation of angular momentum {12}:

$$L = \frac{\partial \mathcal{L}}{\partial \dot{\theta}} = mr^2\dot{\theta} = \text{constant} \quad -(61)$$

and Eq. (60) gives the equivalence of inertial and gravitational mass:

$$F(r) = m\left(\ddot{r} - r\dot{\theta}^2\right) = -\frac{\partial \phi}{\partial r}. \quad -(62)$$

Note that the fundamental kinematic result is:

$$\underline{a} = \left(\ddot{r} - r\dot{\theta}^2\right)\underline{e}_r \quad -(63)$$

because the Coriolis force:

$$\underline{F} = m\underline{a}_{Cor} = m\left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\underline{e}_\theta = \underline{0} \quad -(64)$$

vanishes in all planar orbits (see the accompanying notes 262(1) to 262(3)).

Now transform Eq. (62) using calculus. First use:

$$\frac{d}{d\theta}\left(\frac{1}{r}\right) = -\frac{1}{r^2}\frac{dr}{d\theta} = -\frac{1}{r^2}\frac{dr}{dt}\frac{dt}{d\theta}. \quad -(65)$$

From Eq. (61):

$$\frac{d\theta}{dt} = \frac{L}{mr^2} \quad -(66)$$

so:

$$\frac{d}{d\theta}\left(\frac{1}{r}\right) = -\frac{m}{L}\frac{dr}{dt}. \quad -(67)$$

Now use:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = \frac{d}{d\theta}\left(\frac{d}{d\theta}\left(\frac{1}{r}\right)\right) = -\frac{m}{L}\frac{d}{d\theta}\frac{dr}{dt}. \quad -(68)$$

Let:

$$f = \frac{d}{d\theta}\left(\frac{1}{r}\right) \quad -(69)$$

then:

$$\frac{df}{d\theta} = \frac{df}{dt}\frac{dt}{d\theta} \quad -(70)$$

so:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = -\frac{m^2r^2}{L^2}\frac{d^2r}{dt^2} \quad -(71)$$

Therefore

$$\ddot{r} = \frac{d^2r}{dt^2} = -\frac{L^2}{m^2r^2}\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) \quad -(72)$$

and

$$r\dot{\theta}^2 = \frac{L^2}{m^2 r^3} \quad -(73)$$

Therefore Eq. (62) can be transformed into:

$$\underline{F}(r) = F(r)\,\underline{e}_r \quad -(74)$$

where:

$$F(r) = -\frac{L^2}{mr^2}\left(\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r}\right). \quad -(75)$$

Eq. (75) can be used to find the force for any planar orbit. Note carefully that it is more general and more fundamental than Newton and Einstein. This is another key point. It has been argued already that it is an example of the generally covariant ECE theory. It is more general than any theory that asserts a force law a priori, and originates in the plane polar coordinates themselves, i.e. in geometry, an example of Cartan geometry. Both Newton and Einstein assert force laws a priori, and in fact Einstein is set up to reduce to Newton {11}.

Note carefully that in deriving the Coats spiral orbit (51) of a star in a whirlpool galaxy in the infinite r limit, nor force law was assumed or used. The force law can be calculated however form Eqs. (75) or (62). Use:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = 0 \quad -(76)$$

from Eq. (51), so:

$$F(r) = -\frac{L^2}{mr^3} \quad -(77)$$

and

$$\ddot{r} = \frac{d^2 r}{dt^2} = 0 \quad -(78)$$

so:

$$\frac{dv}{dt} = 0. \quad -(79)$$

The velocity becomes constant at infinite r as observed in astronomy.

The gravitational potential of the star in the infinite r limit is given by:

$$-\frac{\partial \phi}{\partial r} = -\frac{L^2}{mr^3} \quad -(80)$$

so:

$$\phi(r) = \int \frac{L^2}{mr^3} dr = -\frac{L^2}{2mr^2} \quad -(81)$$

which is qualitatively different from the Newton potential:

$$\phi(\text{Newton}) = -\frac{mMG}{r} \quad -(82)$$

and the Newton theory fails in a whirlpool galaxy. The Newton theory gives:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = \frac{m^2MG}{L^2} \quad -(83)$$

(Ref. (12), Eq. (7.73)). The Einstein theory also fails qualittaively in a whirlpool galaxy because it gives:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = \frac{m^2MG}{L^2} + \frac{3GM}{c^2r^2} \quad -(84)$$

(Eq. (7.74) of Ref. (12)).

Here M is the mass assumed to exist at the centre of the galaxy. If it were infinite (a dogmatic black hole of infinite obscurity) it is obvious that the right hand sides of both Eqs. (83) and (84) would go to infinity, an absurd result. It is well known {1 - 10}. that the existence of torsion completely negates black hole theory. Finally note carefully that M enters into the true Coats spiral orbit only through the reduced mass:

$$\mu = \frac{mM}{m+M} \qquad -(85)$$

which reduces to m, the mass of the star, for large M. So to an excellent approximation, M does not enter into the hyperbolic spiral orbit at all. Again this is completely non Newtonian and non Einsteinian. The Coats spiral orbit in the infinite r limit negates the concept of attraction between m and M, and the orbit is due purely to geometry.

It has been shown that the theory of planar orbits produces the force:

$$\underline{F}(r) = -\underline{\nabla}\phi = m(\ddot{r} - r\dot{\theta}^2)\underline{e}_r = -\frac{L^2}{mr^2}\left(\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r}\right)\underline{e}_r . \qquad -(86)$$

Unlike the Hooke / Newton theory, the outward centrifugal force is present in this analysis and it can be best understood by writing Eq. (86) as:

$$m\ddot{r} = F(r) + mr\dot{\theta}^2 . \qquad -(87)$$

The centrifugal force is:

$$\underline{F}_c = mr\dot{\theta}^2\underline{e}_r = mr\omega^2\underline{e}_r = \frac{L^2}{mr^3}\underline{e}_r \qquad -(88)$$

and ω is due to the Cartan spin connection as argued already. It clearly provides direct experimental evidence for the spin connection. Without the centrifugal force a mass m would fall into M in a direct line and there would be no orbit at all. So the inverse square law per se does not describe an orbit. The inverse square law is only part of the answer.

As soon as the geometry of orbits is considered, the angle θ enters in to the analysis, and therefore so does the spin connection and the centrifugal force.

The elliptical orbit discovered experimentally by Kepler is described by:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1 + \epsilon \cos\theta\right). \quad -(89)$$

It follows (see Note 262(4) for the details) that:

$$m\ddot{r} = \frac{L^2}{mr^3} - \frac{L^2}{\alpha m r^2} \quad -(90)$$

and that the force given by Eq. (86) is:

$$\underline{F} = -\frac{L^2}{\alpha m r^2}\,\underline{e}_r. \quad -(91)$$

The Hooke / Newton inverse square law is given by:

$$\underline{F} = -\frac{mMG}{r^2}\,\underline{e}_r \quad -(92)$$

i.e. by using the half right latitude {12}:

$$\alpha = \frac{L^2}{m^2 M G} \quad -(93)$$

so:

$$m\ddot{r} = \frac{L^2}{mr^3} - \frac{mMG}{r^2} \quad -(94)$$

which is what is usually taught as the balance of the outward centrifugal force and the inward inverse square law of attraction. This is why the orbit exists.

The orbits of planets in the solar system, and indeed all planar orbits known in astronomy precess. The precessing ellipse is defined most simply by:

$$\frac{1}{r} = \frac{1}{d}\left(1 + \epsilon \cos(x\theta)\right) \quad -(95)$$

when:

$$x \sim 1. \quad -(96)$$

Therefore:

$$m\ddot{r} = x^2\left(\frac{L^2}{mr^3} - \frac{L^2}{dmr^2}\right) \quad -(97)$$

and the force law is:

$$\underline{F} = -\underline{\nabla}\phi = \left((x^2-1)\frac{L^2}{mr^3} - \frac{x^2L^2}{dmr^2}\right)\underline{e}_r. \quad -(98)$$

This is non Einsteinian, the Einsteinian force is that of Eq. (84), and is also non Newtonian. It is however the direct and very fundamental result of geometry.

The hyperbolic spiral is given by Eq. (51), and in this case:

$$\underline{F} = -\underline{\nabla}\phi = -\frac{L^2}{mr^3}\underline{e}_r. \quad -(99)$$

The outward centrifugal force is always exactly counterbalanced by the inward force of attraction, and this is what is observed in a whirlpool galaxy. So if:

$$m\ddot{r} = \frac{L^2}{mr^3} - \frac{L^2}{mr^3} = 0 \quad -(100)$$

then:

$$\frac{dv}{dt} = \frac{d^2r}{dt^2} = 0 \quad -(101)$$

i.e.

$$\frac{dv_\infty}{dt} = 0 \quad -(102)$$

and as r becomes infinite:

$$v \xrightarrow[r \to \infty]{} v_\infty = \text{constant}. \quad -(103)$$

So it is easily possible to explain the velocity curve of a whirlpool galaxy from Eq. (99).

A possible solution of the anti symmetry law (27) is:

$$-\partial \underline{p} / \partial t = -\underline{\nabla} \phi \quad -(104)$$

$$-\omega_0 \underline{p} = \underline{\omega} \phi \quad -(105)$$

Eq. (104) is the equivalence principle as argued already, while Eq. (105) gives the centrifugal force:

$$-\omega_0 \underline{p} = \phi \underline{\omega} = m r \omega^2 \underline{e}_r. \quad -(106)$$

As described in Note 262(4) this analysis gives the spin connections:

$$\omega_0 = \frac{\omega r}{\left(r^2 + \left(\frac{dr}{d\theta} \right)^2 \right)^{1/2}} \quad -(107)$$

and

$$\underline{\omega} = \frac{m r \omega^2}{\phi} \underline{e}_r \quad -(108)$$

which are developed numerically in Section 3. The fact that the anti symmetry law gives the equivalence of inertial and gravitational mass is conclusive and very precise experimental evidence that the Christoffel connection is anti symmetric and that spacetime torsion always exists. Conversely the Einstein theorem collapses because it uses a symmetric connection.

So in the final part of this Section 2 it is demonstrated why the incorrect Einstein theory gives the illusion of accuracy in the solar system. This is obviously an illusion because the same Einstein theory fails completely in whirlpool galaxies. It cannot describe the totality of available data.

The turning point of a planar orbit is defined by:

$$m\frac{d^2r}{dt^2} = F(r) + \frac{L^2}{mr^3} = 0 \quad -(109)$$

so in the Newtonian theory defined by:

$$F(r) = -mMG/r^2 \quad -(110)$$

the turning point is at the half right latitude:

$$r = \alpha \quad -(111)$$

and occurs at the angle:

$$\cos\theta = 0, \quad \theta = \frac{\pi}{2}. \quad -(112)$$

The half right latitude is related to the perihelion r_{min} and aphelion r_{max} by:

$$\alpha = r_{min}(1+\epsilon) \quad -(113)$$

$$= r_{max}(1-\epsilon) \quad -(114)$$

where ϵ is the eccentricity.

In a precessing ellipse defined by Eq. (95), the turning point is again:

$$r = \alpha \quad -(115)$$

but now at the angle:

$$\cos(x\theta) = 0, \quad x\theta = \frac{\pi}{2}. \quad -(116)$$

So the advance in the angle due to the precession is:

$$\Delta\theta = x\theta - \theta \quad -(117)$$

In the Einstein theory, the force is given by Eq. (84) and the turning point defined by Eq. (109) is given by:

$$-\frac{mMG}{r^2} - \frac{3GML^2}{mc^2 r^4} + \frac{L^2}{mr^3} = 0 \quad -(118)$$

i.e. by:

$$r^2 - \alpha r + r_0 \alpha = 0 \quad -(119)$$

where:

$$r_0 = \frac{3MG}{c^2}. \quad -(120)$$

The solution of Eq. (119) is:

$$r = \frac{1}{2}\left(\alpha \pm \alpha\left(1 - \frac{4r_0}{\alpha}\right)^{1/2}\right). \quad -(121)$$

In the solar system:

$$4r_0 << \alpha \quad -(122)$$

to an excellent approximation, so:

so:

$$r \sim \frac{1}{2}\left(\alpha \pm \alpha\left(1 - \frac{2r_0}{\alpha}\right)\right) \quad -(123)$$

i.e.:

$$r = \alpha - r_0 \quad -(124)$$

or:

$$r = r_0. \quad -(125)$$

The experimental result for all precessions observed by astronomy is almost always claimed to be:

$$\Delta\theta = \frac{3MG}{ac^2(1-\epsilon^2)} \quad -(126)$$

where a is the semi major axis defined by:

$$\epsilon\alpha = a(1-\epsilon^2). \quad -(127)$$

The experimental result (126) is shown in the following analysis to be the result of:

$$r = \alpha - r_0 = \frac{\alpha}{1+\epsilon\cos\theta} \quad -(128)$$

i.e. is the equation of an ellipse at the turning point defined by:

$$r = \alpha - r_0. \quad -(129)$$

The change in angle from Eq. (128) can be easily calculated from:

$$\alpha = (\alpha - r_0)(1+\epsilon\cos\theta) \quad -(130)$$

so:

$$1 + \epsilon \cos\theta = \left(1 - \frac{r_0}{\alpha}\right)^{-1} \sim 1 + \frac{r_0}{\alpha} \quad -(131)$$

in the excellent approximation:

$$r_0 << \alpha. \quad -(132)$$

So:

$$1 + \epsilon \cos\theta = 1 + \frac{r_0}{\alpha} \quad -(133)$$

and the angle at the turning point is given by:

$$\cos\theta = \frac{r_0}{\epsilon\alpha}. \quad -(134)$$

Using a Maclaurin series:

$$\theta = \cos^{-1}\frac{r_0}{\epsilon\alpha} = \frac{\pi}{2} - \frac{r_0}{\epsilon\alpha} + \ldots \quad -(135)$$

The Newtonian result is:

$$\theta = \frac{\pi}{2}. \quad -(136)$$

So the shift in angle is:

$$\Delta\theta = \frac{r_0}{\epsilon\alpha} = \frac{3MG}{ac^2(1-\epsilon^2)} \quad -(137)$$

which is the experimental result, Q. E. D. For a point that has rotated by an angle θ, the shift is:

$$\Delta\theta = \left(\frac{3MG}{ac^2(1-\epsilon^2)}\right)\theta \quad -(138)$$

If: $$\theta = 2\pi \quad (139)$$

the shift is: $$\Delta\theta = \frac{6\pi MG}{ac^2(1-\epsilon^2)} \quad (140)$$

and this is the result given in ref. {12}, but after a hugely protracted and obscure calculation with several assumptions which have been extensively criticized in previous UFT papers.

The real reason for the experimentally claimed result (137) is ECE theory, there is simply a shift in the angular velocity or spin connection. At the turning point:

$$\omega = \frac{L}{m\alpha^2} \rightarrow \frac{L}{m(\alpha - r_0)^2} \quad (141)$$

In the excellent approximation: $$r_0 << \alpha \quad (142)$$

the spin connection changes by:

$$\omega \rightarrow \omega\left(1 + \frac{6MG}{\alpha c^2}\right) \quad (143)$$

to give the experimental result (137), Q. E. D.

So the precessing ellipse (95) gives the force law (98) and does not change the turning point from the Newtonian α . It changes the angle θ from θ to xθ. The Einstein theory changes the turning point from α to $\alpha - r_0$ but does not change the angle θ in the equation of the ellipse.

These results can be understood clearly and the Einstein method dramatically simplified by by the following analysis. In the Newton theory let:

$$r \rightarrow r + r_0 \quad -(144)$$

so that the force law becomes:

$$F = -\frac{mMG}{r^2} \rightarrow -\frac{mMG}{(r+r_0)^2} \sim -\frac{mMG}{r^2}\left(1 - 2\frac{r_0}{r}\right) \quad -(145)$$

in the excellent approximation:

$$r_0 << r \quad -(146)$$

so the Newtonian force is changed to:

$$F = -\frac{mMG}{r^2} + \frac{2mMG}{r^3} r_0 \quad -(147)$$

This has the same structure as the force law (98) from the precessing ellipse (95).

Compare Eqs. (98) and (147) with:

$$x \sim 1, \quad \alpha = \frac{L^2}{m^2 MG} \quad -(148)$$

to find that:

$$x^2 = 1 + 2\frac{r_0}{\alpha} \quad -(149)$$

in an excellent approximation. Using:

$$r_0 << \alpha \quad -(150)$$

then

$$x \sim 1 + \frac{r_0}{\alpha} \quad -(151)$$

It has been shown that if:

$$x = 1 + \frac{r_0}{\alpha} \quad -(152)$$

in Eq. (95) of the precessing ellipse, then this precessing elliptical orbit (95) is equivalent to the elliptical orbit (89) with:

$$r \rightarrow r + r_0 \quad -(153)$$

In other words:

$$r + r_0 = \frac{\alpha}{1 + \epsilon \cos\theta} \quad -(154)$$

is equivalent to:

$$r = \frac{\alpha}{1 + \epsilon \cos\left(\left(1 + \frac{r_0}{\alpha}\right)\theta\right)} \quad -(155)$$

Therefore a precessing elliptical orbit is obtained by replacing r by $r + r_0$ in the turning point equation (109), and wherever r occurs in the analysis of an elliptical orbit, e.g. in equations such as (145). So at the turning point:

$$r + r_0 = \alpha \quad -(156)$$

i.e.

$$r = \alpha - r_0 \quad -(157)$$

which is Eq. (124), the Einstein theory, Q. E. D.

The Einstein theory is therefore a hugely over complicated way of arriving at:

$$r \rightarrow r + r_0 \quad -(158)$$

which gives the claimed experimental result (157). The Einstein method is completely wrong because of neglect of torsion, and fails completely in whirlpool galaxies, whereas ECE succeeds easily in describing solar system precessions and the velocity curve and Coats spiral orbits of a whirlpool galaxy. Furthermore, we have severely criticized the experimental claim in UFT240, but in this paper UFT262 use the claim for the purpose of illustrating the fact that ECE theory can reproduce the data by simply adjusting the Cartan spin connection.

It is quite obvious that ECE is preferred over the Einstein theory, Q. E. D.

3. NUMERICAL ANALYSIS OF THE SPIN CONNECTION.

Section by Dr. Horst Eckardt.

ACKNOWLEDGMENTS

The British Government is thanked for the award of a Civil List Pension to MWE, and the staff of AIAS and others for interesting discussions. Dave Burleigh is thanked for posting, Alex Hill for translation and Robert Cheshire and Alex Hill for broadcasting.

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Turning point method of calculating orbital precession and the ECE antisymmetry law

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3 Numerical analysis of the spin connection

This is the calculation of the spin connections for a precessing ellipse and a hyperbolic spiral. For the ellipse we used the Newton potential, for the spiral a constant and a centrifugal potential. The scalar and vector spin connections are defined in general by Eqs.(107) and (108). The potential cannot be set to zero because it appears in the denominator of the vector spin connection.

The potential ϕ for an elliptic orbit is

$$\phi = -\frac{(\epsilon \cos(\theta\, x) + 1)\; L^2}{\alpha^2\, m} \tag{159}$$

and the spin connections (scalar connection and radial part of the vector connection) are

$$\omega_0 = \frac{(\epsilon \cos(\theta\, x) + 1)\; L}{\alpha\, m \sqrt{\frac{\alpha^2\, \epsilon^2\, x^2 \sin(\theta\, x)^2}{(\epsilon \cos(\theta\, x)+1)^4} + \frac{\alpha^2}{(\epsilon \cos(\theta\, x)+1)^2}}}, \tag{160}$$

$$\omega_r = -\frac{(\epsilon \cos(\theta\, x) + 1)^2}{\alpha}. \tag{161}$$

Both spin connections for an elliptic orbit are shown in Fig. 1. The orbit $r(\theta)$ itself is plotted for comparison. We see that for the elliptic orbit both spin connections are very similar but mirrored at the θ axis. The similarity is remarkable because the formulas are quite different. The shape of the spin connections is deviates from the orbit, see Fig 1.

The second figure (Fig. 2) is for a logarithmic spiral with $\phi = \text{const.} < 0$. The spiral is definde by

$$r = -\frac{\alpha}{\theta} \tag{162}$$

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and resulting spin connections are

$$\omega_0 = -\frac{\theta^3 L}{\alpha^2 m \sqrt{\theta^2+1}}, \tag{163}$$

$$\omega_r = \frac{\theta^3 L^2}{\phi_0 \alpha^3 m} \tag{164}$$

with constant ϕ_0. Because for a spiral the radius diverges at $\theta = 0$, we have to start at negative values of θ. It can be seen that the spin connections go to zero for $r \to \infty$ as to be expected since the orbit is a straight line then.

For the Fig. 3 we used

$$\phi = \frac{\phi_1}{r^2} \tag{165}$$

which mimics a repulsive centrifugal force. It follows

$$\omega_r = -\frac{\theta L^2}{\phi_1 \alpha m} \tag{166}$$

i.e. ω_r is a linear function now, crossing zero for $\theta = 0$ which is consistent with the asymptotic behaviour of the orbit again.

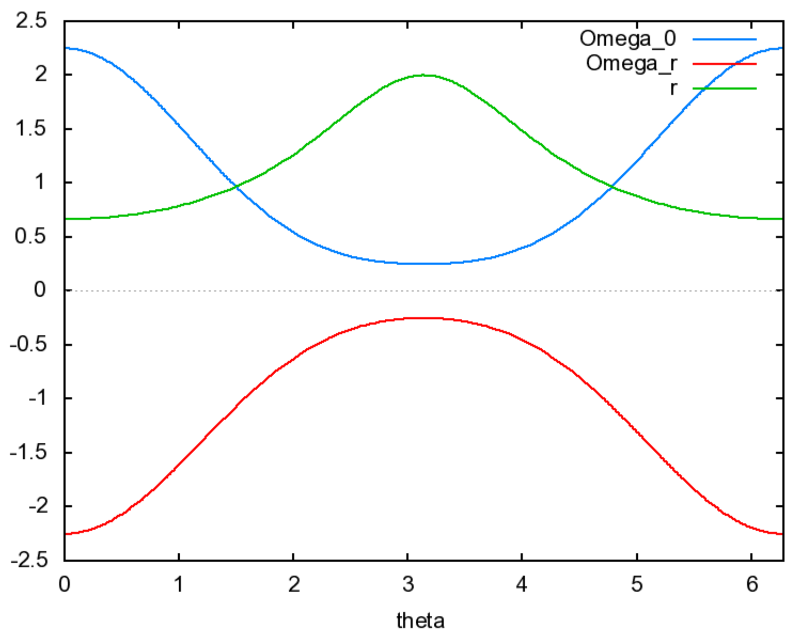

Figure 1: Spin connections and orbit for an ellipse with $x = 1, \epsilon = 0.5, \alpha = 1, L = 1, m = 1$.

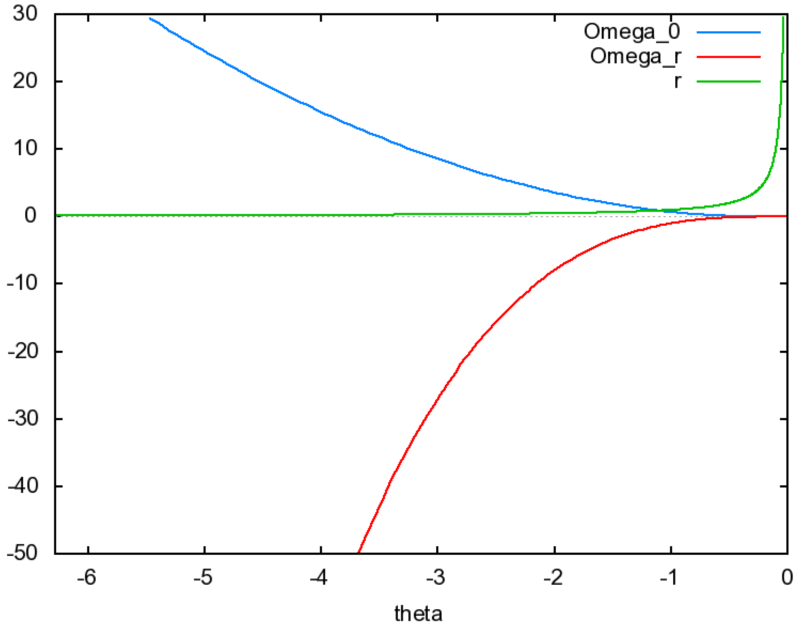

Figure 2: Spin connections and orbit for a hyperbolic spiral with $\alpha = 1, L = 1, m = 1, \phi = -1$.

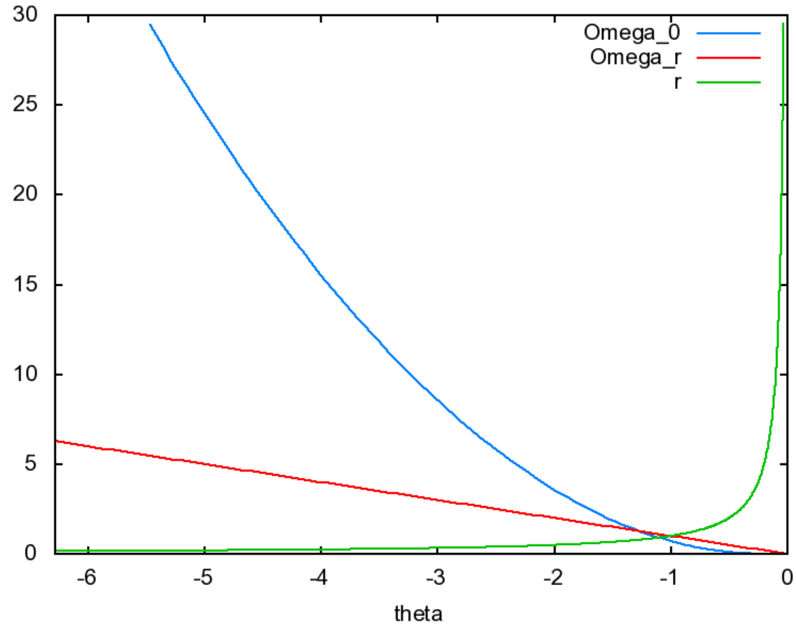

Figure 3: Same as Fig. 2 but with potential of Eq.(165), $\phi_1 = 1$.