ECE2 DYNAMICS IN A ROTATING FRAME DUE TO TORSION.

by

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ABSTRACT

The de Sitter rotation of a frame of reference is shown to have numerous effects on relativistic and non - relativistic dynamics within the context of ECE2 covariant unified field theory. On the classical level, it is shown that de Sitter frame rotation leads to orbital precession and orbital shrinkage, which are the main features of the Hulse Taylor binary pulsar. The complete ECE2 theory is relativistic and the de Sitter rotation produces relativist precession and many more features such as time dilation and length contraction, and in ECE2 relativity the de Sitter rotation is due to spacetime torsion. Frame rotation is shown to be the origin of several new vacuum effects.

Keywords: ECE2 relativity, classical theory of precession, vacuum effects due to de Sitter rotation.

UFT 411

1. INTRODUCTION

In the immediately preceding paper of this series {1 - 41}, the effect of de Sitter rotation on ECE2 relativity was considered. In that paper the angular velocity of the de Sitter rotation was considered to be the same as the angular velocity of an object m in orbit about an object M. In Section 2 of this paper this restriction is lifted, the angular velocity of de Sitter rotation is considered to be different from the orbital angular velocity. This development produces many new effects. The cause of the de Sitter rotation is spacetime torsion, the description of which rests on ECE2 relativity. However, it is shown that de Sitter rotation also leads to orbital precession and shrinkage on a classical level. These are the main features of the Hulse Taylor binary pulsar, produced without gravitational radiation. In the standard model these features are considered to be due to Einsteinian general relativity (EGR). However it is well known that EGR is riddled with errors and obscurities. In Section 2 several new refutations of EGR are demonstrated, so EGR is obsolete and can be replaced by ECE2 relativity, as is well known. The de Sitter rotation due to spacetime torsion produces an entirely new dynamics, both on the classical and ECE2 covariant theories. It is shown to produce vacuum effects through the spin connection, so a multiple cross correlation of concepts emerges. Several of these concepts have been developed in recent papers of this series.

This paper is a short synopsis of extensive calculations in the notes accompanying UFT411 on www.aias.us. Note 411(1) gives a universal law of precessions for orbits that can shrink due to non zero angular acceleration. Note 411(2) is a comprehensive summary of classical dynamics produced by de Sitter rotation, resulting in precessing conical section orbits such as a precessing ellipse. Therefore orbital precession can be described classically. Note 411(3) describes the theory of orbital precession combined with orbital shrinkage. Note 411(4) develops the ECE2 covariant theory of precession. Note 411(5) revels several new and basic flaws in EGR, so that there ae nearly a hundred refutations of EGR in the UFT series on www.aias.us. Since EGR fails by an order of magnitude in S2 star systems, as shown in UFT410, it has been quietly abandoned by leading astronomers. Note 411(6) develops the relativistic theory of rotation and dynamics under de Sitter rotation, and develops the spin connection and vacuum force of the ECE2 covariant theory to the angular velocity of frame rotation. In general this is different from the angular velocity of m about M.

2. CLASSICAL AND ECE2 RELATIVISTIC PRECESSION.

The de Sitter rotation is defined by:

$$\phi' = \phi + \omega_1 t \quad -(1)$$

where ϕ is the angle of the plane polar coordinates r and ϕ. Here ω_1 is the angular velocity of frame rotation and t is the time. In general ω_1 is not the same as the orbital angular velocity of m about M. The de Sitter rotation produces many new effects of dynamics and orbital dynamics, both on a classical and ECE2 relativistic level. A summary of the equations of dynamics in the rotating frame is given in Note 411(2). Quantities in the rotating frame are denoted by $'$. The unit vectors of the plane polar system in the rotating frame are:

$$\underline{e}_r' = \underline{i}\cos\phi' + \underline{j}\sin\phi' \quad -(2)$$

$$\underline{e}_\phi' = -\underline{i}\sin\phi' + \underline{j}\cos\phi' \quad -(3)$$

Note carefully that the Cartesian unit vectors are fixed and do not change under the de Sitter rotation. In the rotating frame:

$$\frac{d\underline{e}_r'}{d\phi'} = \underline{e}_\phi' \quad -(4)$$

and

$$\frac{d\underline{e}_\phi'}{d\phi'} = -\underline{e}_r' \quad -(5)$$

$$\dot{\underline{e}}_r = \dot{\phi}' \underline{e}_\phi \quad -(6)$$

$$\dot{\underline{e}}_\phi = -\dot{\phi}' \underline{e}_r \quad -(7)$$

and in general:

$$\underline{r}' = r' \underline{e}_r'. \quad -(8)$$

The infinitesimal line element of ECE2 relativity prior to de Sitter rotation is:

$$ds^2 = c^2 d\tau^2 = c^2 dt^2 - dr^2 - r^2 d\phi^2 = dt^2 (c^2 - v_N^2) \quad -(9)$$

where v_N is the Newtonian velocity. Eq. (1) is applied to Eq. (9) so:

$$ds'^2 = c^2 d\tau'^2 = c^2 dt^2 - dr^2 - r^2 d\phi'^2 \quad -(10)$$

It follows that:

$$r = r'. \quad -(11)$$

The linear velocity of the rotating frame is:

$$\underline{v}' = \frac{d\underline{r}'}{dt} = \frac{dr}{dt} \underline{e}_r' + r \frac{d\underline{e}_r'}{dt} \quad -(12)$$

so:

$$v'^2 = \left(\frac{dr}{dt}\right)^2 + r^2 \left(\frac{d\phi'}{dt}\right)^2 \quad -(13)$$

in which:

$$d\phi' = d\phi + \omega_1 dt. \quad -(14)$$

The rotating frame Lagrangian is:

$$\mathcal{L}' = \frac{1}{2}\mu\left(\dot{r}^2 + r^2\dot{\phi}'^2\right) - U(r) \quad -(15)$$

where μ is the reduced mass:

$$\mu = \frac{mM}{m+M} \quad -(16)$$

of an object m in orbit about M. The gravitational potential energy is:

$$U = -\frac{mMG}{r}. \quad -(17)$$

The rotating frame Euler Lagrange equations are:

$$\frac{\partial \mathcal{L}'}{\partial \phi'} = \frac{d}{dt}\frac{\partial \mathcal{L}'}{\partial \dot{\phi}'} \quad -(18)$$

and

$$\frac{\partial \mathcal{L}'}{\partial r} = \frac{d}{dt}\frac{\partial \mathcal{L}'}{\partial \dot{r}}. \quad -(19)$$

Eq. (18) gives the conserved angular momentum:

$$L' = \mu r^2 \dot{\phi}' \quad -(20)$$

and Eq. (19) gives the Leibniz equation in the rotating frame:

$$\mu\left(\ddot{r} - r\dot{\phi}'^2\right) = -\frac{\partial U}{\partial r} + \Omega U = F'(r) \quad -(21)$$

The force in the rotating frame is considered to be:

$$\underline{F}' = -\underline{\nabla} U + \underline{\Omega} U \quad -(22)$$

where Ω is the modulus of the vector spin connection. The gravitational potential energy U is a scalar and is frame independent.

Therefore Eq. (1), is considered to be the origin of the spin connection and the modulus of the vacuum force:

$$\underline{F}'(\mathrm{vac}) = \underline{\Omega}\, U \quad -(23)$$

This is a new hypothesis of ECE2 theory.

Eq. (21) can be expressed as the Binet equation in the rotating frame:

$$\frac{d^2}{d\phi'^2}\left(\frac{1}{r}\right) + \frac{1}{r} = -\frac{\mu r^2}{L'^2} F'(r) \quad -(24)$$

The angular velocity in the rotating frame is:

$$\omega' = \frac{d\phi'}{dt} = \frac{d\phi}{dt} + \frac{d}{dt}(\omega_1 t) = \omega + \omega_1 + t\frac{d\omega_1}{dt} \quad -(25)$$

where ω is the orbital angular velocity and ω_1 is the angular velocity of frame rotation. For one orbit t is the time T taken to complete one orbit. The angular momentum in the rotating frame is a constant of motion:

$$L' = \mu r^2 \omega' \quad -(26)$$

so for one complete orbit:

$$L' = \mu r^2 \left(\omega + \omega_1 + T\frac{d\omega_1}{dt}\right) \quad -(27)$$

is a constant. If the angular acceleration $d\omega_1/dt$ is non zero, ω' increases with time, and so r must decrease with time. The orbit must shrink as observed for example in the Hulse Taylor binary pulsar. Gravitational radiation is not necessary for an orbit to shrink.

The hamiltonian in the rotating frame is a constant of motion given by:

$$H' = \frac{1}{2}\mu \dot{r}^2 + \frac{1}{2}\frac{L'^2}{mr^2} + U(r) \quad -(28)$$

and results in the rotating frame conic section for example an ellipse:

$$r = \frac{\alpha'}{1+\epsilon' \cos\phi'} . \quad -(29)$$

Here:

$$\alpha' = \frac{L'^2}{\mu m M G} \quad -(30)$$

is the half right latitude in the rotating frame:

$$\phi' = \phi + \omega_1 t \quad -(31)$$

and

$$\epsilon' = \left(1 + \frac{2H'L'^2}{\mu (mMG)^2} \right)^{1/2} \quad -(32)$$

is the eccentricity in the rotating frame.

Therefore the de Sitter rotation (1) produces the orbit:

$$r = \frac{\alpha'}{1+\epsilon' \cos(\phi + \omega_1 t)} . \quad -(33)$$

For one complete orbit of 2π radians, the precession of the orbit is defined as:

$$\Delta\phi = 2\pi - (2\pi - \omega_1 T) = \omega_1 T . \quad -(34)$$

The classical precession is the angular velocity of frame rotation ω_1 multiplied by the time T taken for one orbit:

$$\Delta\phi(\text{classical}) = \omega_1 T \quad -(35)$$

This is named the universal law of classical precession.

The orbital linear velocity in the rotating frame is:

$$v_N^{2\,\prime} = \frac{n\,m\,G}{\mu}\left(\frac{2}{r} - \frac{1}{a^{\prime}}\right) \quad -(36)$$

where $a^{\prime}$ is the semi major axis of the ellipse in the rotating frame:

$$a^{\prime} = \frac{\alpha^{\prime}}{1-\epsilon^{\prime 2}}. \quad -(37)$$

Eq. (36) is the square of the Newtonian velocity in the rotating frame:

$$v_N^{\prime 2} = \left(\frac{dr}{dt}\right)^2 + r^2\left(\frac{d\phi^{\prime}}{dt}\right)^2 = \left(\frac{dr}{dt}\right)^2 + r^2\left(\omega + \omega_1 + T\frac{d\omega_1}{dt}\right)^2 \quad -(38)$$

for one complete orbit.

In Note 411(5) the simple and elegant law (35) is compared with the much more complicated EGR. Complete details are given in Note 411(5) of the usual EGR theory, which is based on the Binet equation:

$$\frac{d^2u}{d\phi^2} + u = \frac{1}{\alpha} + \delta u^2. \quad -(39)$$

Here:

$$u = \frac{1}{r}, \quad \frac{1}{\alpha} = \frac{n^2 m G}{L^2}, \quad \delta = \frac{3mG}{c^2}. \quad -(40)$$

This method is used for example in a textbook such as Marion and Thornton, chapter 7.9, third edition of "Classical Dynamics of Particles and Systems" {1 - 41}. As shown in Note 411(5), closer scrutiny of this method reveals several fundamental problems as follows:

1) The method of successive approximation is valid if and only if:

$$\frac{\delta}{\alpha^2} << 1 \quad -(41)$$

and for large M and small α this is no longer true.

2) In the first approximation the method gives:

$$u = \left[\frac{1}{\alpha} \left(1 + \epsilon \cos\phi \right) + \frac{\delta\epsilon}{\alpha^2} \phi \sin\phi \right] + \left[\frac{\delta}{\alpha^2} \left(1 + \frac{\epsilon^2}{2} \right) - \frac{\delta\epsilon^2}{6\alpha^2} \cos 2\phi \right] \quad -(42)$$

and this is not in general a precessing orbit. This can be shown directly by graphing Eq. (42).

The EGR theory collapses at this point, but special pleading is given on page 269 of Marion and Thornton to try to rescue the situation. This is reproduced in Note 411(5). Marion and Thornton isolate the secular orbit:

$$u_s = \frac{1}{\alpha} \left(1 + \epsilon \cos\phi \right) + \frac{\delta\epsilon}{\alpha^2} \phi \sin\phi \quad -(43)$$

in which the term

$$u_c = \frac{\delta\epsilon}{\alpha^2} \phi \sin\phi \quad -(44)$$

is added to the Newtonian orbit, the first term on the right hand side of Eq. (43). The correction term:

$$u_c = \frac{\delta\epsilon}{\alpha^2} \phi \sin\phi \quad -(45)$$

can be graphed using Maxima. By inspection, it is seen that:

$$u_c \xrightarrow[\phi \to \infty]{} \infty \quad -(46)$$

because:

$$0 \leq \sin\phi \leq 1. \quad -(47)$$

EGR collapses completely at this point because there is no upper bound on ϕ. In other words, after a sufficient number of orbits, the correction term goes to infinity, reductio ad absurdum.

3) EGR protagonists are either not aware of these major errors, or just ignore them for the sake of dogma. This is a crude violation of science. The method used is to implement:

$$1+\epsilon\cos\left(\phi\left(1-\delta/\alpha\right)\right)=1+\epsilon\left(\cos\phi\cos\frac{\delta}{\alpha}\phi+\sin\phi\sin\frac{\delta}{\alpha}\phi\right)$$
$$\sim 1+\epsilon\cos\phi+\frac{\delta\epsilon}{\alpha}\phi\sin\phi \quad -(48)$$

with the assumption that for small δ/α:

$$\cos\left(\frac{\delta}{\alpha}\phi\right)\sim 1, \quad -(49)$$

and

$$\sin\left(\frac{\delta}{\alpha}\phi\right)\sim\frac{\delta}{\alpha}\phi, \quad -(50)$$

so the EGR orbit becomes:

$$u_s\sim\frac{1}{\alpha}\left(1+\epsilon\cos(x\phi)\right), \quad x=1-\frac{\delta}{\alpha}. \quad -(51)$$

However, the correction term (45) is still present in Eq. (48), and the singularity still remains. The method of arriving at Eq. (51) is therefore completely incorrect.

4) The usual EGR equation (51) is an example of the x theory of ECE, in which the orbit is:

$$r=\frac{\alpha}{1+\epsilon\cos(x\phi)}. \quad -(52)$$

It is known from previous UFT papers on x theory that Eq. (52) gives very intricate results which are not physically observable orbits. These functions are of interest to pure mathematics only. These functions reduce to a precessing orbit if and only if:

$$x - 1 \longrightarrow 0 \quad -(53)$$

At this point EGR collapses again. The dogmatists ignore the mathematics and argue that for one orbit:

$$\phi\left(1 - \frac{\delta}{\alpha}\right) = 2\pi \quad -(54)$$

so:

$$\phi = \frac{2\pi}{1 - \frac{\delta}{\alpha}} \sim 2\pi\left(1 + \frac{\delta}{\alpha}\right) \quad -(55)$$

for small δ / α. Finally the dogmatists arrive at the EGR precession:

$$\Delta \phi = 2\pi \frac{\delta}{\alpha} = \frac{6\pi M G}{\alpha c^2} \quad -(56)$$

and go on to claim that this incorrect equation must always be very precise, reductio ad absurdum. In UFT410 it was shown that there are no data in the solar system with which to test Eq. (56) with any accuracy. Marion and Thornton use results for three planets, results which show vague "agreement". In the S2 star system Eq. (56) fails by an order of magnitude. Eq. (56) also fails completely in the Hulse Taylor binary pulsar. It gives entirely the wrong precession and does not result in a shrinking orbit. It obviously does not give gravitational radiation. In order to arrive at the mythical "precise agreement", the dogmatists invoke the non linear Einstein field equation. This method was shown in 1936 by Einstein himself NOT to give gravitational radiation. So the dogmatists either seem to be unaware of this work by Einstein or again ignore his mathematics in order to claim perfect precision.

Finally in this section consider the rotated infinitesimal lime element:

$$ds'^2 = c^2dt^2 - dr^2 - r^2 d\phi'^2$$
$$= c^2dt^2 - dr^2 - r^2 d\phi^2 - 2\omega_1 r^2 d\phi\, dt - \omega_1^2 r^2 dt^2$$
$$-(57)$$

with Eq. (1):

$$d\phi'^2 = (d\phi + \omega_1 dt)^2. \quad -(58)$$

Using the orbital angular velocity:

$$\omega = \frac{d\phi}{dt} \quad -(59)$$

Eq. (57) becomes

$$ds'^2 = \left(1 - \frac{v^2}{c^2}\right) c^2 dt^2 = c^2 d\tau'^2$$
$$-(60)$$

where

$$v^2 = v_N^2 + r^2\left(\omega_1^2 + 2\omega\omega_1\right) \quad -(61)$$

This result generalizes the theory of UFT410, in which it was assumed that:

$$\omega_1 = \omega. \quad -(62)$$

Similarly for

$$\phi' = \phi - \omega_1 t \quad -(63)$$

Eq. (10) is obtained with

$$v^2 = v_N^2 + r^2\left(\omega_1^2 - 2\omega\omega_1\right).$$
$$-(64)$$

As in UFT410 the ECE2 covariant precession is:

$$\Delta \phi = 2\pi \frac{v^2}{c^2} \quad -(65)$$

while the modulus of the classical precession is:

$$|\Delta \phi|_{classical} = \omega_1 T \quad -(66)$$

The relativistic, rotating frame, hamiltonian corresponding to the result (65) is:

$$H' = \gamma' mc^2 + U(r) \quad -(67)$$

and the relativistic, rotating frame, Lagrangian is:

$$\mathcal{L}' = -\frac{mc^2}{\gamma'} - U(r) \quad -(68)$$

For self consistency, Eqs. (65), (67) and (68) must give the same precession. In previous UFT papers it has been shown that the static frame hamiltonian and Lagrangian also give precessing orbits. The classical precession (66) is a limit of the relativistic precession. In the static frame this limit is defined by:

$$v_N / c \ll 1 \quad -(69)$$

in which the Newtonian velocity very small in comparison with c.

In Note 311(6) the Newtonian force equation in the rotating frame is considered to be:

$$\underline{F}' = m\underline{g}' = -mMG\frac{\underline{r}}{r^3} + \underline{\Omega}\, U \quad -(70)$$

i.e. the frame rotation is considered to introduce the spin connection $\underline{\Omega}$ of the ECE2 covariant theory. This concept is consistent with the fact that the frame rotation is considered to be due to the spacetime torsion, which is defined in terms of the spin connection. The component equations of Eq. (70) can be solved simultaneously to produce precession. These are described in Note 411(6). The analysis can be extended straightforwardly to plane polar coordinates. The rotating frame force equation is:

$$F' = m\ddot{r} - \frac{L'^2}{mr^3} = -\frac{mG}{r^2} + \Omega r \quad -(71)$$

where:

$$L' = mr^2 \frac{d}{dt}\left(\phi + \omega_1 t\right) \quad -(72)$$

so the spin connection magnitude Ω can be related to the angular velocity of rotation of the frame, ω_1. The vacuum force is:

$$F'(\mathrm{vac}) = \Omega r \quad -(73)$$

and using the methods developed in recent UFT papers can be expressed in terms of isotropically averaged vacuum fluctuations and a development of Lamb shift theory.

3. GRAPHICAL RESULTS AND DISCUSSION

Section by Dr. Horst Eckardt.

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