ECE2 APSIDAL AND LARMOR CALCULATION OF PRECESSION DUE TO ROTATION (LENSE THIRRING EFFECT).

by

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ABSTRACT

The apsidal method developed in UFT403 is applied to precession due to a rotating object such as the Earth, and the spin connection found by equating the apsidal and Larmor precessions of UFT345. In the standard physics this effect is known as Lense Thirring precession, but the standard model's development of precession due to rotation is rejected by the large ECE2 school of physics.

Keywords: ECE2 theory, precession due to rotation, apsidal and Larmor methods.

UFT404

1. INTRODUCTION

In the immediately preceding paper of this series {1 - 41}, UFT403, the apsidal method was developed to describe orbital precession in ECE2 physics. In Section 2 the apsidal method is used to calculate the precession due to a rotating object, and the result equated with the precession found from the Larmor method of UFT345, using the gravitomagnetic field. The spin connection can be found using this method, and the vacuum fluctuation which is the cause of precession due to rotation In the standard model this type of precession is known as the Lense Thirring precession, but the methods of the standard model in this and many other context are rejected as incorrect by the ECE2 school of thought.

This paper is a concise summary of extensive calculations in the notes accompanying UFT404 on www.aias.us. Note 404(1) summarizes the basic equations used in the Larmor and apsidal methods, and summarizes the well known calculations that lead to the apsidal method of UFT403. Notes 404(2) to 404(4) are not used and should be viewed as preliminary ideas. Section 2 of this paper is based on Note 404(5).

2. CALCULATION OF THE SPIN CONNECTION.

The apsidal method of calculating orbital precession is derived in detail in Note 404(1) in the near circular approximation of small eccentricity. The apsidal angle is the angle between two consecutive turning points of the orbit and is:

$$\phi = \pi \left(3 + \frac{r F'(r)}{F(r)} \right)^{-1/2} \quad - (1)$$

from the calculation of Note 404(1), where:

$$F = |\underline{F}| = mg, \quad - (2)$$

$$\underline{F} = -\underline{\nabla}\phi + \underline{\omega}\phi, \quad - (2a)$$

and:

$$F' = \frac{dF}{dr} . \quad -(3)$$

From Eqs. (1) and (3) it is possible to calculate the apsidal angle for any scalar gravitational potential ϕ and spin connection vector $\underline{\omega}$.

In general this method can be used for any precession, for example: planetary, precession due to rotation, the Thomas precession and equinoctial precession. The precession named after de Sitter in standard physics can also be calculated in ECE2 physics, which describes all precessions correctly with incorporation of both curvature and torsion.

Immediately preceding UFT papers have shown that any apsidal precession in radians can be expressed in terms of the magnitude ω of the spin connection:

$$\Delta\phi = \frac{r^2}{2}\left(\frac{\omega}{r} - \frac{\partial\omega}{\partial r}\right) \quad -(4)$$

where the acceleration due to gravity is defined by the ECE2 covariant equation:

$$\underline{g} = -\underline{\nabla}\phi + \underline{\omega}\phi \quad -(5)$$

and where:

$$\phi = -\frac{MG}{r} \quad -(6)$$

is the gravitational potential

$$U = m\phi . \quad -(7)$$

The gravitational acceleration due to the vacuum is:

$$\underline{g}(vac) = \underline{\omega}\phi . \quad -(8)$$

In UFT345 it was shown that the precession due to rotation in radians per second (known in standard physics as the Lense Thirring precession) is half the magnitude of the gravitomagnetic field $\underline{\Omega}$ of the Earth:

$$\Delta\phi = \frac{1}{2}|\underline{\Omega}|. \quad -(9)$$

This is a simple and powerful result of ECE2 covariant gravitomagnetism. The precession per year in radians is defined by:

$$\Delta\phi = \frac{1}{2}|\underline{\Omega}|t, \quad -(10)$$

$$t = \text{one year} = 3.156 \times 10^{7} s. \quad -(11)$$

The gravitomagnetic field of the Earth was defined in UFT345 as:

$$\underline{\Omega} = \frac{2}{5}\frac{MGR^2}{c^2 r^3}\left(\underline{\omega}_E - 3\underline{n}\left(\underline{\omega}_E \cdot \underline{n}\right)\right) \quad -(12)$$

where M is the mass of the Earth, R its radius, r the distance of Gravity Probe B to the centre of the Earth, and

$$\underline{\omega}_E = \omega_E \underline{k} \quad -(13)$$

is the angular velocity vector of the Earth which is assumed to rotate about $\underline{k}$. As shown in UFT345 the gravitomagnetic field of the Earth is:

$$\underline{\Omega} = \frac{2}{5}\frac{MGR^2\omega_E}{c^2 r^3}\left(\left(1 - \frac{3Z^2}{r^2}\right)\underline{k} - \frac{3YZ}{r^2}\underline{j}\right) \quad -(14)$$

and its magnitude is:

$$\Omega = \frac{MGR^2\omega_E}{5c^2 r^3}\left(\left(1 - 3\sin^2\theta\right)^2 + 9\sin^2\theta\cos^2\theta\right)^{1/2}. \quad -(15)$$

The quantities used in the calculation are as follows:

$$
\begin{aligned}
\underline{M} &= 5.98 \times 10^{24}\ \mathrm{kg} \\
R &= 6.37 \times 10^{6}\ \mathrm{m} \\
r &= 7.02 \times 10^{6}\ \mathrm{m} \\
c &= 2.998 \times 10^{8}\ \mathrm{m\,s^{-1}} \\
G &= 6.67 \times 10^{-11}\ \mathrm{m^{3}\,kg^{-1}\,s^{-2}} \\
\omega_E &= 7.292 \times 10^{-5}\ \mathrm{rad\,s^{-1}}
\end{aligned}
\qquad -(16)
$$

The earth's gravitomagnetic field $\underline{\Omega}$ produces a torque:

$$\underline{Tq} = \underline{m} \times \underline{\Omega} \qquad -(17)$$

on the gyroscopes of Gravity Probe B. The gyroscopes are currents of mass and set up the gravitomagnetic dipole moment $\underline{m}$. The torque produces the Larmor precession frequency

$$\Omega = \frac{1}{2} |\underline{\Omega}| \qquad -(18)$$

in radians per second.

At the equator:

$$\underline{\omega}_E \cdot \underline{n} = 0 \qquad -(19)$$

so:

$$\Omega = 99 \text{ milliarcseconds a year} \qquad -(20)$$

in milliarcseconds per year, which compares with the experimental claim for Lense Thirring precession from Gravity Probe B:

$$\Omega = 37.2 \text{ milliarcseconds a year.} \qquad -(21)$$

This is a dubious experimental claim because there is no way of distinguishing experimentally between the de Sitter precession and Lense Thirring precession without relying on the theory that Gravity Probe B set out to prove. This was first pointed out in

UFT345. It is well known that de Sitter precession is due to the mass of the Earth, and Lense Thirring precession is due to the rotation of the mass of the Earth. Clearly, both effects are always present simultaneously, so any experiment measures a combination of both effects.

So Gravity Probe B assumed the theory it was trying to prove, and did not measure the de Sitter (geodetic) and Lense Thirring (frame dragging) effects ab initio.

It is possible to obtain clos er agreement with the experimental claim using Eq. (15) and the methods of UFT345, and that is as much as can be done in the present state of the art. The large and permanent ECE School of physics rejects the standard model's Einstein field equation because it was derived without consideration of torsion and as the classic UFT88 shows, becomes totally different when torsion is considered. The well known scientometrics on www.aias.us show that UFT88 has been consulted tens of thousands of times in several hundred of the world's best universities, institutes and similar, for over a decade. So Einsteinian general relativity is obsolete dogma.

In order to find the spin connection we use:

$$\Delta \phi = \frac{r^2}{2}\left(\frac{\omega}{r} - \frac{\partial \omega}{\partial r}\right) = \frac{1}{2}|\Omega| t \quad -(22)$$

where t is one year:

$$t = 3.156 \times 10^{7} \text{ seconds.} \quad -(23)$$

The apsidal method calculates a precession in radians per orbit of Gravity Probe B. The time taken for Gravity Probe B to complete one orbit was ninety minutes. NASA / Stanford reported their results on Cornell's arXiv in milliarcseconds per year. However, it is assumed in Eq. (22) that the two precessions are equal after conversion from radians per ninety minutes to millarcseconds per year.

Therefore:

$$\Delta\phi = \frac{r^2}{2}\left(\frac{\omega}{r} - \frac{\partial\omega}{\partial r}\right) = 1.794 \times 10^{-7} \text{ radians per year} \quad -(24)$$

where the experimental claim of 37.2 milliarcseconds per year has been converted to radians per year. From UFT403:

$$\Delta\phi = \frac{1}{3}\left(4\frac{\langle \delta\underline{r}\cdot\delta\underline{r}\rangle}{r^2} - \frac{1}{r}\frac{\partial}{\partial r}\left(\langle \delta\underline{r}\cdot\delta\underline{r}\rangle\right)\right). \quad -(25)$$

In the limit of an exactly circular orbit:

$$\Delta\phi = 0 \quad -(26)$$

so as shown in UFT403:

$$\frac{\partial}{\partial r}\langle \delta\underline{r}\cdot\delta\underline{r}\rangle \sim \frac{4}{a}\langle \delta\underline{r}\cdot\delta\underline{r}\rangle \quad -(27)$$

where a is the semi major axis. The orbit of Gravity Probe B was almost exactly circular with

$$\begin{aligned} a &= 7.0274 \times 10^6 \text{ m} \\ b &= 7.02739 \times 10^6 \text{ m} \quad -(28) \\ \epsilon &= 0.0014 \end{aligned}$$

where a is the semi major axis, b is the semi minor axis and ϵ is the eccentricity, so Eq. (27) is an excellent approximation. If r is chosen to be the perihelion:

$$r = \frac{d}{1+\epsilon} \sim \frac{a}{1+\epsilon} \quad -(29)$$

then:

$$\frac{\langle \delta\underline{r}\cdot\delta\underline{r}\rangle^{1/2}}{a} = 0.098 \quad -(30)$$

so the root mean square vacuum fluctuation is about 10% of a.

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