THE PRECESSING ORBIT OF ECE FLUID DYNAMICS

by

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ABSTRACT

The Binet equation of ECE fluid dynamics is used to derive a precessing planar orbit which can be compared with the general planar orbit derived in UFT328 by simultaneous solution of the hamiltonian and lagrangian of ECE2 relativity. A three dimensional lagrangian analysis is used to show that the Coriolis accelerations of any planar orbit vanish as a result of a central potential. This is the origin of the Leibnitz equation of orbits. The methods are illustrated with the motion of stars in a whirlpool galaxy.

Keywords: ECE2 fluid dynamics, precessing orbit, motion of stars in a whirlpool galaxy.

UFT 365

1. INTRODUCTION

Recently in this series of papers and books {1 - 12} it has been shown that ECE fluid dynamics applied to orbits results in a modified Binet equation in which the effect of the vacuum is analyzed by the presence of a well defined spin connection. In Section 2 of this paper a three dimensional lagrangian analysis is used to show that the vacuum, represented by the spin connection, results in a precessing planar orbit as observed experimentally. The experimental observations can be used to measure the spin connection. The essential method is to replace classical dynamics by fluid dynamics. The fluid is the vacuum or aether, and in ECE2 is defined by Cartan geometry. The precessing orbit derived analytically in this way is compared with the general precessing orbit derived numerically in UFT328 by simultaneous solution of the ECE2 lagrangian and hamiltonian. The methods are illustrated by an analysis of the motion of stars in a whirlpool galaxy. These can be outwards or inwards depending on basic definitions. Finally the force law of the precessing orbit is found from the modified Binet equation.

This paper is a brief synopsis of detailed calculations found in the notes accompanying UFT365 on www.aias.us . Note 365(1) defines the relevant three dimensional lagrangians for relativistic and non relativistic motion, note 365(2) analyzes the modified Binet equation, note 365(3) is the first step of an iterative procedure in which the force law of the precessing orbit is an inverse square law in the first approximation. The latter defines the precessing ellipse in terms of a spin connection of ECE2 fluid dynamics. Note 365(4) shows that the Coriolis accelerations vanish for any planar orbit in conventional dynamics as the result of assuming a central potential of any kind. Note 365(5) illustrates the methods used in this paper by analyzing the motions of stars in a whirlpool galaxy. Finally Note 365(6) defines the force law for the precessing ellipse as the second step of the iterative procedure of

Note 365(3).

2. DERIVATION OF THE PRECESSING ORBIT

Consider the Binet equation of ECE2 fluid dynamics derived in UFT363:

$$\left(1+\Omega^1{}_{01r}\right)\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right)+\frac{1}{r}=-\frac{m^2r^2}{L^2}F(r) \quad -(1)$$

in which the spin connection represents the effect of the vacuum, aether, or spacetime and is defined by:

$$\Omega^1{}_{01r}=\frac{\partial R_r}{\partial r}. \quad -(2)$$

The plane polar coordinate system (r, θ) is used in Eq. (1) for a mass m orbiting a mass M. Here L is the constant angular momentum of the system and G is Newton's constant. In Eq. (2) the position of an element of the fluid spacetime is defined by:

$$\underline{R}=\underline{R}\left(r(t),\theta(t),t\right). \quad -(3)$$

In deriving Eq. (1) it was assumed that:

$$\frac{\partial\underline{R}}{\partial\theta}\sim 0 \quad -(4)$$

in the first approximation. More generally $\underline{R}$ is a function of r(t) and $\theta(t)$. In the orbital theory of classical dynamics:

$$\Omega^1{}_{01r}=0. \quad -(5)$$

In the first approximation assume that

$$F(r) \sim -\frac{mMG}{r^2} \quad -(6)$$

in Eq. (1), i.e. that the force is a central inverse square law. Assume that the orbit is the precessing ellipse:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1+\epsilon\cos\left(f(r)\theta\right)\right) \quad -(7)$$

where f(r) is a function to be determined. For very small precessions such as those in the solar system, the orbit is an ellipse:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1+\epsilon\cos\theta\right) \quad -(8)$$

and standard analysis {1 - 12} shows that:

$$\frac{m^2 MG}{L^2} = \frac{1}{\alpha} \quad -(9)$$

where α is the half right latitude. It follows that:

$$\left(1+\Omega'_{01r}\right)\frac{d^2}{d\theta^2}\left(\frac{1}{\alpha}\left(1+\epsilon\cos\left(f(r)\theta\right)\right)\right)+\frac{1}{\alpha}\left(1+\epsilon\cos\left(f(r)\theta\right)\right) = \frac{1}{\alpha} \quad -(10)$$

i.e.

$$\left(1+\Omega'_{01r}\right)\frac{d^2}{d\theta^2}\cos\left(f(r)\theta\right)+\cos\left(f(r)\theta\right) = 0. \quad -(11)$$

This is the equation:

$$\frac{d^2 y}{d\theta^2} = \frac{-y}{1+\Omega'_{01r}} \quad -(12)$$

where:

$$y = \cos\left(f(r)\theta\right). \quad -(13)$$

Its solution is:

$$y = \exp\left(\frac{i\theta}{(1+\Omega'_{0}r)^{1/2}}\right) = \cos\left(\frac{\theta}{(1+\Omega'_{0}r)^{1/2}}\right) + i\sin\left(\frac{\theta}{(1+\Omega'_{0}r)^{1/2}}\right) \quad -(14)$$

So:

$$\text{Real}\, y = \cos\left(\frac{\theta}{(1+\Omega'_{0}r)^{1/2}}\right) = \cos\left(f(r)\theta\right). \quad -(15)$$

It follows that:

$$f(r) = \frac{1}{(1+\Omega'_{0}r)^{1/2}}. \quad -(16)$$

Therefore the precessing ellipse is:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1 + \epsilon\cos\left(\frac{\theta}{(1+\Omega'_{0}r)^{1/2}}\right)\right) \quad -(17)$$

Q. E. D. In Section 3 this analytical result is compared with the numerical result of UFT328, obtained by simultaneous solution of the ECE2 hamiltonian and lagrangian. Experimentally:

$$\frac{1}{(1+\Omega'_{0}r)^{1/2}} \sim \frac{3MG}{c^2\alpha} \quad -(18)$$

to high precision, where c is the vacuum speed of light. So the spin connection can be found experimentally for any planar orbit.

As described in Note 365(4), a complete understanding of planar orbits in classical dynamics requires use of the three dimensional hamiltonian:

$$H = \frac{1}{2} m \dot{\underline{r}} \cdot \dot{\underline{r}} + U \quad -(19)$$

and the three dimensional lagrangian:

$$\mathcal{L} = \frac{1}{2} m \dot{\underline{r}} \cdot \dot{\underline{r}} - U \quad -(20)$$

where the velocity is defined by:

$$\underline{v} = \dot{\underline{r}} = \frac{d\underline{r}}{dt} . \quad -(21)$$

The three dimensional Euler Lagrange equation:

$$\underline{\nabla} \mathcal{L} = \frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{\underline{r}}} \quad -(22)$$

gives the force law:

$$\underline{F} = m \ddot{\underline{r}} = -\underline{\nabla} U . \quad -(23)$$

In plane polar coordinates:

$$\underline{F} = m \left(\left(\ddot{r} - r\dot{\theta}^2 \right) \underline{e}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta} \right) \underline{e}_\theta \right) . \quad -(24)$$

For a central potential (one that depends only on r):

$$\underline{\nabla} U = \frac{\partial U}{\partial r} \underline{e}_r + \frac{1}{r} \frac{\partial U}{\partial \theta} \underline{e}_\theta = \frac{\partial U}{\partial r} \underline{e}_r \quad -(25)$$

so the force law becomes:

$$\underline{F} = m \ddot{\underline{r}} = -\frac{\partial U}{\partial r} \underline{e}_r \quad -(26)$$

i. e.

$$F \qquad -\frac{\partial U}{\partial r} . \quad -(27)$$

In plane polar coordinates:

$$\underline{F} = m\ddot{\underline{r}} = -\frac{\partial U}{\partial r}\underline{e}_r \quad -(28)$$

and it follows that:

$$\underline{F} = m\left(\ddot{r} - r\dot{\theta}^2\right)\underline{e}_r = -\frac{\partial U}{\partial r}\underline{e}_r \quad -(29)$$

and

$$\left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\underline{e}_\theta = \underline{0}. \quad -(30)$$

Eq. (30) shows that the Coriolis acceleration vanishes for any planar orbit if it is assumed that the force law is central. Eq. (29) is the Leibnitz orbital equation, and can be rewritten as the Binet equation of conventional dynamics:

$$F(r) = -\frac{L^2}{mr^2}\left(\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r}\right). \quad -(31)$$

To illustrate the use of the Binet equation consider Note 365(5) which analyses the hyperbolic spiral orbit:

$$r = \frac{r_0}{\theta}. \quad -(32)$$

It follows from the Binet equation that:

$$F(r) = -\frac{L^2}{mr^3} \quad -(33)$$

and that:

$$m\ddot{r} = 0. \quad -(34)$$

The force (33) is an outward centrifugal force, and Eq. (34) shows that there is no force of attraction. In this case:

$$\frac{dr}{dt} = \frac{dr}{d\theta}\frac{d\theta}{dt} = \frac{L}{mr^2}\frac{dr}{d\theta} = -\frac{L}{mr^2}\frac{r_0}{\theta^2} = -\frac{L}{mr_0}, \quad -(35)$$

$$r = -\frac{L}{mr_0}t, \quad -(36)$$

which shows that the stars are moving inwards. There is a contradiction between Eqs. (33) and (36). This contradiction is resolved by reversing the sign of the angular velocity:

$$\omega = \frac{d\theta}{dt} = -\frac{L}{mr^2} \quad -(37)$$

so Eq. (36) is changed to:

$$r = \frac{L}{mr_0}t. \quad -(38)$$

Eqs. (33) and (38) self consistently show that the stars are moving outwards from a large central mass M.

However, if it is assumed that:

$$r = -\frac{r_0}{\theta} \quad -(39)$$

together with Eq. (37), it follows that:

$$r = -\frac{L}{mr_0}t. \quad -(40)$$

The centrifugal force from Eqs. (33) and (39) is:

$$F = \frac{L^2\theta^3}{mr_0^3} \quad -(41)$$

and is positive valued, meaning that it is an attractive force. Eqs. (39) and (41) show that the stars are moving inwards. The motion of the stars in a whirlpool galaxy is complicated, and must be determined experimentally. The above is meant to convey a simple model analysis.

Finally, as in note 365(5), the force law for the orbit (17) is found using the modified Binet equation (1). Computer algebra is used to eliminate human error, and the result shows that the force law is not that of the incorrect Einstein theory.

3. FURTHER ANALYTICAL AND COMPUTATIONAL ANALYSIS

Section by Dr. Horst Eckardt

The precessing orbit of ECE fluid dynamics

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3 Further analytical and computational analysis

An elliptic orbit without precession is known to be

$$r_0(\theta) = \frac{\alpha}{1+\epsilon\cos(\theta)}. \tag{42}$$

We will inspect the effect of different kinds of precession. In the simplified precession model of ECE theory the elliptic conical section with a constant precession is described by

$$r_1(\theta) = \frac{\alpha}{1+\epsilon\cos(x\theta)} = \frac{\alpha}{1+\epsilon\cos((1-A)\theta)} \tag{43}$$

where

$$x = 1 - A \tag{44}$$

and A is a small positive constant. The general form with a non-constant angular factor is:

$$r_2(\theta) = \frac{\alpha}{1+\epsilon\cos(f(\theta)\,\theta)}. \tag{45}$$

From (17) we have:

$$f(\theta) = \frac{1}{\sqrt{1+\Omega^1{}_{01r}}}. \tag{46}$$

This means that the spin connection Ω is θ-dependent and is not constant. the exact form of $f(\theta)$ could be determined numerically from the numerical solution of the relativistic orbital problem as in UFT328. This is however difficult to extract, therefore we make an analytical approach that gives a behaviour similar to Fig. 8 in UFT328. We use

$$f(\theta) = 1 + \frac{A}{2}\left(\sin\left((1+3A)\theta\right) - 2\right). \tag{47}$$

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The different models for the x factor (44) and (47) are graphed in Fig. 1. The function $f(\theta)$ oscillates around the constant value of $1 - A$. For the model calculations we chose

$$A = 0.05, \quad \alpha = 1, \quad \epsilon = 0.3. \tag{48}$$

The corresponding orbits r_0, r_1, r_2 in dependence of θ are graphed in Fig. 2. It can be seen that the maxima and minima (aphelion and perihelion) are mostly identical for both types of precession, but the complete orbits are different. This can also be seen from the polar orbit plots, Fig. 3 and Fig. 4 where the orbits r_1 and r_2 are compared with the non-precessiong orbit r_0. The variable factor $f(\theta)$ makes the orbit look more irregular, compared to the orbit with constant precession factor.

The three types of orbit approaches r_0, r_1 and r_2 have been used in the Binet equation (1). The Newtonian orbit r_0 leads to

$$F_0(r) = -\frac{L^2}{\alpha m r_0^2} \tag{49}$$

which is the Newtonian force law, rewritten with constants L and α. When inserting the conical section orbit (43) of x theory, the result is

$$F_1(r) = -\frac{L^2 \left(\left(A^2 - 2\,A + 1\right)\, r_1 + \left(2\,A - A^2\right)\, \alpha\right)}{\alpha\, m\, {r_1}^3}. \tag{50}$$

This is obviously a combination of a $1/r^2$ and $1/r^3$ force as is known from earlier investigations.

Using the more general form (47) leads to a highly complicated expression $F_2(r)$ which nevertheless can be plotted. The three forms of the Binet force equation are graphed in Fig. 5. The results resemble the orbits (Fig. 2), but there is a drop of Force for the case F_2 which may be induced by the analytical form (47).

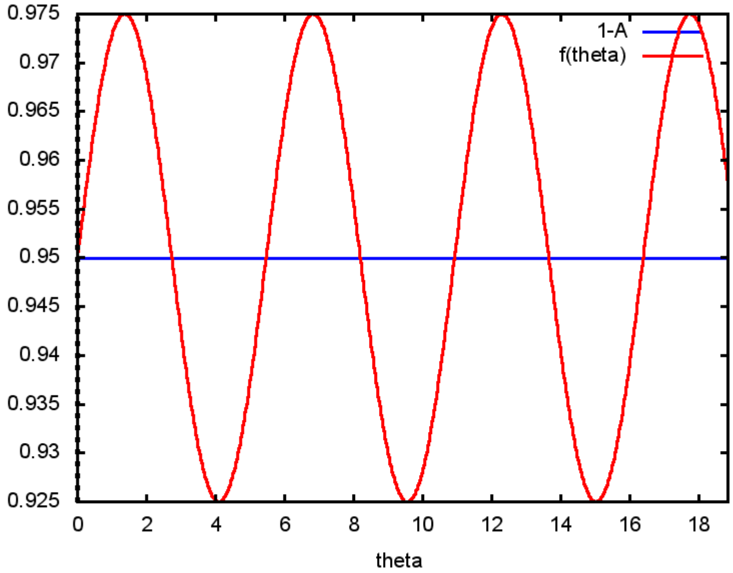

Figure 1: Models for the orbital precession factor x.

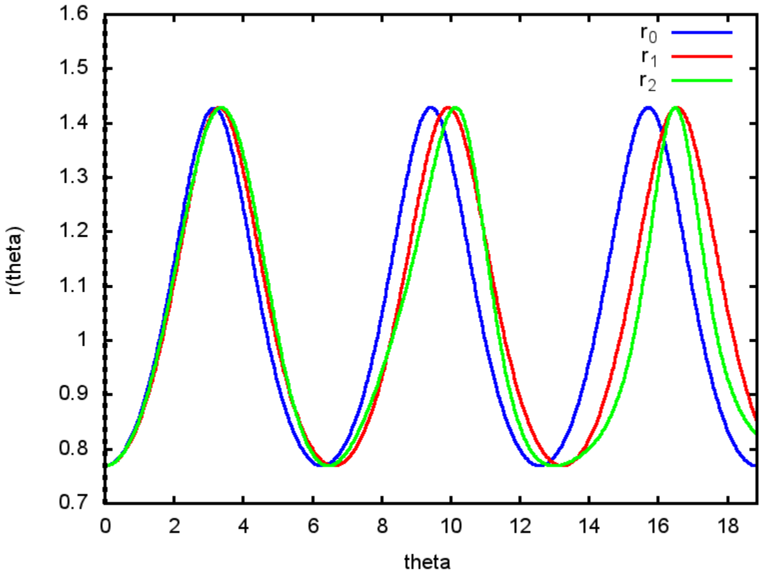

Figure 2: Orbits r_0, r_1, r_2 in dependence of θ.

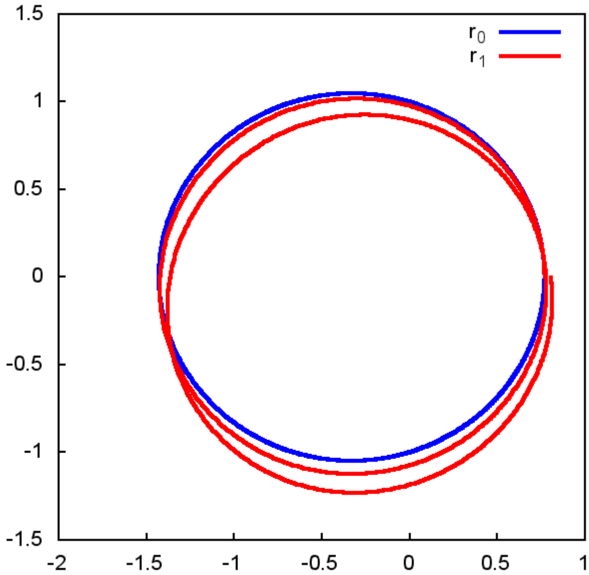

Figure 3: Polar plot of orbits r_0, r_1.

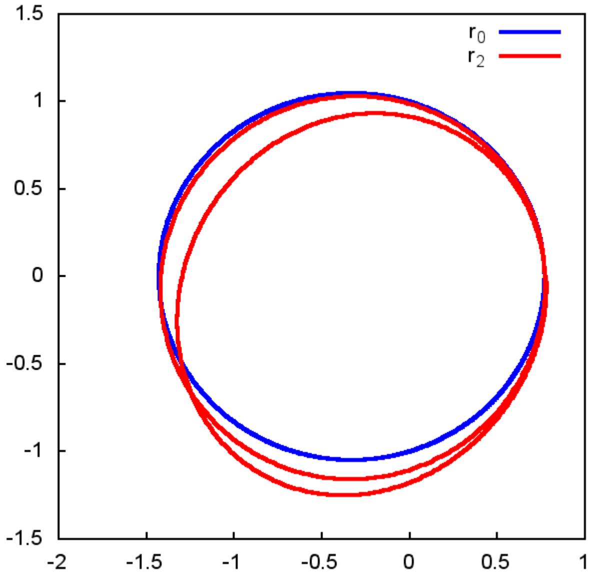

Figure 4: Polar plot of orbits r_0, r_2.

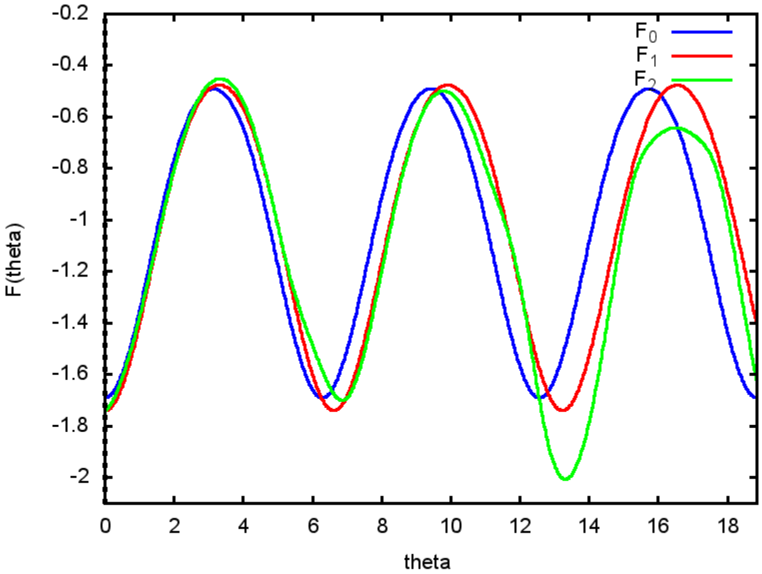

Figure 5: Radial force from the Binet equation for r_0, r_1, r_2.

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