ANALYTICAL CALCULATION OF PRECESSION FROM ECE2 RELATIVITY.

by

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ABSTRACT

An analytical method is developed to show that the hamiltonian of ECE2 relativity produces a differential orbital function whose difference from the non relativistic theory can be calculated directly. The differential function can be compared directly with experimental data. By a comparison of UFT363 and UFT372 it is shown that the methods of fluid dynamics also produce a precessing orbit.

Keywords: ECE2 relativity and fluid dynamics, orbital precession.

UFT 373

1. INTRODUCTION

In the immediately preceding paper of this series {1 - 12} (UFT372), a numerical method was used to solve the lagrangian of ECE2 relativity to give a precessing orbit. This important result shows that the incorrect Einsteinian general relativity (EGR) is also redundant by Ockham's Razor, in that a simpler theory can produce precession. The result of UFT371 also confirms the method used in UFT328, simultaneous numerical solution of the lagrangian and hamiltonian. The theory of ECE2 fluid dynamics also produces a precessing orbit as shown in this paper by comparison with UFT372. The main result of Section 2 is a differential orbital function which can be calculated analytically from ECE2 relativity and compared with the same function from the non relativistic theory of planar orbits. The differential function can also be observed experimentally. The difference is known from UFT372 to be due to a precessing orbit, which can therefore be calculated analytically.

This paper is a synopsis of extensive calculations in the notes accompanying UFT373 on www.aias.us. Note 373(1) is a comparison of the orbital precession produced by ECE2 fluid dynamics (UFT363) and the ECE2 lagrangian (UFT372). It is important and significant that both theories produce precession of a planar orbit. Notes 373(2) to 373(5) are preparatory attempts at an analytical solution. Note 373(6) calculates an orbital differential function by simultaneous solution of the relativistic and non relativistic hamiltonians, and Note 373(7) calculates the same differential function from experimental data at the perihelion, so a comparison with theory and experiment is possible.

2. ANALYTICAL CALCULATION OF PRECESSION.

Consider the non relativistic orbital hamiltonian:

$$H = \frac{1}{2}mv^2 + U \quad -(1)$$

of an object of mass m orbiting a mass M with orbital velocity $\underline{v}$. The gravitational potential energy is well known to be:

$$U = -\frac{mMG}{r} \quad -(2)$$

where G is Newton's constant and r the distance between m and M. The relativistic hamiltonian of ECE2 theory is {1 - 12}:

$$H_0 := H_1 - mc^2 = (\gamma - 1)mc^2 + U \quad -(3)$$

where the :Lorentz factor is:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} \quad -(4)$$

The velocity appearing in the Lorentz factor is {1 - 12}:

$$v^2 = \left(\frac{L}{mr}\right)^2 \left(1 + \frac{1}{r^2}\left(\frac{dr}{d\phi}\right)^2\right) \quad -(5)$$

where L is the angular momentum of the system, a constant of motion defined by:

$$L = mr^2\dot{\phi} \quad -(6)$$

where the angular velocity is:

$$\dot{\phi} = \frac{d\phi}{dt} \quad -(7)$$

in the plane polar coordinate system (r, ϕ).

Using Eqs. (1) and (3) the differential orbital function $dr / d\phi$ can be calculated in terms of the constants of motion $H_0 - H$ and L. This calculation is carried out using computer algebra in Section 3. The non relativistic hamiltonian is given by:

$$H = -\frac{mMG}{2a} \quad -(8)$$

where a is the semi major axis of the non relativistic orbit:

$$r = \frac{\alpha}{1+\epsilon\cos\phi}, \quad a = \frac{\alpha}{1-\epsilon^2}, \quad -(9)$$

where α is the half right latitude and ϵ the eccentricity. The relation between the non relativistic L and α is as follows:

$$L^2 = m^2MG\alpha. \quad -(10)$$

In the non relativistic limit:

$$v \ll c \quad -(11)$$

the differential orbital function reduces to:

$$\left(\frac{dr}{d\phi}\right)^2 = \frac{\epsilon^2 r^4}{\alpha^2}\sin^2\phi = \frac{\epsilon^2 r^4}{\alpha^2}\left(1-\frac{1}{\epsilon^2}\left(\frac{\alpha}{r}-1\right)^2\right) \quad -(12)$$

The numerical lagrangian analysis of UFT372 shows that the function $dr/d\phi$ from Eqs. (1) and (3) is due to orbital precession. This is a major discovery that makes Einsteinian general relativity obsolete.

By astronomical observation it is claimed that the perihelion advance after 2π radians is:

$$\phi = 2\pi\left(1+\frac{3MG}{\alpha c^2}\right). \quad -(13)$$

From the elliptical orbit (9), the orbital function is:

$$\frac{dr}{d\phi} = \frac{\epsilon r^2}{\alpha} \sin\phi \quad -(14)$$

and it follows that:

$$r = \frac{\alpha}{1+\epsilon\cos\phi}. \quad -(15)$$

The perihelion, or distance of closest approach of M to m is defined by:

$$\phi = 2\pi \quad -(16)$$

because M is situated at one focus of the ellipse. Under the condition (16):

$$r_{min} = \frac{\alpha}{1+\epsilon} \quad -(17)$$

and therefore at the perihelion:

$$\frac{dr}{d\phi} = 0 \quad -(18)$$

for the static elliptical orbit (15) of the non relativistic theory.

However, by observation, the perihelion advances every orbit by:

$$\phi = 2\pi\left(1 + \frac{3MG}{\alpha c^2}\right) \quad -(19)$$

so using this value of ϕ in Eq. (14) produces:

$$\frac{dr}{d\phi} = \frac{\epsilon\alpha}{(1+\epsilon)^2} \sin\left(2\pi\left(1 + \frac{3MG}{\alpha c^2}\right)\right). \quad -(20)$$

Now use:

$$\sin(A+B) = \sin A \cos B + \cos A \sin B \quad -(21)$$

to find that:

$$\sin\left(2\pi\left(1+\frac{3MG}{\alpha c^2}\right)\right) = \sin\left(\frac{6\pi MG}{\alpha c^2}\right) \sim \frac{6\pi MG}{\alpha c^2} \quad -(22)$$

using the small angle approximation:

$$\sin x \sim x. \quad -(23)$$

Therefore the precession of the perihelion produces the change:

$$\Delta\left(\frac{dr}{d\phi}\right) = \frac{6\pi MG}{c^2}\frac{\epsilon}{(1+\epsilon)^2} \quad -(24)$$

in the differential orbital function $dr/d\phi$. Using:

$$r_0 = \frac{2MG}{c^2} = 2{,}950 \text{ metres} \quad -(25)$$

for the mass M of the sun, and using the Earth's eccentricity:

$$\epsilon = 0.0167 \quad -(26)$$

it is found that the experimental change in $dr/d\phi$ is:

$$\Delta\left(\frac{dr}{d\phi}\right) = 299.46 \text{ metres} \quad -(27)$$

and this is produced analytically by ECE2 relativity. The change in the orbital differential function can be calculated as in Section 3. The experimental value (27) is found by adjusting the relativistic hamiltonian H_0.

Note 373(1) shows that precession can be produced from fluid dynamics

(UFT363) and also from the lagrangian theory of UFT372. These are important confirmations of both theories, because the astronomically observed orbit is a precessing orbit. From fluid dynamics:

$$\ddot{r} = \frac{r}{(1+\Omega^1_{01})^2}\,\dot{\phi}^2 - \frac{mG}{(1+\Omega^1_{01})^2\, r^2} \quad -(28)$$

where Ω^1_{01} is a spin connection, and from the lagrangian theory:

$$\ddot{r} = r\dot{\phi}^2 - \frac{mG}{r^2}\left(\frac{1}{\gamma}\left(1-\frac{\dot{r}^2}{c^2}\right)\right). \quad -(29)$$

These two expressions can be compared as in Note 373(1). In the limit:

$$\Omega^1_{01} \ll 1 \quad -(30)$$

Eq. (28) reduces to:

$$\ddot{r} \sim r\dot{\phi}^2 - \frac{mG}{(1+\Omega^1_{01})^2\, r^2} \quad -(31)$$

so:

$$\frac{1}{(1+\Omega^1_{01})^2} \sim \frac{1}{\gamma}\left(1-\frac{\dot{r}^2}{c^2}\right) \quad -(32)$$

and:

$$\Omega^1_{01} \sim \left(\left(1-\frac{v^2}{c^2}\right)\left(1-\frac{\dot{r}^2}{c^2}\right)\right)^{-1/2} - 1 \quad -(33)$$

For small precessions as in the solar system, the experimental precession can be modelled by:

$$r = \frac{\alpha}{1+\epsilon\cos(x\phi)}, \quad -(34)$$

$$x = 1 + \frac{3mG}{\alpha c^2} \quad -(35)$$

in the first approximation. Note carefully that Eq. (34) is not the true orbit. The latter must be calculated numerically and analytically. In Eq. (34):

$$\sin^2(x\phi) + \cos^2(x\phi) = 1 . \quad -(36)$$

Therefore the experimental differential orbital function is modelled to be:

$$\frac{dr}{d\phi} = \frac{x\epsilon r^2}{\alpha} \sin(x\phi) . \quad -(37)$$

This result can be reproduced theoretically by finding $\dot{r}$ and $\dot{\phi}$ numerically as in UFT372, so:

$$\frac{dr}{d\phi} = \frac{dr}{dt}\frac{dt}{d\phi} = \frac{\dot{r}}{\dot{\phi}} . \quad -(38)$$

From the fluid gravitational theory, Eq. (28), Eq. (37) is found by adjusting the spin connection to the experimental result. From the lagrangian theory (29) is found directly by expressing $\dot{r}$ in terms of $\dot{\phi}$:

$$r\dot{\phi} = A - B\dot{r}^2 \quad -(39)$$

where:

$$A = \ddot{r} + \frac{mG}{\gamma r^2} \quad -(40)$$

and:

$$B = \frac{mG}{\gamma r^2 c^2} . \quad -(41)$$

So

$$\left(\frac{\dot{\phi}}{\dot{r}}\right)^2 - \frac{1}{r}\left(\frac{A}{\dot{r}^2} - B\right) = \left(\frac{\alpha}{x\epsilon r^2 \sin(x\phi)}\right)^2 . \quad -(42)$$

The experimentally observed x is therefore given by:

$$\left(\frac{\alpha}{x\epsilon}\right)^2 = r^3\left(\frac{A}{\dot{r}^2} - B\right)\left(1 - \frac{1}{\epsilon^2}\left(\frac{\alpha}{r} - 1\right)^2\right) \quad -(43)$$

and an exact match obtained between experiment and theory.

As shown in Note 373(1), the kinetic energy used in the non relativistic UFT363 is:

$$T = \frac{1}{2}m\left(\left(1+\Omega^1{}_{01}\right)^2\dot{r}^2 + \dot{\phi}^2 r^2\right) \quad -(44)$$

so the differential function found by comparing Eqs. (1) and (3) can be expressed in terms of the spin connection. This is carried out with computer algebra in Section 3.

In conclusion, the lagrangian and relevant Euler Lagrange equations of ECE2 relativity produce a precessing orbit, and the hamiltonian analysis of this Section develops and confirms the result of UFT372.

3. COMPUTER ALGEBRA AND GRAPHICAL RESULTS

Section by Dr. Horst Eckardt

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