ECE2 COVARIANT PRECESSION VERSUS THE EINSTEIN THEORY IN

THE S2 STAR AND HULSE TAYLOR BINARY PULSAR.

by

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ABSTRACT

The ECE2 covariant theory is developed of any mass m orbiting any mass m on the non relativistic and relativistic levels. The relativistic, ECE2 covariant, lagrangian produces precession of the orbit without the need for Einsteinian general relativity. The ECE2 covariant theory is applied to the orbit of the S2 star around a massive object near Sagittarius B, and to the Hulse Taylor (HP) binary pulsar. The Einstein theory is shown to fail by two orders of magnitude in the HP system and to fail qualitatively to give retrograde precession in the S2 system.

Keywords: ECE2 relativity, the general two body orbit, S2 star system, Hulse Taylor binary pulsar.

UFT 375

INTRODUCTION

In recent papers of this series {1 - 12}, various applications have been developed of ECE2 relativity, which is special relativity developed in a space with finite torsion and curvature. In section 2, ECE2 relativity is applied to the general orbit of any mass m_1 around any mass m_2, the general two body problem in gravitation. ECE2 relativity is applied to the orbit of the S2 star around a very massive object near Sagittarius B, and to the Hulse Taylor binary pulsar (HP). It is shown that the Einstein theory fails by eight orders of magnitude in the S2 star system, and by several orders of magnitude in the HP system. The ECE2 theory produces reasonable results.

This paper is a short synopsis of detailed calculations in notes accompanying UFT375 on combined sites (www.aias.us and www.upitec.org). Notes 375(1) and 375(2) discuss the equivalence of the Cartesian and plane polar coordinate systems in an ellipse. Note 375(3) discusses the relativistic lagrangian in Cartesian coordinates and is developed in Section 3 to show that the relativistic angular momentum is a constant of motion. Note 374(4) adds a term to the potential to produce a shrinking orbit as observed experimentally in HP. Notes 375(5) and 375(8) are first attempts to describe the final version in Note 375(10) of the lagrangian of the general two body problem. Note 375(10) is the basis of Section 2 of this paper. Note 375(6) defines the half right latitude and eccentricity of an ellipse. Note 375(7) is a comparison of experimental HP data from a Stanford site and Wikipedia. There are large discrepancies in the experimental data. This note shows that the Einstein theory is incorrect by several orders of magnitude. Note 375(9) gives the relevant experimental data for the S2 star system and shows that the Einstein theory is incorrect by eight orders of magnitude.

Section 3 summarizes computations and graphics of ECE2 relativity applied to HP and the S2 star system, and to the general two body gravitational problem.

2. ECE2 COVARIANCE IN THE GENERAL ORBIT

Consider the orbit of a mass m_1 around a mass m_2. The non relativistic lagrangian is:

$$\mathcal{L} = \frac{1}{2} m_1 \dot{\mathbf{r}}_1 \cdot \dot{\mathbf{r}}_1 + \frac{1}{2} m_2 \dot{\mathbf{r}}_2 \cdot \dot{\mathbf{r}}_2 + \frac{m_1 m_2 G}{r} \quad -(1)$$

where $\mathbf{r}_1$ is the vector from the centre of mass to mass m_1, and $\mathbf{r}_2$ is the vector from the centre of mass to m_2. Here G is Newton's constant and:

$$\mathbf{r} = \mathbf{r}_1 - \mathbf{r}_2 , \quad -(2)$$

$$r = |\mathbf{r}| = |\mathbf{r}_1 - \mathbf{r}_2| . \quad -(3)$$

The lagrangian can be developed as:

$$\mathcal{L} = \frac{1}{2} \frac{m_1 m_2}{m_1 + m_2} \dot{\mathbf{r}} \cdot \dot{\mathbf{r}} + m_1 m_2 G \frac{|\mathbf{r}|}{r^2} \quad -(4)$$

where:

$$|\mathbf{r}| = (\mathbf{r} \cdot \mathbf{r})^{1/2} . \quad -(5)$$

The Euler Lagrange equation is:

$$\frac{\partial \mathcal{L}}{\partial \mathbf{r}} = \frac{d}{dt} \frac{\partial \mathcal{L}}{\partial \dot{\mathbf{r}}} = \left(\frac{m_1 m_2}{m_1 + m_2} \right) \ddot{\mathbf{r}} = m_1 m_2 G \frac{\partial}{\partial \mathbf{r}} \left(\frac{1}{|\mathbf{r}|} \right) \quad -(6)$$

in which:

$$\frac{\partial}{\partial \mathbf{r}} \left(\frac{1}{|\mathbf{r}|} \right) = -\frac{1}{2} \, 2\mathbf{r} \frac{1}{(\mathbf{r} \cdot \mathbf{r})^{3/2}} = -\frac{\mathbf{r}}{r^3} . \quad -(7)$$

Therefore:

$$\left(\frac{m_1 m_2}{m_1 + m_2} \right) \ddot{\mathbf{r}} = - m_1 m_2 G \frac{\mathbf{r}}{r^3} \quad -(8)$$

i..e.

$$\ddot{\underline{r}} = -(m_1 + m_2) G \frac{\underline{r}}{r^3} . \quad -(9)$$

This equation is valid in any coordinate system in two and three dimensions and can be solved in Cartesian coordinates as in UFT374.

In the solar system and S2 star system:

$$m_2 \gg m_1 \quad -(10)$$

and

$$\ddot{\underline{r}} \sim -m_2 G \frac{\underline{r}}{r^3} \quad -(11)$$

but in the HP system:

$$m_1 \sim m_2 . \quad -(12)$$

The centre of mass is defined by:

$$m_1 \underline{r}_1 + m_2 \underline{r}_2 = \underline{0} \quad -(13)$$

so:

$$\underline{r}_1 = \frac{m_2}{m_1 + m_2} \underline{r} , \quad -(14)$$

$$\underline{r}_2 = \frac{-m_1}{m_1 + m_2} \underline{r} . \quad -(15)$$

From these equations, Note 375(10) shows that there are three equations of motion in the general two body gravitational problem:

$$\ddot{\underline{r}} = -(m_1 + m_2) G \underline{r} / r^3 \quad -(16)$$

$$\ddot{\underline{r}}_1 = -(m_1+m_2)G\,\underline{r}_1 / r^3 \quad -(17)$$

$$\ddot{\underline{r}}_2 = -(m_1+m_2)G\,\underline{r}_2 / r^3. \quad -(18)$$

Eq. (16) gives a Newtonian ellipse with mass:

$$M = m_1 + m_2 . \quad -(19)$$

Eqs. (17) and (18) are simultaneous differential equations:

$$\ddot{\underline{r}}_1 = -MG\,\underline{r}_1 / \left(|\underline{r}_1 - \underline{r}_2|^3\right) \quad -(20)$$

$$\ddot{\underline{r}}_2 = -MG\,\underline{r}_2 / \left(|\underline{r}_1 - \underline{r}_2|^3\right) \quad -(21)$$

which must be solved numerically for any coordinate system, for example the Cartesian system of Section 3.

The ECE2 covariant lagrangian in its relativistic form is:

$$\mathcal{L} = -mc^2\left(\left(1 - \frac{\dot{\underline{r}}_1 \cdot \dot{\underline{r}}_1}{c^2}\right)^{1/2} + \left(1 - \frac{\dot{\underline{r}}_2 \cdot \dot{\underline{r}}_2}{c^2}\right)^{1/2}\right) + \frac{m_1 m_2 G}{|\underline{r}_1 - \underline{r}_2|} \quad -(22)$$

Using Eqs. (13), (14) and (15), Eq. (22) reduces to:

$$\mathcal{L} = -mc^2\left(\left(1 - \left(\frac{m_2}{m_1+m_2}\right)^2 \frac{\underline{r}\cdot\underline{r}}{c^2}\right)^{1/2} + \left(1 - \left(\frac{m_1}{m_1+m_2}\right)^2 \frac{\underline{r}\cdot\underline{r}}{c^2}\right)^{1/2}\right) + \frac{m_1 m_2 G |\underline{r}|}{r^3} \quad -(23)$$

which can be solved with the Euler Lagrange equation (6) to give a precessing orbit entirely without use of the Einsteinian general relativity (EGR) {1 - 12}.

Some astronomical data for the HP system are summarized in Note 375(7) from Wikipedia and a Stanford University site www.large.stanford.edu/courses/2007/ph210/ There is severe self inconsistency of data as summarized in Note 375(7). EGR gives the well known result:

$$\Delta\phi = \frac{6\pi MG}{c^2 a(1-\epsilon^2)} \quad -(24)$$

for the precession of the orbit of the pulsar. Eq. (24) is derived in the weak gravitational limit of EGR as is well known. Here M is the mass of the attracting object, G is Newton's constant, c is the speed of light, a is the semimajor axis, and ϵ is the eccentricity. Using the Stanford data it gives:

$$\Delta\phi = 0.16^\circ \text{ per earth year} \quad -(25)$$

in degrees per earth year, and using the Wikipedia data it gives:

$$\Delta\phi = 0.11^\circ \text{ per earth year} \quad -(26).$$

in degrees per earth year. The experimental result form both sites is about 4.2° per earth year. So EGR is wildly incorrect for weak gravitation, and the two sites give wildly inconsistent results.

It is unlikely that a small metric adjustment for strong field gravitation can ever give a precise match to experimental data as so often claimed uncritically by protagonists of EGR.

In order to apply ECE2 gravitational theory the following data are used, taken from two sites in the literature:

$$m_1 = m_p = 2.824 \times 10^{30} \text{ kg} \quad -(27)$$

$$m_2 = m_c = 2.804 \times 10^{30} \text{ kg}. \quad -(28)$$

The perisastron is taken to be 1.1 solar radii, a value easily found by Google. This is

$$r(0) = 7.6527 \times 10^8 \text{ m} \quad -(29)$$

in the required S. I. Units. The orbital velocity with respect to the centre of mass of the two neutron stars of the HP system is used as in the literature:

$$v(0) = 4.5 \times 10^{5}\ ms^{-1} \quad -(30)$$

Therefore $r(0)$ and $v(0)$ can be used as initial conditions for the computations of Section 3. However, there is such wild inconsistency in the astronomical data that the initial velocity can be used as an input parameter, and the effect on the computed orbits graphed.

As in Note 375(9) Eq. (24) can be applied with the following S2 data, easily found by Google and various sites:

$$\begin{aligned} M &= 7.956 \times 10^{36}\ kg \\ G &= 6.67408 \times 10^{-11}\ m^3 kg^{-1} s^{-2} \\ c &= 2.99792458 \times 10^{8}\ ms^{-1} \\ a &= 1.4253 \times 10^{14}\ m \\ \epsilon &= 0.8831 \\ T &= 15.56 \text{ earth years} \end{aligned} \quad -(31)$$

All these data are given in the obscure, non S. I., units used in astronomy, and are given above in the required S. I. Units. EGR and Eq. (24) give:

$$\Delta\phi = 3.549 \times 10^{-3}\ rad \quad . \quad -(32)$$

This is converted to degrees per orbital interval T of S2, (i.e. per orbit) using:

$$T = 15.56 \times 3.154 \times 10^{7}\ \text{seconds} \quad -(33)$$

The result is:

$$\Delta\phi = 0.203^{\circ} \text{ per orbit.} \quad (34)$$

The vague experimental claims vary from about -1 to 2 degrees per orbit. It is known that the orbit of S2 is nearly a Newtonian ellipse. The semimajor axis of this ellipse is:

$$a = 1.4253 \times 10^{14} \text{ m.} \quad (35)$$

So the S2 star is about a thousand times more distant from the central mass than the distance of the earth from the sun. The ratio of the mass of S2 to the central mass is roughly similar to the ratio of the mass of the earth to the sun.

So it is expected therefore that the weak gravitational limit is an excellent approximation for S2. Nevertheless EGR fails by an order of magnitude if the precession is taken to be 2° per orbit, and fails qualitatively if the precession is taken to be -1° per orbit. ECE2 has been shown {1 - 12} in many papers to be an acceptable theory of gravitation. In three hundred and seventy five UFT papers and books to date{1 - 12} it has been shown that EGR is riddled with errors, notably the neglect of torsion. The S2 data show clearly that it fails completely in that system. It also fails completely in whirlpool galaxies for which ECE gives an acceptable description.

SECTION 3: COMPUTATION AND GRAPHICS

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REFERENCES

{1} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "ECE2 : The Second Paradigm Shift" (open access on combined sites www.aias.us and www.upitec.com as UFT366 and ePubli in prep., translation by Alex Hill)

{2} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "The Principles of ECE" (open access as UFT350 and Spanish section, ePubli, Berlin 2016, hardback, New Generation, London, softback, translation by Alex Hill, Spanish section).

{3} M. W. Evans, S. J. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" (open access as UFT301, Cambridge International, 2010).

{4} M. W. Evans, H. Eckardt and D. W. Lindstrom, "Generally Covariant Unified Field Theory" (Abramis 2005 - 2011, in seven volumes softback, open access in relevant UFT papers, combined sites).

{5} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, open access as UFT302, Spanish translation by Alex Hill).

{6} H. Eckardt, "The ECE Engineering Model" (Open access as UFT303, collected equations).

{7} M. W. Evans, "Collected Scientometrics (Open access as UFT307, New Generation 2015).

{8} M. W. Evans and L. B Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific 2001, Open Access Omnia Opera Section of www.aias.us).

{9} M. W. Evans and S. Kielich (eds.), "Modern Nonlinear Optics" (Wiley Interscience, New York, 1992, 1993, 1997, 2001) in two editions and six volumes.

{10} M. W. Evans and J. - P. Vigier, "The Enigmatic Photon", (Kluwer, 1994 to 2002, in five volumes hardback and softback, open access Omnia Opera Section of www.aias.us).

{11} M. W. Evans, Ed., "Definitive Refutations of the Einsteinian General Relativity" (Cambridge International 2012, open access on combined sites).

{12} M .W. Evans and A. A. Hasanein, "The Photomagneton in Quantum Field Theory" (World Scientific, 1994).