GRAVITATION IN ECE2 PHYSICS

by

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ABSTRACT

The complete set of wave and field equations and the complete set of five equations of conservation of antisymmetry are given for gravitational physics. Their basic geometrical structure is the same for electrodynamics and fluid dynamics because of the triple unification achieved by ECE2 theory. A scheme of computation is suggested.

Keywords: ECE2 physics, gravitation, suggested scheme of computation.

UFT389

1 INTRODUCTION

In recent papers of this series {1 - 12} the law of conservation of antisymmetry has been developed to give five equations which apply in all areas of ECE2 physics. These must be solved simultaneously with the ECE2 wave and field equations of physics {1 - 12}. In general this requires computation, but some simple cases have analytical solutions given in the immediately preceding UFT papers on combined sites (www.aias.us and www.upitec.org). In section 2 the gravitational equations of ECE2 physics are collected for ease of reference, and a general scheme of computation suggested. Many other methods of solution are possible, depending on the problem being considered in gravitation, electrodynamics or fluid dynamics. Regauging may be necessary for rigorous self consistency. In section 3 some self consistent results are given for orbital precession. ECE2 physics is preferred to Einsteinian general relativity (EGR) because the former has several advantages, notably the ability to describe the velocity curve of a whirlpool galaxy and the ability to produce both forward and retrograde planetary precessions {1 - 12}. In this series {1 -12}, EGR has been refuted in at least eighty three ways, so is completely obsolete.

This paper is a short synopsis of extensive calculations in the notes that accompany UFT389 on combined sites. Note 389(1) gives the set of gravitational wave and field equations. Note 389(2) is a preliminary scheme of computation, Note 389(3) considers the Newtonian limit, Note 389(4) gives the spin connections for precessing orbits in ECE2 physics. Notes 389(5) and 389(6) apply the theory to spin connections of B(3) field theory {1 - 12}, Note 389(7) gives a solution of the scalar and trace antisymmetry conservation equations, and Note 38((8) gives a generally applicable scheme of computation.

2. GRAVITATIONAL EQUATIONS AND SCHEME OF COMPUTATION

The ECE2 gravitational field equations are {1 - 12}:

$$\underline{\nabla} \cdot \underline{\Omega} = 0 \quad -(1)$$

$$\underline{\nabla} \times \underline{g} + \frac{\partial \underline{\Omega}}{\partial t} = \underline{0} \quad -(2)$$

$$\underline{\nabla} \cdot \underline{g} = 4\pi G \rho \quad -(3)$$

$$\underline{\nabla} \times \underline{\Omega} - \frac{1}{c^2} \frac{\partial \underline{g}}{\partial t} = \frac{4\pi G}{c^2} \underline{J} \quad -(4)$$

Here $\underline{g}$ is the acceleration due to gravity, $\underline{\Omega}$ is the gravitomagnetic field, ρ is the mass density, $\underline{J}$ is the current of mass density and G is Newton's constant. Therefore ECE2 physics and cosmology contains a lot more information than its Newtonian counterpart, and si part of a generally covariant unified field theory. It is therefore fully relativistic in all aspects.

Define the gravitational four current by:

$$J^\mu = (c\rho, \underline{J}) \quad -(5)$$

and the gravitational four potential by:

$$Q^\mu = \left(\frac{\Phi}{c}, \underline{Q} \right). \quad -(6)$$

From the tetrad postulate and ECE wave equation {1 - 12} the gravitational wave equation is:

$$\square Q^\mu = \frac{4\pi G}{c^2} J^\mu \quad -(7)$$

i.e.

$$\square \Phi = 4\pi G \rho \quad -(8)$$

and

$$\square \underline{Q} = \frac{4\pi G}{c^2} \underline{J} \quad -(9)$$

The gravitational continuity equation follows from the inhomogeneous field equations (3) and (4) and is:

$$\frac{\partial \rho}{\partial t} + \underline{\nabla} \cdot \underline{J} = 0. \quad -(10)$$

The equation of trace antisymmetry (the Lindstrom constraint) is derived from the tetrad postulate of Cartan geometry and is:

$$\frac{1}{c^2}\left(\frac{\partial}{\partial t} + \omega_0\right)\Phi = \left(\underline{\nabla} - \underline{\omega}\right) \cdot \underline{Q}. \quad -(11)$$

The scalar antisymmetry equation is:

$$\underline{g} = -\underline{\nabla}\,\Phi + \underline{\omega}\,\Phi = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} \quad -(12)$$

and the vector antisymmetry equations are

$$\frac{\partial Q_Z}{\partial Y} + \frac{\partial Q_Y}{\partial Z} = \omega_Y Q_Z + \omega_Z Q_Y \quad -(13)$$

$$\frac{\partial Q_X}{\partial Z} + \frac{\partial Q_Z}{\partial X} = \omega_Z Q_X + \omega_X Q_Z \quad -(14)$$

$$\frac{\partial Q_Y}{\partial X} + \frac{\partial Q_X}{\partial Y} = \omega_X Q_Y + \omega_Y Q_X \quad -(15)$$

All these equations must be applied simultaneously to gravitation on the ECE2 level in physics, and more generally to any problem in physics and cosmology, chemistry and engineering. The vector antisymmetry equations follow from the definition of the gravitomagnetic field:

$$\underline{\Omega} = \underline{\nabla} \times \underline{Q} - \underline{\omega} \times \underline{Q}. \quad (16)$$

In these equations the spin connection four vector:

$$\omega^{\mu} = \left(\frac{\omega_0}{c}, \underline{\omega} \right) \quad (17)$$

maps spacetime, (the aether or vacuum). Terms containing the spin connection describe the interaction with the vacuum as described in immediately preceding UFT papers.

In order to solve the homogeneous field equations (1) and (2) it is necessary to define the vector potential $\underline{Q}_1$ as follows:

$$\underline{\nabla} \times \underline{Q}_1 := -\underline{\omega} \times \underline{Q} \quad (18)$$

and to define the total vector potential:

$$\underline{Q}_t = \underline{Q} + \underline{Q}_1. \quad (19)$$

It follows that the gravitomagnetic field is:

$$\underline{\Omega} = \underline{\nabla} \times \underline{Q}_t. \quad (20)$$

Defining the gravitational field by:

$$\underline{g} = -\underline{\nabla} \Phi - \frac{\partial \underline{Q}_t}{\partial t} \quad (21)$$

it follows immediately that $\underline{g}$ and $\underline{\Omega}$ obey the homogeneous field equations, Q. E. D.

Defining the four potential:

$$Q_t^{\mu} = \left(\frac{\phi}{c}, \underline{Q}_t \right) \quad (22)$$

it follows that $\mathbf{g}$ and $\mathbf{\Omega}$ are unchanged by regauging:

$$A_t^{\mu} \rightarrow A_t^{\mu} + \partial^{\mu} \chi \quad -(23)$$

i. e. if :

$$\Phi \rightarrow \Phi + \frac{1}{c^2} \frac{\partial \psi}{\partial t} \quad -(24)$$

and

$$\mathbf{A}_t \rightarrow \mathbf{A}_t - \nabla \psi \quad -(25)$$

$\mathbf{g}$ and $\mathbf{\Omega}$ are unaffected. Here ψ is the arbitrary gauge function as is well known in field theory and quantum field theory. Regauging can always be used to achieve rigorous self consistency. In ECE2 physics regauging can be used in electrodynamics, gravitation and fluid dynamics because ECE unifies all three subject areas with the same Cartan geometry, giving a rigorously and generally covariant unified field theory far in advance of the standard model of physics.

From Eqs. (3) and (8):

$$\nabla \cdot \mathbf{g} = \Box \Phi = 4\pi G \rho . \quad -(26)$$

It follows that:

$$-\nabla^2 \Phi + \nabla \cdot (\boldsymbol{\omega} \Phi) = \Box \Phi = \left(\frac{1}{c^2} \frac{\partial^2}{\partial t^2} - \nabla^2 \right) \Phi \quad -(27)$$

so there is a hitherto undiscovered link between the scalar potential and the vector spin connection:

$$\frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = \underline{\nabla}\cdot\left(\underline{\omega}\,\Phi\right) = \Phi\,\underline{\nabla}\cdot\underline{\omega} + \underline{\omega}\cdot\underline{\nabla}\Phi \qquad -(28)$$

It is suggested that a standardized procedure be adopted for solving all these equations self consistently. For gravitation the scheme is as follows, and in general needs computation and numerical methods.

1) Measure the mass density ρ experimentally

2) Compute the gravitational scalar potential Φ from:

$$\Phi(\underline{x}) = G\int\frac{\rho(\underline{x}')}{|\underline{x}-\underline{x}'|}\,d^3x' \qquad -(29)$$

3) Find the vector spin connection from Eq. (28).

4) Find the gravitational vector potential $\underline{Q}$ from the vector $\underline{\omega}$ and the antisymmetry equations (13) to (15).

5) Find $\underline{Q}$(total) from:

$$\frac{\partial \underline{Q}_t}{\partial t} = -\underline{\omega}\,\Phi \qquad -(30)$$

and find $\underline{Q}_1$ from:

$$\underline{Q}_1 = \underline{Q}_t - \underline{Q}. \qquad -(31)$$

6) Find $\underline{g}$ from Eq. (12) and $\underline{\Omega}$ from Eq. (16).

7) Find the scalar spin connection from the Lindstrom constraint:

$$\omega_0 = \frac{1}{\Phi}\left(c^2\left(\underline{\nabla}-\underline{\omega}\right)\cdot\underline{Q} - \frac{\partial \Phi}{\partial t}\right) \qquad -(32)$$

8) Check for self consistency using:

$$\underline{g} = -\underline{\nabla}\Phi + \underline{\omega}\,\Phi = -\frac{\partial \underline{Q}}{\partial t} - \frac{1}{\Phi}\left(c^2\left(\underline{\nabla}-\underline{\omega}\right)\cdot\underline{Q} - \frac{\partial \Phi}{\partial t}\right)\underline{Q} \qquad -(33)$$

and if necessary regauge Φ and $\underline{A}$ so that Eq. (33) is obeyed, and find the gauge function ψ .

9) Produce maps of the vacuum using the spin connection four vector.

The ECE lagrangian and hamiltonian must also be considered as in immediately preceding UFT papers and in Note 389(4). The theory must be checked against experimental data at each stage. The above procedure rigorously conserves the law of conservation of antisymmetry. In UFT131 it was shown that the U(1) sector of the standard model violates conservation of antisymmetry. So the U(1) (electromagnetic), U(1) x SU(2) (electroweak) and U(1) x SU(2) x SU(3) (grand unified) sectors of the standard model are refuted, together with Higgs mechanism and Higgs boson theories. The EGR sector of the standard model has been refuted in at least eighty three ways during the course of development of the UFT papers and has been refuted by Crothers {1 - 12} in many more ways. The electroweak sector is also refuted entirely in UFT225.

There have been no objections to any of these refutations and ECE2 has a vast following worldwide, well known from scientometrics that have a vast reading in their own right. In the early twenty first century (2003 to present), physics has changed completely.

3. COMPUTATION AND GRAPHICS

Section by Dr. Horst Eckardt

Gravitation in ECE2 physics

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3 Computation and graphics

As an example we consider the non-relativistic and relativistic motion of a particle in a central field. This problem has partially been solved already in section 3 of UFT paper 384. We recapitulate the results and add some new calculations. For a given scalar potential $\phi(r)$ and central gravitational field $\mathbf{g}(r)$ we compute the spin connections $\boldsymbol{\omega}$ and ω_0 as well as the gravitational vector potential $\mathbf{Q}$ and do some consistency checks. We used cartesian coordinates with radius function

$$r = \sqrt{X^2 + Y^2 + Z^2}, \tag{34}$$

the orbit was placed in the XY plane. The spin connections have been obtained from comparing the gravitational field

$$\mathbf{g} = -\boldsymbol{\nabla}\phi + \boldsymbol{\omega}\phi \tag{35}$$

with the result from the relativistic and non-relativistic Lagrangian as described in UFT 384. We used the non-relativistic scalar potential

$$\phi = -\frac{MG}{r}. \tag{36}$$

The vector potential $\mathbf{Q}$ follows from the gravitomagnetic antisymmetry conditions (13-15) in general. The spin connection is determined from the antisymmetry condition of the gravitational field:

$$\mathbf{g} = -\boldsymbol{\nabla}\phi + \boldsymbol{\omega}\phi = -\frac{\partial \mathbf{Q}}{\partial t} - \omega_0 \mathbf{Q} \tag{37}$$

with $\frac{\partial \mathbf{Q}}{\partial t} = 0$. We also used the non-relativistic scalar spin connection

$$\omega_0 = -\frac{c}{r} \tag{38}$$

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to determine $\mathbf{Q}$. After having obtained $\boldsymbol{\omega}$ and $\mathbf{Q}$, we checked the consistency of the result by computing ω_0 via the Lindstrom constraint (11):

$$\omega_0 = \frac{c^2}{\phi}(\boldsymbol{\nabla} - \boldsymbol{\omega}) \cdot \mathbf{Q}. \tag{39}$$

The resulting formulas are listed in Table 1, as far as they are not too complicated. For the non-relativistic case a consistent result follows for all equations except the Lindstrom constraint. A dimensional factor of 3 could be missing in Eq. (11). There is no gravitomagnetic field.

For both relativistic cases we kept at the non-relativistic Newtonian potential (36). This approach follows the philosophy that relativistic effects are dynamic effects of orbital motion. The gravitational field for forward and retrograde precession follows from the Lagrangian and the vector spin connection has been derived as described above. For determining the relativistic vector potential $\mathbf{Q}$, one has to solve the differential equations (13-15) numerically which is difficult because they have to be solved on a path representing the orbit in space. We used the non-relativistic formula for $\mathbf{Q}$ which gives a non-vanishing gravitomagnetic field $\boldsymbol{\Omega}$ in both relativistic cases. For forward precession, the gravitational field is not curl-free, as is the vector potential. This may be interpreted like the Lense-Thirring effect of general relativity, there is a vortex in the gravitational field. For retrograde precession, there is no such effect. However there is a spacetime contribution $\boldsymbol{\omega} \times \mathbf{Q}$ in the gravitomagnetic field which has been graphed below. Due to the approximations in ϕ and $\mathbf{Q}$, the Lindstrom constraint (last line of Table 1), resolved for ω_0, deviates from the non-relativistic form for both relativistic cases. It can be seen that, for retrograde precession, ω_0 takes the non-relativistic value for $\gamma \to 1$, without a factor of 3.

For a graphical analysis we solved the equation of an elliptic orbit numerically in the Newtonian limit. Then we inserted the orbital and velocity coordinates $X(t), Y(t), \dot{X}(t), \dot{Y}(t)$ into the above equations. The results have been graphed on the orbital line as described in UFT 384. Although the formulas of the spin connection look quite different for forward and retrograde precession, the graphs for $\boldsymbol{\omega}$ are identical within precision of graphical representation. They have been plotted in Fig. 1, for details see UFT 384. We selected an ultra-relativistic case with up to $\gamma = 27$.

To present the difference between forward and retrograde precession, we graphed the difference between both spin connections, $\boldsymbol{\omega}$(forward)$-\boldsymbol{\omega}$(retrograde), in Fig. 2. It can be seen that the spin connection for forward precession is somewhat larger at the periastron (left hand side) where velocity is very high. Finally we graphed the gravitomagnetic field of retrograde precession in Fig. 3. This vanishes for $Z = 0$, therefore we used a plane slightly above $Z = 0$. The field qualitatively equals the spin connection in the apastron region but is asymmetric near to the periastron, revealing a rotational structure in direction of the precession.

	non-rel.	forward precession	retrograde precession
ϕ	$-\frac{MG}{r}$	$-\frac{MG}{r}$	$-\frac{MG}{r}$
$\mathbf{g}$	$-MG\frac{\mathbf{r}}{r^3}$	$\frac{MG}{\gamma r^3}\left(\frac{\dot{\mathbf{r}}(\dot{\mathbf{r}}\cdot\mathbf{r})}{c^2}-\mathbf{r}\right)$	$-\frac{MG}{\gamma^3}\frac{\mathbf{r}}{r^3}$
$\mathbf{Q}$	$-\frac{r}{c}\mathbf{g}$	$-\frac{r}{c}\mathbf{g}$	$-\frac{r}{c}\mathbf{g}$
$\boldsymbol{\omega}$	$-2\frac{\mathbf{r}}{r^2}$	$\frac{1}{\gamma c^2(X^2+Y^2)}\begin{bmatrix}-c^2(\gamma-1)X-\dot{X}\dot{Y}Y-X\dot{X}^2\\-c^2(\gamma-1)Y-\dot{X}\dot{Y}X-Y\dot{Y}^2\\0\end{bmatrix}$	$\frac{\gamma^3-1}{\gamma^3(X^2+Y^2)}\begin{bmatrix}-X\\-Y\\0\end{bmatrix}$
ω_0	$-\frac{c}{r}$	$-\frac{c}{r}$	$-\frac{c}{r}$
$\nabla\times\mathbf{g}$	$\mathbf{0}$	$\neq\mathbf{0}$	$\mathbf{0}$
$\nabla\times\mathbf{Q}$	$\mathbf{0}$	$\neq\mathbf{0}$	$\mathbf{0}$
$\boldsymbol{\omega}\times\mathbf{Q}$	$\mathbf{0}$	$\neq\mathbf{0}$	$\frac{GM(\gamma^3-1)}{cr^2\gamma^6(X^2+Y^2)}\begin{bmatrix}-YZ\\XZ\\0\end{bmatrix}$
$\boldsymbol{\Omega}$	$\mathbf{0}$	$\neq\mathbf{0}$	$\frac{GM(\gamma^3-1)}{cr^2\gamma^6(X^2+Y^2)}\begin{bmatrix}YZ\\-XZ\\0\end{bmatrix}$
ω_0 (Lindstrom)	$-\frac{3c}{r}$	$\neq\mathbf{0}$	$-\frac{c(2\gamma^3-1)}{\gamma^6 r}$

Table 1: Orbital and vacuum quantities for non-relativistic and relativistic orbits.

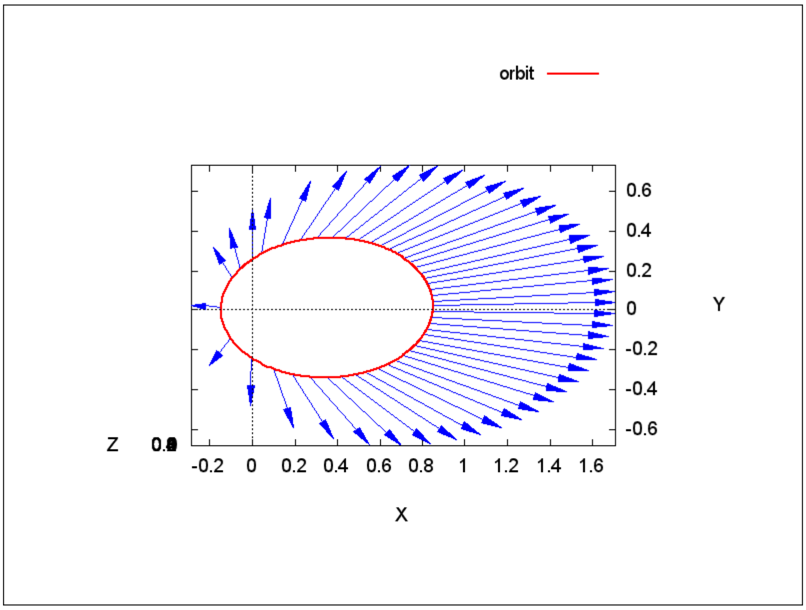

Figure 1: Path and vector spin connection $\boldsymbol{\omega}$ of a relativistic 2D orbit (graphically identical for forward and retrograde precession).

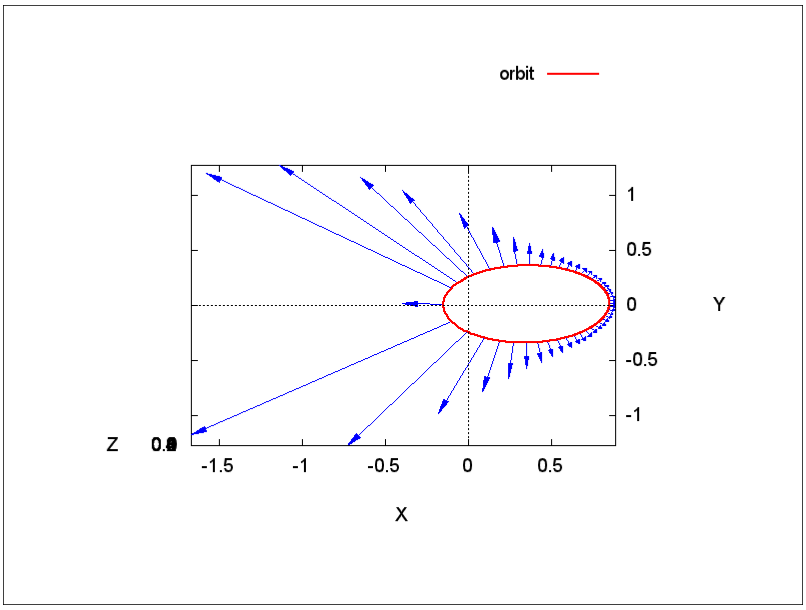

Figure 2: Path and difference of vector spin connections $\boldsymbol{\omega}$(forward) − $\boldsymbol{\omega}$(retrograde).

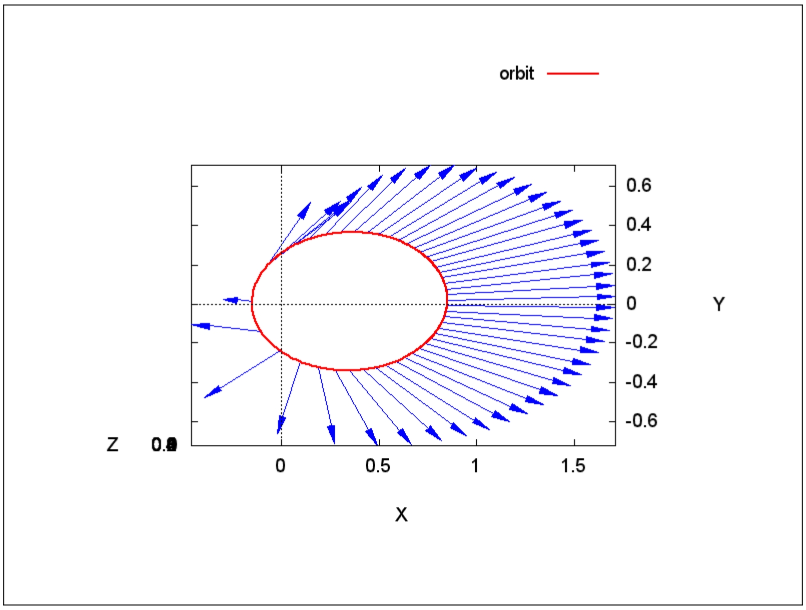

Figure 3: Gravitomagnetic field $\mathbf{\Omega}$ for retrograde precession, $Z = 0.1$.

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