SELF CONSISTENT METHODOLOGY FOR ECE2 GRAVITATION

by

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ABSTRACT

A rigorously self consistent methodology is developed for ECE2 gravitation, one which conserves the laws of trace, scalar and vector antisymmetry in ECE2 physics. The methodology is illustrated with orbital precession, bur is applicable to any type of data, for example deflection of electromagnetic radiation due to gravity, de Sitter and Lense Thirring precessions, equinoctial precessions, the velocity curve of a whirlpool galaxy, and retrograde precession.

Keywords: ECE2 physics, gravitation, rigorous conservation of antisymmetry, orbital precessions.

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INTRODUCTION

In recent papers of this series {1 - 12} new laws of conservation of antisymmetry have been discovered and developed systematically. In Section 2 of this paper rigorous self consistency is achieved by solving a system that is made up of ECE2 wave equations, field equations and trace, scalar and vector antisymmetry laws. The result is a richly powerful new theory of gravitation and indeed, all of physics, a theory that accounts for the structure of spacetime and which is all based self consistently on Cartan geometry.

This paper is a brief synopsis of detailed calculations in Notes accompanying UFT390 on www.aias.us. Note 390(1) considers the Newtonian and Coulombic limits, and introduces a new equation found by simultaneous solution of the wave equation and scalar antisymmetry law. Note 390(2) develops a detailed solution for orbital precession, Note 390(3) reveals a major self inconsistency in the Poisson equation of Newtonian physics, and corrects it with a wave equation for gravitation. Note 390(4) develops Note 390(4), and Note 390(5) is the basis of Section 2 of this paper.

Section 3 is a numerical and graphical analysis of novel aspects of ECE2 gravitation.

2. SELF CONSISTENT METHODOLOGY

In general, orbits are three dimensional, so the general gravitational scalar potential $\underline{\Phi}$ and vector potential $\underline{Q}$ are found from the source mass density (ρ_m) and current of source mass density (J_m) using the ECE wave equation {1 - 12}:

$$\Box \underline{\Phi} = 4\pi G \rho_m \quad - (1)$$

and

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

Numerical methods of solution are needed in general. The methodology is as follows.

1) The precession of orbits is a very tiny phenomenon in the solar system, in which the orbits appear to be planar but are nevertheless defined in three dimensional space. So to an excellent approximation, ths scalar potential is:

$$\underline{\Phi} = -\frac{MG}{r} . \quad -(3)$$

Note carefully that in three dimensions:

$$r = (X^2 + Y^2 + Z^2)^{1/2} \quad -(4)$$

and that r depends on time:

$$r = r(t) \quad -(5)$$

because it is the distance between a mass m orbiting a mass M. This distance is not constant in general, for example in an ellipse or hyperbola and their precessing counterparts.

2) Define the ECE2 hamiltonian:

$$H = \gamma mc^2 - \frac{mMG}{r} \quad -(6)$$

and lagrangian:

$$\mathcal{L} = -\frac{mc^2}{\gamma} + \frac{mMG}{r} \quad -(7)$$

in which:

$$r = (X^2 + Y^2 + Z^2)^{1/2} \quad -(8)$$

and in which the Lorentz factor is:

$$\gamma = \left(1 - \frac{v^2}{c^2} \right)^{-1/2} \quad -(9)$$

with velocity:

$$\underline{v} = \dot{X}\,\underline{i} + \dot{Y}\,\underline{j} + \dot{Z}\,\underline{k}. \quad -(10)$$

There are three proper Lagrange variables, X, Y, and Z. These define three Euler Lagrange equations which are solved for forward and retrograde precession as in previous work. This gives:

$$\underline{g} = \ddot{X}\,\underline{i} + \ddot{Y}\,\underline{j} + \ddot{Z}\,\underline{k}. \quad -(11)$$

3) Find the spin connection vector:

$$\underline{\omega} = \omega_X\,\underline{i} + \omega_Y\,\underline{j} + \omega_Z\,\underline{k} \quad -(12)$$

from

$$\underline{g} = -\underline{\nabla}\,\underline{\Phi} + \underline{\omega}\,\underline{\Phi} \quad -(13)$$

knowing $\underline{g}$, $\underline{\Phi}$ and $-\underline{\nabla}\,\underline{\Phi}$.

4) Find the gravitational vector potential:

$$\underline{Q} = Q_X\,\underline{i} + Q_Y\,\underline{j} + Q_Z\,\underline{k} \quad -(14)$$

from the vector antisymmetry law:

$$\frac{\partial Q_Z}{\partial Y} + \frac{\partial Q_Y}{\partial Z} = \omega_Y Q_Z + \omega_Z Q_Y \quad -(15)$$

$$\frac{\partial Q_X}{\partial Z} + \frac{\partial Q_Z}{\partial X} = \omega_Z Q_X + \omega_X Q_Z \quad -(16)$$

$$\frac{\partial Q_Y}{\partial X} + \frac{\partial Q_X}{\partial Y} = \omega_X Q_Y + \omega_Y Q_X \quad -(17)$$

according to the law of conservation of vector antisymmetry in ECE2 physics.

5) Find the gravitomagnetic field $\underline{\Omega}$ in three dimensions:

$$\underline{\Omega} = \underline{\nabla} \times \underline{Q} - \underline{\omega} \times \underline{Q} . \quad -(18)$$

6) Simultaneously solve the scalar wave equation (1) and the field equation:

$$\underline{\nabla} \cdot \underline{g} = 4\pi G \rho_m \quad -(19)$$

to give an equation previously unknown in the ECE development {1 - 12}:

$$\frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = \frac{1}{c^2}\frac{d^2 \Phi}{dt^2} = \underline{\nabla} \cdot (\underline{\omega} \Phi) \quad -(20)$$

and find $\partial \Phi / \partial t$ from integration of this equation.

7) Find ω_0, the scalar part of the spin connection four vector:

$$\omega^\mu = \left(\frac{\omega_0}{c}, \underline{\omega} \right) \quad -(21)$$

from the law of conservation of trace antisymmetry in ECE2 physics (the Lindstrom Law);

$$\frac{1}{c^2}\left(\frac{\partial}{\partial t} + \omega_0 \right) \Phi = \left(\underline{\nabla} - \underline{\omega} \right) \cdot \underline{Q} . \quad -(22)$$

The spin connection four vector can be graphed, and is a map of spacetime, (the aether or vacuum).

8) Find $\frac{\partial \underline{Q}}{\partial t}$ from the law of conservation of scalar antisymmetry

$$\underline{g} = -\underline{\nabla}\Phi + \underline{\omega}\,\Phi = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} \quad -(23)$$

in ECE2 physics.

This procedure conserves the laws of conservation of trac e, scalar and vector antisymmetry of ECE2 and can be applied to all problems of gravitation, not only precession. For example deflection of electromagnetic radiation by gravitation; Lense Thirring and de Sitter precession; equinoctial precession; retrograde precession and the velocity curve of a whirlpool galaxy, and evolution of the universe. This is work for future papers.

Eq. (20) is obeyed automatically in the classical limit of the ECE2 covariant theory, a limit defined by:

$$c \to \infty, \quad \underline{\omega} \to \underline{0}. \quad -(24)$$

In Note 390(5) it is shown in all detail that:

$$\frac{\partial^2 \Phi}{\partial t^2} = \frac{d^2 \Phi}{dt^2} \quad -(25)$$

is not zero in Newtonian or classical gravitation. For ECE2 covariant retrograde or forward precession, Eq. (20) must be solved knowing Φ and $\underline{\omega}$ to give:

$$\frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = \frac{1}{c^2}\frac{d^2 \Phi}{dt^2} \quad -(26)$$

in which c is the speed of light in vacuo. The resulting function:

$$\frac{d^2 \Phi}{dt^2} = -mG\frac{d^2}{dt^2}\left(\frac{1}{r(t)}\right) \quad -(27)$$

gives an equation for r(t). Note carefully that Φ is a function of r which is a function of t. The rule for differentiation of a function of a function must therefore be used:

$$\frac{d\Phi}{d\tau} = \frac{d\Phi}{dt}\frac{dt}{d\tau} \qquad (28)$$

In the Newtonian limit {1 - 12}:

$$\frac{dt}{d\tau} = \frac{dt}{d\phi}\frac{d\phi}{d\tau} = \frac{mr^2}{L}\frac{d\phi}{d\tau} \qquad (29)$$

where L is the conserved angular momentum, and Eq. (29) may be used as a rough approximation.

Section 3 by Horst Eckardt

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