THE NEW GENERAL RELATIVITY: SELF CONSISTENCY AND FIELD EQUATION

by

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ABSTRACT

Using a cyclic permutation of three chain rule equations the new general relativity is shown to be rigorously correct and self consistent. The orbital Evans identities are computed and shown to be two simultaneous equations which describe the time evolution of the orbit. These reduce to a simple differential equation which can be solved by computer.

Keywords: ECE theory, the new general relativity, the Evans orbital identities, time evolution and field equation.

4FT 207

1. INTRODUCTION

In recent papers of this series {1 - 10} it has been shown that the Einsteinian general relativity is trivially incorrect in many ways, and it has been replaced by efforts towards forging a new relativity based on special relativity developed straightforwardly into general relativity in the context of orbital dynamics. The method employed is to constrain the Minkowski metric with any observed orbit, so the new relativity is perfectly general. As shown in Section 2 of this paper the constraint reduces the dimensionality of the metric, and introduces a mathematical space in which Riemann torsion and curvature are non-zero. In the unconstrained space of the Minkowski metric of special relativity, all elements of torsion and curvature are zero. The infinitesimal line element may be deduced rigorously from the constrained metric. The constraint is the observed orbit itself, so in the new relativity the orbit is analysed in terms of torsion and curvature. There is one independent torsion element and two independent curvature elements for each observed orbit. So an ephemeris of all cosmology may be built up using torsion and curvature. In section 3 the field equation and time evolution equation of any orbit is deduced from the Evans identity {1 - 10}, which is a fundamental identity of geometry deduced during the evolution {1 - 10} of the ECE theory.

2. METRIC, LINE ELEMENT AND CONNECTIONS

Consider the Minkowski line element of special relativity in the plane:

$$d\tau^2 = 0 \qquad -(1)$$

of any planar orbit. In cylindrical polar coordinates {11} the line element ds^2 is related to the metric $g_{\mu\nu}$ by:

$$ds^2 = g_{\mu\nu}\, dx^\mu dx^\nu = c^2 dt^2 - dr^2 - r^2 d\theta^2 \quad -(2)$$

where

$$g_{00} = 1,\ g_{11} = -1,\ g_{22} = -1, \quad -(3)$$
$$dx^0 = c\,dt,\ dx^1 = dr,\ dx^2 = r\,d\theta.$$

Here c is the vacuum speed of light, assumed to be a constant. The cylindrical polar coordinates in the plane (1) are denoted (r , θ), and t is time. Any planar orbit is described by the orbital equation:

$$g = \frac{dr}{d\theta} = g\left(r(t), \theta(t)\right) \quad -(4)$$

in which $r(t)$ and $\theta(t)$ are both functions of time. Therefore the infinitesimal line element of any planar orbit may be written as:

$$ds^2 = c^2 dt^2 - dr^2 - \left(r\frac{d\theta}{dr}\right)^2 dr^2 \quad -(5)$$

in which:

$$dx^2 = \left(r\frac{d\theta}{dr}\right) dx^1 \quad -(6)$$

and:

$$ds^2 = g_{00}\, dx^0 dx^0 + g_{11}\, dx^1 dx^1 + g_{22}\left(r\frac{d\theta}{dr}\right)^2 dx^1 dx^1. \quad -(7)$$

Note carefully that the number of coordinates have been reduced from three to two. The spacetime becomes non-Minkowski in the sense that:

$$ds^2 = g_{00}\, dx^0 dx^0 + g'_{11}\, dx^1 dx^1, \quad -(8)$$

$$g'_{11} = g_{11} + f g_{22} \quad -(9)$$

where the function f is defined by:

$$f = \left(r \frac{d\theta}{dr} \right)^2. \quad -(10)$$

The metric of the new general relativity is therefore:

$$g_{\mu\nu} = \begin{bmatrix} 1 & 0 \\ 0 & -(1+f) \end{bmatrix}. \quad -(11)$$

Previous work {1 - 10} has shown that the connection is antisymmetric, and that the metric compatibility equation defines the one independent connection of any orbit as:

$$\Gamma^1_{01} = \frac{1}{2c\, g_{11}} \frac{\partial g_{11}}{\partial t} \quad -(12)$$

with, by definition of antisymmetry:

$$\Gamma^1_{01} = -\Gamma^1_{10}. \quad -(13)$$

In order to evaluate the connection consider the function f written out as follows in three cyclic permutations. If:

$$f = f(r(t), \theta(t)) \quad -(14)$$

then by the chain rule {12} of differentiation:

$$\frac{df}{dt} = \frac{\partial f}{\partial r}\frac{dr}{dt} + \frac{\partial f}{\partial \theta}\frac{d\theta}{dt}. \quad -(15)$$

Similarly, if:

$$f = f(t(\theta), r(\theta)) \quad -(16)$$

then:

$$\frac{df}{d\theta} = \frac{\partial f}{\partial r}\frac{dr}{d\theta} + \frac{\partial f}{\partial t}\frac{dt}{d\theta} \quad -(17)$$

Finally if:

$$f = f(\theta(r), t(r)) \quad -(18)$$

then:

$$\frac{df}{dr} = \frac{\partial f}{\partial \theta}\frac{d\theta}{dr} + \frac{\partial f}{\partial t}\frac{dt}{dr}. \quad -(19)$$

From Eqs. (15) and (19):

$$\frac{df}{dt} = \frac{\partial f}{\partial r}\frac{dr}{dt} + \frac{d\theta}{dt}\frac{dr}{d\theta}\left(\frac{df}{dr} - \frac{\partial f}{\partial t}\frac{dt}{dr}\right) \quad -(20)$$

so:

$$\frac{\partial f}{\partial t} = \frac{\partial f}{\partial r}\frac{dr}{dt}. \quad -(21)$$

From Eqs. (15) and (17) it may be shown similarly that:

$$\frac{\partial f}{\partial t} = \frac{\partial f}{\partial \theta}\frac{d\theta}{dt} \quad -(22)$$

From Eqs. (17) and (21):

$$\frac{\partial f}{\partial t} = \frac{d\theta}{dr}\frac{dr}{dt}\left(\frac{df}{d\theta} - \frac{\partial f}{\partial t}\frac{dt}{d\theta}\right) = \frac{df}{dt} - \frac{\partial f}{\partial t} \quad -(23)$$

therefore:

$$\frac{\partial f}{\partial t} = \frac{1}{2}\frac{df}{dt}. \quad -(24)$$

From Eqs. (15) and (22):

$$\frac{\partial f}{\partial t} = \frac{d\theta}{dt}\frac{dr}{d\theta}\left(\frac{df}{dr} - \frac{\partial f}{\partial t}\frac{dt}{dr}\right) = \frac{df}{dt} - \frac{\partial f}{\partial t} \quad -(25)$$

so the same result as Eq. (24) is obtained self consistently:

$$\frac{\partial f}{\partial t} = \frac{1}{2}\frac{df}{dt} \quad -(26)$$

Finally use:

$$\frac{df}{dt} = \frac{df}{d\theta}\frac{d\theta}{dt} \quad -(27)$$

to find that:

$$\frac{\partial f}{\partial t} = \frac{1}{2}\omega\frac{df}{d\theta} \quad -(28)$$

The function $df/d\theta$ can be found from any observed orbit, and the angular velocity:

$$\omega = \frac{d\theta}{dt} \quad -(29)$$

can be observed by astronomy. So the connection (12) can be found for any orbit.

3. TORSION, CURVATURE AND EVANS IDENTITY.

As in previous work and using computer algebra any orbit in the plane (1) is due to the connection:

$$\Gamma^1_{01} = -\Gamma^1_{10} = \frac{\partial f/\partial t}{2c(1+f)} . \quad -(30)$$

The single independent element of torsion of any planar orbit is twice the connection:

$$T^1_{01} = -T^1_{10} = \frac{\partial f/\partial t}{c(1+f)} . \quad -(31)$$

For any planar orbit of the type (1) there are two independent elements of curvature:

$$R^1_{001} = -R^1_{010} = -\frac{\left((1+f)\,\partial^2 f/\partial t^2 - (\partial f/\partial t)^2\right)}{2c^2(1+f)^2} \quad -(32)$$

and:

$$R^1_{101} = -R^1_{110} = \frac{(\partial f/\partial t)(\partial f/\partial r) - (1+f)\,\partial^2 f/\partial r\partial t}{2c(1+f)^2} \quad -(33)$$

Finally there are two equations of the Evans identity {1 - 10}:

$$D_0 T^1_{01} = R^1_{001} \quad -(34)$$

and

$$D_1 T^1_{10} = R^1_{110} \quad -(35)$$

for any planar orbit of cosmology. Computer algebra evaluates these to be:

$$6(1+f)\frac{\partial}{\partial t}\left(\frac{\partial f}{\partial t}\right) = 5\left(\frac{\partial f}{\partial t}\right)^2 \quad -(36)$$

and

$$(1+f)\frac{\partial}{\partial r}\left(\frac{\partial f}{\partial t}\right) = \frac{\partial f}{\partial r}\frac{\partial f}{\partial t}. \quad -(37)$$

These must be solved simultaneously. Denoting:

$$x = \frac{\partial f}{\partial t}, \quad y = \frac{\partial f}{\partial r} \quad -(38)$$

then dividing Eq. (36) by Eq. (37) it is found that:

$$6\frac{\partial x}{\partial t} = 5\frac{\partial x}{\partial t} \quad -(39)$$

Therefore:

$$\frac{\partial}{\partial t}\left(\frac{\partial f}{\partial t}\right) = 0. \quad -(40)$$

This is a type of conservation law for any planar orbit. It is a time evolution equation:

$$\frac{\partial}{\partial t}\left(\omega\frac{df}{d\theta}\right) = \frac{\partial \omega}{\partial t}\frac{df}{d\theta} + \omega\frac{\partial}{\partial t}\left(\frac{df}{d\theta}\right) = 0 \quad -(41)$$

which is true for any planar orbit. Its solution is:

$$\omega\frac{df}{d\theta} = A\,(\text{no explicit } t \text{ dependence}) \quad -(42)$$

an equation which may be integrated to give f in terms of two constants A and B:

$$f = \int \frac{\dot{A}}{\omega}\, d\theta . \quad -(43)$$

The second constant B is a constant of integration.

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