# ECE2 ORBITAL THEORY AND COUNTER GRAVITATION

by

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ABSTRACT

A new method is demonstrated of removing the internal indices from Cartan geometry, to give field and potential equations and antisymmetry conditions, and the Aharonov Bohm condition. These are used together with the ECE2 covariant lagrangian and hamiltonian to define the spin connections unequivocally and to define the conditions for zero gravitation. The orbit is defined under this condition.

Keywords: ECE2 theory, removal of internal indices in Cartan geometry, orbital theory and counter gravitation.

4FT 379

## 1. INTRODUCTION

In the immediately preceding paper of this series {1 - 12}, UFT378, it was shown that the ECE2 covariant lagrangian can produce both forward and retrograde precession, an advance on Einsteinian general relativity (EGR), which can only produce forward precession. In this paper a new method is given for removal of the tangent indices a and b in Cartan geometry. This method produces field equations which are of immediate use in physics and engineering, because they correct the standard model in a straightforward manner. The new method is applied to orbital theory and counter gravitation.

This paper is a brief synopsis of detailed calculations in notes for UFT379 on www.aias.us and www.upitec.org. Notes 379(1) to 379(4) give a summary of the ECE2 theory and its equations, and apply them to resonant counter gravitation using the ECE wave equation. These notes are an important background to this paper, UFT379. Note 379(5) reviews the basic Cartan geometry and introduces a new method of removing the indices a and b. Note 379(6) defines the condition for vanishing g, the acceleration due to gravity. Note 379(7) interprets the gravitational vector potential Q as particle linear velocity v. Note 379(8) is the basis for Section 2 of this paper, in which orbital theory and counter gravitational theory are both developed.

## 2. FIELD EQUATIONS, HAMILTONIAN AND LAGRANGIAN.

Consider the first Maurer Cartan structure equation {1 - 12}

$$T^a_{\mu\nu} = D_\mu q^a_\nu - D_\nu q^a_\mu \quad -(1)$$

where $T^a_{\mu\nu}$ is the torsion two-form, $q^a_\nu$ is the Cartan tetrad, and $D_\mu$ is the covariant derivative. The antisymmetry condition is:

$$D_\mu q^a_\nu = -D_\nu q^a_\mu \quad -(2)$$

because a two-form is antisymmetric by definition:

$$T^a_{\mu\nu} = -T^a_{\nu\mu}. \quad -(3)$$

By definition:

$$D_\mu q^a_\nu = \partial_\mu q^a_\nu + \omega^a_{\mu b} q^b_\nu \quad -(4)$$

where $\omega^a_{\mu b}$ is the Cartan spin connection.

By definition (Note 379(5)):

$$\omega^a_{\mu b} q^b_\nu = \omega^a_\mu q_\nu. \quad -(5)$$

Therefore the first structure equation can be reduced to

$$T^a_{\mu\nu} = \partial_\mu q^a_\nu - \partial_\nu q^a_\mu + \omega^a_\mu q_\nu - \omega^a_\nu q_\mu. \quad -(6)$$

With reference to UFT316 on www.aias.us and www.upitec.org multiply both sides of Eq. ( 6 ) by the unit vector - $e_a$ . It follows that:

$$T_{\mu\nu} = (\partial_\mu + \omega_\mu) q_\nu - (\partial_\nu + \omega_\nu) q_\mu \quad -(7)$$

Q. E. D. The internal indices a and b have been removed, thus simplifying the theory for practical applications. The antisymmetry law from Eq. ( 7 ) is:

$$(\partial_\mu + \omega_\mu) q_\nu = -(\partial_\nu + \omega_\nu) q_\mu \quad -(8)$$

in which the covariant derivative is:

$$D_\mu = \partial_\mu + \omega_\mu . \quad -(9)$$

The field tensor of electromagnetism {1 - 12} is:

$$F_{\mu\nu} = (\partial_\mu + \omega_\mu) A_\nu - (\partial_\nu + \omega_\nu) A_\mu \quad -(10)$$

with antisymmetry law:

$$(\partial_\mu + \omega_\mu) A_\nu = -(\partial_\nu + \omega_\nu) A_\mu . \quad -(11)$$

For the electric field:

$$F_{0\nu} = (\partial_0 + \omega_0) A_\nu - (\partial_\nu + \omega_\nu) A_0 . \quad -(12)$$

Now translate into vector notation using:

$$\partial_\mu = \left( \frac{1}{c} \frac{\partial}{\partial t}, \underline{\nabla} \right), \; A_\mu = \left( \frac{\phi}{c}, -\underline{A} \right), \; \omega_\mu = \left( \frac{\omega_0}{c}, -\underline{\omega} \right) \quad -(13)$$

and it follows as in Note 379(5) that:

$$\underline{E} = -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} - \underline{\nabla} \phi + \phi \underline{\omega} . \quad -(14)$$

Note that:

$$D_0 A_\nu \rightarrow -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} \quad -(15)$$

and

$$D_\nu A_0 \rightarrow \underline{\nabla} \phi - \phi \underline{\omega} \quad -(16)$$

so antisymmetry law translates as follows:

$$D_0 A_\nu = -D_\nu A_0$$

$$\longrightarrow -\frac{\partial \underline{A}}{\partial t} - \omega_0 \underline{A} = -\underline{\nabla}\phi + \phi\underline{\omega} \quad -(17)$$

The gravitational field is:

$$G_{\mu\nu} = Q^{(0)} T_{\mu\nu} \quad -(18)$$

and the gravitational potential is:

$$Q_\mu = Q^{(0)} V_\mu \quad -(19)$$

where $\underline{\Phi}$ and $\underline{Q}$ are the gravitational scalar and vector potentials. Therefore the acceleration due to gravity is

$$\underline{g} = -\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} - \underline{\nabla}\underline{\Phi} + \underline{\Phi}\underline{\omega} \quad -(20)$$

and the antisymmetry condition is:

$$-\frac{\partial \underline{Q}}{\partial t} - \omega_0 \underline{Q} = -\underline{\nabla}\underline{\Phi} + \underline{\Phi}\underline{\omega} \quad -(22)$$

so:

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

Zero gravitation is defined by:

$$\left(\frac{\partial}{\partial t} + \omega_0\right)\underline{Q} = \underline{0} \quad -(24)$$

and

$$\left(\underline{\nabla} - \underline{\omega}\right)\underline{\Phi} = \underline{0} \quad -(25)$$

and is defined in covariant notation by:

$$D_\mu Q_\nu = (\partial_\mu + \omega_\mu) Q_\nu = 0 \quad -(26)$$

This is the gravitational Aharonov Bohm condition.

Similarly, the electromagnetic Aharonov Bohm condition is:

$$D_\mu A_\nu = 0. \quad -(27)$$

If the spin connection is regarded as a small perturbation, then:

$$\Phi \sim -\frac{MG}{r} \quad -(28)$$

which is the Hooke Newton gravitational potential. Here a mass m orbits a mass M and r is the scalar distance between m and M. G is Newton's constant. From Eqs. ( 23) and ( 28 ), the force equation is:

$$\underline{F} = m\underline{g} = -\frac{mMG}{r^3}\underline{r} - \frac{mMG}{r}\underline{\omega}. \quad -(29)$$

The presence of a spin connection vector shows that this is a relativistic theory, it is ECE2 covariant, so its hamiltonian and lagrangian are as defined in UFT378:

$$H = \gamma mc^2 + U \quad -(30)$$

and

$$\mathcal{L} = -\frac{mc^2}{\gamma} - U \quad -(31)$$

where the potential energy is:

$$U = m\Phi \quad -(32)$$

and where the Lorentz factor is:

$$\gamma = \left(1 - \frac{v_0^2}{c^2}\right)^{-1/2} \quad - (33)$$

in which $\underline{v_0}$ is the Newtonian velocity in the non relativistic limit.

Eq. (29) in Cartesian component notation is:

$$\ddot{X} = -\frac{mG}{(X^2+Y^2)^{1/2}}\left(\frac{X}{X^2+Y^2} - \omega_X\right) \quad - (34)$$

and

$$\ddot{Y} = -\frac{mG}{(X^2+Y^2)^{1/2}}\left(\frac{Y}{X^2+Y^2} - \omega_Y\right) \quad - (35)$$

in which the spin connection vector is:

$$\underline{\omega} = \omega_X \underline{i} + \omega_Y \underline{j}. \quad - (36)$$

The orbit obtained from Eqs. (34) and (35) must be the same as the orbit obtained in UFT378 from the hamiltonian and lagrangian. Therefore the spin connection vector can be found by a method such as two variable least mean squares curve fitting {1 - 12}.

Similarly:

$$-\left(\frac{\partial}{\partial t} + \omega_0\right) Q_X = -\frac{mG}{(X^2+Y^2)^{1/2}}\left(\frac{X}{X^2+Y^2} - \omega_X\right) \quad - (37)$$

and

$$-\left(\frac{\partial}{\partial t} + \omega_0\right) Q_Y = -\frac{mG}{(X^2+Y^2)^{1/2}}\left(\frac{Y}{X^2+Y^2} - \omega_Y\right) \quad - (38)$$

Therefore $Q_X$ and $Q_Y$ can be found numerically. In the non relativistic limit the spin connection vanishes so:

$$\frac{\partial Q_X}{\partial t} = \frac{mGX}{(X^2+Y^2)^{3/2}} \quad -(39)$$

and

$$\frac{\partial Q_Y}{\partial t} = \frac{mGY}{(X^2+Y^2)^{3/2}} . \quad -(40)$$

Knowing the time dependencies:

$$X = X(t),\ Y = Y(t) \quad -(41)$$

the gravitational vector potential can be found:

$$\underline{Q} = Q_X \underline{i} + Q_Y \underline{j} . \quad -(42)$$

Additional information is available as in UFT378 through the ECE2 gravitational Coulomb law:

$$\underline{\nabla} \cdot \underline{g} = \underline{\kappa} \cdot \underline{g} = 4\pi G \rho_m \quad -(43)$$

where $\rho_m$ is the experimentally measurable mass density of M, and where $\underline{\kappa}$ is the kappa vector. From Eqs. ( 23 ) and ( 43 ):

$$\nabla^2 \Phi - \underline{\omega} \cdot \underline{\nabla} \Phi - \Phi \underline{\nabla} \cdot \underline{\omega} = \underline{\kappa} \cdot \underline{g} = 4\pi G \rho_m . \quad -(44)$$

In the non relativistic limit Eq. ( 44) becomes the Poisson equation {1 - 12}:

$$\nabla^2 \Phi = -4\pi G \rho_m \quad -(45)$$

with well known analytical solutions.

Zero gravitation occurs under the condition:

$$\nabla^2 \underline{\Phi} = \underline{\nabla} \cdot (\underline{\Phi}\, \underline{\omega}) \quad -(46)$$

i. e.

$$\underline{\nabla}\, \underline{\Phi} = \underline{\omega}\, \underline{\Phi}. \quad -(47)$$

In the non relativistic limit this condition is equvalent to the Laplace equation:

$$\nabla^2 \underline{\Phi} = 0 \quad -(48)$$

which again has well known analytical solutions {1 - 12}. When $\underline{g}$ is zero, $\underline{\Phi}$ and $\underline{Q}$ are in general non zero, a gravitational Aharonov Bohm effect which does not occur in the standard model. The spin connection for zero gravitation can be found bu solving Eqs. ( 47) and (48 ). From eqs. ( 34 ) and ( 35 ) the orbit under zero gravitation is found by solving :

$$\frac{X}{X^2 + Y^2} = -mG\omega_X \quad -(49)$$

and

$$\frac{Y}{X^2 + Y^2} = -mG\omega_Y \quad -(50)$$

3. NUMERICAL METHODS AND GRAPHICS

Section by Dr. Horst Eckardt

# ECE2 orbital theory and counter gravitation

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## 3 Numerical methods and graphics

In the Newtonian limit, from Eqs. (39,40) follows that

$$\ddot{X} = -\dot{Q}_X, \tag{51}$$

$$\ddot{Y} = -\dot{Q}_Y. \tag{52}$$

In this case $\mathbf{Q}$ is the inverse of the particle velocity $\mathbf{v}$:

$$\mathbf{v} = -\mathbf{Q}. \tag{53}$$

In the case of antigravity (if the gravitational force is completely canceled out) the particle is held at rest (or in a linear motion) by the field potential $\mathbf{Q}$, i.e. is free of gravity in a gravitational field. This means that

$$\ddot{X} = 0, \tag{54}$$

$$\ddot{Y} = 0. \tag{55}$$

From Eqs. (34,35) then follows:

$$\omega_X = \frac{X}{X^2 + Y^2}, \tag{56}$$

$$\omega_Y = \frac{Y}{X^2 + Y^2}. \tag{57}$$

Both the orbits $(X, Y)$ and $(\omega_X, \omega_Y)$ are graphed in Fig. 1 for a model system with elliptic orbit. The spin connection trajectory is symmetrical relative to the axis $Y = 0$.

Alternatively, antigravity can be obtained by defining a scalar spin connection $\omega_0$ in such a way that it cancels out the time derivatives of $Q_X$ and $Q_Y$ in Eqs. (37,38). These conditions can be formulated as:

$$\omega_0 = -\frac{1}{Q_X}\frac{\partial Q_X}{\partial t} = -\frac{\ddot{X}}{\dot{X}}, \tag{58}$$

$$\omega_0 = -\frac{1}{Q_Y}\frac{\partial Q_Y}{\partial t} = -\frac{\ddot{Y}}{\dot{Y}}. \tag{59}$$

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This gives two possible and different conditions for $\omega_0$ which have to be fulfilled both in the case of exact antigravity. For graphical representation, both possible values have been considered as point coordinates $(\omega_0(X), \omega_0(Y))$. Then the graph of Fig. 2 results. There are several hyperbolic curves because at return points of the orbit (in both coordinate directions) it is $\dot{X} = 0$ and $\dot{Y} = 0$. The curves are close together so that it can be expected that both antigravity conditions (58,59) are realizeable to a sufficient extent.

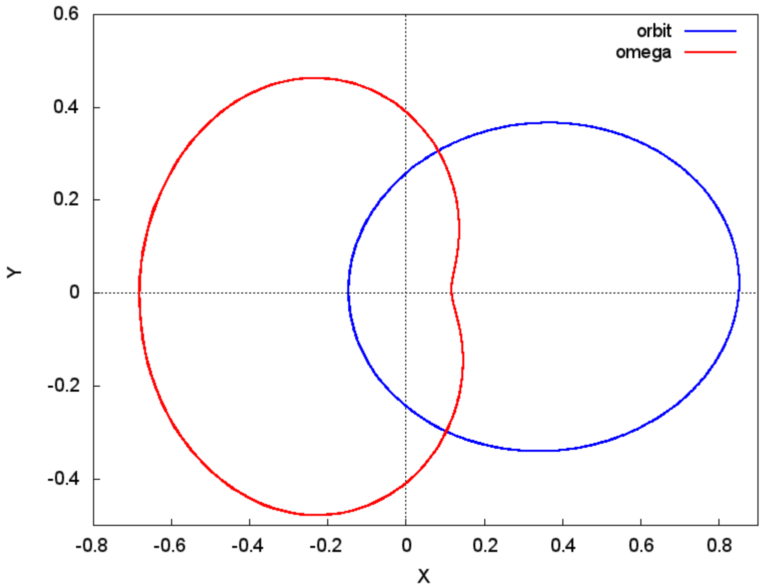


Figure 1: Path and vector spin connection $\boldsymbol{\omega}$ of a 2D elliptic orbit.

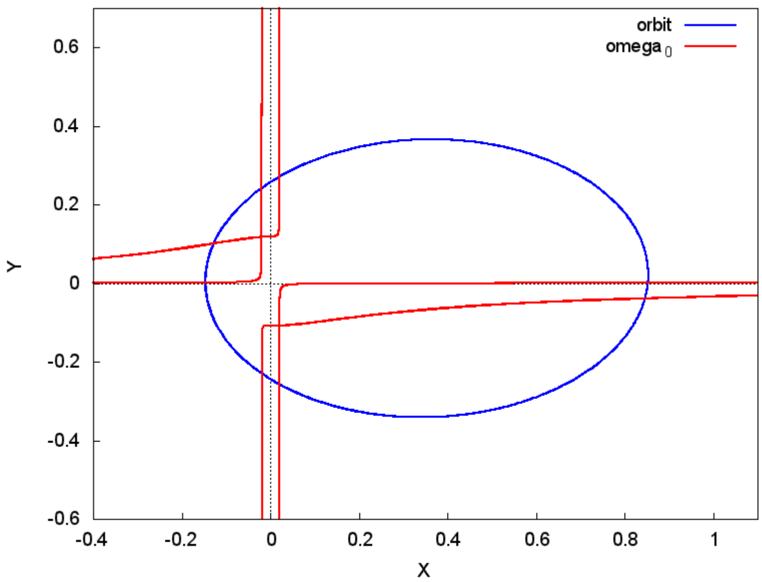


Figure 2: Path and scalar spin connection $\omega_0$ of a 2D elliptic orbit.

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