ORBITAL THEORY IN A FLUID SPACETIME

by

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ABSTRACT

By considering the convective or Lagrange derivative of the general vector field, orbital theory in classical dynamics is extended to orbital theory in fluid dynamics within the context of ECE2 generally covariant unified field theory. The Lagrange derivative is developed as a Cartan covariant derivative. It is shown that if sapcetime (or the ather or vacuum) is considered to be a fluid, classical orbital theory is changed by the presence of additional spin connection components.

Keywords: ECE2 theory, orbital theory in fluid dynamics.

UFT362

1. INTRODUCTION

In recent papers of this series {1-12} the subject areas of gravitation, fluid dynamics, classical dynamics and gravitation have been shown to be examples of ECE2 unified field theory. Earlier papers of this series (www.aias.us and www.upitec.org) have shown that the unified field theory also encompasses nuclear physics. In this paper it is shown that orbital theory in classical dynamics is affected if the orbit is considered to take place in a spacetime or vacuum that is considered to have a fluid structure. The relevant derivatives of orbital theory are shown to be generally covariant Cartan derivatives of differential geometry. The Cartan derivative generalizes the material, convective or Lagrange derivative of fluid mechanics. If the background spacetime or ether or vacuum in which the orbit takes place is a fluid, then the orbit becomes different from the familiar result of classical dynamics. These differences may well be observable in such effects as precession of the perihelion.

This paper is meant to be a concise synopsis of detailed calculations in the accompanying background notes to UFT362 on www.aias.us. The reader is referred to these notes for more detail. Note 362(1) is a preliminary development of the convective derivative in a plane polar coordinates system. The final form of this note is note 362(5), on which Section 2 of this paper is based. In Note 362(2) the concept of an elliptical polar system of coordinates is introduced in order to eliminate a self inconsistency of the plane polar system. This elliptical polar system is developed further in UFT363 in preparation. Note 362(3) is a clarification of Note 362(1). In note 362(4) it is shown that the well known expressions for velocity and acceleration in the plane polar system are examples of the Cartan covariant derivative in which the spin connection is the rotation generator of the plane polar frame.

In Section 2 the convective derivative of the general vector field $\underline{V}$ is calculated, and used to show that the familiar orbital theory of classical dynamics is affected if the orbit is assumed to take place in a vacuum that is considered to be a fluid, and not in a vacuum considered to be a "nothingness" as in classical dynamics.

In Section 3, the effect of the background aether on the Coriolis velocity is evaluated and graphed numerically..

2. EFFECT OF A FLUID SPACETIME ON ORBITAL THEORY

Consider the convective or Lagrange derivative of the general vector field $\underline{V}$:

$$\frac{D\underline{V}}{Dt} = \frac{\partial \underline{V}}{\partial t} + (\underline{v} \cdot \underline{\nabla})\underline{V} \quad -(1)$$

where:

$$\underline{V} = \underline{V}(t, r(t), \theta(t)) - (2)$$

in plane polar coordinates used for orbital theory. It is seen that $\underline{V}$ is a function of t, r(t) and $\theta(t)$. Here $\underline{v}$ is the velocity field:

$$\underline{v} = \underline{v}(t, r(t), \theta(t)). - (3)$$

In plane polar coordinates Eq. (1) becomes:

$$\begin{aligned}\frac{D\underline{V}}{Dt} &= \frac{\partial \underline{V}}{\partial t} + \left(v_r \frac{\partial}{\partial r} + \frac{v_\theta}{r}\frac{\partial}{\partial \theta}\right)\left(V_r \underline{e}_r + V_\theta \underline{e}_\theta\right) \\ &= \frac{\partial \underline{V}}{\partial t} + v_r \frac{\partial}{\partial r}\left(V_r \underline{e}_r\right) + \frac{v_\theta}{r}\frac{\partial}{\partial \theta}\left(V_r \underline{e}_r\right) \\ &\quad + v_r \frac{\partial}{\partial r}\left(V_\theta \underline{e}_\theta\right) + \frac{v_\theta}{r}\frac{\partial}{\partial \theta}\left(V_\theta \underline{e}_\theta\right)\end{aligned}$$

$$= \frac{\partial \underline{V}}{\partial t} + V_r \left(\frac{\partial V_r}{\partial r} \underline{e}_r + V_r \frac{\partial \underline{e}_r}{\partial r} \right) + \frac{V_\theta}{r} \left(\frac{\partial V_r}{\partial \theta} \underline{e}_r + V_r \frac{\partial \underline{e}_r}{\partial \theta} \right)$$

$$+ V_r \left(\frac{\partial V_\theta}{\partial r} \underline{e}_\theta + V_\theta \frac{\partial \underline{e}_\theta}{\partial r} \right) + \frac{V_\theta}{r} \left(\frac{\partial V_\theta}{\partial \theta} \underline{e}_\theta + V_\theta \frac{\partial \underline{e}_\theta}{\partial \theta} \right) \quad -(4)$$

where the Leibnitz Theorem has been used. In plane polar coordinates it is well known that:

$$\frac{\partial \underline{e}_r}{\partial r} = \underline{0}, \quad \frac{\partial \underline{e}_\theta}{\partial r} = \underline{0},$$

$$\frac{\partial \underline{e}_r}{\partial \theta} = \underline{e}_\theta, \quad \frac{\partial \underline{e}_\theta}{\partial \theta} = -\underline{e}_r, \quad -(5)$$

so the convective derivative of $\underline{V}$ is:

$$\frac{D\underline{V}}{Dt} = \frac{\partial \underline{V}}{\partial t} + \left(V_r \frac{\partial V_r}{\partial r} + \frac{V_\theta}{r} \frac{\partial V_r}{\partial \theta} - \frac{V_\theta}{r} V_\theta \right) \underline{e}_r$$

$$+ \left(V_r \frac{\partial V_\theta}{\partial r} + \frac{V_\theta}{r} \frac{\partial V_\theta}{\partial \theta} + \frac{V_\theta}{r} V_r \right) \underline{e}_\theta \quad -(6)$$

where:

$$\frac{V_\theta}{r} = \dot{\theta} = \frac{d\theta}{dt} = \omega. \quad -(7)$$

Here $\underline{\omega}$ is the angular velocity of the rotating plane polar frame. In component format Eq. (6) is:

$$\frac{D}{Dt}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} + \begin{bmatrix} \frac{\partial V_r}{\partial r} & \frac{1}{r}\frac{\partial V_r}{\partial \theta} \\ \frac{\partial V_\theta}{\partial r} & \frac{1}{r}\frac{\partial V_\theta}{\partial \theta} \end{bmatrix}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} \quad -(8)$$

where the complete vector $\underline{V}$ is:

$$\underline{V} = V_r\left(t, r(t), \theta(t)\right)\underline{e}_r + V_\theta\left(t, r(t), \theta(t)\right)\underline{e}_\theta . \quad -(9)$$

Here $\underline{e}_r$ and $\underline{e}_\theta$ are the unit vectors of the plane polar system. In classical dynamics the vector field $\underline{V}$ reduces to a time dependent vector of classical dynamics:

$$\underline{V} = \underline{V}(t) \quad -(10)$$

and has no functional dependence on r(t) and $\theta(t)$. This is the key difference between classical dynamics and fluid dynamics. In classical dynamics therefore:

$$\frac{D}{Dt}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix}\begin{bmatrix} V_r \\ V_\theta \end{bmatrix} \quad -(11)$$

and this result is assumed implicitly in orbital theory and cosmology.

The assumption (10) simplifies Eq. (6) to:

$$\frac{D\underline{V}}{Dt} = \frac{\partial \underline{V}}{\partial t} - \dot{\theta} V_\theta \underline{e}_r + \dot{\theta} V_r \underline{e}_\theta \quad -(12)$$

which is the Cartan derivative of ECE2 theory {1 - 12} with spin connection:

$$\omega^a{}_b = \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix} . \quad -(13)$$

This is the rotation generator of the axes of the plane polar system. In Note 362(4) it is shown in all detail that if $\underline{V}(t)$ represents the time dependent position vector $\underline{r}(t)$ of the plane polar system, then the orbital velocity is given by the Cartan derivative:

$$\frac{D}{Dt}\begin{bmatrix} r \\ 0 \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} r \\ 0 \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix}\begin{bmatrix} r \\ 0 \end{bmatrix}. \quad -(14)$$

In vector notation the orbital velocity is the familiar:

$$\underline{v} = v_r \underline{e}_r + v_\theta \underline{e}_\theta = \dot{r}\,\underline{e}_r + r\dot{\theta}\,\underline{e}_\theta \quad -(15)$$

of the classical dynamics of rotating systems. If $\underline{V}(t)$ represents the time dependent velocity vector $\underline{v}(t)$ of the plane polar system then the orbital acceleration is given by the Cartan derivative:

$$\frac{D}{Dt}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix}. \quad -(16)$$

In vector notation this is the familiar acceleration in the plane polar system:

$$\underline{a} = a_r \underline{e}_r + a_\theta \underline{e}_\theta = (\ddot{r} - r\dot{\theta}^2)\underline{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\underline{e}_\theta. \quad -(17)$$

The terms in $\underline{e}_\theta$ are the Coriolis accelerations. In previous UFT papers it has been shown that the Coriolis accelerations disappear for any planar orbit in classical dynamics:

$$r\ddot{\theta} + 2\dot{r}\dot{\theta} = 0 \quad -(18)$$

so the acceleration of a planar orbit in classical dynamics is:

$$\underline{a} = (\ddot{r} - r\dot{\theta}^2)\underline{e}_r \quad -(19)$$

leading to the well known Leibnitz equation:

$$\underline{F} = m\underline{a} = m(\ddot{r} - \omega^2 r)\underline{e}_r = -\frac{mMG}{r^2}\underline{e}_r. \quad -(20)$$

In classical dynamics the background spacetime (or vacuum or aether) is a "nothingness". This is an anthropomorphic assumption originating in the seventeenth century. It is well known in contemporary physics that the vacuum is richly structured. If it is assumed that the vacuum is governed by fluid dynamics, as in recent papers of the UFT series, then the spin connection (13) of classical dynamics becomes the following spin connection of fluid dynamics:

$$\omega^a{}_{ob} V^b + \Omega^a{}_{ob} v^b = \begin{bmatrix} \frac{\partial V_r}{\partial r} & \frac{1}{r}\frac{\partial V_r}{\partial \theta} \\ \frac{\partial V_\theta}{\partial r} & \frac{1}{r}\frac{\partial V_\theta}{\partial \theta} \end{bmatrix} \begin{bmatrix} v_r \\ v_\theta \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix} \begin{bmatrix} V_r \\ V_\theta \end{bmatrix} \quad -(21)$$

The Coriolis velocity of an orbit is generalized to:

$$\frac{D}{Dt}\begin{bmatrix} r \\ 0 \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} r \\ 0 \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix}\begin{bmatrix} r \\ 0 \end{bmatrix} + \begin{bmatrix} \Omega^1{}_{01} & \Omega^1{}_{02} \\ \Omega^2{}_{01} & \Omega^2{}_{02} \end{bmatrix}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} \quad -(22)$$

and the Coriolis acceleration of an orbit is generalized to:

$$\frac{D}{Dt}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} = \frac{\partial}{\partial t}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 & -\dot{\theta} \\ \dot{\theta} & 0 \end{bmatrix} + \begin{bmatrix} \Omega^1{}_{01} & \Omega^1{}_{02} \\ \Omega^2{}_{01} & \Omega^2{}_{02} \end{bmatrix}\begin{bmatrix} \dot{r} \\ r\dot{\theta} \end{bmatrix} \quad -(23)$$

where:

$$\begin{bmatrix} \Omega^1{}_{01} & \Omega^1{}_{02} \\ \Omega^2{}_{01} & \Omega^2{}_{02} \end{bmatrix} = \begin{bmatrix} \frac{\partial V_r}{\partial r} & \frac{1}{r}\frac{\partial V_r}{\partial \theta} \\ \frac{\partial V_\theta}{\partial r} & \frac{1}{r}\frac{\partial V_\theta}{\partial \theta} \end{bmatrix}. \quad -(24)$$

The switch from classical to fluid dynamics means that:

$$r(t) \rightarrow r(t, r(t), \theta(t)), \quad -(25)$$

$$v(t) \rightarrow v(t, r(t), \theta(t)). \quad -(26)$$

For example, the usual orbital velocity components:

$$v_r = \dot{r} \quad -(27)$$

$$v_\theta = \omega r \quad -(28)$$

are generalized by using:

$$v_r = \dot{r} + \Omega^1{}_{01}\,\dot{r} + \Omega^1{}_{02}\,\omega r \quad -(29)$$

$$v_\theta = \omega r + \Omega^2{}_{01}\,\dot{r} + \Omega^2{}_{02}\,\omega r \quad -(30)$$

so they become:

$$v_r = \left(1 + \Omega^1{}_{01}\right)\dot{r} + \Omega^1{}_{02}\,\omega r, \quad -(31)$$

$$v_\theta = \left(1 + \Omega^2{}_{01}\right)\omega r + \Omega^2{}_{01}\,\dot{r}. \quad -(32)$$

The complete Coriolis velocity is:

$$\underline{v} = v_r\,\underline{e}_r + v_\theta\,\underline{e}_\theta \quad -(33)$$

and the square of the orbital velocity is:

$$v^2 = v_r^2 + v_\theta^2. \quad -(34)$$

The familiar Newtonian result:

$$v^2 = MG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(35)$$

is changed by the presence of a fluid spacetime, aether or vacuum. In Eq. (35) a is the semi major axis of an elliptical orbit of an object m around an object M fixed at one focus of the ellipse. Here G is Newton's constant. It may well be possible to explain orbital precession with spin connection components of the aether.

3. NUMERICAL ANALYSIS AND GRAPHICS OF THE AETHER EFFECT

Section by Dr. Horst Eckardt

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REFERENCES

{1} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "Principles of ECE" (open source on www.aias.us , , hardback 2026 www.epubli.de Berlin and softback 2016 New Generation, London, Spanish translation by Alex Hill on www.aias.us)

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

{3} M .W. Evans, H. Eckardt and D. W. Lindstrom, "Generally Covariant Unified Field Theory (Abramis 2005 to 2011 and open source in relevant UFT papers), softback in seven volumes.

{4} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, open source as UFT302, Spanish translation by Alex Hill on www.aias.us).

{5} H. Eckardt, "The Engineering Model" (UFT303).

{6} M. W. Evans, "Collected Scientometrics" (UFT307 and New Generation 2015).

{7} M .W. Evans, Ed. J. Found. Phys. Chem. (CISP 2011 and relevant UFT papers).

{8} M. W. Evans, Ed. "Definitive Refutations of the Einsteinian General Relativity" (CISP 2012, open source www.aias.us).

{9} M. W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(3)

Field" (World Scientific 2001, Omnia Opera of www.aias.us).

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

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

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