ECE2 FLUID GRAVITATION AND THE PRECESSING ORBIT.

by

M .W. Evans and H. Eckardt,

Civil List and AIAS / UPITEC

(www.aias.us, www.upitec.org, www.et3m.net, www.archive.org, www.webarchive.org.uk)

ABSTRACT

It is shown that a precessing planar orbit is produced by ECE2 fluid gravitation, using a general theory based on the Hamilton Principle of Least Action and the lagrangian of fluid dynamics. The correct Euler Lagrange equation and canonical formulation is defined. Orbital precession is caused by a fluid spacetime described by the classical equations of fluid dynamics. Any coordinate system can be used, and it is shown that precession is produced by Cartesian coordinates.

Keywords: ECE2 fluid gravitation, orbital precession in a plane, gravitational Navier Tokes equation.

4FT 374

1. INTRODUCTION

In preceding papers of this series {1 - 12} it has been shown that ECE2 fluid gravitation produces orbital precession, notably in UFT363. In Section 2 the theory of UFT363 is developed with the Hamilton principle of least action and a generally valid classical, canonical formulation of fluid gravitation. The canonical formulation is valid for any coordinate system and is exemplified by the production of a precessing planar orbit on the classical level using Cartesian coordinates. Therefore Einstein's general relativity is unnecessary as well as being erroneous in many well known ways {1-12}. This paper is a brief synopsis of extensive calculations contained in the notes accompanying UFT374 on combined sites (www.aias.us and www.upitec.org) and in the web archives (www.archive.org and www.webarchive.org.uk) .

Note 374(1) describes orbital precession in an incompressible fluid spacetime. Notes 374(2), 374(3) and 374(7) give all details of the general canonical theory of fluid gravitation, using the Hamilton principle of least action and the Lagrange and Hamilton equations of motion. A simple and useful lagrangian is derived for fluid gravitation and fluid dynamics in general. Note 374(4) introduces a time dependence into the spin connection defined in UFT363. Note 374(5) gives the general planar orbit of fluid gravitation and defines the transition to Newtonian orbital theory. Note 374(6) defines the gravitational Navier Stokes, continuity and vorticity equations.

Section 3 is a numerical and graphical analysis, and shows that orbital precession can be produced on the classical level using Cartesian coordinates. This means that it is not necessary to use relativity to produce a precessing orbit, although ECE2 relativity is necessary in other contexts, and also produces precession. The Einstein theory of orbital precession is unnecessary and contains many errors {1 - 12} as is well known.

2 CANONICAL FORMULATION OF FLUID GRAVITATION.

Consider the velocity field of fluid spacetime {1 - 12} or aether:

$$\underline{v} = \underline{v}\left(r(t), \phi(t), t\right) \qquad -(1)$$
$$= v_r \underline{e}_r + v_\phi \underline{e}_\phi$$

in plane polar coordinates (r, ϕ). As in UFT361 the total time derivative of the velocity field is the convective or Lagrange derivative:

$$\frac{d\underline{v}}{dt} = \frac{\partial \underline{v}}{\partial t} + \frac{dr}{dt}\frac{\partial \underline{v}}{\partial r} + \frac{d\phi}{dt}\frac{\partial \underline{v}}{\partial \phi}$$
$$= \left(\frac{\partial v_r}{\partial t} + v_r \frac{\partial v_r}{\partial r} + \frac{v_\phi}{r}\frac{\partial v_r}{\partial \phi} - \frac{v_\phi^2}{r}\right)\underline{e}_r + \left(\frac{\partial v_\phi}{\partial t} + v_r \frac{\partial v_\phi}{\partial r} + \frac{v_\phi}{r}\frac{\partial v_\phi}{\partial \phi} + \frac{v_\phi v_r}{r}\right)\underline{e}_\phi$$
$$= \frac{\partial \underline{v}}{\partial t} + (\underline{v}\cdot\underline{\nabla})\underline{v} \qquad -(2)$$

where:
$$(\underline{v}\cdot\underline{\nabla})\underline{v} = \left(v_r \frac{\partial v_r}{\partial r} + \frac{v_\phi}{r}\frac{\partial v_r}{\partial \phi}\right)\underline{e}_r \qquad -(3)$$
$$+ \left(v_r \frac{\partial v_\phi}{\partial r} + \frac{v_\phi}{r}\frac{\partial v_\phi}{\partial \phi}\right)\underline{e}_\phi .$$

These are equations of fluid ECE2 covariant fluid gravitation defined by the gravitational Navier Stokes equation:

$$m\frac{d\underline{v}}{dt} = m\left(\frac{\partial \underline{v}}{\partial t} + (\underline{v}\cdot\underline{\nabla})\underline{v}\right) = -\frac{mMG}{r^2}\underline{e}_r \qquad -(4)$$

in any coordinate system. In Section 3 the Cartesian system of coordinates is shown to produce orbital precession from Eq. (4).

The transition to classical, single particle, dynamics is defined by:

$$\underline{v}(r(t), \phi(t), t) \rightarrow \underline{v}(t) \quad -(5)$$

i. e. by:

$$(\underline{v} \cdot \underline{\nabla})\underline{v} \rightarrow \underline{0}. \quad -(6)$$

In the limit of classical, single particle dynamics:

$$\frac{d\underline{v}}{dt} \rightarrow \frac{\partial \underline{v}}{\partial t} = (\ddot{r} - r\dot{\phi}^2)\underline{e}_r + (r\ddot{\phi} + 2\dot{r}\dot{\phi})\underline{e}_\phi$$

$$= -\frac{mG}{r^2}\underline{e}_r \quad -(7)$$

i.e.

$$\frac{\partial v_r}{\partial r} = \frac{\partial v_r}{\partial \phi} = \frac{\partial v_\phi}{\partial r} = \frac{\partial v_\phi}{\partial \phi} \rightarrow 0. \quad -(8)$$

The ECE2 equation of fluid gravitation is:

$$\frac{\partial \underline{v}}{\partial t} + (\underline{v} \cdot \underline{\nabla})\underline{v} = -\frac{mG}{r^2}\underline{e}_r \quad -(9)$$

and can be identified with the gravitational Navier Stokes equation of classical fluid dynamics. It is shown in note 374(6) that the continuity equation of fluid gravitation is:

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

where

$$V = 1/\rho \quad -(11)$$

is the specific volume of fluid spacetime. This is the equation of conservation of matter in the fluid spacetime. In plane polar coordinates:

$$\underline{\nabla} \cdot \underline{v} = \frac{1}{V}\frac{dV}{dt} = -\frac{1}{\rho}\frac{\partial \rho}{\partial t}. \quad -(12)$$

It follows that:

$$\underline{\nabla} \cdot \underline{v} = \frac{1}{r} v_r + \frac{\partial v_r}{\partial r} + \frac{1}{r} \frac{\partial v_\phi}{\partial \phi} = \frac{1}{V} \frac{\partial V}{\partial t}. \quad -(13)$$

In the limit of classical dynamics:

$$\frac{\partial v_r}{\partial r} \rightarrow 0, \quad \frac{\partial v_\phi}{\partial \phi} \rightarrow 0 \quad -(14)$$

so from Eq. (12):

$$\frac{1}{r} v_r \rightarrow \frac{1}{V} \frac{\partial V}{\partial t} \quad -(15)$$

i. e.

$$\frac{\dot{r}}{r} \rightarrow \frac{1}{V} \frac{\partial V}{\partial t}. \quad -(16)$$

If the fluid spacetime is incompressible:

$$\frac{\partial V}{\partial t} \rightarrow 0 \quad -(17)$$

so

$$\frac{\dot{r}}{r} \rightarrow 0. \quad -(18)$$

Eq. (18) corresponds to a circular obit, in which

$$\dot{r} = 0. \quad -(19)$$

The area and volume of the orbit do not change with time.

The orbital vorticity equation is calculated from:

$$\underline{\nabla} \times \left(\frac{\partial \underline{v}}{\partial t} + (\underline{v} \cdot \underline{\nabla}) \underline{v} \right) = -MG \, \underline{\nabla} \times \left(\frac{1}{r^2} \underline{e}_r \right) = \underline{0} \quad -(20)$$

and as shown in Note 374(6) is:

$$\frac{\partial \underline{w}}{\partial t} + (\underline{v} \cdot \underline{\nabla}) \underline{w} = (\underline{w} \cdot \underline{\nabla}) \underline{v} - \underline{w} (\underline{\nabla} \cdot \underline{v}) \quad -(21)$$

where

$$\underline{w} = \underline{\nabla} \times \underline{v} \quad -(22)$$

is the vorticity of fluid spacetime. Eq. (21) is the equation of conservation of angular momentum of fluid spacetime.

In the Newtonian limit the gravitational Navier Stokes equation reduces to:

$$m \frac{\partial \underline{v}}{\partial t} = -\frac{mMG}{r^2} \underline{e}_r \quad -(23)$$

so the gravitational vorticity equation reduces to:

$$\underline{v} \times \frac{d \underline{v}}{dt} = \underline{0} \quad -(24)$$

i.e.:

$$\frac{\partial \underline{w}}{\partial t} = \underline{0} . \quad -(25)$$

In plane polar coordinates:

$$\frac{\partial \underline{v}}{\partial t} = (\ddot{r} - r\dot{\phi}^2) \underline{e}_r + (2\dot{r}\dot{\phi} + r\ddot{\phi}) \underline{e}_\phi = (\ddot{r} - r\dot{\phi}^2) \underline{e}_r \quad -(26)$$

because:

$$2\dot{r}\dot{\phi} + r\ddot{\phi} = 0. \quad -(27)$$

So in the Newtonian limit:

$$\underline{\nabla} \times \left(\left(\ddot{r} - r\dot{\phi}^2 \right) \underline{e}_r \right) = \underline{0}. \quad -(28)$$

The relevant acceleration is defined by:

$$\underline{a} = a_r \underline{e}_r = \left(\ddot{r} - r\dot{\phi}^2 \right) \underline{e}_r \quad -(29)$$

so in plane polar coordinates:

$$\underline{\nabla} \times \underline{a} = \left(\frac{1}{r}\frac{\partial a_Z}{\partial \phi} - \frac{\partial a_\phi}{\partial Z} \right) \underline{e}_r + \left(\frac{\partial a_r}{\partial Z} - \frac{\partial a_Z}{\partial r} \right) \underline{e}_\phi + \frac{1}{r}\left(\frac{\partial (r a_\phi)}{\partial r} - \frac{\partial a_r}{\partial \phi} \right) \underline{k} \quad -(30)$$

because:

$$a_Z = a_\phi = 0 \quad -(31)$$

It follows that

$$\frac{\partial a_r}{\partial Z} = \frac{\partial a_r}{\partial \phi} = 0 \quad -(32)$$

in the Newtonian limit, in which the orbit is an ellipse.

The orbit from ECE2 fluid gravitation is however, a precessing ellipse. This is an important result and is illustrated in Section 3 using Cartesian coordinates. Provided that the spacetime is considered to be a fluid aether, precession of a planar orbit is produced by the classical equations of fluid dynamics.

The gravitational Navier Stokes equation (9) is produced from the lagrangian

$$\mathcal{L} = \frac{1}{2} m \underline{\dot{r}} \cdot \underline{\dot{r}} + mMG / |\underline{r}| \quad -(33)$$

where:

$$\underline{r} = \underline{r}\left(r(t), \phi(t), t\right) \quad -(34)$$

is the vector field of the position of an element of fluid spacetime. The Euler Lagrange equation of relevance is:

$$\frac{\partial \mathcal{L}}{\partial \underline{r}} = \frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{\underline{r}}}\right). \quad -(35)$$

From Hamilton's principle of least action the lagrangian must have the functional dependence:

$$\mathcal{L} = \mathcal{L}\left(\underline{r}, \dot{\underline{r}}\right). \quad -(36)$$

The velocity field is defined by the convective derivative of the position element:

$$\underline{v} = \frac{\partial \underline{r}}{\partial t} + \left(\underline{v} \cdot \underline{\nabla}\right)\underline{r}. \quad -(37)$$

Note carefully that the potential energy:

$$U = -\frac{mMG}{|\underline{r}|} \quad -(38)$$

can be a function of r(t) and $\phi(t)$. In classical gravitational theory it is a function only of r as is well known.

Note 374(2) is a summary of the canonical formulation of classical dynamics, whose hamiltonian is:

$$H = \frac{1}{2m}\underline{p}\cdot\underline{p} - \frac{mMG}{r} \quad -(39)$$

and whose lagrangian is:

$$\mathcal{L} = \frac{1}{2m}\underline{p}\cdot\underline{p} + \frac{mMG}{r} \quad -(40)$$

The Lagrange equations of motion are:

$$\underline{p} = \frac{\partial \mathcal{L}}{\partial \underline{\dot{r}}} \quad -(41)$$

and

$$\underline{\dot{p}} = \frac{\partial \mathcal{L}}{\partial \underline{r}} \quad -(42)$$

and the relation between the hamiltonian and lagrangian is:

$$H = \underline{p} \cdot \underline{\dot{r}} - \mathcal{L}. \quad -(43)$$

The Hamilton, or canonical, equations of motion are:

$$\underline{\dot{r}} = \frac{\partial H}{\partial \underline{p}} \quad -(44)$$

and

$$\underline{\dot{p}} = -\frac{\partial H}{\partial \underline{r}}. \quad -(45)$$

In plane polar coordinates:

$$\underline{v} = \underline{\dot{r}} = \dot{r}\,\underline{e}_r + r\,\underline{\dot{e}}_r = \dot{r}\,\underline{e}_r + r\dot{\phi}\,\underline{e}_\phi \quad -(46)$$

so:

$$H = m\underline{v}\cdot\underline{v} - \mathcal{L} = \frac{1}{2}m\underline{\dot{r}}\cdot\underline{\dot{r}} - \frac{mMG}{r} \quad -(47)$$

and the classical momentum is:

$$\underline{p} = \frac{\partial \mathcal{L}}{\partial \underline{\dot{r}}} = m\underline{\dot{r}}. \quad -(48)$$

Note carefully that the correct Euler Lagrange equation in classical dynamics is:

$$\frac{\partial \mathcal{L}}{\partial \underline{r}} = \frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{\underline{r}}}\right) \quad -(49)$$

where:

$$\mathcal{L} = \frac{1}{2m}\,\dot{\underline{r}} \cdot \dot{\underline{r}} + \frac{mMG}{|\underline{r}|}. \quad -(50)$$

It follows that:

$$\frac{d}{dt}\left(\frac{\partial \mathcal{L}}{\partial \dot{\underline{r}}}\right) = m\ddot{\underline{r}}. \quad -(51)$$

By definition:

$$\frac{1}{r} = \frac{1}{|\underline{r}|} = \frac{1}{(\underline{r}\cdot\underline{r})^{1/2}} \quad -(52)$$

so:

$$\frac{\partial}{\partial \underline{r}}\left(\frac{1}{(\underline{r}\cdot\underline{r})^{1/2}}\right) = -\frac{1}{2}(\underline{r}\cdot\underline{r})^{-3/2}(2\underline{r}) = -\frac{1}{r^2}\underline{e}_r \quad -(53)$$

where we have used:

$$\underline{r} = r\,\underline{e}_r. \quad -(54)$$

Therefore:

$$\frac{\partial \mathcal{L}}{\partial \underline{r}} = -\frac{mMG}{r^2}\underline{e}_r \quad -(55)$$

and the Euler Lagrange equation (49) gives:

$$\underline{F} = m\ddot{\underline{r}} = -\frac{mMG}{r^2}\underline{e}_r. \quad -(56)$$

Q. E. D.

The basis of the Lagrangian method is the Hamilton principle of least action:

$$\int (T - U)\, dt = 0 \quad -(57)$$

where the kinetic and potential energies must have a functional dependence as follows:

$$T = T(\dot{x}_i), \quad U = U(x_i). \quad -(58)$$

The lagrangian (49) is:

$$\mathcal{L} = \mathcal{L}(\underline{r}, \dot{\underline{r}}) \quad -(59)$$

and has the required functional dependence, as discussed in detail in Note 374(3), which

shows that classical dynamics leads to:

$$\ddot{r} - r\dot{\phi}^2 = -mG / r^2 \quad -(60)$$

$$2\dot{r}\dot{\phi} + r\ddot{\phi} = 0 \quad -(61)$$

$$\dot{\phi} = \frac{L}{mr^2}. \quad -(62)$$

These have been solved numerically in this work (see Section 3) to give the well known

elliptical (or conic section) orbit:

$$r = \frac{\alpha}{1 + \epsilon \cos\phi} \quad -(63)$$

Here α is the observable half right latitude and ϵ is the observable eccentricity.

The angular momentum magnitude L in Eq. (62) is a constant of motion obtained from:

$$\underline{L} = \underline{r} \times \underline{p}. \quad -(64)$$

Eqs. (60) to (62) are solved numerically using Maxima to give the differential orbital

function:

$$\frac{dr}{d\phi} = \frac{\dot{r}}{\dot{\phi}} \quad -(65)$$

and the orbit:

$$r = \int \frac{dr}{d\phi} d\phi. \quad -(66)$$

In UFT363, the gravitational Navier Stokes equation (9) was approximated to give the momentum:

$$\underline{p} = m\underline{v} = m\left(x\dot{r}\,\underline{e}_r + r\dot{\phi}\,\underline{e}_\phi\right) \quad -(67)$$

where:

$$x = 1 + \frac{\partial R_r}{\partial r} \quad -(68)$$

with:

$$R_r = R_r\left(r(t), \phi(t), t\right). \quad -(69)$$

The simultaneous equations (60) to (62) are modified to:

$$x\ddot{r} - r\dot{\phi}^2 = -mG/r^2 \quad -(70)$$

$$(x+1)\dot{r}\dot{\phi} + r\ddot{\phi} = 0 \quad -(71)$$

$$\dot{\phi} = \frac{L}{mr^2}\,; \quad -(72)$$

when solved numerically these equations give a precessing ellipse as observed in astronomy. The x factor can be considered to be time dependent as in Note 374(4). The result is again a precessing ellipse.

Note carefully that the lagrangian from Eqs. (40) and (67) is:

$$\mathcal{L} = \frac{1}{2} m \left(x^2 \dot{r}^2 + r^2 \dot{\phi}^2 \right) + \frac{mMG}{r} . \quad -(73)$$

However, if it is assumed that the proper Lagrange variables are r and ϕ The Euler Lagrange equation:

$$\frac{\partial \mathcal{L}}{\partial r} = \frac{d}{dt} \left(\frac{\partial \mathcal{L}}{\partial \dot{r}} \right) \quad -(74)$$

gives the incorrect equation:

$$x^2 \ddot{r} = r \dot{\phi}^2 - \frac{MG}{r^2} . \quad -(75)$$

The correct equation is:

$$x \ddot{r} = r \dot{\phi}^2 - \frac{MG}{r^2} . \quad -(76)$$

The use of Eq. (74) is incorrect because the lagrangian (73) does not satisfy the fundamental functional requirement (58) of the Hamilton principle of least action. The lagrangian (73) contains a kinetic energy:

$$T = \frac{1}{2} m \left(x^2 \dot{r}^2 + r^2 \dot{\phi}^2 \right) \quad -(77)$$
$$= T (x^2, \dot{r}, \dot{\phi}) .$$

The required format of kinetic energy is:

$$T = T (\dot{r}, \dot{\phi}) . \quad -(78)$$

The equation (74) is fortuitously correct if and only if:

$$x = 1 \quad -(79)$$

which is true only in the Newtonian limit of classical dynamics. For fluid gravitation the general canonical formalism must always be used.

These points are illustrated in Section 3, where a precessing orbit is obtained on the classical level with Cartesian coordinates.

3. COMPUTATION AND GRAPHICS

Section by Dr. Horst Eckardt

ECE2 fluid gravitation and the precessing orbit

M. W. Evans[*], H. Eckardt[†]
Civil List, A.I.A.S. and UPITEC

(www.webarchive.org.uk, www.aias.us,
www.atomicprecision.com, www.upitec.org)

3 Computation and graphics

3.1 Models for R_r

We start the numerical results section of central motion with a model for the spin connection function R_r defined in Eq. (69). R_r enters the function x of (68) which appears in the equations of motion (70-71). With the approach

$$\frac{\partial R_r(r)}{\partial r} = 1 + f(r) \tag{80}$$

the equations of motion take the form:

$$\ddot{\phi} = -\frac{(\mathrm{f}(r)+2)\ \dot{r}\,\dot{\phi}}{r}, \tag{81}$$

$$\ddot{r} = \frac{r\,\dot{\phi}^2}{\mathrm{f}(r)+1} - \frac{MG}{r^2(\mathrm{f}(r)+1)}. \tag{82}$$

During all calculations we used a model with $m = 1, M = 10, G = 1$. In Fig. 1 the resulting orbit is graphed with parameters

$$f(r) = a_0, \tag{83}$$

$$a_0 = -0.06. \tag{84}$$

This gives a constant function R_r and the result should be comparable with the model of a constant spin connection which was already investigated in UFT363. As can be seen from Fig. 1, there is a clear precession of the elliptic orbit as was found in UFT363.

Then a less trivial model with

$$f(r) = a_0\,r, \tag{85}$$

$$a_0 = -0.006 \tag{86}$$

was used and the results are graphed in Fig. 2. There is a precession too. The radial variation of R_r obviously does not change the type of deviation from the

*email: emyrone@aol.com
†email: mail@horst-eckardt.de

Newtonian elliptic orbit. That the orbit is not Newtonian can also be seen from Fig. 3 where the angular momentum

$$L = mr^2\dot{\phi} \tag{87}$$

is displayed. This shows a significant variation over time, correlated with the position of the mass m in the orbit.

3.2 Models for x

Next we investigated a time-dependence of the function x. Then the normalized equations of motion (70-71) read:

$$\ddot{\phi} = -\frac{\dot{r}\dot{\phi}(x+1)}{r}, \tag{88}$$

$$\ddot{r} = \frac{1}{x}\left(r\dot{\phi}^2 - \frac{MG}{r^2}\right). \tag{89}$$

The coefficients of the differential equations now dependent on time by $x(t)$. When defining a periodic time dependence

$$x = 1 + a_0 \sin\left(\frac{t}{2}\right) \tag{90}$$

with $a_0 = 0.03$ we obtain the result of Fig. 4. This orbit is an ellipse with varying radius but no visible precession. Obviously a time dependence of x effects a different type of behaviour than a radial dependence, at least in this example. The corresponding angular momentum is graphed in Fig. 5, manifesting a variation on a time scale smaller than a full orbit. This is the effect of the oscillatory term in Eq. (90).

3.3 Models for a fluid velocity field

The general planar orbit of fluid gravitation is defined by a velocity field $v(r(t), \phi(t), t)$, see the gravitational Navier Stokes equation (4). The x factor can be integrated into the fluid velocity as worked out in note 374(5). The approach for the components of v is:

$$v_r = x\,\dot{r}, \tag{91}$$

$$v_\phi = r\,\dot{\phi} \tag{92}$$

with a full coordinate dependence of x:

$$x = x(r(t), \phi(t), t). \tag{93}$$

The appearance of v leads to a different set of equations of motion compared to (88-89), therefore we have to introduce a factor s to "switch on" the fluid velocity in a continuous transition:

$$v_r = s\,x\,\dot{r}, \tag{94}$$

$$v_\phi = s\,r\,\dot{\phi} \tag{95}$$

$$\tag{96}$$

with $0 \leq s \leq 1$. This gives an extended set of equations of motion:

$$\ddot{\phi} = -\frac{\dot{r}\dot{\phi}(s^2 x + x + 1)}{r}, \tag{97}$$

$$\ddot{r} = \frac{1}{x}\left(r\dot{\phi}^2 - \dot{r}\dot{x} - \dot{r}^2 \frac{\partial x}{\partial r} - \dot{r}\,\dot{\phi}\,\frac{\partial x}{\partial \phi}(s^2+1) - \frac{MG}{r^2} \right) - s^2 \dot{r}^2 \frac{\partial x}{\partial r}. \tag{98}$$

All partial derivatives of x appear in the above equation. We consider a model with an oscillatory ϕ dependence:

$$x = 1 + a_0 \sin(\phi/2). \tag{99}$$

Setting $a_0 = 0, s = 1$ leads to $x = 1$, describing a model with a factor of 3 instead of 2 in Eq. (61). The result is an elliptical rosette orbit as shown in Fig. 7. This makes clear that we need a possibility for reducing the effect of fluid velocity to achieve a continuous transition from an orbit with no fluid velocity. The solution is introducing the factor s as described above.

Another example is $a_0 = 0.2, s = 0.1$: This gives a kind of elliptical spiral, see Fig. 7. Very exotic orbits are possible by corresponding choice of parameters.

3.4 Fluid velocity models with Cartesian coordinates

So far we haave used planar polar coordinates. We can use Cartesian coordinates instead. We investigate a model of simplified fluid dynamics by adding a velocity term $v(X,Y,t)$ to the kinetic energy term in the Lagrangian:

$$\mathscr{L} = \frac{m}{2}\left((\dot{X} + \dot{v}_X)^2 + (\dot{Y} + \dot{v}_Y)^2 \right) + \frac{mMG}{(X^2+Y^2)^{3/2}}. \tag{100}$$

The Lagrange formalism leads to an extended set of equations of motion:

$$\ddot{X} = \left(\dot{X} + v_X\right)\frac{\partial v_X}{\partial X} + \left(\dot{Y} + v_Y\right)\frac{\partial v_Y}{\partial X} - \dot{v}_X - MG\frac{X}{(X^2+Y^2)^{3/2}}, \tag{101}$$

$$\ddot{Y} = \left(\dot{Y} + v_Y\right)\frac{\partial v_Y}{\partial Y} + \left(\dot{X} + v_X\right)\frac{\partial v_X}{\partial Y} - \dot{v}_Y - MG\frac{Y}{(X^2+Y^2)^{3/2}}. \tag{102}$$

Our first model for the velocity is:

$$v_X = a_0 X, \tag{103}$$

$$v_Y = a_0 Y. \tag{104}$$

Then for the equations of motion (101-102) follows:

$$\ddot{X} = a_0^2 X - MG\frac{X}{(X^2+Y^2)^{3/2}}, \tag{105}$$

$$\ddot{Y} = a_0^2 Y - MG\frac{Y}{(X^2+Y^2)^{3/2}}. \tag{106}$$

There is an additional linear term appearing. There are no centrifugal or Coriolis terms since Cartesian coordinates represent a static frame where these effects are all contained in. When setting $a_0 = 0.05$, we obtain the result graphed in Fig. 8 which is a rosette orbit very similar to that in in Fig. 6. Obviously precession of orbits can be obtained in various ways. A second, slightly more complicated model is

$$v_X = a_0 X^2, \tag{107}$$
$$v_Y = a_0 Y^2. \tag{108}$$

This leads to cubic terms in the equations of motion:

$$\ddot{X} = a_0^2 X^3 - MG\frac{X}{(X^2+Y^2)^{3/2}}, \tag{109}$$
$$\ddot{Y} = a_0^2 Y^3 - MG\frac{Y}{(X^2+Y^2)^{3/2}}. \tag{110}$$
$$\tag{111}$$

We have to reduce the parameter to $a_0 = 0.005$ to obtain non-diverging solutions. In this case it is an orbit which is periodic in multiples of 2π, see Fig. 9. In total we see that fluid dynamics effect can alter orbits to all kinds of exotic motion. The universe is a source of multifaceted discoveries.

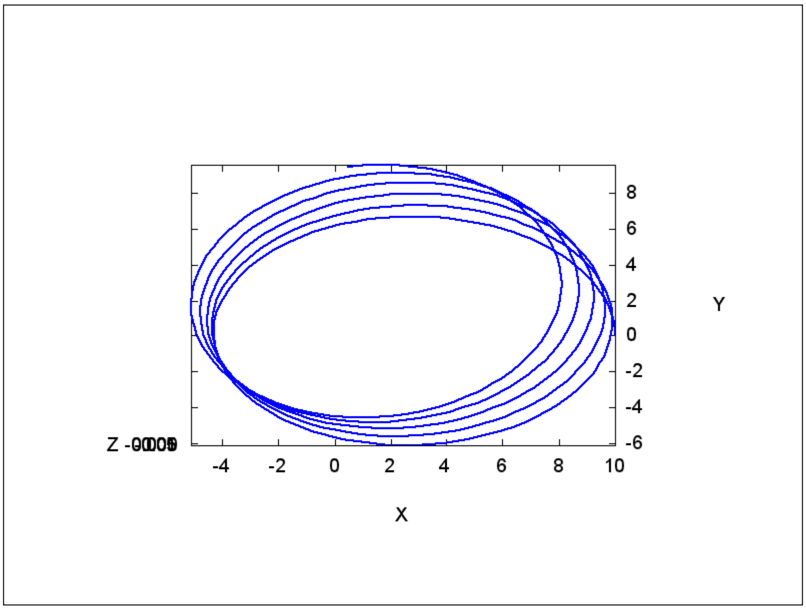

Figure 1: Orbit of model $f(r) = a_0$, Eqs. (80-82).

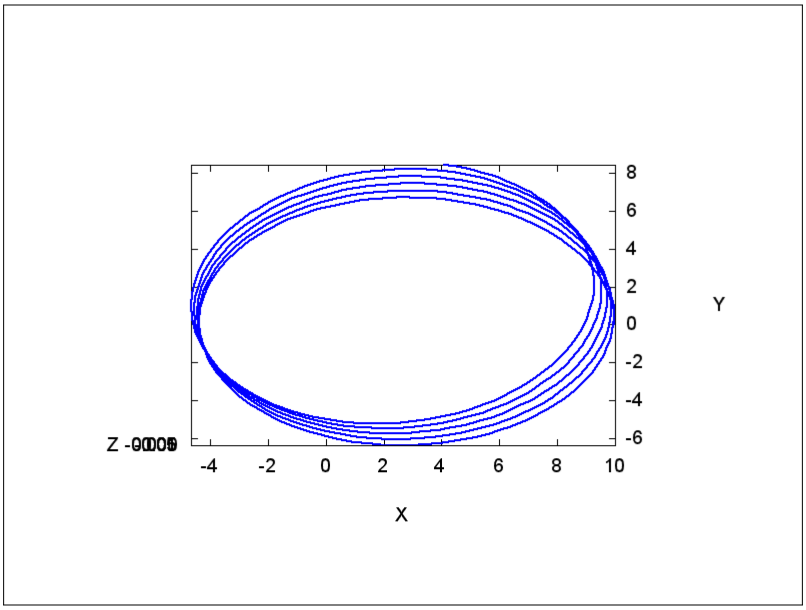

Figure 2: Orbit of model $f(r) = a_0\, r$, Eqs. (80-82).

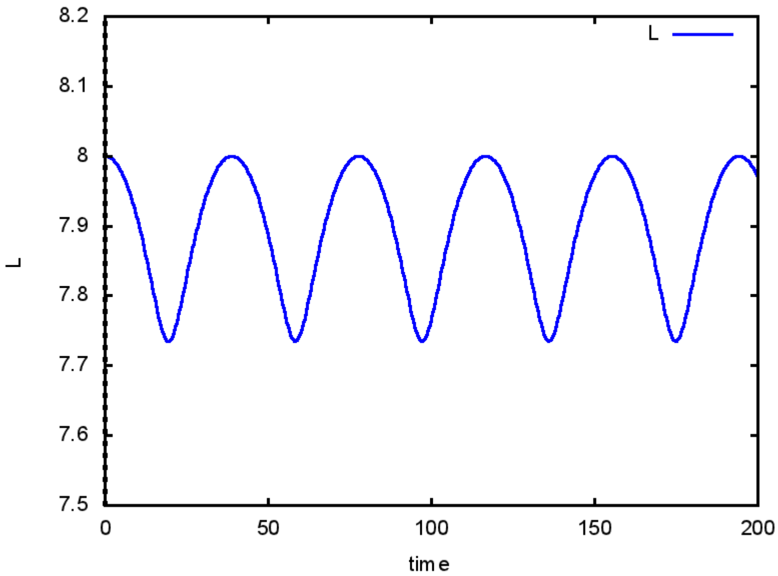

Figure 3: Angular momentum corresponding to orbit of Fig. 2.

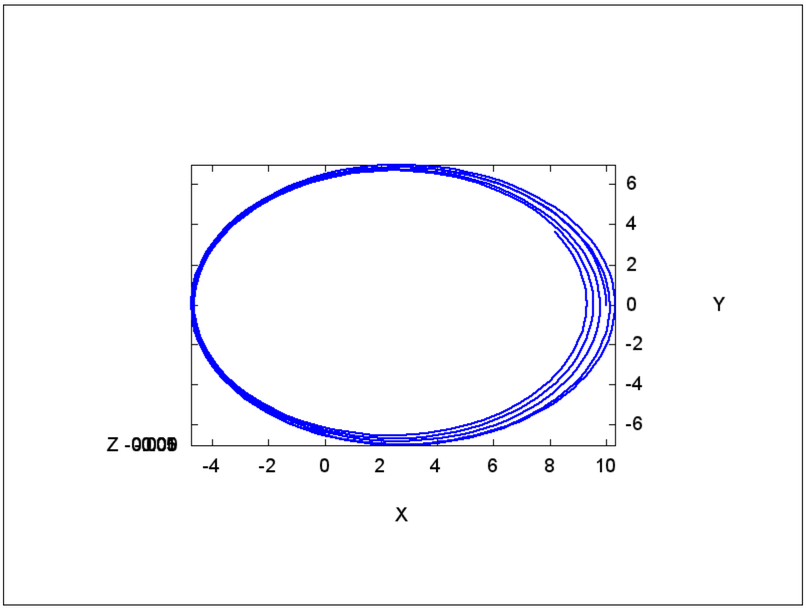

Figure 4: Orbit of x model defined in (90).

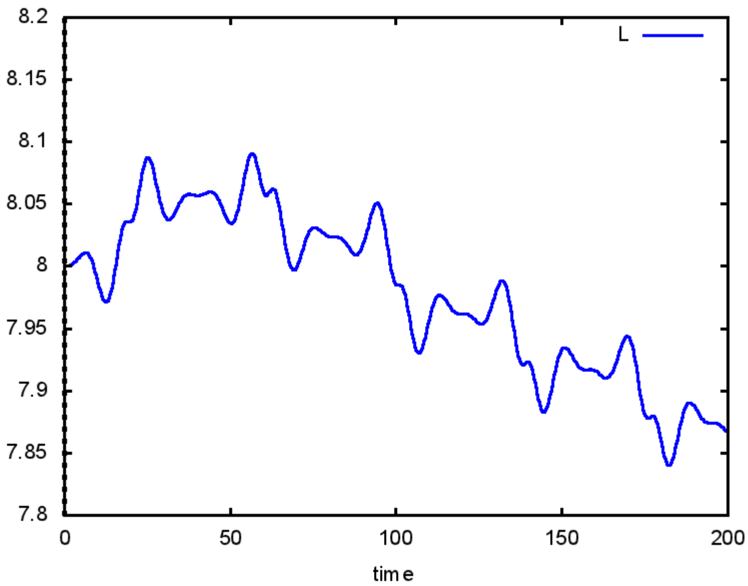

Figure 5: Angular momentum corresponding to orbit of Fig. 4.

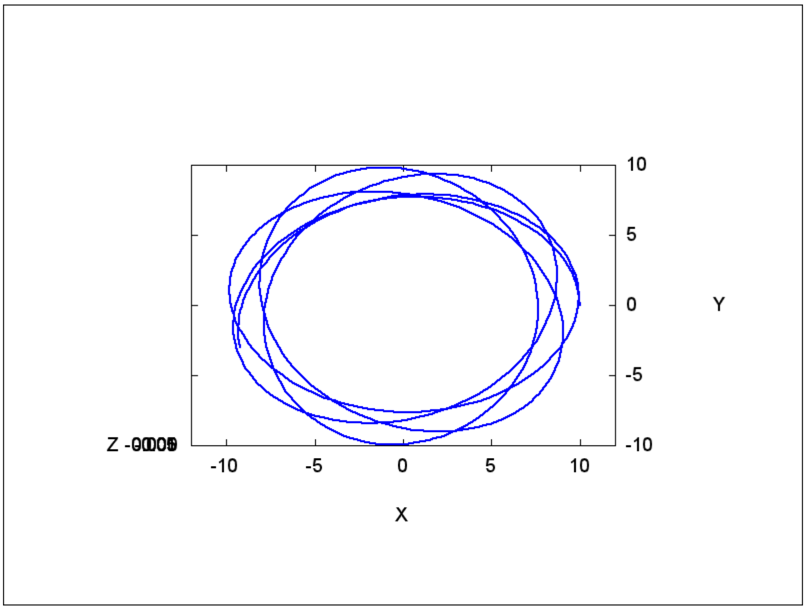

Figure 6: Orbit of fluid velocity model with $x = 1$.

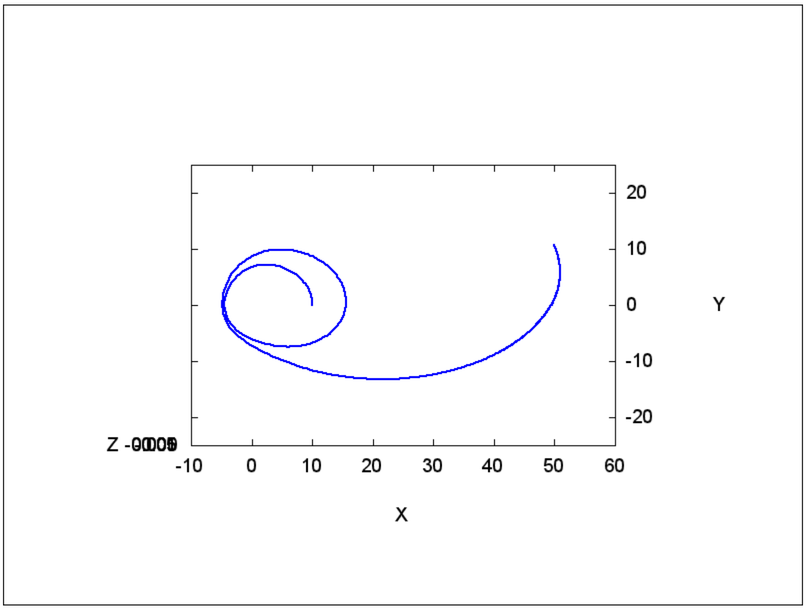

Figure 7: Orbit of fluid velocity model from Eq. (99).

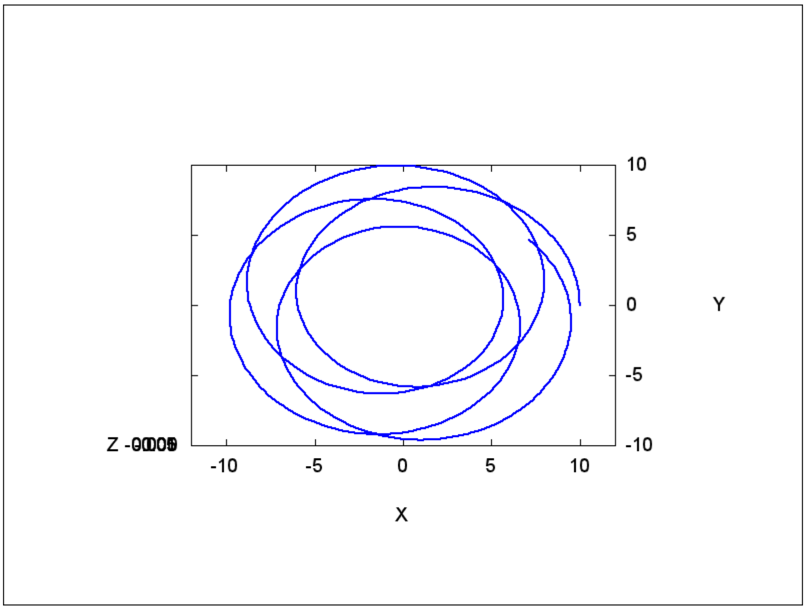

Figure 8: Orbit of Cartesian fluid velocity model from Eqs. (103-104).

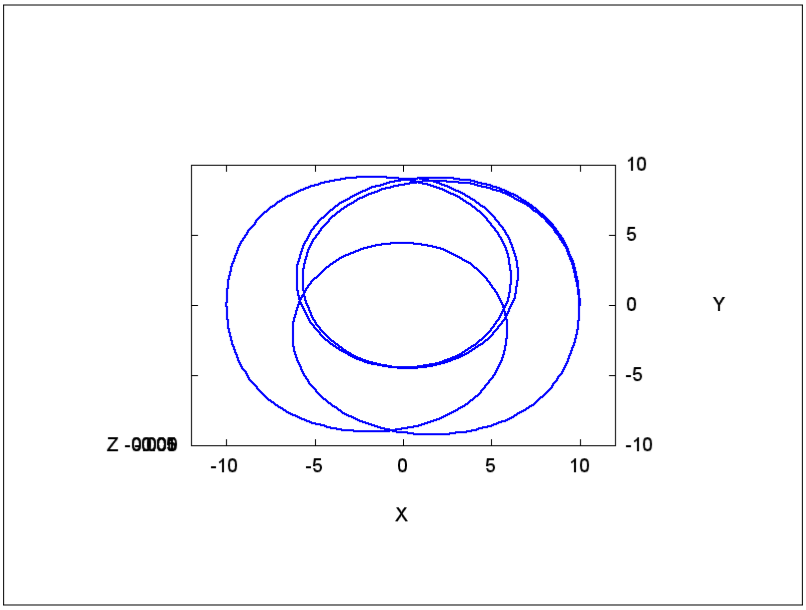

Figure 9: Orbit of Cartesian fluid velocity model from Eqs. (108-109).

ACKNOWLEDGMENTS

The British Government is thanked for a Civil List Pension and the staff of AIAS and others for many interesting discussions. Dave Burleigh, CEO of Annexa Inc., is thanked for hosting www.aias.us, site maintenance and feedback software and hardware maintenance. Alex Hill is thanked for translation and broadcasting, and Robert Cheshire for broadcasting.

REFERENCES

{1} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "ECE2 : The Second Paradigm Shift" (open access on combined sites www.aias.us and www.upitec.com as UFT366 and ePubli in prep., translation by Alex Hill)

{2} M. W. Evans, H. Eckardt, D. W. Lindstrom and S. J. Crothers, "The Principles of ECE" (open access as UFT350 and Spanish section, ePubli, Berlin 2016, hardback, New Generation, London, softback, translation by Alex Hill, Spanish section).

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

{4} M. W. Evans, H. Eckardt and D. W. Lindstrom, "Generally Covariant Unified Field Theory" (Abramis 2005 - 2011, in seven volumes softback, open access in relevant UFT papers, combined sites).

{5} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, open access as UFT302, Spanish translation by Alex Hill).

{6} H. Eckardt, "The ECE Engineering Model" (Open access as UFT303, collected equations).

{7} M. W. Evans, "Collected Scientometrics (Open access as UFT307, New Generation 2015).

{8} M. W. Evans and L. B Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific 2001, Open Access Omnia Opera Section of www.aias.us).

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

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

{11} M. W. Evans, Ed., "Definitive Refutations of the Einsteinian General Relativity" (Cambridge International 2012, open access on combined sites).

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