SPACETIME STRUCTURE GENERATED BY NEWTONIAN GRAVITATION

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ABSTRACT

Using the theory of fluid gravitation developed in the previous paper for a whirlpool galaxy it is shown that Newtonian gravitation produces a rich fluid dynamic structure in spacetime (aether or vacuum). By solving the fundamental equation for fluid gravitation the spacetime structure is illustrated with the velocity field, vorticity, charge and static current using gnuplot graphics. A new law of planar orbital theory is inferred, the Newtonian acceleration due to gravity is the convective derivative of the orbital linear velocity.

Keywords: ECE2 theory, fluid gravitation, Newtonian gravitation, new law of orbits.

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1. INTRODUCTION

In the preceding paper of this series {1 - 12} the theory of fluid gravitation was developed and applied to the whirlpool galaxy. In this paper the theory is applied to Newtonian gravitation and conic sections or planar orbits. A new law of planar orbits is inferred: the Newtonian acceleration of a mass m orbiting a mass M in a plane is the convective derivative of the velocity field of spacetime, and the spacetime structures induced by the Newtonian or inverse square force between m and M are exemplified by the velocity field, vorticity, charge and current defined in immediately preceding papers (UFT349 ff.).

This paper is a synopsis of the main conclusions of detailed calculations found in the notes accompanying UFT359 on www.aias.us. Note 359(1) defines the fundamental expression for acceleration due to gravity in fluid dynamics. This equation applies more generally to any acceleration in any coordinate system. Notes 359(2) and 359(3) solve the equation by inspection using a weighted sum approach. Note 359(4) calculates the charge and vorticity components in the weighted sum approach, and note 359(5) is a summary of results in this approach. Note 359(6) is a summary of more elegant solutions inferred by co author Horst Eckardt. These solutions are summarized in Section 2. Note 359(7) applies the theory of fluid gravitation to the conic section orbits of the Newtonian field.

In Section 3, gnuplot graphics are given of the solutions summarized in Note 359(6), and reveal a rich structure of spacetime (or aether or vacuum) induced by any Newtonian field of force between a mass m and M. This is the famous inverse square law inferred by Robert Hooke and developed by Isaac Newton.

All the results of this paper are applicable to the Coulombic inverse square law between two charges.

2. SUMMARY OF RESULTS

The velocity field $\underline{v}_F$ induced by the Newtonian acceleration due to gravity $\underline{g}$ is defined by:

$$\underline{g} = -\frac{MG}{r^2}\underline{e}_r = (\underline{v}_F \cdot \underline{\nabla})\underline{v}_F \quad -(1)$$

where M is a central mass such as the sun, and G is Newton's constant. Here

$$\underline{r} = r\,\underline{e}_r \quad -(2)$$

is the polar vector between M and an orbiting mass m where $\underline{e}_r$ is the unit radial vector. On the right hand side of this equation appears the convective derivative of the spacetime velocity field, denoted $\underline{v}_F$. The subscript F denotes a spacetime assumed to obey the equations of fluid dynamics. In UFT349 ff it has been shown that the field equations of sapcetime fluid dynamics have the same structure as the ECE2 field equations of gravitation and of electrodynamics. So the three subject areas hav been unified by Cartan geometry.

Similarly the static electric field strength $\underline{E}$ in volts per metre induces spacetime structure in an exactly analogous manner:

$$\underline{E} = \frac{-e}{4\pi\epsilon_0 r^2}\underline{e}_r = x(\underline{v}_F \cdot \underline{\nabla})\underline{v}_F \quad -(2)$$

Here - e is the charge on the electron and ϵ_0 is the vacuum permittivity in S.,I. Units. The factor x is a proportionality defined in UFT349 ff. For fluid gravitation it is unity.

In general there are probably many possible solutions for $\underline{v}_F$ given the Newtonian $\underline{g}$. Two example solutions are summarized in the notes accompanying UFT359 on www.aias.us. Finding the most general solution is a mathematical problem which probably needs numerical methods. This Section summarizes a solution given in detail in Note 359(6). The spacetime (or aether or vacuum) velocity field induced by the Newtonian acceleration due to gravity is:

$$\underline{v}_F = \underline{v}_{F1} + \underline{v}_{F2} + \underline{v}_{F3} \quad -(3)$$

where:

$$\underline{v}_{F1} = \frac{\sqrt{2}\,(mG)^{1/2}}{(X^2+Y^2+Z^2)^{3/4}}\left(-Y\underline{i} + X\underline{j}\right), \quad -(4)$$

$$\underline{v}_{F2} = \frac{\sqrt{2}\,(mG)^{1/2}}{(X^2+Y^2+Z^2)^{3/4}}\left(-Z\underline{i} + X\underline{k}\right), \quad -(5)$$

$$\underline{v}_{F3} = \frac{\sqrt{2}\,(mG)^{1/2}}{(X^2+Y^2+Z^2)^{3/4}}\left(-Z\underline{j} + Y\underline{k}\right). \quad -(6)$$

The velocity field components and sum are graphed in Section 3 using gnuplot, and are seen to be richly structured. In note 359(6) it is shown that the velocity field gives the correct Newtonian acceleration in Cartesian coordinates:

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

Q. E. D. Here:

$$r^2 = X^2 + Y^2 + Z^2. \quad -(8)$$

This acceleration is graphed using gnuplot in Section 3, and is a central field.

The three Kambe charges (UFT349 ff) of material matter are:

$$q_{F1} = \underline{\nabla}\cdot\underline{g}_{F1}$$

$$= -\frac{mG}{2}\left(\frac{2Z^2 - Y^2 - X^2}{(X^2+Y^2+Z^2)^{5/2}}\right) \quad -(9)$$

$$\nu_{F2} = \underline{\nabla}\cdot\underline{g}_{F2} = \frac{mG}{2}\left(\frac{z^2 - 2y^2 + x^2}{(x^2+y^2+z^2)^{5/2}}\right), \quad -(10)$$

$$\nu_{F3} = \underline{\nabla}\cdot\underline{g}_{F3} = \frac{mG}{2}\left(\frac{z^2 + y^2 - 2x^2}{(x^2+y^2+z^2)^{5/2}}\right) \quad -(11)$$

and sum to zero in this solution:

$$\nu_{F1} + \nu_{F2} + \nu_{F3} = 0 \quad -(12)$$

indicating the presence of a governing symmetry whose nature is as yet unknown. The charges are graphed using gnuplot in Section 3. They exhibit a swirling motion in spacetime.

The vorticities generated by the Newtonian field are gravitomagnetic fields accompanying the Newtonian field.

$$\underline{w}_{F1} = \underline{\nabla}\times\underline{v}_{F1} = \frac{(mG)^{1/2}}{2^{3/2}(x^2+y^2+z^2)^{7/4}}\left(3xz\underline{i} + 3yz\underline{j} + (4z^2+y^2+x^2)\underline{k}\right) \quad -(13)$$

$$\underline{w}_{F2} = \underline{\nabla}\times\underline{v}_{F2} = \frac{(mG)^{1/2}}{2^{3/2}(x^2+y^2+z^2)^{7/4}}\left(-3xy\underline{i} - (z^2+4y^2+x^2)\underline{j} - 3yz\underline{k}\right) \quad -(14)$$

$$\underline{w}_{F3} = \underline{\nabla}\times\underline{v}_{F3} = \frac{(mG)^{1/2}}{2^{3/2}(x^2+y^2+z^2)^{7/4}}\left((z^2+y^2+4x^2)\underline{i} + 3xy\underline{j} + 3xz\underline{j}\right) \quad -(15)$$

$$\underline{\nabla} \cdot \underline{w}_{F1} = \underline{\nabla} \cdot \underline{w}_{F2} = \underline{\nabla} \cdot \underline{w}_{F3} = 0 \quad -(16)$$

and these are graphed using gnuplot in Section 3. They exhibit a richly structured swirling motion.

It is seen that these quantities are given by a factor MG or $(MG)^{1/2}$ multiplied by geometrical factors. So it can be argued that spacetime induces these observable quantities in matter through the intermediacy of M and G. For example the velocity field is observable as the orbital velocity of a planet orbiting the sun. We therefore arrive at a new law of orbits: the Newtonian acceleration due to gravity between m orbiting M is the convective derivative of the orbital linear velocity.

By definition:

$$\underline{\nabla} \times \underline{g}_F + \frac{\partial \underline{w}_F}{\partial t} = \underline{0} \quad -(17)$$

because:

$$\underline{g}_F = (\underline{v}_F \cdot \underline{\nabla})\underline{v}_F = -\frac{\partial \underline{v}_F}{\partial t} - \underline{\nabla} h_F \quad -(18)$$

and:

$$\underline{w}_F = \underline{\nabla} \times \underline{v}_F. \quad -(19)$$

So:

$$\underline{\nabla} \times \underline{g}_F = -\frac{\partial}{\partial t}(\underline{\nabla} \times \underline{v}_F) = -\frac{\partial \underline{w}_F}{\partial t} \quad -(20)$$

Q. E. D.

The quantity:

$$h_F = \phi_F \quad -(21)$$

is the enthalpy of scalar potential (UFT349 ff). Eq. (17) is the ECE2 gravitational law equivalent to the Faraday law of induction.

Also by definition:

$$\underline{\nabla} \cdot \underline{w}_F = 0 \qquad -(22)$$

which is a gravitomagnetic ECE2 law equivalent to the Gauss law of magnetism.

In ECE2 electromagnetism they become the homogeneous field equations:

$$\underline{\nabla} \cdot \underline{B} = 0 \qquad -(23)$$

$$\underline{\nabla} \times \underline{E} + \frac{\partial \underline{B}}{\partial t} = \underline{0} \qquad -(24)$$

where $\underline{B}$ is the magnetic flux density in S. I. Units of tesla.

The Kambe current of the fluid spacetime is defined as in UFT349 ff by:

$$\underline{J}_F = a_0^2 \, \underline{\nabla} \times (\underline{\nabla} \times \underline{v}_F) - \frac{\partial}{\partial t} \left((\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \right) \qquad -(25)$$

where a_0 is the assumed constant speed of sound. Therefore the inhomogeneous field equations are:

$$\underline{\nabla} \cdot \underline{v}_F = q_F \qquad -(26)$$

and

$$\underline{\nabla} \times \underline{w}_F - \frac{1}{a_0^2} \frac{\partial \underline{g}_F}{\partial t} = \frac{1}{a_0^2} \underline{J}_F . \qquad -(27)$$

If it is assumed that the Newtonian acceleration due to gravity does not change with time:

$$\frac{\partial \underline{g}_F}{\partial t} = \underline{0} \qquad -(28)$$

then

$$\underline{J}_F = a_0^2 \underline{\nabla} \times (\underline{\nabla} \times \underline{v}_F) \quad -(29)$$

and using Eq. (1), the three components of current can be calculated by computer algebra to be:

$$\underline{J}_{F1} = \frac{9 a_0^2}{2^{5/2}(X^2+Y^2+Z^2)^{7/4}} (-Y\underline{i} + X\underline{j}) \quad -(30)$$

$$\underline{J}_{F2} = \frac{9 a_0^2}{2^{5/2}(X^2+Y^2+Z^2)^{7/4}} (-Z\underline{i} + X\underline{k}) \quad -(31)$$

$$\underline{J}_{F3} = \frac{9 a_0^2}{2^{5/2}(X^2+Y^2+Z^2)^{7/4}} (-Z\underline{j} + Y\underline{k}). \quad -(32)$$

These are graphed in Section 3 and again exhibit a swirling motion.

The fundamental philosophy of fluid gravitation is that:

$$\underline{g}\,(\text{matter}) = \underline{g}_F\,(\text{spacetime}). \quad -(33)$$

So the familiar Newtonian $\underline{g}$ (matter) induces $\underline{v}_{F1}, \underline{v}_{F2}, \underline{v}_{F3}, \underline{g}_{F1}, \underline{g}_{F2}, \underline{g}_{F3}, q_{F1}, q_{F2}, q_{F3}, \underline{w}_{F1}, \underline{w}_{F2}, \underline{w}_{F3}, \underline{J}_{F1}, \underline{J}_{F2}, \underline{J}_{F3}$.

In other words all observable material quantities are induced by the structure of spacetime itself. The latter is Cartan geometry in ECE2 unified field theory. In UFT311 for example, details of the Osamu Ide circuit are given. This circuit picks up $\underline{E}$ from spacetime in a process that is described exactly by ECE theory, and also by its development, ECE2.

Spacetime therefore contains an unlimited source of electric energy and is also the source of gravity.

In order to apply fluid gravitation to planar orbits consider the definition of linear velocity in plane polar coordinates {1 - 12}:

$$\underline{v} = \dot{r}\,\underline{e}_r + r\dot{\theta}\,\underline{e}_\theta \quad -(34)$$

where:

$$\underline{e}_r = \underline{i}\cos\theta + \underline{j}\sin\theta \quad -(35)$$

and

$$\underline{e}_\theta = -\underline{i}\sin\theta + \underline{j}\cos\theta. \quad -(36)$$

In fluid gravitation there is a new and general relation between the orbital velocity $\underline{v}$ and the Newtonian acceleration $\underline{g}$:

$$\underline{g} = (\underline{v}\cdot\underline{\nabla})\underline{v}. \quad -(37)$$

From Eqs. (4) and (34) it follows that:

$$(mG)^{1/2}\frac{X}{(X^2+Y^2)^{3/4}} = \dot{r}\sin\theta + r\dot{\theta}\cos\theta \quad -(38)$$

and:

$$(mG)^{1/2}\frac{Y}{(X^2+Y^2)^{3/4}} = r\dot{\theta}\sin\theta - \dot{r}\cos\theta. \quad -(39)$$

From Eqs. (38) and (39) it follows that:

$$v^2 = \dot{r}^2 + r^2\dot{\theta}^2 = \frac{mG}{(X^2+Y^2)^{1/2}} \quad -(40)$$

Therefore for any planar orbit:

$$X = \frac{mG}{v^3}\left(\dot{r}\sin\theta + r\dot{\theta}\cos\theta\right) \quad -(41)$$

and:

$$Y = \frac{mG}{v^3}\left(r\dot{\theta}\sin\theta - \dot{r}\cos\theta\right) \quad -(42)$$

and many other quantities.

Therefore Eq. (37) is valid for all planar and three dimensional orbits.

For an elliptical planar orbit for example {1 - 12}:

$$v^2 = \dot{r}^2 + r^2\dot{\theta}^2 = mG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(43)$$

and

$$\frac{1}{(x^2+y^2)^{1/2}} = \frac{2}{r} - \frac{1}{a} \quad -(44)$$

where

$$a = \frac{\alpha}{1-\epsilon^2}. \quad -(45)$$

Here a is the semi major axis of the ellipse:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad -(46)$$

where α is the half right latitude and ϵ is the eccentricity. In plane polar coordinates the ellipse is:

$$r = \frac{\alpha}{1+\epsilon\cos\theta} \quad -(47)$$

and in Cartesian coordinates:

$$b^2 x^2 + a^2 y^2 = a^2 b^2 \quad -(48)$$

where the semi minor axis is:

$$b = \frac{\alpha}{(1-\epsilon^2)^{1/2}} . \quad -(49)$$

The ellipse reduces to a circle when:

$$\epsilon = 0, \quad r = a \quad -(50)$$

and for the circle:

$$v^2 = \frac{mG}{r}, \quad x^2 + y^2 = r^2 . \quad -(51)$$

For the ellipse:

$$\frac{dr}{d\theta} = \frac{\epsilon r^2}{\alpha} \sin\theta \quad -(52)$$

and from a Lagrangian analysis:

$$\frac{d\theta}{dt} = \frac{L}{\mu r^2} \quad -(53)$$

where L is the angular momentum, a constant of motion and μ is the reduced mass:

$$\mu = \frac{mM}{m+M} \sim m . \quad -(54)$$

.For the Newtonian field:

$$L^2 = m^2 MG\alpha . \quad -(55)$$

It follows that for the planar elliptical orbit:

$$X = \alpha^{1/2} \frac{\left(\frac{\epsilon}{\alpha} \sin^2\theta + \frac{1}{r} \cos\theta \right)}{\left(\frac{2}{r} - \frac{1}{a} \right)^{3/2}}, \quad -(56)$$

$$Y = \alpha^{1/2} \frac{\left(\frac{1}{r} \sin\theta - \frac{\epsilon \sin\theta \cos\theta}{\alpha} \right)}{\left(\frac{2}{r} - \frac{1}{a} \right)^{3/2}}, \quad -(57)$$

and

$$r = \frac{\alpha}{1 + \epsilon \cos\theta}. \quad -(58)$$

Using Eq. (58), X and Y can be plotted against θ, or against r, or against both in a three dimensional graph. These graphs are reported and analyzed in Section 3.

For the circular orbit:

$$\epsilon = 0, \ \frac{2}{r} - \frac{1}{a} = \frac{1}{r}, \ r = \alpha \quad -(58)$$

so:

$$X = r\cos\theta \quad -(59)$$

and

$$Y = r\sin\theta \quad -(60)$$

Q. E. D. This method holds for any planar orbit or any three dimensional orbit. For example it holds for a hyperbolic orbit or the hyperbolic spiral orbit of a whirlpool galaxy.

Therefore a new general theory of orbits has been inferred.

Spacetime structure generated by Newtonian gravitation

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3 Graphical analysis

The equations for all quantities of fluid spacetime have been analyzed graphically, using unity constants. The mapping of equations to the graphs is compiled in Table 1. The velocity fields $\mathbf{v}_{F1}$-$\mathbf{v}_{F3}$ are parallel to the planes spanned by the three cartesian axes. The total field $\mathbf{v}_F$ is a vortex with angular momentum axis in (1,-1,1) direction. This axis can be altered by using different signs for the velocity components. This shows that different solutions for the velocity field are possible. The gravitational field $\mathbf{g}_F$ is a central field as expected. The vorticity $\mathbf{w}_F$ looks complicated. An analysis by computer algebra shows that $\mathbf{w}_F$ is always perpendicular to $\mathbf{v}_F$. The current $\mathbf{J}_F$ is parallel to the velocitiy field as expected. The three components of the Kambe charge density q_F look different but their sum vanishes, indicating a new kind of symmetry not yet investigated.

The cartesian elliptical orbit components $X(\theta)$ and $Y(\theta)$ for an orbit $r(\theta)$ fixed by Eq.(58) show oscillating behaviour. When, in addition, the radius is taken as a parameter, There are surfaces $X(r,\theta)$ and $Y(r,\theta)$ whose cuts reproduce the behaviour of orbits with fixed $r(\theta)$ relation.

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Figure no.	Quantity	Equations
1	$\mathbf{v}_{F1}$	(4)
2	$\mathbf{v}_{F2}$	(5)
3	$\mathbf{v}_{F3}$	(6)
4	$\mathbf{v}_{F}$	(3)
5	$\mathbf{g}_{F}$	(1)
6	$\mathbf{w}_{F}$	(13-15)
7	$\mathbf{J}_{F}$	(29)
8	q_{F1}	(9)
9	q_{F3}	(10)
10	q_{F3}	(11)
11	$X(\theta), Y(\theta)$	(56,57,58)
12	$X(r,\theta), Y(r,\theta)$	(56,57)

Table 1: Mapping of figures to equations.

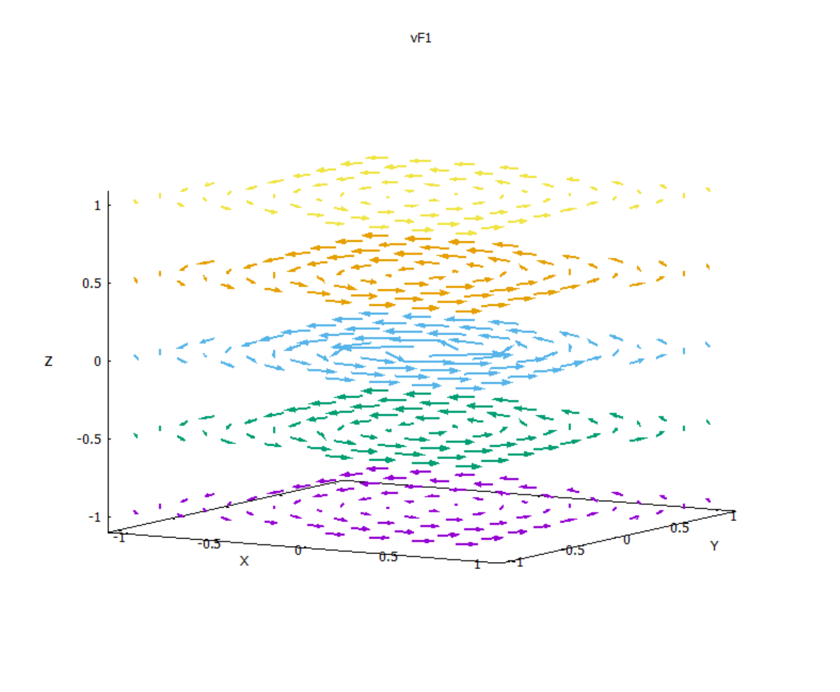

Figure 1: Component $\mathbf{v}_{F1}$ of velocity field.

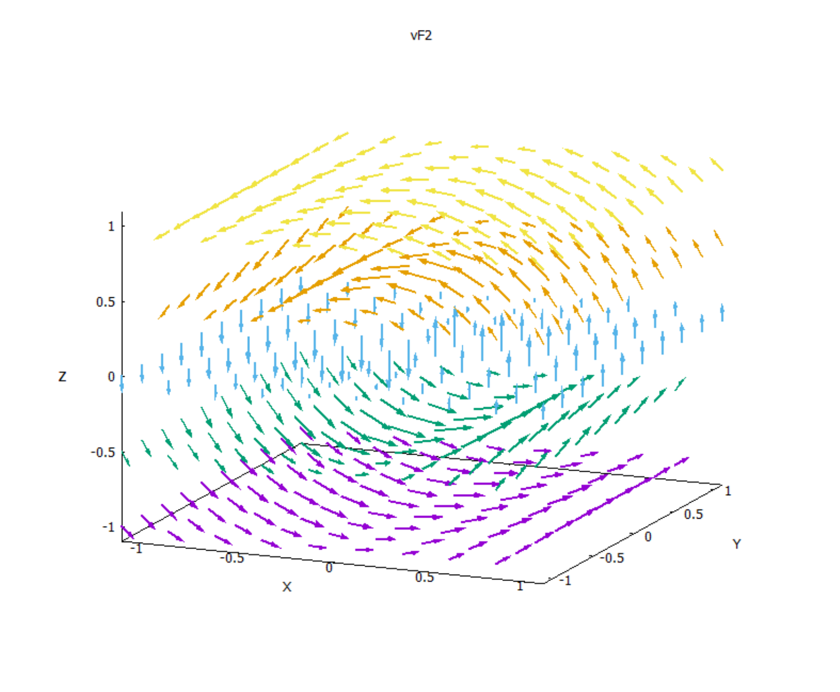

Figure 2: Component $\mathbf{v}_{F2}$ of velocity field.

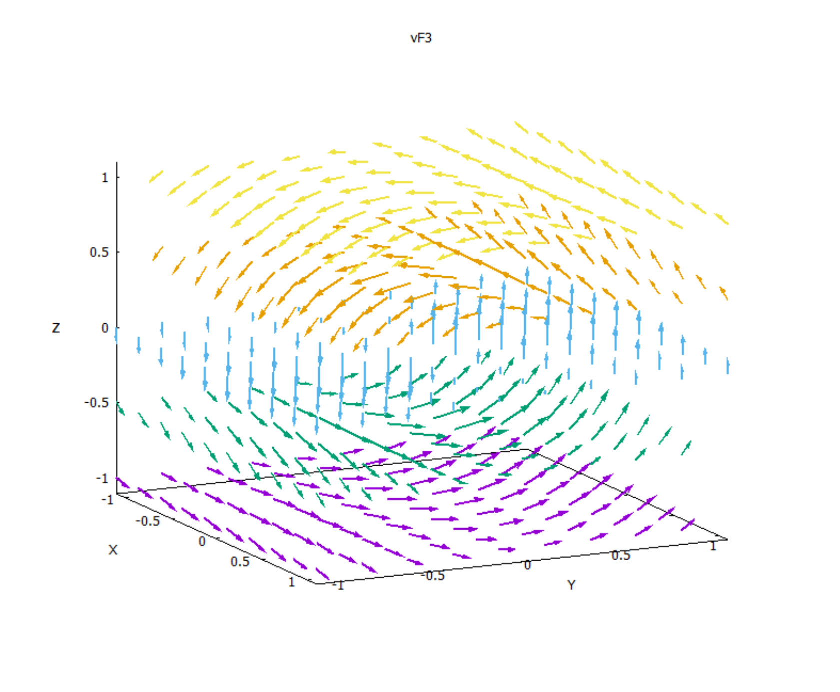

Figure 3: Component $\mathbf{v}_{F3}$ of velocity field.

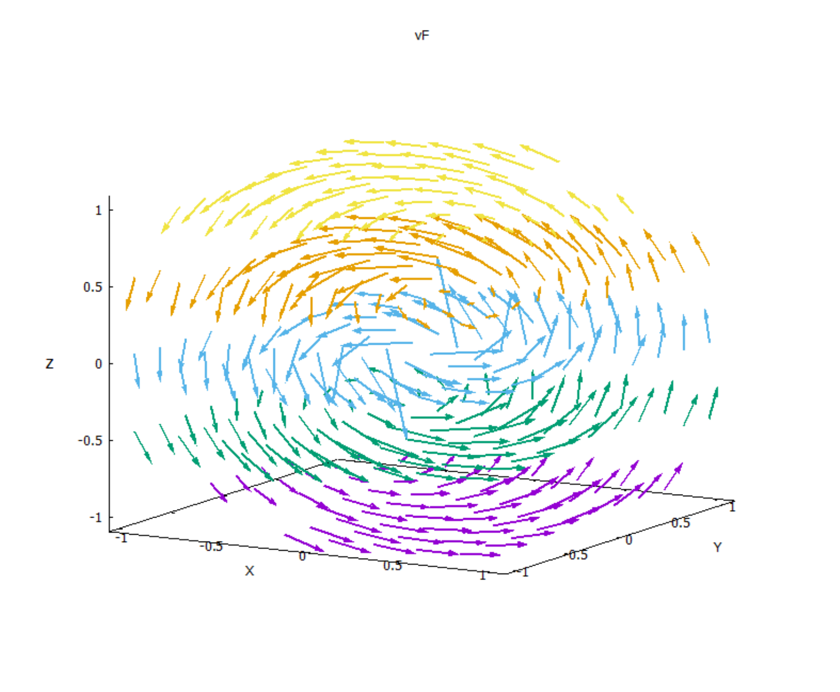

Figure 4: Velocity field $\mathbf{v}_F$.

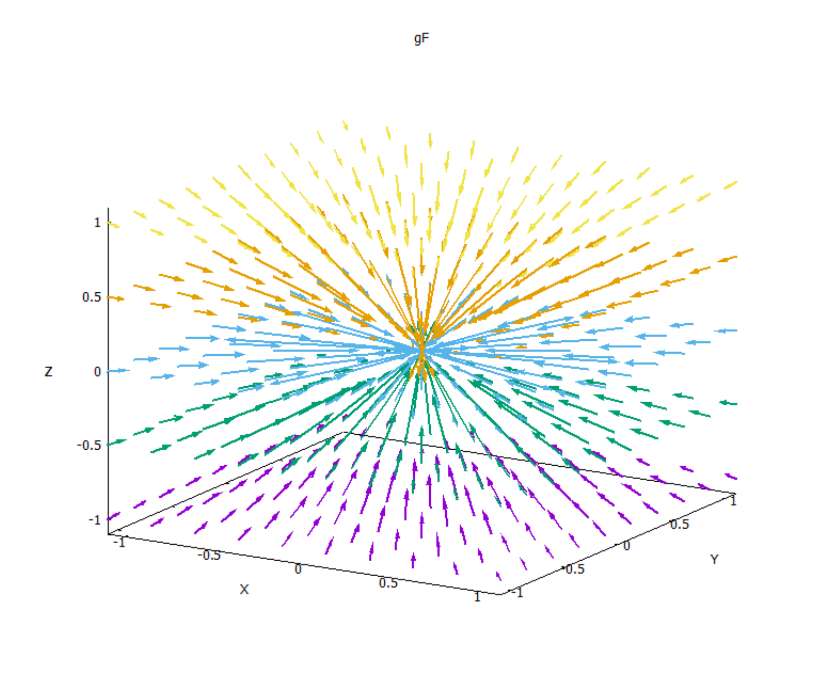

Figure 5: Gravitational field $\mathbf{g}_F$.

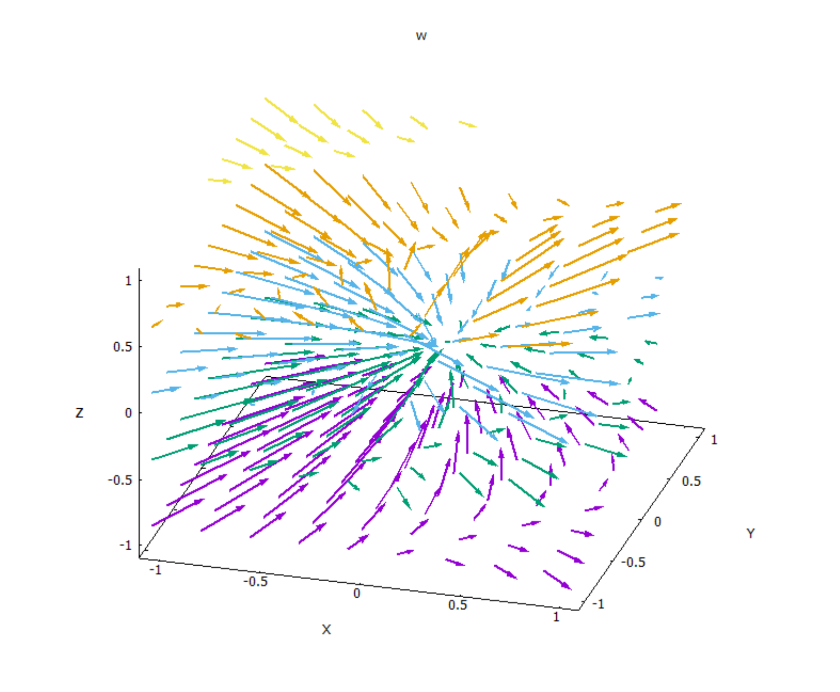

Figure 6: Vorticity field $\mathbf{w}_F$.

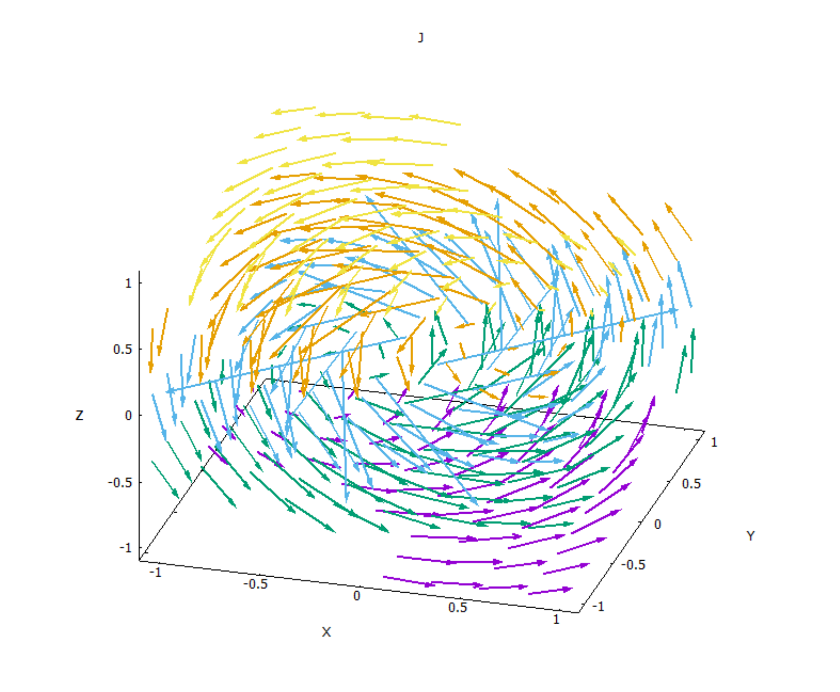

Figure 7: Static current density $\mathbf{J}_F$.

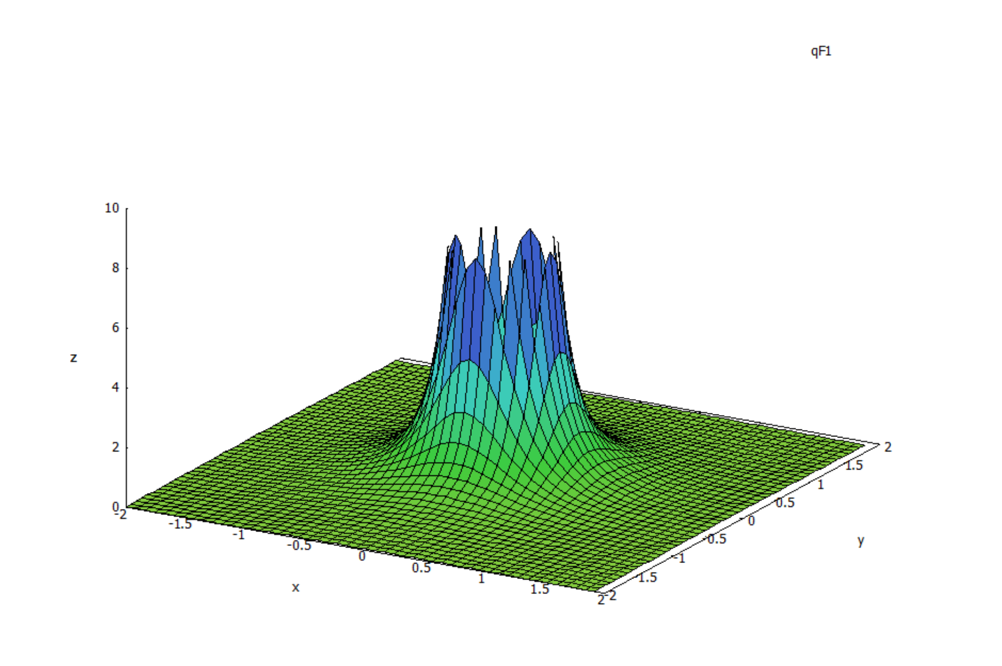

Figure 8: Kambe charge density qF_1 for $Z = 0$.

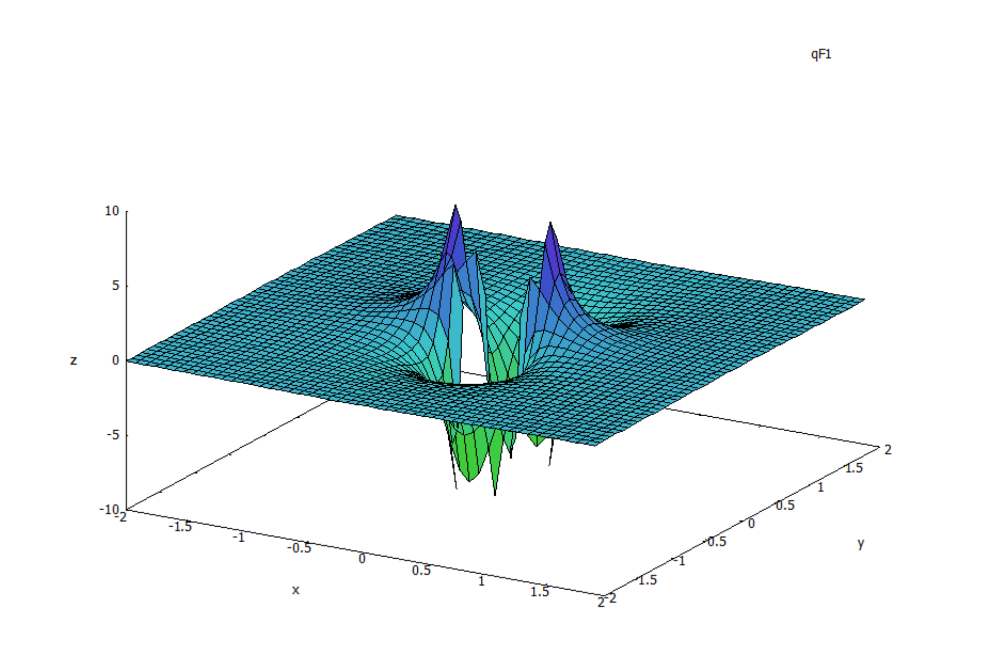

Figure 9: Kambe charge density qF_2 for $Z = 0$.

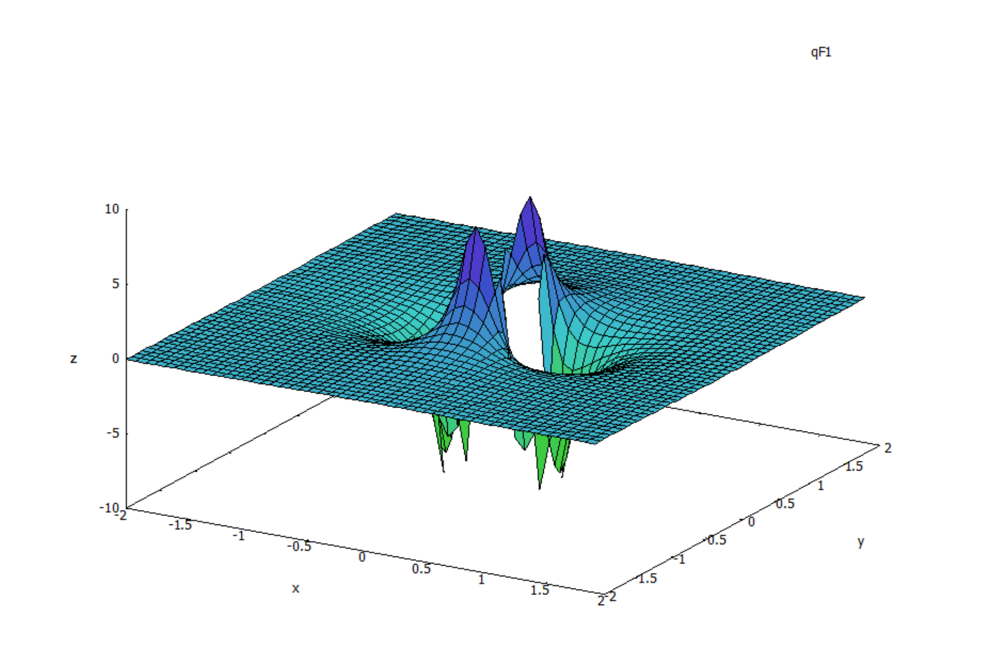

Figure 10: Kambe charge density qF_3 for $Z = 0$.

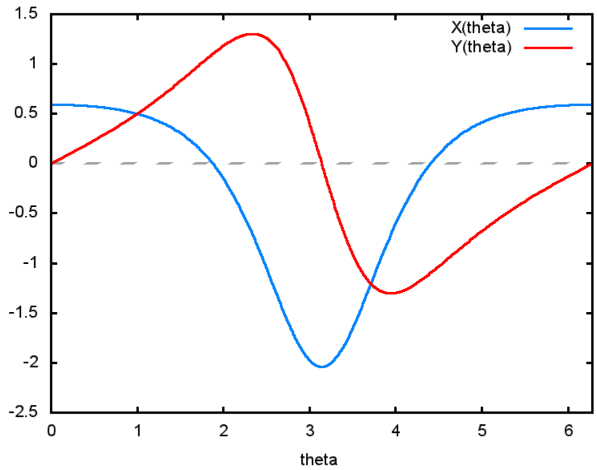

Figure 11: Elliptical orbit components $X(\theta)$ and $Y(\theta)$.

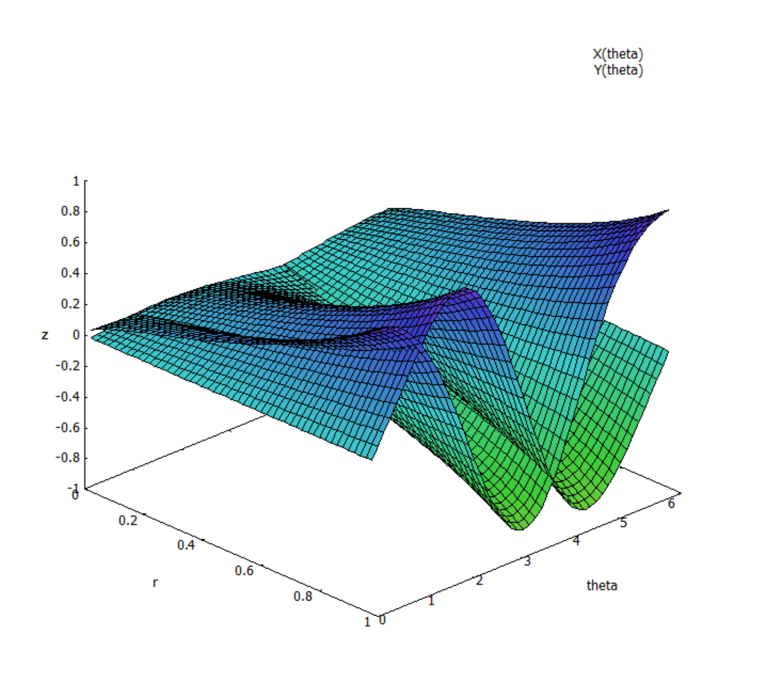

Figure 12: Elliptical orbit components $X(r, \theta)$ and $Y(r, \theta)$ in the (r, θ) plane.

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