THE DESCRIPTION OF TWO AND THREE DIMENSIONAL ORBITS WITH THE GENERALIZED CONICAL SECTIONS.

by

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ABSTRACT

It is shown that Einsteinian general relativity (EGR) can be refuted straightforwardly by simple considerations of its own force law. A new theory of cosmology is developed on the basis of generalized conical sections in which any orbit in two or three dimensions can be described using simple mathematics and in the classical limit of ECE theory.

Keywords: Classical limit of ECE theory, general theory of orbits, generalized conical sections.

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1. INTRODUCTION

In recent papers of this series of papers developing ECE theory {1 - 10} it has been shown that the conical sections have hitherto unknown fractal properties. Each of these fractal conical sections can be in theory an orbit, so a vast array of new orbits is predicted by the theory. The well known conical sections are transformed into fractal conical sections with a constant x that multiplies the polar angle. The theory is developed in Section 2 by allowing x to become r dependent. Here (r , θ) are the cylindrical polar coordinates in a plane. It is shown that any orbit can be synthesised from the general conical section (GCS) by well defined transformation equations. The analysis is extended to three dimension using straightforward lagrangian analysis with the cylindrical polar coordinates (r , θ , Z). In Section 3 the new orbits are illustrated and analysed graphically. All orbits of cosmology can be described with the GCS method without Einsteinian general relativity (EGR). Section 2 is opened with a straightforward and conclusive refutation of EGR from its own force law and its own lagrangian methods.

2. TWO AND THREE DIMENSIONAL ORBITS FROM THE GCS METHOD

The Einsteinian general relativity (EGR) is easily refuted as follows, so there is an urgent need to develop a new cosmology based on far simpler, and correct, mathematics. Consider the lagrangian equation developed in recent papers:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = -\frac{mr^2}{L^2} F(r) \quad -(1)$$

Here L is the total angular momentum a constant of motion, m the orbiting mass, and F the central force between m and M. EGR claims {11} that:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = \frac{Gm^2M}{L^2} + \frac{3GM}{c^2r^2} \qquad -(2)$$

where G is Newton's constant and where c is the vacuum speed of light, assumed in EGR to be a constant. EGR claims that Eq. (2) produces the precessing ellipse:

$$r = \frac{\alpha}{1 + \epsilon\cos(x\theta)} \qquad -(3)$$

where α is the half right latitude, ϵ the eccentricity, and x is a constant. Graphical analysis in recent papers has shown that x must be close to unity to produce a simple precessing ellipse. The precessing ellipse is observed in a large class of orbits in the solar system to binary neutron stars, and in this class of orbits x is always close to unity. EGR claims to describe this class of orbits with precision, but simple algebra as follows shows that EGR cannot describe this class of orbits at all. It is obvious from the outset that the force law (2) is incorrect mathematically because Eqs. (1) and (3) produce:

$$F(r) = -\frac{mMGx^2}{r^2} + (x^2 - 1)\frac{L^2}{mr^3}. \qquad -(4)$$

It is equally obvious that the x needed to produce the incorrect EGR force law (2) cannot be a constant, and in consequence the incorrect force law (2) does not produce a precessing ellipse. The most famous claim of EGR is trivially incorrect.

Consider that x in general is a function of θ and denote:

$$y = \theta x(\theta) \qquad -(5)$$

then the generalized conic section (GCS) is defined as:

$$r = \frac{\alpha}{1 + \epsilon\cos(\theta x(\theta))} \qquad -(6)$$

It follows that:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = -\frac{\epsilon}{\alpha}\left(\frac{d^2y}{d\theta^2}\sin y + \left(\frac{dy}{d\theta}\right)^2\cos y\right) \quad -(7)$$

The incorrect claim (2) of EGR means that:

$$\frac{\epsilon}{\alpha}\left(\frac{d^2y}{d\theta^2}\sin y + \left(\frac{dy}{d\theta}\right)^2\cos y\right) = \frac{1}{r} - \frac{m^2 m G}{L^2} - \frac{3GM}{c^2}\frac{1}{r^2} \quad -(8)$$

where:

$$\frac{dy}{d\theta} = x + \frac{dx}{d\theta}, \quad -(9)$$

$$\frac{d^2y}{d\theta^2} = 2\frac{dx}{d\theta} + \theta\frac{d^2x}{d\theta^2}, \quad -(10)$$

and so x cannot be a constant QED. The orbit (6) is not a simple precessing ellipse, QED.

In order to emphasise the trivial incorrectness of EGR the following is a straightforward reduction to absurdity. Assume that x is a constant independent of r and of the polar angle θ . Then Eq. (8) reduces to the quadratic:

$$A\cos^2(x\theta) + B\cos(x\theta) + C = 0 \quad -(11)$$

where

$$A = 3GM\left(\frac{\epsilon}{\alpha c}\right)^2 \quad -(12)$$

$$B = \frac{\epsilon}{\alpha}\left(1 - x^2\right) - \frac{6GM\epsilon}{c^2\alpha^2} \quad -(13)$$

$$C = \frac{m^2 m G}{L^2} + \frac{3GM}{c^2\alpha^2} - \frac{1}{\alpha}, \quad -(14)$$

are constants. Therefore:

$$\cos(x\theta) = \frac{1}{2A}\left(-B \pm \left(B^2 - 4AC\right)^{1/2}\right) \quad -(15)$$

and θ can have only two values, reductio at absurdum.

There is therefore an urgent need for a post Einsteinian paradigm shift, otherwise a multiplication of incorrect cosmological ideas will persist.

The GCS method is able to describe all known orbits straightforwardly using the simple equation:

$$r = \frac{\alpha}{1 + \epsilon \cos(\theta x(\theta))} \quad -(16)$$

from which the force law for all two dimensional orbits is:

$$F(r) = -\frac{L^2}{m r^2}\left(\frac{1}{r} + \frac{d^2}{d\theta^2}\left(\frac{1}{r}\right)\right) \quad -(17)$$

in which the differentiation is defined in Eq. (7). In general x is a function of r which is a function of θ . In the special case of constant x, x is defined to have no dependence on r or θ . For example, consider a hyperbolic spiral orbit:

$$\frac{1}{r} = \frac{\theta}{r_0}. \quad -(18)$$

This orbit can be synthesised from a GCS as follows:

$$\frac{1}{r} = \frac{\theta}{r_0} = \frac{1}{\alpha}\left(1 + \epsilon \cos(\theta x(\theta))\right) \quad -(19)$$

By differentiation of the GCS:

$$x + \theta \frac{dx}{d\theta} = -\frac{\alpha}{\epsilon r_0 \sin(\theta x(\theta))} \quad -(20)$$

so:

$$\frac{dx}{d\theta} = -\frac{x}{\theta} - \frac{\alpha}{\epsilon r_0 \theta \sin(\theta x(\theta))}. \quad -(21)$$

Eq. (21) can be rewritten using:

$$\frac{dx}{d\theta} = \frac{dx}{dr}\frac{dr}{d\theta} \quad -(22)$$

to give:

$$\frac{dx}{dr} = -\frac{1}{\theta}\frac{d\theta}{dr}\left(x + \frac{\alpha}{\epsilon r_0 \sin(\theta x(\theta))}\right). \quad -(22)$$

The equation of the hyperbolic spiral gives:

$$\frac{d\theta}{dr} = -\frac{r_0}{r^2} \quad -(23)$$

and

$$\theta\frac{dx}{d\theta} = -r\frac{dx}{dr}. \quad -(24)$$

So the transformation equation of the GCS into the hyperbolic spiral is the first order differential equation:

$$\frac{dx}{dr} = \frac{x}{r} + \frac{\alpha}{r_0\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}} \quad -(25)$$

If it is considered that:

$$r_0 = \alpha \quad -(26)$$

then the following transformation equation results:

$$\frac{dx}{dr} = \frac{x}{r} + \frac{1}{\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}} \quad -(27)$$

This may have an analytical solution but if not, it can be integrated numerically in a straightforward manner to find the r dependence of x.

In general:

$$\frac{1}{r} = f(\theta) = \frac{1}{\alpha}\left(1 + \epsilon\cos\left(\theta x(\theta)\right)\right) \qquad -(28)$$

i.e. any planar orbit can be synthesised from a GCS where f (θ) is any function of θ.

Define:

$$\frac{d}{d\theta}\left(\frac{1}{r}\right) = f'(\theta) = -\frac{\epsilon}{\alpha}\left(x + \theta\frac{dx}{d\theta}\right)\sin\left(\theta x(\theta)\right) \qquad -(29)$$

then:

$$\frac{dx}{d\theta} = -\frac{1}{\theta}\left(x + \frac{\alpha}{\epsilon}\frac{f'(\theta)}{\sin\left(\theta x(\theta)\right)}\right) \qquad -(30)$$

Now use:

$$\frac{dx}{d\theta} = \frac{dx}{dr}\frac{dr}{d\theta} \qquad -(31)$$

so:

$$\frac{dr}{d\theta} = \frac{d}{d\theta}\left(\frac{1}{f(\theta)}\right) = -\frac{f'(\theta)}{f^2(\theta)} \qquad -(32)$$

i. e.

$$\frac{dr}{d\theta} = -r^2 f'(\theta). \qquad -(33)$$

From Eqs. (30) and (33):

$$\frac{dx}{dr} = \frac{1}{\theta}\left(\frac{x}{r^2 f'(\theta)} + \frac{\alpha}{r\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}}\right) \qquad -(34)$$

Eq. (34) transforms the generalized conical section (GCS) into any planar orbit f(θ).

In Eq. (34):

$$f'(\theta) = \frac{df(\theta)}{d\theta} \quad -(35)$$

and θ is defined by the inverse function:

$$\theta = f^{-1}\left(\frac{1}{r}\right). \quad -(36)$$

The fact that any function f (θ) can be synthesized from a GCS is a new theorem akin to the well known Fourier synthesis. In the example of the hyperbolic spiral:

$$\frac{1}{r} = \frac{\theta}{r_0}, \quad f'(\theta) = \frac{1}{r_0}, \quad \theta r = r_0 \quad -(37)$$

and Eq. (25) results, QED.

This analysis can be extended straightforwardly to three dimensions using the cylindrical polar coordinates (r , θ , Z). The three Euler Lagrange equations are:

$$\frac{\partial \mathcal{L}}{\partial r} = \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{r}} \quad -(38)$$

$$\frac{\partial \mathcal{L}}{\partial \theta} = \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\theta}} \quad -(39)$$

$$\frac{\partial \mathcal{L}}{\partial Z} = \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{Z}} \quad -(40)$$

in which the lagrangian is:

$$\mathcal{L} = \frac{1}{2}m\left(\dot{r}^2 + r^2\dot{\theta}^2 + \dot{Z}^2\right) - U(r, Z). \quad -(41)$$

Conserved total angular momentum is:

From Eqs. (38) and (39)

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = -\frac{mr^2}{L^2} F(r) \quad -(42)$$

where

$$F(r) = -\frac{\partial U}{\partial r}. \quad -(43)$$

From Eqs. (39) and (40)

$$m\ddot{Z} = F(Z) \quad -(44)$$

where

$$F(Z) = -\frac{\partial U}{\partial Z}. \quad -(45)$$

The radial vector is defined as:

$$\underline{R} = r\,\underline{e}_r + Z\,\underline{e}_Z \quad -(46)$$

so

$$R^2 = r^2 + Z^2. \quad -(47)$$

The distance between mass m and mass M is $|\underline{R}|$, so the new universal pootential of recent papers of this series is consistently applied and is:

$$U(R) = -x^2\frac{mMG}{R} + \frac{(x^2-1)L^2}{2mR^2}. \quad -(48)$$

Now define:

$$\underline{R} = r\underline{e}_r + Z\underline{e}_Z = R\underline{e}_r' \quad -(49)$$

where $\underline{e}_R'$ is aligned between m and M . Then:

$$\underline{v} = \dot{\underline{R}} = \dot{R}\underline{e}_r' + R\dot{\theta}_1\underline{e}_\theta' \quad -(50)$$

and

$$v^2 = \dot{R}^2 + R^2\dot{\theta}_1^2. \quad -(51)$$

The lagrangian is therefore:

$$\mathcal{L} = \frac{1}{2}m\left(\dot{R}^2 + R^2\dot{\theta}_1^2\right) - U(R) \quad -(52)$$

and the potential U (R) is defined by eq. (48).

The Euler Lagrange equation is:

$$\frac{\partial\mathcal{L}}{\partial R} = \frac{d}{dt}\frac{\partial\mathcal{L}}{\partial\dot{R}}. \quad -(53)$$

Eqs. (39) and (53) give:

$$\frac{d^2}{d\theta_1^2}\left(\frac{1}{R}\right) + \frac{1}{R} = -\frac{mR^2}{L^2}F(R) \quad -(54)$$

where the conserved total angular momentum is:

$$L = mR^2\frac{d\theta_1}{dt}. \quad -(55)$$

The three dimensional orbit corresponding to Eqs. (48) and (54) is:

$$R = \frac{\alpha}{1+\epsilon\cos(x\theta_1)} \quad -(56)$$

where:

$$\alpha = \frac{L^2}{mk}, \quad \epsilon = \left(1 + \frac{2EL^2}{mk^2}\right)^{1/2}, \quad k = mMG, \qquad -(57)$$

and where the conserved total energy is:

$$E = \frac{1}{2} m \left(\dot{R}^2 + R^2 \dot{\theta}_1^2 \right) + U(R). \qquad -(58)$$

For an ellipse, $E < 0, \; 0 < \epsilon < 1$; for a hyperbola $E > 0, \; \epsilon > 1$; for a parabola $E = 0, \; \epsilon = 1.$

So:

$$R = \left(r^2 + Z^2 \right)^{1/2} = \frac{\alpha}{1 + \epsilon \cos(x \theta_1)} \qquad -(59)$$

which is a three dimensional and precessing conical section. The transformation used in deriving this result is:

$$\underline{R} = R \underline{e}_r' = r \underline{e}_r + Z \underline{e}_Z \qquad -(60)$$

so:

$$\underline{v} = \dot{\underline{R}} = \dot{R} \underline{e}_r' + R \dot{\underline{e}}_r' \qquad -(61)$$

where

$$\dot{\underline{e}}_r' = \dot{\theta}_1 \underline{e}_\theta' \qquad -(62)$$

i.e.:

$$\underline{v} = \dot{R} \underline{e}_r' + R \dot{\theta}_1 \underline{e}_\theta' = \dot{r} \underline{e}_r + \dot{Z} \underline{e}_Z + r \dot{\theta} \underline{e}_\theta \qquad -(63)$$

Therefore

$$v^2 = \dot{R}^2 + R^2 \dot{\theta}_1^2 \qquad -(64)$$
$$= \dot{r}^2 + \dot{Z}^2 + r^2 \dot{\theta}^2.$$
$$=$$

The three dimensional orbit is therefore:

$$R = \frac{\alpha}{1 + \epsilon \cos(x \theta_1)} \qquad -(65)$$

where:

$$R^2 = r^2 + Z^2. \qquad -(66)$$

The two dimensional orbit:

$$r = \frac{\alpha}{1 + \epsilon \cos(x \theta)} \qquad -(67).$$

is recovered when Z vanishes.

3. GRAPHICAL ANALYSIS OF ORBITS WITH THE GCS AND THREE DIMENSIONAL ANALYSIS.

Section by Horst Eckardt, Ray Delaforce and Gareth Evans.

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3. Graphical analysis of orbits with the GCS and three dimensional analysis

In this section we investigate some helical-like orbits which are obtained from the equation

$$R^2 = \left(\frac{\propto}{1+\varepsilon\cos(x\theta)}\right)^2 + Z_0^2\theta^2. \tag{68}$$

Fig. 1 develops the familiar circular helix into the elliptical helix as drawn. This figure illustrates the Newtonian ellipse ε=0.5, x=1. The conventional planar orbit occurs around a mass M. The latter is assumed to move in the Z axis out of the plane and perpendicular to it. The helical formula

$$Z = Z_0\theta \tag{69}$$

is used for illustration. A value of $Z_0 = 0.1$ is used throughout the section. The Cartesian X and Y components are

$$X = r(\theta)\cos(\theta), \tag{70}$$
$$Y = r(\theta)\sin(\theta) \tag{71}$$

with

$$r(\theta) = \frac{\propto}{1+\varepsilon\cos(x\theta)}. \tag{72}$$

This is a static elliptical helix.

Fig. 2 is a precessing elliptical helix with ε=0.5, x=0.5. Fig. 3 shows a precessing elliptical helix with ε=0.5, x=1.2. Fig. 4 is the result of Fig. 3 with Z=0, i.e. a projection onto the X-Y plane. Here the graph is reduced to the well know precession pattern.

Fig. 5 is a Newtonian hyperbolic orbit with ε=1.2, x=1.0 around an object M that moves in the Z axis according to Eq.(69). Fig. 6 shows the same orbit with Z=0 (projected). Fig. 7 is a side view (X-Z plane).

A precessing hyperbola with ε=1.2, x=0.3 is graphed in Figs. 8 and 9 (projection to X-Z plane and three dimensional view). A completely new type of orbit emerges.

Fig. 10 is based on the above equations (69-72) with a variable x dependence

$$x = \theta. \tag{73}$$

It produces a hitherto unknown chaotic orbit projected onto the base plane in Fig. 11. The chaotic orbit is therefore given by

$$r(\theta) = \frac{\propto}{1+\varepsilon\cos(\theta^2)}. \tag{74}$$

A huge number of other new orbits is expected when the Z dependence is made more complex than in Eq.(69).

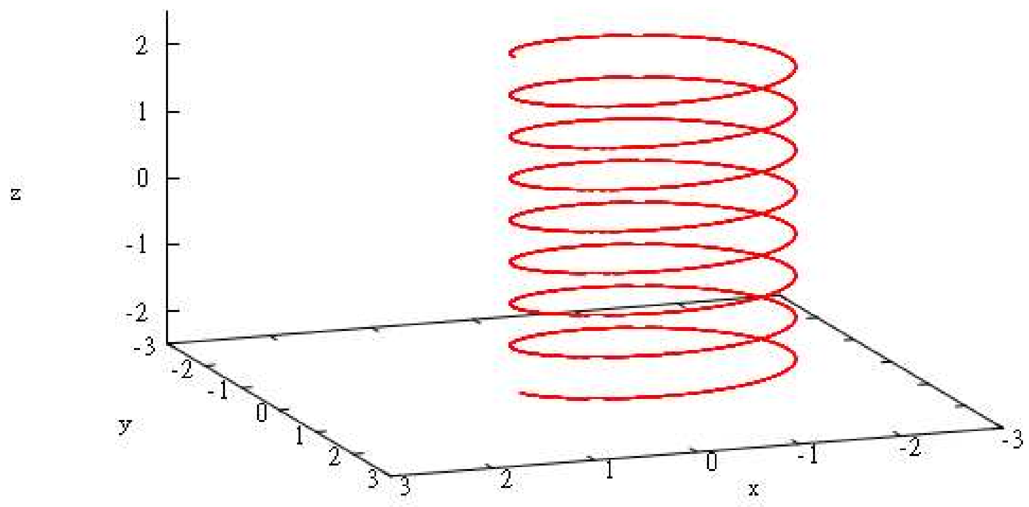

Fig. 1. Ellipse, ε=0.5, x=1.

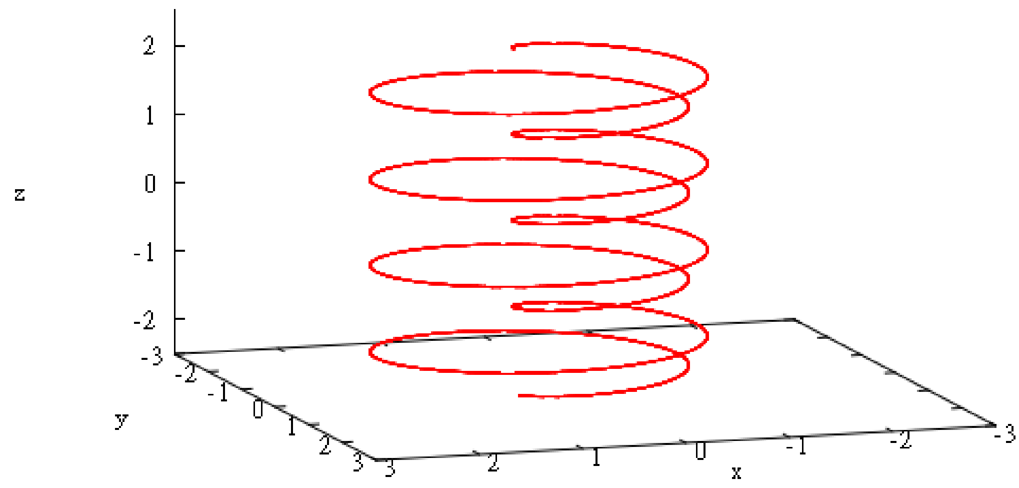

Fig. 2. Periodic orbit, ε=0.5, x=0.5.

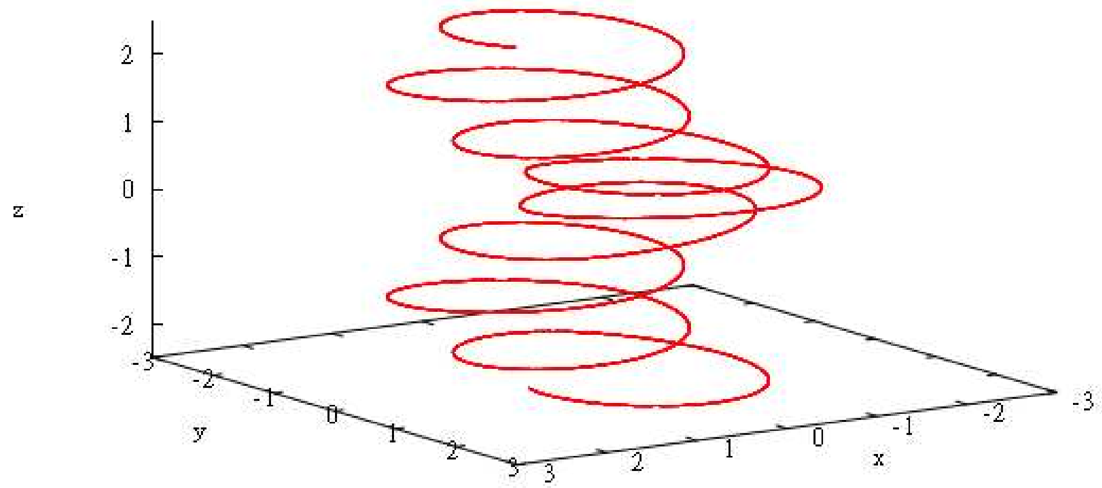

Fig. 3. Precessing ellipse, ε=0.5, x=1.2.

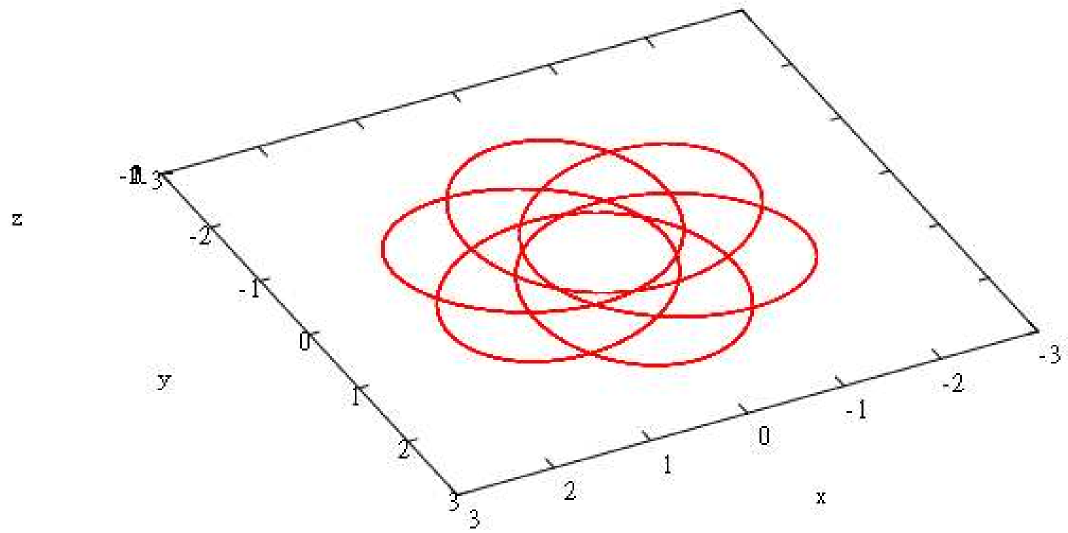

Fig. 4. Projection of ellipse of Fig. 3 to X-Y plane.

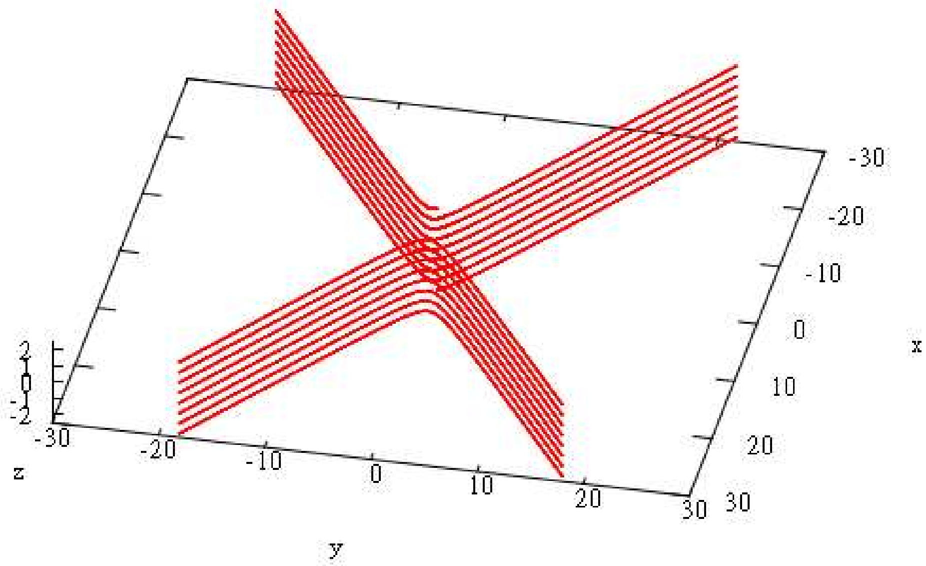

Fig. 5. Hyperbola, ε=1.2, x=1.0.

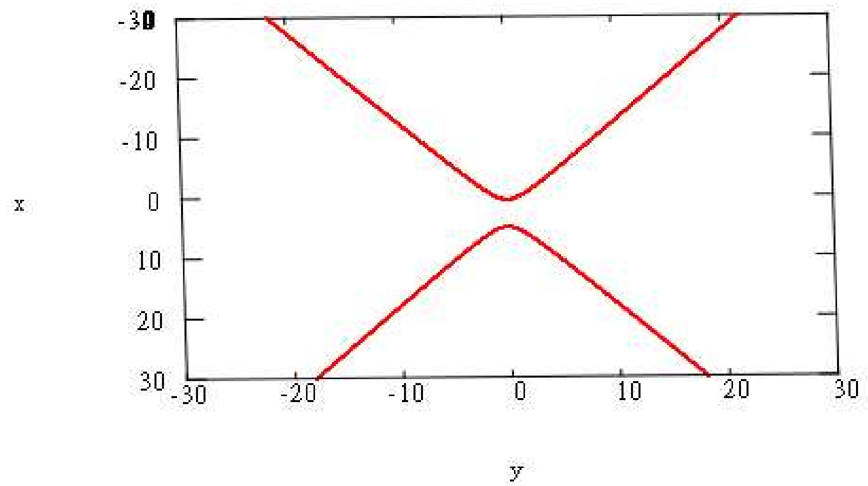

Fig. 6. Hyperbola, ε=1.2, x=1.0, projection to X-Y plane.

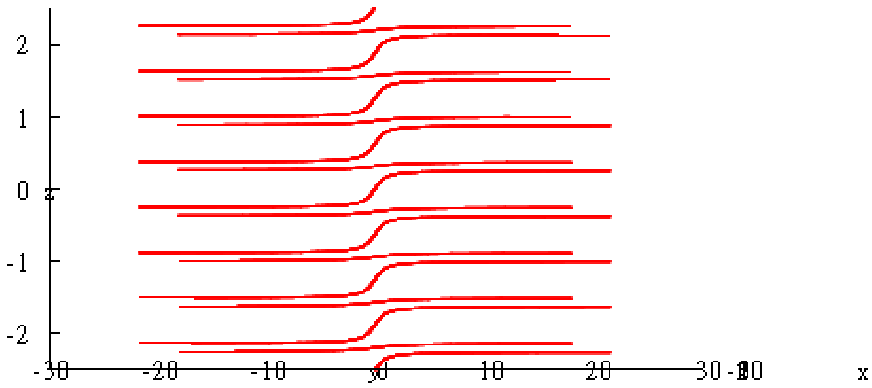

Fig. 7. Hyperbola, ε=1.2, x=1.0, projection to X-Z plane.

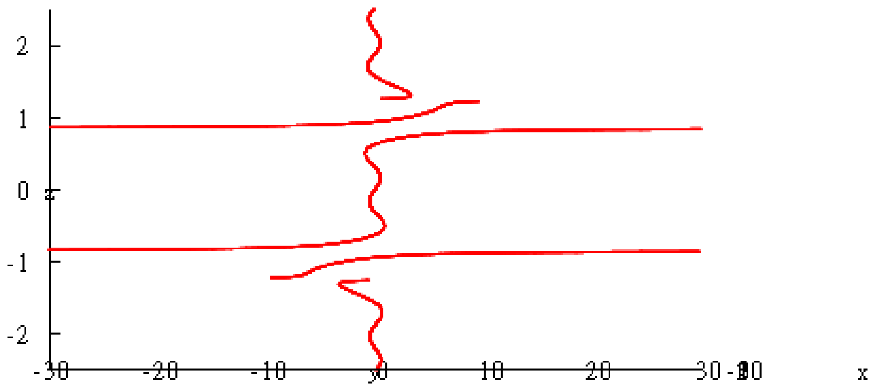

Fig. 8. Generalized hyperbola, ε=1.2, x=0.3, projection to X-Z plane.

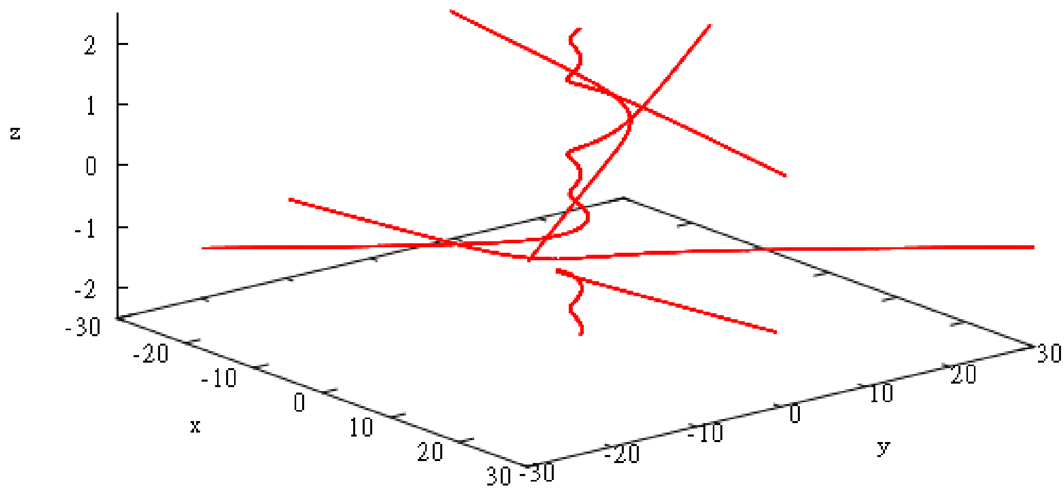

Fig. 9 Generalized hyperbola, ε=1.2, x=0.3.

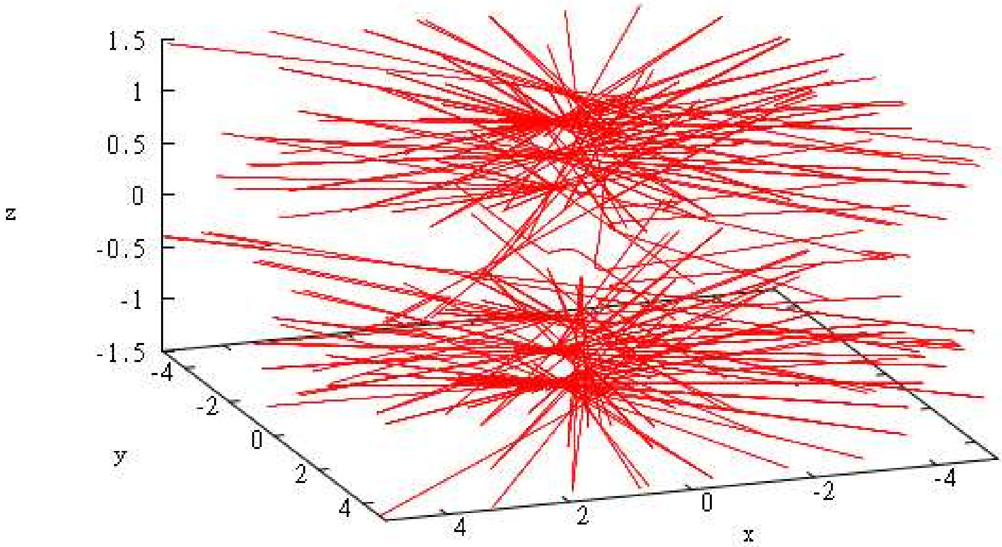

Fig. 10. Chaotic orbit with epsilon=1.2, x(θ) = θ.

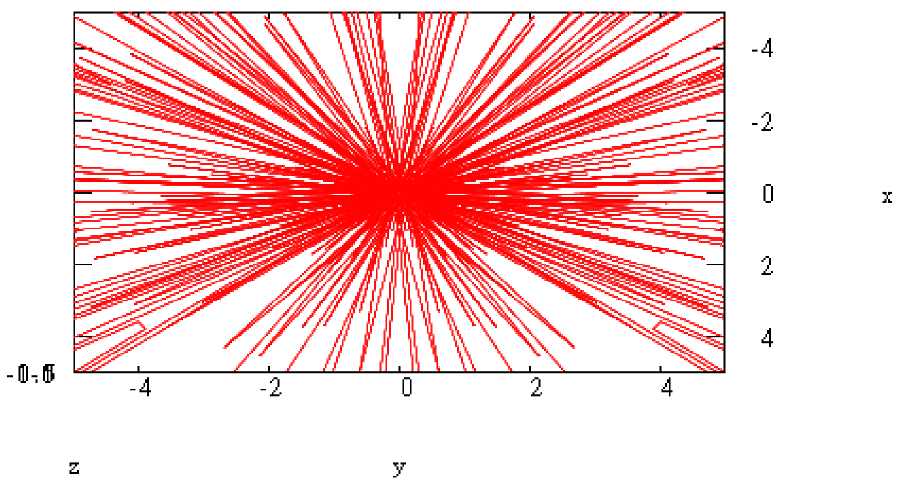

Fig. 11. Projection of Fig. 10 onto X-Y plane.