CONSERVATION OF ANTISYMMETRY IN LIGHT DEFLECTION AND ORBITAL PRECESSION.

by

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ABSTRACT

It is shown that antisymmetry is rigorously conserved in the ECE2 theories of light deflection due to gravitation, orbital precession, and the velocity curve of a whirlpool galaxy. Catastrophic failure of the Einstein theory is proven by accurate numerical integration of the relevant Binet equation, and a simple proof is given that the ECE2 theory gives an exact and simple description of any orbital precession. ECE2 is therefore preferred to Einsteinian general relativity.

Keywords: ECE2, conservation of antisymmetry in light deflection, precession and the velocity curve of a whirlpool galaxy.

UFT391

1. INTRODUCTION

In recent papers of this series {1 - 12} the principle of conservation of antisymmetry has been introduced to physics, and shown to be obeyed in electrodynamics and gravitation. In so doing, detailed maps of the vacuum or aether are obtained. In this paper the principle is shown to be obeyed in the phenomena of light deflection due to gravitation, orbital precession and in the velocity curve of a whirlpool galaxy. The conditions are determined under which the Einstein theory of orbital precession fails catastrophically, and it is shown that the ECE2 theory is always capable of giving an exact description of the universal orbital precession observed experimentally. Therefore ECE2 is preferred for many reasons to the obsolete Einstein theory. The latter has been refuted in this series {1 -12} in almost a hundred different ways.

This paper is a short synopsis of detailed notes posted with UFT391 on www.aias.us. Note 391(1) discusses the precise agreement between EC2 and the data on universal light deflection due to gravitation. The theory is shown to conserve antisymmetry. In Note 391(2) three dimensional precessions ae discussed with an ECE2 lagrangian theory that conserves antisymmetry. Note 391(3) discusses the precise computation of the Einsteinian precessing orbit from the relevant Binet equations. The conditions are defined and illustrated which the Einstein theory fails catastrophically, in that the orbiting mass m collides with the attracting mass M. Such a theory is therefore blatantly unscientific. Note 391(4) discusses an analytical integration of the Binet equation using the theory of autonomous second order differential equations to transform it into a well known integral. In a well defined binomial approximation the integral has an analytical solution. Notes 391(6) and 391(8) show that there is a large difference in the NASA and Wikipedia values of the precession of Mercury. This casts doubt on the idea of using minute precessions to test a theory. Finally Note 391(9) gives a simple demonstration that ECE2 can always give a precise description of any orbital precession.

2. UNIVERSAL LIGHT DEFLECTION AND ORBITAL PRECESSION

Light deflection due to gravitation {1 - 12} is explained very simply in ECE2 theory through the definition of the relativistic velocity (Note 391(1)):

$$\underline{v} = \gamma\, \underline{v}_N \quad -(1)$$

where the Lorentz factor is

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

and where $\underline{v}_N$ is the Newtonian velocity. The experimentally observed light deflection is

$$\Delta\phi = \frac{4MG}{R_0 c^2} \quad -(3)$$

where M is the attracting mass, G is Newton's constant, R_0 the distance of closest approach and c the vacuum speed of light. It is claimed experimentally that this is known with great precision, and it is universal. This result can be explained with the ECE2 theory by considering its hamiltonian:

$$H = \gamma mc^2 - \frac{mMG}{r} \quad -(4)$$

and its lagrangian:

$$\mathcal{L} = -\frac{mc^2}{\gamma} + \frac{mMG}{r}. \quad -(5)$$

Here, an object of mass m orbits an object of mass M. The scalar magnitude of the distance between the two objects is r. Antisymmetry is conserved as in immediately preceding papers because the same lagrangian is being used. In the non relativistic or Newtonian limit:

$$H \rightarrow \frac{1}{2} m v_N^2 - \frac{mMG}{r} \quad -(6)$$

and

$$\mathcal{L} = \frac{1}{2} m v_N^2 + \frac{mMG}{r}. \quad -(7)$$

The Newtonian orbital velocity is:

$$v_N^2 = MG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(8)$$

and the Newtonian planar orbit is the well known conic section:

$$r = \frac{\alpha}{1+\epsilon\cos\phi} \quad -(9)$$

where α is the half right latitude and ϵ the eccentricity. The semi major axis is:

$$a = \frac{\alpha}{1-\epsilon^2} \quad -(10)$$

and the distance of closest approach is:

$$R_0 = \frac{\alpha}{1+\epsilon}. \quad -(11)$$

It follows that:

$$v_N^2 = \frac{MG}{R_0}\left(2 + \frac{\epsilon^2 - 1}{\epsilon + 1}\right) = \frac{MG}{R_0}\left(1+\epsilon\right). \quad -(12)$$

Light grazing the sun or any massive object follows a hyperbolic orbit with:

$$\epsilon \gg 1 \quad -(13)$$

so:

$$v_N^2 \sim \frac{mG\epsilon}{R_0} \quad -(14)$$

The angle of deflection {1 - 12} is:

$$\Delta\gamma = \frac{\alpha}{\epsilon} = \frac{2mG}{R_0 v_N^2} \quad -(15)$$

From the fundamental definition of relativistic velocity, Eq. (1), it follows that:

$$v_N^2 = \frac{v^2}{1 + v^2/c^2} \quad -(16)$$

where the observable velocity is $\underline{v}$. For light grazing the sun this is:

$$v \rightarrow c \quad -(17)$$

and the Newtonian velocity of the Lorentz factor in Eq. (1) has an upper bound:

$$v_N^2 \rightarrow \frac{c^2}{2} \quad -(18)$$

so Eq. (15) becomes:

$$\Delta\gamma = \frac{\alpha}{\epsilon} = \frac{4mG}{R_0 c^2} \quad -(19)$$

which is precisely the experimental value, Q. E. D.

This calculation conserves antisymmetry and is a far simpler and far more powerful explanation than Einsteinian general relativity, severely criticised in many ways in UFT150 - UFT155, now classic and well accepted papers.

The same lagrangian (5) is used to give forward and retrograde precession, so that theory also conserves antisymmetry. Details of the calculation in three dimensions are given in Note 391(2).

It is important to note that the Einsteinian general relativity (EGR) fails catastrophically when tested numerically with sufficient care and rigour. This was first shown in the UFT series some years ago and in Section 3 the failure is vividly illustrated by the fact that under well defined conditions, EGR means that m collides with M, a catastrophic failure of the theory. A theory that fails completely cannot be used to describe any data under any circumstance. The claims of EGR are no longer acceptable, and data have been described satisfactorily with ECE2 {1 - 12}.

The lagrangian of EGR is:

$$\mathcal{L} = \frac{1}{2} m v_N^2 + \frac{mMG}{r} + \frac{MGL^2}{mc^2 r^3} \quad -(20)$$

where $\underline{L}$ is the conserved angular momentum. The well known effective force used in EGR is:

$$F(r) = -\frac{\partial U(r)}{\partial r} = -\frac{mMG}{r^2} - \frac{3MGL^2}{mc^2 r^4} \quad -(21)$$

According to EGR this produces the precession per orbit (i.e. per 2π revolution of m around M) of

$$\Delta\phi = \frac{6\pi MG}{\alpha c^2} \quad -(22)$$

This claim can be tested by Euler Lagrange theory applied to the lagrangian (20). The theory produces an orbit that can be tested experimentally. In papers such as UFT328 it has been shown that this orbit is not the EGR orbit. The Newtonian orbital velocity in the lagrangian is:

$$v_N^2 = MG\left(\frac{2}{r} - \frac{1}{a}\right) \quad -(23)$$

and the relativistic velocity is given by Eq (1). In a whirlpool galaxy the observed orbital velocity becomes constant for very large r, and the numerical integration of the lagrangian (20) should give this result.

It is well known that EGR fails catastrophically in a whirlpool galaxy because it gives a velocity curve that goes to zero in the large r limit (UFT350, "The Principles of ECE", chapter eight). The Newton theory also fails catastrophically in a whirlpool galaxy for the same reason, but several UFT papers have shown that ECE2 theory gives the right result qualitatively, that the orbital velocity becomes constant at large r. The Binet equation of EGR {1 - 12} is the well known:

$$\frac{d^2u}{d\phi^2} + u = \frac{1}{\alpha} + \frac{3MG}{c^2}u^2 \quad -(24)$$

where

$$u = \frac{1}{r} \quad -(25)$$

and in which the half right latitude is:

$$\alpha = \frac{L^2}{m^2MG}. \quad -(26)$$

This is integrated numerically in the present paper and in Section 3 it is shown that under well defined conditions, the orbit given by Eq. (24) is catastrophically incorrect , in that m collides with M. The numerical method correctly gives a static ellipse in the Newtonian limit:

$$\frac{d^2u}{d\phi^2} + u = \frac{1}{\alpha} \quad -(27)$$

and a small precession if and only if:

$$\frac{3MG}{c^2}u^2 \ll \frac{1}{\alpha} \quad -(28)$$

Under all other conditions the theory fails completely as illustrated in section 3.

Eq. (   ) is a second order autonomous equation:

$$\frac{d^2 u}{d\phi^2} = f(u) \quad -(29)$$

of the theory of differential equations (http://eqworld.ipmnet.ru). Its general solution is:

$$C_2 \pm \phi = \int \left(C_1 + 2\int f(u)\, du \right)^{-1/2} du \quad -(30)$$

where C_1 and C_2 are constants of integration. In Note 391(4) Eq. (30) is shown to be:

$$\phi = -\int \left(\frac{2mH}{L^2} + \frac{2u}{\alpha} - u^2 + \frac{2\alpha mG}{c^2} u^3 \right)^{-1/2} du \quad -(31)$$

which has an approximate solution:

$$\phi \sim -\int \frac{du}{\left(\frac{2mH}{L^2} + \frac{2u}{\alpha} - u^2 \right)^{1/2}} + \frac{mG}{c^2} \int \frac{du}{\left(\frac{2mH}{L^2} + \frac{2u}{\alpha} - u^2 \right)^{3/2}} \quad -(32)$$

for:

$$\frac{2mG}{c^2} \ll \left(\frac{2mH}{L^2} + \frac{2u}{\alpha} - u^2 \right). \quad -(33)$$

The first term on the right hand side of Eq. (32) gives a static ellipse, as is well known {1 - 12}. There are two constants of motion: H and L. To an excellent approximation these are the Newtonian hamiltonian and total angular momentum. For a given Newtonian orbit these are defined by:

$$H = -\frac{m M G}{2a} \quad -(34)$$

and

$$L^2 = m^2 M G \alpha . \quad -(35)$$

The second term can be integrated analytically using the Wolfram online integrator to give: $-(36)$

$$\phi \sim -\int \frac{du}{\left(\frac{2mH}{L^2} + \frac{2u}{\alpha} - u\right)^{1/2}} + \frac{2MG}{c^2}\left[\frac{(2/\alpha - 2u)}{\left(\frac{4}{\alpha^2} + \frac{8mH}{L^2}\right) u \left(\frac{2}{\alpha} + \frac{2mH}{L^2} - u\right)^{1/2}}\right]$$

The analytical result (36) can also be tested in its range of validity, given by Eq. (33), but the numerical method is by far the better method. The analytical result is graphed in Section 3 for the sake of comparison.

In addition to the catastrophic theoretical failure of EGR, there are also large literature disagreements in the experimental data for planetary precession. It is rarely made clear in the literature how the precession is calculated. The precession per revolution from EGR is:

$$\Delta\phi = \frac{6\pi M G}{\alpha c^2} . \quad -(37)$$

Using the experimental data for Mercury from Wikipedia and other sources:

$$\left.\begin{aligned} G &= 6.67408 \times 10^{-11}\ m^3 kg^{-1} s^{-2} \\ \alpha &= 5.7909050 \times 10^{10}\ m \\ M &= 1.989 \times 10^{30}\ kg. \\ c &= 2.99792 \times 10^{8}\ m s^{-1} \end{aligned}\right\} \quad -(38)$$

and the conversion factor:

$$1.0'' = 4.84814 \times 10^{-6}\ \text{radians} \quad -(39)$$

it follows that

$$\Delta\phi = 0.09915'' \quad -(40)$$

per orbit (the Mercury year). So in a hundred Mercury years:

$$\Delta\phi = 9.915'' \quad -(41)$$

According to the Wikipedia site on the planet Mercury, one Mercury year is 0.240846 Earth years. It follows that:

$$\Delta\phi = \frac{9.915}{0.240846} = 41.17'' \quad -(42)$$

per Earth century. The NASA site on the other hand gives:

$$\Delta\phi = 42.98'' \text{ per Earth century} \quad -(43)$$

and the observed value is claimed to be 43.11 $''$ per earth century. Both Wikipedia and NASA claim to use precise data, but give significantly different results.

Precise agreement between any observed precession and ECE2 can be obtained by considering the ECE2 hamiltonian:

$$H_0 = H - mc^2 = (\gamma - 1)mc^2 - \frac{mMG}{r} \quad -(44)$$

in a theory that conserves antisymmetry. At the perihelion (distance of closest approach):

$$\phi = 2\pi \quad -(45)$$

and the precession per 2π revolution is:

$$\Delta\phi = \frac{6\pi MG}{\alpha c^2} \quad -(46)$$

If it is assumed that:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1+\epsilon\cos\left(\phi+\Delta\phi\right)\right) = \frac{1}{\alpha}\left(1+\epsilon\cos\left(2\pi\left(1+x\right)\right)\right) \quad -(47)$$

where:

$$x = \frac{3MG}{\alpha c^2} \quad -(48)$$

then the hamiltonian is:

$$H_0 = \left(\gamma-1\right)mc^2 - \frac{mMG}{\alpha}\left(1+\epsilon\cos\left(2\pi\left(1+x\right)\right)\right). \quad -(49)$$

The Newtonian orbital velocity at the perihelion is:

$$v_N^2 = MG\left(\frac{2}{R_0} - \frac{(1-\epsilon^2)}{\alpha}\right) = \frac{MG}{\alpha}\left(2(1+\epsilon)-1+\epsilon^2\right)$$
$$= \frac{MG}{\alpha}\left(1+\epsilon\right)^2 \quad -(50)$$

Therefore the Lorentz factor in the hamiltonian (49) is:

$$\gamma = \left(1 - \frac{MG}{\alpha c^2}\left(1+\epsilon\right)^2\right)^{-1/2} \quad -(51)$$

at the perihelion. So for any given orbit H_0 can be computed and an ephemeris drawn up for H_0 for all orbits. This ensures that ECE2 agrees exactly with the universal precession (46) for any precessing orbit in the universe. The theory rigorously obeys the law of conservation of antisymmetry.

Conservation of antisymmetry in light deflection and orbital precession

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3 Computation and graphics

3.1 Solution of Einsteinian precession equation (24)

Einstein's general relativity leads the the Binet equation (24). This is an orbital equation for $u(\phi)$ and has been solved analytically in Eqs. (32-36). The second term in (36) represents the changes to the Newtonian ellipse; the latter is described by the first term. The second term, denoted by $\Delta\phi_2$, has been graphed in Fig. 1 for a model system with constants being unity. It is seen that there is no solution for $u > 4$. This means that there is the restriction $1/u = r > 0.25\,\alpha$ because $\alpha = 1$ in this calculation. For high elliptic orbits, however, $r < 0.25\,\alpha$ is possible. So Einsteinian general relativity fails in such cases. This situation is also evident from Fig. 2 where the function $\Delta\phi_2(r)$ has been plotted. $\Delta\phi_2$ falls below each limit when $r \to 0.25$.

3.2 Lagrange solution of Einsteinian orbits (20)

The dynamics of Einsteinian precession is obtained directly from a numerical solution of the Lagrange equations for the Lagrangian (20) obtained from Einstein theory:

$$\mathscr{L} = \frac{1}{2} m v_N^2 + \frac{mMG}{r} + \frac{MGL^2}{mc^2 r^3} \tag{52}$$

with

$$r = \sqrt{X^2 + Y^2}, \tag{53}$$

$$v_N^2 = MG\left(\frac{2}{r} - \frac{1}{a}\right), \tag{54}$$

$$L^2 = m^2 MG\,\alpha. \tag{55}$$

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The resulting Euler-Lagrange equations are

$$\frac{d^2}{dt^2}X = -\frac{GM(X\,Y^2 + X^3)}{r^5} - \frac{3\,G\,M\,L^2 X}{m^2\,c^2\,r^5}, \tag{56}$$

$$\frac{d^2}{dt^2}Y = -\frac{GM(X^2\,Y + Y^3)}{r^5} - \frac{3\,G\,M\,L^2 Y}{m^2\,c^2\,r^5}. \tag{57}$$

Their solution for unity parameters is graphed in Figs. 3-5. The weight of the Einstein term (last term in above equations) wsa varied by using different values of c. For small contributions, a precessing ellipse results (Fig. 3). With increasing relativistic effects, precession grows significantly (Fig. 4). For highly relativistic cases, however, there is an abrupt change in the orbital characteristic: The orbiting mass falls into the centre where motion ends due to singularities. It is clear that Einsteinian theory fails drastically for ultrarelativistic cases. This behaviour is consistent with numerical solutions of the Binet equation (24) in earlier UFT papers where the function $u(\phi)$ diverges when the relativistic term exceeds a certain size.

3.3 Calculation of precession angle of Mercury

The orbital precession of the planet Mercury is so small that direct numerical solutions of the Euler-Lagrange equations cannot be applied to compute this value. Using the Mercury data from NASA[1] the result of the known formula (37) is

$$\Delta\phi = 5.019 \cdot 10^{-7}\text{rad} = 42.98 \text{ arc sec per earth century}. \tag{58}$$

The ECE2 Hamiltonian is

$$H_0 = (\gamma - 1)mc^2 - \frac{mMG}{r} \tag{59}$$

where the gamma factor can be expanded to third order in the form:

$$\gamma = \left(1 - \frac{v_N^2}{c^2}\right)^{-1/2} \approx 1 + \frac{1}{2}\frac{v_N^2}{c^2} + \frac{3}{8}\frac{v_N^4}{c^4} + \frac{5}{16}\frac{v_N^6}{c^6}. \tag{60}$$

The Newtonian Hamiltonian is

$$H_{0N} = \frac{1}{2}mv_N^2 - \frac{mMG}{r} = -\frac{mMG}{2a} \tag{61}$$

and is a constant of motion. Assuming the precessing orbit

$$r = \frac{\alpha}{1 + \epsilon\cos(\phi + \Delta\phi)}, \tag{62}$$

we have at perihelion:

$$v_N^2 = \frac{MG}{\alpha}(1+\epsilon)^2, \tag{63}$$

$$r = \frac{\alpha}{1 + \epsilon\cos(2\pi + \Delta\phi)}. \tag{64}$$

[1] https://nssdc.gsfc.nasa.gov/planetary/factsheet/mercuryfact.html

Inserting these expressions into H_0 and H_{0N}, we obtain an equation for $\cos(\Delta\phi)$ as described in note 391(9). Equating both Hamiltonians gives the result for $\cos(\Delta\phi)$:

$$\cos(\Delta\phi) = \frac{5\alpha {v_N}^6}{16GM\,c^4\epsilon} + \frac{3\alpha {v_N}^4}{8GM\,c^2\epsilon} + \frac{\alpha {v_N}^2}{2GM\epsilon} - \frac{\epsilon}{2} - \frac{1}{2\epsilon} \tag{65}$$

Numerical evaluation gives

$$\cos(\Delta\phi) > 1 \tag{66}$$

because we have exceeded $\phi = 2\pi$. Taking this result modulo 1 and subtracting $\pi/2$ gives

$$\Delta\phi = -8.786 \text{ arc sec per earth century.} \tag{67}$$

This is nearly a factor of 5 too small if we trust the experimental value of -42.98 arc sec per earth century. The value is negative because also the deviation from 2π is negative in the original derivation of Eq. (37). To adopt the value to the experimental result, we add a constant vacuum potential U_0 to the Newtonian Hamiltonian:

$$H_{0N} = -\frac{mMG}{2a} + U_0. \tag{68}$$

Setting this value to

$$U_0 = -6.49 \cdot 10^{23} \text{ Joule} \tag{69}$$

we obtain exactly the experimental value of -42.98 arc sec per earth century. The Hamiltonians H_0 and H_{0N} are in the order of $-3.8 \cdot 10^{30}$ Joule. Therefore U_0 is a small correction, being in the order of difference between the Newtonian and relativistic Hamiltonian.

The gamma factor at perihelion from experimental data is:

$$\gamma = 1.000000019350196. \tag{70}$$

It deviates from unity only in the eighths decimal place. This is the reason why it is so difficult to obtain a reliable result from numerical calculations. In our approach, we only considered one single point of the orbit, the perihelion. Therefore our original result (67) is satisfactory. Small vacuum effects obviously can change this value significantly so we do not know if the experimentally observed precession, with all its uncertaintenties by impacts of other planets, is a consequence of relativistic orbital dynamics at all.

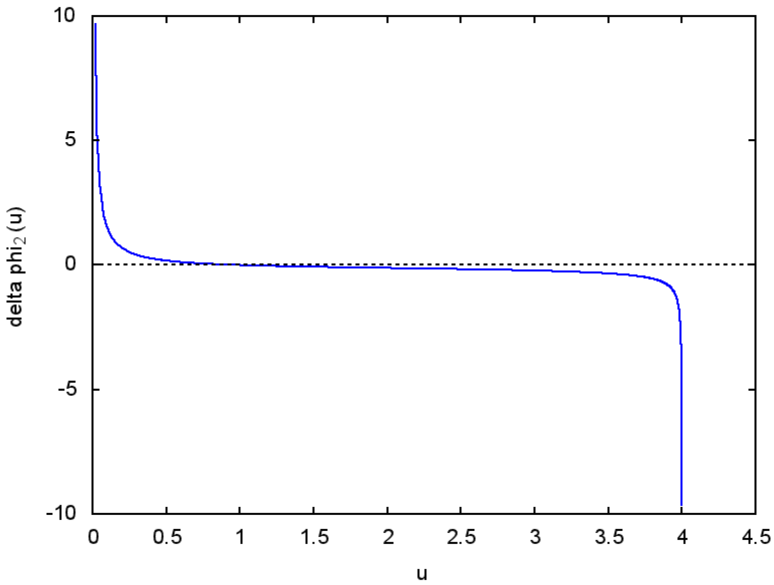

Figure 1: Precession angle $\Delta\phi_2(u)$.

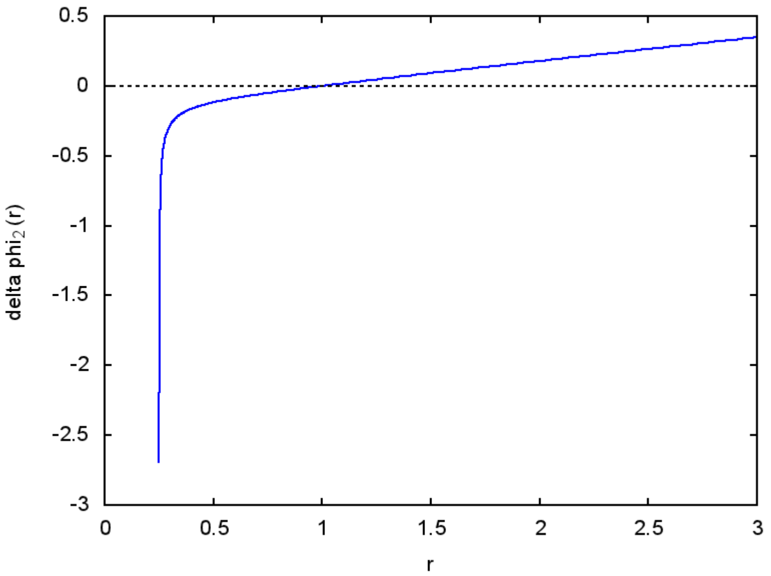

Figure 2: Precession angle $\Delta\phi_2(r)$.

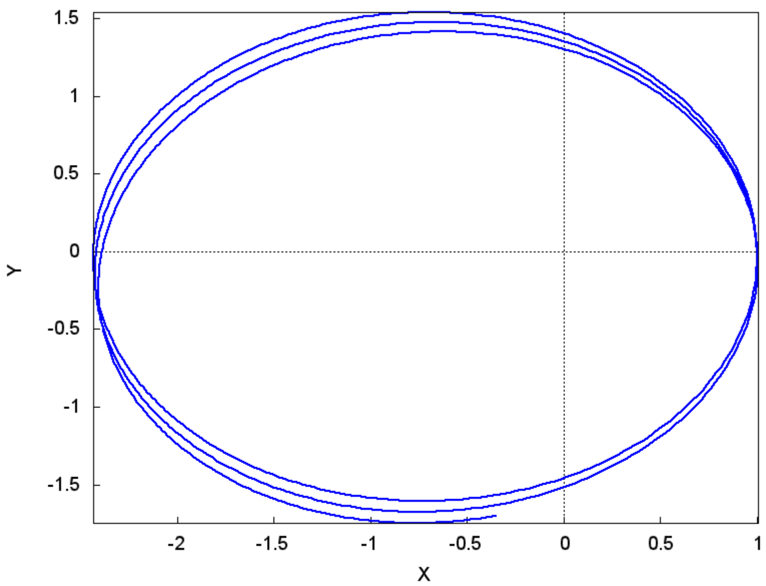

Figure 3: Elliptic orbit with low precession.

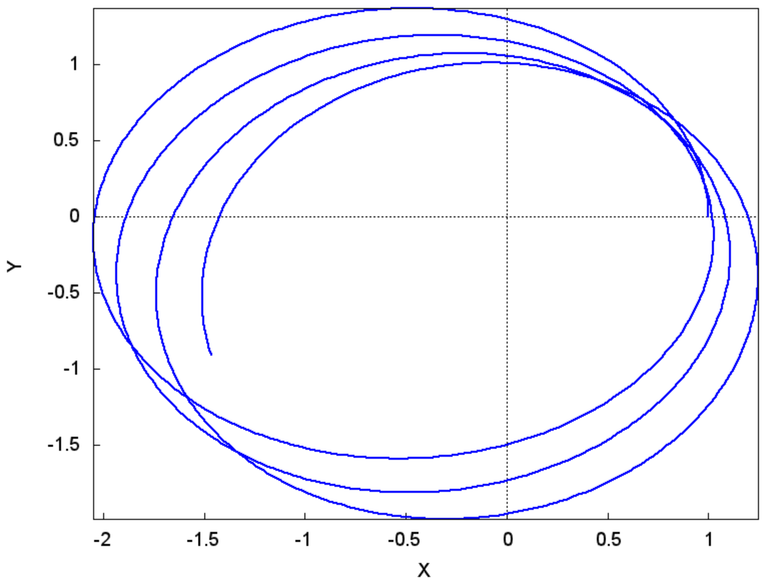

Figure 4: Elliptic orbit with high precession.

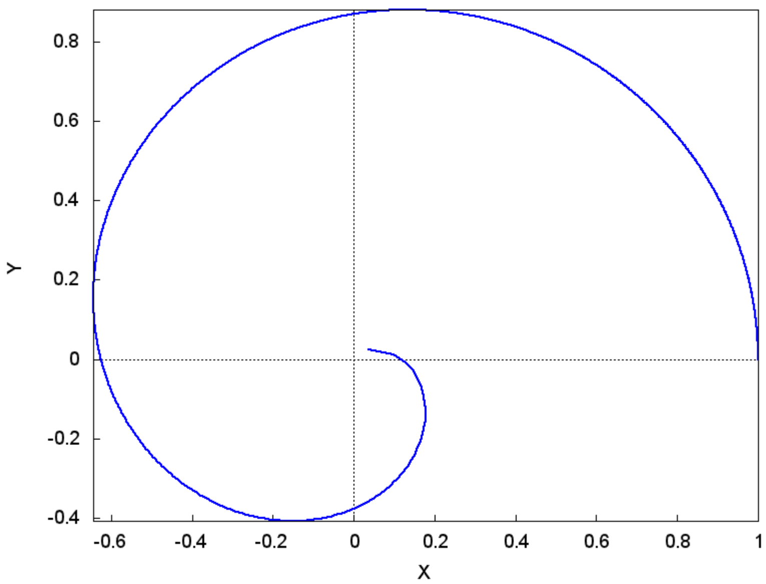

Figure 5: Unstable orbit (mass falls into centre).

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