CLASSICAL LIMIT OF ECE THEORY: DEVELOPMENT of x THEORY FOR PRECESSING CONICAL SECTIONS.

by

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ABSTRACT

The x theory of precessing conical sections is developed to derive expressions for the area and circumference of a closed and precessing conical section. The x theory is a theory of all observable orbits in terms of the precessing conical sections, and an example is given of the theory at work. The meaning of the familiar Newtonian force law is explained with lagrangian dynamics, and the universal force law of the x theory derived in a simple way. The effect of the precession factor x on experimentally observable quantities is evaluated.

Keywords: Classical limit of ECE theory, x theory, force law for precessing orbits.

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1. INTRODUCTION

Recently in this series of over two hundred papers to date a theory of all observable orbits has been developed on the basis of the precessing conical sections {1 - 10}. The latter are characterized by the precession factor x. The angle of precession is also defined by x and is $2\pi(x - 1)$. In the solar system it is well known that the precession angle is a few arc seconds per century, so x is very close to unity in the solar system. In binary pulsars and binary neutron stars, systems in which the largest precessions are observed, x is a few percent different from unity. However, it has been discovered in recent papers of this series that when x is increased the precessing conical sections take on a variety of hitherto unknown properties, including fractal properties. When x is allowed to become r dependent, all observable orbits can be described by precessing conical sections. Straightforward lagrangian analysis produces the force law for orbits that are described by precessing conical sections. The force law is a sum of inverse square and inverse cube terms in r, the distance between the planet and the sun. The universal gravitational potential is therefore the sum of terms inverse and inverse squared in r. The x theory describes precessing orbits straightforwardly without the need for Einsteinian general relativity (EGR), which is erroneous in many ways {1 - 10}. The definitive refutation {1} of EGR is that it claims erroneously to produce a precessing conical section from the wrong force law. The force law of EGR is a sum of terms inverse squared and inverse fourth in r. It is perfectly easy to show that this force law does not produce planetary precession, and this was first pointed out by Schwarzschild {11}. The whole development of EGR during the twentieth century is erroneous. This realization has led to the much simpler and more powerful x theory of all orbits. So the end result is a significant advance in physics and also mathematics. Before this work, fractal conical section theory was unknown, and is a potentially rich subject area that can be developed mathematically.

In Section 2 Green's Theorem is used to derive an expression for the area of a closed and precessing conical section, the precessing ellipse. These simple mathematical exercises take on a new meaning and importance now because it is known that increasing x produces wholly new mathematics. In physics the area of an orbit is well known to be related to Kepler's second and third laws. Precise details are given of the derivation of the polar equation of the ellipse from the Cartesian equation of the ellipse, and again, such details take on a new importance. A worked example is given of x theory, the derivation of a logarithmic spiral orbit from a precessing conical section. The precise meaning is developed with lagrangian dynamics of the Newtonian force law, and the new universal force law derived of the x theory. The derivation is a simple consequence of well known lagrangian dynamics, but again takes on a new meaning in mathematics as x is increased. Conceivably, there may be orbits in astronomy that show the fractal properties of x theory. Finally the circumference is calculated of a precessing orbit, and again, as x is increased, the properties of the circumference take on a completely new meaning.

In Section 3, graphical results of the derivations of Section 2 are presented and analysed.

2. PROPERTIES OF THE PRECESSING ORBITS IN x THEORY

Consider the Cartesian equation of the ellipse:

$$\frac{X^2}{a^2} + \frac{Y^2}{b^2} = 1 \quad -(1)$$

where a and b are respectively the semi major and semi minor axes. In Eq. (1):

$$X = a\cos\theta, \quad Y = b\sin\theta \quad -(2)$$

where θ is the polar angle of the plane cylindrical polar system of coordinates. In planetary theory the sun is at one focus P of the ellipse, so the polar equation is needed of the ellipse with respect to the focus P. The focus P is the point ($a\epsilon$, 0) where ϵ is the eccentricity of the ellipse. The distance r from the point (X, Y) to ($a\epsilon$, 0) is the radial coordinate of the plane cylindrical system. From elementary considerations:

$$r^2 = X^2 - a^2\epsilon^2 + Y^2 \quad -(2)$$

$$= X^2 - a^2\epsilon^2 + b^2\left(1 - \frac{X^2}{a^2}\right).$$

The eccentricity of the ellipse is defined by:

$$\epsilon^2 = 1 - \frac{b^2}{a^2}, \quad -(3)$$

so:

$$r^2 = X^2\epsilon^2 - 2a\epsilon X + a^2. \quad -(4)$$

Therefore:

$$r = \pm(\epsilon X - a) \quad -(5)$$

in which:

$$X = a\epsilon + r\cos\theta. \quad -(6)$$

It is customary to take the negative root of Eq. (5) to define the polar equation of the ellipse, so:

$$r = -\epsilon(a\epsilon + r\cos\theta) + a \quad -(7)$$

i.e.

$$r = \frac{\alpha}{1+\epsilon\cos\theta} \quad -(8)$$

in which the semi right latitude is:

$$\alpha = a\left(1-\epsilon^2\right). \quad -(9)$$

Eq. (8) is the polar equation of the ellipse, Q. E.D. It is also the polar equation of all the conical sections as first shown by Bernoulli.

The area of the ellipse is given by a simple application of Green's Theorem:

$$\frac{1}{2}\oint X\,dY - Y\,dX = \int dX\,dY. \quad -(10)$$

In elliptical polar coordinates:

$$X = a\cos\theta, \quad Y = b\sin\theta, \quad -(11)$$
$$dX = -a\sin\theta\,d\theta, \quad dY = b\cos\theta\,d\theta.$$

So:

$$A = \oint X\,dY = \int_0^{2\pi} ab\cos^2\theta\,d\theta \quad = \pi ab. \quad -(12)$$

In circular polar coordinates:

$$X = r\cos\theta, \quad Y = r\sin\theta, \quad -(13)$$
$$dX = \cos\theta\,dr - r\sin\theta\,d\theta,$$
$$dY = \sin\theta\,dr + r\cos\theta\,d\theta,$$

so:

$$A = \frac{1}{2}\oint\left(X\,dY - Y\,dX\right) = \frac{1}{2}\oint r^2\,d\theta \quad -(14)$$

from which follows the well known {12} equation for any line in a plane:

$$dA = \frac{1}{2} r^2 d\theta . \quad -(15)$$

In astronomy, eq. (15) leads to Kepler's second law {12}.

Therefore:

$$A = \frac{1}{2} \oint r^2 d\theta = \oint X dY \quad -(16)$$

where:

$$X = a \cos\theta , \quad Y = b \sin\theta , \quad -(17)$$
$$r = \frac{\alpha}{1 + \epsilon \cos\theta} ,$$

and the area is self consistently:

$$\begin{aligned} A &= \frac{1}{2} \oint r^2 d\theta = \frac{\alpha^2}{2} \int_0^{2\pi} \frac{d\theta}{(1+\epsilon\cos\theta)^2} \\ &= \frac{\alpha^2}{2(1-\epsilon^2)} \left[\frac{2}{(1-\epsilon^2)^{1/2}} \tan^{-1}\left(\frac{(1-\epsilon)\tan(\theta/2)}{(1-\epsilon^2)^{1/2}} \right) - \frac{\epsilon \sin\theta}{1+\epsilon\cos\theta} \right]_0^{2\pi} \\ &= ab \tan^{-1}\left(\left(\frac{1-\epsilon}{1+\epsilon} \right)^{1/2} \tan\pi \right) = ab \tan^{-1} 0 \quad -(18) \\ &= \pi ab. \end{aligned}$$

In this case it is easier to derive the area from Green's Theorem. For the precessing ellipse ($\theta \rightarrow x\theta$), the area is:

$$A = \oint X dY \quad -(19)$$

where:

$$X = a\cos(x\theta);\; Y = b\sin(x\theta), \qquad -(20)$$
$$dX = -ax\sin(x\theta)\,d\theta,$$
$$dY = bx\cos(x\theta)\,d\theta,$$

so:

$$A = \oint X\,dY = \int_0^{2\pi} abx^2\cos^2(x\theta)\,d\theta. \qquad -(21)$$

The integral can be evaluated straightforwardly using the change of variable:

$$\beta = x\theta \qquad -(22)$$

so

$$A = abx\int_0^{2\pi x}\cos^2\beta\,d\beta \qquad -(23)$$
$$= abx\left(\pi x + \frac{1}{4}\sin(4\pi x)\right).$$

The result is graphed in Section 3, and as x increases the area develops new mathematical properties that may conceivably be observable in astronomy. The solar system is the case where x is very close to unity.

It is convenient to exemplify x theory by considering the logarithmic spiral orbit:

$$r = r_0 e^{a\theta}. \qquad -(24)$$

In x theory this is represented by a precessing conical section:

$$r = r_0 e^{a\theta} = \frac{\alpha}{1+\epsilon\cos(x\theta)}. \qquad -(25)$$

The force law responsible for the orbit (24) is found straightforwardly using elementary methods {12} from the lagrangian equation:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = -\frac{\mu r^2}{L^2} F(r) \quad -(26)$$

where the conserved total angular momentum is:

$$L = \mu r^2 \frac{d\theta}{dt} . \quad -(27)$$

The reduced mass μ of two interacting particles of masses m (planet) and M (sun) is

$$\mu = \frac{mM}{m+M} \quad -(28)$$

and F (r) is the radially or centrally directed force between m and M. From Eqs. (24) and (26):

$$F(r) = -\frac{L^2}{\mu r^3}\left(1 + a^2\right) \quad -(29)$$

so a logarithmic spiral orbit is given by an inverse cube force law. The angular velocity is

given by:

$$\omega = \frac{d\theta}{dt} = \frac{L}{\mu r^2} \quad -(30)$$

and elementary integration produces the orbital interval:

$$t = \left(\frac{\mu r_0^2}{2aL}\right) \exp\left(2a\theta\right) \quad -(31)$$

an equation which is easily inverted to give θ as a function of t:

$$\theta = \frac{1}{2a} \log_e\left(\left(\frac{2aL}{\mu r_0^2}\right)t\right) \quad -(32)$$

In general, from Eq. (14) and Green's Theorem:

$$\frac{dA}{dt} = \frac{1}{2} r^2 \dot{\omega} = \frac{L}{2\mu} \quad -(33)$$

which is Kepler's second law, "equal areas in equal times". Therefore in general:

$$dt = \frac{2\mu}{L} dA = \frac{\mu}{L} r^2 d\theta \quad -(34)$$

and the orbital interval in general is:

$$t = \frac{\mu}{L} \int r^2 d\theta . \quad -(35)$$

This is a useful equation which is true for all orbits in a plane. The orbital interval can be measured with great accuracy in contemporary astronomy. From Eqs. (24) and (35):

$$t = \frac{\mu r_0^2}{L} \int e^{2a\theta} d\theta = \left(\frac{\mu r_0^2}{2aL}\right) \exp(2a\theta) \quad -(36)$$

which is Eq. (31). Q. E. D.

Elementary integration {12} gives:

$$r = \left(\frac{2aLt}{\mu}\right)^{1/2} \quad -(37)$$

for the logarithmic spiral orbit. From Eq. (25):

$$1 + \epsilon \cos x\theta = \frac{\alpha}{r_0} e^{-a\theta} \quad -(38)$$

so:

$$\cos x\theta = \frac{1}{\epsilon}\left(\frac{\alpha}{r} - 1\right) = \frac{1}{\epsilon}\left(\frac{\alpha}{r_0} e^{-a\theta} - 1\right) - (39)$$

and the precession factor is:

$$x = \frac{1}{\theta} \cos^{-1}\left(\frac{1}{\epsilon}\left(\frac{\alpha}{r} - 1 \right) \right) \qquad -(40)$$

$$= \frac{a}{\log_e\left(\frac{r}{r_0}\right)} \cos^{-1}\left(\frac{1}{\epsilon}\left(\frac{\alpha}{r} - 1 \right) \right).$$

Therefore a logarithmic spiral orbit can be represented as a precessing conical section given the x factor of Eq. (40). Similarly any planar orbit can be represented as a precessing conical section, giving a consistent theory of all cosmology, one which represents all orbits as precessing conical sections with the same universal force law.

With reference to the accompanying background note 222(3) on www.aias.us

The force law of the static ellipse:

$$F(r) = \mu \frac{d^2 r}{dt^2} - \frac{L^2}{\mu r^3} \qquad -(41)$$

is given from the lagrangian Eq. (26) as:

$$F(r) = -\frac{L^2}{\mu \alpha r^2}. \qquad -(42)$$

Note carefully that this is what is known conventionally as the Newtonian force law. Here:

$$\frac{d^2 r}{dt^2} = \frac{L^2}{\mu^2 r^2}\left(\frac{1}{r} - \frac{1}{\alpha} \right) \qquad -(43)$$

from lagrangian dynamics. The conventional inverse square law emerges from a combination of Eqs. (41) and (43) as:

$$F(r) = \frac{L^2}{\mu r^2}\left(\frac{1}{r} - \frac{1}{\alpha} \right) - \frac{L^2}{\mu r^3} \qquad -(44)$$

in which {12}:

$$L^2 = d\mu m M G, \quad -(45)$$

so we obtain the familiar:

$$F(r) = -\frac{mMG}{r^2}. \quad -(46)$$

Newton's theory cannot explain planetary motion as is well known {12}. The force law (46) is pure attraction, and the contrivance of centrifugal force is just that, a contrivance. There is no centrifugal force, there is only rotational kinetic energy. In ECE theory {1 - 10} a completely new approach to planetary motion has been forged based on the Cartan torsion of spacetime itself. The basic problem with Newtonian dynamics is that it applies to motion in a straight line, and it cannot deal with angular motion self consistently. The lagrangian theory on the other hand produces the information just given, and does so self consistently. For example, the lagrangian theory produces the net orbital force of Eq. (41), and this net force is zero if:

$$\mu \frac{d^2 r}{dt^2} = \frac{L^2}{\mu r^3}. \quad -(47)$$

In the usual textbook dogma it is claimed that the attractive Newtonian central force $\mu d^2 r/dt^2$ is balanced by the repulsive centrifugal force $L^2/(\mu r^3)$ and this produces the well known condition of weightlessness. This explanation is clearly fallacious however because the net force in Eq. (46) is the same as that in Eq. (41), and it is not zero. The correct explanation is that the acceleration of the ellipse is:

$$a = \frac{1}{\mu} F(r) = \frac{d^2 r}{dt^2} - \frac{L^2}{\mu^2 r^3}$$

$$-(48)$$

and this result was derived in another way in UFT196. Newton's "explanation" of the Keplerian laws is pure empiricism and was in fact discovered not by Newton, but by Hooke. This historical fact is made very clear by John Aubrey in the online "Brief Lives".

The precessing ellipse is defined by:

$$\frac{1}{r} = \frac{1}{\alpha}\left(1+\epsilon\cos(x\theta)\right) \quad -(49)$$

and from elementary lagrangian dynamics:

$$\frac{dr}{dt} = -\frac{L}{\mu}\frac{d}{d\theta}\left(\frac{1}{r}\right) = -\frac{xL\epsilon}{\mu\alpha}\sin(x\theta) \quad -(50)$$

and

$$\frac{d^2r}{dt^2} = -\frac{L^2}{\mu^2}\frac{1}{r^2}\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) = \left(\frac{xL}{\mu}\right)^2\frac{\epsilon}{\alpha r^2}\cos(x\theta). \quad -(51)$$

These simple derivations of lagrangian dynamics again take on a new meaning when x is increased, so polar plots of Eqs. (50) and (51) show many new properties. They are exemplified briefly in Section 3. For any curve in a plane {12}:

$$dA = \frac{1}{2}r^2\,d\theta \quad -(52)$$

and in Newtonian dynamics:

$$dA = \frac{L}{2\mu}\,dt \quad -(53)$$

(Kepler's second law). So:

$$\frac{dA}{dr} = \frac{dA}{dt}\frac{dt}{dr} = \frac{\alpha}{2\epsilon\sin\theta} \quad -(54)$$

where:

$$\cos\theta = \frac{1}{\epsilon}\left(\frac{\alpha}{r} - 1\right) \quad -(55)$$

and

$$\sin\theta = \frac{1}{\epsilon r}\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}. \quad -(56)$$

Therefore the infinitesimal of area is:

$$dA = \frac{\alpha r \, dr}{2\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}} \quad -(57)$$

and its integral is the area in Newtonian dynamics:

$$A = \int dA. \quad -(58)$$

However this area is the area of the ellipse:

$$A = \pi a b = \pi \alpha^2 \left(1 - \epsilon^2\right)^{-3/2}. \quad -(59)$$

If the circumference of the ellipse is R then:

$$\int_0^R \frac{r \, dr}{\left(\epsilon^2 r^2 - (\alpha - r)^2\right)^{1/2}} = \frac{2\pi\alpha}{\left(1 - \epsilon^2\right)^{3/2}}. \quad -(60)$$

This equation gives the circumference of the ellipse analytically.

With reference to note 222(4) of www.aias.us the adjustments to these results due to precession are as follows. The universal force law is:

$$F(r) = \frac{L^2}{\mu r^2}\left(\frac{x^2 - 1}{r} - \frac{x^2}{\alpha}\right) \quad -(61)$$

and produces all known orbits given the appropriate x. This law has been exemplified already with the logarithmic spiral orbit. The law (61) is the only law that produces a precessing ellipse in lagrangian dynamics. The claims of EGR to produce a precessing ellipse are badly erroneous and EGR uses the same lagrangian dynamics. The linear central velocity and acceleration are adjusted as follows:

$$\frac{dr}{dt} = \left(\frac{x \epsilon L}{d\mu}\right) \sin(x\theta) \quad -(62)$$

and

$$\frac{d^2 r}{dt^2} = \left(\frac{xL}{\mu}\right)^2 \frac{1}{r^2}\left(\frac{1}{r} - \frac{1}{d}\right) \quad -(63)$$

and again the use of an increasing x leads ot new physics and mathematics. These results are summarized graphically in Section 3. Finally the area of the precessing orbit is adjusted to:

$$A = \frac{d}{2x}\int_0^R \frac{r\,dr}{\left(\epsilon^2 r^2 - (d-r)^2\right)^{1/2}} \quad -(64)$$

and this result is again graphed in Section 3. In general:

$$\int_0^R \frac{r\,dr}{\left(\epsilon^2 r^2 - (d-r)^2\right)^{1/2}} = \frac{x}{d}\int_0^{2\pi}\left(\frac{d}{1+\epsilon\cos x\theta}\right)^2 d\theta. \quad -(65)$$

SECTION 3: GRAPHICAL RESULTS AND ANALYSIS.

Section by Dr. Horst Eckardt

Classical Limit of ECE Theory: Development of X Theory for Precessing Conical Sections

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3 Gaphical Results and Analysis

In this section the functions dr/dt, $A(r,\theta)$ and its derivative dA/dr are graphed in different representations. The formulae are derived in full detail in the concomitant note 222(5) of this paper. We present a form $f(r)$ and $f(\theta)$ to be able to display the radial and angular dependencies. For the radial velocity dr/dt we have from Eqs.(50) or (62):

$$\frac{dr}{dt}(r) = \frac{x\,L}{\alpha\,\mu\,r}\sqrt{\epsilon^2\,r^2-(\alpha-r)^2}, \tag{66}$$

$$\frac{dr}{dt}(\theta) = \frac{\epsilon x L}{\alpha\mu}\sin(x\theta). \tag{67}$$

The area of the ellipse is

$$A(r) = \frac{\alpha}{2\,x}\left(\frac{\alpha\,\mathrm{asin}\left(\frac{2\left(\epsilon^2-1\right)r+2\,\alpha}{\sqrt{4\,\alpha^2\,(\epsilon^2-1)+4\,\alpha^2}}\right)}{\sqrt{1-\epsilon^2}\,\left(\epsilon^2-1\right)}+\frac{\sqrt{\left(\epsilon^2-1\right)\,r^2+2\,\alpha\,r-\alpha^2}}{\epsilon^2-1}\right), \tag{68}$$

$$A(\theta) = 2\,\alpha\left(\frac{\mathrm{atan}\left(\frac{(2\,\epsilon-2)\sin(\theta\,x)}{2\,\sqrt{1-\epsilon^2}\,(\cos(\theta\,x)+1)}\right)}{\sqrt{1-\epsilon^2}\,\left(\epsilon^2-1\right)}\right. \tag{69}$$

$$\left.-\frac{\epsilon\sin\left(\theta\,x\right)}{\left(\cos\left(\theta\,x\right)+1\right)\,\left(\frac{(\epsilon^3-\epsilon^2-\epsilon+1)\sin(\theta\,x)^2}{(\cos(\theta\,x)+1)^2}-\epsilon^3-\epsilon^2+\epsilon+1\right)}\right),$$

and its derivative is

$$\frac{dA}{dr}(r) = \frac{\alpha}{2\,\epsilon\sin\left(x\,\theta\right)}, \tag{70}$$

$$\frac{dA}{dr}(\theta) = \frac{\alpha\,r}{2\,x\sqrt{\epsilon^2\,r^2-(\alpha-r)^2}}. \tag{71}$$

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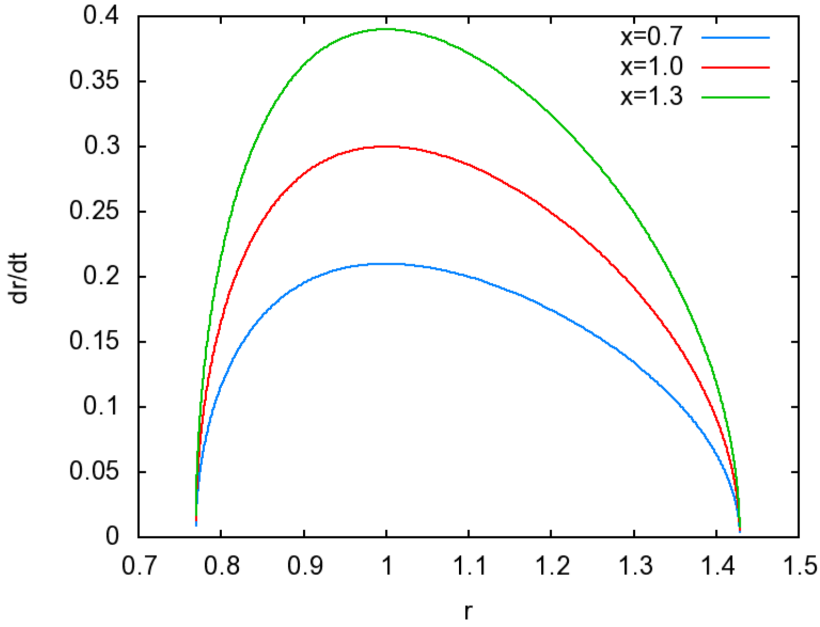

Figure 1: dr/dt for parameters $L = 1$, $\mu = 1$, $\alpha = 1$, $\epsilon = 0.3$.

The effects of the factor x are as follows. Fig. 1 shows the radial velocity which is largest for high x values. The polar plot (Fig. 2) of the same function shows that this is a circle for $x = 1$ which transforms into a precessing figure as does the radial function for x values different from unity.

The area of the ellipse grows with a rate dependent on x (Fig. 3). The starting area value is not zero but negative because of the definition of the tangens fuction in Eq.(69). All area functions are crossing zero at the same radius. The dependence of A on x is shown for three fixed radius values in Fig. 4. Rising as well as falling area values are possible with growing x. The counterpart of Fig. 3 is graphed as a polar diagram in Fig. 5. When the sign of A changes, the the graphical representation of the function value is shifted by 180 degrees as is customary for this kind of plots.

The radial derivative of A (Fig. 6) is infinite at the minimum and maximum radius as can be seen from the vertical tangents in Fig. 3. In the polar diagram (Fig. 7) this leads to an unlimited growth of the curves. Finally the total area integrated for a full circle (i.e. the area of 360 degrees of a precessing ellipse) is graphed in Fig. 8. The curve has to be shifted at the discontinuities to give a continuous graph. This is again an effect of the definition fo the inverse tangens function in Eq.(69). A grows as an injective function with x.

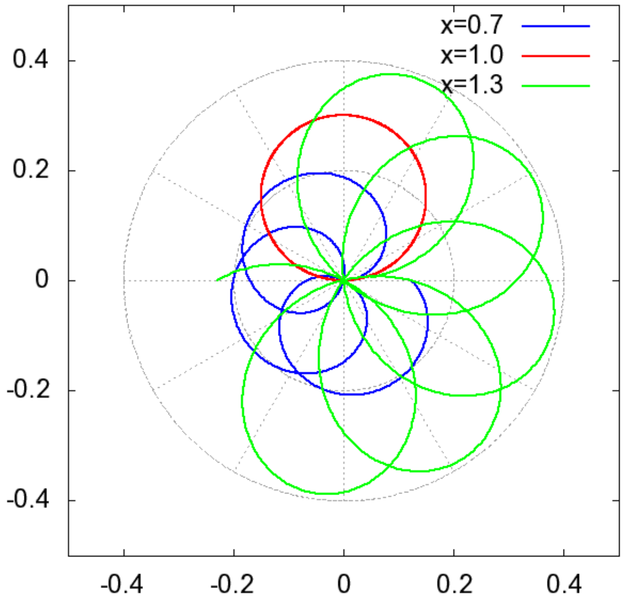

Figure 2: dr/dt (polar plot) for parameters $L = 1$, $\mu = 1$, $\alpha = 1$, $\epsilon = 0.3$.

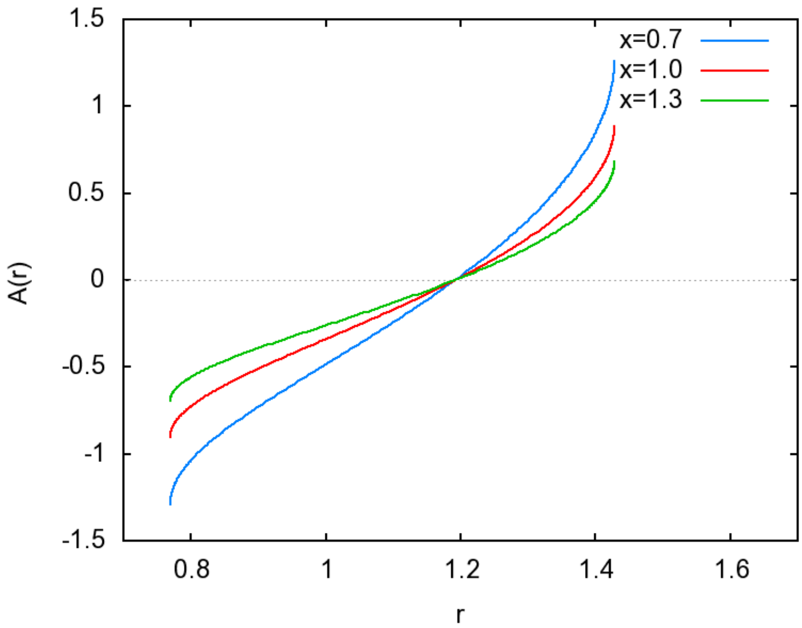

Figure 3: $A(r)$ for parameters $\alpha = 1$, $\epsilon = 0.3$.

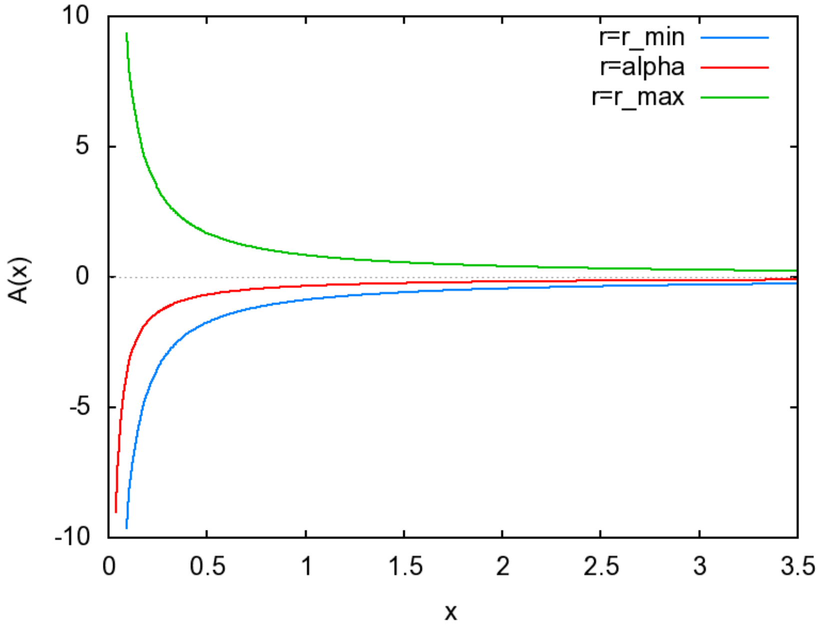

Figure 4: x dependence $A(x)$ for three fixed radii with parameters $\alpha = 1$, $\epsilon = 0.3$.

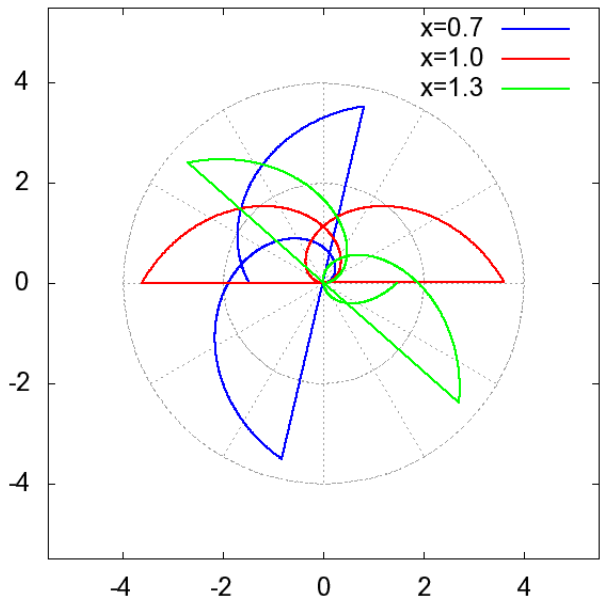

Figure 5: $A(\theta)$ (polar plot) for parameters $\alpha = 1$, $\epsilon = 0.3$.

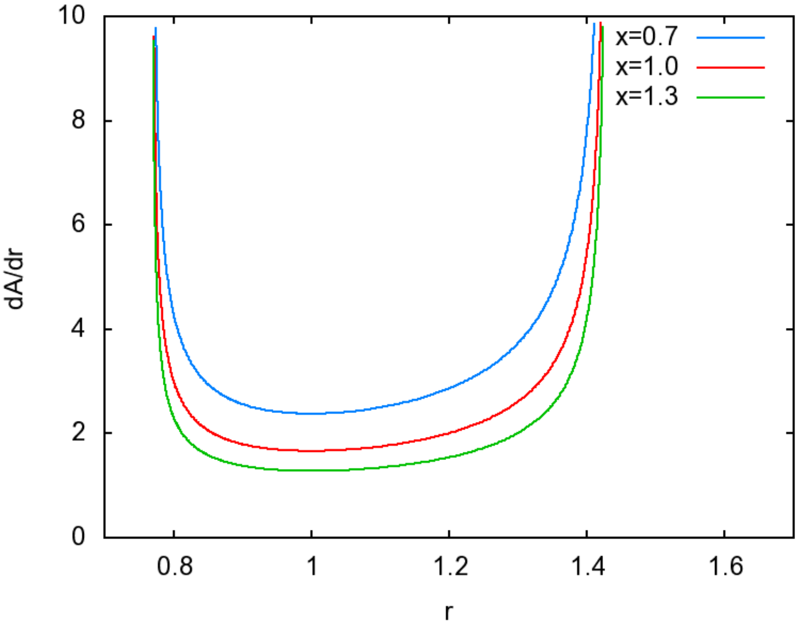

Figure 6: dA/dr for parameters $\alpha = 1$, $\epsilon = 0.3$.

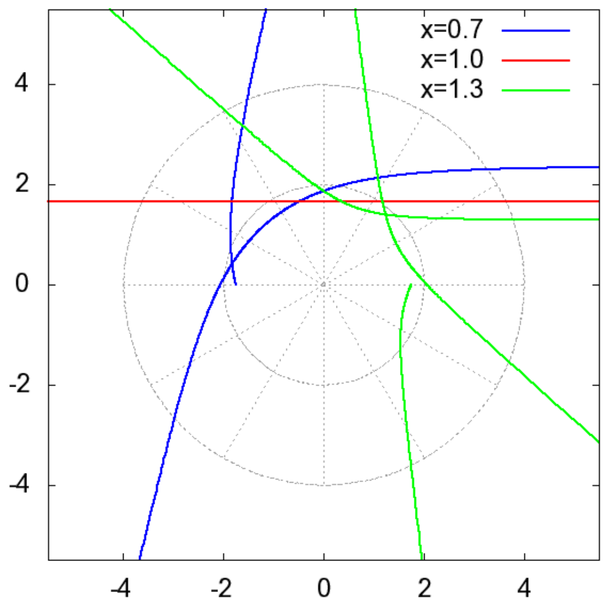

Figure 7: dA/dr (polar plot) for parameters $\alpha = 1$, $\epsilon = 0.3$.

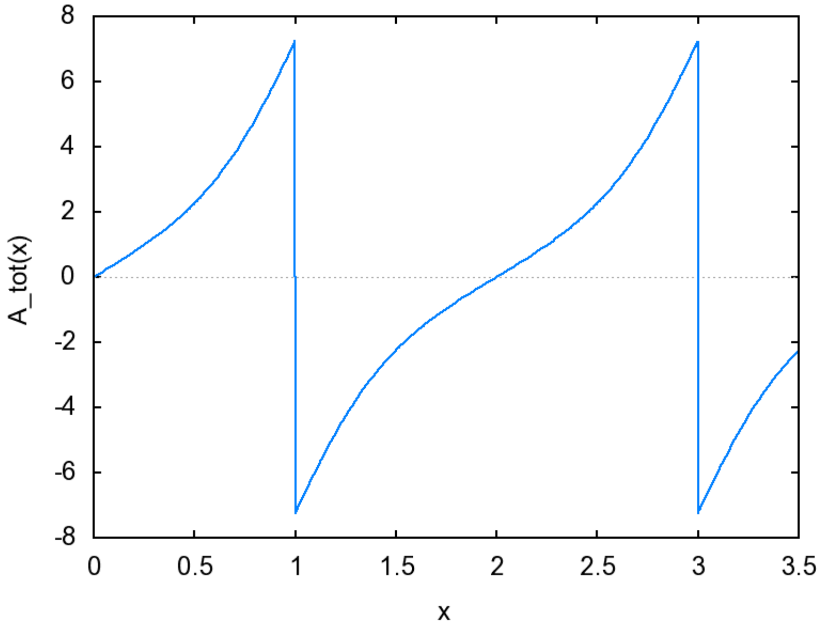

Figure 8: Angular integrated value $A(x)$ for parameters $\alpha = 1$, $\epsilon = 0.3$.

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