TIME EVOLUTION OF THE EQUATION OF THE NEW RELATIVITY IN WHIRLPOOL GALAXIES

by

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ABSTRACT

The time evolution is given of the equation of the new relativity using simple models of the orbits of stars in a whirlpool galaxy. The time evolution is deduced of the radial vector, the torsion and the linear and angular velocities, and consideration given to a simple model of a double spiral galaxy.

Keywords: ECE theory, whirlpool galaxies, time evolution of the equation of the new general relativity.

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1. INTRODUCTION

Recently in this series of papers the Einsteinian general relativity (EGR) has been refuted in several ways {1 - 10}. A new relativity has been initiated by restricting the Minkowski metric with any observable orbit. It has been shown that the constrained Minkowski metric produces a spacetime with torsion and curvature, and also provides a new equation of motion from the Evans identity, an example of the Cartan identity of differential geometry {11}. This equation of motion has been applied to the orbits of spiral galaxies and in the solar system, where it predicts small perturbations of the precessing elliptical motion observed routinely. In Section 2 the dynamics of the new equation of motion are developed, so that the evolution of the stars in a whirlpool galaxy can be assessed in a number of ways. Simple models of the orbits are used in a first approximation. The rigorous method would use the observed orbits as a starting point and would analyse the orbits in terms of the new relativity. It is well known that EGR fails entirely to describe galactic dynamics or cosmology in general, and dark matter has been refuted experimentally.

2. DYNAMICS OF THE NEW RELATIVITY IN WHIRLPOOL GALAXIES.

If the orbit is assumed for the sake of simplicity to be the hyperbolic spiral then:

$$r(t) = r_0 / \theta(t) \qquad — (1)$$

in which the plane polar coordinates r and θ are both functions of time t. Here r_0 is a dimension needed for correct units. As in previous work the equation of motion of the new relativity implies that the angular velocity of a star in a whirlpool galaxy is:

$$\omega(t) = \frac{d\theta}{dt} = \frac{\omega_0}{\theta(t)} . \qquad — (2)$$

Therefore:

$$\omega_0 dt = \theta(t)\, d\theta \quad -(3)$$

and

$$\omega_0 \int dt = \int \theta(t)\, d\theta \quad -(4)$$

whose solution is:

$$\theta^2 = 2(\omega_0 t + C) \quad -(5)$$

where C is a constant of integration. The equation of motion therefore gives:

$$\theta(t) = \sqrt{2}\,(\omega_0 t + C)^{1/2} \quad -(6)$$

and therefore:

$$r(t) = \frac{r_0}{\sqrt{2}}(\omega_0 t + C)^{-1/2} \quad -(7)$$

The motion of the star may be animated with these equations. More accurately the observed orbit may be used to produce the trajectory of the star.

Using the results of previous work the time evolution of torsion is given by:

$$T^1{}_{01}(t) = \frac{\omega_0}{c}\left(1 + 2(\omega_0 t + C)\right)^{-1} \quad -(8)$$

and the orbital linear velocity of the star is given by:

$$v(t) = \frac{\omega_0 r_0}{2(\omega_0 t + C)}\left(1 + \frac{1}{2(\omega_0 t + C)}\right) \quad -(9)$$

In the hyperbolic spiral some care has to be taken as to the definition of the origin because r is infinite when θ is zero and vice versa. From Eq. (6) it is seen that the angle increases with time. If the origin is defined at the centre of the spiral :

$$r \to \infty, \ \theta = 0 \qquad -(10)$$

then the star travels outwards from the centre. This is leading arm motion. If the origin is defined at the end of the spiral the star travels inwards. This is trailing arm motion. In general in a galaxy such as Andromeda it is well known that both types of motion are observed. The sense of the spiral is:

$$r = \frac{r_0}{\theta} \qquad -(11)$$

and

$$r = -\frac{r_0}{\theta}. \qquad -(12)$$

The angular velocity of the star is given by:

$$\omega(t) = \frac{d\theta}{dt} = \frac{\omega_0}{\sqrt{2}}\left(\omega_0 t + c\right)^{-1}. \qquad -(13)$$

So the dynamics of the star can be evaluated completely by assuming a given orbital function. In accurate applications of the new relativity the simple model function just used in this Section is replaced by the observed orbit.

The dynamics depend critically on the type of spiral used as a model. For example the simplest type of Archimedes spiral is:

$$r(t) = b\,\theta(t) \qquad -(14)$$

and the equation of motion of the new relativity gives

$$\omega = \frac{d\theta}{dt} = \omega_0 \exp\left(-\frac{\theta^2(t)}{2}\right) \qquad -(15)$$

so:

$$\omega_0 \int dt = \int \exp\left(\frac{\theta^2(t)}{2}\right) d\theta. \quad -(16)$$

This type of time evolution is quite different form that in a galactic model based on a hyperbolic spiral. The basic equation of the time evolution of the polar angle is:

$$\int \exp\left(\frac{\theta^2(t)}{2}\right) d\theta = \alpha(\theta(t)) + C \quad -(17)$$

from which theta may be found as a function of time numerically and expressed as $\beta(t)$.

The time evolution of torsion in the Archimedes spiral is then:

$$T^{1}{}_{01}(t) = \frac{\omega_0}{c}\left(\frac{\theta^2(t)}{1+\theta^2(t)}\right)\exp\left(-\theta^2(t)\right). \quad -(18)$$

The time evolution of the radial coordinate is:

$$r(t) = b\,\theta(t) \quad -(19)$$

that of the linear orbital velocity is:

$$v(t) = b\left(1+\theta(t)\right)^{1/2} \omega_0 \exp\left(-\theta^2(t)\right) \quad -(20)$$

and that of the angular velocity is:

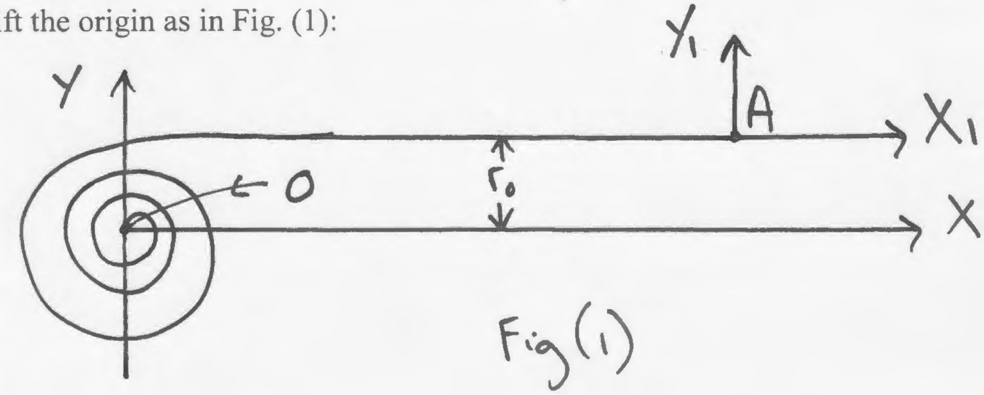
$$\omega(t) = \omega_0 \exp\left(-\frac{\theta^2(t)}{2}\right). \quad -(21)$$

For the hyperbolic spiral:

$$v(t) = \frac{\omega_0 r_0}{\theta^2(t)}\left(1 + \frac{1}{\theta^2(t)}\right) \quad -(22)$$

and if the polar angle approaches a large constant as r becomes infinite the orbital velocity becomes constant as observed.

In order to understand with simple models the essential features of the galaxy structures observed in astronomy, the new relativity is required because the EGR fails qualitatively as is well known and dark matter theory is failed empiricism. One of the structures observed resembles a double spiral. To describe this double spiral it is convenient to shift the origin as in Fig. (1):



Fig(1)

In the X Y coordinate system:

$$X = \frac{r_0}{\theta}\cos\theta, \quad Y = \frac{r_0}{\theta}\sin\theta, \qquad -(23)$$

$$r^2 = X^2 + Y^2, \qquad -(24)$$

and

$$\theta \to 0 \Rightarrow X \to \infty, \; Y \to r_0. \qquad -(25)$$

The point A is defined by:

$$r \to \infty, \; \theta \to 0. \qquad -(26)$$

This system describes an orbit of a star of mass m starting at A at time t = 0 and spiralling in to O at time t. The opposite motion can be described by choosing the point A to be:

$$\theta \to \infty, \; r \to 0. \qquad -(27)$$

In the X_1 Y_1 coordinate system of the figure the point A is at:

$$X_1 = 0, \; Y_1 = 0, \qquad -(28)$$
$$X \to \infty, \; Y = r_0,$$

so:

$$Y_1 = Y - r_0 \qquad -(29)$$
$$X_1 = X - \infty$$

and

$$r^2 = X_1^2 + Y_1^2 . \qquad -(30)$$

Therefore the point A is at:

$$r^2 = X_1^2 + Y_1^2 = 0 \qquad -(31)$$

and the point O is at:

$$r^2 = X_1^2 + Y_1^2 \to \infty . \qquad -(32)$$

The time at point A is t, and that at point O is zero, so the star moves out of point O towards point A. The time is always that of the observer frame because a shift of coordinates has been used, not a Lorentz transform. The linear orbital velocity at point A is:

$$v(t) = \frac{\omega_0 r_0}{2(\omega_0 t + C)} \left(1 + \frac{1}{2(\omega_0 t + C)} \right) \qquad -(33)$$

and it is seen from Fig (1) that it is directed in the X_1 axis. If it is assumed that the time elapsed from point O to A is τ, and that the angle at point A is θ_1, then:

$$\omega_0 \int_0^{\tau} dt = \int_0^{\theta_1} \theta(t)\, d\theta \qquad -(34)$$

and

$$\omega_0 \tau = \frac{\theta_1^2}{2}, \quad -(35)$$

therefore in Eq. (33)

$$v(\tau) = \frac{\omega_0 r_0}{2\omega_0 \tau}\left(1 + \frac{1}{2\omega_0 \tau}\right) \quad -(36)$$

and

$$v(\tau) \xrightarrow[r \to \infty]{} \frac{r_0}{2\tau}\left(1 + \frac{1}{2\omega_0 \tau}\right). \quad -(37)$$

This is observed to be constant in the velocity curve of a spiral galaxy so the galaxy has evolved to essentially its final state over a time τ , a characteristic evolution time.

The double spiral galaxy may now be described as in Fig. (2)

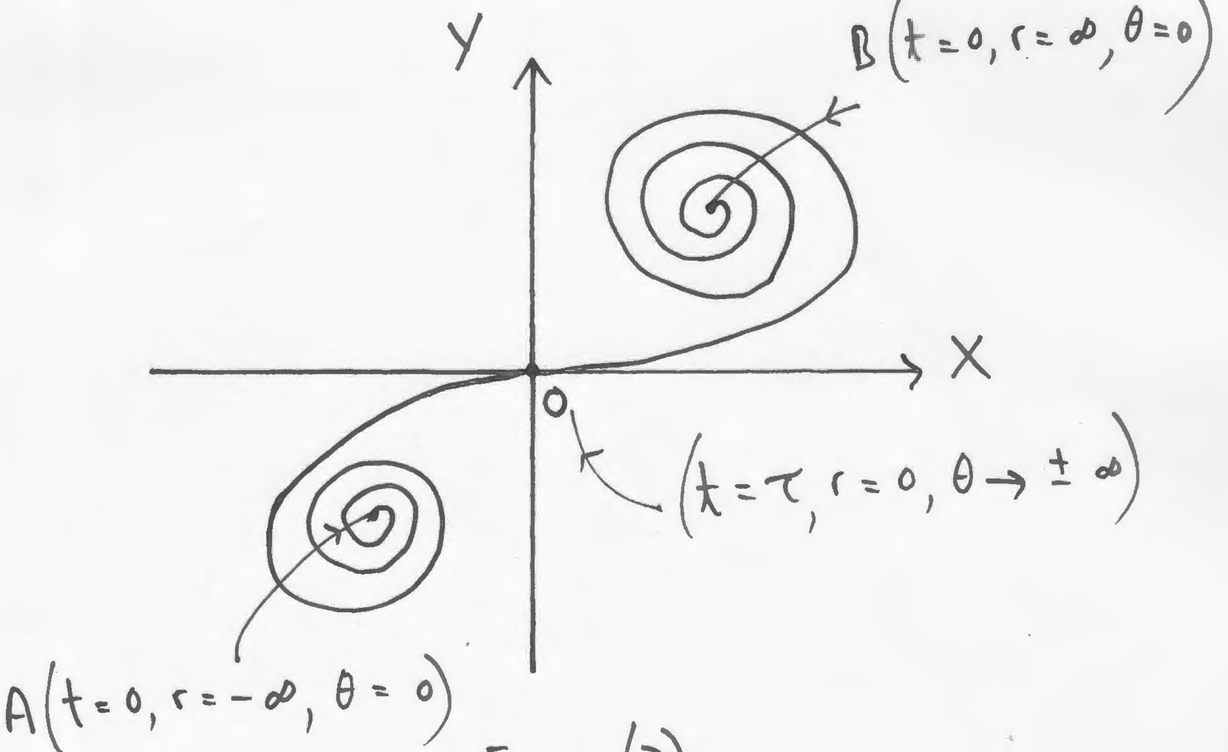


Fig. (2)

in which the overall spacetime torsion is in a clockwise direction. For galaxy A

$$r^2 = X^2 + Y^2$$
$$r = -\left(X^2 + Y^2\right)^{1/2} = -\frac{r_0}{\theta} \quad -(38)$$
$$X = r\cos\theta = -\frac{r_0}{\theta}\cos\theta$$
$$Y = r\sin\theta = -\frac{r_0}{\theta}\sin\theta$$

and for galaxy B:

$$r^2 = X^2 + Y^2$$
$$r = \left(X^2 + Y^2\right)^{1/2} = \frac{r_0}{\theta} \quad -(39)$$
$$X = r\cos\theta = \frac{r_0}{\theta}\cos\theta$$
$$Y = r\sin\theta = \frac{r_0}{\theta}\sin\theta$$

For galaxies A and B stars emerge from the galactic centres A and B due to overall clockwise torsion. The time origin t = 0 is the same at A and B, where the polar angle is zero in both cases. In practice the infinite r of the figure is replaced by a finite distance reached after millions of years of evolution, and

$$\theta \to \pm\infty \quad -(40)$$

is replaced by

$$\theta \to \pm\theta_1 . \quad -(42)$$

The double spiral galaxy actually observed by Hubble is not the perfectly planar model used here, but this simple analysis can be extended to three dimensions, in which double helix nebulae are also observed. None of these structures can be remotely described by EGR.

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