Galaxy structures described by ECE theory

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Abstract

Some graphical work is presented to understand how the structure of galaxies and galaxy clusters is explained by Einstein-Cartan-Evans (ECE) theory in comparison to the cosmological standard model. In the standard model, formation and movement of galaxy arms can only be described by postulating additional, non-visible “dark” matter. By ECE theory, galaxy arms as well as the central bulge are explainable correctly without additional ad-hoc assumptions. The standard model postulate of dark matter becomes obsolete. This is demonstrated by graphical comparisons with existing galaxies and a model calculation of spiral formation.

1 Introduction

Cosmology is a popular area of physics. New insights in this field are often reported by the daily press. Nearly all explanations use the standard model of cosmology which is based on big bang and the existence of dark matter [1].

The mysterious behaviour of stars in arms of galaxies is derived from studying their motion. From Doppler shift measurements it is found that they move at nearly constant velocity [2]. This contradicts Newton's theory of gravitation where stellar objects moving around a gravitational center move the slower the farther they are away from the center. Astrophysicists therefore have postulated that there is additional matter in a "galactical halo" which extends from the center all over the space of a galaxy. The halo is required to contain up to 90% of the mass, which is needed to maintain the observed velocities of stellar masses. A similar mechanism is required for keeping together galaxy clusters and superclusters.

This paper shows by some graphical work how the structure of galaxies and larger clusters is explained by Einstein-Cartan-Evans (ECE) theory in comparison to standard theory. Essentially the torsion being not present in the conventional theory of gravity is responsible for creating the observed cosmic structures. As a result the standard model assumptions of dark matter become obsolete. The detailed ECE model was worked out in the original papers ([3], [4]) and a simulation was added being presented in this article. Graphical results were processed by Gnuplot and Paintshop Pro.

2 Explanation of galaxy structure by ECE theory

A spiral galaxy normally consists of two parts, the central bulge and the spiral arms. The formation of spiral arms is a challenge for cosmology which is based on standard theory, i.e. on Einstein's general relativity and Newton's law of gravitation. If stars are not too far distant from each other, as is the case in planetary systems (not taking into account binary star systems and black holes), Newton's law is a good approximation and is widely used in simulations. This method is also applied to cosmological problems.

The standard model uses gravitational forces only. This works well as far as the star density is high as in the central bulge of galaxies. In the outer region where only some branched "arms" of stars are present the gravitational forces are so small that neither the formation nor the motion of these arms can be explained by the gravitation of matter being provided by the stars themselves. Therefore invisible, "dark" matter has been postulated to provide the Newtonian forces required for explaining the observed structures and motions.

The distribution of tangential velocity of stars in a galaxy is shown in Fig. 1. The velocity of stars in dependence of their distance from the center according to the Newtonian law is given by the dashed line. In this case we expect roughly

(1) $$v^2 \propto \frac{1}{r},$$

but experimentally

(2) $$v = const$$

is found for all radii on the galaxy arms outside the central bulge (solid line of Fig. 1). This motion of spiral arms is depicted schematically in Fig. 2. The orbital velocity is tangential to virtual centric circles. Simulations with Newtonian gravitation (Fig. 3) result in an instable structure where the spiral arms vanish over time which is obviously wrong.

In contrast to this, ECE theory is able to explain the spiral structure by torsion effects which are not contained in Newtonian gravitation and Einsteinian general relativity. According to ECE theory, the central bulge creates a spacetime torsion which is constant in the outer region. This is equivalent to a constant torque

(3) $$N = cmv,$$

where m is the mass of a celestial body in a spiral arm. The constant velocity is shown in Fig. 1, curve C (dotted line) and fits very well the experimental data. The angular velocity of the moving body is

(4) $$\omega = \frac{d\theta}{dt} = \frac{v}{r}$$

with θ being the polar angle. For constant $v=v_0$ we obtain

(5) $$\theta = v_0 \int_0^{\tau} \frac{dt}{r} = \frac{v_0 \tau}{r}$$

with a time constant τ. This is the structure of a *hyperbolic spiral* of the form

(6) $$r = \frac{v_0 \tau}{\theta}$$

(Fig. 4). For this kind of spiral there is an asymptote $y = v_0 * \tau$ which leads to a stretching of the spiral form for $\theta \to 0$.

As a different example a *logarithmic spiral* is shown if Fig. 5.

Now we consider the real galaxy M101 ("pinwheel galaxy", Fig. 6) as an example. The picture of this galaxy from the Hubble telescope is very impressive per se and may be one with the most details of a spiral galaxy. All spiral arms of M101 can be fittet to hyperbolic spirals of the form

(7) $$r = \frac{a}{\theta}$$

where a is varied within a factor of two, see Fig. 7. The fit was done graphically by stretching the graph appropriately. Since according to Eq. (6) the parameter a is physically

(8) $$a = v_0 \tau$$

with a time parameter τ, this may mean that the arms have a different age, because v_0 is constant. It is not clear whether the two single clusters at the left belong to this galaxy. If they do, then even these clusters fit perfectly to an otherwise hidden or only partly existing galaxy arm.

Also the central bulge of a galaxy can be explained by ECE theory. The spherical structure of the bulge follows from a spun plasma model of [4], the so-called primordial plasma. This is assumed to consist mainly of electrons, the most important particles for forming atoms. Protons are less mobile because their mass is much higher. Several model assumptions of the plasma can be made, leading to a smooth transition from a spherical central region to the outer region of galaxy arms. In the center a strong constant magnetic field is present which forces the electrons to cyclic orbits. After matter has been condensed to stars, they retain these orbits and move under their gravitational interaction. At the border of the buldge, stars move away from the center due to reduced gravitation and form the hyperbolic arms. An inhomogeneity has to be assumed where this takes place, otherwise there would not be localized arms.

There are not many observable examples by which the internal structure of the central bulge can be studied, since this region appears unstructured in most photographs of galaxies. An exception is the barred spiral galaxy NGC1300 (Fig. 8). The center shows some circular structures as predicted by ECE theory.

Finally we present some modelling results for the formation of the spiral arms. The migration of stars from the bulge into the arms has been simulated by a computer program. Based on Eq. (6), the stars move according to the difference equations

$$r[i+1] = r[i] + v_r \Delta t$$

$$\theta[i+1] = \theta[i] + \frac{v_0}{r[i+1]} \Delta t \qquad (9)$$

The argument i denotes the instant of time, v_r is the radial component of the velocity, leading to an outward movement of masses and, consequently, the population of the spirals.

Gravitation has been neglected according to the ECE model. The orbital velocities v_0 and v_r have been distorted randomly by ±20% in order to regard any interfering effects. Although this is a quite strong disturbance, the structure of the hyperbolic spirals remains stable as can be seen from Fig. 9. This may be a hint that the spiral structure is a stable phenomenon in cosmology.

In conclusion we have shown that ECE theory is able to explain the existence and formation of spiral galaxies without additional assumptions. The same holds for galaxy clusters and superclusters which exhibit the same structure. Contrary to ECE, the standard model has to assume dark matter which has never been observerd experimentally and it is to be presumed that up to 90% of all matter in the universe consists of this type. ECE theory is clearly superior to this speculative model.

References

[1] http://www.esa.int/esaCP/SEMZ6GSVYVE_index_0.html

[2] http://astro.berkeley.edu/~mwhite/darkmatter/rotcurve.html

[3] http://www.aias.us/, UFT paper 76: Spiral galaxies and Cartan torsion

[4] http://www.aias.us/, UFT paper 77: Spun plasma model for cosmological evolution and Einstein Cartan Evans (ECE) unified field theory

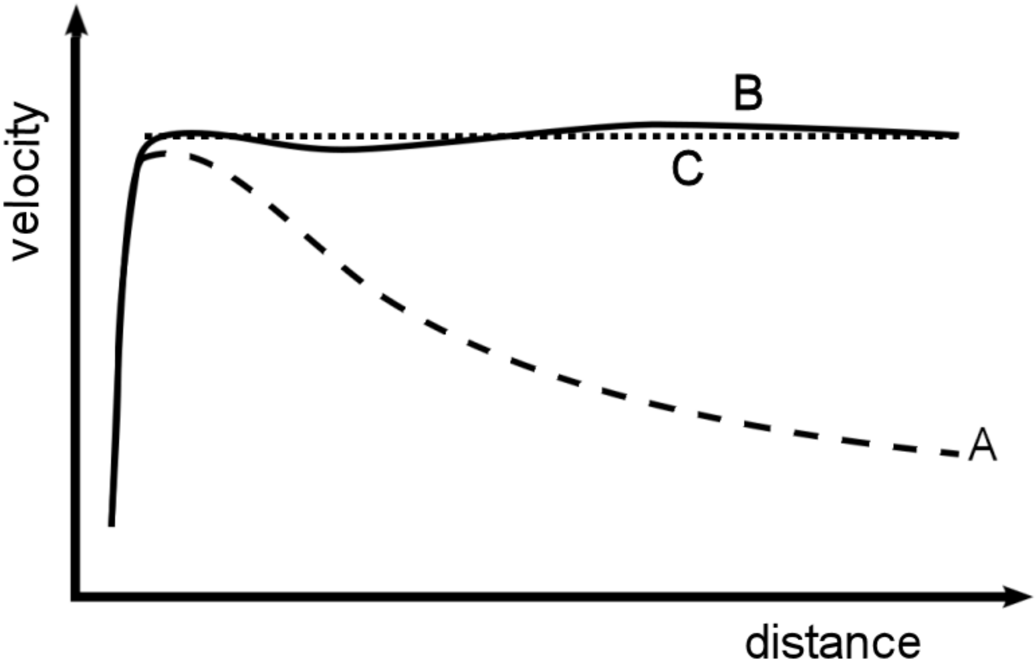

Fig. 1. Schematic velocity of stars in spiral arms of a galaxy according to temporary theory (Newtonian gravitation) (A), experimental measurements (B) and ECE theory (C).

Source of A and B: http://en.wikipedia.org/wiki/Galaxy_rotation_problem

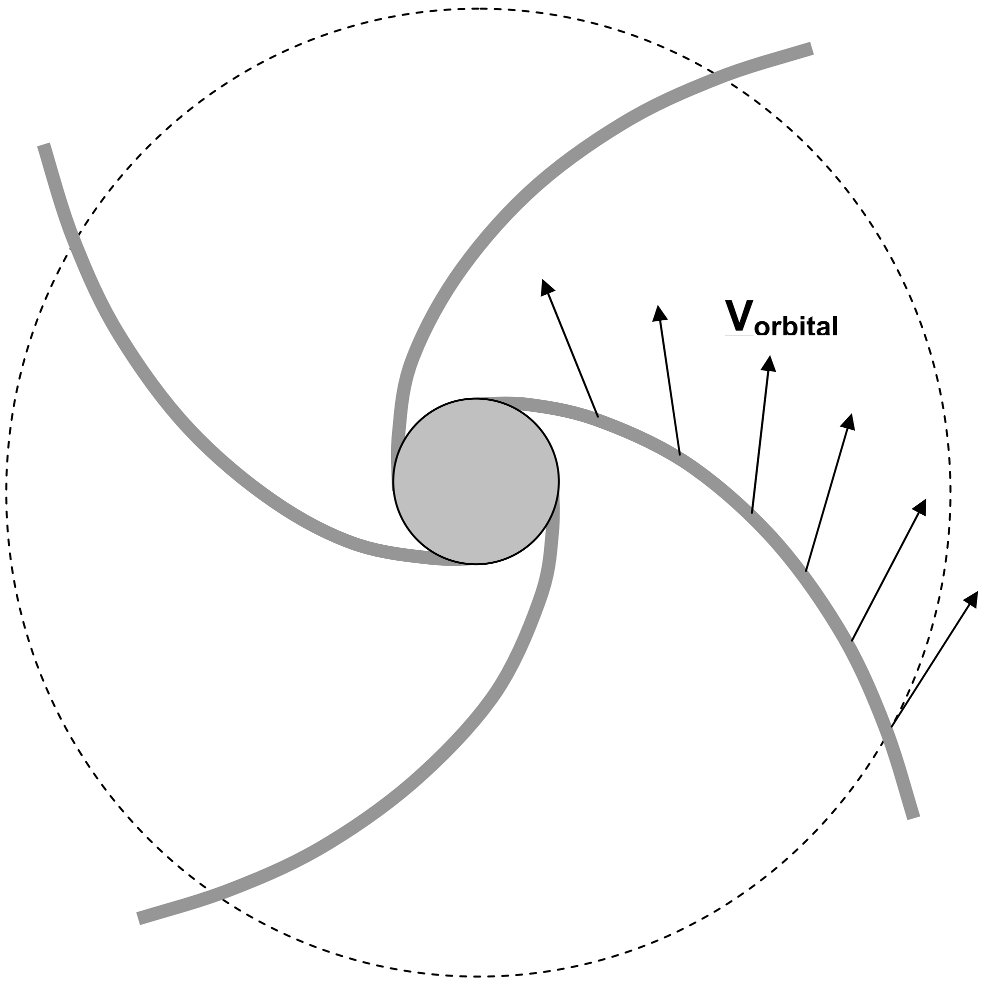

Fig. 2. Galaxy model according to ECE theory. Gravitation dominates the central bulge while torsion dominates the spiral arms. Orbital velocity is tangential to virtual centric circles (dashed line).

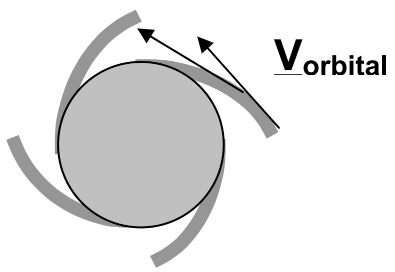

Fig. 3. Galaxy model according to Einstein-Hilbert theory. Gravitation is the only interaction and enforces any spiral arms to move into the central bulge.

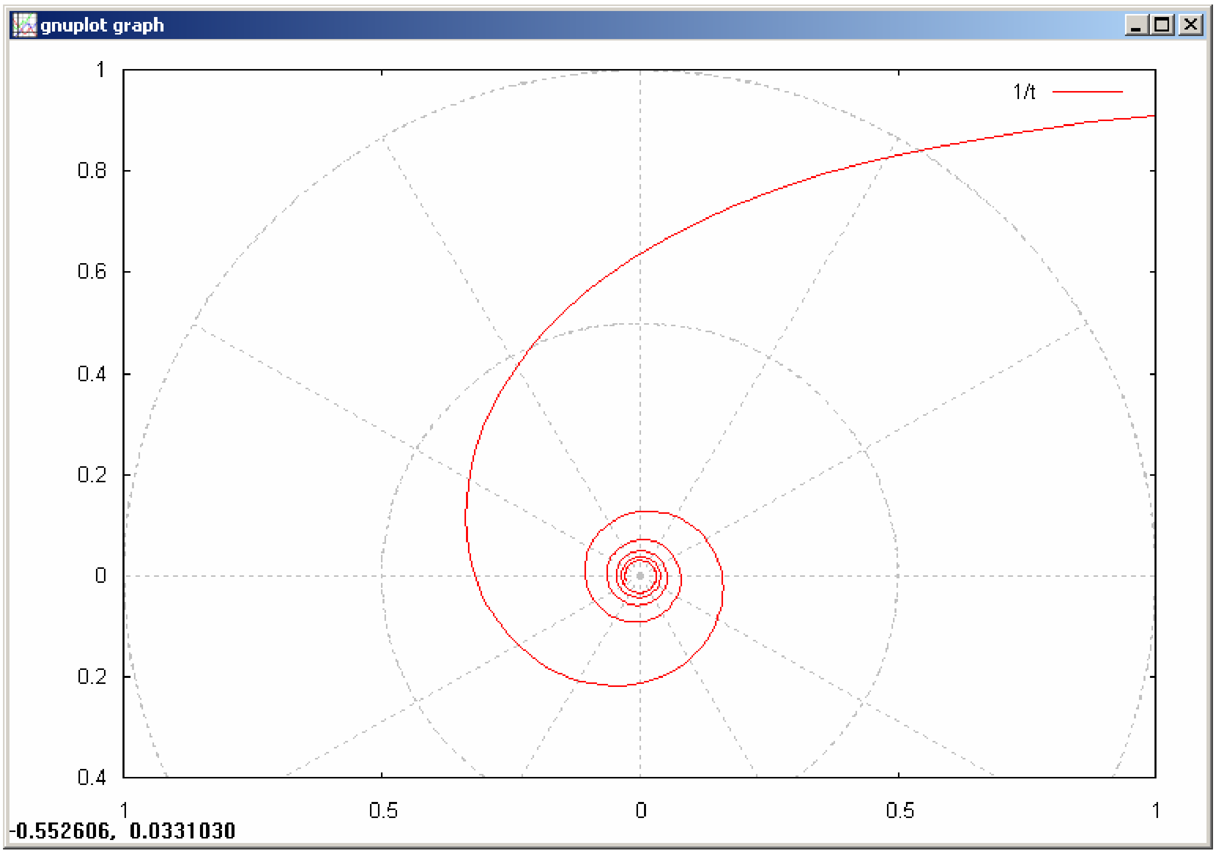

Fig. 4. Hyperbolic spiral r = 1/t,
t = θ is polar angle.
For t → 0 the curve goes to the asymptote y=1.
For t → ∞ it spirals against the origin.

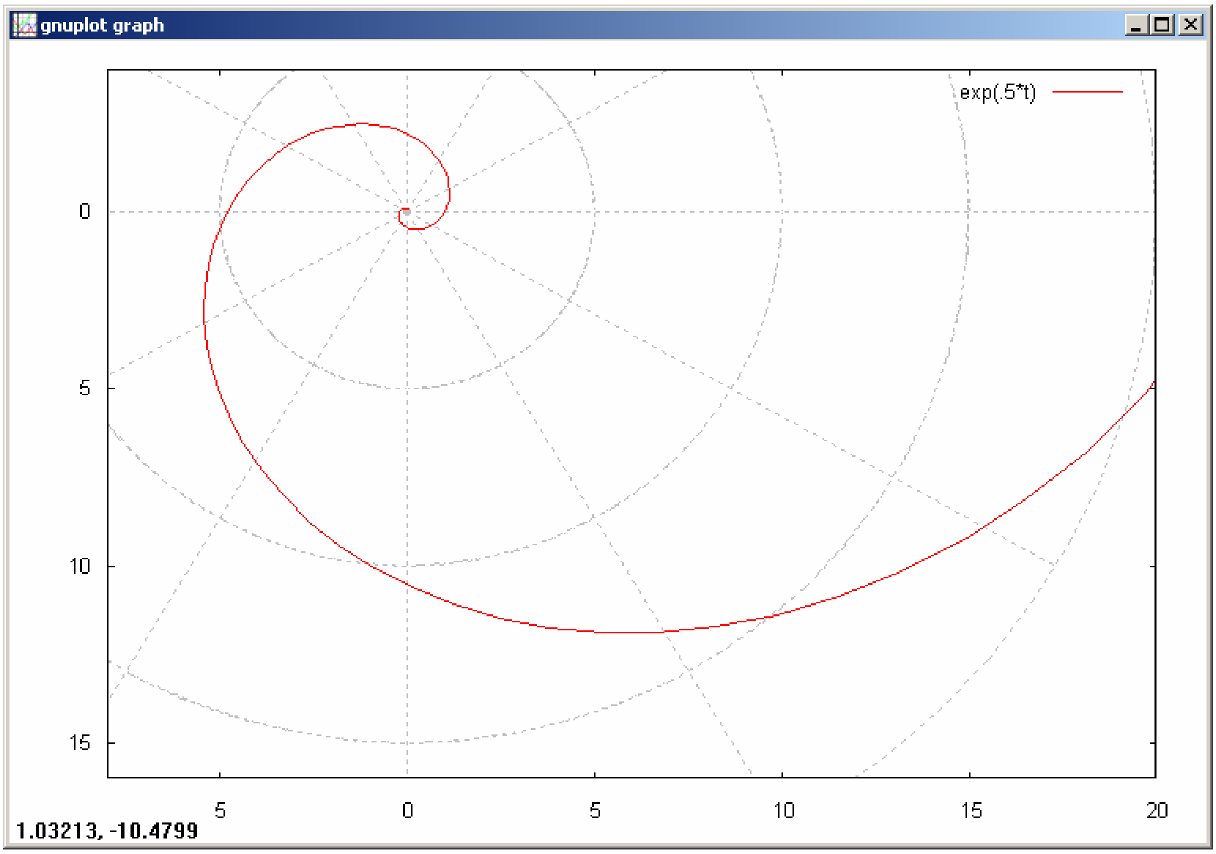

Fig. 5. Logarithmic spiral r = exp(0.5*t).
For t ⟶ -∞ the curve spirals against the origin.
For t ⟶ +∞ there is no asymptote.

Fig. 6. Picture of galaxy M101 from Hubble telescope.
Source: http://en.wikipedia.org/wiki/Messier_101

Fig. 7. Hyperbolic spirals fitted to arms, linear stretching in the range 100-200%.

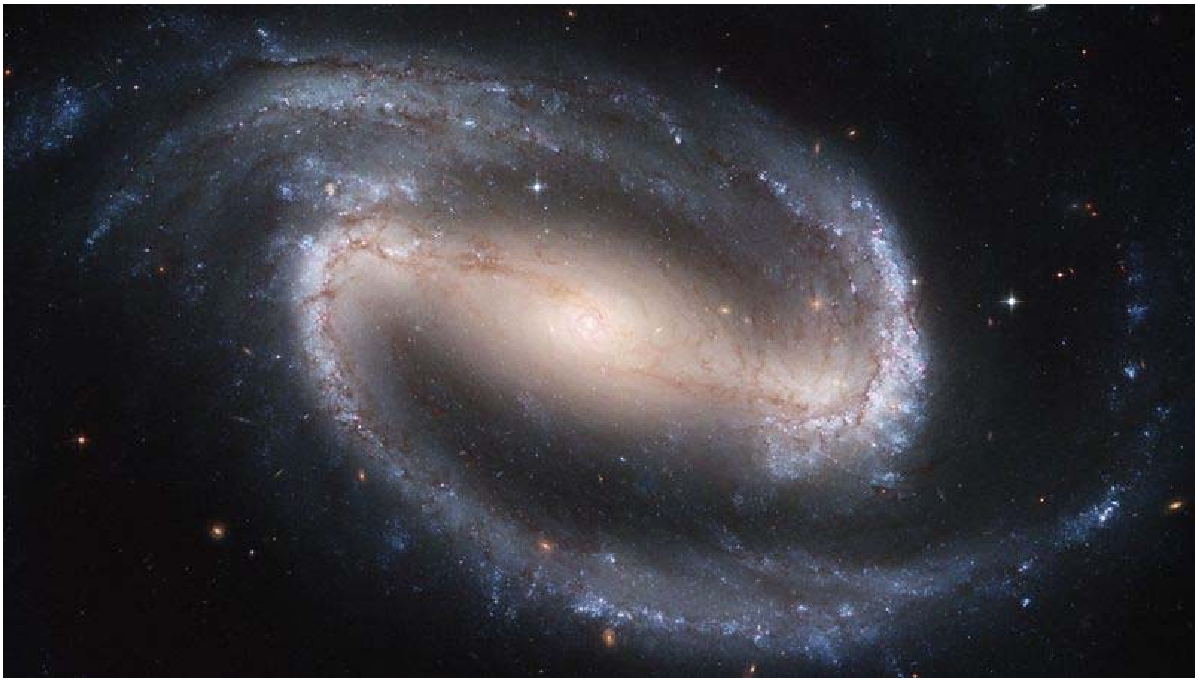

Fig. 8. Picture of galaxy NGC1300 from Hubble telescope.
Source: http://en.wikipedia.org/wiki/NGC1300

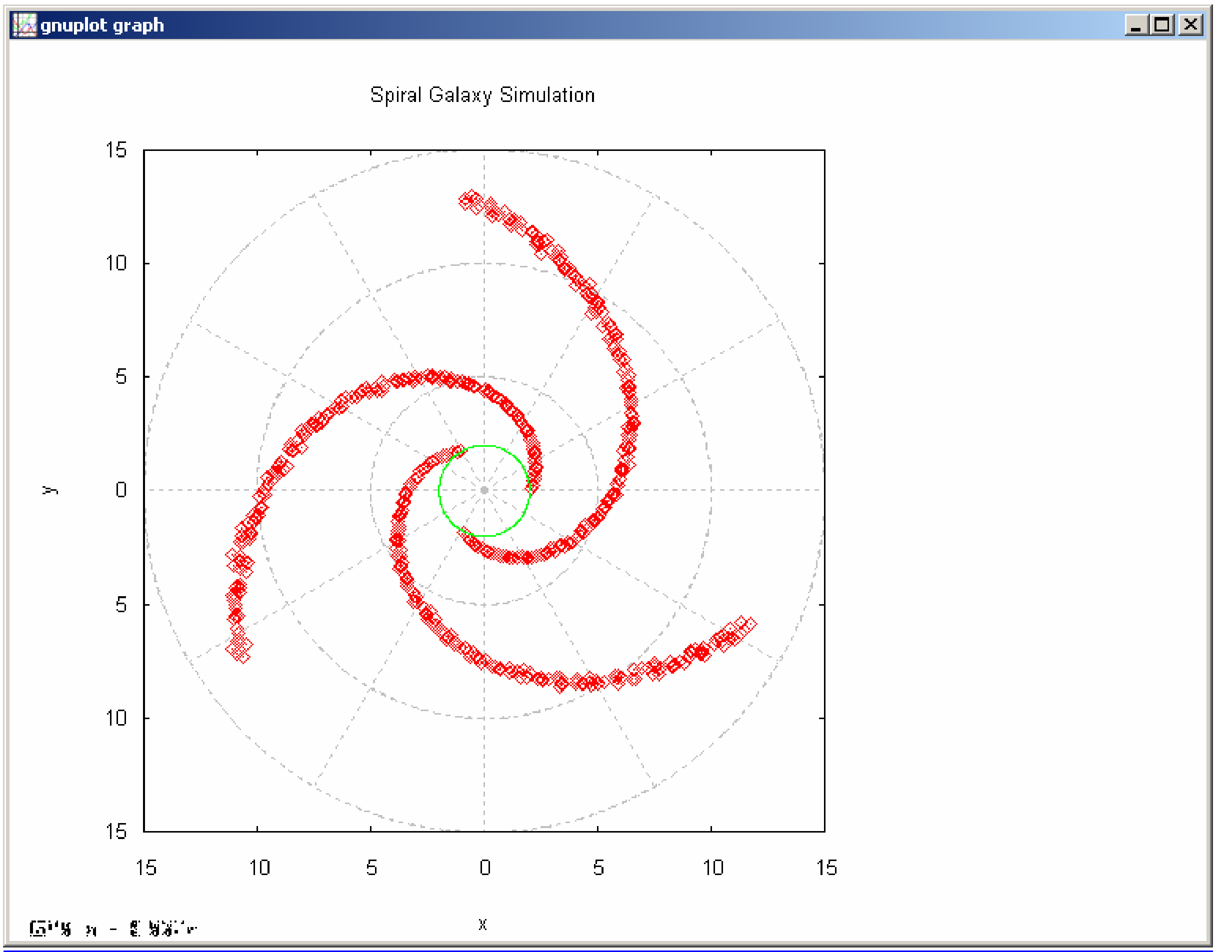

Fig. 9. Simulated spiral arms with ±20% variance in velocity.