The lag effect of the gravitational field as the cause of the curved form of the Milky Way.

Bezverkhniy Volodymyr Dmytrovych, Bezverkhniy Vitaliy Volodymyrovich.
Ukraine, e-mail: bezvold@ukr.net

Abstract: Using gravitational field lag effect we can explain why the Milky Way galaxy has a curved shape of a “Chair”. Galaxies what having the form of a flat disk due to the effect of the field lag have an increased energy of gravitational interaction, to reduce this energy, galaxies take a curved shape of the “Galaxy-Chair”. This phenomenon resembles a decrease in energy in the cyclohexane molecule, where the most stable conformation is also the “Chair” conformation, which is almost identical in shape to the curved Milky Way.

Keywords: gravitational field lag effect, Milky Way galaxy, Cepheids, conformations of the cyclohexane molecule, “Chair”, “Galaxy-Chair”.

INTRODUCTION.

Researchers from Macquarie University (Australia) and the Chinese Academy of Sciences found that the Milky Way galaxy is not actually flat, as previously thought, but has a curved shape and looks like the letter S [1]. They made it becouse of the analysis of 1339 pulsating stars-cepheids, which have a mass of 4-20 times the mass of the Sun, and the luminosity of Cepheids is 100 thousand times brighter than the Sun. The Cepheids pulsate at a very accurate frequency, by measuring which one can calculate the distance to them and their neighbors. Having done a big job, these scientists compiled the most accurate 3D map of the Milky Way and found that the Milky Way's disk is not flat, but noticeably curved around the edges, and in shape it resembles a strongly elongated letter S, or such a “Galaxy-Chair”.

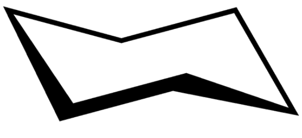
Using the effect of the delay of the gravitational field it is possible to explain why the outer regions of the Milky Way are derived from the plane of the disk and the galaxy takes on the characteristic curved shape in the form of the letter S. This form of the galaxy resembles the conformation of the cyclohexane molecule "Chair" [2], and therefore we will call it “Galaxy-Chair”. The form of a “Chair” is well known to chemists and is one of the most stable conformations of the cyclohexane molecule, it have a lower energy than other conformations. Using the different conformations of cyclohexane as a model of a galaxy, one can try to predict the change in the shape of galaxies over time and explain the cause of various forms of galaxies. The applicability of such an analogy is justified by the fact that different conformations of cyclohexane molecule and their transitions between themselves essentially reflect the change in the energy of the system depending on the topology of the system itself, which can be easily used to the study of galaxies.

RESULTS AND DISCUSSION.

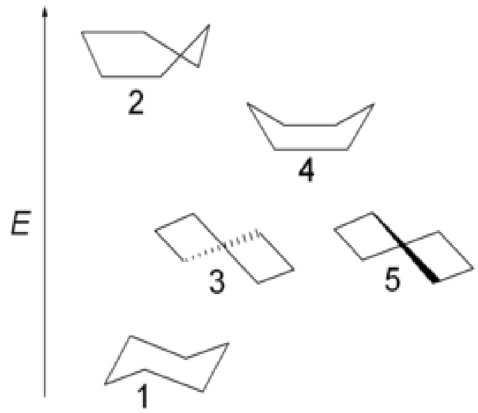
To begin, consider the image of the Milky Way provided by Chinese Academy of Sciences (impression: Chen Xiaodian).

This artistic image of the Milky Way made by scientist Chen Xiaodian from the Chinese Academy of Sciences. Chen Xiaodian is one of the authors of the relevant work published in Nature Astronomy [1], and its picture very accurately conveys the real shape of the Milky Way galaxy.

Before explaining the reason why the galaxy assumes such a curved shape, we once again look at the artistic image of the Milky Way, created by Chen Xiaodian. We see the characteristic shape «Chair». Here is a typical image [3] of the "Chair" conformation for a cyclohexane molecule:



For several reasons, the molecule of cyclohexane cannot be as flat as benzene. These reasons will not be analyzed, as they are described in all university textbooks on organic chemistry [2, 4]. If we explain it brief and simplistic, then in the "flat conformation" the cyclohessane molecule, due to Coulomb repulsion between hydrogen atoms, and due to the Baeyer's strain of cycle (deviations of chemical bond angles from tetrahedral), has very significant energy, and it can reduce this energy only if non-planar. For a non-planar cyclohexane molecule, several such conformations are possible, and the “Chair” conformation has the lowest energy. The energy diagram [5] shows all the conformations of the cyclohexane molecule:



1. Conformation 1 is the “Chair”.
2. Conformations 3 and 5 - this is “Twist” (“Twist-Boat”).
3. Conformation 4 is “Boat”.
4. Conformation 2 is “Half-Chair” or “Envelope.”

As we see from this energy diagram, the “Chair” conformation (1) will have the lowest energy, and then, as the energy increases, they will follow:

"Twist" (3 and 5),
"Boat" (4),
"Half-Chair" (2).

All the above data on the energy balance of the cyclohexane molecule can be generalized to the Milky Way galaxy (and other galaxies) and its shape, which follows from this.

In galaxies, due to the effect of the gravitational field delay, the intensity of the gravitational field increases (the curvature of the space-time continuum increases), which leads to anomalously high rotational speeds of the external galaxy areas and to making in center of galaxys giant black holes [6, 7].

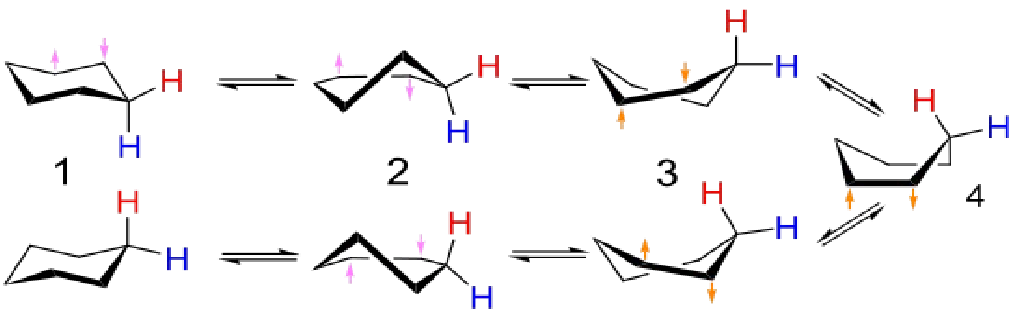
The greater the distance, the greater the lag effect of the gravitational field, and the greater the "pumping" energy of the galaxy (the interaction of the central black hole and the periphery of the galaxy), so the stars are accelerated at the periphery of the galaxy ("abnormal"). In addition, naturally, two peripherals interacting at the ends of the galactic disk (the periphery - periphery).

In the center of the galaxy, in a black hole, is the "processing" of matter into elementary particles. At the periphery of the stars is accelerating. At the same time, the galaxy (as a whole) is “pumped” with energy or the space-time continuum is strongly bent. But the galaxy, like any physical system, wants to occupy a lower energy level, in other words, the galaxy will, if possible, minimize its energy (or reduce the curvature of spatial-continuum). And the galaxy can only lower its energy in one way: a transition to the “Chair” form, since with this a strong acceleration of stars by the field lag effect is impossible becouse stars outside the plane. In addition, the interaction between the two peripheries is greatly weakened (the periphery - periphery, those two ends of the galaxy that are outside the plane of the disk).

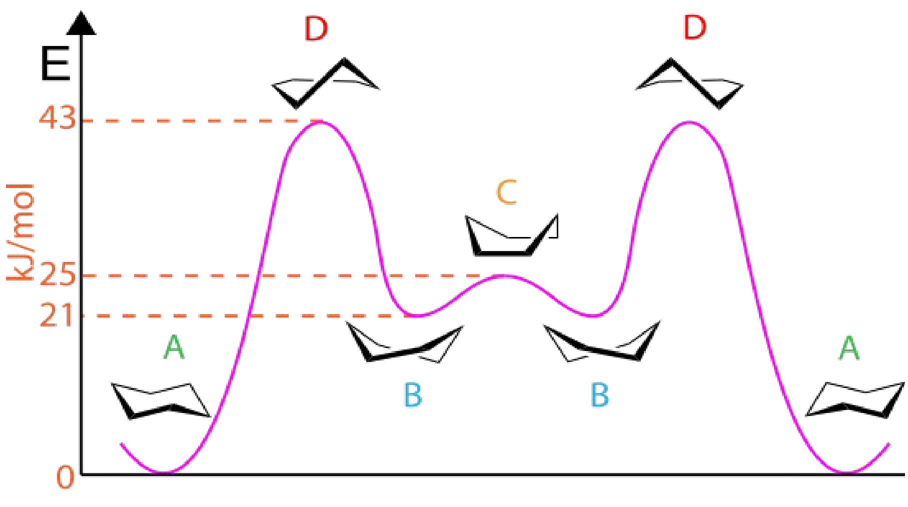
The mechanism of the field retardation effect actually prohibits "acceleration" to high velocities of stars (or other objects) outside the galactic disk, outside the disk plane, since the star must move in a circle (or ellipse) around the galaxy center (black hole). The rotation of the stars located outside the galactic disk around its axis (due to the field lag effect) will give a much smaller "pumping" of galaxy energy than with orbital motion around a giant black hole. This logically follows from the effect of the field lag and the restrictions on the speed of rotation of stars around its axis, becouse nothing can move faster than the speed of light in a vacuum. And therefore, the energy balance of a galaxy with a curved disk, for example, in the form of "Chair" will be smaller compared to the same galaxy with a flat disk.

So, in the general case, the galaxy can only reduce its energy by curving its flat disk and switching to the “Chair” form or another curved non-planar form (depending on specific conditions). The curvature of the space-time continuum in this case decreases, in fact, by reducing the interaction between the part of the galaxy (periphery), which is out of the disk plane, and the center of the galaxy (that is, the black hole). In fact, we have to admit that the stars (outside the plane, on the periphery) and the center of the galaxy should interact much less strongly (as well as the periphery - the periphery), and therefore the energy balance of the galaxy will be less (galaxy like "Chair"). This is equivalent to reducing the curvature of the space-time continuum of the galaxy or reducing the intensity of the gravitational interaction. From this it follows that the gravitational interaction depends on the curvature of the space-time continuum of the galaxy (galaxy as a whole), which is clearly given by A. Einstein's GR. Moreover, such a gravitational interaction will “occur” along geodesic curves, which only confirms what has been said above.

In essence, this is similar to why cyclohexane goes into the “Chair” conformation: a cyclohexane molecule simply lowers its energy. Moreover, in the form of "Chair" is a huge amount of organic substances, such as glucose, lactose, maltose, raffinose, etc., and almost all sixmembered carbohydrates, as well as polysaccharides (starch, cellulose, glycogen, etc. molecules) [8]. In carbohydrate molecules, the same "Chair" conformation, just in cyclohexane, one group (-CH2-) is replaced by an oxygen atom (-O-), and there are still different substitutes. But the essence is the same: the "Chair" conformation (in organic chemistry) is the universal conformation of various molecules, which "guarantees" the lowest possible energy of the system. If we continue to draw an analogy between the conformation of the cyclohexane "Chair" molecule and galaxies, then some questions arise. The fact is that the conformations of cyclohexane "Chair 1" and "Chair 2", in the presence of sufficient energy, transform into each other (inversion occurs). See the picture [9], it conveys the meaning:



The figure shows the inversion of the "Chair 1" into the "Chair 2" in the presence of energy to overcome the energy barrier of this transition, see the picture [9].



Conformations: "Chair" (A), "Twist-Boat " (B), "Boat" (C) and "Half-Chair" (D).

(Source for the conformation names & claim of lowest/highest energy - [10]).

Hence the question: will there be an inversion of galaxies, that is, will the shape of "Galaxy-Chair 1" change over time into the shape of "Galaxy-Chair 2" similarly to the inversion of cyclohexane conformers?

In galaxies, stars and other massive objects move around the center of the galaxy, and over time, there will be some changes (fluctuations) in the energy balance of the galaxy as a whole. Therefore, a galaxy that has enough energy to overcome the potential barrier (during the transition) will be able to move from one shape ("Galaxy-Chair 1") to another ("Galaxy-Chair 2"). That is, there will be an inversion of the shape of the galaxy similarly as in the cyclohexane molecule. If the galaxy does not have enough energy to overcome the potential barrier, then there will be no inversion. Everything will be individual for each galaxy, depending on the size of the barrier, and on the energy balance of the galaxy. As confirmation of the inversions of galaxies (indirectly), we can perceive the observability of galaxies in various forms: in the form of flat disks, twisted galaxies, galaxies in the form of "Galaxy-Chair", etc. The inversion time for galaxies will be big, and in different galaxies we can see different inversion phases, hence the variety of galaxy shapes.

CONCLUSION.

In conclusion, we can say that, by the "work" of the lag effect of the gravitational field we can explains why the Milky Way galaxy has a curved shape. Due to the lag effect of the field in galaxies that have the shape of a flat disk, the energy of this disk is becoming bigger. It is in the plane of the disk that stars can accelerate to high velocities on the outer regions of galaxies, which means a strong curvature of the space-time continuum of the galaxy or greater intensity of the gravitational field in the disk. In order to reduce its energy, the galaxy takes a curved shape. Therefore, we are seeing the Milky Way in the form of "Galaxy-Chair", and not in the form of a flat disk.

Naturally, the shape of the galaxies will depend on the "work" of the field lag effect, and this will be expressed in the curvature of the space-time continuum, which in turn will depend on the mass of the galaxy, on the mass of its stars and other constituent parts, as well as the geometric dimensions of both the galaxy itself and its constituent objects. Therefore, the shape of the galaxies will be different for different cases. There will be "Chair", "Twist", and "Bath", and "Semi-Chair", nature loves variety, simplicity and versatility.

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