Swivelling time of spherical galaxies towards disk galaxies.

by using the Maxwell Analogy for Gravitation.

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Summary

This is the second paper dedicated to detailed calculations of disk galaxies. The first is "*On orbital velocities in disk galaxies : "Dark Matter", a myth?*" wherein I explain how to calculate the mass distribution of a disk galaxy and the orbital velocities of the stars, starting from a mass distribution of the originally spherical galaxy. This is based on the extended gravitation theory, called the Maxwell Analogy for Gravitation (MAG) or "Gyro-Gravitation", or gravitomagnetism etc. No existence of Dark Matter nor any other fancy supposition is needed at all in these calculations.

The objective of this paper is to find the mathematical equations related to the time which is needed for the star's orbit to swivel down to the equator. The total diameter-change of the disk galaxy in the time can be found as well. Yet, these deductions are simplified by keeping constant the bulge's gyrogravitational properties during the process. I leave to the reader to experiment with time-dependent models of gyrogravitational fields in the bulge.

An explanation for the very limited windings of our Milky Way's spirals is a direct consequence of this paper.

1. From a spherical to a disk galaxy.

Let us consider a spherical galaxy. When the centre contains massive spinning stars or spinning black holes, a gyrotation field will start to make the stars' orbit swivel.
After a time t , the radius of the disk galaxy is $\mathcal{R}_e$. The stars beyond $\mathcal{R}_e$ did only swivel partly, and are not part of the disk itself.

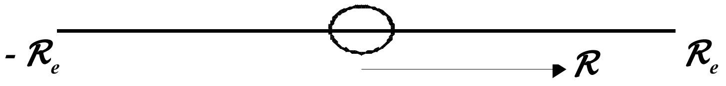

fig. 1.1

The schematic view of a disk galaxy with radius $\mathcal{R}_e$ *. The bulge is nearly a sphere or an ellipsoid. The bulge area, the disk and the fuzzy ends are studied separately.* $\mathcal{R}$ *is the considered place.*

The considered star m orbits at a distance $\mathcal{R}$ from the galaxy's centre.

From the former paper we know that the tangential gyrotational acceleration of a star's orbit is given by:

$$a_{\Omega,t} = \frac{G}{5c^2}\sum_{i=1}^{n}\frac{m_i\,\omega_i^2\,R_i^2}{D_i^2}\sin 2\alpha_i \qquad (1.1)$$

where m_i , ω_i and R_i are the rotation parameters of the n spinning stars, which can be moving anywhere in the bulge. Considering that the most significant spinning stars are massive spinning black holes, we have to take in account the shape of rings and not spheres. Equation (1.1) can then be changed in :

$$a_{\Omega,t} = \frac{G}{2c^2}\sum_{i=1}^{n}\frac{m_i\,\omega_i^2\,R_i^2}{D_i^2}\sin 2\alpha_i \qquad (1.2)$$

The reader can experiment with linear combinations of (1.1) and (1.2), but I will continue with (1.2) for further calculations. In fig 2.1 , the meaning of the symbols is visually shown. The values D_i and α_i are the position parameters of the black holes. D_i and α_i are variables in time.

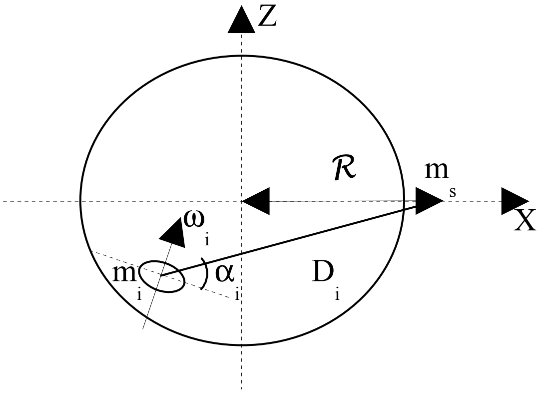

fig. 2.1

The bulge of the disk galaxy. A mass m *at a horizontal distance* $\mathcal{R}$ *from the centre is influenced by the gyrotation of black hole* i. *The bulge and its surrounding are fuzzy, caused by a quasi-random distribution of* n *black holes which result in unwell defined vectors of the gyrotation fields.*

Below, I now will study the swivelling time for the orbits in a simplified form, because the time-dependency of the black hole's positions is not known. The problem is the one of a n-spinning-body system with a gravitation and a gyrotation component. This study is not relevant to this paper. Consequently, we will replace some values by approximations or by their average value.

2. The swivelling time from a spherical galaxy to a disk galaxy.

The transformation from a spherical galaxy to a disk galaxy is quite clear. We have seen that random orbits of planets about the sun have swiveled until they arrived to the sun's equatorial plane. Also the stars outside the galaxy's bulge swivel to the bulge's equator plane.

Out of (1.2) it follows that at a certain distance $\mathcal{R}$, the path length between the random angle α of an orbit lays between zero and $\pi\,\mathcal{R}$. The average path length is $\pi\,\mathcal{R}\;/\;2$ until the equator. And this is also the average path length until the swivelling star passes at the disk's equator for the first time (remember that the motion is an exponential decreasing oscillation) . Remark that the complete swiveling will not occur nearby the bulge, due to the fuzzy and strongly variable gyrotation fields in that region.

Integrating (1.2) twice over time gives the time which the average star need to reach the disk region.

Hence,

$$\pi\,\mathcal{R}/2 = \int_0^t\left(\int_0^t a_{\Omega,t}\,\mathrm{d}t\right)\mathrm{d}t \qquad (2.1)$$

In a first attempt to simplify (2.1), we can suppose that all the rotating stars are placed in the bulge's centre, while the global geometry is the bulge itself. Then the acceleration in (2.1) is independent in time, so D_i can be replaced by $\mathcal{R}$ for each value of i . By that replacement, the only remaining time-dependent parameter is the angle α for each black hole.

To get rid of $\sin 2\alpha_i$, let us replace it by its average value between $\alpha_i = 0$ and $\alpha_i = \pi / 2$. Thus, $(\sin 2\alpha_i)_{av} = (\pi/2)\int_0^{\pi/2} \sin 2\alpha \, d\alpha = \pi/2$.

Hence, with (1.2) , equation (2.1) brings us, after integration and rearranging, the following result for the swiveling time :

$$\boxed{t = c\sqrt{\frac{\mathcal{R}^3}{G\sum_{i=1}^{n} m_i \omega_i^2 R_i^2}}} \tag{2.2}$$

The farther away from the bulge, the longer it takes before the disk takes form. At the extremities $\mathcal{R}_e$ of the disk, there is still a fuzzy zone of stars because only a part of the stars did swivel entirely, namely those who were the closest to the disk's equator in a prograde orbit.

Inversely, after a time t , the disk diameter of the galaxy is given by:

$$\mathcal{R} = \sqrt[3]{\frac{G t^2}{c^2}\sum_{i=1}^{n} m_i \omega_i^2 R_i^2} \tag{2.3}$$

Closer to the bulge, the disk is quickly generated. The growth velocity of the galaxy's disk decreases steadily in time.

3. Discussion.

The time delay which is observed in spirally wound galaxies such as the Milky Way does not correspond at all to the total lifetime of the galaxy. The reason is that there are several phases of time to consider.
The starting point is the spherical galaxy with a spinning center, made of spinning stars and eventually black holes.
Then follows the swivelling of the orbits, by which the disk diameter increases steadily, beginning from the centre and becoming very thin -in cosmic terms- at some places, causing a hyper-density of the disk compared with the original density of the spherical galaxy.
The third phase is the formation of the spirals by the contraction of some hyper-dense zones, even yet after a partial formation of the disk. When observing the actual spiral-gradient, it appears as if the delay of time between the formation of the inner and the outer parts of the disk were very short, but in fact this delay is much longer because the stars that are farther away from the bulge can only form spirals at the time that the disk has become hyper-dense enough at that place, while the inner disk zone has its spirals yet formed.
The observed strange form of the spirals, I would rather say: many parts of spirals, correlate quite well with this explanation.

4. Conclusion.

The time for an average orbit-swivelling is proportional to an exponent 3/2 of the orbit radius of the star. Although the found time-equation is only a limited part of the formation time of our actual Milky Way, it allows us already to have a clearer view on the formation of disk galaxies.

5. References and interesting lecture.

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