the general science journal

On the Formation of Close Binary Systems out of a Spinning Star

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Abstract

In this paper, black holes are discussed based upon the improved gravity theory originated by Oliver Heaviside [2] and it is found that the Schwarzschild metric is highly improbable to occur at all, if not impossible. Earlier, it was found that a spinning black hole is always emitting information at the poles [6]. The possible creation of close binary stars out of one single star is studied, based upon the internal pressure in spinning stars. Close binary stars containing a fast spinning star or black hole and a companion are found to emerge from only one original star. We find a logical reason why much more rarely, close binary stars consisting of two fast spinning stars or black holes are found.

Keywords: black hole, close binary star, fast spinning star, Oliver Heaviside, gravitomagnetism, gravity.
Method: analytic gravitomagnetism

1. Do "classical" Black Holes exist?

The Schwarzschild black hole is an approximated theoretical solution from the general relativity theory: it says that there a spherical mass is supposed to exist, so heavy that light couldn't escape, because the escape velocity of that mass would need to be greater than the speed of light.

But can such black holes exist? In reality, stars are made of dust from a nebula that conglomerated due to gravity. These nebulae contain matter that is not standing still during this contraction. Merely, like our Sun, the mass has some kinetic energy.

Based upon the work of the genius Oliver Heaviside, it is clear [4] that like-oriented flows of matter will more attract than opposite-oriented flows, since matter-flows respond to similar laws as electromagnetism [2] [4]. By the segregation of velocities, there is a tendency to spontaneously obtain rotational velocities, instead of purely randomly spread ones.

Even if at the start these velocities are rather small, the contraction of the masses, combined with the conservation of angular momentum, makes that the angular velocity dramatically increases with decreasing radius. A reduction of the radius by a factor 1000 increases the angular velocity with a factor of 1,000,000.

Hence, it is clear that the least velocity segregation in the original nebula will result in a star with a considerable angular velocity. And if the star's mass is sufficient, this might result in a heavy, collapsed star, whereof the spin even increases more dramatically, to a fast spinning 'black hole'.

But there is more: when the gravitational characteristics of a rotating star are calculated, it appears that [11] the angular velocity accounts for an additional (but apparent) mass, that applies to it. In reality, there is an induced field that acts upon orbiting objects as if the star were heavier. So, even a relatively lightweight star can obtain, by a high angular velocity, nearly the same characteristics as a very heavy star [11].

2. Fast spinning spherical stars.

From my former papers it is clear that fast spinning stars exist and will be able to partially never explode, whatever the rotation speed is [6]. This is due to the magnetic-like gravity field, comparable to the Kerr metric [8] of GRT that leads to the alleged "event horizons" of fast spinning black holes.

When the star is sufficiently compressed, and gets a radius that is smaller than its compression radius R_C, the parts above the northern latitude of nearly 36°, and under the southern latitude of nearly 36° can explode [8]. Such explosions give typical bipolar explosions such as SN1987A, the Southern Crab Nebula and Eta Carinae.

Let us analyze the inside of the fast spinning star before the explosion. In my papers [6], eq. (3.8) and (3.9), I have found the inside accelerations of fast spinning stars due to gravity, the effect of angular inertia and the magnetic-like gravity (gyrotation).

The equatorial internal acceleration is given by:

$$a_{x,tot} = r\omega^2 \cos\alpha \left\{1 - \frac{Gm}{5R^3c^2}\left(r^2\left(6-3\sin^2\alpha\right)-5R^2\right)\right\} - \frac{Gm\cos\alpha}{\left(1/r\right)R^3} \tag{1}$$

The latitude on the spherical star is given by α, the angular velocity by ω, the star's radius by R and the considered radius inside the star by r. The other nomenclature is general. For our convenience, we consider a constant density in the star, but we will improve this situation afterwards. The first term between the curly brackets is the angular inertial term, the second one is the gravity gyrotation due to motion. The last term of the equation is the Newtonian gravity.

Remark that the gyrotation term will be directed outwards like the angular inertia when $r^2\left(6-3\sin^2\alpha\right)<5R^2$ and directed inwards like the Newtonian gravity when $r^2\left(6-3\sin^2\alpha\right)>5R^2$. (1.a) (1.b)

In the direction of the spin axis, the acceleration is given by:

$$-a_{y,tot}=\frac{3Gm\,\omega^2 r^3\sin\alpha\cos^2\alpha}{5R^3c^2}+\frac{Gm\sin\alpha}{(1/r)R^3} \qquad (2)$$

Here, the first term is the velocity-dependent gyrotation and the second one is the Newtonian gravity.

If we want to know the maximal internal pressure, we first need to find the equation for the internal pressure.

In general, this is given by:

$$p=\int_r^R \rho\,a\,\mathrm{d}r \qquad (3)$$

However, we have two different kinds of forces involved here, and the integration must be considered with caution. At a certain radius r , the pressure is given by the integration of the acceleration between the surface of the star (radius R) to the considered radius if the force is pushing like a weight, and for the pulling forces like the angular inertia, it must be integrated between the star's center to the radius r. Both groups of forces will merge at the radius r , because of their opposite directions.

Now, we will look at the gyrotation part. It is found [12] that the pressure is maximal on the x-axis, which lays in the equatorial plane. The expected maximal acceleration will be found by setting $\alpha = 0$.

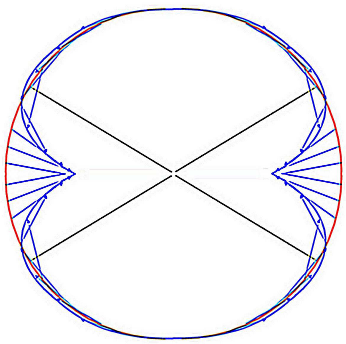
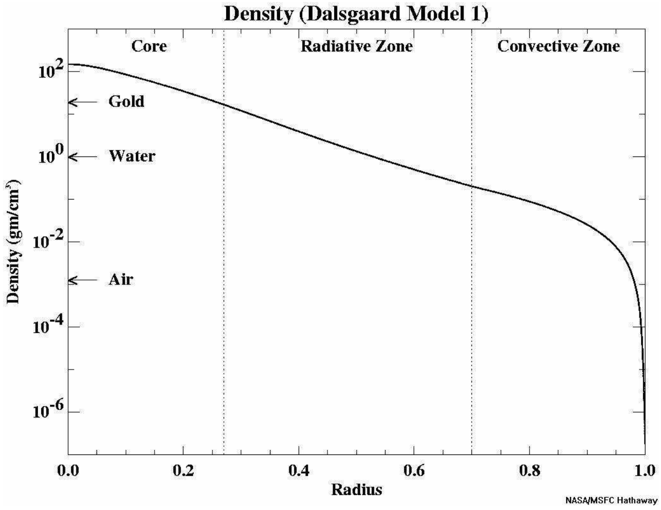


Fig 1. The gyrotational forces of a spinning sphere, caused by the gravitational transmission of angular momentum, are directed inwards near the equatorial zone.

The fig. 1 shows the vectors of compression caused by gyrotation, which is the transmitted angular momentum by gravity. It is found that the forces are maximal at the equatorial level, and that they are oriented inwards, counteracting the inertial effect of rotation. Hence, we have to look for the accelerations in the equatorial plane.

The now following approach complies with the study performed by Dalsgaard [13] on the internal pressure in the Sun. Indeed, the form of this curve follows the internal pressure curve of heavenly objects if one assumes the inside density being constant. Hence, the internal density curve and the internal pressure curve can be considered as directly proportional.



The equation of this internal pressure distribution, when solely occasioned by the Newtonian case of a spherical mass (non-spinning), is found in the literature:

$$p=\frac{3G}{8\pi}\left(\frac{m}{R^3}\right)^2\left(R^2-r^2\right) \qquad (4)$$

The general shape of this eq.(4) matches the Dalsgaard model quite well. Since eq.(3) contains the density, which is unknown, we can reason that it should be direct proportional with the internal pressure itself.

Hence, it is reasonable to consider that the pressure and the density will be directly proportional: $\rho \sim p$ so that there exists a constant k for which $\rho = p/k^2$ The constant k has the dimensions of a velocity.

Now, the eq.(3) can be written as:

$$\frac{\mathrm{d}\,p_x}{p_x}=\frac{\left|a_{\mathrm{cp}}\right|+\left|a_{\Omega}\right|+\left|a_{\mathrm{g}}\right|}{k^2}\mathrm{d}\,r \quad \text{for} \quad \alpha = 0. \qquad (5)$$

with the accelerations of angular inertia, gyrotation and the Newtonian gravity. Integrating eq.(5) and using the partial accelerations for each physical process in eq.(1) for $\alpha = 0$ and considering the limits given by eq.(1.a) and (1.b) gives:

$$k^2\ln\left(p_x\right)=\int_0^r r\omega^2\,\mathrm{d}\,r+\int_r^R\frac{Gm\,r}{R^3}\left(\frac{\omega^2}{5c^2}\left(6r^2-5R^2\right)+1\right)\mathrm{d}\,r \qquad (6.a)$$

for $r/R>\sqrt{5/6}$, and:

$$k^2 \ln(p_x) = \int_0^r r\omega^2 \left(1 + \frac{Gm}{5R^3c^2}\left(5R^2 - 6r^2\right)\right) \mathrm{d}\, r + \int_r^R \frac{Gm}{R^3} r \, \mathrm{d}\, r \quad (6.b)$$

for $r/R \le \sqrt{5/6}$.

This gives the following result:

$$2k^2 \ln(p_x) = r^2\omega^2 + \frac{3Gm\,\omega^2}{5R^3c^2}\left(R^4 - r^4\right) + \frac{Gm}{R^3}\left(1 - \frac{\omega^2 R^2}{c^2}\right)\left(R^2 - r^2\right)$$

for $r/R > \sqrt{5/6}$, and: (7.a)

$$2k^2 \ln(p_x) = r^2\omega^2 \left(1 + \frac{Gm}{Rc^2}\right) + \frac{Gm}{R^3}\left(R^2 - r^2 - \frac{3\omega^2}{5c^2} r^4\right) \quad (7.b)$$

for $r/R \le \sqrt{5/6}$.

Hence:

$$p_x = \exp\left\{ r^2\omega^2 + \frac{3Gm\,\omega^2}{5R^3c^2}\left(R^4 - r^4\right) + \frac{Gm}{R^3}\left(1 - \frac{\omega^2 R^2}{c^2}\right)\left(R^2 - r^2\right) \right\} \exp\left(-2k^2\right)$$

for $r/R > \sqrt{5/6}$, and: (8.a)

$$p_x = \exp\left\{ r^2\omega^2 \left(1 + \frac{Gm}{Rc^2}\right) + \frac{Gm}{R^3}\left(R^2 - r^2 - \frac{3\omega^2}{5c^2} r^4\right) \right\} \exp\left(-2k^2\right)$$

for $r/R \le \sqrt{5/6}$. (8.b)

In order to find the place of the maximal pressure, we need to find the radius wherefore:

$$\frac{\mathrm{d}\, p_x}{\mathrm{d}\, r} = 0 \quad (9)$$

which, after solving with respect to r, results in:

$$r_{\max} = \sqrt{\frac{5}{6}\left\{ R^2\left(1 + \frac{R\,c^2}{G\,m}\right) - \frac{c^2}{\omega^2} \right\}} \quad (10)$$

for both $r_{\max}/R > \sqrt{5/6}$ and $r_{\max}/R \le \sqrt{5/6}$.

Of course, we have the extra condition $0 \le r_{\max} \le R$.

In this study, we will assume that $R\,\omega \le c$.

In terms of a relative radius, we can write eq.(10) as:

$$\frac{r_{\max}}{R} = \sqrt{\frac{5}{6}\left(1 + \frac{R\,c^2}{G\,m} - \frac{c^2}{R^2\omega^2}\right)} \quad (11)$$

The reader can find some examples that will fit the eq.(11) and solve the pressure values in eq.(8.a) or (8.b), depending on the value of $r_{\max}$. In any case, we can deduce from eq.(11) that the order of magnitude of ω to get a maximum within the star, is $\omega \approx \sqrt{Gm/R^3}$. However, a large value for ω is mandatory to get a high internal pressure in the star, according to eq.(8.a) and (8.b).

Of course, if the mathematic maximum is situated outside the star, the physical limit will be taken.

3. Formation of black hole and close binary system candidates.

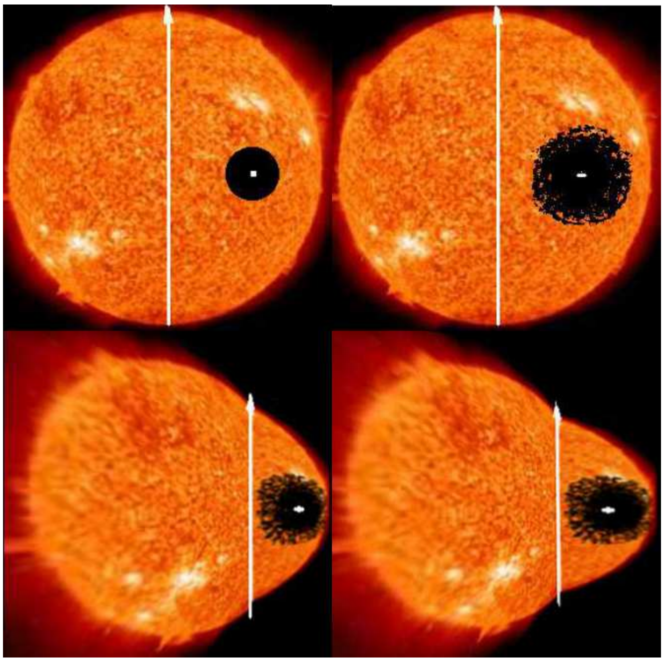
We see that the place where a possible collapse occurs will we somewhere outside the star's center, at the place where the pressure is the highest. Since stars are physical objects, not perfectly symmetrical, the collapse will occur at one place, causing a chain reaction because of the local extreme high density that suddenly occur.

Important to notice is that in almost all the cases, the sudden collapse will occur at one place only, situated eccentrically in the star.

At that place, the collapsed matter coming from lower radii will have a lower velocity than that of the collapsed matter coming from the higher radii. This means that there is a gradient of velocities, corresponding to a certain angular momentum, which by the contraction due to the atom crush will cause a strongly increasing angular velocity.

Due to this increased angular velocity, the gravity field, especially the velocity-dependent part of it, which resemble the magnetic component in electromagnetism, will increase much more at very high velocities, spites the conservation of angular momentum. The star even can become a very fast spinning object or a (partial) black hole. Indeed, spinning stars will always allow matter and light to escape from the poles.

The new-born fast spinning unit has got an increased gravity force that imitates an increased mass. Therefore, the system's center of mass will strongly deviate towards the new spinning unit.



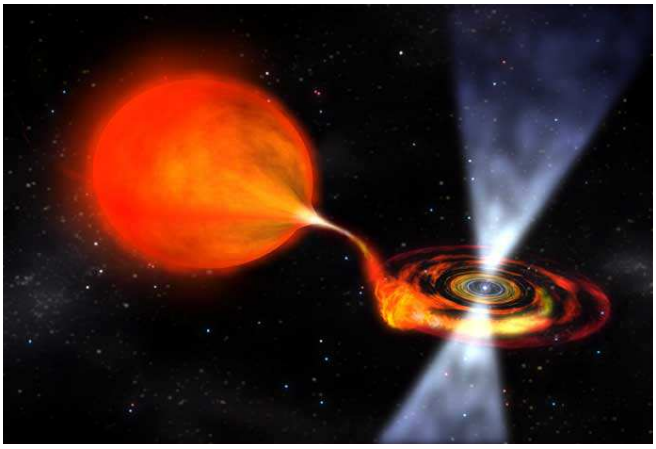


Fig.2. Schematic view of the evolution after a local collapse of atoms due to the internal pressure at 90 to 100% of the radius. Eventually, the original star has split up in a fast spinning collapsed unit and a large companion of the remaining available matter.

The matter around the contracting part can further be absorbed, and this will increase the overall mass of the newborn fast spinning unit. But as we explained in an earlier paper [8], fast spinning stars don't absorb new matter easily, but when the magnetic part of gravity will have become strong, it rather will expel that matter again through the poles, while maintaining an accretion disk around it.

The fast spinning unit inside the original star will rather become a brand-new collapsed, fast spinning star, around which the remaining original matter will form a second unit and become a large companion. The matter closest to the new fast spinning star will form an accretion disk.

This explains why we find close binary stars quite easily, while it is not common to find star doublets in general. Binaries come out of only one star.

It is also possible, but very rare, that a matter collapse would occur simultaneously at two places at the radius $r_{\max}$. That would generate two fast spinning units instead of one, which is found more rarely.

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