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The Gravitational Stellar Constant Allows for an Improved Description of Stellar and Black Hole Dynamics

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Abstract: The Sun's dynamics defines our Gravitational Constant. In a former paper [2], that strict relationship has been shown, based upon the most fundamental equations of gravity and gyrotation (the magnetic equivalent for gravity), applied upon elementary particles. The consequence is that one parameter can be eliminated, as explained before [6] and this allows me to unveil some issues on the shape and the moments of inertia of stars, supernovae and black holes, and the possibility of double bursts of forming black holes.

Keywords: Gravitational Constant, spinning stars, black holes, Coriolis Gravity.

1. The Gravitational Stellar Constant

Several papers concerning the gravitational Coriolis interaction between particles and inertia opened the path to new insights on the gravitational constant. It appears that for the Sun, the following relationship between the solar parameters exists [2], [6]:

$$\upsilon_{eq} \Leftarrow \frac{G\, m_{Sun}}{2c\, R_{eq}{}^{2}} \qquad (1)$$

Herein : G = 6.67x10^{-11} m^3 kg^{-1} s^{-2},
c = 3.00x10^8 m s^{-1}
and for the Sun, m_{Sun} = 1.98x10^{30} kg
R_{eq} = 6.96x10^8 m.

and υ_{eq} is the according solar rotation frequency. The arrow expresses an unilateral validity.

Based upon the stellar lifecycle, I found an extrapolation of the apparent unilateral direction of the validity of eq.(1). I stated that, based upon the fundamental gravitomagnetic laws that are fully compatible with eq.(1), this equation should be valid for any active star. The importance of this finding and its consequences for the description of gravity for distant stars and exo-planets are evident.

Indeed, eq.(1) can also be written as:

$$G_{star}\, m_{star} = 2c\, R_{eq}^{2} \upsilon_{eq} = \frac{c\, \omega_{eq} R_{eq}^{2}}{\pi} \qquad (2)$$

This means that the product of the Gravitational Constant with its mass can be replaced by the product of a pure "specific angular moment", completed by the proper constants.

2. Derivation of the fast spinning star's shape

In a former paper [4], I discussed the shape of fast spinning and exploding stars and I found their exploding-free zones, which are compressed by 'gyrotation'-forces (the magnetic equivalent for gravity) and which are stronger than the centrifugal effect.

3.1 The dynamics of a non-exploding fast spinning star

The spherical star (a white dwarf) that rotates fast will partially explode [1] [4] and become a supernova. Near the equator, and up to the latitude of nearly 35°16', the star will be kept together by the gyrotational-compression [1].

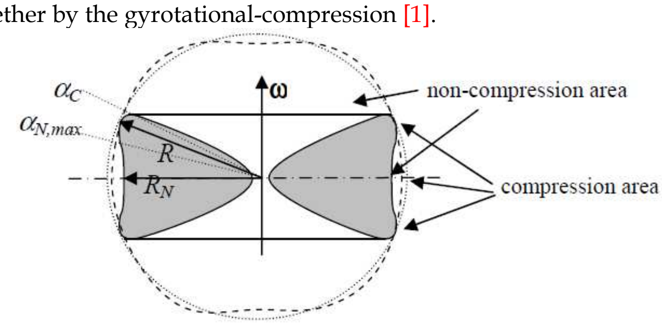

Figure 1: What remains just after the explosion of a fast spinning star is the area between a latitude of 0 to about 35°16'. Of the equator itself, about 10% of the star's radius will explode as well.

As long as the star's equatorial radius R_{eq} is larger than a critical radius R_C found in [4] , eq.(3.5) , with:

$$R_{eq} > R_C = G\, m / 5c^2 \qquad (3)$$

the star will continue to lose matter. When the actual radius is smaller than R_C , the loss of mass stops. The condition for non-explosion is:

$$R_{eq} < R_C = G\, m / 5c^2 \qquad (4)$$

This is the result at the equator.
At a certain latitude α , we found that the equation becomes:

$$R_{\alpha} < R_{C\alpha} = \left(G\, m / 5c^2\right)\left(1 - 3\sin^2 \alpha\right) \qquad (5)$$

which limits the compression zone between the latitudes of 0° and 35°16'. Above that value, compression is strictly speaking not possible.

Eq. (4) can be combined with (2) as follows:

$$R_{eq} < \frac{Gm}{5c^2} = \frac{\omega R_{eq}^2}{5\pi c} = R_C \quad (6)$$

which reduces the criterion to the single parameter of the angular velocity of the star. The higher that velocity, the smaller the maximal stellar radius has to be.

Remark that (6) is valid for a sphere (with a moment of inertia $I = 2\, m R_{eq}^2 / 5$ and that the general equation of (3) is:

$$R_C = \lambda G\, m / 2c^2 \quad (7)$$

wherein λ is a dimensionless shape-factor that equals 2/5 for a sphere and 1 for a thin ring.

Then, the eq.(6) of the non-explosion condition can be generalized, by using eq.(2) to:

$$R_{eq} < \frac{\lambda G m}{2c^2} = \frac{\lambda \omega R_{eq}^2}{2\pi c} = R_C \quad \text{for an axis-symmetric shape,} \quad (8)$$

Since eq.(8) can be written as : $v_{eq} = \omega R_{eq} < \frac{2\pi c}{\lambda}$ (9)

it is clear that the left hand of eq.(9) is the equatorial velocity, normally speaking restricted to velocity c , and the right hand is far above the speed of light because the shape parameter λ will always have a value below or around the figure one. Since eq.(9) tells us nothing new, I need to make a more detailed analysis.

I assume that eq.(8) is valid even after the explosion as a supernova. Indeed, although the value of the star's mass after the explosion has been reduced by nearly 39% (= 35°16'/90°) of its original mass, I didn't attribute the drop of mass to any of the dynamical constants, because the star in that stage is 'dead' and not more active. Hence, I don't expect any intrinsic change of these parameters and I rather expect a change in shape only.

3.2 The light horizon of a fast spinning star

In equation (2.4.b) of the same paper [5], I deduced the light horizon r_{LH} , i.e. the extreme radius where light can escape from a fast spinning star, at the equator level.

It was found that $r_{LH} = 2\, r_{MH}$, where r_{MH} is the mass horizon, i.e. the orbital radius of any satellite around a fast spinning star whereby the orbital velocity would reach the speed of light due to gravitomagnetism, and whereby the satellite would consequently disintegrate.

This is why we will not see the disintegration of orbiting objects about fast spinning stars and black holes: first, they are hidden from view before they are destroyed.

3.3 The matter horizon of a fast spinning star

In a former paper [5], I deduced the matter horizon r_{MH} in equation (1.18) , which I adapt here for any shape.

$$r_{MH}^{+-} = \frac{Gm\lambda}{2c^2}\left(1 \pm \sqrt{1 + \frac{2Ic\omega}{Gm^2}}\right) = \frac{Gm\lambda}{2c^2}\left(1 \pm \sqrt{1 + \frac{2\lambda R_{eq}^2 c\omega}{Gm}}\right)$$

Here, we kept the star's mass of before its explosion; using eq(2) :

$$r_{MH}^{+} = \frac{\lambda \omega R_{eq}^2}{2\pi c}\left(1 + \sqrt{1 + 2\pi\lambda}\right) \quad (8)$$

It appears that the matter horizon r_{MH} depends from the star's radius and the angular velocity, which fully defines it.

As noticed in , there is also a negative solution, which here, results in:

$$r_{MH}^{-} = \frac{\lambda \omega R_{eq}^2}{2\pi c}\left(1 - \sqrt{1 + 2\pi\lambda}\right) \quad (9)$$

Since (9) is negative, I assume that the rotation direction is inversed inside the torus' hole.

It is then assumed that the fast spinning star is a torus whereof the inner radius is larger than the negative matter horizon r_{MH}^{-} and the outer radius is smaller than the positive matter horizon r_{MH}^{+} .

For the Sun, I find very small, hypothetical values for $r_{MH}\,(\approx 850\,\text{m})$ and $r_{MH}^{-}(\approx 260\,\text{m})$, and this means that its radius lays according: $|r_{MH}^{-}| < r_{MH}^{+} < R_{eq}$.

Thus, in general, we start from the situation:

$$\left|\frac{\lambda \omega R_{eq}^2}{2\pi c}\left(1 - \sqrt{1 + 2\pi\lambda}\right)\right| < \frac{\lambda \omega R_{eq}^2}{2\pi c}\left(1 + \sqrt{1 + 2\pi\lambda}\right) < R_{eq} \quad (10)$$

or, in order to fix the ideas for a value of ωR_{eq} , the velocity v_{eq} at the equator is deduced from eq.(10):

$$v_{eq} = \omega R_{eq} < \frac{2\pi c}{\lambda\left(1 + \sqrt{1 + 2\pi\lambda}\right)} < \left|\frac{2\pi c}{\lambda\left(1 - \sqrt{1 + 2\pi\lambda}\right)}\right| \quad (11)$$

which gives the lower limit for v_{eq} in 'normal' cases being a constant.

3.4 From an inner light and matter horizon towards the external light and matter horizon of a black hole

Remark that under the condition of a sphere, the following is true:

$$|r_{MH}^{-}| < r_{MH}^{+} < |r_{LH}^{-}| < r_{LH}^{+} < R_{eq} \quad (12)$$

In general and preliminary, we can assume that eq.(12) is valid for any active star.

The eq.(10) , (11) and (12) are also valid for the torus-like shape of fig.1. Also here, it is found that the shape of the torus will only be ruled by the star's radius and angular velocity. Moreover, I found an upper boundary of the fast spinning torus star.

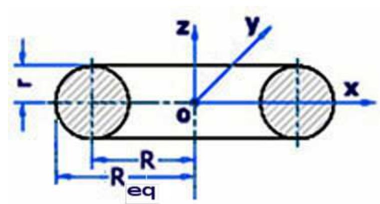

Figure 2: Torus-approximation of a stabilized fast spinning star after its explosion.

Due to gravity and gyrotation, the section of the torus of fig.1 will be contracted to a quasi elliptic section which can be approximated by a circular section, as in fig.2.

It is then possible to estimate the upper boundary of the spinning star and the transition moment with eq.(10).

Since $I_{\text{torus}} = m\left(R^2 + \frac{3}{4}r^2\right)$ and since we had defined, in general: $I = \lambda m R_{\text{eq}}^2$, I combine this to $\lambda_{\text{torus}} = 1 + \frac{3}{4}\frac{r^2}{R^2}$. (13)

Indeed, in the case of eq.(10) we cannot speak of black holes, but of 'normal' non-exploding stars (white dwarfs).

But in order to reach the black hole status, there must have been a transition period after which we get $R_{\text{eq}} < \left|r_{\text{LH}}^-\right| < r_{\text{LH}}^+$ and so $R_{\text{eq}} < 2\left|r_{\text{MH}}^-\right| < 2r_{\text{MH}}^+$.

In general and preliminary, we can assume that the following is true for Black Holes: $R_{\text{eq}} < \left|r_{\text{MH}}^-\right| < r_{\text{MH}}^+ < \left|r_{\text{LH}}^-\right| < r_{\text{LH}}^+$

During the transition period T_1, we get a situation where first the place $\left(R_{\text{eq}} - 2r\right)_{T1} = r_{\text{LH}}^+$ at the inner side of the torus is reached which is transiting first, then the middle of the torus' section $\left(R_{\text{eq}} - r\right)_{T1} = r_{\text{LH}}^+$, next the outer side of the torus at $\left(R_{\text{eq}}\right)_{T1} = r_{\text{LH}}$, and which results in the equatorial velocity:

$$\left(v_{\text{eq}}\right)_{T1} = \omega\left(R_{\text{eq}}\right)_{T1} = \frac{\pi c}{\lambda\left(1 + \sqrt{1 + 2\pi\lambda}\right)} \tag{14}$$

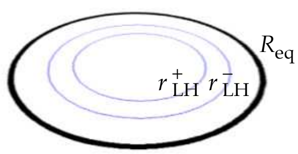

Figure 3: A normal star has internal light and matter horizons with very tiny diameters.

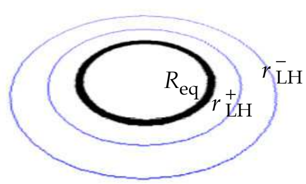

Figure 4: When the star collapses the radius decreases and the light and matter horizons become external. It became a Black Hole.

It is clear, out of eq.(13) that $v_{\text{eq}}/c < 1$, if $\lambda \geq 0.88$. (15)

Later, at moment T_2, the negative light horizon could pass from the inner side to the outer side as well, then at T_3 the positive matter horizon and at T_4 the negative matter horizon.

Based upon eq.(13) , and analogical to eq.(15), this means that the respective torus shape constants and r/R are

$$\begin{aligned} &T_1: \lambda \geq 0.88 \text{ and } r/R \text{ is undefined under eq. (13),} \\ &T_2: \lambda \geq 1.45 \text{ and } r/R \geq 0.77, \\ &T_3: \lambda \geq 1.49 \text{ and } r/R \geq 0.81, \\ &T_4: \lambda \geq 2.20 \text{ and } r/R \text{ is undefined under eq. (13).} \end{aligned} \tag{16}$$

Remark that for a Black Hole under the condition of eq.(15) the following is true:

$$\left|r_{\text{MH}}^-\right| < r_{\text{MH}}^+ < \left|r_{\text{LH}}^-\right| < r_{\text{LH}}^+ \tag{17}$$

3.5 Transition bursts when black holes are formed

When the matter horizon switches from the inside to the outside of the torus, there really is a moment of a possible double successive burst by an exaggerated equatorial speed. Such an acceleration of speed, possibly caused by a matter collapse, can cause the (partial) death of the star, if $\lambda < 1.49$ by a reduction of R_{eq} and an increase of ω.

Remark that the transition to a black hole depends upon the equatorial velocity ωR_{eq} (see eq.(11) and (14)), not only upon the specific angular moment of inertia ωR_{eq}^2.

3. Conclusion

Since the gravitational constant can be deduced from the Sun's dynamics, I assumed that any active star functions the same way [6]. When this feature is strictly extrapolated to active stars in general, it is possible to predict quite precisely the required shape of the stars in different cases: non-exploding stars, supernovae, and black holes, as showed in the equations (16), where I started from the hypothetical shape of a torus.

References

[1] De Mees T., "Analytic Description of Cosmic Phenomena Using the Heaviside Field", Physics Essays, Vol. 18, No. 3 (2005).

[2] De Mees T., "Is the Differential Rotation of the Sun Caused by a Graviton Engine", General Science Journal (2010).

[3] De Mees T., "On the Gravitational Constant of Our Inflating Sun and On the Origin of the Stars' Lifecycle", General Science Journal (2010).

[4] De Mees T., "On the geometry of rotary stars and black holes", General Science Journal (2005).

[5] De Mees T., "Mass- and light-horizons, black holes' radii, the Schwartzschild metric and the Kerr metric", General Science Journal (2006, upd. 2010).

[6] De Mees T., "The Discovery of the Gravitational Constant as a Specific Stellar Property Simplifies the Description of Gravity", General Science Journal (2011).