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BLACK HOLE METRIC IS MASSLESS

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Abstract: In this paper, we show that black hole metric is massless and cannot be used to describe black holes. Moreover, in earlier studies, we showed that a stellar object cannot collapse beyond the event horizon, i.e., cannot collapse to a black hole.

Contents

1. INTRODUCTION

In this paper, we investigate the possibility of black hole formation. First, we examine the black hole metric, which is a prolongation of the Schwarzschild metric into the inner region ($r < 2M$) of the model. By calculating the field quantities and solving the field equations for the black hole metric, we obtain a vacuum solution. Further, we assess the black hole metric using another approach: the collapse of a star. Here, we address some misunderstandings in literature.

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2. THE BLACK HOLE METRIC

The Schwarzschild metric in standard coordinates is as follows:

$$ds^2 = \frac{1}{1-2M/r}dr^2 + r^2 d\vartheta^2 + r^2 \sin^2\vartheta d\varphi^2 - \left(1-2M/r\right)dt^2. \tag{2.1}$$

We review literature and extend the Schwarzschild metric into the inner region $r < 2M$ as follows:

$$ds^2 = \left(2M/r-1\right)dt^2 + r^2 d\vartheta^2 + r^2 \sin^2\vartheta d\varphi^2 - \frac{1}{2M/r-1}dr^2. \tag{2.2}$$

Compared to (2.1), the meaning of the variables r and t are interchanged in (2.2); now, t is the spatial coordinate and r is the time coordinate[1]. This metric is believed to describe a black hole.

To question this, we determine the field quantities from the metric and solve Einstein's field equations. We use the original Minkowski notation $x^4 = i\left(c\right)r$, the tetrads, and the Ricci-rotation coefficients.

For further investigations, we use the following formulae:

$$a = \sqrt{\frac{2M}{r} - 1}, \quad \alpha = 1/a. \tag{2.3}$$

The radial and time differentials in tetrad notation are

$$dx^1 = a dt, \quad dx^4 = i\alpha dr. \tag{2.4}$$

Considering the new interpretations of the variables, the tetrad partial differentiation in the radial and time directions is as shown below:

$$\partial_1 = \frac{\partial}{a\partial t}, \quad \partial_4 = -ia\frac{\partial}{\partial r}. \tag{2.5}$$

We obtain the following time derivatives:

$$r_{|4} = -ia, \quad a_{|4} = i\frac{M}{r^2}. \tag{2.6}$$

From (2.2), we find the 4-beine to be

$$\overset{1}{e}_1 = a, \quad \overset{2}{e}_2 = r, \quad \overset{3}{e}_3 = r\sin\vartheta, \quad \overset{4}{e}_4 = \alpha, \tag{2.7}$$

considering the time coordinate $x^4 = ir$.

In tetrad calculus, the Ricci-rotation coefficients are

$$A_{mn}{}^{s} = \overset{s}{e}_j \, e^j_{[n|m]} + g^{sr} g_{nt} \overset{t}{e}_j \, e^j_{[m|r]} - g^{sr} g_{mt} \overset{t}{e}_j \, e^j_{[r|n]}, \tag{2.8}$$

After applying (2.7) and respecting $g_{mn} = \delta_{mn}$, we obtain

$$A_{14}{}^{1} = -i\alpha\frac{M}{r^2}, \quad A_{24}{}^{2} = -ia\frac{1}{r}, \quad A_{34}{}^{3} = -ia\frac{1}{r}, \quad A_{32}{}^{3} = \frac{1}{r}\cot\vartheta. \tag{2.9}$$

[1] Some authors also change the notation to $r \leftrightarrow t$.

In Fig 1, we show the evolution of $U = A_{1r}{}^{1} = \alpha M/r^2$ and $B = A_{2r}{}^{2} = a/r$ in the interval $0 \le r \le 2M$. U has an exotic behavior and two singularities at $r = 0$ and $r = 2M$, while B shows no peculiar behavior.

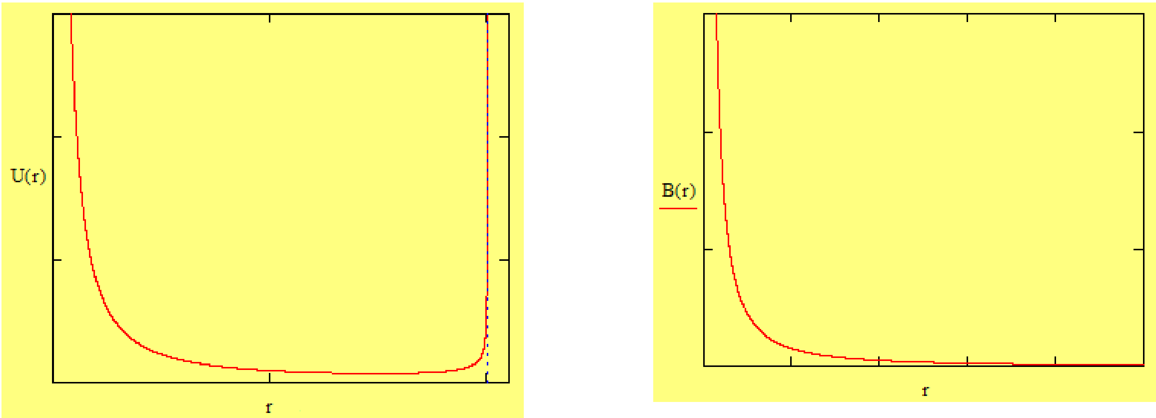

Fig.1. The field quantities U and B

By introducing $C_2 = A_{32}{}^{3}$, we obtain the auxiliary relation $C_{2|2} + C_2 C_2 = \frac{1}{r^2}$. By using this relation and inserting the Ricci-rotation coefficients (2.9) into the Ricci

$$R_{mn} = A_{mn}{}^{s}{}_{|s} - A_{n|m} - A_{sm}{}^{r} A_{rn}{}^{s} + A_{mn}{}^{s} A_{rs}{}^{r}, \tag{2.10}$$

we obtain

$$R_{mn} = 0, \quad T_{mn} = 0, \quad p = 0, \quad \mu_0 = 0. \tag{2.11}$$

Thus, the black hole metric is a vacuum solution of Einstein's field equations, where pressure and matter density are zero; it describes an empty space. This is not surprising, since the black hole metric was derived from a vacuum metric. Thus, the black hole metric cannot represent dark matter objects in the centers of galaxies, and it is difficult to assign a physical meaning to the construct (2.2). Moreover, since one extends the exterior solution into the region where a stellar object, i.e., the object responsible for the gravitational field, is located, it remains unclear where this object has gone to.

According to the textbook of Mitra [1], the black hole metric (2.2) is accurate for a *mathematical black hole* that has a mass $m = 0$. He prefers the term 'black hole candidate' for dark objects in the universe and notes that many of them have characteristics contradicting the assumed properties of a black hole. These objects may have magnetic fields or spontaneous X-ray bursts.

Thus, we have good reason to believe that black holes are fictional.

3. BLACK HOLES: A RESULT OF GRAVITATIONAL COLLAPSE?

In the literature, one finds another approach to explaining black hole formation: the collapse of a star surrounded by a Schwarzschild field into a singularity. This approach presumes that the event horizon of the Schwarzschild model can be penetrated. However, in our opinion, this is not possible.

In their textbook [2] Misner, Thorne, and Wheeler (MTW) calculated the free fall of an object falling from an arbitrary position in the Schwarzschild field and noted an asymptotical approach to the event horizon, as seen by an observer at infinity; in contrast, a comoving observer crosses the horizon in a relatively short time. This is likely due to a calculation error. The proper length measured by an observer falling from a finite position has been combined by MTW with the proper time of an observer coming from infinity: $ds^2 = dx'^2 - dT''^2$. However, the results of these calculations greatly influenced developments in physics. Apparently, the authority of these three researchers prevented people from re-examining the problem. The formulae, resulting from the MTW approach, contradict the basic formulae of the theory of relativity. We addressed this problem in a talk in Berlin a few years ago. An illustration of these results can be found in the English translation of the paper [3].

We re-calculated the fall time of observers in the Schwarzschild field using several methods: the standard Schwarzschild coordinate system, Einstein-Rosen coordinates, isotropic coordinates, the angle of ascent, and the Lorentz angle [4-5]. All these calculations show that observers can only reach the event horizon in infinite proper time, as shown in Fig. 2, if the observer starts from an arbitrary point r_0. Obviously, this is true for any point on the surface of a collapsing star. Thus, no stellar object can collapse beyond the event horizon.

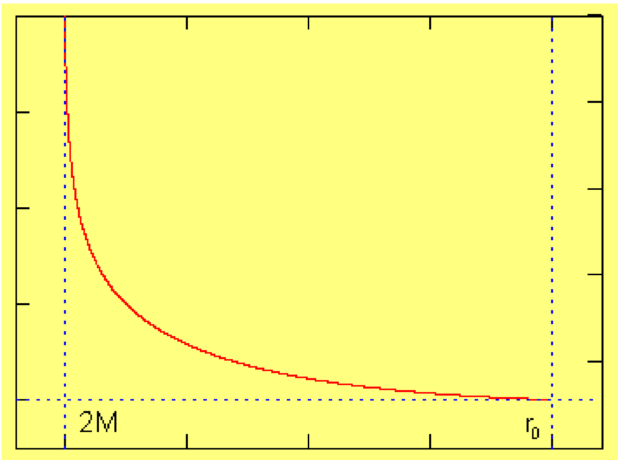

Fig. 2. Fall time

In contrast, it is commonly stated in literature that black holes are the final fate of collapsing stars. After a collapse, matter should be concentrated in a single point where it has infinite density and space has infinite curvature. This singular point is surrounded by an empty space and shielded by the event horizon.

This problem has attracted great research interest and many papers have been published on this subject. In a previous paper [7], we presented an overview of the problem and provided remarks on some published papers regarding collapse. Closer analysis of some of these reports may show that their models allow the event horizon to be crossed.

Upon analyzing new ansätze regarding gravitational collapse, we found that these sometimes have considerable problems with the linking conditions to the surrounding Schwarzschild field. In some cases, these are not considered at all. It would be more obvious to consider the collapse of the interior Schwarzschild solution. We presented this problem in detail in a previous paper [8]. Here, the interior Schwarzschild solution matches smoothly with the exterior solution, and both linking conditions are fulfilled. The solution can be geometrized, i.e., represented as a descriptive surface (spherical cap), and complements Flamm's paraboloid of Schwarzschild's exterior solution.

The interior Schwarzschild solution has an interesting property: a stellar object can only contract to a certain minimum size, at which the pressure at the center of the star becomes infinite. Schwarzschild has already recognized this and specified the minimum value as $r_H = 2.25M$. According to Schwarzschild, there can be no nonrotating star in the universe that is smaller than the inner horizon r_H. A collapse to a singularity, i.e., a black hole, is not possible. The event horizon is degraded to a mathematical artifact, and all considerations of what could happen at the event horizon are obsolete. We have further shown that the integral for the collapse time diverges at r_H, suggesting that the collapse occurs rapidly at first but slows down when approaching the inner horizon and finally needs infinitely long time to get infinitely close to the inner horizon. Ultimately, a quasi-steady state is attained. For an observer, this object does not change noticeably. Such stars can be ultracompact, grow to considerable size, and may no longer emit light. Therefore, these stars have properties that are usually attributed to black holes. According to Mitra's theory of eternally collapsing objects, the centers of galaxies can contain such objects.

4. DISCUSSION

We have presented arguments, both in previous reports and here, that do not support the existence of black holes. Nevertheless, the publication of studies on black holes is important. It is, however, fascinating to assume that our universe has holes through which one can reach distant regions of the universe via Einstein-Rosen bridges or even enter a parallel universe. Such considerations are the subject of scientific research and are published in popular literature and daily newspapers. Science and Sci-Fi are often rather close to each other.

5. REFERENCES

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