Relativistic Theory of Black Holes

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Abstract

The gravitational theory is the most accredited theory for explaining black holes. In this paper we present a new interpretation based on the relativistic theory that explains black holes as a consequence of the relativistic speed of departure between the speed of celestial system and the speed of both light and quantum rays at very high energy, calculated with respect to the observer.

1. Historical introduction to black holes

The term "black hole" was introduced by American physicist J.A. Wheeler because everything, inclusing the light, that went into that astronomical zone wasn' t able to get out and consequently it appeared black.

In the 18th century Laplace and Michell hypothesized for the first time the existence of a celestial body provided with a greatest mass that was able to cause an escape velocity greater than the speed of light for which neither light was able to resist the strongest gravitational force generated by the celestial body.

This hypothesis got on with Newton's corpuscular theory of light but not with the wave theory: on this account the concept of black hole was abandoned.

Some month after the publication of General Relativity by Einstein (1916) the black hole was again contemplated because gravitation in GR was considered a geometric variation of the space and not a force. In 1919 Eddington on the occasion of a total solar eclipse[1] measured the deflection of light coming from a remote star when light passed near the sun. He deduced that in place of the sun a greatest celestial mass should have produced a so great deflection of light that this once gone into the even horizon wasn' t able to get out any longer.

More or less in the same years also Karl Schwarzschild calculated that the black hole should have possessed a greatest mass because the calculus implied a smallest radius of the celestial body ($R=2GM/c^2$) and consequently in order to have an acceptable value of radius a very great mass was necessary.

It is also suitable to say that lastly a few published papers have denied the existence of black holes [2]. Future further experiments will say if black holes represent a physical reality also if already now there are many evidences in this regard. In the gravitational theory the black hole looks like an astronomical monster that devours all what passes in the proximity of its even horizon, the relativistic theory intends also to propose a more friendly explanation of the black hole.

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2. Gravitational theory

Whether in Newton's or Einstein's gravitational theory black holes can be explained with a very strong intensity of the gravitational field that is caused by a greatest mass. In fact in Newton' s theory the F_G gravitational force on a m mass in a point at r distance from the centre of gravity is given by

$$F_G = \frac{G\,M\,m}{r^2} \qquad (1)$$

where $G=6{,}67 \times 10^{-11} Nm^2Kg^{-2}$ is the constant of universal gravitation and M is the mass of the celestial body generating the gravitational field. The gravitational force is the more strong the more M is great and the more r is small.
A body with m mass in order to leave the surface of M celestial mass has to be provided with an escape force $F_e=ma_e$ with opposed direction with respect to the direction of the gravitational force. In order to calculate the initial minimum speed (v_e escape speed) that a m mass has to possess at the r distance for leaving definitively the celestial body it has to be

$$\frac{G\,M\,m}{r^2} = -\,m\frac{dv}{dt} \qquad (2)$$

Being

$$\frac{dv}{dt} = \frac{dv}{dr}\frac{dr}{dt} \qquad (3)$$

we have

$$\frac{dv}{dr}\frac{dr}{dt} = -\frac{G\,M}{r^2} \qquad (4)$$

$$v\,dv = -\,\frac{G\,M\,dr}{r^2} \qquad (5)$$

$$v^2 = \frac{2\,G\,M}{r} \qquad (6)$$

and

$$v_e = \sqrt{\frac{2\,G\,M}{r}} \qquad (7)$$

From the (7) equation we deduce that the escape speed depends on both the r distance from the centre of gravity and the M mass of the celestial body.
From the (6) equation, in the event of light (v=c), we find again Schwarzschild's radius

$$R = \frac{2\,G\,M}{c^2} \qquad (8)$$

In this theory R represents the radius of the even horizon because M mass is concentred into a smallest volume because of the strongest gravitational field.
A graphic representation of black hole is given in fig.1.

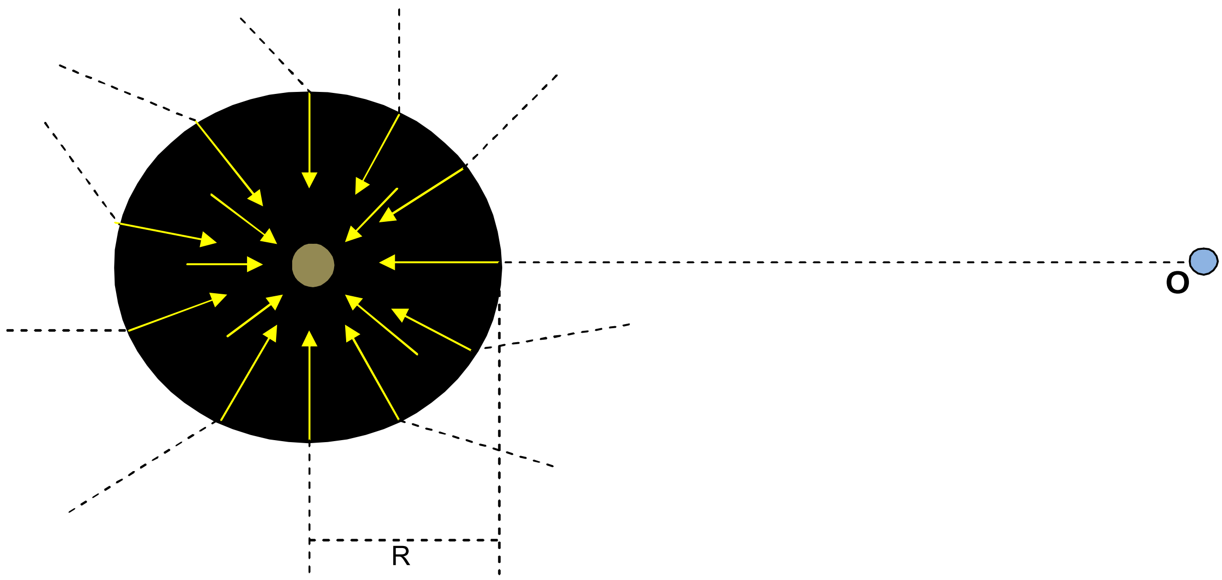

Fig.1 Graphic representation of black hole in the gravitational theory. R is the radius of the event horizon: all what is inside cannot go out, all what passes very near to the horizon (also the light) is attracted inside. The observer is in the O point.

In the gravitational theory black hole represents an astronomical entity whose prospective motion would have no revealing effect on its behavior. In GR the gravitational force is replaced with the space and time warp that is the more strong the more M mass is great and consequently the behavior of black hole is equivalent to a suction effect so great that also the light isn' t able to go out.

3. Relativistic theory

Let us consider an O observer who is in the origin of the S reference frame supposed at rest and similarly consider a celestial body which constitutes the S' reference frame. Suppose still that S' moves with V velocity in reverse with respect to S. Any object launched with speed u from the surface of the celestial body towards the S reference frame along the conjoining line the centre of gravity of S' and the O point where the observer is placed (fig.2), has with respect to S the vector velocity[3][4]

$$\mathbf{v} = \mathbf{u} + \mathbf{V} \qquad (9)$$

In concordance with intensities of **V** and **u** the following cases can happen:

1. V<u : the launched object reaches the O observer with scalar velocity v=u-V in a time d/(u-V) only if the resultant velocity v is greater than the escape speed of the celestial body $v_e=\sqrt{2GM/R}$ ($v>v_e$).

2. V=u : the launched object doesn't reach the O observer and the object staies at a constant distance from O.
3. V>u : the launched object doesn't reach the O observer and in any case it moves away from O with speed v=V-u (this case is represented in fig.2).

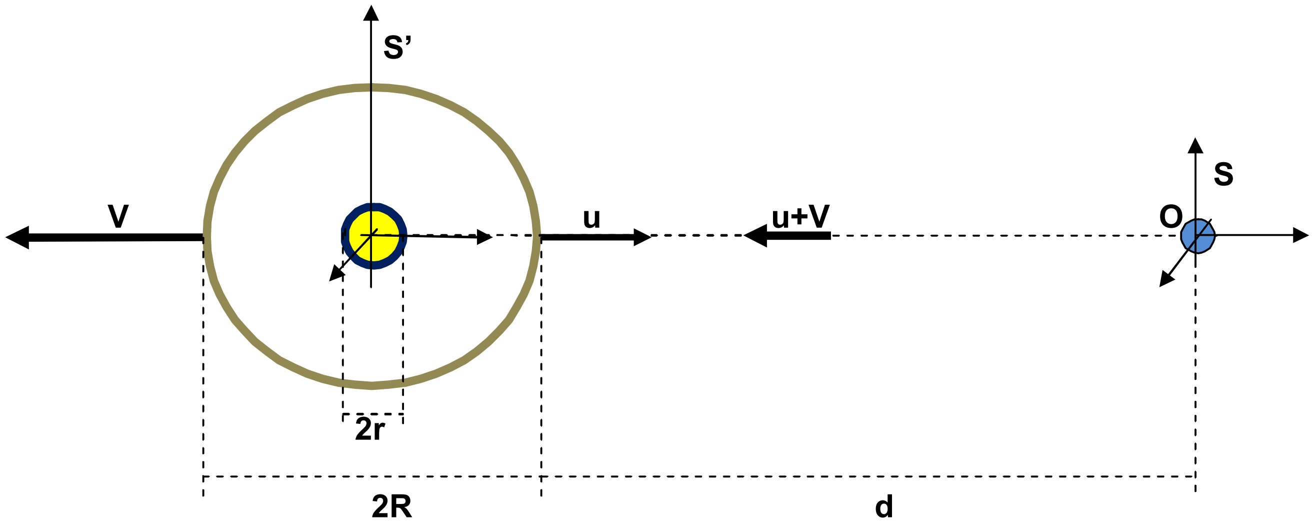

Fig.2 Graphic representation of black hole in the relativistic theory where **V** is the speed of departure of black hole with respect to the O observer, **u** is the speed of an object launched from the surface of black hole and **u+V** is the speed of the same object with respect to S. In figure the case V>u is represented. In the graphic the black hole is represented by a sphere with R radius which because of very great distance from the O observer appears like a small sphere with r radius. d is the distance between the observer and the launch point of the object. In the event of the light the **u** speed coincides with **c.**

In the event of light or energy rays emitted by the celestial body we have u=c. The following cases can happen:

1. V<c : the light reaches the O observer with velocity v=c-V in a time d/(c-V)[4].
2. V=c : with respect to O observer the light has null velocity and consequently it isn't able to reach the O observer.
3. V>c : the light isn't able to reach the O observer.

In the both cases 2. and 3. the celestial body behaves like a black hole. If during its motion black hole collides with couds of cosmic dusts these behave towards the black hole like a friction that raises by far the temperature of dusts with emission of electromagnetic radiations at very high energy.

4. Black holes and binary stars

With reference to fig.3, supposing that **V** is the speed of the bynary system and that the orbital speeds of the two stars are smaller than c (v_1<c , v_2<c), the following cases can happen:

a. The **V** speed is greater than c (speed of light and speed of quantum rays at high energy): V>c.
   In figure the star binary system moves away with V speed from the observer, but the speed of each star with respect to the observer depends on the reciprocal position. In positions of figure star1 moves away with $V-v_1$ speed and star2 moves away with $V+v_2$ speed. In that event star2 certainly is a black hole while star1 is a black hole only if $V-v_1>c$.

b. The **V** speed is equal to c: V=c.
   In that event star2 is certainly a black hole and star1 isn't certainly a black hole in reciprocal positions of figure.

c. The **V** speed is smaller than c: V<c. Always with reference to the situation in figure star1 is an ordinary star while star2 is a black hole if $V+v_2>c$.

Fig.3 Graphic representation of a binary star. $\mathbf{o_1}$ is the orbit of star 1 and $\mathbf{o_2}$ is the orbit of star 2. **B** is the centre of mass of the binary star system which moves away from the observer with **V** speed. In the situation of figure, $\mathbf{v_1}$ is the approach orbital speed of the star1 with respect to the O observer and $\mathbf{v_2}$ is the departure orbital speed of the star2.

It is interesting to observe that in the relativistic theory the binary star system has a different behavior according to the reciprocal position between the two stars inside the binary system. Only astromical observations will be able to confirm this behavior.
The relativistic theory here described represents an alternative way with respect to the gravitational theory for explaining astronomical nature and physical behavior of black holes.

References

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