On the Existence of the Black Holes

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In this note, it is shown that the black holes can exist but also can lose mass and stop being it.

Key words: black hole, escape velocity, gravitational refractive index.

From the Newton's mechanics, we have that for a body of mass M and radius R, it would be:

$$E = T + V = \frac{1}{2}mv^2 - G\frac{Mm}{R} \tag{1}$$

E, T and V being, respectively, the total, kinetic and potential energies of a particle of the surface of the body with a mass m and a speed v, and G the Newton's gravitational constant.

From (1), we obtain the so-called escape velocity:

$$E = T + V = \frac{1}{2}mv_e^2 - G\frac{Mm}{R} = 0$$

$$v_e = \sqrt{\frac{2GM}{R}} \tag{2}$$

When $v_e = c$, where c is the speed of the light in the vacuum, the body is in the limit of being converted in a so-called black hole (BH):

$$\frac{M}{R} = \frac{c^2}{2G} \tag{3}$$

For a BH, it would be $v_e > c$ ($M/R > c^2/2G$).

But from the gravitational redshift [1], it is obtained that the speed of the light would be $c - v_{eph} = c - GM/Rc$, where $v_{eph} = GM/Rc$ is the escape velocity of a photon. Then

$$\frac{c}{n} = c - \frac{GM}{Rc}$$

$$n = \frac{1}{1 - \frac{GM}{Rc^2}} \tag{4}$$

n being a gravitational refractive index.

This would change, respectively, the values of the electric permittivity, ε_0, and the magnetic permeability, μ_0, of the vacuum to the values $\varepsilon = n\varepsilon_0$ and $\mu = n\mu_0$, and the speed of the light in the vacuum would be $1/(\varepsilon\mu)^{1/2} = 1/n(\varepsilon_0\mu_0)^{1/2} = c/n$, instead of only $c = 1/(\varepsilon_0\mu_0)^{1/2}$.

And, for the vacuum, n changes from $n = 1$ to $n > 1$, and c changes to $c/n < c$. Hence, the particles of the surface of the BH with speeds $v < c$ but $v \geq v_e > c/n$ can escape of it. Therefore, the BHs can exist but also can lose mass and stop being it: $v_e \leq c/n$ ($M/R \leq (c/n)^2/2G$).

Note, finally, that when the body is in the limit of being converted in a BH then, from (3) and (4), $n = 2$. And also that as for $M/R = c^2/G$ it is, from (4), $n = \infty$ and $c/n = 0$, then $M/R < c^2/G$. And n can change from $n = 1$ to $n < \infty$.

[1] José Francisco García Juliá, Gravitational Redshift, viXra: 0903.0001 [Relativity and Cosmology]
http://vixra.org/abs/0903.0001