On the Existence of Black Holes

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The *non existence* of black holes has been predicted by the *Relativistic Theory of Quantum Gravity* as a consequence of the existence of *negative gravitational mass* evidenced in the expression of correlation between *gravitational mass* m_g and *inertial mass* m_i, obtained after the quantization of gravity [7]. Here, we review this theoretical discovery, which point to a revolution in fundamental physics.

Key words: Quantum Gravity, Event horizon, Black Hole Information Paradox, Black Hole.

1. Introduction

After the development of the Einstein's General Relativity Theory in 1915, Karl Schwarzschild found a solution to the Einstein field equations, which describes the gravitational field of a spherical mass [1]. This solution had a peculiarity; the gravity becomes infinity in a surface around the spherical mass, defined by the called Schwarzschild radius. This surface, called an *event horizon*, marks the point of no return, and defines the edge of a "hole", which is called "black" because it absorbs all the light that hits the horizon, reflecting nothing, just like a perfect black body in thermodynamics [2, 3].

In the early 1970s, Stephen Hawking shows what can happen at the event horizon in terms of quantum mechanics. Pairs of particle-antiparticle can be created near the event horizon, with some sucked into the central singularity, while their partners escape into space. Thus, black holes leak radiation into space, slowly sucking energy from their gravitational core, and that, given enough time, black holes evaporate completely into radiation. There is, however, a bigger problem: the Hawking radiation does not carry *information*.

The black hole information paradox was first observed by Hawking [4], when he looked at the nature of radiation emitted by black holes. He concluded that *the emitted radiation does not transport the information of the matter that made the hole*. Numerous efforts have been made to resolve the paradox.

In the past 40 years it has been suggested that the "lost" information ends up in parallel universes where no black holes exist, or that Hawking radiation is not entirely thermal but has some quantum effects as well. The own Hawking in 2005 published a paper that suggested quantum perturbations of the event horizon of a black hole would allow information to escape. However, these theories have shown inconsistency.

In 2012, it was proposed by Ahmed Almheiri, Donald Marolf, Joseph Polchinski, and James Sully [5] the existence of a *black hole firewall* at the event horizon.

An interesting debate has erupted in the physics community recently, mainly after the publication of Hawking's paper [6], because there are several indications that beloved theories believed to be true cannot be true all at once.

In his paper, Hawking concludes: "There would be no *event horizons* and no *firewalls*."… "*The absence of event horizons means that there are no black holes* - in the sense of regimes from which light can't escape to infinity."

The possibility of do not exist Black Holes it has been previously predicted by the *Relativistic Theory of Quantum Gravity*, as a consequence of the existence of *negative gravitational mass* evidenced in the expression of correlation between *gravitational mass* m_g and *inertial mass* m_i , which can be put in the following form [7]:

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{W}{\rho\ c^2}n_r\right)^2} - 1\right]\right\} \qquad (1)$$

where W is the density of energy on the particle (J/kg) and ρ is the matter density of the particle (kg/m^3); n_r is its index of refraction; m_{i0} is its inertial mass at rest.

Equation (1) shows that *only* for $W = 0$ *the gravitational mass is equivalent to the inertial mass*. Also, it shows that the gravitational mass of a particle can be reduced or made *negative* when the particle is subjected to high-densities of electromagnetic energy.

On the other hand, the *Schwzarzschilds' equation*, is given by

$$g = \frac{Gm_g}{r^2\sqrt{1-2Gm_g/rc^2}} \qquad (2)$$

The Einstein's equivalence principle predicts that $m_g = m_i$. Therefore, the current interpretation of Eq. (2) is that, if $r = 2Gm_g/c^2$ (*Schwzarzschilds' radius*), then $g \to \infty$. Based on this singularity arose the concept of *event horizon* and *Black Hole*. However, we see here that, according to Eq. (1), the gravitational mass m_g can be *negative*. This can occur, for example, in a stage of gravitational contraction of a *neutron star**, when the gravitational masses of the neutrons, in the core of the star, are progressively turned *negative*, as a consequence of the increase of the density of magnetic energy inside the neutrons, $W_n = \frac{1}{2}\mu_0 H_n^2$, reciprocally produced by the *spin* magnetic fields of the own neutrons, $\vec{H}_n = \left[\vec{M}_n / 2\pi\ (r_n^2 + r^2)^{\frac{3}{2}}\right] = \gamma_n\left[e\vec{S}_n / 4\pi m_n (r_n^2 + r^2)^{\frac{3}{2}}\right]$ [8], due to the decrease of the distance between the neutrons, during the very strong compression at which they are subjected.

The *neutron star's* density varies from below 1×10^9 kg/m^3 in the *crust* - increasing with depth – up to 8×10^{17} kg/m^3 in the *core* [9]. From these values we can conclude that the neutrons of the core are much closer to each other than the neutrons of the crust†.

This means that the value of W_n in the crust is much smaller than the value in the core. Therefore, the gravitational mass of the core becomes negative *before* the gravitational mass of the crust. This makes the gravitational contraction culminates with an explosion, due to the *repulsive* gravitational forces between the core and the crust. Therefore, the contraction has a limit and, consequently, the singularity ($g \to \infty$) never occur. This means that *Black Hole does not exist*.

However, we would like to draw the attention to the possible existence of celestial bodies similar to "black holes". These bodies would have ultra-strong electromagnetic fields. Then, according to Eq. (1) their gravitational masses would be strongly negative. Thus, when another body approaches them, the gravitational mass of the body also becomes negative due to the action of the ultra-strong magnetic field. The result is an enormous gravitational *attraction* between them, similar to that would be produced by a "black hole".

* There is a critical mass for the stable configuration of neutron stars. This limit has not been fully defined as yet, but it is known that it is located between 1.8M$_\odot$ and 2.4M$_\odot$. Thus, if the mass of the star exceeds 2.4M$_\odot$, the contraction can continue.

† The density 1×10^9 kg/m^3 in the *crust* shows that the radius of a neutron in the crust has the normal value (1.4×10^{-15}m). However, the density 8×10^{17} kg/m^3 shows that the radius of a neutron in the *core* should be approximately the *half* of the normal value.

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