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On the Anatomy of Black Holes, the G-Boson, Dark Matter and Dark Energy

Were things different at the big bang?

Table of Contents

1. Abstract

In this work it is investigated whether it is possible to say more about what is hidden behind the event horizon of black holes than only about mass, angular momentum and charge by means of theoretical physics.
Thereby it is tried to find boundary statements with the help of natural constants, in order to give then on this basis the phenomenon "black hole" space to a general physical understanding and to clarify thereby, what black holes actually are, whether they can degenerate to the singularity and why the space-time metric fails at the event horizon. Furthermore, the question is examined whether there are new interpretations of the dark matter interacting exclusively via gravity with the world of the standard model of particle physics and why this is so. Likewise the question of the dark energy is treated in this context, since new conclusions for the big bang arise.

2. Introduction

Since Karl Schwarzschild in 1916 calculated a solution of Einstein's theory of general relativity for gravitational fields of non-rotating uncharged masses, whose center he saw as singularity, and in the resulting metric (tensor, which describes the spatial properties of arbitrarily dimensioned spaces in differential geometry) a radius (Schwarzschild radius, event horizon) resulted, at which the geometry collapses, the theory of black holes was born. Because within this radius no more statements could be made by the GRT, only so much was clear, nothing, not even light, could, once it had disappeared behind this radius, ever appear there again. And where no radiation, certainly no matter can come from, it is absolutely black. Therefore one designated these formations as "black holes" (in such a way first 1967 of John Archibald Wheeler named), without knowing whether such a thing could exist at all in the reality. Decades should pass, until astronomy delivered hints to these formations. Theoretical physics and astrophysics had to limit itself to calculate what can happen at the edge and to derive further metrics for charged and/or rotating masses. The existence of black holes is meanwhile astronomically proven, by proof of the predicted lens effect, by orbit measurements in the center of our galaxy, where in the constellation Sagittarius an oversized not directly visible mass could be made responsible for the orbits of neighboring stars (Physics Nobel Prize 2020) and recently astronomy even succeeded in visualizing a black hole by radio telescope [1)].
So it is clear, there are black holes and behind the event horizon nobody can look, there exists only possibly rotating and/or charged mass. Better one should speak of energy than of mass as I will show in this essay. But how can one do this, if nobody is able to look behind the event horizon? One cannot look, but science has means: imagination, logic, thoughts, theories, mathematics, reality. First the imagination creates model conceptions, then the scalpel of the logic checks these with existing already sufficiently substantiated knowledge, bundles the thoughts and drafts a theory which must be mathematically built up consistent in itself and exist in the reality. In the latter lies now increasingly in the research the main problem. The experimental testing effort can increase to the point of impracticability, and reality can put a stop to our desire for knowledge. Then we are literally not only at the event horizon, but at the knowledge horizon. And yet there remains a way. We have to reduce the event horizon and hope to come across a limit caused by natural constants without singularities. Then it is not the horizon of cognition, but the cognition of a smallest something that is elementary. Chemistry has gone this way and landed at the periodic table, physics has arrived at the standard model, which is

consolidated experimentally and by the quantum theories. Only gravity wants to hinder us by the event horizon. But it should be natural constants which set real limits, the event horizon is not a natural constant. It is the limit of a theory, its validity restriction, dependent on the mass (energy) behind it and exists actually only if this mass is big enough or shows a corresponding density to produce it actually. However, it is used as a calculation aid, independently of whether it exists, in order to determine the curvatures in space and time outside of it in their effect, which was confirmed in many experiments and in the application with the GPS finally probably eliminated the very last doubts about the validity of the general relativity theory (GRT).
Black holes occurring in reality are as far as we know the most compact, what exists and at the same time the simplest, because they are described only by their mass (energy), their angular momentum and possibly by their charge completely in their effect to the outside and the event horizon is either spherical or if they possess an angular momentum a deformed sphere.
More interesting however is the question, since the approach suggests a singularity, whether it really comes to singularities in the nature or whether nature constants prevent this, thus something like a smallest possible black hole exists.
The further considerations shall show this.

3. Preliminary consideration on the basis of Planck units

Among the constants of nature, there are two that set limits. One is the vacuum speed of light

$$c = 299.792.458 \text{ m/sec},$$

the other one is the Planck's quantum of action

$$h = 6.62607015 \cdot 10^{-34} \text{ kg m}^2\text{/sec}$$

or differently $\hbar = h/2\pi = 1.054571818 \cdot 10^{-34} \text{ kg m}^2\text{/sec}$

The speed of light defines the maximum possible speed of signal transmission in vacuum, Planck's quantum of action the smallest possible orbital angular momentum.
In 1906, Max Planck traced all physical quantities back to natural constants¬ and used, in addition to c and $\hbar$, the gravitational constant (G), the Boltzmann constant (k) and the electric field constant (ε), also called permittivity, and thus established the Planck units. These definitions showed the identity of two forces, namely the gravitational force (F_{GP}) between two Planck masses (m_p) and the Coulomb force (F_{CP}) between two Planck charges (q_p). It is astonishing that the fine structure constant, which was discovered only in 1916 by Arnold Sommerfeld, was not already recognized, which results immediately if one squares the ratio of elementary charge to Planck charge. If one inserts its definition instead of the Planck mass (m_P), one receives a "force" which contains only the two absolute nature constants $\hbar$ and c apart from the radius square, which also occurs with the two other forces and therefore plays no role, and thus defines a kind of boundary force. Now only a ratio factor between elementary charge and Planck charge (q_P) is needed, which one can determine with the help of this boundary force and astonished one will find out, the factor is the fine structure constant.
The subscript "$_P$" always indicates in this work that we are dealing with Planck quantities.
If one puts the fine structure constant reciprocally in front of the electrostatic Coulomb force (F_C), then it turns out, the boundary force is about 137 times as large as the second strongest of all forces known in nature and thus obviously a force boundary because of the natural constants. For this reason it represents the greatest possible elementary force occurring in nature and it shall therefore also bear the name "limit force" (F_L; for limit the index "$_L$" from the Latin "Limes").
But which character has this force?

4. The boundary force

As it results here from the derivation, it is an attractive force. According to Newton's theorem "actio = reactio" there should also be the opposite one, which plays a decisive role.
We pursue this with the following thought experiment.
An energy quantum should move stationary on a circular path with speed of light by an unknown force ($F_?$). So an equivalent force must compensate the unknown force, which is then a centrifugal force.

We set this centrifugal force (F_Z) as energy ($E = h\nu$) of the light quantum divided by the orbital radius and replace "ν" according to $c = \lambda\nu$. Then we get the centrifugal force as $F_Z = hc/\lambda r$. For a stationary orbit, however, the wavelength "λ" must correspond to the orbit circumference (or integer fractions thereof). If the wavelength is reduced by a whole number, this is equal to a multiplication of the frequency, means multiplication of energy and is therefore not of interest in this thought experiment. It follows $\lambda = 2\pi\, r$ and then it shows:

$$F_Z = F_L = F_{GP} = F_{CP} = F_? = \hbar\, c/r^2. \tag{1}$$

This **centrifugal force** is an elementary force because of the reduced Planck constant and a boundary force by the speed of light and has the same distance dependence as the Coulomb force and the Newtonian gravitational force. So it is also a central force and if "r" corresponds to a Planck length it is identical with the magnitude of the Planck force.

The Planck force is defined as: $F_P = c^4/G = 1.210 \cdot 10^{44}$ N
The Planck length as: $l\text{p} = (\hbar\, G / c^3)^{1/2} = 1.616\,255\ldots \cdot 10^{-35}$ m

If one substitutes the Planck length in (1) for "r", then one receives accordingly a nature constant, the Planck force:

$$F_Z(r{=}l\text{p}) = \hbar\, c / (\hbar\, G / c^3) = c^4/G = F_P.$$

5. Boundary force and black holes, the G-boson

At this point we formulate the decisive question:
Can two identical quanta of light keep each other on stable orbits (states) by the gravitational force and inertia inherent in their energy, and if so, what does this state or states look like and what properties do they have?
The centrifugal force acting thereby on both quanta was already formulated as:

$$F_Z = E / r = h\nu / r.$$

The gravitational force between both quanta is formulated according to Newton as:

$$F_G = E^2 / (d^2 c^4) = G (h\nu)^2 / (d^2 c^4)$$

It must be noted that the gravitational force at the distance of d = 2r must compensate the inertial force on the radius r and so it follows:

$$h\nu/r = G (h\nu)^2 / (4 r^2 c^4) \quad (2)$$

which results after "r" transformed:

$$r = G h \nu / (4 c^4) \quad (3)$$

Here, however, becomes important that the light curvature at the sun proved by observation has confirmed the validity of the general relativity theory (GRT) and that after that obviously a twice as large gravitational effect works as with Newton's gravitational law at light speed, thus Newton's gravitational law cannot be applied so. Completely correct would be to determine the gravitation with Einstein's equation of the GRT for this case, which required a difficult computational effort. But with the following consideration a good approximation can be found. The light deflected at the sun is deflected by exactly the factor 2 more strongly than according to Newton and since according to the GRT its orbit is a geodesic, only the effect of the sun plays a role for it, which one also reached, if in Newton's law a twice as large sun mass would be assumed.
But for our model conception, where both energy quanta should be of the same size, then each of them plays this role for the other one and both energies should, if one wants to use Newton's equation, be assumed as apparently twice as large. This leads for (2) and (3) to:

$$h\nu/r = G (2h\nu)^2 / (4 r^2 c^4) \text{ und } r = G h \nu / c^4 \quad (4)$$

A stable state can only emerge if the orbital length is in integer ratio to the wavelength of the quanta, and with the relations $c = \nu\lambda$ and $\lambda = 2\pi r$ this gives for the radius of this state

$$r = G h c / (2 \pi r c^4) \quad \Rightarrow \quad r^2 = G \hbar / c^3 = l_p^{\,2}$$
$$r = l_p$$

and means that obviously only one smallest possible radius comes into question, on which two light quanta, holding each other by their gravitational effect, can orbit each other.
By the stability condition ($\lambda = 2\pi\, r$), the energy of each of the quanta is also determined:

$$E = h\,\nu = h\,c\,/\,\lambda = h\,c\,/\,(2\pi\, l\mathrm{p}\,) = \hbar\,c\,/\,l\mathrm{p}$$
$$= E_P \quad \text{mit} \;\; \hbar\,c\,/\,l\mathrm{p} = \hbar\,c\,/\,(\hbar\,G\,/\,c^3\,)^{1/2} = m_P\,c^2 = E_P$$

E_P is defined as Planck energy. The associated wavelength is $\lambda = 2\,\pi\, l\mathrm{p}$.
This state of the mutually circulating energy quanta appears from the outside like an apparently "resting" mass with a spin of

$$S = 2\,m_P\,c\,r = 2\,m_P\,c\;\; l\mathrm{p} \;= 2\,\hbar$$

and would thus be a boson if the state is stable. Then it would even be a new elementary particle.
The question of stability can be answered with the help of GRT. If the Schwarzschild radius of this state is larger than "r", then it is indeed a stable new particle.
The Schwarzschild radius for a non-rotating uncharged mass is

$$Rs = 2\,G\,2m_P\,/\,c^2 = 4\,(\hbar\,G\,/\,c^3\,)^{1/2} \;= 4\,l\mathrm{p}$$

(In the case of the actual rotation to be considered, it becomes larger, which would reinforce the statement for this question).
It follows for the ratio

$$Rs\,/\,r >= 4.$$

Consequently, this is on the one hand the smallest possible and densest black hole and on the other hand an extremely stable elementary particle which is an uncharged boson of pure energy and which I call G-boson because of its origin and its integer spin (G of gravitation).

6. Properties of the G-boson

What are the properties of the G-boson and what is its behavior with respect to each other, to other energy and finally to baryonic matter?

From the previous explanations, the following properties are directly evident:
Diameter (D) = 2 Planck-lengths
Mass (M) = 2 Planck masses
Total angular momentum (S) = 2 reduced Planck effective quanta, which is perceived as spin.
Energy (E) = 2 Planck energies.

Perhaps its most important property, however, is that there is nothing at the point r = 0 since the matter particle is represented by 2 energy quanta running around each other at r = lp. That means, there is no singularity occurs.

Descriptive size data for it are:
Diameter (D) $= 3.23251 \cdot 10^{-35}$ m
Mass (M) $= 4.35287 \cdot 10^{-8}$ kg $= 2.442 \cdot 10^{19}$ GeV/c²
Total angular momentum (S) = 13.16423914 eVs
Energy (E) = 1.0868 MWh

These data make clear the big difference to particles of the standard model of particle physics (baryonic matter), because their heaviest particle, the top quark, has in comparison only a mass of $1.7276 \cdot 10^{2}$ GeV/c², thus it is lighter by a factor of $1.4135 \cdot 10^{17}$
(interesting: $1.4135^2 = 1.998$; thus by a factor of $2^{1/2} \cdot 10^{17}$).
At the same time the diameter of the G-boson is smaller in relation to the electron by a factor of $0.8717 \cdot 10^{20} \sim 10^{20}$ (related to the classical electron radius).
In this case, it is possible to look behind the event horizon, at least theoretically, but the values also make clear that experimental access to these energy ranges will in all likelihood remain elusive.
It can be concluded further that the Hawking radiation does not apply to G-bosons, because they consist only of 2 light quanta, which cannot leave the Schwarzschild radius.

7. Origin of the G-bosons, the dark matter and energy

The formation or release of the G-bosons can only occur in a single tiny instant of the first phases after the big bang, exactly when the expanding and thus cooling reaches the wavelength of „2 π *l*p“ is reached. This is likely to generate a myriad of such G-bosons almost simultaneously.
The first question is, how do they behave among themselves?
There acts between them only the gravity and since they originate close together and their event horizon is larger than themselves, they will "clump" to a large extent with each other.
For this a short calculation.
Sagittarius-A, the central black hole of our galaxy possesses ~ $4.3 \cdot 10^{6}$ solar masses, is thus ~ $8.6 \cdot 10^{36}$ kg heavy, which corresponds to the mass of $1.98 \cdot 10^{44}$ G-bosons. These would have a volume of ~ $9 \cdot 10^{-55}$ m³, which would be
~ $1.56 \cdot 10^{11}$ times smaller than the classical volume of an electron.
From this estimation one recognizes that the G-bosons can clump to innumerable gigantic black holes which are necessary for the formation of the later galaxies, however the black holes arising from it are based on another formation mechanism than all those black holes which form at the life end of heavy stars from remaining collapsed star remainders.
The second question is, why don't the G-bosons then clump together into a few supergiants instead of many "small" ones and why doesn't the whole thing collapse?
For this not to happen, an energy is essential which is repulsive to the energy from which the G-bosons form. The two kinds of energy have at first nothing in common, than that they repel each other and must be extremely well mixed with each other, what again concludes on simultaneous emergence compellingly.
So one can explain that on the one hand the many galaxies originate and on the other hand also an immense number of smaller black holes remains in them and causes as dark matter the changed gravitational behavior of the galaxies compared with Newton's mechanics and Kepler's laws.
The assumption of a repulsive energy leads to the third question.
Where are the galaxies of this energy form?

For this, central black holes from this "negative" energy were needed, which held such galaxies together. So that such black holes could originate, analogous bosons to the G-boson would be necessary. Let's look at equation (4), which describes the formation mechanism of the G-bosons. There the left expression becomes important, because a form of energy which is repulsive must act like an apparently negative mass according to Newton's law, which looks like negative energy according to Einstein's relation $E = m c^2$. For all light-fast energy quanta, however, their energy is described by $E = h\nu$, so one of the two quantities must also be assumed negative. But then equation (4) does not make sense any more, because it would result in a negative radius. Conclusion is, the repulsive energy cannot form bosons corresponding to the G-bosons, thus no galactic nuclei and also no galaxies of this kind are formed. The repulsive energy remains diffuse and acts only by its gravity: repulsive towards the baryonic and dark matter, but attracting itself. It remains diffuse, no matter whether it cools down and expands or heats up and contracts.

8. What does this mean for the big bang?

If as described above both energy forms originate at the same time to be well mixed, it remains to be clarified whether they originated from the amount in different quantity or in the best case in the same quantity. If the amounts are different, it is difficult to understand from what they have originated, what was before and why it has come to the big bang at all. My biggest objection, however, is that it would have nothing to do with the law of conservation of energy, but this law is supposed to be unrestrictedly valid after the big bang. For this reason I come to the assumption, both kinds of energy have originated not only at the same time, but also in exactly the same quantity, because then the energy theorem would not be violated. Open remains at first, if both kinds released by the big bang were not present shortly before the big bang, where were they. They would have to have "waited" then, compensating themselves completely, in the vacuum for an event triggering the big bang. So, there would have to exist a corresponding vacuum state which did not interact with either species individually in any way. In addition, a reason for the triggering of the big bang must be found.
In the following it shall be tried to solve at least one of these problems.
For the explanation of the vacuum state I don't see any possibility, because it seems to be mathematically just trivial but physically not explicable by the simple connection that the same amount of energy of both kinds at the same

place "extinguishes" each other, thus from each of the two kinds of energy individually practically no longer exists.
Can something be said about the cause of the big bang?
Conceivable is actually only that one of the two kinds of energy was already present before the big bang in certain quantity, because each of the two kinds of energy enables compression for itself and this can lead to a condition which "breaks the vacuum" and disturbs the equilibrium of the compensating both energies and releases equal parts of them.
A compressing "positive" kind of energy (our baryonic and the dark matter) formed at a defined specific degree of compression G-bosons and long before black holes and before that neutron objects. So a process would take place, which we know at the life end of stars, only in other scale and reversed order. Even if this process in the direction of the omega point led to a single gigantic black hole, which could never exceed the energy density of the G-bosons, because G-bosons are not only the smallest possible, but also the densest black holes. Their density, however, is not sufficient for the disturbance of the vacuum, because G-bosons can form only if the big bang (vacuum breakup) has cooled down accordingly, or has expanded. The densest possible state of black holes is that of the G-boson, that is, black holes do not contain singularities.
Conclusion is, positive energy cannot have been the trigger. What of it is present now, originated only with and by the big bang.
It looks differently with the "negative" energy. It remains diffuse, no matter in which compression state. It can exceed the density of the G-bosons arbitrarily. It remains the assumption, it was the trigger of the big bang and must have existed consequently already before it and must have increased by the big bang
and in fact by the amount exactly by the part which was released at "positive" energy. It is obvious to assume the dark energy behind the "negative" energy, because everything what we know about dark energy is congruent, it acts repulsive in the universe, does not clump and there must be more of it than of baryonic and dark matter together.
During the first moment of the big bang the repulsive interaction between normal and dark energy should be stronger than at later times, because at the beginning the above mentioned boundary force (approx. 137 times stronger than the electromagnetic one) is effective, then at some point the areas of the strong nuclear force, the weak force come and finally only the gravity acting on large distances remains. Thus also the inflation occurring immediately after the big bang becomes explicable.

If there are concentration effects in the negative energy by increasing displacement of the other energy (outward, so to speak), this should look to the observable universe as if the amount of negative energy is increasing.

9. Astronomical findings

The following astronomical observational results supporting the previous considerations are available:

- Black holes both from stellar corpses and in giant dimensions in galaxy centers are confirmed. (They are formed in two different ways either by cooling down when reaching the G-boson density or by compressing sufficiently large masses. Their densest possible state is at the G-boson density).
- Also in globular clusters (M87) there are black holes
- The rotation analyses of galaxies prove the existence of a kind of matter, which is not directly observable (dark matter) but contributes to the gravitation
- Interactions of the dark matter to the baryonic could not be proved except in the area of the gravitation.
- The portion of this matter is indicated with approx. 25% of the whole so far, the observable portion amounts to however only approx. 5%.
- Observations show an increasingly accelerated expansion of the universe, which suggests a repulsive type of energy.
- The portion of this kind of energy (dark energy) amounts to approx. 70 % of the whole.
- It is described as diffuse, i.e. not agglutinating.
- The initial phase after the big bang is called inflationary, because it was inferred from investigations of the background radiation as extremely fast.

I could not find any observational results and findings contradicting the deductions and conclusions presented in this paper. I hope for more exact and further leading observation results in the future. Maybe by the recently launched James Webb Space Telescope (also especially to the statements of the macro quantum theory [2)] I hope for measurement results which confirm the interaction of the celestial bodies by the probability densities derived by me).

10. Summary

Black holes have an event horizon no matter how they are formed. To look behind it, remains denied to us. But we can imagine and calculate small black holes, which are limited by natural constants, thus represent the smallest possible. The way to this leads over the idea, under which circumstances light-fast quanta can catch themselves by their own gravity so to speak and hold each other stable in a common state. It shows that there is only one defined possibility for this and this leads to a new very stable elementary particle which represents at the same time the smallest possible black hole, is part of the dark matter and must be counted because of its properties by the integer spin to the bosons, is called G-boson, but has nothing to do with the particles of the standard model.
It interacts with these only about the gravity and therefore because of the big energetic and above all size-wise difference, as good as not at all. It can form only in the extreme energy densities shortly after the big bang and this also only in practically one single moment. The density of the G-bosons formed in this way leads partly by clumping to very large black holes, which form the nuclei of the future galaxies and concentrate smaller black holes formed from G-bosons as well as remaining G-bosons as dark matter there.
So that the large number of galaxies, which have all in the center nuclei in form of black holes (assertion of the author) can originate and not only few oversized formations, a simultaneously originating well mixed repulsive energy form is necessary.

Note: *In the macro-quantum theory [2)] it becomes necessary independently of the model described in this paper also and there by the extension of the main equation of this theory to the special relativity theory. This is done on analogous ways as Dirac, Gordon, Klein and others have done in quantum physics.*

A general validity of the law of conservation of energy of physics assumed by me requires that at the big bang two different forms of energy compensating each other completely beforehand are released in the same quantity.
If one of them shall be the trigger of the big bang, it must not "clump". Thus, the compression towards the omega point in the case of energy from baryonic and dark matter would end in a single black hole, which cannot exceed the density of the G-boson (smallest possible black hole) and thus cannot reach the density necessary for the disturbance of the vacuum, i.e. cannot be the cause of a big bang. The repulsive energy form on the other hand remains diffuse in every state and can contract up to a density disturbing the vacuum. It remains to consider it

as big bang trigger. According to this logic, there must be more of it after the big bang than baryonic and dark matter together. At the same time then our big bang has not been the first one and the now bigger quantity of this energy will compress again sometime and will release a further big bang which will have no influence on our universe (baryonic and dark matter) because our universe is displaced far then. How many big bang events there have been before our big bang and will be after ours is probably indeterminable.

Dresden, January 2022

Source reference:

1) H. Falcke, Licht im Dunkeln, 2020 G. Cotta'sche Buchhandlung
2) https://slub.qucosa.de/landing-page/?tx_dlf[id]=https%3A%2F%2Fslub.qucosa.de%2Fapi%2Fqucosa%253A72389%2Fmets

Used data from Wikipedia

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