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Astronomy

The Black Hole Phase of the Universe

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ABSTRACT. A state of the universe by its average density and possible radius is considered. By a mass assessed on the basis of these parameters, the expectable cases when the universe may occur inside the Schwarzschild's sphere and form the black hole, are calculated. An inner non-stationary nature of the Universe by an example of the evolutionary stages of its existence as the black hole are analyzed, which indicates that a non-stationary nature of the black holes is their usual form of state.

Key words: *universe, gravity radius, Schwarzschild's sphere, black hole.*

It is a logical view that the universe was not created in the time of the Big Bang. It would be logical also to think that the universe had not remained for a long term in the pre-Big Bang state. Moreover, it cannot be disputable too that at the moment of the Big Bang the universe was the black hole and according to Einstein's Relativity Theory [1], its radius R met the condition:

$$R < \frac{2GM}{c^2}. \quad (1)$$

The universe started expansion from this state of the black hole and, by effect of the inner forces, probably, already got out of the boundaries of Schwarzschild's sphere. However, we may assume also that the Universe is still in the state of the black hole, which can be substantiated by assessment of its mass and density.

If the universe turned into the state of the black hole before the Big Bang from a state of a lower density, then, the existence of the force of gravitation that at a certain stage of development had become greater than the forces of internal pull and turned the universe into the condition of suppression, is proved. Thereafter, the forces of internal pull caused the Big Bang and expansion. The forces acting in the micro-universe, as well as the gravitation, form the stages of evolution of the dynamics and structure of the total universe beginning from the Big Bang to the further stages of development passing into the current era. Since we accepted as possible that before the Big Bang the universe had been in the state of a lower density, it can be thought that because of changes of correlations between the forces of gravity and pull, at some stages of the state of the universe the forces of pull dominate, while at other stages – the forces of gravity. Logically, a changeability of these forces should cause pulsation of the universe. In this view and approach, the universe is pulsing.

If we accept that at the moment of the Big Bang the size of the universe was relatively small, then the upper limit of its diameter can be assessed. The upper limit of the current size of the universe should be less than $2ct$, where c is the speed of the light and t is the age of the universe, i.e. the time passed from the moment of the Big Bang to the present day. This condition is met with a higher probability if it is supposed that the universe was the black hole until a certain stage. If the afore-mentioned limited diameter is accepted as the current size of the universe, then it depends on today's average density of the universe whether it is the black hole.

The gravity radius $r_g = \frac{2GM}{c^2}$ increases in proportion to the mass M. So, finally the average density of the universe is a determinant of whether it can be put within the limits of Schwarzschild's sphere (black hole) or not.

According to the contemporary assessments the universe is 13.7x10^9 years old [2]. As we have mentioned above, the radius of the universe cannot be more than 13.7x10^9 light years. If the upper limit of this size is accepted as the radius and the universe considered to be a uniform mass having a spherical symmetry (based on the isotropic nature of the 3K microwave radiation), then its mass can be assessed by the approximate value of its present density. Taking into account the known features of differential rotation of the large-scale objects (galaxies) of the universe, as well as the existence of the inter-galaxy material, elementary particles and the low luminocity objects, the lower limit of the density may increase very much. In such a case, the mass will also increase proportionally, which, in its turn will correspondingly increase the radius of Schwarzschild's sphere for the universe.

In the case of the pulsing universe, the conditions of displacement of which are reviewed in [3], when its size and mass satisfy the condition of the black hole $R \le \frac{2GM}{c^2}$ it must be self-closed and, no information (wave) will be spread outside.

At the moment of the Big Bang the temperature of the universe must have been very high and, such an environment could have been the radiant relevant to the Planck law. However, if at a near stage of the Big Bang the universe was inside the Schwarzschild's sphere, then it could have been impossible for the energy to go beyond this border.

Thus, it turns out that at some stages of development, the pulsing universe satisfied the conditions of the black hole and was a self-closed environment. So, the existence of the black hole is determined by its inner state. The best example of this statement is the universe itself, with its integrity. Therefore, the inner non-stationary nature is a general characterizing feature of the black hole. Proceeding from this, an approach where the black hole is considered as only the space located inside the r_g radius of gravity with its outer border inaccessible both to inner and outer observers, seems to be one-sided. For an outer observer, the duration of the process is endless when approaching the borders of the black hole, while an inner observer will never cross this border.

By using the assessed parameters of the universe and, if we assume that its size cannot be higher than its age multiplied by the speed of spread of light doubled, we may discuss whether the universe is inside of Schwarzschild's sphere or not.

If we assume that the average density of the universe is the same as the average density of the Metagalaxy ρ=8x10^{-27} kg·m^{-3} and its radius R=13.7x10^9 light years, then we shall receive that its mass $M \approx$ 7.3x10^{52}kg. Thus, $R_g \approx$ 11.4x10^9 light year for the values of the constants c = 2.998x10^8 m·sec^{-1} and G = 6.672x10^{-11}m^3·kg^{-1}·sec^{-2}.

If the upper limit of the universe's radius is 13.7x10^9 light years, we can assume that today's radius of the universe must be less than the above value and, the universe should be the black hole because it was the same at the early stage of evolution, no radiation could have spread out of it and, its size could have depended upon the tempo of its expansion, only. The radiation could run ahead of the substance and increase the size of the universe through spreading only when the value of R-radius of the universe exceeded the value of its R_g-radius of gravitation. In the above considered case of the average density of the universe could be 9.8x10^{-27} kg·m^{-3} instead of 8x10^{-27} kg·m^{-3}, then we receive the radius of gravitation of the universe as equal to 14x10^9 light years, that is higher than the radius of today's universe and, it could be the black hole.

Assuming that the universe is a closed mass having a spherical symmetry and meets the condition of Schwarzschild's sphere, i.e. R_g, then its average density will be

$$\rho_g = \frac{3c^6}{32\pi G^3 M^2}. \quad (2)$$

By equalizing ρ_g density with the $\rho_c = \frac{3H^2}{8\pi G}$ critical density [1], we obtain the following dependence for assessment of the mass:

$$M = \frac{c^3}{2GH}$$

where H is the Hubble constant. Applying different values of the Hubble constant in formula (3), masses of the universe respectively will be:

H = 100 km·sec^{-1}·Mpc^{-1} M = 6.2·10^{52}kg
H = 75 km·sec^{-1}·Mpc^{-1} M = 8.3·10^{52}kg
H = 50 km·sec^{-1}·Mpc^{-1} M = 1.2·10^{53}kg

in the case where the universe meets the condition of Schwarzschild's sphere and its density coincides with the critical density.

On the other hand, the universe is 13.7·10^9 years old. Its radius, as we have already indicated above, is $R \le$ 13.7·10^9 light years. Taking into account the critical densities corresponding to the values of the Hubble constant, we shall receive the relevant masses of the universe:

$$H = 100\ \mathrm{km\cdot sec^{-1}\cdot Mpc^{-1}} \quad \rho_c = 1.88\cdot 10^{-26}\ \mathrm{kg\cdot m^{-3}}$$
$$M = 1.7\cdot 10^{53}\ \mathrm{kg}.$$
$$H = 75\ \mathrm{km\cdot sec^{-1}\cdot Mpc^{-1}} \quad \rho_c = 1.06\cdot 10^{-26}\ \mathrm{kg\cdot m^{-3}}$$
$$M = 9.6\cdot 10^{52}\ \mathrm{kg}.$$
$$H = 50\ \mathrm{km\cdot sec^{-1}\cdot Mpc^{-1}} \quad \rho_c = 4.70\cdot 10^{-27}\ \mathrm{kg\cdot m^{-3}}$$
$$M = 4.3\cdot 10^{52}\ \mathrm{kg}.$$

Therefore, for H=71.6 km·sec^{-1}·Mpc^{-1} and M=8.7·10^{52} kg and 13.7·10^{9} years age of the universe and, proceeding from this, for the upper limit of the universe radius 13.7·10^{9} light years, the universe is inside Schwarzschild's sphere, i.e. it can be considered to be the black hole.

Conclusion. Proceeding from a gradual precising of the average density of the universe, the contemporary tendency of its change is directed to an increase, which is an obvious result of development of observational astronomy and physics of the micro-universe. It is impossible to shift this tendency in the opposite direction. Therefore, based on the provided calculations and assessments and a perspective increase of density of the universe, we may state with a higher probability that at present, the universe with its parameters, stands closer to the parameters of Schwarzschild's sphere, i.e. to the state of the black hole.

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ნაშრომში განხილულია სამყაროს მდგომარეობა მისი საშუალო სიმკვრივისა და შესაძლო რადიუსის მიხედვით. ამ პარამეტრების გამოყენებით შეფასებული მასის საფუძველზე გაანგარიშებულია მოსალოდნელი შემთხვევები, როცა სამყარო შვარცშილდის სფეროს შიგნით შეიძლება მოექცეს და შავ ორმოს ქმნიდეს. გაანალიზებულია შავი ორმოების შინაგანი არასტაციონარული ბუნება სამყაროს შავ ორმოდ არსებობის ევოლუციური ეტაპების მაგალითზე, რაც მიანიშნებს შავი ორმოების არასტაციონარულობაზე, როგორც მათი მდგომარეობის ზოგად ფორმაზე.

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