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Can the Universe not be a black hole?

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The statement that our Universe is black hole is argued in the paper. The statement consequences are discussed.

1. Introduction

The standard cosmological model (SCM) supposes that our Universe is specified by flat geometry and (geometrically) open metrics[1]. Particularly, this means that the Universe special volume is not limited, i.e., *infinite*.

Meanwhile, a number of the Universe features leads to the idea that it is a black hole. As I know, the eminent American physicist John Archibald Wheeler was first who came to this idea. Author of the paper **[Smolin, 1994]** informs about it and writes:

> It may then be conjectured that each black hole of our universe leads to such a creation of a new universe and that, correspondingly, the big bang in our past is the result of the formation of a black hole in another universe.

Several authors also consider similar ideas just now[2]. I came to such the concept independently while I developed since 1993 the model of the Universe expansion as the main and unique phenomenon determining the time course. So far I stated that this hypothesis is *admissible* (like SCM and other models). However, just now I *exclude* all the alternative models:

Universe cannot not be a black hole.

2. Why the Universe must be a black hole

Let us start from the physical argumentation. Any material body is specified by *gravitational* radius $R_G=2MG/c^2$ (where M is the body mass, G is the gravity constant, c is velocity of light). *Geometrical* radius R of a (spherical) body is usually much more than R_G; however, it is not the case of a black hole, where $R_G \geq R$.

Furthermore, let us consider the *infinite* Universe having a given (average) density ρ and *infinite* mass. We can select a virtual sphere having a very small radius R. If we increase our sphere radius, we increase its mass M (and its gravitation radius R_G respectively) proportionally to the cube of geometrical radius. Hence, the geometrical radius R is proportional to the *cube root* from the mass M. This dependence non-linearity means that at some critical value (that depends on selected density ρ) the gravitational radius *inevitably* will become more than the sphere geometrical radius (see Fig. 1), i.e., the sphere will collapse to a black hole where the *critical* density $\rho_{cr} \sim (R_G)^{-2}$ will be equal to the given density ρ. Thus, the Universe cannot be infinite due to the inevitable collapse.

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[1] The flat Universe idea is not *immediately* deduced from the observed data, as one often believes. In fact, such the picture is deduced from the SCM with the cosmological constant what can be disputed. This problem is considered in details in my work **[Shulman, 2010]**.

[2] Particularly, in the recent work **[Poplawsky, 2011]** a concrete scenario of the Universe birth from a black hole is considered.

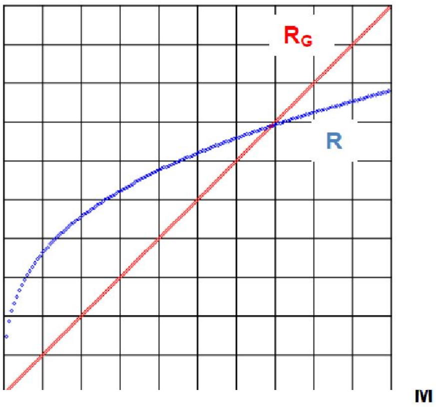

Figure 1.
Gravitational radius (R_G) and geometrical one (R) dependence from mass M
at a given density ρ=const

Let us now consider our Universe that has average density near 10^{-29} g/sm^3. In the tab. 1 you can see the calculation results of the ratio (ρ/ρ_{cr}) which shows different astrophysical object proximity to the collapse state.

Table 1

Ratio (ρ/ρ_{cr}) for different astrophysical objects

Object	Mass M (kg)	Radius R (m)	Gravitational radius R_G (m)	$(\rho/\rho_{cr}) = (R_G/R)^3$
Earth	$6\cdot10^{24}$	$6\cdot10^{6}$	10^{-2}	$\sim 10^{-26}$
Sun	$2\cdot10^{30}$	$7\cdot10^{8}$	$3\cdot10^{3}$	$\sim 10^{-16}$
Milky Way	$3\cdot10^{42}$	$\sim 10^{19}$	$\sim10^{15}$	$\sim 10^{-12}$
Universe	$\sim 10^{53}$	$\sim 10^{26}$	$\sim 10^{26}$	~ 1

It follows from this table that our Universe is in fact in the collapse state.

The *geometrical* argumentation leads to the same conclusion. As I noted above, SCM departs from certain *observed data interpretation* and supposes that expanding Universe is spatially *infinite* and has flat geometry. The typical description of that model is given in the famous book **[Greene, 2004]**, chapter 8:

> "… if the universe is spatially infinite, there was already an infinite spatial expanse at the moment of the big bang... In this setting, the big bang did not take place at one point; instead, the big bang eruption took place everywhere on the infinite expanse. Comparing this to the conventional 'single-dot' beginning, it is as though there were many big bangs, one at each point of the infinite spatial expanse. After the bang(s), space swelled, but its overall size didn't increase since something already infinite can't get any bigger. What did increase are the separations between objects like galaxies (once they formed). "

However, as I believe, the Greene's logics is admissible for any time moment excluding the *initial* one. At this time point all the distances should be equal to *zero*. But it means in a space having the metrics that the Bing Bang happened just in a *single* spatial point, not everywhere.

In spite of such the common model the evolving Universe is usually depicted as having a certain size and closed geometry at each time moment (see typical picture with Universe 2D representation in Fig. 2):

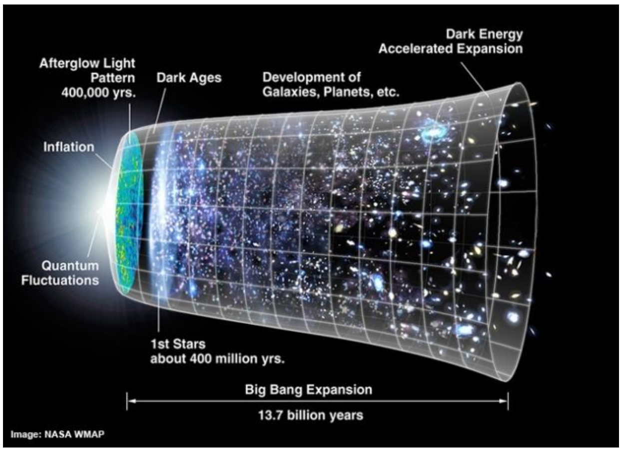

Figure 2. The Universe evolution picture
(Illustration from website http://bccp.lbl.gov/cosmology.html)

Of course, there are many arguments to advance of SCM with non-zero cosmological constant and the Universe flat geometry that are based on the interpretation of the observe data. The work that was made by cosmologists to build this interpretation is great and is worthy of the great respect as well as some kind of a "truth presumption". But not of the naked faith.

To date I analyzed many such the arguments and (as I believe) showed that the alternative cosmological model gives the more satisfactory predictions than SCM (see **[Shulman, 2006 – 2011]** and the other authors works that appear regularly in the ArXiv). The more, the time course phenomenon itself can be naturally explained by the irreversible black hole expansion.

3. Universe evolution and thermodynamics

SCM supposes that our Universe is:

- *geometrically open*, i.e., it has flat metrics (zero curvature radius) and infinite volume;
- *thermodynamically isolated*, i.e., does not exchange energy or matter with some environment; hence, the energy and matter conservation law should be valid in it.

In the previous Section we argued that our Universe must be a *black hole*, i.e., it is *geometrically* closed, has a positive curvature and finite volume. But a black hole also cannot be *thermodynamically* isolated since it absorbs energy and matter from outside and irreversibly expands just due to that process.

The Universe isolated model leads to a number of difficulties when one tries to explain the real observed picture (particularly, the general equilibrium absence). Because of that the modern cosmology refers to the General Relativity were the whole World has to be considered as a system in alternative gravitation field (not as isolated one) for which the Second Law of thermodynamics may do not be accomplished (**[Landau and Lifshitz, 1976]**).

The Universe "black hole" model concretizes this thesis in a sense. On the one hand, energy comes from external environment. On the other hand, in our Universe the supermassive black holes in the center of galaxies exist that can be considered as power energy absorbers[3]. Thus, the Universe turns out to be the open thermodynamic system.

There are the reasons to believe that the input entropy flow is *less* than the output one. Due to that the Universe entropy *decreases*, not increases. Just due to that a continuous differentiation of the Universe structure happens during 14 billion years of its evolution (см. **[Shulman, 2009]**).

Acknowledgments

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[3] These supermassive black holes bring a dominant contribution into the Universe total entropy. As it is shown in the paper **[Egan and Lineweaver, 2009]**, this contribution is 20 orders more than the rest of the Universe entropy. The event horizon absolute temperature of these black holes is practically equal to zero (knowingly less than 2.72 K).