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On Our Peculiar Black Hole Universe

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Abstract

The black hole model of the Universe evolution, accompanied by matter creation, already successfully accounting for many features of the past is discussed and further justified. It is once more stressed that even a very large object but with a big mass is in its own right a black hole. As a consequence, the extrapolation of the past predicts for the future no big crunch, nor big bounce but a steady expansion with smaller matter density.

Keywords

Universe Expansion, Black Hole Model, Matter Creation, Gravitational Self Energy

1. Introduction

The inadequacy of the GR Friedman equations [1] for the description of the Universe evolution has to be attributed to the fact that in the one for the acceleration, the potential, due to the Hubble expansion, is not a state function [2]. Thus in its derivative another term enters in addition to the usual Newtonian one and the corresponding mass variation (matter non conservation) produces a totally different scenario corresponding to a black hole one (b.h.).

This description of the Universe evolution as a gigantic and evolving black hole, which successfully combines gravitation and QM, in spite of its successes (prediction of the time dependent Universe age [3], inertial forces and gravitational radiation, causality [4], and the relevance to the problem of the existence of dark energy and of the cosmological constant), has encountered many criticisms which can be summarized by the following referee's report "the universe and black holes are fundamentally different, and one should explain why the universe is expanding from the viewpoint of a black hole." Indeed one is traditionally attached to the picture of a small very dense object, eventually shrinking, and one can view the numerical agreement of the model with present data at most as a mere coincidence.

The aim of the present work is to argue that this is not so.

Starting from the "elementary" observation by Feynman [5] many people [6]-[14] have tried to elucidate the problem about what is known and what not about black holes. However with different degrees of sophistication (adding rotation for instance) they remain essentially attached to General Relativity whose basic assumption *i.e.* "matter conservation" has been disproved [3] mainly because of the obvious time dependence of the Universe age.

We therefore proceed with very simple arguments to the justification of **this unconventional black hole of a big mass in a large volume obeying however the same relation** $M/R = c^2/G$ **of a conventional tiny and very dense one.**

2. Discussion

The basic relation, backed up **at present** by "data" [15] ($M \simeq 10^{80} m_N$, $R \simeq 10^{26}$ m) is as well known

$$Mc^2 = \frac{GM^2}{R} \tag{1}$$

or

$$\varepsilon = \frac{GM}{c^2 R} = 1 \tag{2}$$

When taken to describe the Universe evolution, *i.e.* as an equation, down to the *Planck epoch* (*whose quantities represents the smallest quantum b.h.*, *where contrary to a wide spread opinion QM and gravitation successfully combine*) **this equation is not stable.** In fact this condition which essentially corresponds to energy conservation does not correspond to a minimum in energy. Indeed if we allow a perturbation in R at the Planck era

$$R \to R + dR$$

we cannot have shrinking with a radius smaller than the Planck one and a bigger one naturally entails a correspondingly increase in the mass.

The same argument also holds true also for later times even if a smaller radius cannot be discarded in principle. However the same observation remains valid: no restoring force!

Consider indeed the radiation dominated era where the mass is given by [2]

$$M \simeq (kT)^4 R^3 \tag{3}$$

Of course in principle both possibilities exist *i.e.* increase and decrease in R with constant $M/R \simeq (kT)^4 R^2$. In the first case M/R remains constant at the price of a decreasing temperature ($(KT)^2 \simeq 1/R$) which is what is actually observed. In the second case the opposite should happen in contrast to actuality.

The possibility of perturbing to a smaller radius (at constant mass) would result in energy violation since the negative self energy would overcompensate the mass. In other words again only a bigger radius is possible (smaller self energy) and mass creation is demanded to restore energy balance.

In the case of the matter dominated era even if photons are a very small fraction of nucleons the above argument remains true. A contraction would decrease the photon wavelength (anti CMB) and this implies that also for nucleons expansion is the only possibility. Thus the particle mass content simply increases.

Therefore expansion in the radiation dominated era would correspond, loosely speaking, to the Boltzmann thermal death whereas in the matter dominated era (where **nucleons are non relativistic**) the negative heat capacity would allow the birth of structures.

In the b.h. model where ε must be constant in time as proved in Ref. [4] the mass variation required by Equation (2) has therefore another fundamental effect in the equations of motion

$$d\varepsilon = 0 = -\frac{GM}{R^2} + \frac{GdM}{RdR} \tag{4}$$

where the first term represents the well known Newtonian acceleration counterbalanced by the second one, due to mass variation. So **self energy is seen to provide the repulsive force since it increases the total energy when particles move away and thus demands matter creation. This is the missing dark energy at present represented by the cosmological constant.**

Consider now the density given in the b.h. model by

$$\rho_{b.h.} = \frac{3}{4\pi G}\frac{c^2}{r^2} \tag{5}$$

which, in line with the previous arguments, reads

$$\rho_{b.h.} = \frac{3H^2}{4\pi G}$$

This has to be compared with the critical density of the standard GR treatment in flat space

$$\rho_{cr} = \frac{3H^2}{8\pi G} \tag{6}$$

$$\rho_{b.h.} = 2\rho_{cr} \tag{7}$$

This represents probably a rather unexpected result in the sense, first, that it seems to suggest that a sort of black hole description is contained also in a particular GR formulation, but with a numerical difference. This point can be understood by remembering that (probably inspired by a non relativistic origin) H^2 appears in GR with the coefficient 1/2 and that in the given case (without the cosmological constant) also GR describes the same situation of the black hole model *i.e.* indefinite expansion consistent with energy conservation determined only by the density. Of course the difference between the two theories lies in the acceleration equation where the mass variation, necessary to account mainly for the time dependent age of the Universe provides the repulsive agent. The doubled ρ has implications for the amount of the presumed dark energy in that it proves how this quantity be model dependent.

In the b.h. model there is no such critical density. The given one, smaller than the GR's, is just of the right amount predicted by the model and the expansion, accompanied by matter creation and density decrease in time, happens independent of the Universe curvature. That must have evolved becoming flatter and flatter from the Planck radius to the present one ($1/R_c^2 \simeq G\rho/c^2$, R_C standing for the curvature radius) *i.e.* a Universe in the matter era essentially flat. A totally different scenario than the GR one, which in connection with curvature probably suffers from being an essentially static, matter conserving, one. This also determines the fate of the Universe: no big crunch, nor big bounce but a density decrease which might anyway foresee the possibility of structure formation due to the negative heat capacity of gravitation.

So an innocent looking, unassuming relation turns out to produce two equations which reproduce and correct the cherished GR ones in the Friedman's metric without the epicycle add-ons criticized by Perlmutter [16].

3. Conclusion

An elementary argument has been presented to show that in the black hole model, the Universe is not stable and expands according to the arrow of time accompanied by mass creation.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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