

## The Big Bang Reconsidered

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### Abstract

Though recent observations made by the James Webb Space Telescope suggest a reformulation of what is called the "Big Bang." Here, we offer a detailed interpretation that incorporates the hypothesis of the universe's rebound as envisioned by Roger Penrose. This hypothesis presents three major advantages: the conservation of energy, the elimination of infinities, and the non-necessity of the inflation hypothesis. We provide numerical data to support this new conception

### 1. Introduction

The Big Bang theory of Alexander Friedmann and Georges Lemaître remains the cornerstone of the Standard Model of Cosmology. Analysis of the CMB by the Planck satellite has confirmed it by specifying certain key values for the expansion (age of the universe, Hubble constant) and also by defining its composition in matter and energy [1]. Nevertheless, unknowns remain regarding the parameters of the early universe and its future (endless expansion or contraction). General Relativity links this future to a critical value for its energy density; this is one of the fundamental concepts to consider. Furthermore, the conception of a granular spacetime, identical to a quantum fluid, has allowed us to propose a curve for the evolution of its dimension with respect to time as well as the various parameters to be taken into account [2].

#### 1.1. From a Hyper Cold Matter (A) to a Hyper Hot Plasma (B)

This involves identifying the Big Bang with an explosive, highly exothermic and endoentropic reaction, effecting a radical phase change from A to B. This reaction must preserve the whole energy of the Universe (E) between the different forms linked to the composition of the hot plasma (B). It must be totally irreversible and unique. What could be this cold matter (A) preceding the explosion be?

#### 1.2. Period of Contraction of the Universe

We saw that the consumption of energy from the ground state by the masses necessitates a final period of contraction of the Universe. This contraction must be accompanied by the collapse of all stars into black holes or, temporarily, into white dwarfs and neutron stars [2]. Then, the disappearance of this level, which is counter-gravitational, allows galaxies composed essentially of "solar"-type black holes to approach each other, to a distance that could lead to

their global merger throughout the contracted Universe.

#### 1.3. Size and Density of the Contracted Universe

We can consider that in the final stage, we will have a collection of contiguous solar black holes, which gives us an idea of the size of the whole system as well as the energy density. We know the order of magnitude of the total number of stars that will collapse into black holes ( $10^{22}$ ); their masses will be close to  $2 \times 10^{31}$  kg and their radius (event horizon) close to 10 km, which leads to a contracted universe of approximately  $4 \times 10^8$  km in diameter (close to that of Earth's orbit) and a density close to  $5 \times 10^{18}$  kg/m<sup>3</sup>.

### 2. The (A→B) Reaction (Big Bang)

Let's examine the main parameters of this reaction:

-Conservation of the universe's energy E. This accepted principle has an implication: the conservation of the product TS, which is equal to it, where T is the temperature and S is the entropy, i.e.,  $T_A S_A = T_B S_B = E$ .

Conservation of the initial nucleus's volume, which implies the conservation of energy density during the very short lifetime of the hot plasma (approximately 1 s), which will expand at a speed on the order of the speed of light.

This reaction can also be seen as a phase transformation from a very dense and very cold solid medium to a very hot gaseous or liquid plasma medium, which will expand adiabatically. The enormous heat released by the reaction corresponds to the whole energy (E), and the entropy value drops dramatically.

The work of Stephen Hawking (and all) made it possible to establish the main characteristics of black holes, namely temperature and

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entropy, using the formulas [3].

$T = \frac{h c^3}{16 \pi^2 k G M}$  and  $S = \frac{\pi k a c^3}{2h G}$ , where  $k$  is the Boltzmann constant,  $a$  is the area of the event horizon,  $G$  is the gravitational constant, and  $M$  is the mass of the black hole.

The numerical application, for a black hole with a mass 10 times that of the Sun (\*), gives  $SA = 10^{78} \text{ J/}^\circ\text{K}$  and a temperature close to  $T = 10^{-30} \text{ }^\circ\text{K}$ . If we consider that the "crunched" universe (state A) is made up of black holes of this type in a number equal to that of the stars that once occupied it (approximately  $10^{22}$ ), we find  $SA TA = 10^{70} \text{ J}$ . Here, we have used the additivity property of entropy ( $SA = 10^{78} \times 10^{22} = 10^{100} \text{ J/}^\circ\text{K}$ ). This consideration of state A also reveals the inability of black holes to exist collectively in the absence of the fundamental medium, which can be likened to "dark energy."

Let us now consider state B, which is considered to be the Quark-Gluon plasma. This plasma has been the subject of much research, well documented on Wikipedia as scientists agree on its presence in the very first moments of the Universe ( $10^{-6} \text{ s}$ ). At the end of its lifetime (1 s), it would precede the birth of the first nucleons at a temperature close to  $T = 10^{10} \text{ K}$  [4].

The phase transition of this plasma (around  $10^{-6} \text{ s}$ ) occurs at an energy density of 3 GeV/femtometer<sup>3</sup>, or  $d = 4.8 \times 10^{35} \text{ J/m}^3$ .

The estimated temperature of the plasma is then close to **TB =  $10^{12} \text{ K}$** .

It is remarkable to note that this energy density is consistent with the total energy value  $E = 10^{70} \text{ J}$ , via the volume of the contracted universe, which we believe is also that of the initial quark-gluon plasma (see previous paragraphs). This allows us to calculate

$SB = E/TB = 10^{58} \text{ J/}^\circ\text{K}$  ( $10^{42}$  times lower than SA!), and we also have  $TB SB = TA SA = E = 10^{70} \text{ J}$ . These results support the identification of the quark-gluon plasma with what the Universe

was like one microsecond after the Big Bang.

It is difficult to imagine that the "primeval atom" could have a diameter similar to that of Earth's orbit! However, this result eliminates the need for "inflation" since it must correspond to its closing value (...).

### 3. Conclusion

Here, we have complemented the cyclic universe model with a description of the Big Bang, which appears to be the large-scale, unconfined inverse reaction of the plasma collapse into a black hole; a reaction that occurs in some stars at the end of their lives [3]. This has led us to refine the value of the total energy of the Universe ( **$E = 10^{70} \text{ J}$** ), an energy that is conserved throughout its complete evolution [4,5]. This result also confirms its initial composition (Quark-Gluon plasma) and allows us to eliminate the hypothesis of inflation, which appears very "strange", from physics standpoint.

It also demonstrates the existence of a critical energy density, regardless of its form (approximately  **$5 \cdot 10^{35} \text{ J/m}^3$** ); remarkably, this density also corresponds to the internal density of the nucleon, which is consistent with the fact that initial energy transformations can occur at constant energy density.

### References

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3. Wikipedia pages: "Black hole entropy" and "Hawking Temperature".
4. Wikipedia page: "Quark-Gluon Plasma."
5. Wikipedia page: "Cosmological Microwave Beam."

(\*) Medium mass estimated of Star Black holes, after all fundamental medium consumption and before their fusion.

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