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On the Uncertainty Relations That Would Be Used in the New Description of the Big Bang According to the Hypothesis of Primary Particles

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Abstract

In this paper, we have determined the structure of the uncertainty relations obtained on the basis of the dimensions that describe the very origin of the Big Bang—in accordance with our Hypothesis of Primary Particles, and with the logically introduced, smallest increment of speed that can exist, the "speed quantum". This approach allowed us to theoretically move the margin for the description of this singularity to values smaller than the Planck time and the Planck length; hence, we also introduced a new constant in the uncertainty relations, which corresponds to the reduced Planck constant. We expect that such a result for the initial singularity itself will enable a more detailed study of the Big Bang, while opening new areas of study in physics.

Keywords

Flat Space and Time, Quantum of Speed, Reduced Planck's Constant, Spherically Symmetric Case

1. Introduction

According to our three previous papers, we have determined the physical quantities that could describe the very moment of the Big Bang.

In the hypothesis [1], in which we postulated the existence of primary particles able to move at a speed greater than that of light in a vacuum in their own flat space and time, we concluded that these particles would possess somewhat symmetrical properties to the properties of the particles in our universe. Thus, the energy and the momentum of primary particles would increase immensely during deceleration due to mutual collisions, as opposed to the increase in energy and the momentum of particles in our universe that occurs when their speed increases. Considering the described dynamic properties of these particles, we deduced that a possibility existed of describing the origin of the Big Bang. Therefore, while decelerating one of these two particles to a speed just slightly greater than the border speed *c*, due to such a collision, the energy and the momentum thus acquired would tunnel through the Big Bang into our universe, resulting in the creation of our energy and matter in our own space and time.

The key value for the speed, just slightly greater than the border speed *c*, to which a primary particle should be decelerated in order to initiate the Big Bang, we took from [2], where we saw a logically introduced new term in physics, the "speed quantum" $\varepsilon = \varepsilon_v = \varepsilon_u \approx 2.38\times10^{-114}\ \text{m}\cdot\text{s}^{-1}$. This term allows us to understand that only a slight difference exists between the actual speed of light in a vacuum and the border speed *c*. For most purposes, the extremely small difference between these two speeds is not important, but this "speed quantum" was essential to us, enabling us to determine the energy of the primary particle in its basic, dynamic state $E_p = m_p c^2 \approx 1.22\times10^{19}\ \text{GeV}$, in [3], and the mass of the primary particle attributed to that energy

$m_p = m_P = \sqrt{\frac{\hbar c}{G}} \approx 1.22\times10^{19}\ \text{GeV}/c^2 \approx 2.18\times10^{-8}\ \text{kg}$, which is equal to the Planck mass m_P. From [2] we also took the data on the total energy generated during the Big Bang $E_t = E_U = m_U c^2 \approx 1.55\times10^{70}\ \text{J}$, accurately corresponding to our hypothesis [3], according to which the value is $E_t = E_U = \frac{m_p c^2}{\sqrt{1-\frac{c^2}{(c+\varepsilon_u)^2}}}$. This energy corresponds to the energy equivalent of the total mass of the universe $m_U \approx 1.73\times10^{53}\ \text{kg}$ including all types of mass (baryonic and dark matter) as well as the mass contained in all types of energy (photons, dark matter, etc.).

Thereafter, in [4] we described the Big Bang quantitatively. The physical quantities that describe the very moment of the Big Bang are the following:

The intensity of the force released at the moment of the Big Bang

$$F_B \approx 5.44\times10^{174}\ \text{N}, \tag{1}$$

The duration of the Big Bang itself

$$t_B \approx 9.51\times10^{-114}\ \text{s}, \tag{2}$$

and the radius within which the Big Bang itself occurred

$$r_B \approx 2.85\times10^{-105}\ \text{m}. \tag{3}$$

Graphic Representation of the Primary Particle Energy Tunnelling through the Big Bang at the Moment of Creation of the Universe

See **Figure 1**.

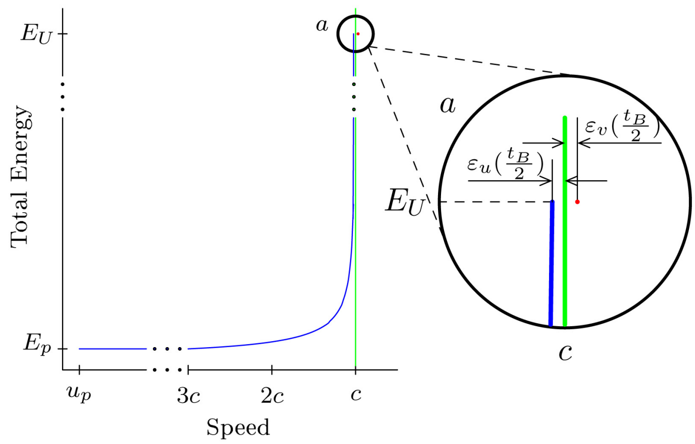

Figure 1. The image depicts how, by decreasing the speed of the primary particle u_p, which it had in its ground state and at which it has energy E_p, (blue curve), to a speed ε_u greater than the border speed *c*, at which it has energy E_U, the Big Bang occurs in area *a*. This area can also be seen magnified. Following the tunnelling of the primary particle energy, our space and time are created with energy E_U (red dot), during which the first moment of time in our universe $t_B/2$ passes. The border speed *c* is represented by the green line.

2. Modified Uncertainty Relations Correspond to the Big Bang

The intensity of the force released at the moment of the Big Bang (1) was obtained in [4], in two ways simultaneously—via the momentum, and via the energy reached by the primary particle at the moment of the Big Bang.

It is evident that in this particular spherically symmetric instance, the product of the indeterminacy of the particle's momentum and its position equals:

$$\Delta p \Delta l = F_B \mathrm{d}t\mathrm{d}l = F_B \frac{t_B}{2} r_B = 7.38\times10^{-44}\ \mathrm{J\cdot s}. \tag{4}$$

Correspondingly, in the case of the Big Bang, the product of the uncertainty of energy and time equals:

$$\Delta E \Delta t = E_U \frac{t_B}{2} = 7.38\times10^{-44}\ \mathrm{J\cdot s}, \tag{5}$$

where E_U represents the energy of the primary particle tunnelled through the Big Bang into our universe, during the first moment of time $t_B/2$.

Thence, as expected, relations (4) and (5) produce the same result, which coincides with Dirac's relativistic quantum mechanics [5], in which he provided a precise and well-defined derivation that treats time symmetrically with the other coordinates.

At first glance, the small value in (4) and (5) with regards to the reduced Planck constant is unusual.

We know that for observables represented by the operators $\hat{\boldsymbol{A}}$ and $\hat{\boldsymbol{B}}$ the relation that associates their uncertainties $\hat{\boldsymbol{A}}$ and $\hat{\boldsymbol{B}}$ in a given state of the system:

$$\Delta \boldsymbol{A} \Delta \boldsymbol{B} \geq \frac{1}{2}\left|\left\langle\left[\hat{\boldsymbol{A}}, \hat{\boldsymbol{B}}\right]\right\rangle\right|, \tag{6}$$

where $\langle\,\rangle$ designates the expected value in the given state. This position is mathematical in nature, and shows that uncertainty relations are inherent to the structure of quantum mechanics. We can also recognize that the observables whose operators commute can be simultaneously measured with arbitrary precision.

Therefore, regarding the uncertainty relations that describe the immediate moment of the Big Bang instead of the reduced Planck's constant which arises from the mutual relations of physical quantities, as a result of this new description of the Big Bang by means of the Hypothesis of Primary Particles, in which the newly introduced notion of speed quantum from [2], has been incorporated, we would get a different value of the constant which is

$$\upsilon_p = 1.48 \times 10^{-43}\ \mathrm{J \cdot s}. \tag{7}$$

Thus, the uncertainty relations in this relativistic case, considering the initial singularity itself, according to the Hypothesis of Primary Particles would be:

$$\Delta p \Delta l \geq \frac{\upsilon_p}{2} \tag{8}$$

and

$$\Delta E \Delta t \geq \frac{\upsilon_p}{2}. \tag{9}$$

3. Results and Discussion

In the previous series of three papers, based on the Hypothesis of Primary Particles, we quantitatively determined the important physical values that describe the immediate moment of the Big Bang. In this instance, we have shown that using the values for the intensity of the force released at the moment of the Big Bang, the time during which it occurred and its radius, it is possible to obtain identical values for the product of the uncertainty of momentum and position, corresponding to the product of the uncertainty of energy and time in this spherically symmetric case.

Given that the Big Bang itself occurred in an extremely narrow margin relative to the border speed c, we receive an additional confirmation by considering this problem through Dirac's relativistic quantum mechanics, in which time is observed symmetrically with the other coordinates. However, regarding the uncertainty relations, a new constant has been introduced instead of the reduced Planck constant $\upsilon_p = 1.48 \times 10^{-43}\ \mathrm{J \cdot s}$. This discrepancy is due to the fact that the reduced Planck constant was derived from the mutual relation of physical constants, while this new constant was additionally shaped by the freshly introduced speed quantum $\varepsilon \approx 2.38 \times 10^{-114}\ \mathrm{m \cdot s^{-1}}$, which we have used to quantify our hypothesis.

Evidently, observed through the constant υ_p and the speed quantum ε, this new perspective for theoretical work on our hypothesis, the explanation of the origin of the Big Bang, also becomes valid. Undoubtedly, this new quantization would open up new horizons in physics as well.

Conflicts of Interest

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

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