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Why the Initial Infinite Singularity of the Universe Is Not There

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Abstract We "explain", using a Classical approach, how the Universe was created out of "nothing", i.e., with no input of initial energy. This is a Universe with no-initial infinite singularity of energy density.

Keywords Cosmology · Einstein · Universe · Singularity · Energy · Density

1 Introduction

We shall show that in the creation instant of the Universe, the so-called initial infinite energy density singularity does not exist. In order to prove that, we take into consideration Robertson-Walker's metric, and find its associated energy. The reason why the Universe began its existence, while obeying this metric, and Einstein's field equations, lies in [4] hypothesis, that General Relativity theory, though not valid for making exact calculations inside Planck's Universe, for times less than 10^{-43} s, due to existence of Quantum uncertainties, reveals the average magnitudes of the otherwise uncertain physical values.

2 Zero-Total Energy of the Universe

Consider Minkowski's metric,

$$ds^2 = dt^2 - [dx^2 + dy^2 + dz^2] \tag{2.1}$$

This is an empty Universe, except for test particles. We agree that its total energy is zero [8].

Now consider the expanding flat metric:

$$ds^2 = dt^2 - R^2(t)[dx^2 + dy^2 + dz^2] \tag{2.2}$$

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Here, $R(t)$ is the scale-factor. At any particular instant of time, $t = t_0$, we may define new variables, by the reparametrization,

$$dx'^2 \equiv R^2(t_0)\, dx^2 \tag{2.3}$$

$$dy'^2 \equiv R^2(t_0)\, dy^2 \tag{2.4}$$

$$dz'^2 \equiv R^2(t_0)\, dz^2 \tag{2.5}$$

$$dt'^2 \equiv dt^2$$

Then,

$$ds^2 = dt'^2 - [dx'^2 + dy'^2 + dz'^2] \tag{2.6}$$

The energy of this Universe is the same as Minkowski's one, namely, $E = 0$. We remember that in energy calculations, the instant of time is fixed.

Consider now the metric:

$$ds^2 = dt^2 - \frac{R^2(t)}{[1 + \frac{kr^2}{4}]^2}[dx^2 + dy^2 + dz^2] \tag{2.7}$$

Here, $k = 0$ yields the flat case, already studied. When $k = \pm 1$, we have finite closed or infinite open Universes.

We want to calculate its energy. We are allowed to choose the way into making the calculation, so we choose a fixed value $\bar{r}$ of the radial coordinate, for which we reparametrize the metric:

$$dx'^{i\,2} \equiv \frac{R^2(t_0)\, dx^{i2}}{[1 + k\frac{\bar{r}^2}{4}]^2} \quad (i = 1, 2, 3) \tag{2.8}$$

For this value of $r = \bar{r}$, the reparametrized metric has zero energy value, by the same token as above. Now we sum for all other values of r, obtaining an infinite sum of zeros, which yields a total energy of zero value.

3 Singularity-Free Universe

Now, we can check the creation instant, where $t \to 0$. Consider that, from Einstein's field equations, we have found a scale-factor that obeys the condition,

$$\lim_{t \to 0} R(t) = 0. \tag{3.1}$$

On the other hand, we are going to calculate the energy density, which is usually defined as,

$$\rho = \frac{E}{V}. \tag{3.2}$$

From energy conservation, the fact that $E = 0$ is an independent of time result. In the above equation, V stands for tri-dimensional volume,

$$V = \frac{4}{3}\pi R^3. \tag{3.3}$$

The so-called initial infinite singularity is in fact, from what we have calculated above, a kind of indeterminated relation of the type $\frac{0}{0}$, when $t = 0$. However, there is a theorem about limits, that says that when the limit to the left is equal to the limit to the right, the limit is equal to that result. In other words,

$$\lim_{t\to 0^-} \rho(t) = \lim_{t\to 0^+} \rho(t) = \lim_{t\to 0} \rho(t) = 0. \tag{3.4}$$

(The first two left-hand side terms in the multiple equality, are zero because they result from the fraction $\frac{O}{V} = 0$, because V^- and V^+ are $\neq 0$.)

The reason for a zero-total energy density, lies in the fact that the positive energies, which are constituted by the sum of visible and dark matter, radiation, cosmological "constant" (dark energy) and other fields, must be added by an equal amount of (negative) potential energy density.

It is now evident that we have no infinite singularity at the origin of time.

4 Conclusions

The above original result, seems not to have been considered by any author. We obtained, from Robertson-Walker's metric, a scale-factor that begins from zero-value at the initial time, while we showed that the initial energy and energy density, are equally zero.

The basis of our calculation has been the zero-total energy of the Robertson-Walker's Universe. It can be checked that pseudo-tensor calculations yield the same result for the total energy [1–3]. Other author calculations of the energy run similarly [5, 6]. Inflationary cosmology also recovers a zero-total energy of the Universe [7].

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