Calculation of the Density of Vacuum Matter, the Speed of Time and the Space Dimension

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An example of calculating the density of vacuum matter is presented based on the hypothesis of fractional dimension of our space. The speed of time and the dimension of our space are calculated.

Introduction

In the previous paper [1], we showed the hypothesis that the reduced density of space energy is constant:

$$d_t\, c_t^{r-1} = const, \tag{1}$$

where d_t is the density of matter (substance) at a given point in the space; c_t is the speed of light (proportional to the speed of time) at the given point in the space; r is the dimension of the space at the given point.

The previous analysis of this hypothesis showed that this formula exactly coincides with the topological thickness of the space with a non-integer dimension value, i.e.,

$$M = X\,Y\,Z^{r-2}, \tag{2}$$

where X, Y, Z are equivalent sets. Their permutations do not change the result of their Cartesian product.

Calculation of the numerical value of r can be performed based on the definition of fractional dimension, as a property of self-similar objects (fractional dimension is a dimension in the form of a fraction, for example, 23900/10000).

In our case, self-similar objects are convex bodies in n-dimensional spaces, for example, in the three-dimensional Euclidean space.

We will use a volume relative increase as an increment that provides fractional dimension (non-integer dimension). This is due to the alleged expansion of space, which is determined by the Hubble constant*.

When moving at a measured distance in seconds, assuming that the speed of light in vacuum is constant, we obtain the value of the Hubble constant in units of acceleration:

$$H_a = H\,c_v = \frac{(55 \div 75)\times 10^3 \times 3\times 10^8}{3.086\times 10^{22}} = \\ = (5.35 \div 7.29)\times 10^{-10}\ \text{m/s}^2, \tag{3}$$

where c_v is the speed of light in vacuum.

Let us take a ball with a single radius equal to 1 second, i.e. 3×10^8 m as a basis for calculating the initial volume of a convex body. Further we will call the radius as a unit length.

*The Hubble constant is defined currently within $H = 55 \div 75$ km/(s Megaparsec).

As a time interval for comparison, we will select the time of transmission of a signal at a distance of the unit length, i.e. the time of 1 s.

As an increment, we will determine the increment of the initial volume v_1 during the passage of the signal at a distance of the unit length, see Fig. 1.

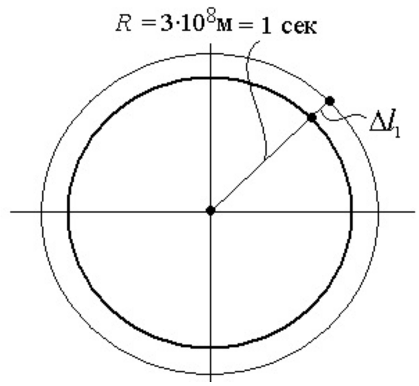

Fig. 1: A ball with a radius of a unit length.

In this case, the increment of the unit length is equal to:

$$\Delta l_1 = \frac{\int_1^2 H_a t\,dt}{c_v} = \frac{1.5 H_a}{c_v} = \frac{1.5\times(5.35 \div 7.29)\times 10^{-10}}{3\times 10^8} = \\ = (2.68 \div 3.65)\times 10^{-18}\ \text{s}. \tag{4}$$

The relative increment is the ratio of the increment to the finite length:

$$\Delta r_1 = \frac{\Delta l_1}{1+\Delta l_1} \simeq (2.68 \div 3.65)\times 10^{-18}. \tag{5}$$

The relative increment of the initial volume v_1 is equal to:

$$\Delta v_1 \simeq 3\Delta r_1 = (8.04 \div 10.95)\times 10^{-18} \simeq 10^{-17}. \tag{6}$$

When the numerical value of r equals 3, the dimension of the constant in formula (1) is equal to

$$\frac{[\text{kg}][\text{m}]^2}{[\text{m}]^3[\text{s}]^2} = \frac{[\text{kg}]}{[\text{m}][\text{s}]^2}$$

or $L^{-1}MT^{-2}$, i.e. Pascal.

Hence, this can be interpreted as the modulus of the volume compression/expansion of the three-dimensional space.

In case when $3 > r > 2$, we will refer to the reviewed constant to as the module of the extension of a non-integer dimension space.

Then the formula (1) can be represented in the form of:

$$d_t\, c_t^{r-1} = M_r\,, \tag{7}$$

where M_r is the module of the expansion of the space of non-integer dimension, taken in Pascals.

Calculation of the density of vacuum matter

Using the ratio (7), we can calculate the density of vacuum matter. With this, it is possible to accept in first approximation the vacuum density inside material bodies as that equal to the density of their substance.

Let is take the following approximations: the space dimension is constant, i.e. $r = const$, and is $r \simeq 3$; the effects of light dispersion are not taken into account.

Formula (1) contains three interrelated parameters: density, the speed of light and the space dimension. Consider the relationship between the speed of light and the matter density in detail. The table data of the refractive index (optical density) and the density of precious stones are shown in Fig. 2.

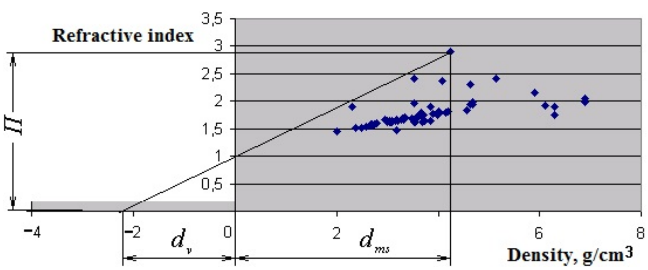

Fig. 2: The precious stones density.

Analysis of Fig. 2 allows us to suggest that the refractive index is linearly dependent on the matter density. Hence, we obtain the formula of the vacuum matter density outside material bodies:

$$d_v = \frac{d_{ms}}{\Pi - 1}\,, \tag{8}$$

where d_{ms} is the density of substance, $\Pi = c_v/c_{ms}$ is the refractive index, c_{ms} is the speed of light in the substance.

Here are the tabular data of the stones, used in jewelry industry. The data give the minimum of the calculated density of vacuum for diamonds and synthetic rutile (see Table for detail).

In the above calculations, we used the average density of substance. However, under real conditions inside real substances there are nodes of the crystal lattice in the form of ions or atoms which have a finite volume and their own density. For example, for a diamond we have the radius of the carbon atom $r_a = 0.077$, and the distance between the reflection planes (interatomic) $d = 0.356$ nm. Hence, the density of the carbon atom itself is 6,274 g/cm^3. Let us calculate the maximum reduced density between two carbon atoms located from each other at a distance d using the following formula:

The group of stones	Stone	Density, g/cm^3	Refract. index	Calc. vacuum density, g/cm^3
Colorless stones	Diamond	3.52	2.42	2.48
	Synthetic rutile	4.25	2.9	2.24

$$d_{red.} = \frac{m_c}{V_{c_1}} + \frac{m_c}{V_{c_2}}\,, \tag{9}$$

where $V_{c_1} = \frac{4\pi}{3} r_1^3$ is the volume of a sphere with the first carbon atom in the center, $r_1 = 0.0385 \div 0.3165$ nm, $V_{c_2} = \frac{4\pi}{3}(0.356 - r_1)^3$ is the volume of a sphere with the second carbon atom in the center, m_c is the mass of the carbon atom.

Calculation by formula (9) shows that approximately 50% of the space between carbon atoms has a density of about 1 g/cm^3. Hence, the estimated density of vacuum substance obtained by formula (8) is less than 0.7 g/cm^3. The actual numerical value, obviously, is much lower, since the reduced density assumes uniform distribution of the substance of the carbon atom within the sphere.

Calculation of the space dimension and the speed of time

On the other hand, it follows from the definition of fractional dimension of space, that any volume of a space generates a volume in a certain multiplicity, which is equal to the speed of time [1]. For vacuum it is:

$$dt \simeq \Delta t = \Delta v_1 = 10^{-17}, \tag{10}$$

i.e. any volume of a space, when a signal passes through it, generates a relative, additional volume equal to the speed of time.

The generation of the volume corresponds to a certain amount of gravitational energy. This amount can be compared to a quantum of energy which, taking into account formula (10), gives the ratio:

$$M_r\, V_1\, dt = h, \tag{11}$$

where V_1 is the generated unit volume, 1 m^3, h is the Planck constant (6.626×10^{-34} J s).

Our three-dimensional space is flat. The critical Friedman density of our space is about $d_f = 1{\times}10^{-28}$ kg/m^3. From here, we calculate the dimension of our space:

$$r = \frac{\log h - \log V_1 - \log d_f - \log dt}{\log c_v} + 1 = \frac{\log 6.626 - 34 - 0 + 28 + 17}{8 + \log 3} + 1 = 2.395; \tag{12}$$

where $c_t \simeq c_v = 3 \cdot 10^8$ m/s; $d_f = d_t = 10^{-28}$ kg/m^3; $V_1 = 1$ m^3; $dt = 10^{-17}$.

If the space has a Friedman energy density, the photon speed in the region of the carbon atom is (on the average):

$$c_c = \sqrt{\frac{d_f}{d_c}}\, c_v = \sqrt{\frac{1 \times 10^{-28}}{6274}}\, c_v = \\ = 1.26 \times 10^{-16} \times 3 \times 10^8 = 37.9 \text{ nm/s}, \quad (13)$$

where d_c is the average density of matter inside the sphere of a carbon atom.

At the obtained speed of light inside the sphere of the carbon atom, the wavelength of visible radiation is:

$$\lambda_c = 1.26 \times 10^{16} \lambda_{mv} = 1.26 \times 10^{-16} \times 600 \times 10^{-9} = \\ = 7.56 \times 10^{-23} \text{ m}, \quad (14)$$

where λ_{mv} is the wavelength of visible radiation. This is about 10^{13} times less than the diameter of a carbon atom. This gives a possibility of interaction between the waves of visible radiation and a carbon atom which is represented as a drain funnel (the source — reverse funnel — tornado). That is the **photon**, as an object of magnetic energy, behaves as a **time magnetic monopole**: it can be absorbed and emitted.

Results

Substantiation and calculation of the density of space matter have been done. The concept of the time speed has been specified. The time speed of our space has been calculated. A formula for calculating the fractional dimension of our space has been obtained. The calculation of the fractional dimension of our space has been performed.

So, on the basis of representation of the fractional dimension of a space as a space with the presence of time, the following calculations were done: the density of vacuum matter, the speed of time and the dimension of our space.

Further calculation of the numerical values of the following properties — the substance density of material objects, the vacuum and space density as a whole — can be continued dealing with (see [1] for detail): conversion of magnetic energy into dark matter; dark matter interaction with matter; synthesis of objects of our space; a three-dimensional model of distribution of density of the outer space mass.

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References

1. Mashkin M.N. Matter in a space of a fractional dimension. A cosmological system of spaces and evolution of the Universe. *Progress in Physics*, 2018, v.14, issue 3, 131–134.