Physical Science International Journal

23(1): 1-23, 2019; Article no.PSIJ.50051
ISSN: 2348-0130

The Big Bang or the Conductivity of the Interstellar Space

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/PSIJ/2019/v23i130142
Editor(s):
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Complete Peer review History: http://www.sdiarticle3.com/review-history/50051

Original Research Article

Received 18 June 2019
Accepted 07 August 2019
Published 13 August 2019

ABSTRACT

Based on the non-zero conductivity hypothesis of the interstellar space, an alternative cosmological model called "Knowledge spherocone" is formulated. Its significant feature is the ultimate size of a scientifically recognizable universe. It also formulated the hypothesis of ageing light in interstellar space, and calculated the approximate value of skin depth of light in interstellar space. Part of the article is a discussion of the consistency of the formulated cosmological model with experimentally verified physical laws.
The text is complemented by analyses of the Big Bang theory conflict with experimentally verified physical laws and internal inconsistencies of Big Bang theory.

Keywords: Big bang theory; cosmology; red shift; cosmic microwave background radiation; conductivity of universe; ageing light; heating interstellar material.

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1. INTRODUCTION

There are currently two widely accepted cosmological theory or hypothesis. Static and the Big Bang Theory (BBT). This text is devoted to that which the majorities currently believe i.e. BBT [1].

Cosmology deals with the remote past of the distant universe. However, scientific experiments cannot be carried out in the past. Nowadays, humanity does not have the means to carry out scientific experiments elsewhere than on Earth or in its very near vicinity (measured by the dimensions that cosmology deals with).

The main arguments for the BBT are the results of measurements made from the Earth or its immediate vicinity at present, respectively in a very near past. This is the effect of red shift and microwave radiation.

The basic methodology of scientific knowledge is the verification of hypotheses and theories by the experiment. Directly or indirectly, using previously authenticated natural laws.

To refute the hypothesis or theory, a single disagreement with the experiment or known, experimentally verified law is sufficient.

Another question is an explanation of the measured values, which can be interpreted differently.

The text formulates a hypothesis that makes it possible to explain the measured results in accordance with known physics laws differently than BBT.

The non-zero conductivity of interstellar space and ageing light hypotheses are used.

The relevant analyses are enclosed.

2. CONDUCTIVITY OF THE UNIVERSE

Let us work with the hypothesis of the non-zero conductivity of interstellar space. This means that we will work with the interstellar space in exactly the same way as with other material, we will not make an exception for interstellar space. We will respect that experimentally validated Maxwell equations [2] also apply in interstellar space, and this is characterized by all three non-zero material constants i.e. permittivity, permeability and conductivity.

That is, we will not consider that the interstellar space is filled with the abstract phenomenon of vacuum, a space without any mass, but we will respect that the distance between the particles in the interstellar space is final, and that these particles make material analogous to other materials known from Earth and its surroundings.

The hypothesis can also be formulated differently. Vacuum does not exist. It is a physically unrealistic abstraction. Everywhere in the universe there are particles of matter. Therefore, the interstellar space also has non-zero conductivity and is no exception.

2.1 Ageing Light

According to Maxwell's equations, the plane electromagnetic wave is attenuated, depending on the conductivity of the material in which it propagates, the energy expressed by the Poynting vector (directional energy flux i.e. the energy transfer per unit area per unit time of an electromagnetic field) [3] decreases depending on the distance $P(D) = P(0) \cdot e^{-2\alpha D}$, where $\alpha = \frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}}$, where σ is conductivity, μ is permeability and ε is permittivity of the material.

Compare this property of electromagnetic radiation with the experimental results described by the Hubble equation, from which we remove the hypothesis of the interpretation of the cause of wavelength change $\frac{\Delta\lambda}{\lambda} = z = \frac{H_0}{c} \cdot D$.

How the wavelength (or frequency) of light is related to energy? The Planck-Einstein relationship is the answer to this question [4,5] $E = hf = \frac{hc}{\lambda}$.

So far, it has not been experimentally verified that the energy and thus the photon wavelength and frequency of the photon would change with long-term light propagation and there is no evidence to the contrary. We can formulate the second part of the hypothesis:

The Planck-Einstein relation remains valid also in the case of loss of photon energy when light propagates in conductive material.

Based on the hypothesis we can describe the dependence of wavelength on the distance

$$E(D) = \frac{hc}{\lambda(D)} = hf(D)$$

$$\lambda(D) = \frac{hc}{E(D)} \equiv \frac{hc}{P(D)} = \frac{hc}{P(0) \cdot e^{-2\alpha D}} = \frac{hc}{P(0)} \cdot e^{2\alpha D}$$

We calculate the average conductivity of the universe from the measured linear approximation of the red shift and distance described by the Hubble relationship using the formulated hypothesis.

According to Hubble law [6] use approximate calculation for small z: $z = \frac{\lambda_o}{\lambda_e} - 1 \approx \frac{H_0 \cdot D}{c}$. We will use a previously derived relationship to which we mark the indexing used above $\lambda(D) \equiv \frac{hc}{P(0)} \cdot e^{2\alpha D} = \frac{hc}{P(e)} \cdot e^{2\alpha D}$, we will get $z = \frac{\lambda_o}{\lambda_e} - 1 = \frac{\frac{hc}{P(e)} \cdot e^{2\alpha D_o}}{\frac{hc}{P(e)} \cdot e^{2\alpha D_e}} - 1 = \frac{e^{2\alpha D_o}}{e^{2\alpha D_e}} - 1$.

Because in the description of the electromagnetic wave attenuation the distance from the source is measured, and in the Hubble relationship from the observer, we get $D_o = D$a $D_e = 0$ and

$$z = \frac{\lambda_o}{\lambda_e} - 1 = \frac{e^{2\alpha D_o}}{e^{2\alpha D_e}} - 1 = \frac{e^{2\alpha D}}{1} - 1 = e^{2\alpha D} - 1$$

To calculate the conductivity, we use a first-order approximation (for small D) $e^{kD} \approx 1 + kD$, we get $z = e^{2\alpha D} - 1 \approx 1 + 2\alpha D - 1 = 2\alpha D$. Compare with $z \approx \frac{H_0 \cdot D}{c}$ and get $2\alpha D = \frac{H_0 \cdot D}{c} \rightarrow \alpha = \frac{H_0}{2c}$.

Relations between the material constants, the speed of light propagation and attenuation of electromagnetic waves are known [7,8] $\alpha = \frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}}$ and $c = \frac{1}{\sqrt{\varepsilon\mu}}$, we can calculate the conductivity

$$\sigma = 2\alpha\sqrt{\frac{\varepsilon}{\mu}} = 2\frac{H_0}{2c}\sqrt{\frac{\varepsilon}{\mu}} = \frac{H_0}{c}\sqrt{\frac{\varepsilon}{\mu}} = H_0\sqrt{\varepsilon\mu}\sqrt{\frac{\varepsilon}{\mu}} = H_0\varepsilon$$

We will count for $H_0 = 2.28 \cdot 10^{-18}[s^{-1}]$ and $\varepsilon = 8.8 \cdot 10^{-12}[Fm^{-1}]$, we get $\sigma = 2.0 \cdot 10^{-29}[Sm^{-1}]$.

The accuracy of the value is determined by the accuracy of the constants used, namely the Hubble constant and permittivity.

It is known that permittivity is a property of the material, and conductivity is also a property of the material.

Sometimes inverse value is used – Resistivity $\rho = \zeta = \frac{1}{\sigma}$, we quantify $\rho = 5.0 \cdot 10^{28}[\Omega m]$.

From the above-defined hypothesis and the derived relation between the Hubble constant and the attenuation of electromagnetic waves, it is possible to describe the dependence of the red shift in a homogeneous environment with a constant conductivity $z = e^{2\alpha D} - 1 = e^{2\frac{H_0}{2c}D} - 1 = e^{\frac{H_0}{c}D} - 1$.

Alternatively, other expressions using material constants used in Maxwell's equations $z = e^{2\alpha D} - 1 = e^{2\frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}}D} - 1 = e^{\sigma\sqrt{\frac{\mu}{\varepsilon}}D} - 1$.

Note: If the conductivity in the vicinity of the Earth is greater than in the distant universe (the conductivity is greater within the Milky Way than in the intergalactic space because the average particle distance is smaller inside the galactic space than between the galaxies), the redshift of nearby sources will be relatively larger than distant.

The same is true of the directional dependence of the conductivity and the resulting redshift. Deviations of the red shift from the red shift of the homogeneous environment can be used to investigate the physical properties of the space in which the light diffuses.

2.2 The Half-life of Light

Physical phenomena with exponential dependencies are characterized in practice by a useful parameter associated with a value of 1/e or ln(2). For example, Skin depth [9] or Half-life [10].

By analogy, we calculate the half-life of light and the skin depth of light in the universe.

Half-life of light - The time at which the energy of the plane wave (photon) is reduced to half, i.e. the time at which the frequency is reduced to one half $T_{1/2} = \frac{\ln(2)}{\frac{\sigma}{\varepsilon}} = \ln(2)\frac{\varepsilon}{\sigma} = \ln(2)\varepsilon\rho = \frac{\ln(2)}{H_0}$.

Enumeration

$$T_{1/2} = 3.04 \cdot 10^{17}[s] = 9.64 \cdot 10^{9}[year].$$

Over a period equal to the half-life the light spread into the distance $D = T_{1/2} \cdot c = 9.64 \cdot 10^{9}[ly]$.

Thus, the skin depth of light in the interstellar space is about 10 billion light-years. Note – this is not a decrease in brightness due to the geometry of the spherical wave.

2.3 Heating Interstellar Material

Because the energy lost as a result of the non-zero conductivity of the universe and the red shift has been transformed into heat, the interstellar space is heated by this energy and therefore radiates electromagnetic radiation according to Planck's law [11]. This means that the measured Cosmic microwave background radiation (CMB) [12] can be interpreted as the radiation of a black body radiated by the material of the universe, and this material has a measured temperature of approximately 2.7K.

The largest proportion of CMB measured from Earth is radiation emitted near Earth. The measured inhomogeneity of CMB can be interpreted as a result of non-homogeneity of material in the Earth's vicinity, manifested as non-homogeneity of conductivity. The amount of energy converted to heat is dependent on conductivity, a known experimentally verified phenomenon.

Therefore, it is expected that the red shift of the source in the direction of the high CMB temperature will be greater than the red shift of the source in the direction of the low CMB temperature.

2.4 Microwave Pollution

According to the hypothesis of the conductivity of the universe, the microwave radiation radiates the surroundings of the observer anywhere in the universe, which is the result of heating the interstellar material due to non-zero conductivity.

At the same time, due to the ageing of light, the wavelength of distant sources is extended. With the increasing distance of the source, the size of the Fresnel zone [13] increases. This is due both to the distance itself and also to the wavelength increase.

The ability to distinguish the direction of the source of electromagnetic radiation deteriorates with the increasing wavelength.

Increasing distance also reduces radiation energy captured by the observer due to geometry and also the ageing of light, the loss of energy by spreading in the conductive material.

At the same time, increasing the distance assuming a homogeneous distribution of resources increases the number of sources in a constant angle segment.

This means that with increasing distance, the possibilities of recognizing radiation from different sources and the differentiation of resources are getting worse.

Closer resources overshadow remote sources. Far more remote sources overshadow even more remote sources. The larger the wavelength, the larger the shadow range.

When the wavelength is prolonged enough to approach the CMB wavelength, it is overshot by near CMB radiation, making observation impossible. There will be an analogy that astronomers know well from the surface of the Earth and is called light pollution or light smog [14].

The local CMB thus creates a barrier to possible research of distant sources of electromagnetic waves.

3. COSMOLOGICAL MODEL

The alternative cosmological model is based on the hypothesis of the universe with non-zero conductivity.

The universe is filled with material characterized by three electromagnetic material constants (permittivity, permeability, conductivity). The material also has other material properties analogous to materials on Earth and its surroundings.

The material is not completely homogeneous. The extent, properties and causes of in homogeneity are not yet known.

Vacuum does not exist. It is a physically unrealistic abstraction. The light spreads in space in accordance with Maxwell's equations, so the speed of light is not constant. It is given by an experimentally verified relationship $c = \frac{1}{\sqrt{\varepsilon \cdot \mu}}$.

The speed of light is related to the material in which it is spreading.

It is not excluded that the speed of light in some parts of the universe is greater than the speed of light around the Earth. This may be due to the fact that the mean distance between the atoms is greater than the average distance between the atoms in the vicinity of the Earth and therefore the permeability and / or permeability is smaller.

Light from distant sources ages and part of energy is absorbed by the material of the universe.

This heated material emits energy in the form of microwave radiation (high wavelength). Geometric properties, along with ageing light and microwave backgrounds, limit the ability to discover distant areas of the universe.

This creates the ultimate spherocone of knowledge.

3.1 Knowledge Spherocone

The observer has the ability to explore the universe using electromagnetic waves (light, microwaves,...). It can only evaluate the waves it captured at the time of observation at the observation site.

This means that it only captures the radiation that was radiated at the right time from the right place. The correct time and place is relative to the observer in the sense that it must be in a time and space just so that the radiation is captured by the observer.

For clarity - when we plot this dependence into a 3D graph with two spatial coordinates and the third coordinate is time, a cone image is created. Cone angle corresponds to the velocity of the radiation.

So the observer can only observe what is happening on the cone shell. All that is inside is the past; the radiation went to the observation point before the observation began. Everything outside is the future, the radiation will go to the observation point after the end of the observation.

The real space has three dimensions and the observer can capture the radiation from any direction, creating a sphere.

Because we live on Earth and nowadays and we have the ability to conduct observations only in relatively near Earth and in a relatively short period of time compared to spatial and temporal scales of the universe, the center-point of our spherocone is located on Earth at present.

In other words, our Earth is the center of a recognizable universe. This does not mean that Earth is the center of the universe, but it is the center of human knowledge of the universe.

Since the effect of microwave pollution, together with the ageing of the light, limits the distance from which it is possible to observe and evaluate information from the received radiation, the spherocone has the final dimension. However, the end is not clearly defined, there is no recognizable boundary between the recognizable and unrecognizable part of the universe. The knowledge and technological possibilities of mankind can increase the size of the spherocone of knowledge.

3.2 The Origin of the Universe

The fundamental part of cosmology is the question of the origin or non-appearance of the universe and its evolution over time.

The answer to this question, according to the cosmological model described, has two variants:

The universe is so small or so young that the origin or edge of the universe is within our spherocone of knowledge.

The universe is larger and older than our spherocone of knowledge.

By roughly estimating the magnitude of our spherocone of knowledge for 100 billion years of time and 100 billion light-years of radius, we have the hope of obtaining a science-based answer to the question of the age or size of the universe only if the universe arose later than 100 billion years ago or the Earth is closer than 100 billion light-years to the edge of the universe (and if such a margin exists).

Otherwise, if the universe is older and larger, we will not know whether the universe originated, when it originated and how it originated.

There is not yet any experimentally proven evidence that would derail the possibility that the universe is much older and larger than our spherocone of knowledge.

Until we have evidence that the creation of the universe or the edge of the universe is in our spherocone of knowledge, we can only humble ourselves that this question remains unanswered or unanswerable.

It only means that we will be reconciled to the fact that space and time are large enough for the question of the origin of the universe not to be troubled.

3.3 The Ultimate Dimension of Knowledge Spherocone

How the knowledge spherocone can have the final dimension and not have borders? What's next? What happens when someone gets to the border?

The situation can be imagined, as we stand on the freshly snow-covered meadow in thick fog. Everywhere is white. There is no known where the snow passes in the fog. All sides are the same white. We see our own hand and things in the immediate vicinity.

Only when we go to the forest (if we are lucky and choose the right direction) then after some time something darker will appear in the fog. And what we will be closer to the forest, the more clearly we will see the border of the forest and then the individual trees.

In the case of the knowledge spherocone it is analogous, except that we have no chance to move in either space or time.

More specifically, human possibilities are negligible compared to the dimensions of space, both in terms of distance and time.

How is the spherocone big?

According to the hypothesis of light ageing and measured data, the Skin depth of light in the interstellar space is about 10 billion light-years.

Sunlight-like light (around 6000°K) is overshadowed by the CMB due to the wavelength change, that is, when the energy drops to roughly a thousandth. This occurs at about ten times the Skin depth. The spherocone dimension, according to today's measured data, is estimated at about 100 billion light-years and 100 billion years old.

Compare this dimension with human possibilities.

Human civilization is about 10,000 years old. Even if civilized humanity survived on Earth a million years, it will be 10^{-5} of spherocone time.

Nowadays, people have moved to the Moon, using automatic probes to the boundary of the Solar System. The closest star (Proxima Centauri) is at distance 4.2 ly. The closest galaxy (Great Magellanic Cloud) is at a distance of 70,000 ly. The distance of 70,000 ly is less than 10^{-6} of knowledge spherocone radius.

That means, after making such enormous effort that the expedition to the neighboring galaxy would certainly require, the knowledge of humankind would change in the same way as when we observe something at a distance of 1 km and shifted by 1 mm.

4. DISCUSSION

4.1 The Existence of a Vacuum

There is experimental evidence that interstellar space is not empty. Let's say, for example, a hydrogen cloud between our galaxy (Milky Way) and the two closest galaxies. [15] - "Streams of neutral hydrogen connect them to the Milky Way and to each other" Or the NASA results [16] - "Plasmas are the most common phase of matter. Some estimates suggest that up to 99% of the entire visible universe is plasma ". [17] and also solar wind [18] and cosmic dust [19].

Light and heat radiation can also be added if we recognize the validity of the principle of equivalence of matter and energy [20].

The idea of vacuum is a well-known abstraction in the professional public, so let's put the following argument. Let us use a reversed look: ordinary material (hydrogen, sulfur, carbon, copper, ...) can be considered a vacuum or a special case of vacuum because most of the space inside the atoms and between the atoms is empty. "Exceptions" can be neglected. This is the same "logical" approach as in interstellar space, only values differ.

4.2 The Speed of Light

It is experimentally verified that light propagates in different materials at different speeds $c = \frac{1}{\sqrt{\varepsilon \cdot \mu}}$. that is why glasses, cameras, binoculars, etc. work.

Present physics recognizes one exceptional speed of light as a universal constant. This exceptional feature has a special environment that is called a vacuum. The formulated hypothesis says that there is no such extraordinary environment or material in the universe that it is merely a human idea.

Thus, the speed of light (in vacuum) used in a number of physical theories is not a real picture of true nature.

It can be argued that the speed of light in the vacuum was measured. Its size is known. This is only partially true. The speed of light was measured, but it was not measured in the actual vacuum, but only in the material declared under vacuum. In fact, there was mass inside the Fresnel Zone [13].

For reliable measurement of the velocity of light in a vacuum, it would be necessary to perform measurements in a space without any mass or energy and which would have a dimension allowing the measurement of propagation time with sufficient precision. So if it were enough to carry out the 1s measurement, there would have to be a space of 300,000 kilometers without a single atom, another photon or other particle of matter in the Fresnel zone. This is roughly the distance of the Earth - the Moon.

4.3 Brightness Attenuation Analysis

From the conductive universe model, the brightness of the remote light source will decrease not only due to the geometric change in energy density, but will also decrease with the attenuation (as much as the frequency drops).

If the attenuation is not included in the calculation of the distance from the measured brightness, the distance will be greater than the actual distance.

Let us start from the relationship between energy and the wavelength of the light quantum $E = \frac{h}{\lambda}$. Let us suppose that the light quantum energy is dependent on the distance from the source according to the general function $E = E_0 . f(r)$, where r is the distance from the source and E_0 is the energy emitted by the source.

We calculate the light intensity of the omnidirectional source depending on the distance for two variants:

1 - no energy dependency of light quantum on distance (zero conductivity of environment) - i_1
2- with the dependence of the light quantum energy on the distance (non-zero conductivity of the environment) - i_2

$i_1 = P\frac{1}{4\pi r^2}$, $i_2 = P\frac{f(r)}{4\pi r^2}$

Depending on the energy of the light quantum we express the red shift z

$E = E_0 . f(r) = \frac{h}{\lambda(r)}$, then $\lambda(r) = \frac{h}{E_0 . f(r)} = \frac{\lambda_0}{f(r)}$ and $z(r) = \frac{\lambda(r) - \lambda_0}{\lambda_0} = \frac{1}{f(r)} - 1 \qquad f(r) = \frac{1}{z(r)+1}$

Calculate the distance ratio of variants 1 and 2 for the same light intensity

$i_1 = P\frac{1}{4\pi r_1^2} = i_2 = P\frac{f(r_2)}{4\pi r_2^2}$, then $\frac{1}{r_1^2} = \frac{f(r_2)}{r_2^2}$ and $\frac{r_2^2}{r_1^2} = f(r_2)$, we get $\frac{r_2}{r_1} = \sqrt{f(r_2)}$.

The ratio of distances with energy dependence and without energy dependency is expressed by the red shift z $\frac{r_2}{r_1} = \sqrt{f(r_2)} = \sqrt{\frac{1}{z(r_2)+1}}$.

We can see that the distance r_2 calculated by including the general energy attenuation that is directly proportional to the red shift z is always smaller than the distance r_1 without counting the attenuation. The ratio increases with the increasing red shift.

4.4 Comparison of the Conductivity Hypothesis with the Measurement Results and Applicable Laws

Compare the hypothesis of conductivity of the universe with experimentally verified laws and measurement results.

The hypothesis works with constant distances as well as classical physical laws. There is no problem with the wavelength, frequency and propagation velocity of electromagnetic waves, there is no problem with Kepler's laws, with the kinetic energy of the planets, changes in planetary distances. There is no need to consider the time dependencies of physical constants or even the time dependency of the length unit.

There is no need to predict the effects of an unknown gravitational force or other source of exponential or other acceleration growth of all bodies in space.

The measured red shift is not due to the movement of light sources or the expansion of the light wavelength. It is caused by the conductivity of the universe; it is the manifestation of ageing of light, which is in accordance with known and experimentally verified laws of thermodynamics. It is no hidden Perpetuum.

There is no need for an exception applied to interstellar space; it is possible to work with a complete set of Maxwell's equations in interstellar space as well.

CMB can be interpreted directly as radiation of heated interstellar material.

The second hypothesis used is the light ageing hypothesis, which is based on the assumption of the validity of the experimentally verified Planck-Einstein relation even in the case of loss of photon energy due to the conductivity of the material.

This hypothesis has not yet been experimentally refuted. If we do not take into account the experiments below, it goes from a methodological point of view to a hypothesis analogous to the Scale factor wavelength expansion hypothesis, or a hypothesis explaining the red shift as a consequence of the Doppler effect of the receding source.

It can be argued that the Doppler effect is experimentally verified.

The Planck-Einstein relationship is also verified.

There are experiments that can be interpreted as experimental verification of this hypothesis.

4.4.1 Gravitational redshift of light

It has been experimentally verified that the wavelength of light changes in the Pound-Rebka experiment [21].

Changing the wavelength in this experiment cannot be interpreted as Doppler effect because the source and the light detector do not move each other. Changing the wavelength cannot be interpreted either as a result of the space expansion effect.

The result can be interpreted as changing the part of the photon energy to potential gravitational energy and the red shift as a result of diminishing photon energy.

According to [22] is $\frac{\Delta\lambda}{\lambda} \approx \frac{g\Delta y}{c^2}$ where Δy is height difference.

According to Pound et al. [23] $\Delta\nu_h = \nu_h - \nu_0 = \nu_0\, gh/c^2\,(1 + h/R)$ where h is the height relative to the Earth's surface, R is the radius of the Earth, ν_h the frequency measured at the height h and ν_0 the frequency measured at the Earth's surface.

The results of the experiment [24] are in line with the theory - $(\Delta\nu)_{\exp}/(\Delta\nu)_{theor} = +1.05 \pm 0.10$.

For comparison, we calculate the change in photon frequency caused by photon energy change equal to potential photon energy in the gravitational field.

We express the effective mass of the photon $E = m \cdot c^2$ then $m = \frac{E}{c^2}$. Potential gravitational energy in the near field of Earth $E = m \cdot g \cdot h$. Planck-Einstein relationship [4,5] is $E = hf = \frac{hc}{\lambda}$, for better comprehensibility, we label Plack's constant to k $E = kf = \frac{kc}{\lambda}$, then $f = \frac{E}{k}$.

We calculate the change of frequency from the energy change $\Delta f_h = f_h - f_0 = \frac{E_h}{k} - \frac{E_0}{k} = -\frac{\Delta E}{k} = -\frac{m \cdot g \cdot \Delta h}{k} = -\frac{E}{c^2} \cdot \frac{g \cdot \Delta h}{k} = -\frac{E}{k} \cdot \frac{g \cdot \Delta h}{c^2} = -f_0 \cdot \frac{g \cdot \Delta h}{c^2}$ then $\frac{\Delta f_h}{f_0} = -\frac{g \cdot \Delta h}{c^2}$.

Because for small frequency changes $\frac{\Delta f}{f} \approx -\frac{\Delta\lambda}{\lambda}$, we get a relationship that was experimentally verified for $h \ll R$.

The result of R. V. Pound and G. A. Rebka, Jr experiment can be interpreted as confirming the hypothesis of changing the frequency and the wavelength of light depending on the photon energy change.

4.4.2 Santilly isoredshift

Changing the wavelength of the light depending on the environment through which the light passes has been experimentally verified by R. M. Santilli experiments [25].

4.4.3 Spectrum of red sky

The red shift effect, depending on the light passing through the non-zero conductivity material, can be observed by the naked eye at sunset and at sunrise.

If the spectral filtration in the air had a dominant influence, it would change the color of Sunlight at sunset and at sunrise to blue or blue-green. Not red as observed.

The air consists of nitrogen, oxygen and argon (99.97% in total) [26]. Only oxygen has

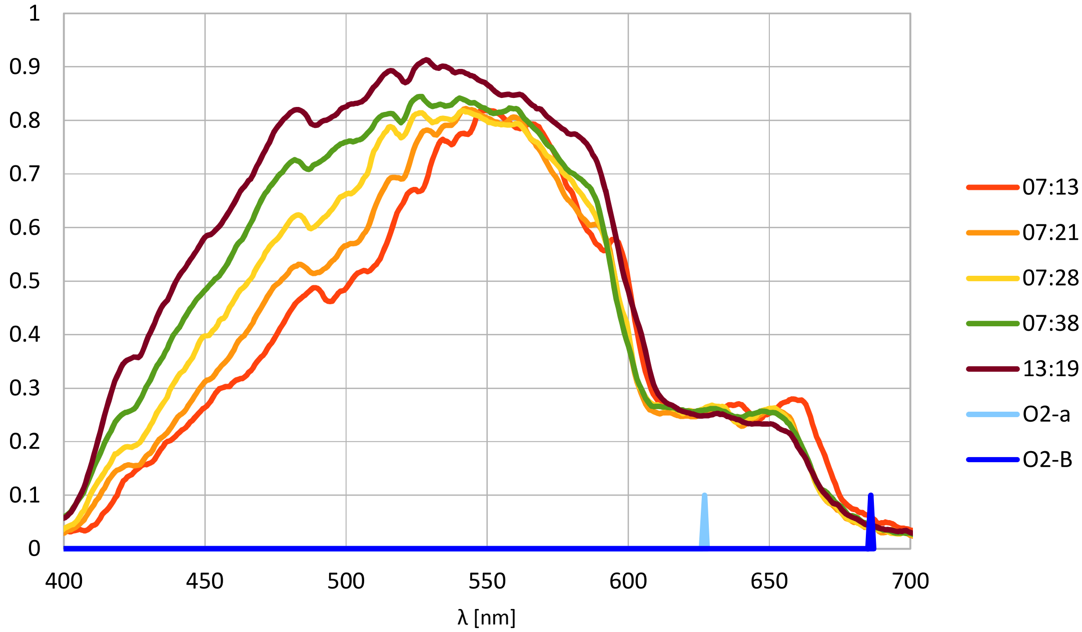

Fig. 1. The result of measuring the time dependence of the Sun's spectrum at sunrise. Measured with a simple spectrometer with a conventional color USB camera (containing an infrared filter). O2-a, O2-B – Oxygen Fraunhofer lines

interesting Fraunhofer lines (y - 898nm, Z - 822nm, A - 759nm, B - 686nm and a – 627nm) [27]. These absorption wavelengths are only in the red and infrared sections of the Sun spectrum.

The red shift effect can be verified by a simple experiment. It is enough to measure the shift of the sunlight spectrum of the red sky, the difference between daylight when the light passes through a relatively short path through the dense layers of atmosphere and red sky, when the light passes a much longer distance through the dense air – see Fig. 1.

4.5 Dark Matter

BBT works with the hypothesis of the existence of dark matter [28]. This has not yet been confirmed experimentally. In the case of a conducting space hypothesis, interstellar matter shines; it can be observed and examined by CMB, but only in the near vicinity of Earth.

4.6 Dark Energy

New red shift measurements on remote sources are interpreted as a red shift dependency on source age, showing a deviation from the original Hubble hypothesis of linear dependence that is the basis of the BBT. BBT explains this internal inconsistency with the new hypothesis of the existence of dark energy.

Measured results are interpreted as acceleration of space expansion. The measured average unit red shift (the measured red shift divided by the distance of the source) decreases with the increasing distance of the source.

Because of the BBT hypothesis, the red shift is proportional to the expansion of the universe and the measured dependence can be interpreted as a dependence on the time of radiation of the measured light, the measured data is interpreted so that today the universe expands faster than it used to be in the past.

The hypothesis of the conducting universe allows a different interpretation of the measured data.

According to the results of the measured large red shifts [29] „Adam Riess *et al.* found that "the distances of the high-red shift SNe Ia were, on average, 10% to 15% farther than expected in a low mass density Ω_M = 0.2 universe without a cosmological constant". This means that the measured high-redshift distances were too large, compared to nearby ones, for a decelerating universe.

Compare the measured data with the above Brightness attenuation analysis. First of all, it should be noted that distance measurement was based on the measurement of light source brightness. Only the brightness reduction effect of geometry and not the effect of attenuation of the conductive environment were included in the calculation of the distance in [29].

We quantify the conductive environment attenuation effect for z = 0.5 $\frac{r_2}{r_1} = \sqrt{\frac{1}{z+1}} = \sqrt{\frac{1}{1.5}} = 0.816$.

In the case of calculating the decrease of the energy of the light quantum for z = 0.5, the distance of the source is 18.4% smaller than when the energy loss is not counted. Thus, if the dimming effect is included in the distance calculation, proportional to the red shift, i.e., the attenuation corresponding to the hypothesis of the conducting universe, the distance corresponding to the red shift is obtained, and the acceleration effect does not occur. So there is no need to correct the measurement results using speculation about the existence of dark energy.

5. ANALYSIS 1 - SPREADING ELECTROMAGNETIC WAVES, PERPETUUM AND FORGOTTEN MAXWELL EQUATION

5.1 Fresnel Zone

Common idea of propagation of light is that light propagates in a straight line, that the thickness of the light beam is negligible.

Such an idea is simplified and simplification is only justified sometimes.

It is experimentally verified that electromagnetic waves do not extend only through a direct line between two points (from the transmitter to the receiver), but also around the line. Designers of microwave communication routes know this from practice.

The Fresnel Zone is used to calculate the magnitude and shape of the area with the dominant influence on the transmission of electromagnetic waves [13].

Let's make an engineering estimate of the size of the Fresnel Zone in astronomical conditions. Calculate the volume of the Fresnel zone for a light beam with a mean wavelength of the visible spectrum, i.e. a wavelength of 500 nm, spread from a distance of 1 billion light-years.

Fresnel zone volume is calculated as the volume of an ellipsoid of revolution $V = 4/3\,\pi abc$ a, b, c – semi-axes [30].

$F_1 = \frac{1}{2}\sqrt{\lambda D}$, where F_1 - maximum radius of Fresnel zone 1, λ - wavelength, D - distance between source and detector.

For the mean wavelength of visible light 500 nm - $5*10^{-7}$ m and D = 1 * 10^9 ly (light years) we get F_1 = $2.17*10^9$ m = 14.6 AU and the volume of the zone is V = $9.33*10^{43}$ m^3.

The Fresnel zone has a radius of about 15 AU at its widest point. This is about half the radius of the solar system measured by Neptune's orbit. Volume of Fresnel zone corresponds to the volume of a sphere of a radius of 10^{14} m, i.e. 10^3 AU, which corresponds to a sphere of radius about 30 times greater than the radius of the solar system.

This means that it is not possible without further analysis neglect the volume of space in which the light beam propagates from the remote space. According to experimentally verified physical laws, all matter in the Fresnel zone has an effect on the propagation of electromagnetic waves and thus on the propagation of light.

The open question remains what the material is, what are the electromagnetic properties and how it affects the light beam.

5.2 Perpetuum and the Forgotten Maxwell Equation

The engineer normally struggles with heat losses, with efficiency. He knows there is no old dream called Perpetual motion machine or Perpetuum Mobile, a lossless system [31].

The light beam propagating from the distant universe should not be an exception. There is no experimental evidence that the light beam preserves all of its energy for a long time traveling from the distant universe.

At the same time, it is known and experimentally verified that electromagnetic waves do not propagate without energy loss in any environment on the surface and around the Earth.

Currently, simplified Maxwell equations are used. Normally, there are 4 equations with two material-dependent constants. Typically, the material constants of the vacuum are given. These equations only work with two material constants with permittivity and permeability. They do not include any energy losses; they describe the electromagnetic Perpetual motion machine [2].

It is true that the solution of these simplified equations is simpler and more elegant. Missing members describe the attenuation in the material.

Electro technical engineers know from practice, i.e. from experimentally verified physical laws, that there is no material with zero or infinite conductivity, always non-zero resistance or conductivity, always creating energy losses of the electromagnetic field.

Maxwell knew that, so he included Ohm's law into the published system of equations [32].

Thus, the original and experimentally widely validated system of Maxwell equations is parameterized by three material-dependent coefficients (permittivity, permeability and conductivity / resistivity).

Only by incorporating the conductivity losses thus it becomes credible application of Maxwell's equations. Without conductivity, it is an unrealistic abstraction that cannot approximate the real world. It is a modern Perpetuum.

5.3 Plain Wave Attenuation in Conductive Material

If the electromagnetic waves propagate in a material having non-zero conductivity, the solution of the wave equation for the plane wave propagating in the z direction is $E_x(z,t) = Ae^{-\alpha z}\cos(\omega t - \beta z)$, where $k = \beta - j\alpha$, i.e. the root of the quadratic equation $k^2 = \omega^2\mu(\varepsilon - j\frac{\gamma}{\omega})$.

For small losses (conductivity) it can be simplified $\alpha = \frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}}$, where σ - conductivity, μ - permeability, ε - permittivity.

Plane wave performance attenuation can be expressed using the Poynting vector [3] depending on the distance on the z axis $P(z) = P(0) \cdot e^{-2\alpha z}$ and dependence on time $P(t) = P(0) \cdot e^{-2\alpha ct}$.

We see that the rate of energy reduction of planar electromagnetic waves is directly proportional to the conductivity of the material through which the wave propagates. This attenuation is not due to the propagation geometry but to the conductivity of the material. Therefore, electromagnetic waves are dampened more quickly, for example, in sea water compared to air.

5.4 Photon Energy

Quantum mechanics based on many experimental evidence (photo effect, black body radiation, semiconductors, LEDs) represents the photon energy as indivisible and unchangeable quantum of energy $E = hf$ or $E = \frac{hc}{\lambda}$ [5]. The photon energy is uniquely bound to frequency and wavelength, that is, to the color of light. It is not possible to change the photon wavelength without changing the photon energy.

5.5 Summary 1

At the Earth's surface and in its vicinity, it is experimentally proven that electromagnetic waves do not extend only along the line between the transmitter and the receiver but that the propagation is influenced by the atoms that are near the propagation path in the Fresnel zone. The volume of such a Fresnel zone of beam spreading from a distant universe is astronomical.

The original Maxwell equations describe an experimentally verified effect of energy loss of electromagnetic radiation by means of a third material constant called conductivity or resistance.

Electromagnetic wave loses energy when spreads material with a non-zero conductivity. It is experimentally confirmed that the photon energy is inversely proportional to the wavelength, so the wavelength extension corresponds to the photon energy reduction.

6. ANALYSIS 2 - BBT and WELL-KNOWN PHYSICAL LAWS

Well-known and experimentally verified laws are verified on Earth, so apply the BBT to Earth and the Solar System and compare the results with known laws.

6.1 Expansion of the Solar System

Calculate by BBT parameters of the Earth and the Sun during the formation of the Earth. Calculate the orbit parameters and other physical parameters on Earth, assuming the universe expanded according to BBT in the Solar system.

Earth's age is 4.54 billion years. BBT's cornerstone is the dependence of the red shift z on the source distance called the Hubble Law [6]. The measured dependence of the red shift on the time the beam was radiated can be described $z \approx (t_0 - t_e) \cdot H(t_0)$, where t_0 – reference time and t_e – emit time.

The Hubble constant H_0 has a magnitude $H_0 = 22.6 \cdot 10^{-19}[s^{-1}] = 2.26 \cdot 10^{-18}[s^{-1}]$ then $H_0 \cdot \Delta T = 2.26 \cdot 10^{-18} \cdot 4.54 \cdot 10^9 \cdot 3.15 \cdot 10^7 = 0.32$, for the Earth at the time of its creation we have $z \approx 0.32$.

Definition of $z = \frac{\lambda_0}{\lambda_e} - 1$ can be overwritten to $\lambda_e = \frac{\lambda_0}{1+z} = k_e \cdot \lambda_0$, where k_e is the wavelength expansion coefficient.

Since, according to BBT, wavelength expands as much as space, it is possible to calculate how the universe expanded in the Solar system since the formation of the Earth. We get $k_e = 0.757$.

Thus, assuming the validity of the BBT, the Earth orbited the orbit of about 0.75 Au, roughly in the same orbit as Venus is currently circulating.

6.2 Expansion on Earth

As the BBT is expanding everywhere, it also expands within the Earth. Therefore, the Earth's diameter was 0.75 times smaller and therefore the gravity on the surface was 1.74 times larger, assuming that Earth's weight or Newton's gravitational law (experimentally verified) or gravitational constant did not changed.

Because the space is expanding everywhere, all the objects on the Earth's surface are expanding, so the water on Earth is expanding. Therefore, at the time of the Earth's origin, the water had a specific weight of 40N / liter (less water volume times greater gravitational acceleration due to a smaller Earth radius). This is almost twice the actual concrete specific weight or roughly half of today's specific weight of iron.

Are there any experimental proofs of such effects?

6.3 Planetary Orbit Expansion

Relationships between the parameters of the orbital bodies are known and verified experimentally (Kepler's laws [33]). Is the hypothesis of expanding the orbit of the Earth or other planets according to the BBT in accordance with these validated laws?

Third Kepler law [33] gives $\frac{P^2}{r^3} = constant$ where P – period of circulation, r – mean radius (radius for circle).

For simplicity of calculation, we work with a circular path. Circular speed is $v = \frac{2\pi r}{P}$. Apply third Kepler's law on expanding universe according BBT where R (t) is Scale Factor [34]. We shall use the designation R according Hubble law [6] to avoid confusion with the acceleration.

$\frac{P_0^2}{r_0^3} = constant = \frac{P(t)^2}{r(t)^3} = \frac{P(t)^2}{(R(t) \cdot r_0)^3}$, this means that when the radius of the circular path changes, the circulation time must also change: $P(t) = P_0 \cdot \sqrt{R(t)^3}$

Calculate the velocity of the planet, depending on the expansion space by BBT respecting Kepler's third law: $v(t) = \frac{2\pi r(t)}{P(t)} = \frac{2\pi a(t) r_0}{P_0 \cdot \sqrt{a(t)^3}} = \frac{v_0}{\sqrt{R(t)}}$

Thus upon expansion the space, according to the third Kepler's law should decrease the speed of each planet to the square root of the scale factor of R. This is a time-dependent value.

Changing speeds is not possible without acceleration and speed up the experimentally verified by Newton's law of motion requires an applied force.

Because BBT space is constantly expanding at every moment, this braking force should still be applied so today.

Since the direction of the circulation speed changes at every moment, this braking force should change its direction exactly in line with the direction of the velocity of circulation.

This is not a known physical phenomenon.

Changing the speed also means a change in kinetic energy. Decreasing speed means a loss of kinetic energy [35] $E_k = \frac{1}{2} \cdot mv^2$, then $E_k(t) = \frac{1}{2} \cdot mv(t)^2 = \frac{1}{2} \cdot m\frac{v_0^2}{R(t)} = \frac{E_{k0}}{R(t)}$.

According to known experimentally validated laws of energy cannot be lost "without a trace". According to BBT, the energy of the planets should be diminished in proportion to the expansion of the universe.

What is the result of changes in kinetic energy of the planets during the expansion of the universe by BBT?

The previous analysis worked with what BBT describes, i.e. the expansion of distances, that is, expansion of space in time.

It is also possible to work with the hypothesis of expanding space and time so that there is no change in speed and therefore there is no problem with the acceleration of the planets.

It means $v(t) = v_0$. From velocity definition $v(t) = \frac{d(t)}{t(t)}$ we get $v(t) = \frac{d(t)}{t(t)} = \frac{R(t) \cdot d_0}{t(t)} = \frac{d_0}{t_0} = v_0$, ie. $t(t) = R(t) \cdot t_0$.

If time expands as fast as the distance, the speed will not change and the kinetic energy will remain.

Because the speed remains constant and the radius of the track changes, the Kepler's law, which is experimentally verified, will be violated. That hypothesis must be rejected.

6.4 Expansion of Wavelength

According to BBT, space is expanding in time. There is an interpretation that the reason for the measured red shift is the expansion of the wavelength in accordance with the expansion of the space. Thus, the cause of the red shift is not the Doppler effect but the space expansion itself. Recall that there is a clear physical relationship between the wavelength, the velocity of propagation and frequency $c = \lambda \cdot v = \lambda \cdot f$ thus $\lambda = \frac{f}{c}$.

In the case of the Doppler effect, the source emits wavelengths with different wavelengths and corresponding to other frequencies. The wavelength and frequency do not change over time.

The interpretation of the measured red shift using BBT, where the wavelength extension is explained as a consequence of expanding space, has its physical reasons.

If the wavelength change were interpreted as the Doppler effect, the radiation would have to be emitted with the changed wavelength by the source, with a red shift proportional to the distance from the observer a billion years ago. This would be against the principle of causality and the source would have to "know" when and where the emitted light will be measured.

The other option is that there are other physical patterns that ensure that the relationship between the red shift and the distance between the radiation source and the observer is maintained. See chap. „Doppler effect“.

Let us return to the wavelength extension hypothesis in line with the Scale Factor [34], that is, the change in wavelength during the time of light propagation.

The question remains if the wavelength changes depending on the expansion of the space, what else changes so that the relationship between the propagation velocity, the frequency and the wavelength $\lambda = \frac{f}{c}$ remains preserved. Moreover, that at any moment.

Increases speed of light or decreasing frequency, or both?

Expands the speed of light, or extends the time?

There is an experimentally verified Planck's law [11] which has two equivalent forms, both for wavelength and for the black body radiation frequency.

In that case, it should be noted that if the wavelength is changed as a result of the expansion of the space, the frequency of the radiation must also be changed, inversely proportional to the expansion of the space. In such a theory, the speed of light can be constant, unchanging in time.

The consequence is that hypotheses based on the space expansion hypothesis should allow for the same time extension to maintain the ratio between wavelength and frequency at any given time.

The BBT effect of expanding or compressing time does not include. This has resulted in inconsistencies with Planck's law.

There is also an experimentally verified relationship between photon energy and wavelength [4]. According to it, the photon energy is inversely proportional to the wavelength and at the same time proportional to the frequency.

According BBT photon wavelength increases due to the expansion space. Therefore, the effect of expanding the wavelength is to reduce the energy of the photon. Asked what happened to the lost energy, BBT has no answer.

And there is an analogous problem with the photon frequency. Does photon frequency change to maintain the relationship between frequency and energy at wavelength extension?

6.5 Expansion of Physical Constants

Relationships between different physical quantities contain physical constants.

The series of constants have their magnitude dependent on the distance unit. Then the value of the constant varies according to the unit of distance so that the physical effect remained.

According to the BBT, the distance is not constant but changes over time.

Are BBT physical constants that depend on the distance unit time-constant? So they still have the same numerical value or the same physical effect? For example.

Varies gravitational force between two objects or the value of the gravitational constant when expanding space and thus expanding the distance?

Changes to photon energy, or the value of Planck's constant during the space expansion and hence wavelength expansion of the photon?

Does the photon frequency change or propagation velocity of light change when space is expanding, and thus expanding the photon wavelength?

Important constants that could change according to BBT depending on the expansion of the universe:

Boltzmann constant [$J.K^{-1}$] [$m^2.kg.s^{-2}.K^{-1}$]
Gravity Constant [$m^3.kg^{-1}.s^{-2}$]
Permeability of vacuum [$N.A^{-2}$] [$m.kg.s^{-2}.a^{-2}$]
Permittivity of vacuum [$F.m^{-1}$] [$m^{-3}.kg^{-1}.s^4.A^2$]
Planck constant [J.s] [$m^2.kg.s^{-1}$]
Speed of light [$m.s^{-1}$]

6.6 Expansion of the Atom

According to BBT, space is expanding. There is no reason why the BBT should not expand the space within the atom. Changing the dimensions of the atom can change its physical properties. We know only atoms of today's dimensions. The BBT is based on the assumption that the atoms that emit the analyzed photons with a measured red shift are the same as today's atoms, i.e. they emit photons with the same properties as today's atoms. It is not experimentally verified that an atom of another dimension has the same properties or that an atom of another dimension exists.

6.7 Expansion of the Distance Unit

BBT describes the expansion of the universe by relationship (using R and D writing) [34]) $D(t) = R(t) \cdot D_0$, where D is the distance and R is the Scale Factor. This is a mathematical record interpreted as a description of the expansion of the universe in all directions, depending on time. The result of the calculation is not the distance but the number. Intuitively, a larger number is interpreted as a larger distance.

Let's recall that physics uses defined physical units and the physical value of the respective magnitude is quantitated in multiples of the respective physical unit. The question is: what is the time dependency of the length unit if the universe expands according to the BBT? Does the distance unit depending on the same dependency or otherwise? By what?

Can we measure very distant events in the deep past with our current local distance unit size if the unit changes over time and event information is spreading at the ultimate rate?

It is known that the length unit has been defined differently in history. Consider therefore metric system meter. The meter was defined by the Earth Quadrant, the distance of the markings on the standard, the wavelength, and the speed of light and time. As discussed earlier, BBT expansion refers to or may concern all physical phenomena used to define the distance unit.

We get into a complicated situation. Is the physical unit length according to BBT time-dependent or independent?

If the base unit expands $D(t) = R(t) \cdot D_0$, how can a different number occur when calculating the distance when the distance extends as much as the distance unit? Does the distance extend differently than the distance unit? If the distance expands equally as a distance unit, the distance expressed in numbers will be unchanged. If the unit of distance is defined physically, how is it possible for the unit of distance not to be covered by the general law of expansion applicable by BBT universally?

Does BBT deny itself?

6.8 Summary 2

This analysis shows that it is not physically possible to apply BBT in general. That the application of space expansion hypothesis to physically verifiable phenomena conflicts with experimentally verified physical laws, or it brings significant uncertainties into the system of verified physical laws such as the time dependence of physical constants, physical units, or the questioning of assumptions used in the interpretation of measured data. The hypothesis may be applied only to such phenomena and objects where experimental verification is missing.

7. ANALYSIS 3 - EXPERIMENTAL BBT VERIFICATION

Analyze the measured physical phenomena interpreted as experimental evidence of BBT's compliance with the real world.

7.1 Cosmic Microwave Background Radiation

Cosmic microwave background radiation (CMB) is interpreted as BBT experimental verification so that measured microwave radiation is a relic of early stages of the universe (relic radiation). This is, however, an interpretation of measured data. The radiation that corresponds to the radiance of a black body of about 2.7K was measured.

The question is why the measured elm. radiation that corresponds to black body radiation according to the experimentally verified Planck's law [11] is interpreted otherwise than under this law?

Why is not the measured radiation interpreted as radiation of a black body with a temperature of about 2.7K surrounding Earth?

It is true that according to Planck's law, the radiance of the black body B_1 at the temperature T_1 cannot be distinguished from the radiation of the black body B_2 at temperature $T_2 = z.T_1$ when the radiance of the body B_2 is modified by the red shift z.

Experimental results can be interpreted with at least two different hypotheses:
A - Hypothesis of the local source, i.e. the radiation emitted by the black body surrounding the Earth without a red shift (z = 0).

B - Hypothesis of the remote source, i.e. radiation with a red shift of z = 1100, as is interpreted as evidence of BBT [12].

Let us look at hypothesis B - a hypothesis of a remote CMB source. We will not address the issue of the direction of radiation. The analysis deals with the source in any direction. According to the [35], the measured temperature of CMB Tr = 2.726 K. This is according to hypothesis B to correspond to the original black body radiation of about 3000 K and a red shift of about 1100.

7.2 Yesterday's Storm

There is nothing surprising in the fact that today you cannot shoot lightning from yesterday's storm. Let alone the same opportunity to shoot lightning today and tomorrow at the same place. It is possible to speculate that today it is possible to photograph the lightning of the day yesterday from the distance of one light day, where the light has just arrived, but it is certain that tomorrow the light will be two light days away.

Analyze analogous situation with CMB according to hypothesis B. We know that microwave radiation has been measured many times in different periods. So we have a certainty that the radiation from the emission site has arrived on Earth. According to BBT, we can determine when the radiation was emitted, so we can calculate how far from Earth radiation was emitted so that it could be measured from Earth at present [1,36]. The BBT recombination period occurred at t_{e0} before the present $t_{e0} = 13.8 \times 10^9 - 378 \times 10^3 [Year] \simeq 13.8 \times 10^9 [Year]$.

We get a distance $D_{e0} = 13.8 \times 10^9[ly]$.

How did it before, for example at the time of the creation of the Earth? We can assume that the position of the Earth and the moment of Earth's creation are not physically significant, and therefore there is no reason for CMB to affect the Earth's surface at the time of Earth's creation, or at any time in the past between the time of Earth's creation and the present. Let us analyze cautiously both possible variants, i.e. variant B1, that CMB was on Earth at the time of Earth's creation, and variant B2 that CMB did not exist on Earth at that time.

In the case of B1, we can similarly calculate the distance CMB resources from Earth at the time of formation of the Earth $t_{e1} = 13.8 \times 10^9 - 378 \times 10^3 - 4.54 \times 10^9[Year] \simeq 9.26 \times 10^9[Year]$. We get $D_{e1} = 9.26 \times 10^9[ly]$.

From the difference of distances and times we can calculate the average velocity of movement of the CMB source with respect to the Earth or the Earth relative to the CMB source (the duration of the recombination time is negligible).

$$v_{sA} = \frac{D_{e0} - D_{e1}}{t_{earth}} = \frac{13.8 \times 10^9 - 9.26 \times 10^9}{4.54 \times 10^9} = 1[ly/Year]$$

Thus, in the case of B1, the CMB source must move at an average speed of 1 light year per year relative to Earth, that is, the speed of light.

In the case of B2, we know that today CMB falls on Earth and that the evolution of the universe is monotone according to BBT (no oscillations). Therefore, we can rule out the situation that CMB existed at Earth's place before the Earth originated and then ceased to fall (and then began again). In the case of B2, we also know that the distance of CMB source from Earth was greater than D_{e1} and therefore CMB began to fall on Earth only later.

We can calculate the smallest possible average speed of CMB resource from the moment of the Big Bang to the moment of the Earth creation $v_{sB} > \frac{D_{e1}}{t_{e1}} = \frac{9.26\times10^9}{9.26\times10^9} = 1[ly/Year]$.

Thus, for variant B2, the CMB source had to move at least at an average speed greater than the light velocity over the entire period from Big Bang to the moment Earth was created.

Therefore, from the fact that we are able to measure CMB interpreted as the radiation of a remote source according to hypothesis B, CMB source has to move at the average speed of light with respect to the Earth, all the time from the time of recombination until today. At the same time, the CMB source had to be at a distance $D_{e0} = 13.8 \times 10^9[ly]$ from Earth.

The CMB is measured in all directions from Earth. According to BBT, the CMB source is a point source when compared to the current size of the universe. It follows that, according to BBT, the Earth moves at the speed of light in all directions at the same time, that is, it moves simultaneously in two opposite directions (i.e. the same direction with the opposite orientation) to the same source at the speed of light.

We have an interesting paradox. At the time of CMB radiation, i.e. about 378,000 years after the Big Bang [36], the CMB source was $D_{e0} = 13.8 \times 10^9[ly]$ away from the Earth (in order to receive its radiation nowadays), yet the dimension of the whole universe had to be such that recombination may occur. So it had to be significantly smaller than $D_{e0} = 13.8 \times 10^9[ly]$.

At the same time, the same CMB source had to be far $D_{e1} = 9.26 \times 10^9[ly]$ from the same Earth in order to be able to accept CMB on Earth at the time of Earth's creation. So, the CMB Source and the Earth had to move away at the speed of light. According to theory of relativity [37], it is not possible if the CMB source has a nonzero rest mass.

7.2.1 Cross check

Check the internal consistency BBT different ways to calculate and compare the results. Calculate the CMB source velocity according to Hubble law, CMB source distance and CMB source temperature.

7.2.1.1 Source speed based on distance

According to BBT - Hubble law [5], we calculate the current CMB source speed (index 0) and speed at the time of formation of the Earth (index 1) by distance (calculated from the CMB propagation time and velocity).
$v = H_0 \cdot D$

$$v_{s0} = H_0 \cdot D_{e0} = 70.4[km\,s^{-1}/Mpc] \cdot \frac{1}{3.26} \times 10^{-6}[Mpc/ly] \cdot 13.8 \times 10^9[ly] = 298 \times 10^3[kms^{-1}]$$

$$v_{s1} = H_0 \cdot D_{e1} = 70.4[km\,s^{-1}/Mpc] \cdot \frac{1}{3.26} \times 10^{-6}[Mpc/ly] \cdot 9.26 \times 10^9[ly] = 200 \times 10^3[kms^{-1}]$$

In the first case, the speed roughly corresponds to the previous calculation, i.e. the speed of light, in the latter case the deviation is very high (33% and 50% respectively).

Since Hubble's constant is time-dependent according to BBT, let us try to calculate the constant size to get the correct speed, the same speed as in the first case

$$H_1 = H_0 \frac{v_{s0}}{v_{s1}} = 104.9[km\, s^{-1}/Mpc].$$

This suggests that the rate of expansion of the universe should be significantly greater at the time of Earth's creation than at present. This is in contradiction with new measurements that are interpreted to the contrary, that is, the rate of expansion is increasing [29].

7.2.1.2 Source distance according to red shift

Relict radiation corresponds to the black body radiation temperature of T_r = 2.726 K. According to the BBT, this corresponds to the original radiation of the black body of about 3000 K and the red shift of about 1100. According to Hubble law [6] recessional velocity $cz \approx v_r$, which only applies to small red shifts. For big red shifts, the BBT does not offer a clear answer – see [38].

According to published theories for z = 1100 velocity needed to achieve such a shift either 1100c (thousand times the speed of light) for the linear dependence or about 3 times the speed of light for general relativity or near the speed of light (special relativity).

Distance calculation resources by Hubble law by the red-shift determined by Planck's law i.e. z = 1100 system.

According to Hubble law can calculate the distance to the source with known red shift $D \approx \frac{cz}{H_0} = \frac{300\times10^3[kms^{-1}]\cdot 1100[1]}{70.4[kms^{-1}/Mpc]} = 4.7 \times 10^6[Mpc] = 15.3 \times 10^{12}[ly]$.

Thus, according to the red shift could be the source of more than a thousand times more distanced than traveled by light from the Big Bang.

Thus, light with the red shift corresponding to the CMB-measured temperature and BBT-calculated temperature, would have to reach 15.3 Ty on the Earth according to the Hubble Law. Age universe by BBT is 13.8 Gy, therefore more than 1000 times smaller. This means that if the BBT is used strictly, the radiation from the CMB source should not be measurable or its redshift is different from that reported and therefore inconsistent with the BBT.

7.2.1.3 CMB source temperature

Calculate the red shift and the source temperature of the measured CMB, provided the light was emitted at BBT recombination time, i.e. at a distance $D_{e0} = 13.8 \times 10^9[ly]$

$$z \approx \frac{H_0 \cdot D}{c} = \frac{70.4[kms^{-1}/Mpc]\cdot\frac{1}{3.26}\times10^{-6}[Mpc/ly]\cdot 13.8\times10^9[ly]}{300\times10^3[kms^{-1}]} = 0.99$$

$$\frac{\lambda_0}{\lambda_e} = z + 1 = 1.99$$

This means that the source of the measured CMB has a temperature of T_s = 5.43 K and not 3000K as reported by BBT. This is more than 500 times lower. This means that according to the Hubble’s equation and according to Planck's law, the source of the measured CMB has a temperature of T_s = 5.43 K and not 3000K as reported by BBT.

7.2.1.4 Largest red shifts

According to [39], the maximum measured red shifts are z = 11.1, corresponding to 400 million years after the Big Bang. In addition, "The cosmic microwave background has a redshift of z = 1089, corresponding to an age of approximately 379,000 years after the Big Bang and a commoving distance of more than 46 billion light years." Because light travels at the speed of light travels a distance of 1 ly per year. CMB rays from a distance of 46 billion light-years spread 46 billion years. Because according to BBT CMB was emitted 13.8 billion years ago, rays CMB may arrive at Earth until after 32 billion years. This means that the measured CMB cannot be explained by BBT.

7.3 Red Shift, Speed and Expansion

The basic experimental BBT argument is the measured dependence of the red shift on the distance of the source, which can be approximated by linear dependence in the first approximation.

This led to the quantification of the Hubble constant and the formulation of Hubble law [6] the Hubble constant, i.e. the approximation of the measured results, gradually changed with the improvement of the measurement technology (in a ratio greater than 1: 7). This results from the problem of the accuracy of measuring the distance of very distant light sources in space.

The first interpretation of the measurement results indicates the speed of the light source as a result of the measurement, although the distance was measured very inaccurately and the speed is defined as the time change of the distance.

How was the radiation source velocity measured? Was it measured? How was the speed detected? In deeper study of this question, we find that speed was never measured, the change in wavelength of spectral lines in the spectrum of distant sources, called the red shift, was measured. The speed was calculated based on the interpretation of Vesko Slipher [40] by using the Doppler effect in 1921. Hubble then used this interpretation [41]. It was not experimentally verified that the measured red shift is due to the Doppler effect. This means that the speed of the light source has never been scientifically verified. So whether it is a speed calculated according to the Hubble equation or zero speed or negligible velocity or other. Only the difference in the spectrum of remote sources and the dependence on the source distance were measured.

There are currently two hypotheses in the BBT on the interpretation of the measured red shift: "At the time of the discovery and development of Hubble's law, it was acceptable to explain the redshift phenomenon as a Doppler shift in the context of special relativity, and use the Doppler formula to associate redshift z with velocity. Today, the velocity-distance relationship of Hubble's law is viewed as a theoretical result with a velocity to be associated with the observed redshift not by the Doppler effect, but by a cosmological model correlating the recessional velocity to the expansion of the Universe. Even for small, the velocity entering Hubble law is no longer interpreted as a Doppler effect, although at a small velocity-redshift relation for both interpretations is the same."-[6].

Before we analyze the physical properties of both hypotheses i.e.:

A - Red shift is due to the Doppler effect

B - The red shift is a result of expansion of the wavelength ("recessional velocity").

We analyze the general relationship between distance, velocity, and space expansion.

7.3.1 Time dependence

BBT Scale Factor Definition: $D(t) = R(t) \cdot D_0$.

Physical definition of speed $v(t) = \acute{D}(t)$ - speed is the time change of distance. From the Scale factor definition we get $v(t) = \acute{R}(t) \cdot D_0$ (if we consider the reference distance D_0 as constant).

We calculate the general relation for the velocity and distance ratio from the Scale factor:

$$\frac{v(t)}{D(t)} = \frac{\acute{R}(t) \cdot D_0}{R(t) \cdot D_0} = \frac{\acute{R}(t)}{R(t)}.$$

7.3.2 Spatial dependence

Take two bodies B_1 and B_2 at the distance D_1 and D_2 from the observer where $D_1 \neq D_2$.

Expansion is described by the Scale factor definition $D(t) = R(t) \cdot D_0$.

Calculate the time dependence of the distance of both bodies (at the same time):

$$D_1(t) = R(t) \cdot D_{10} \qquad D_2(t) = R(t) \cdot D_{20}.$$

Speed is calculated as the time derivative of the distance:

$$v_1(t) = \dot{R}(t) \cdot D_{10},\ v_2(t) = \dot{R}(t) \cdot D_{20}.$$

Acceleration as the second time derivative of the distance $a_1(t) = \ddot{R}(t) \cdot D_{10}$, $a_1(t) = \ddot{R}(t) \cdot D_{10}$.

If the Scale Factor time derivative is different from zero and the reference distance is different from zero, we can calculate the ratio of velocities $\frac{v_2(t)}{v_1(t)} = \frac{\dot{R}(t) \cdot D_{20}}{\dot{R}(t) \cdot D_{10}} = \frac{D_{20}}{D_{10}}, \quad v_2(t) = \frac{D_{20}}{D_{10}} \cdot v_1(t)$.

The ratio of the speeds caused by the expansion of the space is equal to the distance ratio. This ratio is time independent. The speeds expand as well as the distance (for any non-zero Scale factor time derivative).

If the second time derivative of Scale factor is different from zero and the reference distance is different from zero, we can calculate the acceleration ratio

$$\frac{a_2(t)}{a_1(t)} = \frac{\ddot{R}(t)\cdot D_{20}}{\ddot{R}(t)\cdot D_{10}} = \frac{D_{20}}{D_{10}}\,,\ \ a_2(t) = \frac{D_{20}}{D_{10}}\cdot a_1(t).$$

The acceleration ratio due to expansion of space is equal to the distance ratio. Acceleration expands as well as distances (for any non-zero time derivative Scale factor and at any time).

Distance, velocity, and acceleration are thus expanded at the same time-constant ratio

$$\frac{a_2(t)}{a_1(t)} = \frac{v_2(t)}{v_1(t)} = \frac{D_2(t)}{D_1(t)} = \frac{D_{20}}{D_{10}}.$$

We have three theoretical options:

I. $\dot{R}(t) = 0$ and $\ddot{R}(t) = 0$
II. $\dot{R}(t) \neq 0$ and $\ddot{R}(t) = 0$
III. $\dot{R}(t) \neq 0$ and $\ddot{R}(t) \neq 0$

After these general analyzes of the properties of the expanding space, we analyze two basic physical hypotheses of the experimentally verified red shift.

7.3.3 Doppler effect

Hypothesis A: The original Hubble's law applies; the ratio between speed and distance is constant. Thus the red shift is due to an experimentally verified Doppler effect.

The general relationship between velocity and distance $\frac{v(t)}{D(t)} = \frac{\dot{R}(t)\cdot D_0}{R(t)\cdot D_0} = \frac{\dot{R}(t)}{R(t)}$ can be rewritten into the form of the ordinary differential equation $\frac{v(t)}{D(t)}\cdot R(t) - \dot{R}(t) = 0$. According to the hypothesis, the ratio of velocity and distance is constant and is equal to Hublov constant $\frac{v(t)}{D(t)} = H$, we reach the equation $H\cdot R(t) - \dot{R}(t) = 0$.

This equation has a known solution $R(t) = e^{Ht} + R_0$. From the Scale factor definition, we get the value of the integration constant R_0. $D(t) = R(t)\cdot D_0$ for t = 0 $D(0) = R(0)\cdot D_0 = D_0$ then $R(0) = 1$. Therefore $R_0 = 0$.

Let us summarize. From the constant ratio of velocity to distance hypothesis, the only possible solution of the Scale factor time dependence $R(t) = e^{Ht}$ is obtained. Since speed and acceleration directly derive from the Scale factor definition, we find: $v(t) = \dot{R}(t)\cdot D_0 = H\cdot D_0\cdot e^{Ht}$ and $a(t) = \ddot{R}(t)\cdot D_0 = H^2\cdot D_0\cdot e^{Ht}$.

Distance, velocity and acceleration increase exponentially with time. Because in this case the terms $\dot{R}(t) \neq 0$ and $\ddot{R}(t) \neq 0$ of option III of the spatial dependency analysis are applicable and the spatial dependency $\frac{a_2(t)}{a_1(t)} = \frac{v_2(t)}{v_1(t)} = \frac{D_{20}}{D_{10}}$ also applies. This means that speed and acceleration increases linearly with increasing distance. Thus, time dependence is exponential and spatial is directly proportional to distance.

7.3.3.1 Physical consequences

According to Newton's laws, the force of acceleration of the material body is a necessary condition. The acceleration is inversely dependent on the mass of the body. Because the expansion of space is independent of the mass of bodies and therefore the acceleration does not depend on the mass of bodies, the hypothetical force must be dependent on the body mass.

As the acceleration increases linearly with the increasing distance between the bodies, the force must increase linearly with the increasing distance. Since the acceleration must be positive, it must have the force direction repelling bodies among themselves. Because acceleration increases exponentially over time, the force must grow exponentially over time. Physics knows the only force that is dependent on the mass of the body and that is the gravitational force. However, it has an inverse dependence on the distance and the opposite direction of force, rather than the force required to move the body during expansion.

A necessary condition of expansion according to hypothesis A is the existence of an unknown kind of gravitational force, which has the following characteristics:

•Is directly proportional to the weight of the body.
•Grows linearly with increasing distance between bodies and exponentially over time.
•Causes repulsion of bodies.

Therefore, the further the bodies are, the greater the repulsive force between them, the later the greater the force.

Such a physical phenomenon has not yet been experimentally verified.

On the other hand, wavelength variation, depending on the velocity between the observer and the source of the waves, is a known and experimentally verified Doppler effect.

7.3.4 Expansion of wavelength

Hypothesis B: The wavelength of the light expands in the same way as the space; the ratio between the distance and the wavelength expansion is constant. Thus the red shift is caused by the unverified physical effect that is the subject of the hypothesis.

The wavelength extends as much as space. By applying the Scale factor definition

$D(t) = R(t) \cdot D_0$ to wavelength we get $\lambda(t) = R(t) \cdot \lambda_0$.

The linear dependence of the wavelength growth on the distances is expressed by the relationship $\frac{\Delta\lambda}{\lambda_0} = k_A \cdot D$.

Because $\Delta\lambda = \lambda - \lambda_0$ we are adjusting $\frac{\Delta\lambda}{\lambda_0} = k_A \cdot D$ for $\Delta\lambda = k_A \cdot D \cdot \lambda_0 = \lambda - \lambda_0$ that $\lambda = k_A \cdot D \cdot \lambda_0 + \lambda_0$ we use $\lambda(t) = R(t) \cdot \lambda_0$ and get $R(t) \cdot \lambda_0 = k_A \cdot D \cdot \lambda_0 + \lambda_0$ therefore

$$R(t) = k_A \cdot D + 1.$$

As light propagates from the distance D at time t where $D = c \cdot t$ we recalculate

$$R(t) = k_A \cdot D + 1 = k_A \cdot c \cdot t + 1 = v_R \cdot t + 1$$

where the constant v_R denotes the velocity of expansion of the Scale Factor.

This result can be interpreted as the time dependency of the Scale Factor.

Calculate the time dependence of the rate of expansion and distance using the same procedure as in Variant A.

$$\frac{v(t)}{D(t)} = \frac{\dot{R}(t)}{R(t)} = \frac{v_R}{v_R \cdot t+1} = \frac{1}{t+1/v_R} = H(t).$$

In this hypothesis, the expansion acceleration is zero, i.e., the body is moving away due to a constant expansion velocity.

This hypothesis corresponds to Option II. of spatial analysis where $\dot{R}(t) \neq 0$ and $\ddot{R}(t) = 0$. In this case, the limited spatial dependency $\frac{v_2(t)}{v_1(t)} = \frac{D_{20}}{D_{10}}$ applies, i.e. the velocity of the body increases with increasing distance. This is due to the speed versus distance dependence. The velocity of expansion is constant over time.

The ratio between velocity and distance decreases inversely in proportion to time as the bodies move away from each other at a constant speed.

Now compare the size of the red shift of the hypothesis formed by the expansion space with the size of the red shift arising from the Doppler effect for distant source.

For Doppler's light effect, for example, see [6] $z = \frac{\Delta\lambda}{\lambda_0} \approx \frac{v}{c}$. The speed of the source and the observer is given by $v(t) = \dot{R}(t) \cdot D_0 = v_R \cdot D_0$. Therefore, there is another red shift according to the Doppler effect $z_D \approx \frac{v}{c} = \frac{v_R \cdot D_0}{c}$

The red shift according to the wavelength expansion hypothesis is $\lambda(t) = R(t) \cdot \lambda_0$ where $R(t) = k_A \cdot D + 1$.

We will adjust

$$z_E = \frac{\Delta\lambda}{\lambda_0} = \frac{\lambda - \lambda_0}{\lambda_0} = \frac{R(t) \cdot \lambda_0 - \lambda_0}{\lambda_0} = R(t) - 1 = k_A \cdot D.$$

The relationship between constants is $k_A \cdot c = v_R$

We calculate the red shift ratio

$$\frac{z_D}{z_E} = \frac{\frac{v_R \cdot D_0}{c}}{k_A \cdot D} = \frac{k_A \cdot D_0}{k_A \cdot D} = \frac{D_0}{D} = \frac{D_0}{R(t) \cdot D_0} = \frac{1}{R(t)} = \frac{1}{z_E+1}.$$

Thus, the red shift caused by the Doppler effect is approximately the same as the red shift resulting from the wavelength expansion hypothesis for small red shifts.

The total red shift is the sum of both shifts $z = z_D + z_E = \frac{z_E}{z_E+1} + z_E = \frac{z_E + (z_E+1) z_E}{z_E+1} = \frac{2z_E + z_E^2}{1+z_E}$.

For small red shifts, the total red shift is nearly twice the red shift according to the wavelength expansion hypothesis.

7.3.4.1 Physical consequences

In this variant, there is apparently no problem with unknown gravitational force as in variant A.

Instead, the variant is built on the wavelength expansion hypothesis just as the expansion of space. Such a phenomenon has not yet been experimentally verified in any other way.

According to the hypothesis, the speed increases with increasing distance, and the ratio between speed and distance decreases inversely in proportion to time.

At the same time, this variant does not include the influence of wavelength variation due to the nonzero velocity of the radiation source relative to the observer. It should exhibit an experimentally verified Doppler effect with the appropriate properties. Thus, for small red shifts, the measured red shifts should be doubled, and a red shift dependence corresponding to the dependence of red shift ratios should be shown. If such a phenomenon is not analyzed in the measured results, it is inconsistent with physical laws. It is not experimentally verified that the Doppler effect could be turned off or otherwise removed.

7.3.4.2 Reference time and reference distance

The Scale factor definition is described $D(t) = R(t) \cdot D_0$. Physically, the reference time t = 0 or the reference distance D_0 is ambiguously determined. It is not clear whether or not the reference time is shifting as is common in reproducible experiments, so it is not clear whether the hypothesis is verifiable by reproducible experiments.

This is equally true of the reference distance. It's a certain distance fixed in the history of the evolution of the universe or the distance at any moment. Is it a distance relative to the history or future of the radiation source and its long-term existence, or is the distance at any given moment, e.g. the moment of the radiation of the observed photon or the distance at the moment of observation?

How to calculate the speed correctly according BBT? When computed according to the Scale factor definition, the speed of motion is not included as a result of the speed-to-distance ratio. Let's show it on an example with a constant rate of expansion

$R(t) = v_R \cdot t + 1$ where v_R is time-invariant constant.

At time t_1 the body is at a distance D_1 from the observer and it moves at a speed v_1 $v_1(t_1) = \dot{R}(t_1) \cdot D_0 = v_R \cdot D_0$. We use the distance D_1 as the reference distance to calculate the velocity v_2 at time t_2. Since the time derivative of Scale factor is constant, we need not address the issues of the time shift, therefore

$v_2(t_2) = \dot{R}(t_2) \cdot D_1 = v_R \cdot D_1$.

Calculate D_1

$D_1(t_1) = R(t_1) \cdot D_0 = (v_R \cdot t_1 + 1) \cdot D_0 = D_0 + D_0 \cdot v_R \cdot t_1$ and substitute

$v_2(t_2) = v_R \cdot D_1 = v_R \cdot (D_0 + D_0 \cdot v_R \cdot t_1) = v_R \cdot D_0 + D_0 \cdot v_R^2 \cdot t_1 = v_1(t_1) + v_1(t_1) \cdot v_R \cdot t_1$.

This is a surprising result. Although the rate of expansion is unchanged over time, the body velocity varies due to the change in the distance of the body and the speed dependence on the distance.

Speed is changing; there must be acceleration and therefore force. Therefore, even in this case, an unknown gravitational force with the opposite direction of force and the opposite distance dependence is needed than Newton's gravity.

7.3.5 Summary 3

BBT uses two different physical interpretations of the measured red-shift dependence on the distance of the radiation source. These interpretations have significantly different physical properties.

The direct consequence of the interpretation based on the experimentally verified Doppler effect (hypothesis A) is exponential growth of velocity and acceleration of space expansion over time. Otherwise, the physical conditions necessary for the validity of this hypothesis could not be met. The consequence of such a hypothesis is the exponential growth of the red shift over time.

The direct consequence of the hypothesis B, i.e. the interpretation of the red shift as a consequence of recessional velocity, is the necessity of a constant velocity expansion and thus the independence of the space expansion velocity over time and distance. This hypothesis is in direct conflict with Hubble's law, which is considered to be the BBT pillar.

Experimental results of the measured red shift are roughly twice lower than would be expected for hypothesis B (for small z).

In both cases, an unknown gravitational force with properties relevant to the given hypothesis is needed to expand the space and movement of the mass bodies in such an expanding space. No hypothesis can be demonstrated by the use of only known and experimentally verified physical laws.

The actual expansion velocity of light sources and hence the rate of expansion of space has not yet been directly verified experimentally.

8. CONCLUSIONS

Based on analyzes performed, significant physical shortcomings of the BBT cosmological model have been identified.

The formulated alternative cosmological model does not have these shortcomings.

It is left to the reader to make his / her own opinion.

ACKNOWLEDGEMENT

Many thanks go to my family, especially my wife Světla. The contribution could not be made without tolerance and support.

COMPETING INTERESTS

Author has declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle3.com/review-history/50051