Universe Modeling by the Variable Measurement Standards

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Abstract: - This work discusses an approach developed for the study of Universe simulators based on the idea of measurement standards variability. It permits us to develop simulators of the Universe, describing the Hubble law, red shifts' independence of the wavelength, "tired light" effect and some others as manifestations of measurement standards variability. Studies using this approach suggest that the universe is likely to be more stable than it is believed today.

Keywords: - universe; Hubble law; red shifts; Doppler Effect; measurement standards variability; tired light; modeling

1 Introduction

In 1744, Swiss astronomer J.P. Cheseaux was the first to cast doubt on the correctness of the belief about an endless universe [1]: if the number of stars in the universe is infinite, why all the sky does not shine as the surface of a single star?

About 170 years latter in 1915, in Germany Albert Einstein demonstrated a new theory of gravitation based on the Theory of Relativity and on a stable universe idea [2].

In the first half of the 1920s Alexander Friedmann in the Soviet Union is credited with developing dynamic equations based on the theory of Einstein for an expanding and oscillating universe [3].

Adopted today the Standard Model of the Universe is based on the proposed in 1927 by the Belgian Catholic priest George Lemaitre idea of the Big Bang [4]. According to this concept, the monstrous explosion of energy, initially focused in the compact "egg", gave birth to our Universe, its galaxies, stars, planetary systems, etc. The experimental law describing galaxies expansion, meeting Friedmanns' findings and thus illustrating this consequence of the Big Bang was discovered by an American astronomer Edwin Powell Hubble in 1929 [5]. This law describing linear dependence of radial velocities of galaxies on distances was based on the one hand on the red shift of galaxies spectra explanation by the Doppler Effect and on the other hand, latently, on the stability of used measurement standards. Alternative to this Law resulting in the slowly expanding flat universe is proposed in [6]. Mentioned above two basic concepts gave birth to the Standard Model, which explaining a lot of phenomena, seems to be not free of inherent contradictions.

In the same 1929 year another Swiss astronomer Fritz Zwicky proposed a "tired light principle" based on the opposite approach - stability of the universe, describing gradual energy loss by photons as they travel through the space which is attributed to the red shift-distance law [7]. This approach was also developed by the other researchers [8], [9].

In 1931, Albert Einstein, taking into account the Hubble law, had to correct his theory, noting that it is possible, only if explanation of the red shift by the Doppler effect is true [10].

At a glance, this sequence of events shows the contradictions that arose between supporters of the models of stable and endless and finite but expanding universe, but both kinds of models have inherent similarities:
1. Both kinds of models are based on the use of stable measurement standards.
2. Both kinds of models contain inherent contradictions.

Some of these contradictions are discussed below.

Three contradictions of the expanding universe theory:

- equal density of matter distributed in the universe if linear measurement standard is equal or exceeds 10^9 light years;
- for the galaxies located at the distances not exceeding 2 – 3 Mpc. from the Centre of the Local Neighborhood, velocities do not meet the Hubble Law;
- all attempts to simulate dark energy distribution explaining status quo for the distances not exceeding 4 Mpc. from the Centre of the Local Neighborhood, failed [11].

Similarly three contradictions of the universe simulators based on the ideas of a stable universe:

- red shift does not depend on the wavelength;
- there is no known interaction that can degrade a photon's energy during its space travel without changing its momentum, thus resulting in blurring of distant objects which is not observed;
- availability of the Cosmic Microwave Background and its anisotropy.

As both kinds of the universe simulators using stable measurement standards are not free of contradictions, below is developed the proposed in [12-16] approach which is based on the variability of measurement standards for new simulators of the universe: we suppose that any measurement process can be presented as consisting of two stages: at the first stage we fix value of the measured parameter using auxiliary units, and at the second one we transform these data presenting them in corresponding measurement standards. Thus result of measurement presented to the observer is the ratio with fixed value of the measured object parameter in auxiliary units in the numerator and measurement standard value in the same units in the denominator. Two examples below illustrate this statement:

a) display of an electronic stopwatch always reflects such a ratio: in the numerator - the number of oscillator pulses issued since the start of measurement, in the denominator - the number of pulses generated within one second;

b) the stretched thread segment connecting points "A" and "B" on a flat surface, fixes the shortest distance between these points, but it does not determine its' value: only by showing that this segment contains "n" times the linear measurement standard, it can be argued that the shortest distance between points "A" and "B" is known and it is equal to “n”.

2 Measurement standards variability

Below we show that an alternative to the explanation of the Hubble Law with the help of the Doppler Effect can be variability of the standards used to measure distances and time. It is easy to show that stability of the standards used to measure distances depends on that of the time measurement standard because of the modern definition of the meter: the meter can be determined by a product of velocity of light and of time interval equal to $3.335640951 \cdot 10^{-9}$ s. In other words stability of the value of the meter as of linear measurement standard directly depends on stability of time measurement standard value. That is why the time measurement standard stability is analyzed by the system, including the Hubble Law and modern definition of a meter as a product of velocity of light “c” and mentioned above time interval “t_0”:

$$\begin{cases} \forall i \in I : \dfrac{dL_i}{dt} \approx HL_i; \\ \forall i : t = \dfrac{T_i}{\tau}; \\ r = c \cdot t_0; \\ \forall i : L_i = \dfrac{R_i}{r} \end{cases} \qquad (1)$$

where: I - the set of space objects; H is the Hubble constant ($H = 2.3 \cdot 10^{-18}$ s^{-1}); R_i is the measured in auxiliary units distance between an observer and i-th space object; r is a linear measurement standard value measured in the same auxiliary units; T_i is the running time in auxiliary units measured by clock of an observer; τ is equal to the number of auxiliary units used for time measurement, corresponding to the time measurement standard; t is the running time measured by the watch of an observer in time measurement standards; L_i - distance between an observer and i-th space object in linear measurement standards. Solving system (1), we get [12]:

$$\begin{cases} \tau = \tau_0 \cdot \exp\{H \cdot t\}, & (2) \\ r = r_0 \cdot \exp\{-H \cdot t\}, & (3) \end{cases}$$

where τ_0 is equal to the value τ if t = 0; r_0 is equal to the value r if t = 0.

Equations (2) and (3) display opposite dependences on time of standards used to measure the distance and time. Equation (2) reflects growth of time measurement standard with time t, corresponding to decreasing duration of physical processes fixed by an observer. It is also possible to say that time motion is accelerating, but in our everyday life we do not fix it directly due to small value of the Hubble constant. Vice versa, equation (3) reflects reduction of linear measurement standard with time t. Table 1 shows the standard values and relative deviations in the determination of radii (column 4) and distances (column 6) to some disposed far stars-super giants caused by using (3).

Table 1

#	Star	Standard radius R value	Relative deviation ΔR	Standard distance L (light years)	Relative deviation ΔL
1	2	3	4	5	6
1	μ Cephei	1500-R_S	$3.7 \cdot 10^{-7}$	5750	$3.27 \cdot 10^{-7}$
2	Cephei A	1450·R_S	$3.9 \cdot 10^{-7}$	5000	$3.72 \cdot 10^{-7}$
3	ρCassiopeia	400·R_S	$5.8 \cdot 10^{-7}$	8200	$5.67 \cdot 10^{-7}$
4	neb	203·R_S	$1.2 \cdot 10^{-7}$	1550	$1.49 \cdot 10^{-7}$

The third column of this table contains the stars radii compared to the radius R_S of the Sun (R_S = $6.957 \cdot 10^8$ m.), in the fifth column the distances to these stars in light years are given.

3 The Hubble Law and Doppler Effect

Substituting (3) and the last equation of system (1) in its first equation, and denoting the velocity of fixed distance value *R* change as *V*, while denoting fixed by an observer velocity *dL/dt* as V_0, we can determine *V* value as follows (see Figure 1): $V = V_0 - HL.$ (4)

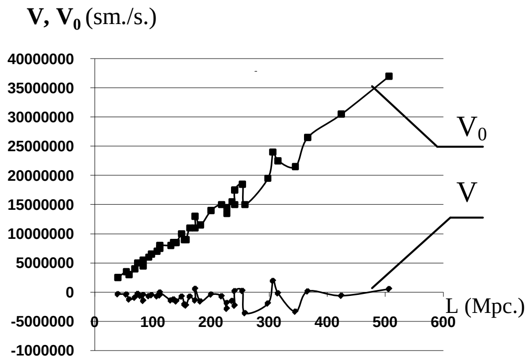

Fig. 1. Dependences of galaxies velocities values V_0 and V on distance L

Thus dependence of galaxies velocities values V_0 on L corresponds to the Hubble Law, whereas dependence V on L and V_0 meeting (4) thus corresponding only to the peculiar velocities of galaxies. In other words, due to the above considerations, there is an alternative explanation of the Hubble law: expanding universe may be an illusion, caused by the reduction of linear measurement standards meeting (3), used by an observer.

As for relation between distance and radial velocity galaxies determination Edwin Hubble used Doppler Effect, applying equation (4) for the objects with the following characteristics:

- relativistic effects can be ignored i.e. V<<c;
- radial velocity direction of electromagnetic oscillations of a moving object – emitter of electromagnetic oscillations coincides with its velocity direction and with direction to the object – receiver of these oscillations, which results in the following transformation of (4):

$$V_0 = c\left(1 - \frac{\nu_0}{\nu_1}\right) + HL, \qquad (5)$$

where: ν_0- oscillation frequency of emitter; ν_1 - oscillation frequency fixed by a receiver.

It is obvious that due to the smallness of the Hubble constant, the second term on the right-hand side of equation (5) would affect only with large values of L.

4 The Red Shift independence on a wavelength

The above analysis allows us to offer an alternative explanation of the red shift independence of the wavelength. The redshift value z is determined as follows:

$z = (\lambda-\lambda_0)/\lambda_0$. (6)

where: λ is the wavelength of electromagnetic waves determined by an observer, λ_0 – the wavelength of electromagnetic waves emitted by the emitter.
Due to the system (7) including equations (3), (6) and last equation of system (1):

$$\begin{cases} \lambda = \dfrac{R}{r}; \\ z = \dfrac{\lambda - \lambda_0}{\lambda_0}; \\ r = r_0 \exp(-Ht); \\ \lambda_0 = \dfrac{R}{r_0}, \end{cases} \qquad (7)$$

relation wavelength-time looks like:

$$\lambda = \lambda_0 \cdot \exp\{Ht\}. \qquad (8)$$

Substituting (8) in (6) we get the redshift z value depending only on time:

$$z = \exp\{Ht\} - 1. \qquad (9)$$

5 The "Tired light" effect as result of exponential shortening of linear measurement standard

Combining equation (6) with the dependences of energy and of wavelength on the oscillation frequency, we obtain the following system:

$$\begin{cases} \lambda = \lambda_0 \exp\{Ht\}; \\ E = h\nu; \\ \lambda = \dfrac{c}{\nu}, \end{cases} \qquad (10)$$

where E is energy of electromagnetic waves, ν - electromagnetic oscillations frequency, h - Planck's constant.
System (10) solution is resulting in the exponential reduction of photon's energy with time: $E = E_0 \cdot \exp\{-Ht\}$. (11)
In other words we fix the photon energy reduction due to exponential increase of a wavelength, corresponding to (8) and caused by our linear measurement standard shortening.

6 Conclusions

The above analysis leads us to the following conclusions:

1. The Hubble Law can be interpreted as a reflection of a comparatively stable Universe according to velocity/distance parameters, whereas used by an observer linear measurement standards are exponentially shortening with time.
2. The proposed approach has proved its productivity in relation to a number of phenomena, which the Standard Model ignores.
3. Since the variability of standards does not contradict the idea of expansion of the Universe, one of the directions of further development of the proposed approach is the combination of both of these concepts.
4. As the weight measurement standard – kilogram is determined as the weight of a cubic decimeter of water, thus depending on linear measurement standard value, it is possible to detect corresponding to shortening of a linear measurement standard loss of mass by any material point. The latter gives rise to reaction forces [17], which control gives us chance to control the forces of the gravitational interaction [14-16].

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