PARAMETERS OF THE ULTRASTABLE EXPANSIVE NONDECELERATIVE UNIVERSE

(Letter to the Editor)

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Abstract. The measurement of the temperature of the cosmic microwave background radiation (CMBR) with the Far InfraRed Absolute Spectrophotometer (FIRAS) on the Cosmic Background Explorer (COBE) satellite gives a possibility for determination of all mutually related parameters of the ultrastable expansive nondecelerative Universe (ENU) with deviations smaller than 0.4%.

The measurement of the large-scale anisotropy of the CMBR with the Differential Microwave Radiometers (DMR) on the COBE satellite allows us to determine the mass density of gravitationally bound systems of large-scale structures of the ENU.

1. The Universe with Total Zero and Local Non-Zero Energy

The total energy of the universe is exactly zero (Hawking, 1988). According to the General Theory of Relativity, gravitational forces are determined by the energy density $\varepsilon$ plus the three-multiple of the pressure $p$. Therefore, in the relativistic universe — with total zero and local non-zero energy — the relation $\varepsilon + 3p = 0$ holds, i.e. it is determined by the state equation (Skalský, 1991):

$$p = -\frac{1}{3}\varepsilon. \quad (1)$$

Using the Robertson–Walker metric (Robertson, 1929, 1935, 1936a,b; Walker, 1936), the Friedmann (1922, 1924) equations of homogeneous and isotropic relativistic universe dynamics can be written as:

$$\dot{a}^2 = \frac{8\pi G \rho a^2}{3} - k c^2 + \frac{\Lambda a^2 c^2}{3}, \quad (2a)$$

$$2a\ddot{a} + \dot{a}^2 = -\frac{8\pi G \rho a^2}{c^2} - k c^2 + \Lambda a^2 c^2, \quad (2b)$$

where $a$ is the gauge factor; $\rho$ the mass density; $k$ the curvature index; $\Lambda$ the cosmologic member; and $p$ the pressure.

The state equation (1) is the solution of the Equations (2a) and (2b) only with $k = 0$ and $\Lambda = 0$. Therefore, the homogeneous and isotropic relativistic universe — with total zero and local non-zero energy — is flat, expansive and non-decelerative (Skalský, 1991).
In this (ultrastable flat) expansive nondecelerative (homogeneous and isotropic relativistic) universe (with total zero and local non-zero energy) (ENU) hold the relations (Skalský, 1991):

\[
a = ct = \frac{c}{H} = \frac{2GM}{c^2} = \sqrt{\frac{3c^2}{8\pi G \rho}},
\]

where \(t\) is the cosmologic time, \(H\) the Hubble coefficient, and \(M\) the mass of ENU.

From relation (3) it follows that in the ENU the permanent constant maximum possible creation of matter (Skalský and Súkeník, 1991a)

\[
\delta = \frac{dM}{dt} = \frac{c^3}{2G} = 2.019 \times 10^{35} \text{ kg s}^{-1},
\]
takes place.

In the ENU the gravitation forces only act on the distances approximately 150 Mpc, i.e. only on approximately 1.5% of its present gauge factor \(a_{\text{pres}}\), which is determined by the relation (11). In the ENU in larger distances and globally, the gravitation is exactly compensated by the expansion of the ENU. Therefore, the ENU in larger distances and globally is homogeneous and isotropic and during the whole expansive-creative evolution phase it expands by velocity \(v = c\), in spite of its non-zero mass density \(\rho\) (Skalský and Súkeník, 1993b).

The model properties of the ENU are in agreement with the following observations:

- According to observations, the observed Universe is inhomogeneous and anisotropic only in distances approximate to 100–200 Mpc, i.e. approximately 1–2% of its present gauge factor \(a_{\text{pres}}\) (11). But, at larger distances it is homogeneous and isotropic.

- The most remote observed quasar PC 1247+3405 (Schneider et al., 1991) expands by velocity \(v > 0.94c\). This means that the observed Universe at the distance of the present gauge factor \(a_{\text{pres}}\) expands at radial velocity \(v \sim c\).

2. The Present Parameters of the ENU and the Parameters at the End of Radiation Era

The specific entropy of ENU \(S_s\) is determined by the relation (Skalský and Súkeník, 1992a,b)

\[
S_s = \frac{m_p c^2}{E_{\text{ph}(e)}} = 6.9 \times 10^7,
\]

where \(m_p\) is the mass of proton; and \(E_{\text{ph}(e)}\) energy of photon at the end of radiation era.

The present energy density of the cosmic microwave background radiation \(\varepsilon_{\text{CMBR(pres)}}\) is determined by the relation: