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Astronomy

On the Displacement of the Universe

Rezo Natsvlishvili

Ilia State University; Abastumani Kharadze Astrophysical Observatory

(Presented by Academy Member Jumber Lominadze)

ABSTRACT. The difference between the instant displacement and the observed movement of the Universe as well as the critical importance of their delimitation are reviewed. Displacement of the Universe according to nature of changes of the Hubble constant is analyzed and the dynamic of displacement in the case of pulsating Universe is introduced. The prospect of determining the ages of the Metagalaxy and of the Universe is considered. *© 2010 Bull. Georg. Natl. Acad. Sci.*

Key words: *Universe displacement, Hubble constant, pulsating Universe, Metagalaxy and Universe ages.*

The Hubble law $v=Hr$ is the instant feature of the state of the Universe, due to the time-dependent change of the Hubble constant. If the Hubble constant is a function of time, then the Hubble law may be generalized as: $v(t)=H(t)r$. The Hubble constant $H=H(t)$ determines the nature of displacement of the Universe at any moment of the real time t (epoch), i.e. $H(t)$ is a function characterizing the displacement of the Universe in time. According to the value of $H(t)$, the picture of displacement of the Universe can be introduced as follows:

1. $H(t) > 0$, the Universe is expanding.
2. $H(t) < 0$, the Universe is compressing.
3. $H(t) = 0$, the Universe remains static.
4. If $H(t) > 0$ and $dH(t)/dt > 0$, the Universe is expanding at an increasing (accelerating) rate.
5. When $H(t) > 0$ and $dH(t)/dt < 0$, the Universe is expanding at decreasing (slowing down) rate.
6. $H(t) = const > 0$, the Universe is expanding at a constant rate.
7. If $H(t) < 0$ and $dH(t)/dt < 0$, the Universe is compressing at a increasing (accelerating) rate.
8. When $H(t) < 0$ and $dH(t)/dt > 0$, the Universe is compressing at a decreasing (slowing down) rate.
9. $H(t) = const < 0$, the Universe is compressing at a constant rate.

The above listed conditions characterize the instant displacement of the Universe, i.e. its dynamic at any concrete t (concrete epoch). It is in principle impossible to observe simultaneously the entire Universe because of the limited light velocity. Therefore, we may observe the far areas of the Universe according to distances at different stages of development. The picture observed through the distances to concrete areas, reflects the different stages of their development, not a realistic instant state of the entire Universe as determined by the above listed conditions.

In the case of the pulsating Universe, if the cosmological constant $\Lambda=0$, a change of the Hubble constant at the stage of compression of the Universe, must be symmetric (quasisymmetric) to its change at the stage of expansion of the Universe and, the same internal drawing off forces, which are acting at the stage of increase of the Hubble constant starting from the moment of significant displacements, will slow down the compression of the Universe at the stage of a negative increase of the Hubble constant up to the initial (singular) state. As to the phase of slowing expansion of the Universe, that is presumably conditioned by the effect of gravitation, it will start from the moment when the drawing off forces become less than the gravity ones.

This stage will be symmetric to the stage of negative decrease of the Hubble constant until the same drawing off forces start acting at a certain stage of increasing the Universe's density, beginning from any increasing value of $\Omega>>1$ $(\Omega=\rho/\rho_c)$.

It is an established fact that beginning from the moment of the Big Bang up to now, the Universe is in an expanding state. Thus, the effect of the internal antigravity forces must have been considerably higher in comparison with the effect of the gravity forces. The nature of and balance between these forces existing at various stages of evolution of the Universe still remain problematic. Since we consider that the effect of the internal drawing off (antigravity) forces does not exist any more, it means that the expansion of the Universe takes place at a slowing down rate. Starting from the era of the Big Bang, the picture of the chronological dynamics of expansions and compressions depends upon the nature of the time-related changes of the internal drawing off forces for the pulsating model of the Universe, the concrete shape of which is in principle possible to obtain on the basis of determining the velocities of and the exact distances to the concrete objects or strata (layers) of the Universe.

We should always take into account that the instant-realistic and the observed Universe, i.e. the actual positions of any objects and areas of the Universe at any fixed moment and the positions thereof observed from the distance between us and them at different stages of development, must be clearly delimited from each other.

The structure of any area of the Universe at any moment must be identical, as proved by the homogeneity and isotropy, but, in principle it is impossible to observe all of them simultaneously. On the other hand. However, we can simultaneously observe the states of objects and areas placed far from us according to distances and being at different evolutionary stages of the Universe. This provides us with both opportunities and perspectives to restore the chronological picture of development of the Universe beginning from the earliest observed phases (objects and areas at the boundary of the Metagalaxy) up to the current phase of evolution and, get knowledge on development of the integral Universe, which, in its turn, forms the basis for understanding the evolutionary scenario of the future of the Universe.

Were it not for the possibility of simultaneous observation of the objects and areas being at different stages of development, one can imagine how difficult it would be to obtain a picture of evolution of the universe and substantiate even the existence of the evolutionary and structural changes thereof.

Undoubtedly, the evolutionary development of the Universe as a whole and of its single objects must be accompanied by their structural-dynamical processes. In particular, galaxies similar to our own and its neighboring galaxies have passed the early evolutionary stages until being formed in the current state. We can reconsrtuct the evolutionary development of the galaxies if we trace the changes of their shapes according to the distances between us and them. As a result of the observation conducted, we can state that the sequence of the galaxies in terms of their distances leads us to quasars – the forms of objects of the most distant and therefore the earliest evolutionary stage of the galaxies. Quasars are the earliest evolutionary phase of the galaxies which can be observed optically, while microwave "background" ("relict") radiation corresponding to 3K temperature, has even an earlier origin.

We think that the background in the Universe is not only of a microwave nature and that it must exist in other ranges of irradiation, as well, because: first, the universe had different temperatures at each stage of development; second, we observe the environment being at different stages of evolution and presumably, the rate of expansion of the Universe was higher at the earlier stages; and third, according to the Hubble law the redshift increases in accordance with distance.

Thus, the extragalactic background must cover the spectral range beyond the limits of 3K microwave radiation: centimeters, decimeters, kilometers, etc., and far and near infrared radiation on the side of the shortwave radiation. These background radiations must in all cases stem from discrete sources, but, their manifestation capacity will depend upon the power of the receiver and its angular resolving capacity.

Only the nearer (z=0) area reflects the current epoch's corresponding Universe and, the more environments containing objects of more z we observe, the farther we become removed from the evolutionary stage of this area in the past. According to the Hubble law, the redshift $z=z(r)$ is the function of the r distance. Thus, at the r distance, we record the evolutionary condition in which it was at some t moment in the past.

If use the expression provided in our earlier article [1],

$$\Theta = \int_0^R \frac{dr}{\Phi(r)},$$

where $v(r) = \Phi(r)$ is the velocity observed according to $\Phi(r)$ distance and, take into account the correlation of velocity v and z redshift, we receive:

$$\Theta_t = \frac{1}{c}\int_0^{R_t}\left[1+\frac{2}{z^2(r)+2z(r)}\right]dr$$

where R_t is the distance to the objects of the t epoch, c – light velocity. Θ_t will be the time period between the evolutionary epoch of the objects placed between the R_t distance and the current state.

If Ψ is the real time that has passed from the Big Bang to the moment t, then $T=\Psi+\Theta_t$ will be the age of the Universe.

To determine the Θ_t value, we must know the functional form of either the redshift z=z(r) or the Hubble constant H=H(t), where the variable t is the epoch, which corresponds to the distance r. It is important to note that in the given case, no time-related change of the distance r is implied. It (r) is only the z-corresponding indicator of the distances for the observed object of different distance at one and the same moment [2]. Yet, finally, to determine Θ_t, we should assess the distances to those objects whose z is measured through observations, directly.

In principle, in terms of changes of the velocities of the objects placed according to their distance and being observed over long time periods, it is possible to determine the functional form of the Hubble constant H(t) and, accordingly, to define the nature of displacement of the Universe during the real time t. The Hubble constant H(t) is the function of dv(t,r)/dt. Its true that simultaneous observation of the entire Universe is impossible, but, on the other hand, a picture of dynamical evolution of the Universe at different stages of development may be reconstructed chronologically according to the nature of changes of the runaway velocities of the observed objects placed at different distances from us, over long time periods of observation.

ასტრონომია

სამყაროს ძრაობის შესახებ

რ. ნაცვლიშვილი

ილიას სახელმწიფო უნივერსიტეტი; აბასთუმნის ხარაძის ასტროფიზიკური ობსერვატორია

(წარმოდგენილია აკადემიკოს ჯ. ლომინაძის მიერ)

ნაშრომში განხილულია სამყაროს მყისიერ ძრაობასა და დამზერილ მოძრაობას შორის განსხვავება და მათი ურთიერთისაგან გამიჯვნის პრინციპული მნიშვნელობა. გაანალიზებულია ჰაბლის მუდმივას ცვლილების ხასიათის მიხედვით სამყაროს ძრაობა. ნაჩვენებია სამყაროს პულსირების შემთხვევაში მისი ძრაობის დინამიკა. განხილულია სამყაროსა და მეტაგალაქტიკის ასაკის განსაზღვრის პერსპექტივა.

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