N. S. Kardashev, V. N. Lukash, and I. D. Novikov. *Observational cosmology and cosmological models.* While ten years ago observational cosmology was a science about the measurement of two number—the Hubble constant H_0 and the deceleration constant q_0, today, due to the advances in the research on the large-scale structure of the Universe, cosmology operates with a much larger number of fundamental parameters.

Despite the fact that many of these parameters are already known rather well (for example, the angular fluctuations of relict radiation—with an accuracy of up to the fifth decimal place), the main cosmological constants H_0 and q_0 still remain known only with an accuracy of a factor of two, although now there are good prospects of obtaining more precise values.

The Hubble constant is usually determined from the red shift—apparent magnitude of a galaxy diagram. For that it is necessary to have the following:

a) measurements at large distances in order to decrease the influence of local inhomogeneity (Virgo supercluster);

b) determination of the distance to at least one of the objects (for example, the central galaxy in the Virgo cluster).

The deformation of the Hubble motions caused by the gravitational influence of the local supercluster, has been studied by now sufficiently well. As for the estimate of distances, here there still remain some ambiguities. Two authoritative groups working on the development of distance scales to galaxies, giving for H_0 respectively the values of 50 (km/s)/Mpc (Sandage and Tamman), 100 (km/s)/Mpc (de Vaucouleurs and colleagues), differ in the choice of calibration systems (Cepheides, bright stars, regions of ionized hydrogen, etc.). This argument can be solved only after the launch of a space optical telescope, planned by NASA for 1987, which will directly determine the distance to Virgo by Cepheides, and thus determine H_0 with an accuracy of up to 10%.

In connection with the measurement of distance objects, the infrared range is very promising, since the effects related to the evolution of stars and to absorption are smaller in it. Here must also be mentioned the Tully-Fisher calibration method based on the dependence of IR emissivity of spiral galaxies on the angular velocity of their rotation, which is measured on the basis of the line width of the hyperfine structure of hydrogen atoms ($\lambda = 21$ cm). Distances to galaxies can be determined independently with the help of other methods (the expansion of radio sources and the shells of supernovae, the Zel'dovich-Syunyaev effect, etc.). Great expectations are connected with cosmological radio interferometers, planned in our country ("Radioastron") as well as abroad. Various methods give now values close to the range $H_0 = 50$–100 (km/s)/Mpc, $q_0 = 0 \pm 1$. It is still difficult to make predictions, although a number of observers think that H_0 is within the range from 65 to 75 (km/s)/Mpc (see, for example, a review by Huchra).

In recent years important data have been obtained on the distribution of visible and hidden matter in the Universe. Galaxies form a honeycomb structure with a typical size of empty areas (cells) of 30–35 Mpc. With an increase of emissivity of the studied objects the correlation scale of their distribution also increases. It is of the order of 8–16 Mpc for galaxies, 25–50 Mpc for clusters, and 100–300 Mpc for the brightest superclusters. The most reliably established today is the correlation scale of clusters; it agrees well with the size of the cells (see above).

From the curves of star rotations in spiral galaxies and from virial velocities of galaxies one can determine the amount of hidden matter in objects. It turned out that there is more hidden matter than visible matter, by factors of ten and hundred respectively for halos of massive galaxies and for clusters and superclusters. If one assumes that galaxies and hidden mass are distributed in the Universe in a similar way, then the total density of material in the Universe in units of critical density turns out to be $\Omega = 0.15 \pm 0.1$. This estimate, in order of magnitude, coincides with the baryon cosmological density, which follows from the data on the distribution of light chemical elements in the Universe. On the other hand, the data from of the infrared satellite IRAS and the discovery of the large-scale motions of matter support the value $\Omega \sim 1$, which corresponds to the predictions of the inflationary Universe theory.

Data which are also important for the theories of galaxy formation have been obtained recently on the distribution of quasars and absorption lines due to them and on the distribution of hot X-ray gas in clusters.

Briefly, the status of the theory is the following. The hot (neutrino) cosmological model gives a good explanation of the large-scale structure of the Universe within the framework of the "pancake" theory due to Zel'dovich and his colleagues, but it is not developed yet to the stage to explain the formation of galaxies. On the contrary, the "cold" model, which assumes that the hidden mass is in the form of axions or very heavy particles gives a good explanation of the formation of light objects, but contradicts data on large-scale structure. Apparently the neutrino model can be improved by the introduction of additional parameters describing evolution on a small scale (heavy or unstable particles, supernova explosions, cosmological strings, etc.).

An important experiment that can dot all the *i*'s, is the measurement of angular fluctuations of relict radiation $\Delta T/T(\theta)$ on the celestial sphere, since they are directly related to the formation of the structure of the Universe. So far such fluctuations have not been found (with the exception of the dipole component, caused by the motion of the Earth relative to the relict radiation), but there is a considerable possibility of their discovery within the next few years. If the fluctuations $\Delta T/T$ will be discovered on the scale $\theta \gtrsim 6°$, it will be possible to determine both the spectrum of the primary perturbations of density, from which clusters and superclusters originated, and the general density of matter Ω in the Universe.

Translated by A. Petelin