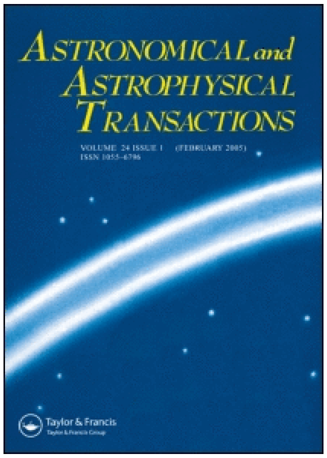

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SPACE ANISOTROPY OF QUASARS

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Statistical processing of the large combined catalogue of quasars indicates the presence of a large-scale (about 2000 Megaparsec) deficit of quasars around quasars with absorption optical spectra. The similar deficit as a result of high-power explosions in the epoch much later than 'big bang' should result in the anisotropy of space distribution of quasars within a standard Friedman cosmology. The idea has been checked. The space anisotropy is detected. The anisotropy is easily explained because the calculations of space distribution of quasars are conducted within a standard Friedman model while some quasars have non-Hubble velocities along the line of sight.The superluminal movements of components of quasars (long ago detected) and large scattering of luminosities of quasars should take place as a consequence of such anisotropy.

KEY WORDS Quasars, spatial distribution, anisotropy, cosmology

1 INTRODUCTION

In our paper (Dravskikh and Dravskikh, 1999) shown that quasars with absorption optical spectra are objects around which a deep large-scale deficiency of quasars takes place. Further we will name the quasars with absorption optical spectra by quasars with absorption.

If the horizontal line 1 (Figure 1) represents the space density of quasars around control quasars (i.e. quasars without absorption having the same Z as quasars with absorption), then the curve 2 is the spatial density of quasars around quasars with absorption.

On scales of 100–500 Mpc, the spatial density of quasars around quasars with absorption is approximately one half of their density around quasars without absorption. Deficiency of quasars around quasars with absorption reaches of a scale in 2000 Mpc. The curves are received for the Friedman model of the Universe with Hubble constant $H = 50$ km s^{-1} Mpc^{-1}, deceleration parameter $q_0 = 0.5$ and $\Lambda = 0$, in co-moving coordinates.

Random errors of measurements are very small and, in this sense, the presence of the effect does not cause any doubts. However, as the research studies were

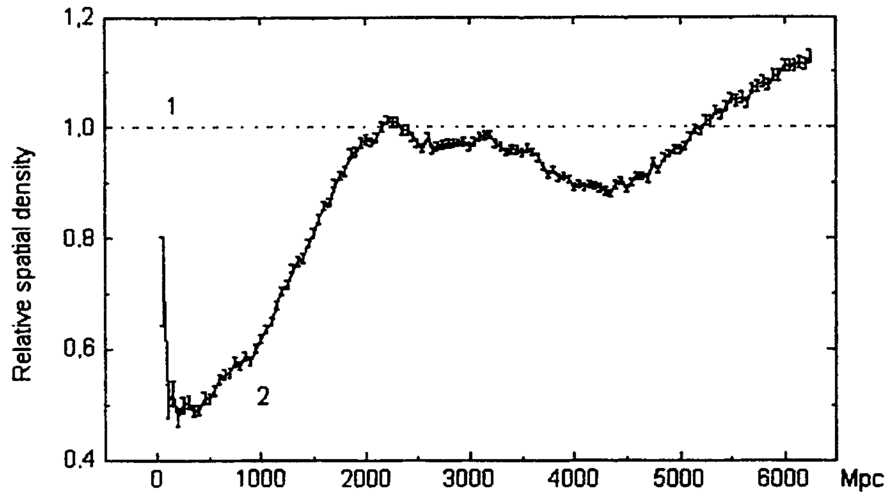

Figure 1 Relative density of spatial distribution of quasars: *1*, around control quasars; *2*, around quasars with absorption.

carried out with the help of the combined catalogue (Hewitt and Burbidge, 1993) not having completeness, it is possible to suggest that the discovered deficiency of quasars is some effect of selection.

Currently there is no homogeneous catalogue with the necessary completeness and which contains a very large number of objects with the appropriate spectral data.

Therefore, we have carried out a number of statistical experiments which show that the phenomenon of deficiency of quasars around quasars with absorption is not an effect of selection.

The processing of the catalogue rarefied up to $1/4$ in α was made. Any half and any quarter of the catalogue show a similar effect of deficiency. Also, the quasars of all hemispheres and quarters of the sphere were processed separately. The effect is kept.

Let us imagine the situation that the catalogue consists of areas of the sky of two kinds. In one area many quasars are fixed, i.e. here there is an apparent large spatial density of them, but in these areas the careful spectral researches were not carried out. Here a share of quasars with absorption is small. In other areas, on the contrary, few quasars are fixed, but the careful spectral researches are carried out. Here a share of quasars with absorption is great and it will be seem that they are in areas with small density of quasars. With such catalogue we would see the effect of deficiency of quasars around quasars with absorption.

To check up, whether our phenomenon is a result of such a situation, we carried out the following experiments.

We transfer a part of quasars with absorption to the category of 'simple quasars', to level the percentage of quasars with absorption in groups of quasars in the whole

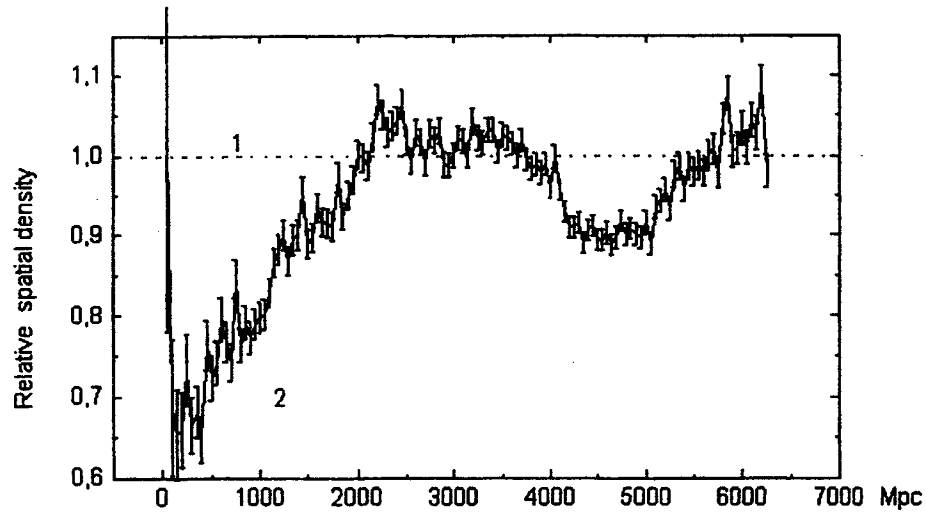

Figure 2 Relative density of spatial distribution of quasars: *1*, around control quasars; *2*, around quasars with absorption. At most 2 quasars with absorption have been kept in each hundred of quasars. Here there are only 148 quasars.

sky. These 'simple quasars' were not considered the ones with absorption and were not used as control quasars without absorption. They were simply used in the total amount of quasars when calculating correlation functions. The alignment was made in two ways: in each one hundred of quasars taken with increase of α, and in each square of the sky by the size of $5^\circ \times 5^\circ$. Percentage of quasars with absorption was reduced to ≤ 5 and ≤ 2 (average percent is 10 in the whole sky, maximal 25 and minimal 2). In all cases the deficiency was retained. Figure 2 is a case of 2% contents of quasars with absorption in each one hundred of quasars. Thus, the most obvious possible effect of selection has seemingly disappeared.

2 NON-HUBBLE VELOCITIES OF QUASARS. APPARENT SPACE ANISOTROPY OF QUASARS

Some grand explosions which, for some reason, are geometrically marked by positions of quasars with absorption may explain the deficiency of quasars around quasars with absorption. These explosions scatter surrounding quasars or material from which the quasars will be formed.

This is similar to the hypothesis about superdense bodies or white holes in the framework of a Friedman model. This hypothesis was independently offered by Novikov (1964) and Ne'eman (1965). But then Zel'dovich (1968) has named this hypothesis nonrealized because of the absence of appropriate displays.

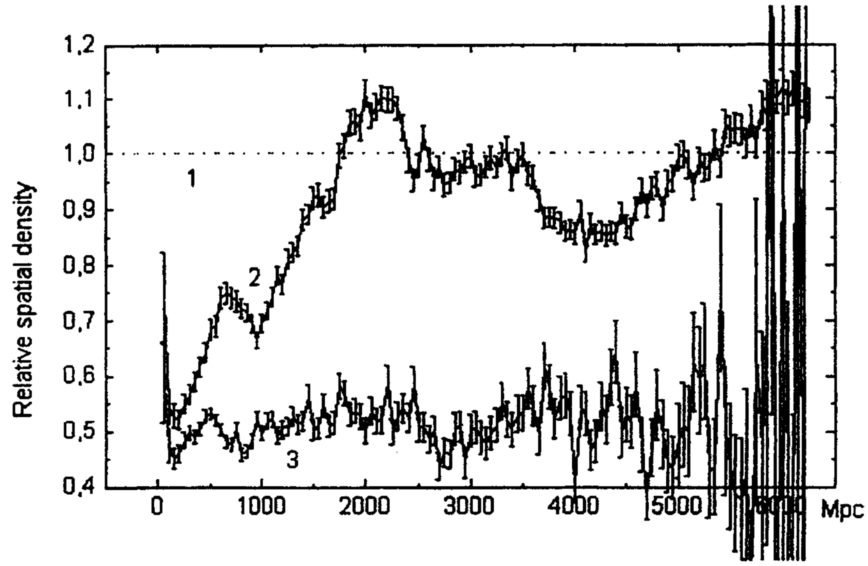

Figure 3 Relative density of spatial distribution of quasars: *1*, around control quasars in both transversal directions; *2*, around quasars with absorption in a plane of the sky ($Z = Z_0 \pm 0.2$); *3*, around quasars with absorption in direction of a beam of sight ($\theta = \theta_0 \pm 0.1$ rad).

It is known that hypothetically the superdense white holes can blow up in any time different from 'big bang'. Because of such non-synchronism the redshifts of a part of quasars should not submit to the Hubble law.

We carried out such testing and obtained a confirming result.

We conduct all calculations concerning a spatial distribution of a density of quasars around quasars with absorption within a standard Friedman cosmology and, naturally, the spherical symmetry of such distribution is supposed.

However, if the observable deficiency of quasars around quasars with absorption is the result of an explosion, non-simultaneous with the birth of the Universe, a correct spherical picture in a distribution of a density of quasars should not be.

Indeed, additional velocities received by quasars in explosion will be perceived by the observer differently, depending on the direction of movement of a quasar in explosion. The quasar taken-off in the direction of the normal to a beam of sight will have for the observer an invariable hubble velocity, and its Z will define its position in space. The quasar received an acceleration along a beam of sight will be perceived as a quasar with larger Z or smaller Z (depending on a direction of ejection). An estimate of its position will show that this quasar is further (closer) than it is really. Thus, if the scattered quasars explosion has occurred recently, the spatial distribution should have the form of an ellipsoid of a rotation with the large axis oriented along the line of sight.

We have carried out a statistical experiment to check this assumption. The size of an area of the deficiency of quasars around quasars with absorption is about 2000

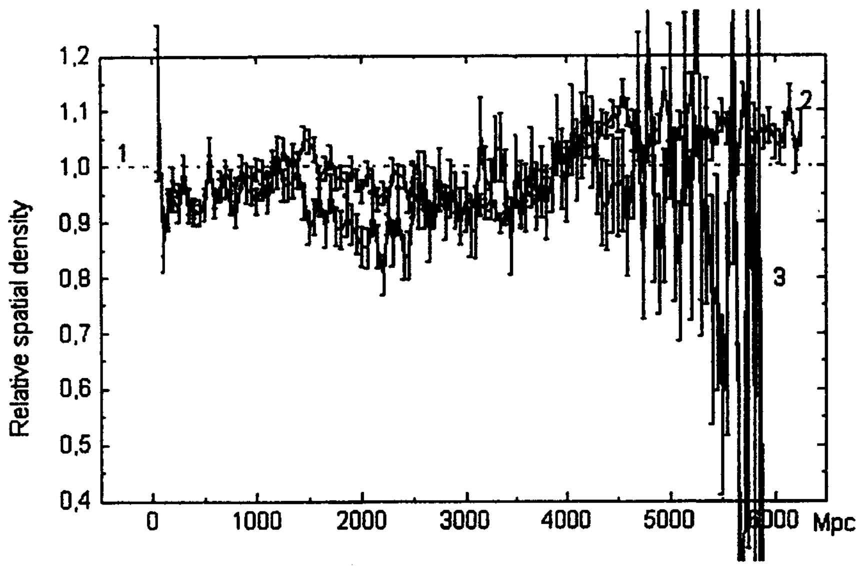

Figure 4 Relative densities of spatial distribution of quasars around control quasars: *1*, in two transversal directions; *2*, in a plane of the sky ($Z = Z_0 \pm 0.2$ of the control quasar); *3*, in direction of a beam of sight (± 0.1 rad).

Mpc. This is equal to a corner 0.4 rad. and $\Delta Z \approx 2$ at $Z = 2$. We measured the relative distribution of quasars around quasars with absorption and around control quasars without absorption in two transversal directions: in a narrow comer of ± 0.1 rad. along a beam of sight and in a wide comer in a direction normal to a beam of sight at $Z = Z_0 \pm 0.2$. Z_0 is Z of a central quasar (quasar with absorption or control one).

In Figure 3 three curves are presented: 1 – the direct line represents the conditional distribution of quasars both in a direction of a beam of sight, and in a perpendicular direction around control quasars without absorption; 2 is a relative spatial distribution of quasars around quasars with absorption in a plane of the sky and 3 is a relative spatial distribution of quasars around quasars with absorption along the line of sight. Curve 2 is very similar to the initial common curve of a relative distribution of quasars around quasars with absorption. Curve 3 (the distribution of quasars in a direction of a beam of sight) indicates that the size of an area of deficiency has essentially increased. However, the level of deficiency remained unchanged. The density of quasars around quasars with absorption is approximately twice less than around quasars without absorption.

In Figure 4 the results of the same experiment with two groups of quasars without absorption are presented. Each group is a control one with regard to a group of quasars with absorption. One of the groups is in a previous one. It is seen that these two groups of quasars without absorption have identical distributions of quasars around them both in a direction of a beam of sight, and in a perpendicular direction.

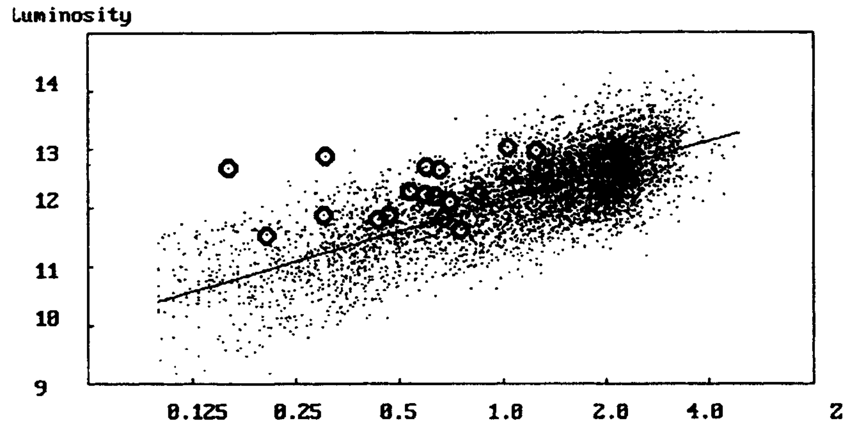

Figure 5 Distribution of quasars. Circles are superluminal sources.

Thus, these experiments confirm the assumption that non-homogeneities in distribution of quasars around quasars with absorption in a standard Friedman model have an extended form along a beam of sight. Certainly, the actual form of non-homogeneities is, probable, spherical. Apparent anisotropy of the density of quasars around quasars with absorption shows that the phenomenon which has resulted in formation of deficiency of quasars around quasars with absorption had a place much later than 'big bang'. Thus, quasars around quasars with absorption have not quite Hubble Z.

In Figure 5 the distribution of 'luminosity–redshift' (L–Z distribution) of all 7000 quasars of Hewitt–Burbidge catalogue is presented.

The direct line approximates this distribution. Imagine, that 2 quasars are situated on this line in the same point. These quasars have identical brightness, redshift and luminosity. As a result of some explosion they have received accelerations, one in a direction from the observer, and a second – to the observer. As the explosion has taken place just now the quasars practically are not able to move anywhere. Hence, their brightness has remained constant and identical. However, their Z have changed proportionally to received increments of velocities. Within the Friedman model the quasar rejected to the observer will be represented located closer than it is really and other, on the contrary, – is farther. But as their brightness has remained constant the evaluation of their luminosity will show that the quasar accelerated to the observer i.e. with small Z, will have small luminosity and the quasar with large Z – large luminosity. If to draw the distribution of luminosity of these quasars, this distribution will have a more positive inclination than the line approximating the distribution of all quasars. Thus, among all observed quasars the part of quasars will have such distribution L–Z, other part will have the normal distribution, corresponding to the Friedman model (which now we do not know). The L–Z distribution of all population of quasars will be, naturally, some average between these two distributions. It should have a more positive inclination than the Friedman distribution. Therefore, the distribution of Figure 5 also represents certain average, more abrupt than the Friedman distribution. By the way, it is difficult to understand why really received distribution (Figure 5) shows systematic increase of luminosity of quasars with increase of Z. If this distribution is really caused by non-Hubble velocities of a part of quasars, it is possible to present a more natural picture that quasars, on the average, have the same luminosity independently from Z. Thus, if there is not non-Hubble velocities, the L–Z distribution of quasars would be approximated by a line, parallel to axis Z. Besides it is possible to represent that scattering of luminosity of quasars is caused, to some extent, by non-Hubble velocities of a part of quasars.

One of the independent phenomena confirming received by us conclusion about non-Hubble velocities of quasars is a phenomenon of superlight velocities of components of quasars.

Long ago in radiointerferometric observations quasars were discovered which have components moving from each other with superlight velocities. These are superluminal sources. In the catalogue which we process there are 22 such quasars. The superlight movement in them is explained by relativistic effects. We have nothing against relativistic effects, but, in view of the facts, which are received by us it is possible to explain superlight movements simply by the presence of non-Hubble velocities of a part of quasars. According to this assumption all superluminal sources on the diagram L–Z should be situated above average line approximating the distribution. And, really, in Figure 5 from 22 superluminal sources marked by circles only 1 is located below average line and 21 – above this line.

In the catalogue of Hewitt–Burbidge there are 1300 quasars that show radioemission. The quasars with superluminal components are to be found above the line 7 times more frequently than one could expect, taking into account the L–Z distribution of radioloud quasars. This seems to be an independent confirmation of the fact that some quasars have non-Hubble velocities.

3 CONCLUSION

1. Relative spatial distribution of quasars around quasars with absorption determined within the Friedman model of the Universe shows the large-scale spatial anisotropy in the density of quasars. Areas of nonhomogeneities with lowered density around quasars with absorption have an essentially greater size in a direction of a beam of sight than in a plane of the sky. This indicates, probably, the non-Hubble character of velocities of some part of quasars.

2. L–Z distribution of quasars having components with superlight velocities, probably, contains another indication of a deviation from the Hubble distribution of velocities of quasars.

3. The presence of non-Hubble velocities of quasars allows us to suggest that quasars are 'standard candles' having identical luminosity independent from

Z. Because of non-Hubble velocities the horizontal L–Z distribution of quasars is transformed into the one observed.

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