Investigations of the extended extragalactic radio sources: The quasars 1502+10 and 0923+39 and their environment

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Abstract

It was studied the environment of quasars 1502+10 and 0923+39. The investigation of the region with radius of 360 arcmin around these extended extragalactic radio sources shows that distribution of extragalactic objects around them is mainly homogeneous. This study is carried out in the framework of a large project, to find large regions with deficit of extragalactic sources around extragalactic radio sources with very large linear sizes, as it is in the case of DA240, NGC315 radiogalaxies.

Keywords: *galaxy, radio galaxy, quasar*

1. Introduction

The extended radio sources were studied in all electromagnetic wavelength region and their research is ongoing. These objects are interesting because of their very large luminosity as well as their large sizes (Waggett et al. (1977), Algaba & Lo (2016), Mingo et al. (2014)). A part of these objects are galaxies, another part are quasars. The investigation of the environment of extended extragalactic radio sources shows that distribution of extragalactic objects around them is mainly homogeneous. But around some of them this distribution is extremely different from the homogeneous.

2. The quasar 1502+10 and its environment

The 1502+10 is one of extended extragalactic radio sources and it is well known quasar. For the investigation of this quasar and extragalactic sources in his environment is dedicated this paragraph. It was studied the quasar and his environment in the region with radius of 360 arcmin. We use the data from the site of NASA (https://ned.ipac.caltech.edu). As the density ρ of galaxies is very large for the analyses of galaxies we use only the objects in the 60 arcmin environment.

The density ρ of galaxies in the regions R_{min} - 10, 20, 30, 40, 50, 60 arcmin is almost the same. In average there are 3.241 galaxies in the region of one square minute. As it is seen from the Table 1 the number of galaxies in the error limits is practically the same.

In the Table 2 we bring GP(galactic pairs), GT(galactic triples), GG(galactic groups), GC(clusters of galaxies), QSO(quasars). QG(quasar groups), GL(gravitational lenses), ABLS(sources with absorption lines), EMLS(sources with emission lines), and number of objects in the regions with radius R_{min} - 60, 120, 180, 240, 300 , 360 arcmin respectively.

The density of these objects almost three orders of magnitude lower than the density of galaxies. In some cases, this difference reaches four orders of magnitude.

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Table 1. Galaxies

R_{min}	N_{gal}	Ring (R_i-R_{i-1})	N_{Ring}	ρ_R	ρ_{Ring}
10	1012	100	1012	3.221	3.221
20	3804	300	2792	3.027	2.962
30	9014	500	5210	3.188	3.318
40	16160	700	7146	3.371	3.249
50	25945	900	9785	3.303	3.461
60	37703	1100	11758	3.334	3.402

Table 2. Number of objects in the region

R_{min}	GP	GT	GG	GC	QSO	QG	GL	ABLS	EMLS
60	61	0	33	81	61	0	0	3	0
120	255	1	153	307	224	0	0	6	0
180	498	5	369	744	478	0	0	26	0
240	729	16	711	1270	901	0	0	28	0
300	1051	29	1095	2069	1388	0	3	47	0
360	1235	380	1564	2980	2023	0	5	49	1

In Table 3 we bring the number and density of Super Nova. These data we bring additional to show that our data is very close to the real data and each Super Nova is used to determine the distances of the quasars because the quasars are behind the Super Nova.

Table 3. SN

R_{min}	N	ρ_R	Ring	ρ_{Ring}
30	0	0	900	0
60	1	0.884×10^{-4}	2700	1.179×10^{-4}
120	11	2.432×10^{-4}	10800	2.947×10^{-4}
180	29	2.849×10^{-4}	18000	3.183×10^{-4}
240	53	2.929×10^{-4}	25200	3.032×10^{-4}
300	92	3.254×10^{-4}	32400	3.832×10^{-4}
360	131	3.217×10^{-4}	39600	3.135×10^{-4}

In the Tables 4 and 5 we bring the data of extragalactic radio sources and quasars. The density of radio sources is nearly the same in everywhere, but is three time more than the density of quasars.

Table 4. Radio sources

R_{min}	N	ρ_R	Ring	ρ_{Ring}
60	239	21.132×10^{-3}	3600	21.132×10^{-3}
120	783	17.374×10^{-3}	10800	16.034×10^{-3}
180	1801	17.694×10^{-3}	18000	18.002×10^{-3}
240	3214	17.761×10^{-3}	25200	17.848×10^{-3}
300	5091	18.006×10^{-3}	32400	18.440×10^{-3}
360	7390	18.151×10^{-3}	39600	18.480×10^{-3}

The analyses of data from Tables 1 - 5 suggest that the density of quasars around the 1502 + 10 are not very different, as is in the case for other type sources.

In the Fig. 1 we bring the distribution of quasars from the distances. From the figure 1 it is clear that the distribution of quasars from the redshift in the neighborhood of quasar 1502+10 is close to homogeneous distribution as in many other domains.

Table 5. QSO

R_{min}	N	ρ_R	Ring	ρ_{Ring}
60	61	5.394×10^{-3}	3600	5.394×10^{-3}
120	224	4.951×10^{-3}	10800	4.804×10^{-3}
180	478	4.696×10^{-3}	18000	4.492×10^{-3}
240	901	4.979×10^{-3}	25200	5.343×10^{-3}
300	1388	4.909×10^{-3}	32400	4.784×10^{-3}
360	2023	4.969×10^{-3}	39600	5.104×10^{-3}

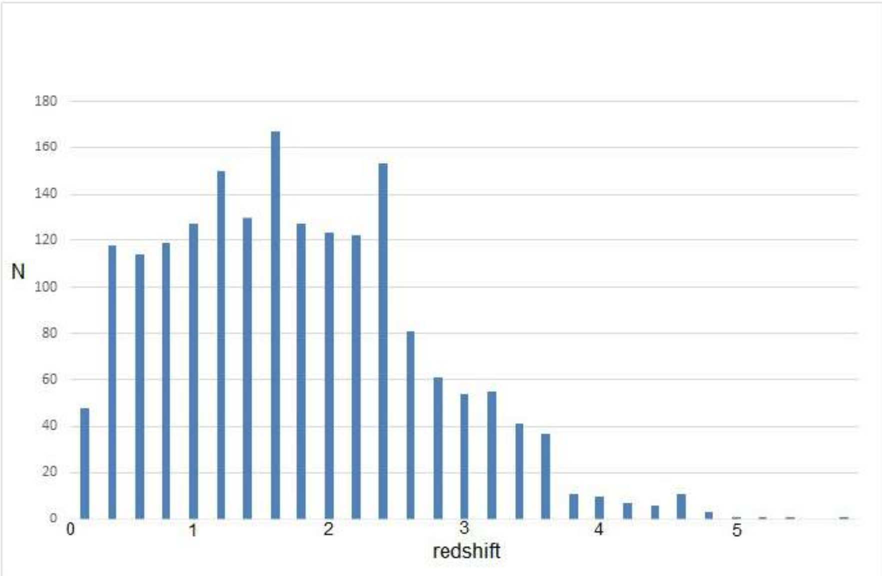

Figure 1. Quasars distribution by their redshifts (by 0.2 intervals) around the quasar 1502+10.

3. The quasar 0923+39 and its environment

In all the Tables 6-10 and Fig. 2 in this paragraph we bring similar data as are given in Tables 1-5 and Fig. 2.

Table 6. Galaxies

R_{min}	N_{gal}	Ring (R_i-R_{i-1})	N_{Ring}	ρ_R	ρ_{Ring}
10	644	100	644	2.050	2.050
20	2804	300	2164	2.231	2.296
30	6520	500	3716	2.304	2.366
40	11514	700	4994	2.291	2.271
50	21032	900	9518	2.678	3.366
60	37682	1100	16650	3.332	4.818

Table 7. Number of objects in the region

R_{min}	GP	GT	GG	GC	QSO	QG	GL	ABLS	EMLS
60	1	3	25	94	68	0	0	0	0
120	8	9	145	444	254	0	0	0	0
180	17	28	327	842	565	0	5	0	1
240	23	47	503	1142	1051	0	5	2	3
300	37	70	754	1516	1630	0	5	2	3
360	46	100	1068	2004	2370	0	6	2	5

Table 8. SN

R_{min}	N	ρ_R	Ring	ρ_{Ring}
40	0	0	1600	0
60	2	1.768×10^{-4}	2000	3.183×10^{-4}
120	6	1.327×10^{-4}	10800	1.179×10^{-4}
180	17	1.670×10^{-4}	18000	1.957×10^{-4}
240	27	1.492×10^{-4}	25200	1.261×10^{-4}
300	48	1.670×10^{-4}	32400	0.970×10^{-4}
360	72	1.768×10^{-4}	9600	1.929×10^{-4}

Table 9. Radio sources

R_{min}	N	ρ_R	Ring	ρ_{Ring}
60	347	30.682×10^{-3}	3600	30.682×10^{-3}
120	1476	32.627×10^{-3}	10800	33.275×10^{-3}
180	3538	34.759×10^{-3}	18000	36.464×10^{-3}
240	5974	33.014×10^{-3}	25200	30.770×10^{-3}
00	9020	31.902×10^{-3}	32400	29.925×10^{-3}
60	12773	31.372×10^{-3}	39600	30.167×10^{-3}

Table 10. QSO

R_{min}	N	ρ_R	Ring	ρ_{Ring}
60	68	6.013×10^{-3}	3600	6.013×10^{-3}
120	254	5.615×10^{-3}	10800	5.482×10^{-3}
180	565	5.551×10^{-3}	18000	5.500×10^{-3}
240	1051	5.808×10^{-3}	25200	6.139×10^{-3}
300	1630	5.765×10^{-3}	32400	5.688×10^{-3}
360	2370	5.821×10^{-3}	39600	5.948×10^{-3}

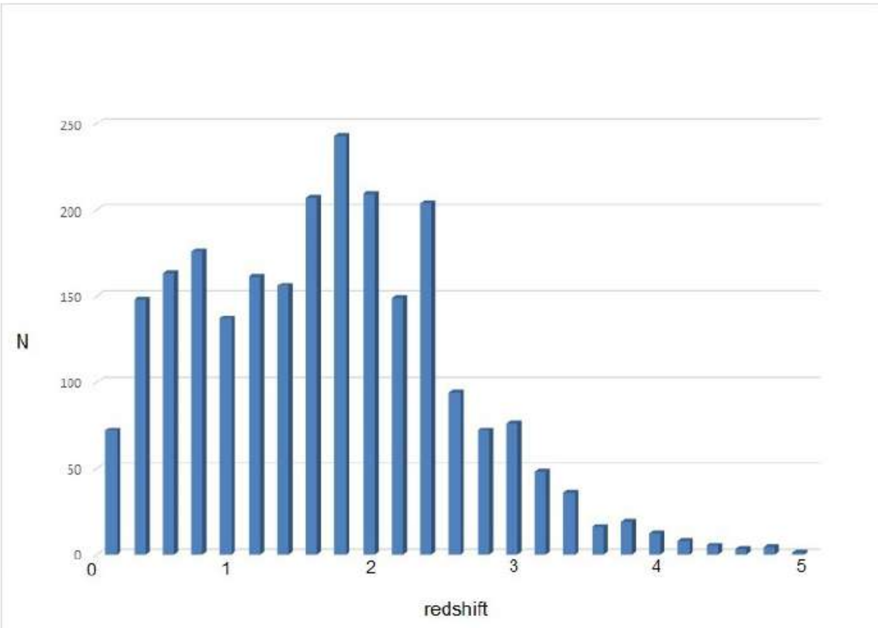

Figure 2. Quasars distribution by their redshifts (by 0.2 intervals) around the quasar 0923+39.

The comparisons of the results suggest that the data surrounding these two quasars are identical to the distribution of such sources in space, similar to the NGC6251 and 3C219 radio galaxies (Hovhannisyan et al. (2018), Hovhannisyan et al. (2019)). This is not the case with DA240 NGC315 radioactivity (Artyukh & Ogannisyan (1988b), Artyukh & Ogannisyan (1988a)).

4. Conclusions

The distribution of extragalactic sources around the quasars 1502 + 10 and 0923+ 39 shows that these universe domains are homogeneous for all types of sources. In future work it is necessary to obtain the distribution of extragalactic sources across all domains, where it cannot be said that the universe is homogeneous in those regions. Such regions already are found (see for example Artyukh & Ogannisyan (1988b), Artyukh & Ogannisyan (1988a)).

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