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Spectral survey of Case emission–line galaxies with the 6 m Russian telescope

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Abstract. The results of the follow–up spectroscopy of 178 emission–line galaxy (ELG) candidates from the Case objective–prism survey and nine Markarian galaxies with the 6 m telescope are described. Only the candidates classified in the Case survey as those with emission lines were observed with the aim to form a statistical sample of blue compact galaxies (BCGs) with strong emission lines in the zone $\alpha = 8^{\rm h} \div 16^{\rm h}$, and $\delta = +29^\circ \div +38^\circ$. We present the redshifts, equivalent widths and flux ratios for the strongest lines and the spectrum type for most of the galaxies with detected emission lines. A significant fraction ($\approx 23\%$) of the observed Case galaxies do not show emission lines in blue. Preliminary analysis of the data is presented and the properties of the observed ELGs are compared with those of other known samples[1].

Key words: surveys — galaxies: fundamental parameters — galaxies: distances and redshifts — galaxies: starburst — galaxies: compact

1. Introduction

Several large objective–prism surveys have been done during the last two decades. They include pioneering work by Markarian 1967; Markarian et al. 1989 and later works (e.g. by Coziol et al. 1994), in which galaxies were primarily selected by strong UV–continuum. Other surveys, such as Tololo (Smith et al. 1976), University of Michigan (UM) survey (MacAlpine et al. 1977, 1981) and surveys by Wasilewski (1983); Moody et al. (1987); Zamorano et al. (1994, 1996) exploited the presence of emission lines in objective–prism spectra.

Two new large objective–prism surveys for ELGs applying new automatized algorithms of search: Hamburg/SAO survey (HSS, Lipovetsky et al. 1996; Ugryumov et al. 1998) and Kitt Peak International Spectral Survey (KISS, Salzer et al. 1994; Kniazev et al. 1996) using CCD as a sensitive detector are now near completion.

Two other large objective–prism surveys used both criteria (unusually strong UV continuum and strong emission lines) to select galaxies with signs of any kind of activity. The first is the Second Byurakan Survey (SBS), in which about 1500 galaxies were selected in the area of 1000 square degrees (Markarian et al. 1983; Stepanian et al. 1993) with a magnitude limit of about $m_{\rm pg} = 18\overset{\rm m}{.}0$. The Case Low–Dispersion Northern Sky Survey is another large survey which combines both selection criteria (Pesch & Sanduleak 1983; Sanduleak & Pesch 1984; Stephenson et al. 1992; Pesch et al. 1995). The Case survey includes also the lists of HII–regions in other galaxies, blue and carbon stars.

Follow–up spectroscopy of the objects selected in Schmidt telescope surveys is very fruitful to build up large samples of extragalactic objects with different kinds of activity — from dwarfs and nuclei of large spirals with enhanced SFR to AGNs of various types from LINERs to QSOs.

In particular, much progress in studies of ELGs has been achieved after extensive studies of Markarian galaxies (Huchra & Sargent 1973; Huchra 1977; Mazzarella & Balzano 1986; Markarian et al. 1988) and the earlier cited therein, and studies of complete samples of ELGs selected from the UM and Wasilewski's surveys (Salzer et al. 1989a,b; Bothun et al. 1989). The follow–up spectroscopy of ELGs from the SBS resulted in many new active star–forming galaxies (Izotov et al. 1993; Stepanian et al. 1993).

The Case survey contains currently 1579 blue and/or emission–line galaxies (see Pesch et al. 1995, for the most

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[1] Tables 2 to 4 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

recent list). It provides us with deep enough (the limit of about $m_{\rm CG} = 18\overset{\rm m}{.}0$) lists of ELG candidates in the large sky area. Spectroscopic observations for several subsamples of Case galaxies have been published by Tifft et al. (1986); Augarde et al. (1987); Weistrop & Downes (1988, 1991) and Weistrop (1989). Large work has been recently done by Salzer et al. (1995), presenting spectroscopy and CCD imaging of 176 Case galaxies from lists I and II.

Our current primary interest lies in studies of low–mass galaxies with star formation burst — blue compact galaxies (BCGs). We assembled large statistical BCG sample on the basis of the follow–up spectroscopy of ELGs from the SBS, and studied the main properties of this sample (Izotov et al. 1993, 1994; Thuan et al. 1994, 1998; Pustilnik et al. 1995; Lipovetsky et al. 1989). To go further into the understanding of star formation (SF) in low–mass galaxies, new large well–selected samples are necessary.

The main goal of this paper is to build up a new large sample of BCGs in a large well–defined sky region. Thus we carried out the follow–up spectroscopy for those Case candidates, which left outside the scope of the previous slit–spectroscopy studies, in order to combine all available data and produce the BCG sample in the zone of Case survey.

One of the characteristics for a current intensive SF burst in a galaxy is the presence of strong [O III] $\lambda\lambda$ 4959, 5007 emission lines in its spectrum. Therefore, to decrease the number of objects to observe and the time necessary to complete the project, we limited ourselves to only the Case galaxies having at least some indication on [O III] $\lambda\lambda$ 4959, 5007 emission lines according to the Case survey classification. We emphasize that our working sample is in no way complete. It combines all Case ELG candidates which were not observed in earlier studies cited above, and thus by construction is highly heterogeneous. Therefore comparing directly their properties with those of other known and well selected ELG samples (like UM sample by Salzer et al. 1989) seems to be unreasonable. Instead we are going to undertake such comparison in the forthcoming article, where we try to combine all the published spectroscopy results for ELG candidates in the sky region discussed. The selection of Case galaxies for this program is described in more detail in Sect. 2. In Sect. 3 we describe the observations and data reduction. Section 4 presents the results of observations, attached in 3 tables. In Sect. 5 we give some preliminary analysis of the observational results, and in Sect. 6 we briefly summarize the results and draw some conclusions. All distance dependent parameters are derived for the Hubble constant 75 $\mathrm{km\,s^{-1}\ Mpc^{-1}}$.

2. The sample description

For the observations we selected all Case galaxies in the zone $\delta = +29^\circ \div +38^\circ$ from the Case lists III, IV, V, VIII, XI, XII and XIII which were classified in the Case survey by some indication on the presence of [O III] $\lambda\lambda$ 4959, 5007 emission lines ("vs" – very strong, "s" – strong, "m" – medium, "w" – weak, "w?" – weak?) and which had not been observed yet. A few galaxies from lists I and II not observed in the Salzer et al. (1995) were observed as well. We did not observe about 30 galaxies in that zone from the lists IV and XIII (Sanduleak & Pesch 1987; Stephenson et al. 1992), which J. Salzer (private communication) has already observed (but has not published yet). To check the accuracy of the redshifts and to estimate the types of spectra we observed also several Case ELGs, which were already observed.

A few galaxies from the lists IX and XI, which were outside the main zone were observed when we were not able to observe the objects from the main program. In total we selected 183 Case ELG candidates, out of which we could observe 178. Additionally nine Markarian galaxies in the same sky region were observed with the hope to have better completeness in picking up all probable BCGs. Three of them appeared to be the galaxies in the Case catalog — CG 795, CG 859 and CG 1210 — but without indication of [O III] emission in the catalog. Altogether we observed in this program 187 objects.

All the observed objects are presented in two tables: in Table 2 — those with detected emission lines, and in Table 4 — those where emission lines have not been detected in the blue part of the spectrum. Further selection of BCGs from the ELGs of Table 2 and their combining with other BCGs in this zone from the cited papers will be the subject of a separate article.

3. Observations and data reduction

The observations were carried out with the 6 m telescope of the Special Astrophysical Observatory of Russian Academy of Sciences (SAO RAS) in the period from December 1992 to October 1996. Medium resolution spectrograph SP–124 in the Nasmyth–1 focus was used over the whole period with two different modes of registration. For the period prior to December 1995 the spectra were obtained in the IPCS mode (see the description of IPCS in Drabek et al. 1986; Afanasiev et al. 1986). Since January 1996 we used for registration Tektronix CCD 1024×1024 provided by Astrophysical Institute Potsdam (AIP, Germany) in the frame of mutual cooperation between AIP and SAO RAS.

3.1. IPCS observations and data reduction

Spectra obtained in the IPCS mode with the grating B1 (600 grooves/mm) cover the range of 3600 – 5500 Å with a scale along the dispersion 1.9 Å/pixel. The spectra were obtained through round apertures with a diameter of 1.5″

Table 1. Journal of observations

Run No. (1)	Date (2)		Telescope (3)	Instrument (4)	Grating (5)	Wavelength Range [Å] (6)	Dispersion Å/pixel (7)	Observed Number (8)
1	Dec.	1992	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	47
2	Jan.	1993	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	37
3	Feb.	1993	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	13
4	Apr.	1993	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	21
5	May.	1993	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	9
6	Mar.	1994	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	16
7	Jun.	1994	SAO 6 m	IPCS, SP–124	B1	3600 − 5500	1.9	15
8	Feb.	1996	SAO 6 m	CCD, SP–124	B0	3600 − 7000	5.2	10
8	Feb.	1996	SAO 6 m	CCD, SP–124	B1	3600 − 5400	2.6	16
9	Oct.	1996	SAO 6 m	CCD, SP–124	B1	3600 − 6000	2.3	3

to 3″ depending on the seeing, centered on the brightest part of the galaxy, usually near its center. Sky spectrum was accumulated simultaneously in the aperture of the same size displaced by 20″ along the current direction to zenith. Typical exposure time was 3 − 5 min (snap–shot mode) in order to detect the strongest emission lines [Oiii] $\lambda\lambda$ 4959, 5007, Hβ and [Oii] λ 3727 from the spectra with low S/N ratio, usually not exceeding 5 − 10 in continuum.

During photometric nights we have observed also spectrophotometric standards from the KPNO list (Massey et al. 1988). These observations then were used to correct the spectra of the program galaxies for the system spectral response. He−Ne−Ar source was used as the reference spectrum. Flat field was accumulated every night before and after the observations and all the spectra were corrected for the flat field after azimuth and modulation correction of the original 1024–channel arrays. The data reduction was done in MIDAS (93NOV version), with several programs from the context Spec combined into the special package and adopted to perfom automatic mode reduction for IPCS 1–D spectra (Kniazev 1994).

3.2. CCD observations and data reduction

The observations in 1996 were carried out with a new CCD–detector in two different set–ups. In February 1996 we used B0 grating (300 grooves/mm) with the wavelength coverage of 3600 − 7000 Å and a scale along the dispersion 5.2 Å/channel and B1 grating (600 grooves/mm) with the interval 3600 − 5400 Å and a scale along the dispersion 2.6 Å/channel. For an experimental set–up of the CCD–detector there was a significant vignetting which limited the actual wavelength range for both gratings. The spectra were obtained through a long slit of 1″ − 2″ width and 45″ length. For the October 1996 run the CCD set–up allowed the coverage of the range 3600 − 6000 Å with a scale along the dispersion 2.3 Å/channel and B1 grating. In these observations we used the registration system NICE under MIDAS (Kniazev & Shergin 1995). As in the case with IPCS observing mode the exposure time for both set–ups did not usually exceed 2 − 3 min which was enough to recognize the strongest emission lines from the low S/N ($\lesssim$ 10) spectra.

Ten exposures have been obtained both in the evening and morning twilight to get the estimate of CCD detector's flat field. All primary reduction of CCD spectra was conducted in the standard way, using MIDAS context Long (94NOV version). 2–D CCD images after the correction for the dark noise, debiasing and sky–subtraction were transformed to linear wavelength scale and converted to 1–D spectra with the following correction for the atmospheric extinction and standard flux calibration. The same as for the IPCS–mode He−Ne−Ar source was used to build up the dispersion curve. Spectrophotometric standards have been observed at least twice during the night to allow the correction for the spectral response of the system.

The information on the set–up of the spectral equipment, used wavelength range, spectral resolution and the number of the observed objects for each run is shown in Table 1.

4. Results of observations

In this section we present the results of the spectra processing. We divided the presentation of the observed galaxies into the two main groups. In Tables 2 and 3 we give some general parameters, line intensities and equivalent widths for 142 galaxies with the detected emission lines. We summarize data in Table 4 for the remaining 44 galaxies where we have not detected emission lines (in the blue part of the spectrum). One Case object CG 273 appeared to be a distant QSO. Its parameters are described separately after the main data. We present in Fig. 1 the spectra of seven emission–line galaxies and that of the quasar CG 273, in order to illustrate the main activity types in our sample.

4.1. The main observational parameters

The structure of the tables is as follows:
Table 2. Column 1 gives the object name from the Case or Markarian catalogs. Columns 2 and 3 give right ascension and declination on the epoch 1950.0 according to the original Case and Markarian catalogs. The coordinates for the Case catalog objects were obtained by the Catalog's authors from the objective–prism plates of Case survey. The estimated accuracy (rms) for α lies within $\pm$ 3″, for δ within $\pm$ 6″ (Pesch & Sanduleak 1983). For Markarian galaxies the errors of coordinates usually lie inside 2″ (Lipovetsky 1986). Column 4 gives the eye–estimated apparent photographic magnitudes according to the same sources. The apparent photographic magnitudes for Case catalog objects are eye–estimated from the objective–prism plates as the density of the continuum near 4500 Å. As was shown by Salzer et al. (1995) the mean difference between Case magnitudes $m_{\rm CG}$ and $m_{\rm B}$ is $m_{\rm B} - m_{\rm CG} = 0.25$, while the scatter about the mean is $\sigma_{m_{\rm B}} \approx 0.6$. We present here the original CG magnitudes in order not to mix the CG magnitude values which were derived in the same homogeneous manner with the $m_{\rm B}$ estimates and measurements for small part of galaxies given in various sources. For the Markarian galaxies apparent photographic magnitudes ($m_{\rm pg}$) were taken from the Zwicky catalog (Zwicky et al. 1961–1968). Column 5 gives heliocentric velocity as determined from our spectra. Less accurate entries are marked by colon. In Sect. 5.3 we discuss the estimate of errors of heliocentric velocities which follow from comparison with the data from CfA catalog (Huchra et al. 1995) and which have rms about 100 km s^{-1}. In Col. 6 we present the estimates of the absolute photographic magnitudes not corrected for the Galaxy extinction, which are derived from the heliocentric velocities of the Col. 5. The other names of the galaxies are given in Col. 7.

Table 3 contains the spectral information for the galaxies from Table 2. In Col. 1 we give the same name as in Col. 1 of Table 2. By an asterisk before the object name we mark the objects for which the spectra were obtained with AIP CCD detector. They are in general of better quality. In Col. 2 we give the IAU–type name of the galaxy for quick and comfortable reference to the same object in Table 2. In Col. 3 we cite the original emission–line code of the galaxy for the strength of [OIII] doublet according to the Case catalog. In Cols. 4 and 5 we give the uncorrected for internal and Galaxy extinction flux ratios of ([OII] λ 3727)/Hβ and ([OIII] λ 5007)/Hβ, respectively. The Galaxy extinction in this sky region is very low. As for the possible internal extinction, it can be significant for some of the galaxies, but for most of them due to low enough signal/noise ratio it was difficult to do flux correction. So, for homogeneity all the line ratios were given only as the observed ones. In Cols. 6, 7 and 8 we present the equivalent widths of Hβ, [OII] λ 3727 and [OIII] λ 5007 respectively. In Col. 9 we make an attempt of classification similar to that of Salzer (1989b) for emission–line galaxies, but without precise information on the size of the galaxies. Since we use only the parameters of excitation and luminosity, some uncorrectness may be present, but we expect that in general this classification correctly reflects the distribution of types in our sample. For the lack of good information on object sizes we joined under BCGs all the galaxies with HII–region spectrum type using Salzer's determination of BCG type as composed from HIIH, DHIIH and SS types. We separated also several galaxies as DANS type in order not to mix this small group of very low excitation dwarfs with other HII–galaxies. For some of the galaxies with weaker emission in [OIII] lines the classification may be ambiguous, especially for border parameters of the line strength or absolute magnitude (BCG or DANS, DANS or SBN). So we mark these objects after the suggested classification by symbol "?" to indicate the uncertainty of the suggested type.

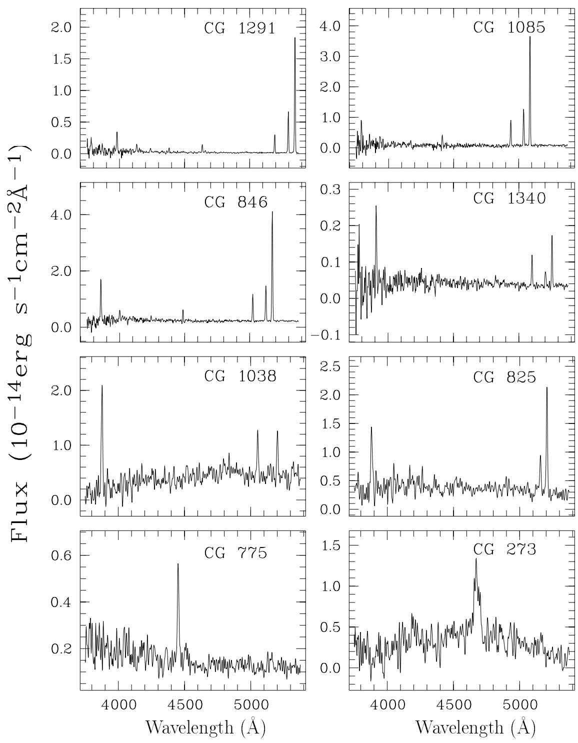

Fig. 1. Examples of spectra of Case emission–line objects detected in this work. The strongest emission lines [OIII] $\lambda\lambda$ 4959, 5007, Hβ and [OII] λ 3727 are seen on most of the spectra. The only line [OII] λ 3727 is seen in the spectrum of CG 775, and only MgII λ 2800 – in the spectrum of QSO CG 273

In Table 4 we present the information about 44 galaxies where emission lines have not been detected. Either common galaxian absorption features were detected (CaII *H* and *K*, *G*−band, MgI) or the spectra were too noisy to extract any information besides the absence of strong emission lines. In Col. 1 the object name from the Case or

Markarian catalogs is given. Columns 2 and 3 are the catalog's right ascension and declination at the epoch 1950.0. The apparent photographic magnitude of a galaxy from the Case or Markarian catalogs is given in Col. 4. In Col. 5 we put the heliocentric velocity determined from absorption lines. Less reliable values are marked by colons. Absolute photographic magnitudes in Col. 6 are based on the data from Cols. 4 and 5. The emission–line code (strength of [OIII] $\lambda\lambda$ 4959, 5007 doublet) as is given in the Case catalog is reproduced in Col. 7. In Col. 8 we give either the absorption features in the spectra, from which the redshift was determined, or refer to the spectra as inconclusive ones due to a quite low S/N ratio. In Col. 9 we give alternative names of Case galaxies, if they are already known.

4.2. Quasar CG 273

One of the Case candidates appeared to be a distant and bright AGN. This is CG 273 ($\alpha = 09^h39^m05^s\!.8$, $\delta = +35°36'42''$, $m_{CG} = 18^m\!.0$). Only one prominent emission line is seen in the wavelength range 3600−5500 Å. This broad emission line is centered at λ 4673 Å and its FWHM is ≈ 50 Å. We identify it with the MgII doublet λ 2798 Å, the corresponding redshift is 0.670. With the Hubble constant 75 km s^{-1} Mpc^{-1} and $q_0 = 0.5$ its absolute photographic magnitude $M_{CG} = -25$ mag, which places CG 273 to the class of quasars. We show its spectrum in Fig. 1.

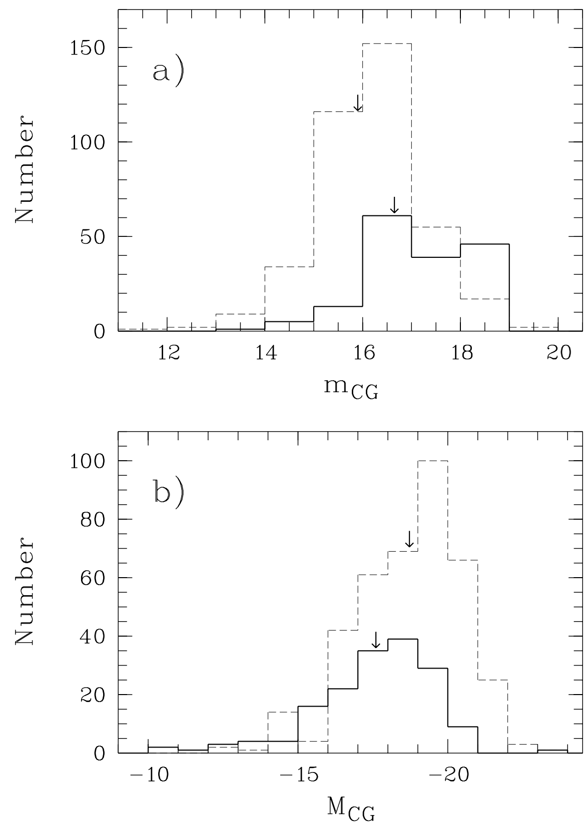

Fig. 2. Histograms of apparent **a)** and absolute **b)** photographic magnitudes (taken from the Case catalog) for our ELGs from Table 2 (solid line) in comparison with the similar histograms for the rest Case ELG in the studied sky region (short–dash line). The arrows indicate the mean magnitudes for each sample

5. Preliminary analysis of the results

5.1. Some statistical trends and distributions

Our resulting sample of ELGs presented in Tables 2 and 3 is not artificially biased to any specific type of galaxies. Besides the selection criterion based on the strength of [OIII] nebular lines, we do not apply any other selection. However, as we observed all the ELGs left after earlier spectroscopy by other groups it appeared that the fraction of the Case catalog faint galaxies in our part is higher. The effect of this is seen on the histograms in Fig. 2a (apparent magnitude) and Fig. 2b (absolute magnitude). Our subsample (solid line) is on average fainter by about one magnitude in comparison with the sample of all other Case ELGs observed by other groups (dashed line). In this respect the correlations shown in Fig. 3 and Fig. 4 may be somehow biased relative to the similar correlations for the whole Case ELG sample.

Since we are looking for selection of a sample of Case BCGs, it is interesting to examine how the detected BCGs are connected with Case emission–line codes. In Fig. 3a we show the histogram with all our observed Case galaxies, distributed versus the 5 Case catalog emission–line codes, with crude separation in each column into the galaxies of 3 different types: BCGs (cross–hatched), all other ELGs (hatched), and galaxies without detectable emission lines (white). The galaxies with inconclusive spectra are not included in this histogram. It is evident that for the emission–line codes "vs", "s" and "m" BCGs dominate all other types, however they represent only 25% of the Case galaxies marked as "w?", and only one fifth, if "w?" inconclusive spectra are also taken into account. Altogether BCGs comprise about 70% of all Case ELGs which display emission lines in our spectra.

Since as we have noticed our Case ELG subsample is biased to the fainter magnitudes relative to the whole sample, it is interesting to check the effect of the faintest ($m_{CG} = 18$ mag) galaxies on these distributions. We show in Fig. 3b the same histogram for 46 faintest galaxies of our subsample. Again Case galaxies with the code "s" and "m" are dominated by BCGs. Among those with the code "w" 60% are BCGs. And those, coded with "w?", have again a fraction of BCGs about 38%. So, in general, the fractions of BCGs relative to the total number of Case

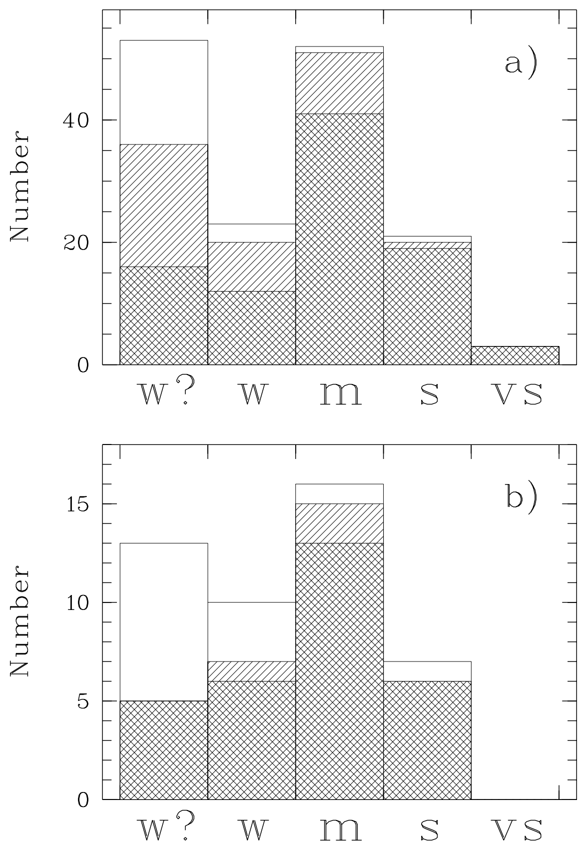

Fig. 3. a) The histogram of ELG types distribution versus the spectral–line code in the Case catalog. Cross–hatched — galaxies, classified as BCGs, hatched ones are all other ELGs, white — galaxies without emission lines. **b)** The same histogram as in **a)**, but only for the faintest Case ELGs ($m_{\rm CG} = 18 - 18+$ mag)

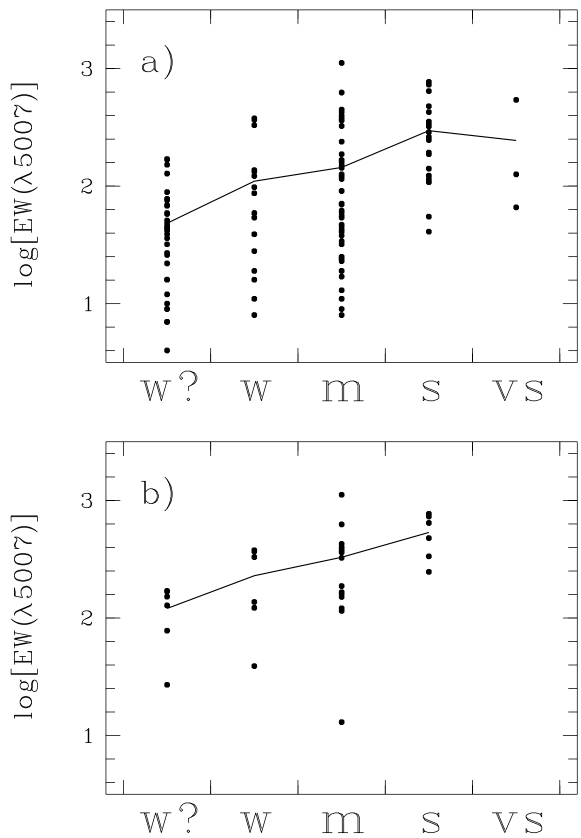

Fig. 4. a) The equivalent widths EW([OIII] λ 5007) (Å) of all Case ELGs from this work versus the spectral–line code (only the objects from Table 2). Solid line joins mean values of equivalent width for corresponding spectral–line codes. There is a clear trend, but the scattering of the data is very large. The corresponding value of Spearman rank-order correlation coefficient is $k = 0.90$, and the confidence level of correlation is $P = 0.96$. **b)** The same distribution as in **a)**, but only for the faintest Case ELGs. The same trend, but the scattering is significantly reduced. The corresponding value of Spearman rank-order correlation coefficient is $k = 0.999$, and the confidence level of correlation is $P = 0.999$

galaxies in various Case codes are quite similar for the whole sample and for the subsample of the faintest galaxies.

However, despite this similarity, we notice that 91% of all the *faintest* Case galaxies with emission lines, are classified as BCGs, which is different from 70% for the whole sample of Case galaxies with some code of presence of [OIII] $\lambda\lambda$ 4959, 5007 emission. So, this should result in some enhancement of BCG fraction in our subsample, in comparison with the whole Case ELG sample.

From our data we can also follow the correlation of the slit–spectroscopy parameters (EW([OIII] λ 5007) with those from objective–prism spectra (the code of emission line strength). As can be seen in Fig. 4a, while there is some correlation of the code and the average for this code the value of EW([OIII] λ 5007), the scattering is extremely large. The brighter galaxies in each code have systematically lower EWs, which is in agreement with assigning the emission–line code in the Case catalog according to the total line flux, and not to the relative strength of the line and underlying continuum. This fact was already noticed by Salzer et al. (1995). The same histogram for the faintest Case catalog galaxies, observed by us (Fig. 4b), clearly demonstrates the same correlation, but the scattering is much reduced, for most of the (brighter) galaxies with very low EWs have gone. The corresponding correlation coefficients and confidence levels are given in the figure legend.

5.2. Sky and redshift distribution

We illustrate in Fig. 5a the sky distribution of all our observed ELGs (filled circles) in comparison with the distribution of all other observed ELGs in the same zone (empty circles). Our ELGs comprise the majority of all Case emission–line galaxies in the upper half of the lane $\delta = +29° \div +38°$, and the most of ELGs in this lane at

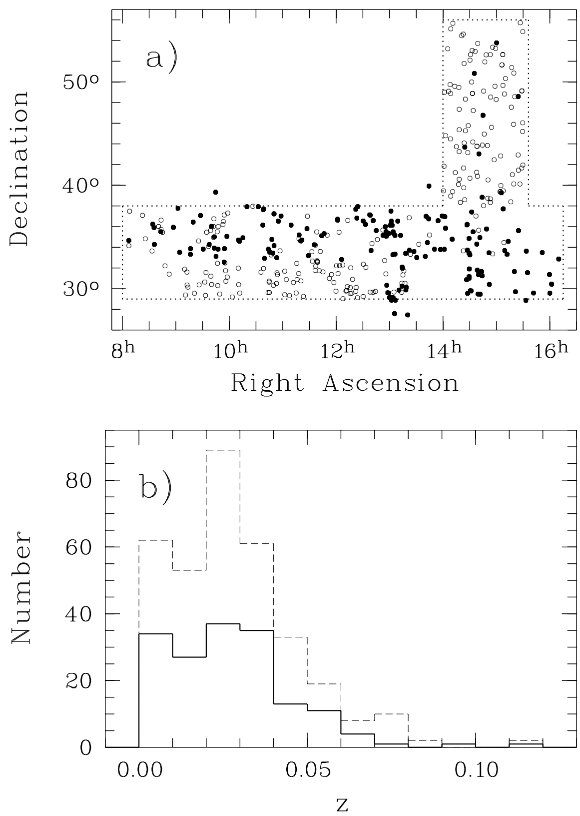

Fig. 5. a) The sky distribution of all ELGs observed in this paper (filled circles) in comparison with the distribution of all other observed ELGs in the same zone (empty circles). **b)** The redshift distribution of our ELGs (solid line) in comparison with the same distribution for all other Case ELGs in this zone (short–dash line)

$\alpha > 13^{\rm h}$. The hole near $\alpha = 14^{\rm h}$ is partly due to the field coverage in the Case survey, and partly due to the absence in this region of Case galaxies which have in the catalog any code of [OIII] $\lambda\lambda\,4959, 5007$ emission lines strength.

The redshift distribution of our ELGs is shown in Fig. 5b (solid line) in comparison with the same distribution for all other Case ELG in this zone (short–dash line). Both distributions look very similar, with abrupt decline of the number of ELGs for $z > 0.04$. A few ELGs are at redshifts $z > 0.06$. This redshift distribution looks very similar to that of BCGs in the zone of the SBS (Pustilnik et al. 1995).

5.3. Accuracy of data, comparison with independent measurements

To get an estimate of the external accuracy of IPCS redshifts we compared our results for common galaxies with the redshifts from CfA catalog (Huchra et al. 1995). For 18 galaxies in common we have as mean difference $\langle \Delta v_0 \rangle = -27$ km s^{-1} with the error 16 km s^{-1} and the standard deviation $\sigma(\Delta v_0) = 64$ km s^{-1}. This comparison indicates that most of IPCS redshifts have an uncertainty less than 100 km s^{-1}.

6. Summary and conclusions

We carried out follow–up spectroscopy of 178 Case galaxies in the zone $\alpha = 8^{\rm h} \div 16^{\rm h}$, and $\delta = +29^\circ \div +38^\circ$, classified in the Case catalog with some code, indicating the presence of the emission doublet [OIII] $\lambda\lambda\,4959, 5007$, and not observed in the previous follow–up studies. One of the Case candidates shows quasar–like features in the spectrum. Nine Markarian galaxies have been observed additionally in the same sky region. We present the redshifts, equivalent widths and flux ratios of strong emission lines for 142 galaxies. In 44 objects we have not detected emission lines (in blue). In half of them we could detect the common absorption features: CaII H and K, $G-$band, MgIb and measured their redshifts. The rest objects have too noisy spectra.

We make a preliminary classification of all emission–line galaxies similar to that of Salzer (1989b). We combined his more detailed types SS, DHIIH, HIIH, all with HII–region type spectrum and of low enough luminosity, into one general type — BCGs.

We conclude that Case ELGs (without added Markarian galaxies) give the high fraction of BCGs — about 70% of all galaxies with strong enough emission lines, and about 52% of all Case galaxies, marked with some code of the presence of [OIII] line. Among the ELGs coded with "vs", "s" and "m", BCGs comprise up to 86%.

The redshift distribution of the detected ELGs shows no undersampling up to $z \approx 0.04$, and thus these galaxies can be used to study their large–scale spatial distribution up to the distances of $120\,h^{-1}$ Mpc. Concatenation of the Case BCG sample with those from the new Hamburg/SAO survey, bording the Case sample from the North, and with SBS BCG sample, closing the large region of about 3000 square degrees, will open new perspectives for studying the spatial distribution of BCGs, the effects of environment on BCG properties and the problems of dwarf galaxy formation and evolution.

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References

Afanasiev V.L., Lipovetsky V.A., Mikhailov V.P., Nazarov E.A., Shapovalova A.I., 1986, SAO internal report No. 138

Augarde R., Figon P., Kunth D., Sevre P., 1987, A&A 185, 4

Bothun G.D., Halpern J.P., Lonsdale C.J., Impey C., Schmitz C., 1989, ApJS 70, 271

Coziol R., Demers S., Peña M., Barnéoud R., 1994, AJ 108, 405

Drabek S.V., Kopylov I.M., Somov N.N., Somova T.A., 1986, Izvestia SAO v. 22, p. 64

Huchra J.P., Sargent W.L.W., 1973, ApJ 186, 433

Huchra J.P., 1977, ApJS 35, 171

Huchra J.P., Geller, M.J., Corwin, H.G., 1995, ApJS 99, 391

Izotov Yu.I., Lipovetsky V.A., Guseva N.G., Kniazev A.Yu, Thuan T.X., 1993, Proc. ESO/OHP workshop Dwarf Galaxies, Meylan G. & Prugniel P. (eds.), p. 455

Izotov Yu.I., Thuan T.X., Lipovetsky V.A., 1994, ApJ 435, 647

Kniazev A.Yu., 1994, SAO internal report No. 223

Kniazev A.Yu., Shergin V.S., 1995, SAO internal report No. 239

Kniazev A., Salzer J., Lipovetsky V., et al., 1996, Proc. IAU Symp. 179, Baltimore (accepted)

Lipovetsky V.A., 1986, Ph.D. Thesis, SAO RAS

Lipovetsky V.A., Engels D., Ugryumov A.V., et al., 1996, Proc. IAU Symp. 179, Baltimore (accepted)

Lipovetsky V.A., Thuan T.X., Richter G.M., Pustilnik S.A., Izotov Yu.I., Kniazev A.Yu., 1998 (in preparation)

MacAlpine G.M., Smith S.B., Lewis D.W., 1977, ApJS 34, 95

MacAlpine G.M., Williams G.A., 1981, ApJS 45, 113

Markarian B.E., 1967, Afz 3, 24

Markarian B.E., Lipovetsky V.A., Stepanian J.A., 1983, Afz 19, 29

Markarian B.E., Erastova L.K, Lipovetsky V.A., Stepanian J.A., Shapovalova A.I., 1988, Afz 28, 476

Markarian B.E., Lipovetsky V.A., Stepanian J.A., Erastova L.K., Shapovalova A.I., 1989, Soobshch. Spets. Astrofiz. Obs. 62, 5

Massey P., Trobel K., Barnes J.V., Anderson E., 1988, ApJ 328, 315

Mazzarella J.M., Balzano V.A., 1986, ApJS 62, 751

Moody J.W., Kirshner R.P., MacAlpine G.M., Gregory S.A., 1987, ApJ 314, L33

Pesch P., Sanduleak N., 1983, ApJS 51, 171

Pesch P., Stephenson C.B., MacConnell D.J., 1995, ApJS 98, 41

Popescu C., Hopp U., Hagen H.J., Elsasser H., 1996, A&AS 116, 43

Pustilnik S.A., Ugryumov A.V., Lipovetsky V.A., Thuan T.X., Guseva N.G., 1995, ApJ 443, 499

Salzer J.J., MacAlpine G.M., Boroson T.A., 1989a, ApJS 70, 447

Salzer J.J., MacAlpine G.M., Boroson T.A., 1989b, ApJS 70, 479

Salzer J.J., Lipovetsky V.A., Boroson T.A., et al., 1994, BAAS 26, 916

Salzer J.J., Moody J.W., Rosenberg J.L., Gregory S.A., Newberry M.V., 1995, AJ 109, 2376

Sanduleak N., Pesch P., 1984, ApJS 55, 17

Sanduleak N., Pesch P., 1987, ApJS 63, 809

Smith M.G., Aguirre C., Zemelman M., 1976, ApJS 32, 217

Stepanian J.A., Lipovetsky V.A., Erastova L.K., et al., 1993, Bulletin SAO v. 35, pp. 15, 24, 32, 38

Stephenson C.B., Pesch P., MacConnell D.J., 1992, ApJS 82, 471

Thuan T.X., Izotov Yu.I., Lipovetsky V.A., Pustilnik S.A., 1994, Proc. ESO/OHP workshop Dwarf Galaxies, Meylan G. & Prugniel P. (eds.), p. 421

Thuan T.X., Lipovetsky V.A., Martin J.-M., Pustilnik S.A., 1998, A&AS (submitted)

Tifft W.G., Kirshner R.P., Gregory S.P., Moody J.W., 1986, ApJ 310, 75

Ugryumov A.V., Engels D., Lipovetsky V.A., et al., 1998 (in preparation)

Wasilewski A.J., 1983, ApJ 272, 68

Weistrop D., Downes R.A., 1988, ApJ 331, 172

Weistrop D., 1989, AJ 97, 357

Weistrop D., Downes R.A., 1991, AJ 102, 1680

Zamorano J., Rego M., Gallego J., Vitores A.G., González-Riestra R., Rodríguez-Caderot G., 1994, ApJS 95, 387

Zamorano J., Gallego J., Rego M., Vitores A.G., Alonso O., 1996, ApJS 120, 323

Zwicky F., Herzog E., Wild P., Kowal C., 1961–1968, Catalogue of Galaxies and Clusters of Galaxies. California Institute of Technology, Pasadena