THE ASTRONOMICAL JOURNAL, 115:1717–1724, 1998 May

SPECTRAL OBSERVATIONS OF FAINT MARKARIAN GALAXIES OF THE SECOND BYURAKAN SURVEY. II.

L. CARRASCO[1] AND H. M. TOVMASSIAN
Instituto Nacional de Astrofísica, Optica y Electrónica, Apdo. Postal 51 y 216, 72000 Puebla, Pue., Mexico; carrasco@inaoep.mx, hrant@inaoep.mx
J. A. STEPANIAN
Special Astrophysical Observatory, Russian Academy of Science, Nizhnij Arkhys, Karachai-Cherkessia 357147, Russia; jstep@sao.ru
V. H. CHAVUSHYAN[2] AND L. K. ERASTOVA[3]
Byurakan Astrophysical Observatory, Byurakan 378433, Armenia; chavush@sao.ru, lke@sao.ru
AND
J. R. VALDÉS
Instituto Nacional de Astrofísica, Optica y Electrónica, Apdo. Postal 51 y 216, 72000 Puebla, Pue., Mexico; jvaldes@inaoep.mx
Received 1997 November 26; revised 1998 January 27

ABSTRACT

We continue the program of spectroscopic observations of objects from the Second Byurakan Survey (SBS). This survey contains more than 1300 galaxies and 1700 starlike objects with $m_{pg} < 19.5$. Our work is directed toward the construction of a complete sample of faint Markarian galaxies. Here we present spectroscopic data for 43 galaxies. Among them six new Seyfert galaxies are found: namely, two Seyfert 1's (SBS 1343+544, 1433+500), one Seyfert 2 (SBS 1620+545), and three likely Seyfert 2's (SBS 1205+556, 1344+527, 1436+597). SBS 1343+544 is a very high luminosity Seyfert galaxy. In the sample reported here, another 36 emission-line galaxies are spectroscopically confirmed. Thus far, 102 SBS galaxies brighter than 17.5 mag have been observed with the Cananea 2.1 m telescope at the Guillermo Haro Observatory. The apparent magnitude and redshift distributions, the spectral classification, the relative intensities of emission lines, and other parameters, as well as slit spectra for all 43 observed galaxies, are presented.
Key words: galaxies: active — galaxies: Seyfert

1. INTRODUCTION

In order to build a complete sample of Markarian galaxies up to $m_{pg} < 17$ contained in the Second Byurakan Survey sample (Markarian & Stepanian 1983, 1984a, 1984b; Markarian, Stepanian, & Erastova 1985, 1986; Stepanian, Lipovetsky, & Erastova 1988, 1990; Stepanian 1994), a follow-up spectral study of the selected objects is required. Our work is directed toward this goal.

While high-resolution spectral observations of faint objects are being carried out primarily with the 6 m telescope at the Special Astrophysical Observatory (SAO) in Russia (Stepanian et al. 1993 and references therein), observations of relatively brighter objects are being performed with the 2.1 m telescope at the Guillermo Haro Observatory (GHO), located in northern Mexico. So far, hundreds of QSOs, Seyfert galaxies, emission-line galaxies (ELGs), and blue compact dwarf galaxies (BCDGs), as well as some peculiar stars, have already been found in the SBS sample. There have been several attempts to produce complete samples of active galactic nucleus (AGN) or ultraviolet excess (UVX) galaxies. Naturally, every method to select AGNs—optical, radio, IR, X-ray, or any other—is biased. The question, then, is which one of them will produce the most complete AGN sample ("complete" meaning that we have selected the most significant part of all objects down to a certain flux limit). As was shown in the Markarian galaxy survey, using the UVX criteria produces a more complete AGN sample than any other method. Of course, the combination of several selection techniques will eventually produce a true complete flux-limited sample. It has been known that our primary source of Seyfert-type galaxies was the First Byurakan Survey. The SBS provides us with objects fainter by 2 mag. On the other hand, it has been shown that the spectroscopic classification of galaxies in a magnitude-limited redshift survey provides the most complete sample of low-luminosity AGNs available today (Huchra & Burg 1992). Our long-term project will allow us to compile the first complete sample of faint ($m_{pg} < 17$) Seyfert and AGN galaxies. Such a sample will also allow us to construct a luminosity function (LF) of AGN and UVX galaxies out to a distance of ~ 500 Mpc.

In a previous paper (Carrasco et al. 1997, hereafter Paper I), the results of the follow-up spectroscopy of 59 SBS galaxies were presented. In that subsample, five new Seyfert galaxies were found and 51 emission-line galaxies were confirmed. In the present paper, we report on the results of the follow-up spectroscopic observations of another 43 relatively bright galaxies (15.0–17.5 mag) from the SBS sample. These observations constitute part of an ongoing effort to obtain the data required by the scientific goals outlined above. There is also a general interest in increasing the sample of known Seyfert and AGN galaxies.

2. OBSERVATIONS

Two observing runs in 1997 March and April were allocated for our project, at the Guillermo Haro Observatory at Cananea, Mexico. Observations were carried out with the

[1] Also Instituto de Astronomía, Universidad Nacional Autónoma de México, Ensenada, Mexico.
[2] Also Special Astrophysical Observatory, Russian Academy of Science, Russia.
[3] Visiting Astronomer, Special Astrophysical Observatory, Russian Academy of Science, Russia.

2.1 m telescope and the LFOSC spectrophotometer equipped with a 600 × 400 pixel CCD. The readout noise of the detector is $8e^-$. A setup covering the spectral range 4000–7100 Å with a dispersion of 5.3 Å pixel^{-1} was adopted. The effective instrumental spectral resolution was about 11 Å.

The journal of observations is presented in Table 1. In consecutive columns, the following data are listed: (1) SBS designation (equinox B1950.0), (2)–(3) J2000.0 coordinates as measured by Stepanian et al. (1998) (these are accurate to about ±1″), (4) eye-estimated m_{pg} magnitude, with an accuracy of about ±0.5 mag, (5) SBS spectral class, (6) date of observation, (7) exposure time, and (8) alternative designation of the object (when available).

3. DATA REDUCTION AND RESULTS

The usual data reduction procedures—cosmic-ray removal, bias and flat-field corrections, wavelength linearization, and flux calibration—for the observations of 1997 March were carried out with the IRAF reduction package. The observations of 1997 April were reduced with software packages developed at the SAO (Vlasyuk 1993), and integrated emission-line fluxes were determined with the help of the spectral analysis software package developed there by V. V. Vlasyuk (1996, private communication). This software determines the best-fit Gaussian profile for every line and is capable of deblending closely spaced lines, as is the case of Hα 6563 and the [N II] λλ6548, 6584 lines. In our case, this

TABLE 1

JOURNAL OF OBSERVATIONS

SBS Designation (1)	R.A. (J2000.0) (2)	Decl. (J2000.0) (3)	m_{pg} (4)	Survey Type (5)	Date of Observation (6)	Exposure (s) (7)	Other Name (8)
0803+565........	08 07 33.23	56 25 33.6	17	dse	1997 Apr 13	2400	
0808+569........	08 12 01.06	56 46 59.1	17	de:	1997 Apr 14	2400	
0824+583........	08 28 52.56	58 12 14.5	16.5	de	1997 Mar 6	1200	
0837+496........	08 41 02.59	49 25 30.9	15.7[a]	de:	1997 Mar 13	1800	
0858+495........	09 01 35.28	49 18 38.7	16.5	dse	1997 Mar 6	1200	
0859+521........	09 03 28.07	51 59 00.0	15.3[a]	dse	1997 Mar 6	1200	
0903+558........	09 06 56.89	55 39 06.8	16	sde	1997 Mar 9	1200	
0906+502........	09 10 10.01	50 02 51.0	15.1[a]	sde	1997 Mar 13	1800	
1005+589A......	10 08 40.40	58 43 56.6	16.5	d2	1997 Mar 7	1200	
1007+536........	10 10 43.10	53 25 14.3	16	de:	1997 Mar 12	1800	
1020+594........	10 23 50.03	59 10 26.6	16	de	1997 Mar 13	1800	
1026+510........	10 29 45.46	50 47 51.1	16.5	ds3e	1997 Mar 7	1800	
1103+506........	11 06 21.29	50 23 18.1	16.5	sd3e	1997 Mar 13	1800	
1124+561........	11 27 42.38	55 55 16.1	16.5	de	1997 Apr 13	2400	
1128+546........	11 30 50.57	54 23 41.9	16	de	1997 Mar 9	1800	
1128+507........	11 30 53.18	50 30 21.8	16	sd3e	1997 Mar 13	1800	
1140+529........	11 43 27.33	52 42 39.8	15.0[a]	sde	1997 Mar 9	1800	NGC 3829
1158+590........	12 00 48.70	58 47 39.7	16.5	sd2e	1997 Mar 9	1800	
1159+544........	12 01 57.75	54 11 11.3	16	sd2	1997 Mar 6	1200	
1204+568........	12 06 43.51	56 32 36.0	16	d3e	1997 Mar 7	1800	
1205+556........	12 08 04.64	55 24 27.3	16.5	dse:	1997 Mar 8	2400	
1218+505........	12 21 24.06	50 14 13.9	15	de	1997 Mar 8	1800	
1229+567........	12 32 08.03	56 28 16.0	14.6	sde	1997 Mar 7	2100	NGC 4511
1248+576........	12 50 50.04	57 20 40.9	16	de	1997 Mar 14	1800	
1252+591........	12 54 22.48	58 53 41.4	15.0[a]	de	1997 Mar 9	1800	
1305+535........	13 07 41.42	53 16 35.7	15.1[a]	se	1997 Mar 9	1800	
1306+550........	13 08 33.53	54 49 54.7	15.2[a]	de	1997 Mar 10	1800	
1306+511........	13 09 01.85	50 51 32.0	15.5	d3e	1997 Mar 9	1800	
1307+542........	13 09 08.75	53 56 36.1	15.5	d3e	1997 Mar 10	1200	I Zw 52
1309+534A......	13 11 23.72	53 11 57.4	15.5[a]	sde	1997 Mar 10	1800	
1343+544........	13 45 16.52	54 09 25.3	17.5	s1	1997 Mar 11	2400	
					1997 Apr 14	3600	
1344+527........	13 46 40.78	52 28 36.2	15.5	de	1997 Mar 10	1200	
1359+521C......	14 01 16.00	51 52 22.5	15.4	sd2	1996 Apr 12	720	Mrk 1488
					1997 Apr 13	3600	
1414+607........	14 15 50.58	60 28 34.7	16	dse	1997 Mar 14	1800	
1433+500........	14 35 10.20	49 48 14.6	17.5	BSO	1997 Apr 15	3600	CSO 670[b,c]
1436+597........	14 37 40.53	59 34 46.7	16.0	d3e	1997 Mar 14	1800	
1509+583........	15 10 17.66	58 10 38.8	16.5	dse	1997 Mar 8	1200	
1510+538........	15 12 01.15	53 38 20.0	16	dse	1997 Mar 7	1200	CG 658[b]
1535+568........	15 36 39.48	56 41 47.7	16	dse	1997 Mar 7	1800	
1620+545........	16 21 45.01	54 27 23.8	16.5	dse:	1997 Mar 12	1200	
1646+536........	16 47 13.54	53 33 39.9	16.5	de	1997 Mar 6	1200	
					1997 Apr 11	1200	
1700+603........	17 01 12.94	60 15 04.3	15.1[a]	ds2	1997 Mar 9	1800	
1707+578........	17 08 35.32	57 48 37.1	17	de	1997 Apr 15	2400	

NOTE.—Units of right ascension are hours, minutes, and seconds, and units of declination are degrees, arcminutes, and arcseconds.
[a] Magnitudes taken from Zwicky & Herzog 1966, 1968.
[b] Magnitudes taken from Sanduleak & Pesch 1987.
[c] Magnitudes taken from Bade at al. 1995.

TABLE 2

SPECTROSCOPIC RESULTS

SBS Designation (1)	z_0 (2)	M_{pg} (3)	c(Hβ) (4)	EW(H_β) E(Å) (5)	[O III] λ5007 (6)	Hα λ6563 (7)	[N II] λ6584 (8)	[S II] λλ(6717+6731) (9)	Spectral Type (10)
0803+565........	0.0268	−18.6	...	...	...	0.00	−0.28	...	
0808+569........	0.0291	−18.8	...	...	...	0.00	−0.39	−0.10	
0824+583........	0.0182	−18.2	...	...	...	0.00	−0.26	−0.58	
0837+496........	0.0089	−17.5		4.6	0.24	0.46	−0.23	−0.03	
			0.01		0.24	0.45	−0.23	−0.03	
0858+495........	0.0281	−19.1	...	...	...	0.00	−0.34	−0.77	
0859+521........	0.0294	−20.4		6.2	0.05	0.66	0.16	0.01	
			0.63		0.03	0.45	−0.05	−0.21	
0903+558........	0.0376	−20.2		11.6	0.03	0.89	0.37	0.44	
			1.32		−0.01	0.45	−0.07	−0.03	
0906+502........	0.0337	−20.9		11.2	−0.19	0.81	0.47	0.32	
			1.07		−0.22	0.45	0.11	−0.06	
1005+589A......	0.0307	−19.3		10.5	−0.24	0.68	0.22	0.22	
			0.68		−0.27	0.45	−0.00	−0.02	
1007+536........	0.0331	−19.9		7.8	0.17	0.57	0.08	0.33	
			0.36		0.16	0.45	−0.04	0.20	
1020+594........	0.0241	−19.2	...	...	...	0.00	−0.24	0.44	
1026+510........	0.0255	−18.8		7.4	−0.35	0.47	0.04	−0.03	
			0.04		−0.35	0.45	0.02	−0.04	
1103+506........	0.0398	−19.8		4.9	0.71	0.82	0.65	0.46	
			1.11		0.68	0.45	0.28	0.06	
1124+561........	0.0182	−18.1		11.7	0.21	0.54	−0.03	0.30	
			0.25		0.20	0.45	0.11	0.22	
1128+546........	0.0190	−18.7		7.8	0.23	0.88	0.48	0.41	
			1.28		0.19	0.45	0.05	−0.04	
1128+507........	0.0257	−19.3		14.6	0.17	0.64	−0.12	0.07	
			0.55		0.16	0.45	−0.30	−0.13	
1140+529........	0.0190	−19.7	...	...	...	0.00	−0.30	−0.46	
1158+590........	0.0543	−20.5		9.1	−0.07	0.77	0.26	0.42	
			0.95		−0.10	0.45	−0.06	0.09	
1159+544........	0.0554	−21.0		10.3	0.44	0.56	−0.15	−0.01	
			0.32		0.43	0.45	−0.25	−0.12	
1204+568........	0.0308	−19.7	...	...	...	0.00	−0.25	−0.43	
1205+556........	0.0517	−20.3	...	...	...	0.00	0.30	−0.19	Seyfert 2:
1218+505........	0.0286	−20.6	...	...	...	0.00	0.12	−0.44	
1229+567........	0.0158	−19.7	...	...	...	0.00	−0.45	−0.24	
1248+576........	0.0430	−20.4	...	...	...	0.00	−0.64	−0.64	
1252+591........	0.0085	−17.9		10.5	0.29	0.53	−0.02	0.20	
			0.21		0.28	0.45	−0.09	0.13	
1305+535........	0.0300	−20.6	...	...	...	0.00	−0.27	−0.58	
1306+550........	0.0166	−19.2	...	10.9	...	0.70	0.36	0.21	
1306+511........	0.0334	−20.4		5.9	0.08	0.80	0.36	0.40	
			1.03		0.05	0.45	0.01	0.04	
1307+542........	0.0082	−17.3		8.8	−0.22	0.66	0.17	0.20	
			0.63		−0.24	0.45	−0.04	−0.03	
1309+534A......	0.0306	−20.2	...	11.7	...	0.61	0.21	0.07	
1343+544........	0.2212	−22.5	...	...	...	...	...	...	Seyfert 1
1344+527........	0.0300	−20.2	...	...	0.33	0.00	0.27	0.12	Seyfert 2:
1359+521C......	0.0076	−17.3	...	...	...	...	...	...	
1414+607........	0.0220	−19.0		4.0	...	0.95	0.34	0.44	
			1.49		...	0.45	−0.16	−0.08	
1433+500........	0.1660	−21.9	...	...	...	...	...	...	Seyfert 1
1436+597........	0.0603	−21.2	...	...	...	0.00	0.16	...	Seyfert 2:
1509+583........	0.0319	−19.3	...	...	...	0.00	−0.18	−0.41	
1510+538........	0.0742	−21.7		9.0	...	−0.19	0.51	0.25	
			0.15		...	−0.24	0.45	0.20	
1535+568........	0.0747	−21.7		8.6	...	−0.19	0.49	0.32	
			0.11		...	−0.19	0.45	0.28	
1620+545........	0.0516	−20.4		18.9	1.10	1.12	0.99	0.58	Seyfert 2
			1.93		1.04	0.49	0.35	0.35	
1646+536........	0.0282	−19.1	...	...	...	0.00	−0.20	0.07	
1700+603........	0.0129	−18.9		9.5	0.45	0.66	0.20	0.20	
			0.63		0.43	0.45	−0.01	−0.01	
1707+578........	0.0297	−18.8		16.8	0.52	0.60	−0.16	0.18	
			0.45		0.51	0.45	−0.31	0.02	

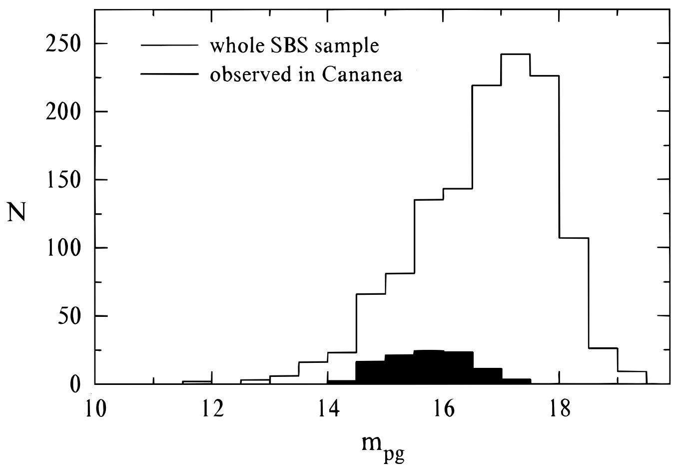

FIG. 1.—Histograms of the stellar magnitude distributions of the entire SBS sample and of the galaxies observed at GHO.

blending is a result of the combined effects of the spectral resolution of the spectrometer and the intrinsic width of the emission lines of the objects. In order to publish data of some relevance, we report measurements for strong emission lines only. Flux corrections for telluric *B*-band absorption were applied when necessary. This was done through dividing by a standard normalized absorption profile until no apparent telluric absorption remained.

For every galaxy in our sample, the value of the dust reddening coefficient $c(\mathrm{H}\beta)$ was determined from the observed ratio of $I(\mathrm{H}\alpha)$ to $I(\mathrm{H}\beta)$, assuming that the intrinsic ratio of $F(\mathrm{H}\alpha)$ to $F(\mathrm{H}\beta)$ is given by

$$F(\mathrm{H}\alpha)/F(\mathrm{H}\beta) = [I(\mathrm{H}\alpha)/I(\mathrm{H}\beta)]10^{c(\mathrm{H}\beta)f(\lambda)} ,$$

where $f(\lambda)$ is listed by Kaler (1976) for a standard Galactic reddening law (Whitford 1958). The values of $c(\mathrm{H}\beta)$ were computed by assuming that the intrinsic ratio of $F(\mathrm{H}\alpha)/F(\mathrm{H}\beta)$ is equal to 2.85 for narrow emission line galaxies, and is equal to 3.1 for Seyfert 2's and for narrow-line components of Seyfert 1.5's (Veilleux & Osterbrock 1987).

The results of spectral observations are presented in Table 2, in which the following data are given:

1. SBS designation;
2. Emission-line redshift, derived as the mean value of the redshifts of strong emission lines, corrected for solar motion:

$$\Delta z = 0.001 \sin l \cos b \; ;$$

3. Absolute magnitude M_{pg}, given by the expression

$$M_{pg} = m_{pg} - 5 \log z - 43.01 - 0.24 \csc b$$

for $H_0 = 75$ km s^{-1} Mpc^{-1};

4. Reddening coefficient $c(\mathrm{H}\beta)$;
5. Hβ equivalent width EW(Hβ);

6.–9. Logarithms of the observed and reddening-corrected relative intensities, normalized to Hβ or to Hα when Hβ is absent (the uncertainty in the intensity ratios for all of the emission lines reported here is less than 30%).

10. Seyfert type (colon indicates ambiguous spectral classification).

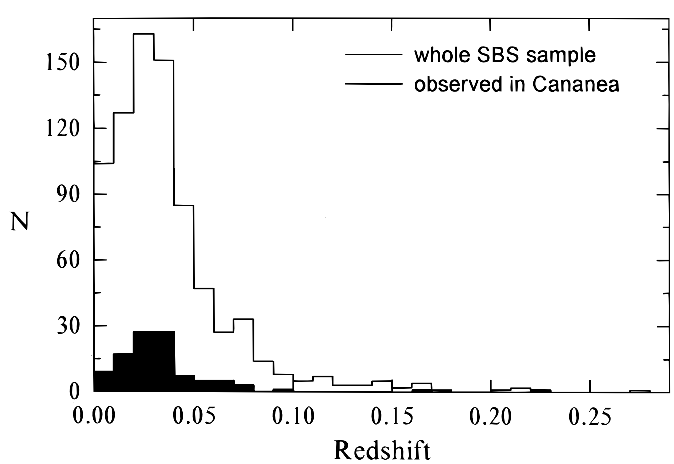

FIG. 2.—Histograms of the redshift distributions of the SBS sample with available velocity data and of the galaxies observed at GHO.

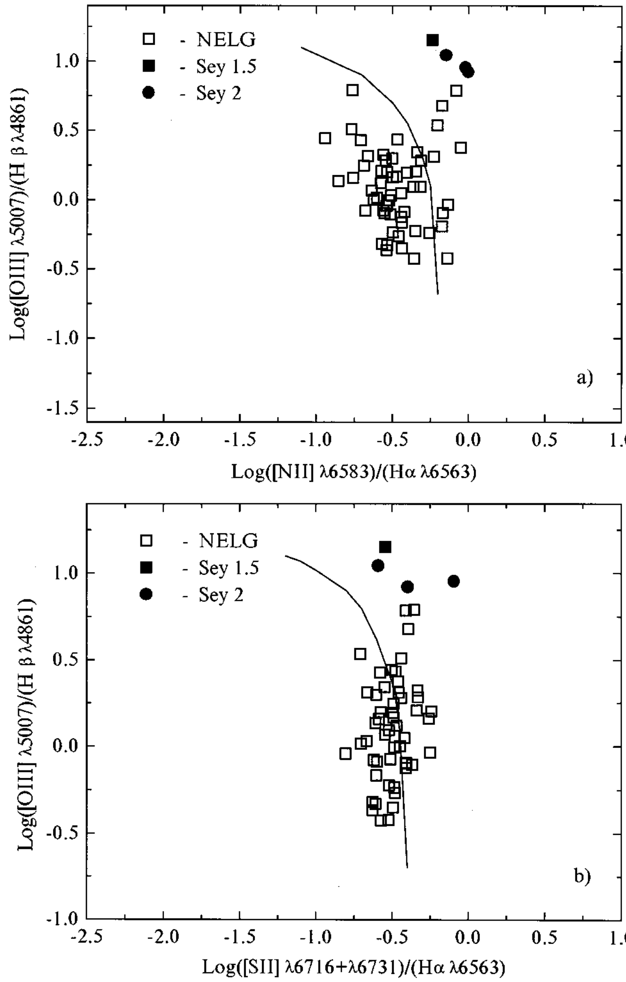

FIG. 3.—Emission-line ratio classification diagrams. The solid line marks the boundary between "H II region–like" galaxies and AGNs.

In the sample studied here, two Seyfert 1 galaxies (SBS 1343+544, 1433+500) were found. The spectrum of SBS 1343+544 shows broad hydrogen emission lines, Hβ (FWHM ~ 8000 km s^{-1}) and Hγ (FWHM ~ 7000 km s^{-1}), while in the spectrum of SBS 1433+500 the broad emission line FWHM Hβ ~ 5000 km s^{-1} is evident. In both cases, there is narrow-line emission of [O III]: SBS 1620+545 has a spectrum rather typical of Seyfert 2 galaxies (two other galaxies, SBS 1205+556 and SBS 1344+527, are most

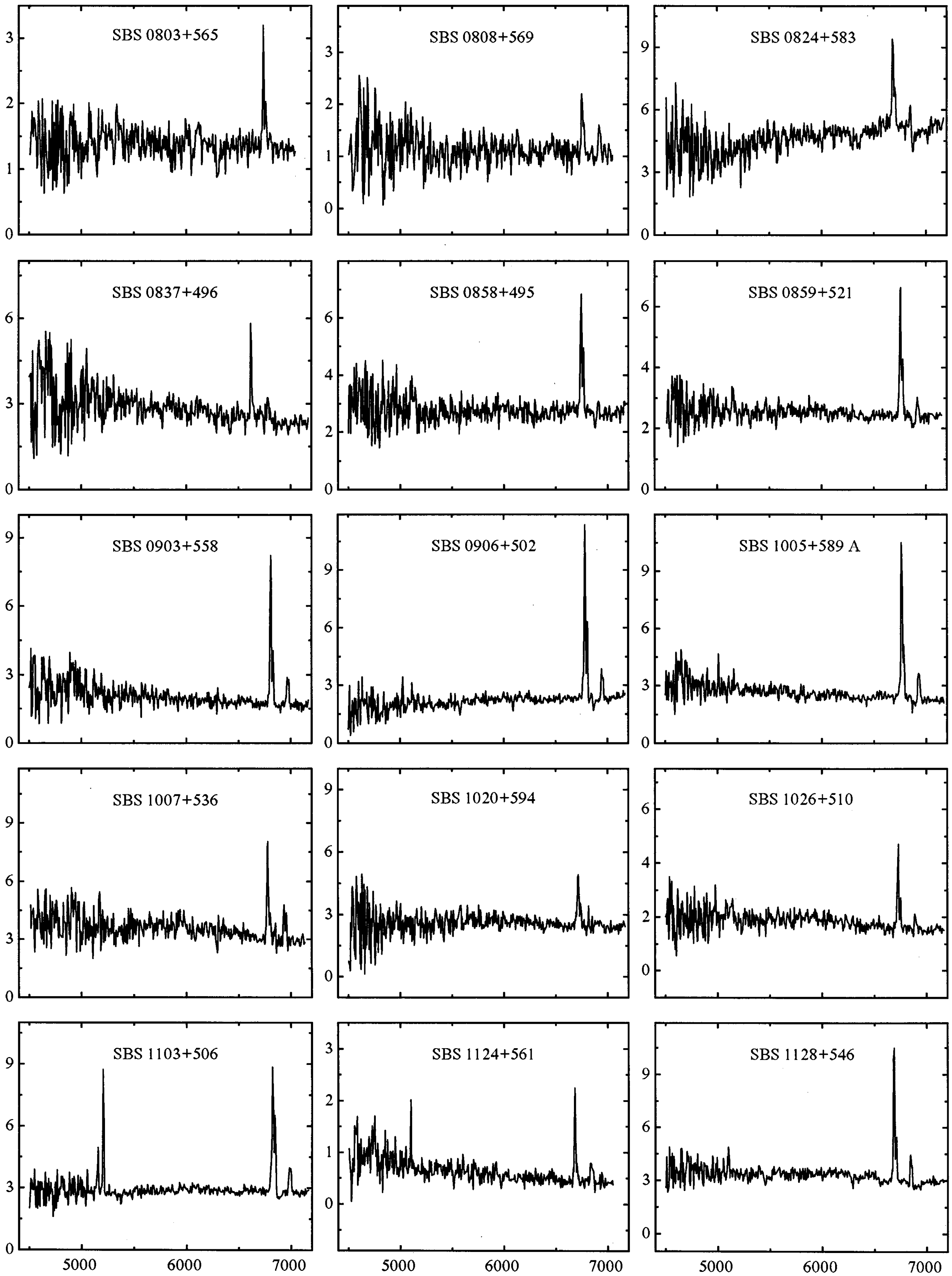

FIG. 4.—Spectra of the observed galaxies in relative flux units (wavelengths in angstroms)

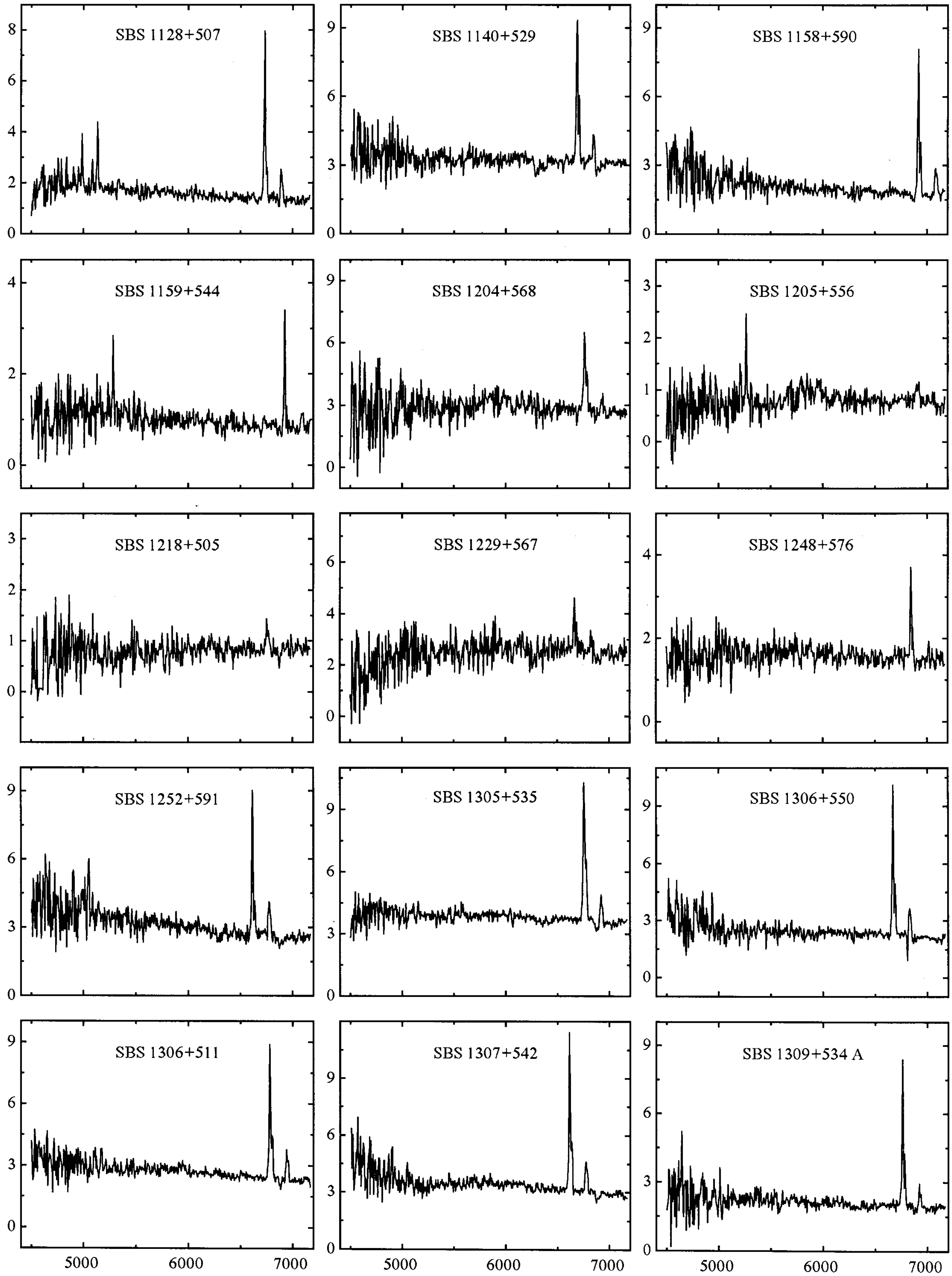

FIG. 4.—*Continued*

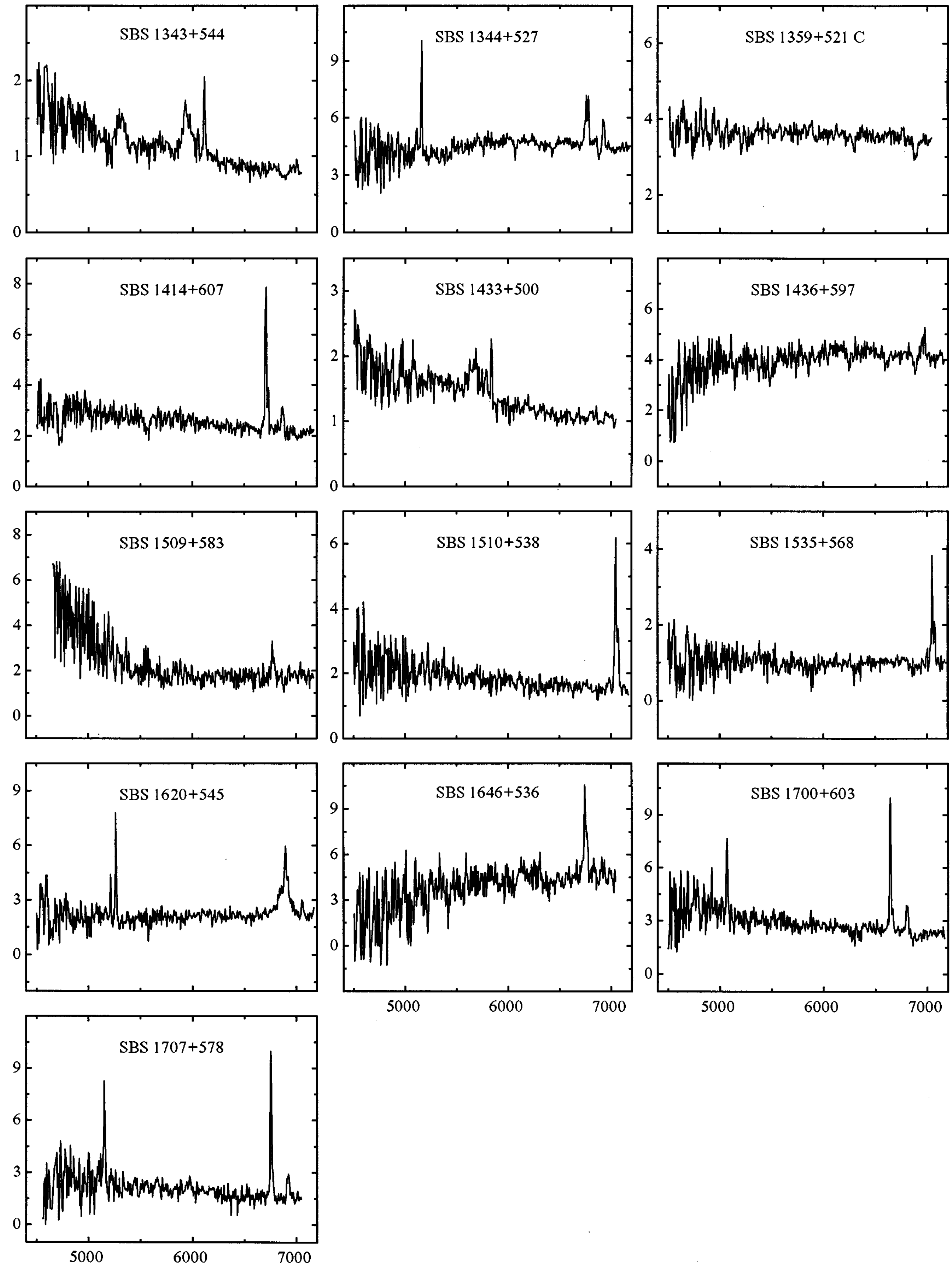

FIG. 4.—*Continued*

likely also of this type). The spectrum of SBS 1436+597 presents [N II] $\lambda6584/H\alpha > 1$, suggesting that it is also a Seyfert 2 (since other emission lines are not evident in our spectra, we cannot exclude the possibility of its being a LINER). Mrk 1488 (SBS 1359+521C) presents in its spectrum the Mg I *b* and Na D absorption lines as prominent features in the spectral range studied. The magnitude and redshift distributions of the entire sample of SBS galaxies and those of the subsample observed at Cananea (including data from Paper I) are presented in Figures 1 and 2, respectively.

The Seyfert 1 galaxy SBS 1343+544 falls in the apparent luminosity gap between Seyfert galaxies and low-redshift QSOs. It is worth noting that the optical QSO surveys discriminate against objects of extended morphology, causing certain incompleteness at low redshifts. Meanwhile, galaxy surveys dedicated to the investigation of the LF of Seyfert 1's (Cheng et al. 1985; Huchra & Burg 1992) are incomplete at high nuclear luminosities. These surveys tend to miss those objects in which the active nucleus outshines the surrounding host galaxy, and thus the corresponding object is not classified as such. The boundary in luminosity between QSOs and Seyfert 1's is probably not physically justified. However, there is an apparent deficiency in the number of Seyfert galaxies at the high-luminosity end, probably on account of selection effects. For this reason, the SBS was designed to avoid, as much as possible, the aforementioned selection biases in order to bridge the gap and to gain further insight into the continuity of the properties of the high-luminosity QSOs and the lower luminosity Seyfert nuclei. As a result of the efforts of the SBS, the number of known intermediate QSO/Seyfert 1 type objects has increased significantly during the last decade (see Martel & Osterbrock 1994). As a consequence, we can now establish that there is a continuity of physical properties between these two types of objects.

The diagnostic classification diagrams based on emission-line ratios (Veilleux & Osterbrock 1987) for the studied objects, including the objects reported in Paper I, are presented in Figure 3. Plots of the spectra of the observed objects are presented in Figure 4.

4. CONCLUSIONS

The results of the spectrophotometric observations of 43 SBS galaxies made with the Cananea GHO 2.1 m telescope in 1997 March and April are presented. Among the objects observed, three new Seyfert galaxies were found. These are two Seyfert 1's (SBS 1343+544, 1433+500) and one Seyfert 2 (SBS 1620+545). Another three galaxies (SBS 1205+556, 1344+527, 1436+597) are probably also Seyfert 2's. In total, 42 emission-line galaxies and one absorption-line galaxy were spectroscopically confirmed. The galaxy SBS 1343+544, being a Seyfert 1 object, has a luminosity and a spectrum that resemble those of QSOs, providing further evidence and support to the idea that Seyferts and QSOs are similar phenomena differing in total luminosity. Spectral classification, redshifts, and relative intensities of the prominent emission lines, as well as other parameters, were determined for all 42 emission-line galaxies.

We thank V. Vlasyuk and A. Burenkov for allowing us to use their data analysis package. V. H. Ch. thanks INAOE's staff for their hospitality during his visit. This work has been partially supported by CONACYT research grants 211290-5-1430PE and 211290-5-0009PE. J. A. S., V. H. Ch., and L. K. E. were partially supported by research grants 97-02-17168 and 1.2.2.2 from the Russian Foundation for Basic Research and from the State Program "Astronomy," respectively. We also thank J. Miramon, G. Miramon, S. Noriega, and J. Genis for excellent assistance and technical support at the telescope. Finally, we would like to thank an anonymous referee for a careful reading of this paper and useful remarks that helped to improve the final version.

REFERENCES

Bade, N., Fink, H. H., Engels, D., Voges, W., Hagen, H.-J., Wisotzki, L., & Reimers, D. 1995, A&AS, 110, 469
Carrasco, L., Serrano, A., Tovmassian, H. M., Stepanian, J. A., Chavushyan, V. H., & Erastova, L. K. 1997, AJ, 113, 1527 (Paper I)
Cheng, F., Danese, L., De Zotti, G., & Franceschini, A. 1985, MNRAS, 212, 857
Huchra, J., & Burg, R. 1992, ApJ, 393, 90
Kaler, J. B. 1976, ApJS, 31, 517
Markarian, B. E., & Stepanian, J. A. 1983, Astrofizika, 19, 639
———. 1984a, Astrofizika, 20, 21
———. 1984b, Astrofizika, 20, 513
Markarian, B. E., Stepanian, J. A., & Erastova, L. K. 1985, Astrofizika, 23, 439
———. 1986, Astrofizika, 25, 345
Martel, A., & Osterbrock, D. E. 1994, AJ, 107, 1283
Sanduleak, N., & Pesch, P. 1987, ApJS, 63, 809
Stepanian, J. A. 1994, Ph.D. thesis, Spec. Astrophys. Obs., Nizhnij Arkhys
Stepanian, J. A., Chavushyan, V. H., Erastova, L. K., Ajvazian, V. T., Bicay, M. D., Seal, J., & Kojoian, G. 1998, in preparation
Stepanian, J. A., Lipovetsky, V. A., & Erastova, L. K. 1988, Astrofizika, 29, 247
———. 1990, Astrofizika, 32, 441
Stepanian, J. A., Lipovetsky, V. A., Erastova, L. K., Hakopian, S. A., Izotov, Yu. I., & Guseva, N. G. 1993, Izv. Spets. Astrofiz. Obs., 35, 38
Veilleux, S., & Osterbrock, D. E. 1987, ApJS, 63, 295
Vlasyuk, V. V. 1993, Izv. Spets. Astrofiz. Obs., 36, 107
Whitford, A. E. 1958, AJ, 63, 201
Zwicky, F., & Herzog, E. 1966, Catalogue of Galaxies and of Clusters of Galaxies, Vol. 3 (Pasadena: Caltech)
———. 1968, Catalogue of Galaxies and of Clusters of Galaxies, Vol. 4 (Pasadena: Caltech)