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THE SLIT SPECTRA OF GALAXIES OF THE SECOND BYURAKAN SKY SURVEY. VI

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ABSTRACT. *The results of follow-up spectroscopy of 56 galaxies from the Second Byurakan Survey are presented. The observations are carried out with the 6 m telescope of the SAO RAS. The redshifts and luminosities of all the galaxies are determined. It is shown, that SBS 1515+579, SBS 1524+604, SBS 1536+577 and SBS 1624+575 are the galaxies of Seyfert type, and SBS 1426+573 is a possible Seyfert type galaxy. Four physical pairs of galaxies are found.*

1. OBSERVATIONS

In the previous five papers of this series (Markarian et al., 1984; Lipovetsky et al., 1988; Stepanian et al., 1991; 1993) the results of studying of the slit spectra of 263 galaxies of the Second Byurakan Sky Survey (SBS) are presented. In the present paper we have compiled together the data on the slit spectra for 56 galaxies as well, 34 from which are situated in the field of the SBS survey with the center coordinates $\alpha=15^h30^m$, $\delta=+59^\circ00'$ (Markarian et al., 1986), the remainder are out of the investigated fields of SBS survey in the region $\alpha=13^h00^m-17^h15^m$, $\delta=+49^\circ-+61^\circ$.

Most spectral observations have been carried out using the 1000-channel TV spectral scanner, placed in the Nasmyth focus of the 6 m telescope of SAO RAS (Drabek et

al., 1986). Two diffraction gratings were used giving spectral resolutions 1.9 Å and 3.5 Å per channel. Some objects were observed consecutively on both strobes of the scanner at identical integration times, thereby making it possible to subtract the night-sky spectrum more accurately, to reduce the noise in the spectra of the objects.

Earlier for some galaxies the spectral observations have been carried out in the prime focus of the 6 m telescope with the UAGS spectrograph plus image tubes UMK-91B or UM-92. As a rule, unwidened spectra in the blue and sometimes in the red range with a linear dispersion of 90 Å/mm and a spectral resolution of about 5 Å were taken, A-600N photographic emulsion being used.

For some objects additional spectra are obtained for better definition of spectral type of an object.

Table 1 presents the data on the objects investigated: 1 - SBS designation in accordance with (Markarian et al., 1986), 2 - date of observations, 3 - observed spectral region in Å, 4 - exposure time in seconds, 5 - redshifts determined from the most confident emission or absorption lines, corrected for the solar motion, $\Delta z = 0.001 \sin l^{II} \cos b^{II}$, 6 - apparent magnitude in the blue spectral region according to (Markarian et al., 1986), 7 - luminosities corrected for extinction in our Galaxy ($H=75$ km $s^{-1}Mpc^{-1}$), 8 - Survey type (Markarian et al., 1986). Coordinates and finding charts for the objects which are outside of the published fields of SBS Survey will be published later.

In the description the results of investigation of the slit spectra are presented: morphology of the objects, observed emission and absorption lines, visual estimations of the intensity ratios of emission lines, spectral type of a galaxy.

Table 1.

Designation SBS	Date of observation	Spectral range Å	Exposure time(s)	z_0	m_B	M_B	Survey type
1	2	3	4	5	6	7	8
1305+542	27.01.90	3650-5560	1053	0.0302	17	-18.7	1e
1305+547	27.01.90	3650-5560	2247	0.0328	16	-19.8	sd2e
1307+562	26.01.90	3650-5460	1537	0.0176	18	-16.5	s1e
1319+579 A	26.01.90	3640-5460	1931	0.0082	18.5	-14.4	s1e
1319+579 B	26.01.90	3640-5450	2711	0.0074	18.5	-14.1	ds2e
1342+562	17.04.90	3680-5640	2128	0.0712	17	-20.6	s1e
1342+562 B	17.04.90	3680-5640	1103	0.0709	18	-19.5	s2e
1408+551 A	22.04.90	3630-5590	2300	0.0783	17.5	-20.2	dse
1408+551 B	22.04.90	3630-5590	1214	0.0408	18	-18.3	s2e
1423+518	17.04.90	3680-5640	1170	0.0077	16.5	-16.2	sde
1426+574	19.02.82	5500-7700	660	0.0435	18.5	-18.0	ds3e
	12.02.92	3520-5570	312				
1430+521	27.01.90	3640-5560	2248	0.0262	18	-17.4	s1e
1432+530	17.04.90	3680-5640	2240	0.0456	17.5	-19.1	ds1e
1444+588	09.03.81	5500-7700	900	0.0681:	17	-20.5	s1e
	14.05.86	3840-5230	1046				
1457+540	17.04.90	3680-5640	1160	0.0275	17.5	-18.0	se
1515+602	31.08.86	3830-5580	1417	0.0458	17.5	-19.1	sde
1515+590	31.08.86	3830-5570	1330	0.0747	17.5	-20.2	sde
	03.09.86	3720-5520	2215				
	14.09.88	3710-5510	1068				
1515+606	09.10.88	3320-6840	1758	0.0747:	18	-19.7	ds3e
1515+579	31.08.86	3830-5580	1108	0.0580	18	-19.2	se
	03.10.88	5330-7210	1268				
	08.10.88	5280-7270	1971				
	08.10.88	5300-7260	1272				
1516+588	10.10.88	3500-6900	1288	0.1736:	17	-22.5	de
1516+579	22.02.82	3700-5700	720	0.0408	18	-18.4	BSO
	13.11.85	3640-5420	891				
	27.09.90	3300-7120	2810				
1520+572	17.09.88	3700-5520	582	0.0722	18.5	-19.1	sd2e
1521+588	16.09.88	3930-5770	2016	0.0341	19	-17.0	sde
	16.09.88	5230-7100	1976				
	16.09.88	3700-5540	1147				
1523+589	10.10.88	3450-6960	1168	0.0602	18.5	-18.7	de
1524+604	09.04.81	5500-7700	480	0.0788	16.7	-21.8	sd1e
	11.11.85	3670-5470	1048				
	11.11.85	4240-6060	1601				
1524+575 A	09.04.81	5500-7700	900	0.0304	17.5	-18.2	sd1e
	09.10.88	3320-6840	954				
1524+575 B	17.09.88	3710-5510	2349	0.0408	18	-18.4	ds3e
1525+580 A	07.09.86	3660-5500	1120	0.0712	17.5	-20.1	sde
1526+585 A	07.09.86	3660-5530	923	0.0588	17.5	-19.7	s2e
1526+585 B	07.09.86	3660-5540	695	0.0308	18	-17.8	sd2e
1527+583	29.04.89	3500-7000	802	0.0221	18	-17.0	dse
1528+589	21.03.86	3800-5600	1480	0.0621	18.5	-18.8	s1e
1528+577 B	07.09.86	3660-5520	981	0.0766	17.5	-20.2	sd1e
1531+572 A	07.09.86	3660-5520	1203	0.0407	17	-19.4	ds2e
1532+585 B	17.09.88	3710-5510	1976	0.1100	18	-20.5	ds2e
1533+574 A	04.09.86	3670-5620	832	0.0116	17.5	-16.2	ds1e
1533+574 B	04.09.86	3690-5570	388	0.0126	18	-15.8	ds1e
	13.09.88	3770-5570	1115				
	13.09.88	5230-7100	1130				

Table 1 (continued).

1	2	3	4	5	6	7	8
1536+573	07.09.86	3660-5530	1274	0.0745	17.5	-20.2	s3
1536+576	14.09.88	3720-5520	990	0.0759	18.5	-19.2	d2
1536+588	07.09.86	3660-5500	582	0.0708	18	-19.6	sd1e
1536+577	07.09.86	3660-5510	2340	0.0745	17.5	-20.2	sd2e
	05.10.88	5280-7270	1971				
	05.10.88	3690-5510	1317				
1538+574	09.04.81	5500-7700	600	0.0821	17.5	-20.4	s1e
	14.05.85	3990-5390	692				
	18.09.88	3700-5500	855				
	18.09.88	5280-7160	847				
1538+584	16.09.90	3710-5720	3447	0.0441	19.5	-17.1	se
1539+597	09.03.81	5500-7700	660	0.0099:	16.5	-16.8	sd3e
	14.11.85	3640-5410	2042				
1542+574	19.07.88	3700-5510	1582	0.0143	18	-16.1	d2e
	19.07.88	5280-7170	2726				
1542+573 A	16.09.88	3700-5520	1558	0.0143	18	-16.1	de
	16.09.88	5220-7110	1635				
1545+592	29.04.89	3500-7000	837	0.0214:	17.5	-16.8	sd2e
1552+602 B	17.09.90	3710-5710	2521	0.0104	18.5	-14.9	sd1e
1559+604	26.08.89	3700-5570	2570	0.0425	17.5	-19.0	sd1e
	26.08.89	5290-7210	1123				
1620+577	27.08.89	3700-5580	4122	0.0198	19	-15.8	s1e
1624+575	15.11.85	3630-5400	1051	0.0675	17.5	-20.0	s1e
	15.11.85	4570-6570	1148				
1650+535	16.09.90	3710-5710	1649	0.1050	16	-22.5	s3e
1651+605	23.09.90	3140-7000	897	0.0558	18.5	-18.6	sd1e
1657+598	28.12.84	4900-7300	630	0.0310	16.5	-19.4	s2e
1706+608 A	28.12.84	4800-7200	480	0.0109	15	-18.6	de
1706+608 B	28.12.84	4900-7300	300	0.0108	15	-18.6	sde

DESCRIPTION

1305+542 - In the blue region of spectrum the emission lines N_1, N_2, H_β, [OIII]λ4363, H_γ, [OII] λ3727 are observed. The ratios N_1/H_β < 3, [OII]/H_β ~ 2.

1305+547 - The following emission lines N_1, N_2, H_β, H_γ, H_δ, [NeIII] λ3968 + H_ε, [NeIII] λ3869 and [OII] λ3727 are present. N_1/H_β > 3, [OII] λ3727/H_β ~ 2.

1307+562 - The spectrum shows N_1, N_2, H_β, [OIII] λ4363, H_γ, H_δ, [NeIII] λ3968+H_ε, [NeIII] λ3869 and [OII] λ3727 in emission. N_1/H_β > 3, [OII] λ3727 ~ H_β.

1319+579 A- N_1, N_2, H_β, [OIII] λ4363, H_γ, H_δ, [NeIII] λ3968+H_ε, [NeIII] λ3869 and [OII] λ3727 emission lines are seen in the spectrum. N_1/H_β > 3, [OII] λ3727 ~ H_β.

1319+579 B- The emission lines N_1, N_2, H_β, [OIII] λ4363, H_γ, H_δ, [NeIII] λ3968+H_ε, [NeIII] λ3869, H_8 - H_{11} and [OII] λ3727 are observed. N_1/H_β > 3, [OII] λ 3727 < H_β.

1342+562 - There are N_1, N_2, H_β, [OIII] λ4363, H_γ, H_δ, [NeIII] λ3968+H_ε, HeI λ4471, [NeIII] λ3868 and [OII] λ3727 in emission. N_1/H_β > 3, [OII] λ3727/H_β ~ 2.

1342+562 B- This is a companion of SBS 1342+562. The emission spectrum is similar to

that of SBS 1342+562. The emission lines N_1, N_2, H_β, H_γ, [NeIII]λ3868 and [OII] λ3727 are seen. $N_1/H_\beta < 3$, [OII] λ3727/$H_\beta \sim 4$.

1408+551 A- The following emission lines N_1, N_2, H_β, [OII] λ3727 are present.

1408+551 B- N_1, N_2, H_β, HeII λ4686, [OIII] λ4363, H_γ, H_δ, [NeIII] λ3968+H_ε, H_8 and [OII] λ3727 are observed in emission. $N_1/H_\beta < 3$, [OII] λ3727 ~ H_β.

1423+518 - The spectrum shows N_1, N_2, H_β, H_γ, H_δ, [NeIII] λ3968+H_ε, [NeIII] λ3869 and [OII] λ3727 emission lines. $N_1/H_\beta > 3$, [OII] λ3727 ~ H_β.

1426+574 - The extended emission lines H_α and [NII] are observed. H_α/[NII] λ6584 ~2. In the blue region of the spectra there are N_1, N_2, H_β, H_γ, [OIII] λ4363, H_δ, [NeIII] λ3968+H_ε, [OII] λ3727 in emission. N_1/H_β ~10, [OII] λ3727~H_β. Possible Seyfert type galaxy.

1430+521 - The blue region of the spectrum shows the following emission lines: N_1, N_2, H_β, H_γ, H_δ, [NeIII] λ3968+H_ε, [NeIII] λ3869 and [OII] λ3727. $N_1/H_\beta > 3$, [OII] λ3727 ~ H_β.

1432+530 - N_1, N_2, H_β, H_γ, H_δ, [NeIII] λ3968 + H_ε, [NeIII] λ3869 and [OII] λ3727 are seen in emission. $N_1/H_\beta \sim 3$, [OII] λ3727/$H_\beta \sim 3$.

1444+588 - H_β, H_γ, [OII] λ3727 emission lines are observed. H_β ~ [OII] λ3727. The Balmer lines H_δ-H_{10} are seen in absorption. In the red spectral range H_α, [NII] λλ6548/84, [SII] λλ6717/31 are present in emission.

1457+540 - There are N_1, N_2, H_β and [OII] λ3727 in emission, and Balmer lines H_γ - H_8 in absorption. $N_1/H_\beta \leqslant 3$.

1515+602 - N_1, N_2, H_β and [OII] λ3727 emission lines are observed. $N_1/H_\beta \leqslant 3$.

1515+590 - G-band, H and K CaII are observed in absorption.

1515+606 - H and K Ca II, and G-band are observed in absorption.

1515+579 - H_α, [NII] λλ6548/84, [SII] λλ6717/31, N_1, N_2, H_β, [NeIII] λ3869 and [OII] λ3727 emission lines are present. A Seyfert 2 type galaxy.

1516+588 - Low-contrast lines N_1, N_2, H_β, [OIII] λ4363, H_γ and [OII] λ3727 are observed in emission.

1516+579 - [OII] λ3727 is suspected to be in emission.

1520+572 - There are N_1, N_2, H_β, H_γ, [OII] λ3727 in emission, and HKG in absorption. $H_\beta/N_1 > 1$, [OII] ~ H_β.

1521+588 - H_α, [SII], N_1, N_2, H_β, H_γ and [OII] λ3727 are observed in emission. $N_1/H_\beta \sim 3$.

1523+589 - The spectrum shows the following emission lines: H_α, [OI] λ6300, N_1, N_2, H_β, H_γ and [OII] λ3727. $N_1/H_\beta > 3$, [OII] λ3727/$H_\beta \sim 1.5$.

1524+604 - The broad lines N_1, N_2, H_β are observed in emission. $N_1/H_\beta \sim 3$. A Seyfert 1 type galaxy.

1524+575 A- In emission the following lines are present: H_α, [SII] λλ6717/31, N_1, N_2, H_β, H_γ and [OII] λ3727. $N_1/H_\beta \sim 1.5$, [OII]/$N_1 > 3$.

1524+575 B- N_1, N_2, H_β, and [OII] λ3727 emission lines are observed. $N_1/H_\beta \sim 3$, [OII]/$H_\beta \sim 2$.

1525+580 A- The strong lines HKG are seen in absorption.

1526+585 A- Only HKG are observed in absorption.

1526+585 B- There are the following emission lines: N_1, N_2, H_β, HeII λ4686, H_γ and [OII] λ3727. H_β and H_γ have a broad absorption component. $N_1/H_\beta > 3$, $[OII]/H_\beta \sim 2.5$. Balmer series lines H_δ- H_{10} are observed in absorption.

1527+583 - [OII] λ3727 is suspected in emission.

1528+589 - [OII] λ3727 emission and H and K CaII, and G-band absorption lines are present.

1528+577 B- Comparable intensity H_β and [OII] λ3727 are present in emission, and the Balmer H_γ-H_{11} and strong HKG lines are observed in absorption.

1531+572 A- The absorption lines H_γ and HKG are seen.

1532+585 B- The spectrum shows weak emission line [OII] λ3727 and the Balmer series lines H_γ-H_ε in absorption.

1533+574 A- N_1, N_2, H_β, and [OII] λ3727 emission lines are observed. $N_1/H_\beta > 3$, [OII] λ3727 ~ H_β.

1533+574 B- There are N_1, N_2, the Balmer series lines H_β-H_8, [NeIII] λ3869 and [OII] λ3727 in emission.

1536+573 - The weak emission line [OII] λ3727, the absorption lines H_γ-H_8, and strong HKG are observed.

1536+576 - The emission lines N_1, N_2, H_β, and [OII] λ3727 are present. $N_1/H_\beta < 1$, $[OII]\ \lambda\ 3727/H_\beta \sim 1$.

1536+588 - The emission lines N_1, N_2, the Balmer series lines H_β-H_ε, [NeIII] λ3869 and [OII] λ3727 are observed. The continuum is weak. $N_1/H_\beta > 3$, $[OII]/H_\beta \sim 1.5$.

1536+577 - The broad low-contrast hydrogen lines H_α, H_β, H_γ as well as HeII λ4686 are observed. $N_1/H_\beta < 0.6$. A Seyfert 1 type galaxy.

1538+574 - H_α, [NII] λ6584, N_1, N_2, H_β, H_γ and [OII] λ3727 emission lines are seen. [OII] λ3727 ~ H_β. This object is double with redshift difference between components ΔV ~ 90 км/s according to long slit spectra.

1538+584 - N_1, N_2, H_β- H_ε, [OII] λ3727 emission lines are observed. The continuum is very weak.

1539+597 - The low-contrast emission lines H_α and [NII] λ6584 and absorption lines H_β-H_ε are observed. H_β has a narrow emission core.

1542+574 - There are the following emission lines: H_α, N_1, N_2, H_β and [OII] λ3727 in the spectra. $N_1/H_\beta \sim 2.5$, $[OII]/H_\beta \sim 1$.

1542+573 A- The spectra show H_α, N_1, N_2, H_β and [OII] λ3727 in emission. This object is a superassociation in the galaxy, for which SBS 1542+574 is its nucleus.

1545+592 - [OII] λ3727 is suspected in emission. H and K CaII and G-band are observed in absorption.

1552+602 B- The emission lines N_1, N_2, H_β, H_γ, and [OII] λ3727 are seen on the

weak continuum. $N_1/H_\beta > 3$.

1559+604 - The emission lines of the Balmer series H_α-H_ε, N_1, N_2 and [OII] λ3727 are observed. [OII] λ3727/H_β > 1.

1620+577 - There are the following emission lines: N_1, N_2, H_β and weak [OII] λ3727. $N_1/H_\beta \sim 3$.

1624+575 - The broad emission lines H_β-H_δ are observed. $N_1/H_\beta < 0.5$. H and K CaII and G-band are present in absorption. A Seyfert 1 type galaxy.

1650+535 - N_1, N_2, H_β and [OII] λ3727 emission lines are observed. $N_1/H_\beta \sim 3$, and [OII] λ 3727/H_β > 1.

1651+605 - The spectrum shows H_α, N_1, N_2, H_β and [OII] λ3727 in emission. $N_1/H_\beta \sim 3$, and [OII]/$H_\beta \sim 1$.

1657+598 - H_α and [NII] λλ6548-84 emission lines are observed. $H_\alpha \sim$ [NII] λ6584.

1706+608 A- The strong emission lines H_α, H_β and moderate intensity [NII] λ6584 are present. [SII] λλ6717/31 is suspected.

1706+608 B- The absorption lines D Na, H and K CaII, G-band are observed. Probably it is a physical pair with SBS 1706+608 A.

RESULTS

At the present time the slit spectra of 319 galaxies of SBS have been investigated, 56 from which are presented in this paper.

Four Seyfert type galaxies are discovered: SBS 1515+579 and SBS 1524+604 are Sy 2 type galaxies, SBS 1536+577, and SBS 1624+575 are Sy 1 type ones. SBS 1426+574 is a possible Seyfert type galaxy.

One object, SBS 1516+579, on the Survey plates and on the Palomar charts does not differ from stars and has a survey type as BSO. It turned out to be an emission line moderate luminosity galaxy.

Four physical pairs of galaxies were discovered: SBS 1319+579 A and B, SBS 1533+574 A and B, SBS 1542+573 A and SBS 1542+574, SBS 1706+608 A and B. In the first three pairs both components are emission ones, whereas in the last pair one galaxy has emission lines, the other has only absorption lines in the spectrum.

SBS 1535+595 is a projection of the star on a galaxy.

Six galaxies have only absorption lines in their spectra.

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