ASTRONOMIE

SPECTROPHOTOMETRIC STUDY OF GALAXIES WITH HIGH SURFACE BRIGHTNESS II. ARAKELIAN 583

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The Arakelian 583 galaxy, included by Arakelian in the list of gala- s with high surface brightness [1], has not been studied as yet. All the known data on it boil down to the following: coordinates — $a_{50}=23^h 20^m$, 7 and $\delta_{50}=32°15'$; magnitude $m_p=14.5$, adduced by Zwicky et al. in CGCG. Nilson describes it as a peculiar object. Akn $583=U$ $12570=MCG$ $05-55-008$.

Galaxies with high surface brightness arouse interest, inasmuch as several Seyfert galaxies, several sources of X-ray radiation and radio-sources have been discovered among them. About 90% of them show emission lines in their spectra. It should be noted, however, that the group as a whole is very heterogeneous so that quite a few objects have to be investigated in detail, if light is to be shed on their nature.

The aim of this work is to determine the physical parameters characterizing the nucleus of the galaxy, as well as the content of some ions emitting in the spectrum's visible region. The same method will be applied in all es, as it permits a sufficiently correct comparative study of different objects.

The galaxy was observed in the autumn of 1980 through a 2.6-m telescope of the Crimean Astrophysical Observatory of the Academy of Sciences of the USSR. Its spectra with a dispersion of ~100 A/mm and a ~5 A spectral resolution were obtained by means of a three-cascade UM-92 ITS on a 103a G emulsion. A tube photometer was used for calibration, and the spectral sensitiveness of the apparatus was determined by fastening to the star with a known energy distribution in the spectum. The galaxy spectra were proces- 1 on a G-III recording microphotometer. A registrogram of the spectrum of the Akn 583 galaxy, comprising the region around the line H_α, is shown in the Figure.

The radial velocity of the galaxy has not yet been determined. The redshift determined by us along the lines H_α 6563, [NII]λ 6583 and [SII]$\lambda\lambda$ 6717, 6731 is $z=0.017$.

The data on the spectrophotometric study of the nucleus of the galaxy Akn 583 are given in Table 1, where, as usual, W_λ denotes the equivalent width of the respective lines and I_λ/IH_α is the line's relative intensity vs that of the line H_α. The typical ratios of the relative intensities of the emission lines show the following general picture of the nucleus' physical state:

Ratio $\dfrac{I\lambda4959+I\lambda5007}{I\,H_\beta}=0.54$ suggests a low degree of gas excitation — ex_

citation class 2.5, according to Aller a. Liller [2]. Ratio $\dfrac{I\lambda6717}{I\lambda6731}=1.3$ about the

forbidden lines of ionized sulfur suggests a low density of the emitted gas. According to Nossov [3], the electronic density is $\lg N_e = 2.13 \pm 0.62$. Ratio $\dfrac{\lambda 6584}{I\,H_\alpha} = 0.4$ is close to that typical of the spirals of normal galaxies and of diffusion nebulae in the galaxy. It does not differ much from the
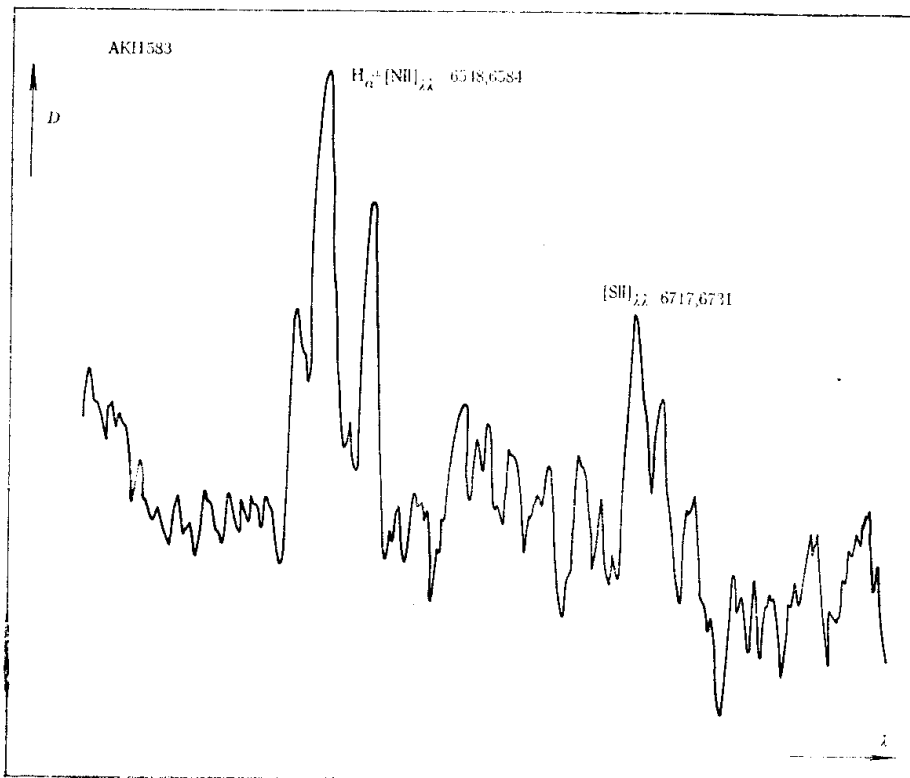

Fig.

mean 0.55 for the nuclei of Arakelian galaxies[4]. Ratio $\dfrac{\lambda 5007[OIII]}{\lambda 6584[NII]} = 2.5$ is a measure of the gas temperature — Alloin et al. [5]. The 2.5 value indicates an electronic temperature $T_e = 8000$ K. Inasmuyh as it was indicated in [5] that, when the line $\lambda 4363$ [OIII] is not observet, the error when determining electronic temperature may attain several thousand degres, $T_e = 10^4 K$ was adopted in our further calculations, as it does not lead to maior errt The ratios $\dfrac{\lambda 6584[NII]}{IH_\alpha}$ and $\dfrac{\lambda 6717}{\lambda 6781}$ [S II] yield information on a possible source of gas ionization in the nucleus. Alloin et al. [6] calculated the values of the ratio couple for the type of objects for which there confidently is shock ioni-

Table 1

Araketian 583

λ	4891 H	5007 [0 I	6548 [N II]		[N II]	6717 [S II]	6731 [S II]	$\dfrac{6717}{6731}$	$\dfrac{6584}{6721}$
$W\lambda$	2.0	0.5	0.5	4.0	1.5	1.0	1.0	1.3	1
$I\lambda/IH_\alpha$	0.35	0.12	0.2	1	0.4	0.25	0.2		

Table 2

Magnitude	$m_p = 14.5$
Redshift	$Z = 0.017$
Flux in Hβ line	$F_{H\beta} = 1.27 \times 10^{-14}$ ergs/cm^2, s
Luminosity in Hβ line	$L_{H\beta} = 7.00 \times 10^{39}$ ergs/sec
Volume coefficient of emissivity	$E_{H\beta} = 2.26 \times 10^{-21}$ ergs/cm^3, s
ctive gas volume	$V_e = 3.10 \times 10^{60}$ cm^3
Effective radius	$R_e = 1.45 \times 10^{20}$ cm
Mass of emitting gas	$= 6.94 \times 10^{38}$ g
Total gas energy	$L_{tot} = 4.20 \times 10^{41}$ erg/sec
Number of ionizing stars	$n = 2350\ 07$ V
Relative number of ions	$N+ = 7.28$
(lg H+ = 12)	$S+ = 6.77$
	$O++ = 7.09$

zation, say, the remains of supernovae (SNR). The Akn 583 galaxy on the diagram ($\lambda 6717/\lambda 6731$)/$\lambda 6584$/I H$_\alpha$) is located outside the region occupied by SNR, which is an indication of priority radiational gas ionization.

Dibay a. Pronik proposed in [7] a method for the determination of the parameters characterizing the emitting gas. For the Akn 583 galaxy the results are adduced in Table 2. The abundance of ions was calculated by the method proposed by Peimbert [8] and is close to the mean for the nuclei of normal galaxies, galaxies of Arakelian and Markarian, and Seyfert galaxies of type 2 [4].

The required number of stars whose UV radiation would suffice to keep the gas in ionization-recombination equilibrium is 2 350, which is an indication of continuing star-formation in the nucleus of the galaxy. This is indirectly confirmed by the following considerations: Although no electrophotometric observations have been made in the UBV system, some preliminary estimates are possible. Huchra [9] examined some dependences connecting the equivalent widths or relative intensities of the emission lines and colours of nucleus, valid for Markarian galaxies of a non-Seyfert type. In its mean characteristics the Akn 583 galaxy is close to them and the colour (U-B) can be evaluated by the dependences

$$\lg W_{H\beta} = 0.61 - 1.39\ (U - B),\quad R = -0.65$$
$$\lambda 5007/IH_\beta = 1.47 - 3.16\ (U - B),\quad R = 0.44.$$

The values — 0.22 and — 0.35 correspondingly suggest that the Akn 583 nucleus is fairly blue with colour (U — B) about — 0.3 — as for galaxies of type Sm-Im [9], i. e the object is probably young. Our results should, of course, be considered as preliminary, insofar as the observation data are quite insufficient.

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