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PHYSICAL CONDITIONS IN NUCLEUS OF SEYFERT GALAXY NGC 7469
II. SPECTROPHOTOMETRIC INVESTIGATION

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The velocity of the field in the galaxy NGC 7469 was investidated in[1]. Here the physical parameters characterizing the nucleus were investigated.

The observation material comprised: a) two scanners including the region from 4000 to 7000 Å obtained on a four-metre telescope at the Kit Peak National Observatory in USA, with a spectral resolution of ~5Å; b) five spectra (obtained at positional angles of 51°, 81°, 111°, 141° and 171°) on a six-metre BTA telescope in USSR with a three-cascade IIS UM-92-dispersion of 46 Å/mm; and c) a scanner including the region λλ 3700 - 5300 Å, obtained on a five-metre telescope at Mt Palomar Observatory in USA.

The initial observation data (see Table) comprised colours ($U-B$) and $B-U$), redshift Z, abs. stellar magnitude in system U, M_{u_0}, equivalent widths of lines H_α, H_β and [OIII] λ 5007 and the corresponding fluxes and luminosities, relative intensities of some emission lines I_λ/I_{H_β} ($I_{H_\beta}=1{,}00$) and the mean width of level 1/2 FWHI and level O-FWOI of the forbidden and permitted lines. The luminosities H_β and [OIII] ($L_{H_\alpha}=2.88\,L_{H_\beta}$) according to [2] and the widths of lines H_α and H_β according to [3] are also shown in the Table for the sake of comparison. All data are adduced on $H=75$ km/s/Mpc and corrected for interstellar absorption and reddening in the generally accepted manner. The method of the initial material has been detailed in [4].

Galaxy NGC 7469 has been repeatedly investigated, but the results obtained have not always been in satisfactory agreement. Dibay a. Pronik [5] found no low-density zone in its nucleus, while Osterbrock's data and our own adduced here suggest that it does exist, and a sufficiently strong one at that.

The relative intensities of the lines [OII] 3727, [NII] 6548+6584 and [SII] 6717+6731 are respectively [OII]/H_β~0.5, 6548+84/H_α~1, [SII]/H_α~0.1.

The observation data permit to analyze the conditions in the galaxy's nucleus. The following estimates were made by method proposed by Dibay a. Pronic [5]: for electron density in zone [OII] by the relative intensities of the lines $[SII]\frac{6717}{6731}=1$ we obtained $n_e\sim 700$ cm^{-3} in accordance with the calculations in [7].

The ratio $[OIII]\frac{I\lambda 4953+I\lambda 5007}{I\lambda 4363}=10.27\frac{7.2\times 10^{\frac{14300}{T_e}}}{1+0.063}$, where $x=10^{-2}\frac{n_e}{\sqrt{T_e}}$, Table

$(U-B)_0$	$(B-V)_0$	z	MU_0	$\lg W_{H_\alpha}$	$\lg W_{H_\beta}$	$\lg W_{[OIII]}$	$\lg F_{H_\beta}$	$\lg F_{[OIII]}$	$\lg L_{H_\beta}$	$\lg L_{[OIII]}$
−0.78	0.46	0.017	−21.66	2.45	1.74	1.83	−11.86	11.78	41.88	41.96

acc. to AGW, Ap.J,199		$\frac{I_{H_\gamma}}{I_{H_\beta}}$	$\frac{I_{4363}}{I_{H_\beta}}$	$\frac{I_{4959}}{I_{H_\beta}}$	$\frac{I_{5007}}{I_{H_\beta}}$	$\frac{I_{[OII]}}{I_{H_\beta}}$	$\langle\frac{6717}{6731}\rangle$[SII]	$\langle V_{\frac{1}{2}}$ restr.$\rangle$	$\langle V_0$.restr$\rangle$	$\langle V_{\frac{1}{2}}\rangle$ allowed
$\lg L_{H\beta}$	$\lg L_{[OIII]}$									
42.05	42.03	0.28	0.11	0.40	0.73	0.50	1.0 lgNe−2.86±0.22 Ne∼700 см$^{-3}$	470	1940	1050

$\langle V_0\rangle$	by Osterbrock			
	FWHI		FWOI	
	Hβ	Hα	Hβ	Hα
6400	1900	1700	8500	7800

does not permit to determine n_e and T_e unequivocally. In such cases the above-equation is usualy solved for two values of $n_e \gg \sim 10^5$ and $n_e - 0$. At $n_e = 10$, $T = 56000$°K is obtained, and at $n_e \to 0$ $T_e = 92700$°K. These temperatures are, of course, greatly increased, bearing in mind that no lines of highly ionized elements are observed in the spectrum.

Dibay a. Pronik [5], examining other lines as well, determined $T_e = 14000$°K and $n_e \sim 5\times10^6$ cm^{-3}. Varying the relative ion content N(OIII)/N(OI) = 0.50, 0.75 and 0.90, Petrov [4] obtained by another method lg $T_e = 3.90$ lg $n_e = 6.60$ as most likely values.

Yankoulova [8] calculated spectrophotometric models of SyG nuclei. The main assumptions were: a central ionizing source with a power spectrum $F\nu = F_0(\nu_e/\nu)^\alpha$ and $\alpha = 0.7$ for NGC 7469.

The chemical composition of gas was according to the Davidson models [9]. It obtains three emission zones HI, [OIII] and [OII] with respective densities of 10^7, 2.5×10^5 and 5×10^4 cm^{-3}. The electron temperature in the external zone, where the ions SII, OII and NII are as well as probably OI and SI, is 16-19. 10^4K, and in the zone (OIII), where the ions OIII, NeIII, ArIV, ArV and NeV are, $15\text{-}30\times10^4$K. The difference is explicable in view of the adopted densities and different zones.

The luminosity in the line H_β is, according to our data [4], as well as to [2], $\lg L_{H_\beta} = 42.00$. Formally, the volume occupied by the emitted gas can be assessed by assuming the density $n_e \sim 1000$ cm^{-3} as mean value. Then $V_{ef} \sim 10^{61}$ cm^3 and $R_{ef} \sim 10^{20}$ cm, i. e. 30÷60 pc, a result in complete agreement with the data obtained in [8]. With a semiwidth of the hydrogen lines $(V_{turb}) = 1050$ km/s, the kinetic energy enclosed in the gas is $E_k = 8\times10^{55}$ erg.

The outlines of the lines H_α and [NII] 6548, 6584 (see Fig.) reveal a structure which does not depend on the positional angle. Asymmetry of the lines is

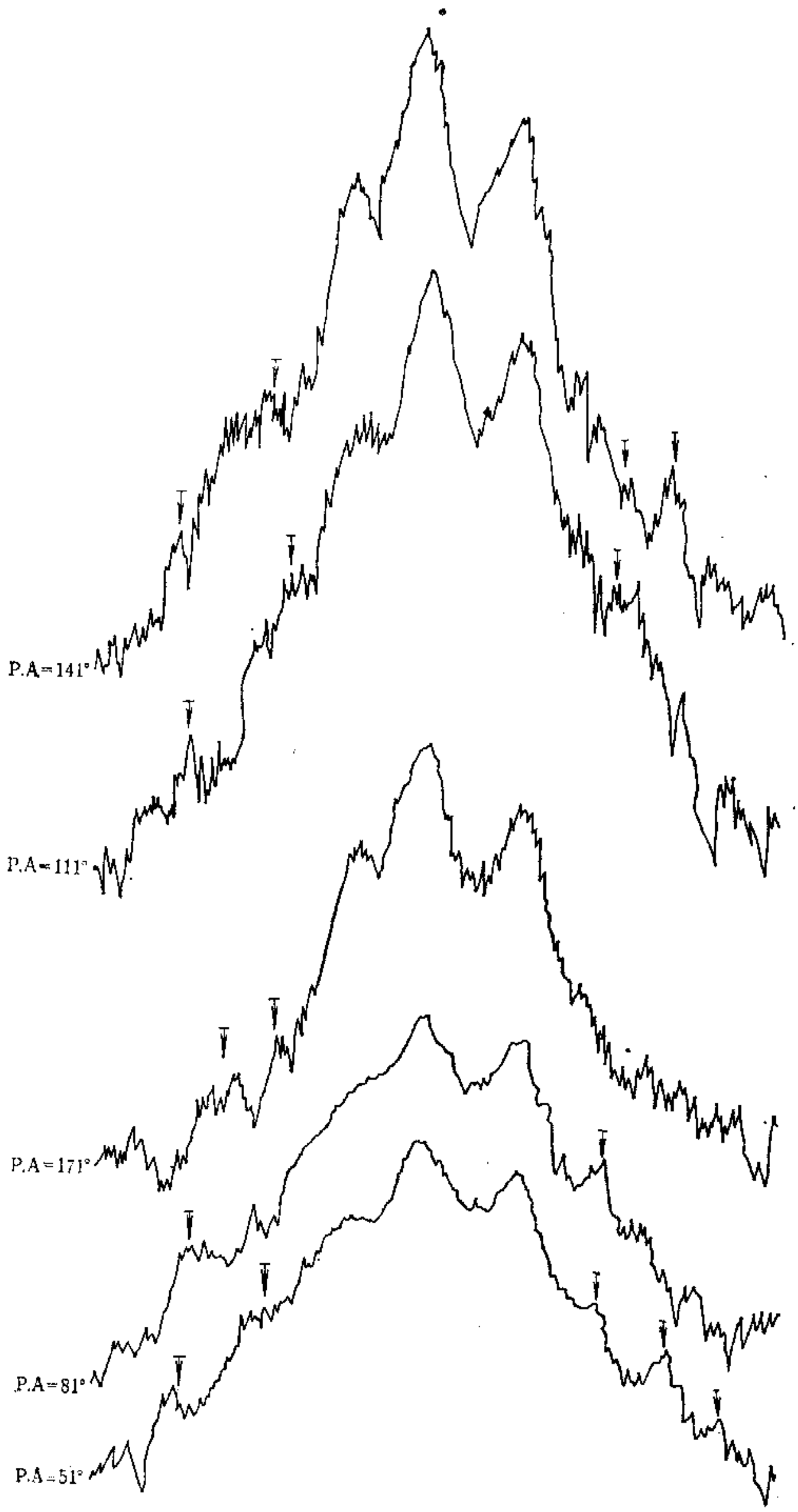

Fig. Comparison of outlines of lines H_α, (NII) 6548,6584 and their nearby regions also observed on our spectra: the centre of H_α is shifted toward the blue side at ca. 700 km/s, while the wings continue farther into the red region. The result obtained for H_β is similar: a shift of ca. 250 km/s.

The recurrent details of all spectrograms are denoted by arrows. This confirms the nebulous structure of the gas, the different compressions moving at different speeds.

In conclusion, let us note that the nitrogen lines on our spectra do not seem to be more intense than on those of other authors. This assumption, however, calls for an additional verification.

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