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GAS COMPONENT PARAMETERS IN THE NUCLEUS OF GALAXY NGC 5879

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In 1978-79 we began a comparative study of galaxies with emission lines. About 200 such galaxies, which definitely are not of the Seyfert type, were selected. The aim of our work was to establish the physical parameters whch characterize the conditions in the galaxy nuclei and to determine the massiof the galaxies and the content of some ions. A comparison of these paramet ers with analogous ones for the Seyfert galaxies should shed light on the evolution of the galaxy nuclei during the transition period from normal to Seyfert galaxies, as well as on the question whether every galaxy goes through the Seyfert phase. Three groups of non-Seyfert galaxies were examined: 1) normal galaxies not belonging to any of the following groups; 2) Arakelian galaxies included in [1]; and 3) Markarian galaxies. The last group also includes the galaxies discovered during the surveys of Michigan University and Tololo Observatory, as well as those discovered by Kazarian. As demonstrated time and gain, these are objects of one and the same type.

Our investigation deals with the NGC 5879 galaxy which belongs to the normal type. In this group we made a detailed study of the NGC 5929, 6503, 7463 and 7537 galaxies. The observed material was treated in all cases in the same manner. The different parameters were determined by a specified method with new atomic constants [2].

The NGC=MCG 10-22-1 ($\alpha_{1950}=15^h08^m,5$; $\delta_{1950}=+58°11',4$) galaxy is of the Sbc type. The spectral class of its nucleus is F8. Its magnitude, as determined by Zwicky et al. in CGCG, is $mp=12.2$. Vorontsov-Velyaminov et al. adduce in MCG the dimensions of the nuclear and the external region $1',3\times0'5$ and $3',2\times1',1$ respectively; in Arakelian's system [1] this gives for the surface brightness of the galaxy $B=mp-0.25$ cosec $(b'')+2.5$ lg $(\frac{\pi}{4}ab)+0.22\frac{a}{b}+0.73$ resp. $B=23.24(m/\square'')$—, in other words a system with a low surface brightness. The magnitude of the galaxy nucleus was $mp=14.9$, while the nucleus itself was referred to Burdkan class 3 according to [3].

The spectrophotometric material included two spectra with a ~100 Å/mm dispersion, obtained on a 125-cm ZTE telescope of the Crimea Station of State Astronomical Institute Shane with a onecascade image tube system. The spectral resolution was ~5 Å. The red part of the spectrum around the H_α line was encompassed. The spectra were processed on a G III microphotometer in the Section of Astronomy of the Bulgarian Academy of Sciences. No reddening corrections were made, as the investigated range was ~500 Å. The equi-

Table

Equivalent widths W_λ and relative intensities $I_\lambda/I_{H\alpha}$ of emission lines

Line	6548[NII]	6563 H_α	6584[NII]	6717[SII]	6731[SII]	$\frac{6717}{6731}$	$\frac{6717+6731}{6584}$
W_λ [Å]	3.0	16.5	4.5	3.0	4.0		
$I_\lambda/I_{H\alpha}$	0.19	1.0	0.26	0.11	0.15	0.77	1.0

valent widths and relative intensities of the emission lines are shown in the Table. The data refer to the position angle of the spectrograph slit PA = 187°. The relation $r=I_\lambda 6717/I_\lambda 6731$ for [SII] gives an estimate of the electron density in the nucleus [4]. For $r=0.77$ $n_e=1550\,\mathrm{cm}^{-3}$. Applying the Dibay a. Pronik [5] method, in its specified form [2], we determined some general parameters characterizing the nucleus.

The luminosity in the H_α line was determined by the magnitude of the nucleus and the equivalent width of the H_α line. $L_{H_\alpha}=19.07\times10^{56}z^2(1+z^2)$ $W_{H_\alpha}\frac{F^{*st}_{H_\alpha}}{e^{0.921\,m_{\bullet}nucl}}$ [erg/sec] and for $H=75$ km/s Mpc $L_{H_\alpha}=3.43\times10^{38}$ erg/sec With an emissivity coefficient $\varepsilon_{H_\alpha}=8.58\times10^{-19}$ [erg/cm^3. sec], an estimate of the effective volume occupied by the emitting gas is $V=4\pi R^2\frac{F_{H_\alpha}}{\varepsilon_{H_\alpha}}=4.00\times10^{56}$ cm^3 or the effective radius of the irradiating region $R_{eff}=7.06\times10^{18}$ cm about 2,3 parsec. At that, for the dimensions of the nuclear region according to MCG at a distance R = 13.6 Mpc for H = 75 km/s. Mpc, 5150×1980 pc was obtained — the 'filling factor' was 0.001—0.0005.

Assuming that the gas in the nucleus is almost entirely hydrogen (an assumption not far from reality), an estimate of $m_{gas}=1\times10^{36}$ (gr) or $\sim510\ M_\odot$ was obtained for the mass of the gas.

Several types of ionization sources are conceivable for a maintenance of $\sim500\ M_\odot$ gas in an ionization-recombination equilibrium:

a) Shock wave — a simple check-up by the dependence $(I_\lambda 6717/I_\lambda 6731)$—$(I_\lambda 6584/I_{H_\alpha})$ for the supernova remnants [6], where this mechanism is basic, shows that other mechanisms for gas-heating should be sought.

b) The most probable ionization source in normal galaxies is that of UV irradiation of hot stars.

Forty stars of class 07 V, each with a mass of $\sim30\ M_\odot$, suffice for the gas ionization in the nucleus of NGC 5879.

The relative intensities of the emission lines permit to assess the content of emitting ions by means of the Peimbert [7] method. Assuming, as usual, $\lg H=12.00$ for the abundance of nitrogen and sulfur ions, $\lg N^+=7.09$ and $\lg S^+=6.53$ were obtained respectively.

In conclusion, let us sum up the results obtained: the electron density $n_e\sim1550\,\mathrm{cm}^{-3}$ is close to the mean one for planetary nebulosity and is two to five times as high as the mean one for the zones (O II) in the other groups of galaxies or H II regions.

The luminosity in the line $H_\alpha - L_{H_\alpha}=3.43\times10^{38}$ erg/sec is by 3-4 orders lower than that at Sy 1 galaxies.

With an effective volume of the gas of one and the same order as that at Sy 1 G, the latter's nucleus contains gas that is of two orders higher. The ionization sources differ substantially.

On the basis of the above data it may be concluded that the NCG 5879 galaxy manifests a weak activity, expressed in relatively strong emission lines, and can be referred to galaxies of the M 51 or M 81 type, studied in detail by Peimbert [8].

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REFERENCES

[1] М. А. Аракелян. Сообщ. Бюр. обс. **47**, 1975, 3. [2] В. К. Голев, З. И. Цветанов, Г. Т. Петров. Астрофиз. изсл. София. 1983. (In Press.) [3] Сообщ. Бюр. обс. **47**, 975, 43. [4] И. В. Носов. АЦ 1050, 1979. [5] Э. А. Дибай, В. И. Проник. Астрофизика **1**, 1965, 78. [6] D. Allion, P. Benvenuti, S. D. Odorico. In: Stars and Galaxies from the Observational Point of View. E. K. Kharadze (Ed.) Tbilisi, 1976, p. 183. [7] M. Peimbert. Ann. Rev. A & Ap **13**, 1975, 113. [8] Id. Ap. J. **154**, 1968, 33.