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SPECTROPHOTOMETRY OF THE NUCLEUS OF NGC 7552

Horácio Dottori and Miriani Pastoriza
Instituto de Física, UFRGS

S.J. Codina Landaberry and J.A. de Freitas Pacheco
Observatorio Nacional, CNPq
Brasil

SUMMARY: In this paper we present new spectrophotometric measurement of the Sérsic-Pastoriza nucleus of NGC 7552, giving absolute fluxes of the continuum between 3650 A and 6900 A and intensities of the lines H_2, Hβ, [O III] 4959+5007 A and Hα+N II. The synthesis of the absorption spectrum indicates 3 or 4 bursts of star formation.

. INTRODUCTION

The nucleus of NGC 7552 was pointed out as a peculiar one by Sérsic and Pastoriza 1965,1967). It was studied by Pastoriza (1975), who derived the form of the continuum, the in- ensity relation for the most striking emission lines and the equivalent width of the main ab- orption lines. Alloin and Sareyan (1974), observing photometric and spectrophotometrically erived absolute fluxes for the continuum and some emission lines, through which Alloin (1974) erived the physical condition of the emitting zone. Alloin and Kunth (1979) analyzed the stel- ar population of the nucleus and derived the existence of a recent cycle of stellar formation.

We present new measurements of absolute fluxes of the continuum between the near UV nd red spectrum, and also line intensities. The stellar content is also rediscussed.

I. THE OBSERVATIONS

Absolute fluxes of the continuum between 3650 A and 6800 A, absolute line intensi- ies were derived from observations with the new Scanner of the Observatório Nacional, with an ntrance 15 arcsec and a slit of 20 A, attached to the Cassegrain f/10 focus of the 160 cm re- lector at the Observatório Astrofísico Brasileiro. Calibration was made through standard S7446 of Hayes (1970) and LTT9239 of Cerro Tololo. The extinction for the night of 01/08/84 as derived through observations of BS7446 with air masses between 1.09 and 1.86. The dependence ith wavelength is quite well represented by

$$a(\lambda) = 0.1127\ (1/\lambda)^2 + 0.223\ (1/\lambda)^2 + \lambda\ -1.1$$

or $$0.37\mu \leqq \lambda \leqq 0.7\mu$$

The equivalent widths of the absorption lines were obtained from a calibrated spec- rum (EN 680), taken with the nebular spectrograph of Córdoba Observatory with a slit of 7" and dispersion of 145 A/mm in the first order, attached to the Newtonian f/5 focus of 154 cm eflector at the Bosque Alegre station, Argentina. This spectrum was calibrated through the ayes' standard and analized with the microdensitormeter Zeiss MD100 of the Instituto de Física, FRGS, Brazil.

II. THE CONTINUUM AND THE SPECTRUM

Figure 1a and 1b display the observed points of the continuum. As a matter of compar- son the absolute fluxes measured by Alloin and Sareyan (1974) are also shown. Our observations eem to be brighter for the spectral interval λ > 0.44μ and approximately equal in mean, for

$\lambda < 0.44\mu$. In our measurements appear the Balmer jump in absorption which seems not to have been detected by Alloin, but is also detected in the spectrum EN680. Finally our point in $\lambda \simeq 0.41\mu$ seems to be fainter than the measurements of these authors.

In regard to the emission lines we have measured the absolute intensities of Hβ, [O III] 4959+5007, Hα and [N II] 6548+6584. In Figure 1 we show the positions of the lines in regard to the continuum and in Figure 2 the profiles of Hα + N II lines. In Table 1 the abs lute intensities of the lines are quoted.

TABLE 1. Absolute Intensities of the Lines

Line	10^{-39} erg s^{-1} cm^{-2}	Alloin (1974) 10^{-39} erg^{-1} cm^{-2}
Hβ	1.70	3.3
O III 4959 A, O III 5007 A	2.6	2.8
N II 6548 A	6.5	...
Hα	7.9	...
N II 6584 A	7.5	...
Hα/Hβ= 4.6		

Our flux for the O III lines are equal to that of Alloin but for Hβ our measure is 1/2 of her value. Although fainter, our measurements indicate a higher degree of excitation fo the ionized region.

IV. THE ABSORPTION SPECTRUM

Table 2 shows our measurements of the equivalent width for all absorption lines de tected. The values found by Alloin and Sareyan (1974) and Pastoriza (1975) are also quoted as matter of comparison. An analysis of the spectrum allowed to detect some heavy elements and molecular absorption features, normally released.

TABLE 2. Observed Equivalent Width for the absorption lines.

Lines	Wavelength(A)	Eq. Width (A)	
Hη + Mg I	3835	4.58 ± 0.51	
Hξ	3889	2.16 ± 0.87	3.3 (A), 3.6 (P)
KCa II	3834	2.72 ± 0.26	6.0 (A), 5.6 (P)
H Ca II + Hε	3970	7.06 ± 0.75	6.7 (A), 5.7 (P)
Hδ	4101	4.12 ± 0.54	
Ca ±	4227	2.39 ± 0.30	
G band	4300	2.78 ± 0.67	
Ca II + Fe I	4590	2.88 ± 0.32	
Mg I	5174	3.04 ± 0.32	
Ma I	5879	6.96 ± 0.39	
Mn I	6015	7.00 ± 2.71	

(A) and (P) are the values obtained by Alloin and Pastoriza respectively.

V. SYNTHESIS OF STELLAR FORMATION

Using the method of non-linear optimization applied to synthesize the absorption spectrum (Dottori and Pastoriza 1983) we were able to obtain the stellar composition of nucleus and the cycles of star formation that occurred within the lines used in the process (not all of them observed in our spectrum) and the relative number of stars of each type, considering 13 types for the main sequence and 8 for the giant branch.

TABLE 3. Synthetic Models giving the Relative Number of Stars, the Equivalent Width of the Absorption Lines and the M/L and H/K Relation.

Spec.Type	N. of Stars	Line	Wavelenght	Eq.Width
O5V	0.	FeI	3632	2.08
BOV	0.11 E+05	Mg+H	3832	5.23
B5V	0.14 E+06	H8+FeI	3889	7.04
AOV	0.21 E+07	KCaII	3933	9.36
A5V	0.22 E+07	HCaII	3970	10.92
FOV	0.38 E+07	HΔ	4101	6.12
F5V	0.92 E+08	G Band	4300	6.35
GOV	0.11 E+09	FeI	4394	5.00
G5V	0.16 E+09	CaI+FeI	4440	1.55
KOV	0.23 E+09	FeI	4592	1.66
K5V	0.31 E+09	Sh, band	4658	4.85
MOV	0.67 E+09	MgI	5174	5.06
M5V	0.27 E+11	FeI+CaI	5270	1.71
		NaD	5890	5.74
FOIII	0.29 E+07	CaI+(FeI)	6161	0.75
F5III	0.24 E+07			
GOIII	0.20 E+07			
G5III	0.14 E+07	M/L(Stars)=0.31		
KOIII	0.12 E+07	H/K(CAIII)=1.02		
K5III	0.62 E+06			
MOIII	0.51 E+06			
M5III	0.35 E+06			

Figure 5 shows the ratio between the present distribution of stars of each type in regard to the IMF adopted for the process of synthesis. The jumps in that diagram indicates the turn off points of the cycles of stars formation occurred in the nuclear region. If the formation were a continuous process, there should not be such types of jumps, but the curve should be a continuous one. Another important characteristic of that curve is the form between successive turn off points. Since, as mentioned, it represents for each spectral type, the ratio between the relative number of stars in the present composition, and the same in the mass function adopted as initial vector for the process of synthesis a Salpeter's one, the non-constancy of the curve indicates clearly that the initial vector does not coincide with the IMF that lead the formation of stars in this nucleus. The situation is more dramatic for the cycle of star formation with TOP at F5V. The last cycle with TOP a BOV is too weak in regard to the preceding ones, and surely correspond to the H II region located S-W of the main nuclear body (Fig. 5 taken from Pastoriza 1975). Compared with the other peculiar nuclei already analyzed (NGC 1097, 2997 and 5236), the importance of the H II in regard to the rest of the nuclear complex is smaller in NGC 7552. The morphology of the nuclear complexes (Pastoriza 1975) analyzed through isodensities seems to indicate this property.

V. CONCLUSION

Some differences are found for the absolute measurements continuum and emission features between our measurements and those of Alloin and co-workers. We deduce a higher excitation for the active region, and the discrepancy could be due to a difference in centering,

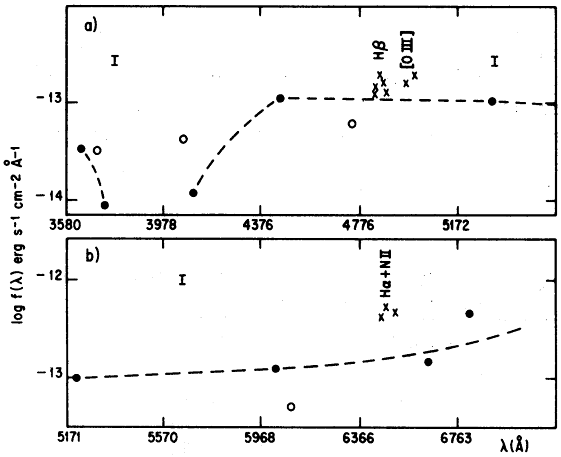

Figure 1.

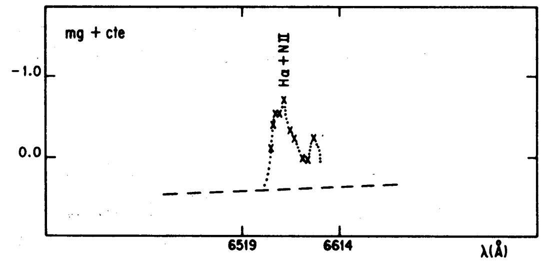

Figure 2.

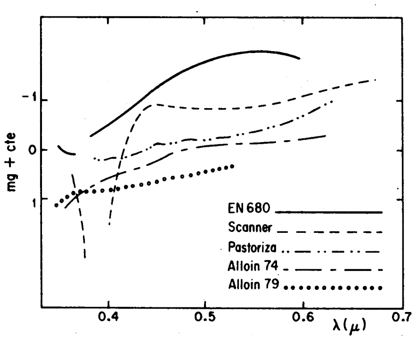

Figure 3.

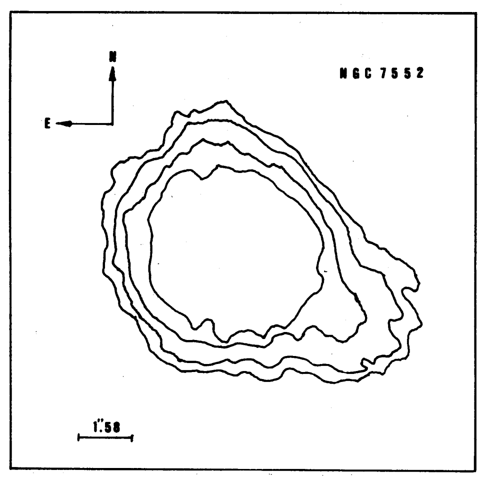

Figure 4.

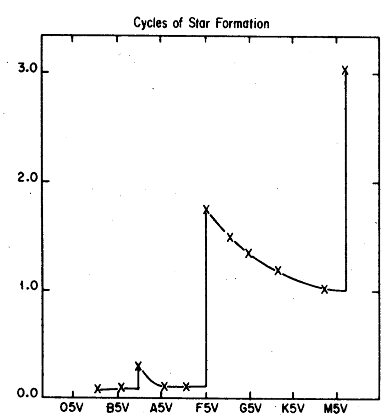

Figure 5.

ince the H II region in NGC 7552 is very small in regard to the whole nucleus.

The absorption spectrum indicates the presence of three or four cycles of star for-
ation, since both cycles with TOP at OBV and AOV could be the same. The cycle with TOP at
5V seems to be occurred following an IMF very different from that of Salpeter with a smaller
kponent. Both spectral types, observed and derived, are compatible with the existence of a
ecent cycle of star formation.

TABLE 4. Line Intensity Ratios for NGC 7552 and for Stars. A Comparison with other Galaxies is also given

	NGC 7552		NGC 2997		NGC 1097		NGC 5236	
	Obs.	Teor.	Obs.	Teor.	Obs.	Teor.	Obs.	Teor.
I (K Ca II) / I(H Ca II + Hε)	0.38	0.85	0.78	0.53	0.91	0.67	0.73	0.45
Type	A8-9	F4	F3	F1	F5	F2	F2-3	A9-F0
I (Gb) / I(H Ca II + Hε)	0.40	0.56	0.57	0.24	0.72	0.40	0.84	0.20
Type	F2-3	F6	F6	F2	F8-9	F4	GO	F2

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ie spectrum EN.

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racio Dottori and Miriani Pastoriza: Instituto de Física, Universidade Federal do Rio Grande do Sul, Rua Luiz Englert, s/n, 90.000 Porto Alegre, RS. Brasil.

J. Codina and J.A. Freitas Pacheco: Observatório Nacional, CNPq, Rua General Bruce 586, São Cristóvão, 20921 Rio de Janeiro, RJ. Brasil.