BV SURFACE PHOTOMETRY OF THE SOUTHERN GALAXIES NGC 2855 AND NGC 4507

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RESUMEN. Fue obtenida fotometría superficial B y V para las galaxias australes NGC 2855 y NGC 4507, habiéndose determinado las magnitudes totales, las distancias, las magnitudes absolutas y también las longitudes de los ejes mayores y menores.

Se muestran mapas de las isofotas B y V y de los perfiles de luminosidad B y V a lo largo de los ejes mayores y menores, así como los perfiles medios. Se ha descompuesto el perfil medio B e identificado a los distintos componentes. Se discute el comportamiento de los perfiles B-V.

ABSTRACT. Surface B and V photometry was obtained for the southern galaxies NGC 2855 and NGC 4507. Total magnitudes, distances, absolute magnitudes, as well as lenghts of major and minor axes are determined.

Isophote B and V maps, B and V luminosity profiles along major and minor axes as well average profiles are shown. The average B profile is decomposed and the different components identified. The behaviour of the B-V profiles is discussed.

I. INTRODUCTION

Extensive works on photographic surface photometry of spiral and SO galaxies has been previously carried out in the B system by Sérsic (1968), Kormendy (1977), Burstein (1979), Tsikoudi (1979) and Boroson (1981). Nevertheless, few studies on the BV system have been made. This work is part of a more extensive program whose primary aim is to make a comparative study of the structural and photometric parameters in the BV system for a group of different morphological type galaxies in order to obtain a more accurate information about the several components and stellar population.

The present paper presents some results obtained for the galaxies NGC2855 classified in the Second Reference Catalogue of Bright Galaxies (RC2, 1976) as (R)SA (rs)O/a and NGC 4507 classified as SBab (rs)I (Sandage and Brucato 1979).

II. OBSERVATIONS

Direct photographic plates were obtained with the Cassegrain Camera attached to the 1.6m telescope of Observatório Astrofísico Brasileiro at Pico dos Dias, Brasopólis, MG, Brasil. A combination of 103a-0 or IIa-0 plate plus GG 395 filter was used for the B system and of IIa-D, plus GG 495 for the V system. Details of the observations are listed on Table 1. The scale of the plates is 12"5/mm. After the exposure, each plate was exposed on a spot sensitometer.

TABLE 1

DETAILS OF PHOTOGRAPHIC OBSERVATIONS

NGC	DATE	PLATE N°	EXPOSURE (min.)	EMULSION (Kodak)	FILTER
	Feb. 21/82	71	100	103a-0	GG-385
	Feb. 21/82	74	90	IIa-D	GG-495
2855	Apr. 8/83	213	35	103a-0	GG-385
	Apr. 8/83	214	55	IIa-D	GG-495
	May 20/82	104	120	IIa-D	GG-495
4507	May 20/82	105	120	IIa-0	GG-385

III. REDUCTIONS

Most of the plates were scanned on the PDS microdensitometer of Observatório Nacional, CNPq, Brasil. A 50μm square aperture corresponding to 0".625 on an edge was used for the scans of NGC 4507 while for NGC 2855 an aperture of 100 μm was used. The plates number 213 and 214 were scanned with the Zeiss Jena microdensitometer of Instituto de Física - UFRGS, Porto Alegre, Brasil, and reduced according to the Sérsic's method (Sérsic 1968).

The PDS density measures were converted to intensities by means of the de Vaucouleurs relation:

$$\log E = \sum_{n=0}^{M} A_n (\log \omega)^n$$

where $\omega = 10^{(d-df)} - 1$ and d is the density of the calibration spot and df is the intensity of the fog.

After this, the superposed sky was subtracted and the relative photographic intensities on the arbitrary scale were photoelectrically calibrated in order to obtain the galactic magnitudes per unit area, using published data (Wegner 1979; Griersmith 1980; Sandage 1975).For NGC 2855 the data were complemented with measured photoelectric photometry with the 50 cm telescope at Morro Santana, Porto Alegre, Brasil, using an EMI9658RA refrigerated photomultiplier.

IV. RESULTS

After the calibration, isophote maps (Figs. 1 and 2) were obtained, as well as luminosity profiles. For NGC 2855 average profiles were obtained from plates 71 and 213 for B and from plates 74 and 214 for V. The luminosity B and V profiles, together with the calculated B-V profile along major and minor axes are shown in Figs. 3 and 4 for NGC 2855 and in Figs. 5 and 6 for NGC 4507.

Numerical integration of I(x, y) over the final image of the galaxy was performed and the total apparent magnitudes calculated. Sérsic's (1968) method for calculating apparent magnitudes was also used, by making an extrapolation in the IS vs μ (intensity times area versus surface brightness) curve. The final values, listed in Table 2 are the average of the magnitudes obtained from the two methods above.

TABLE 2

DERIVED DATA

NGC	TYPE	B_T	V_T	Δ(Mpc)	M_B	a(Kpc)	b(Kpc)	μ_B
2855	(R)SA(rs)0/a	12.42	11.44	19.53	-19.42	11.2	8.55	24.5
4507	SBab(rs)I	13.05	12.22	38.92	-20.43	18.11	14.53	24.85

Distances were estimated from the radial velocities from RC2 for NGC 2855 from Martin (1976) for NGC 4507, adopting H = 85 km/s/Mpc. The absolute magnitudes (M_B) where then obtained after correction for internal and galactic absorption and redshift (RC2, 1976). The values for the distances and absolute magnitudes are listed in Table 2 as well as the values for

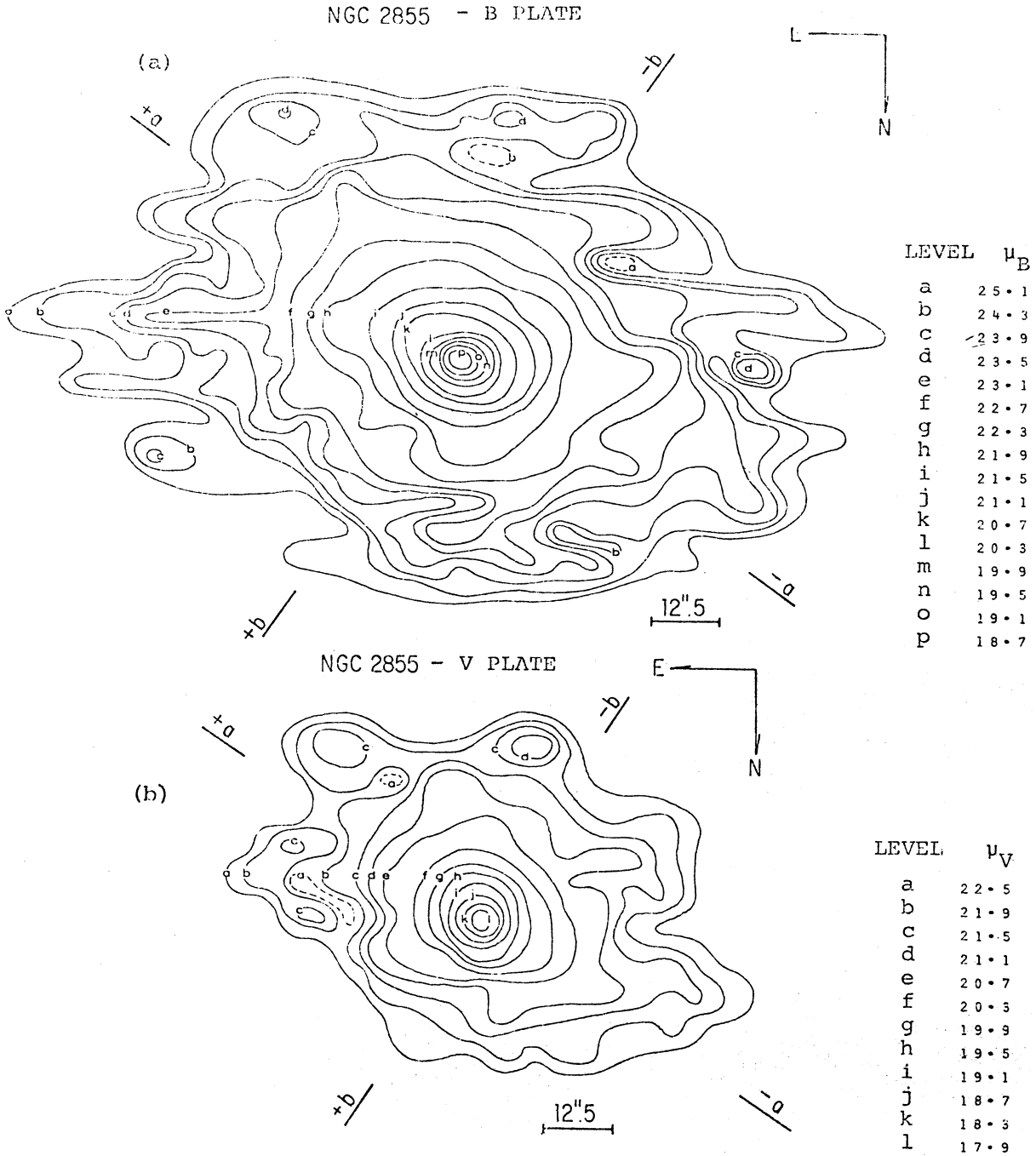

Fig. 1. Isophotes of NGC 2855 from OAB plates 213 (B) (a) and 214 (V) (b). Magnitudes levels are identified. Directions a and b are along the major and minor axes of the galaxy.

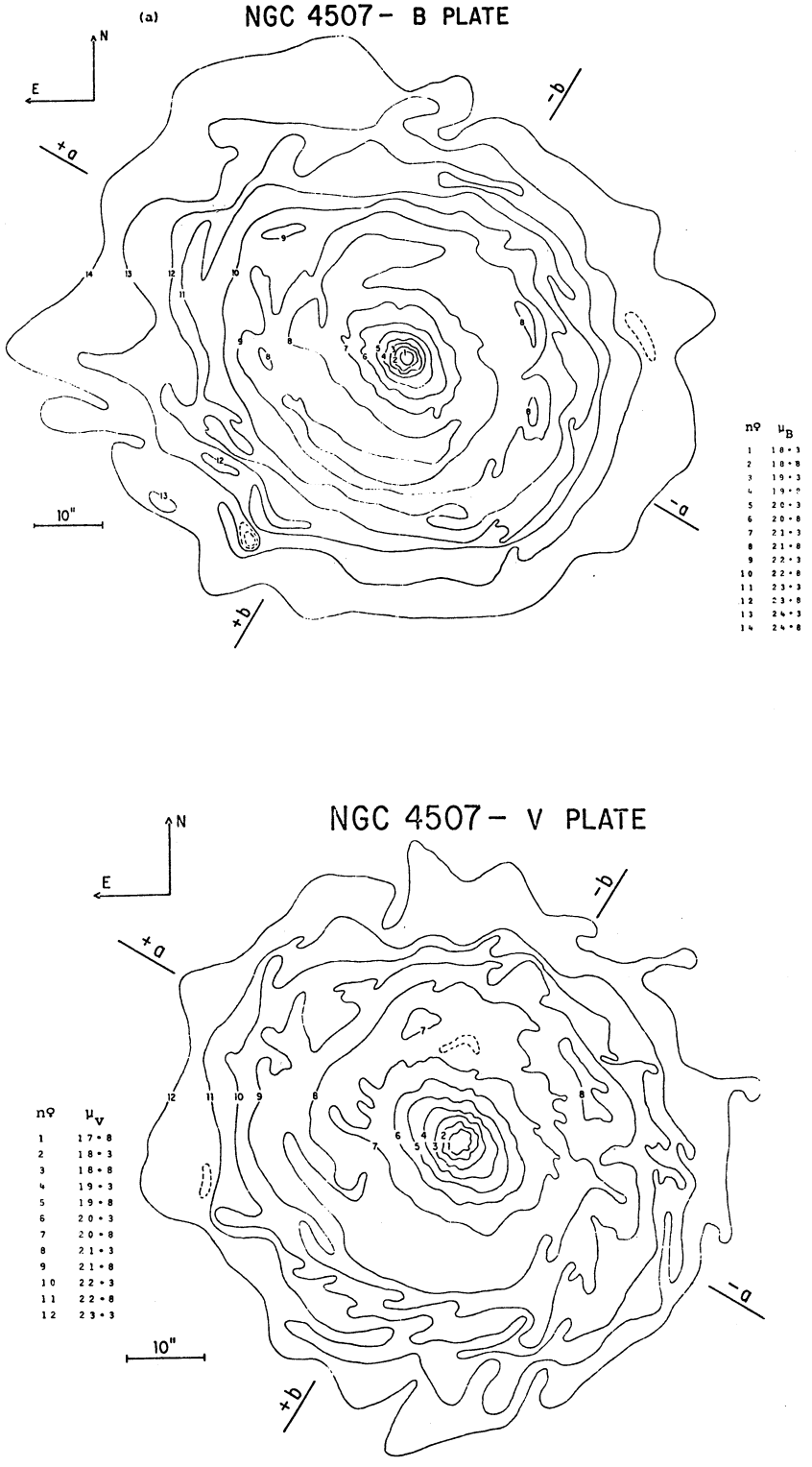

Fig. 2. Isophotes NGC 4507 from OAB plates 105(B) (a) and 104(V) (b). Magnitudes levels are identified. Directions a and b are along the major and minor axes of the galaxy.

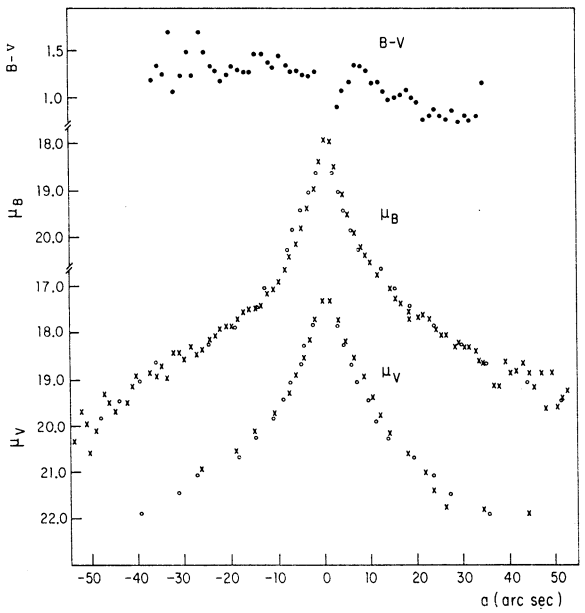

Fig. 3. Plots of (B-V), B and V luminosity profiles versus radius along major axis of NGC 2855.

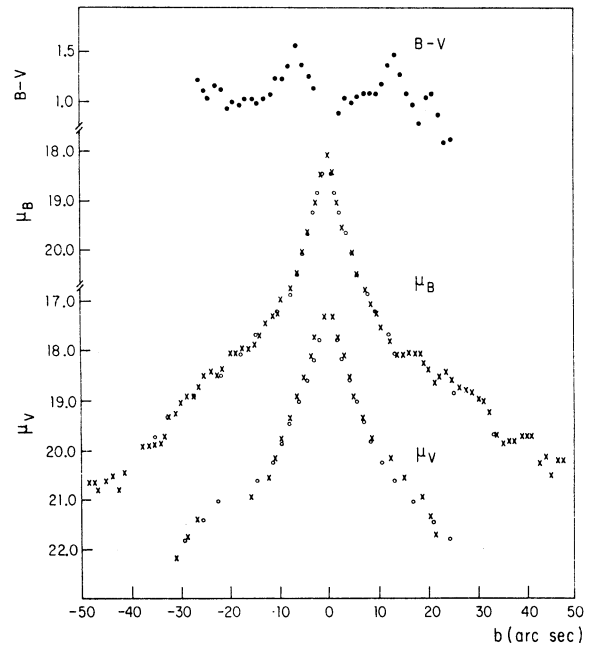

Fig. 4. Plots of (B-V), B and V luminosity profiles versus radius along minor axis of NGC 2855.

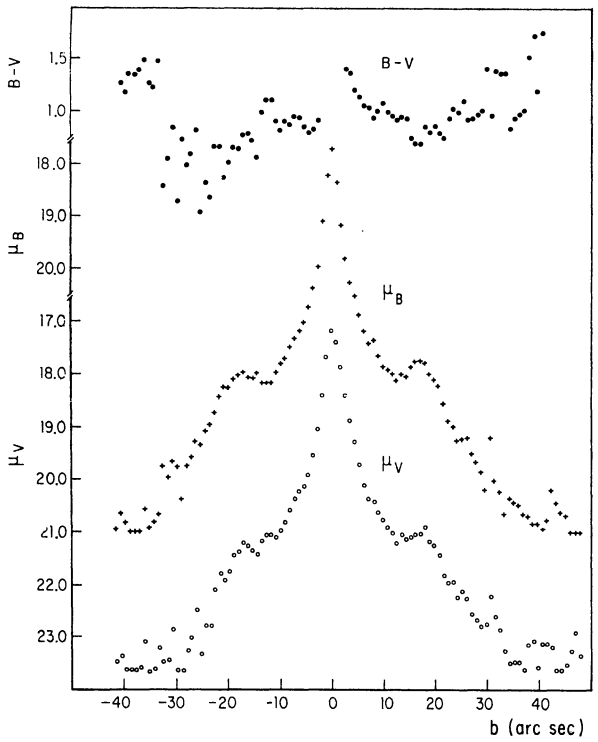

Fig. 5. Plots of (B-V), B and V luminosity profiles versus radius along major axis of NGC 4507.

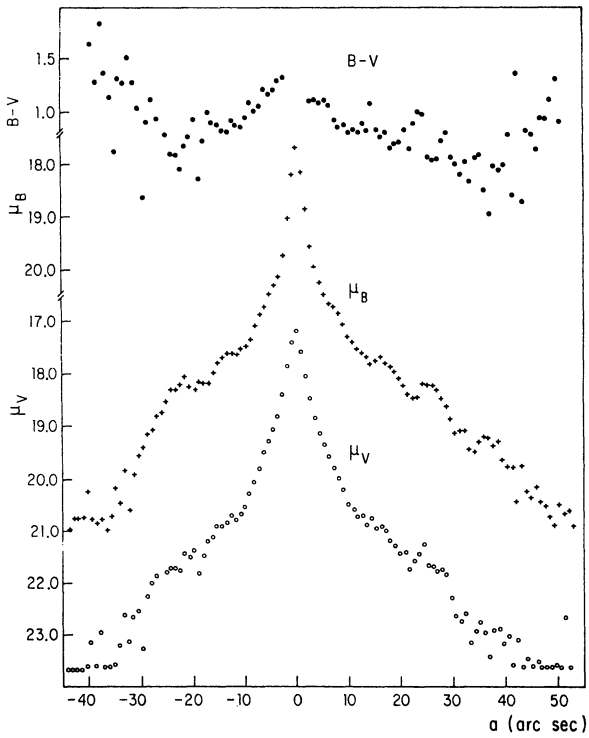

Fig. 6. Plots of (B-V), B and V luminosity profiles versus radius along minor axis of NGC 4507.

the major and minor diameters corresponding to the isophotal level listed in the last column of the table

AVERAGING AND DECOMPOSITION OF LUMINOSITY PROFILES

For NGC 2855 8 radial profiles were obtained, along position angles 33°, 68°, 123°, 158°, 213°, 248°, 303°, 338°. For NGC 4507, 36 radial profiles, 10° apart in angle were obtained. From these, an *elliptically averaged* (Boroson 1981) profile was determined for each galaxy. To do this, ellipses, centered on the nucleus, were fitted to outer isophotes and the apparent flattening and position angles of the major axes were obtained. Then the profiles were co-added, each one beeing stretched according to the radius of the ellipse at that angle relative to the major axes.

A tentative least square fitting to the B luminosity profiles was made using a de Vaucoulers (1948) curve for the bulge: $\mu = \mu_e + 8325\ \{(r/r_e)^{1/4} - 1\}$, and an exponential curve for the disk: $\mu = \mu_0 + 1.0867\ r/r_0$ (Freeman 1970). The surface brightness of the disk region was fitted, within the disk-dominated fitting range. This calculated disk contribution was then subtracted from the observed data points at all radii, and these corrected data were fitted to the bulge fitting function in the range dominated by the bulge light. This fit was then subtracted from the original observed profile and the process repeated until it converged. The elliptically averaged B profile, the de Vaucouleurs and exponential fitting function as well as the sum of these two functions are shown in Fig. 7 for NGC 2855 and in Fig. B for NGC 4507. The parameters μ_e, r_e, μ_0 and r_0 of the adjusted fitting function are listed in Table 3.

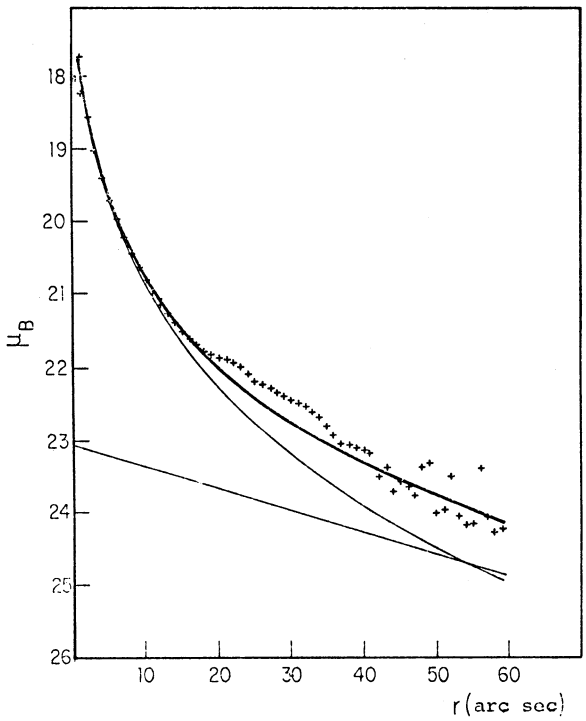

Fig. 7. Elliptically averaged B profile versus radius for NGC 2855 (crosses). $r^{1/4}$ and exponential luminosity laws are showed, as well as the sum of them (heavy lines).

TABLE 3

PARAMETERS OF LEAST SQUARE FITTING FOR B AVERAGE PROFILES

NGC	μ_e	r_e(arc sec)	r_e(K_{pc})	μ_0	r_0(arc sec)	r_0(K_{pc})
2855	21.95	17.14	1.6	23.08	35.71	3.34
4507	21.22	5.84	1.10	22.09	18.17	3.43

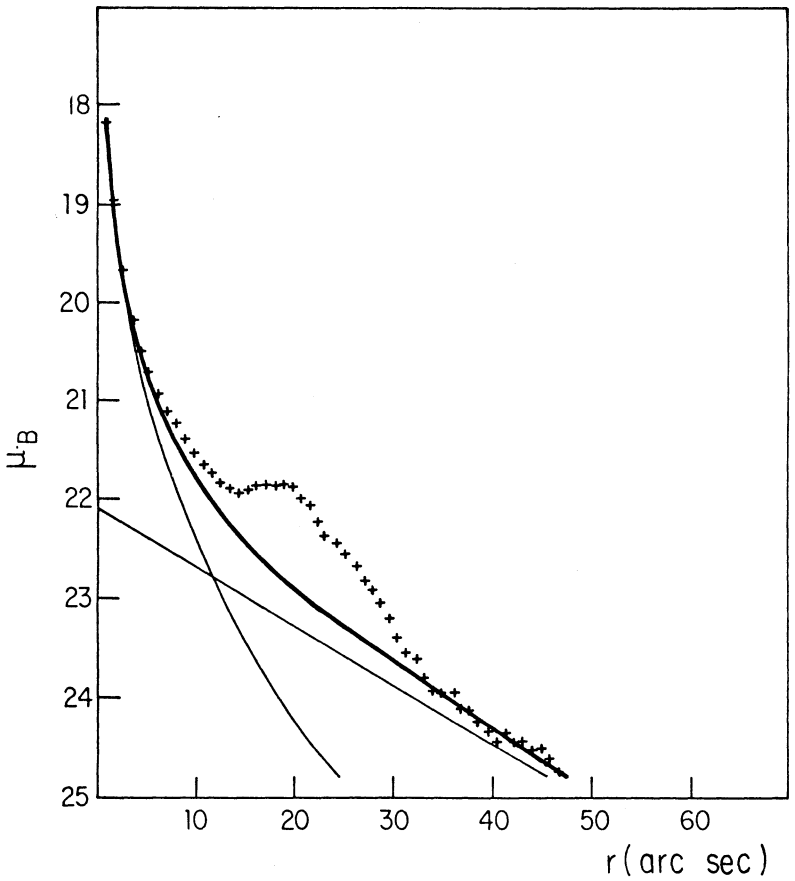

Fig. 8. Elliptically averaged B profile versus radius for NGC 4507 (crosses). $r^{1/4}$ and exponential luminosity laws are showed, as well as the sum of them (heavy line).

From the elliptically average B and V profiles an average B-V profile was obtained, which is showed in Fig. 9 for NGC 2855 and in Fig. 10 for NGC 4507.

V. DISCUSSION

For NGC 2855 the elliptically averaged B profile appears to be composed of an extensive nuclear bulge with a luminosity distribution obeying the $r^{1/4}$ law which dominates the profile until 40 arc seconds where the contribution of an exponential disk begins to become

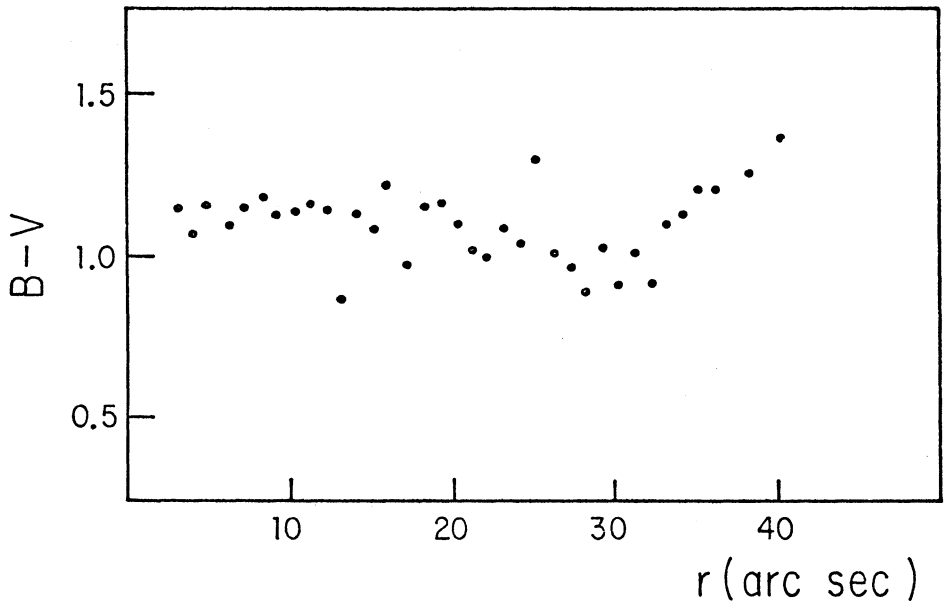

Fig. 9. (B-V) elliptically averaged profile for NGC 2855.

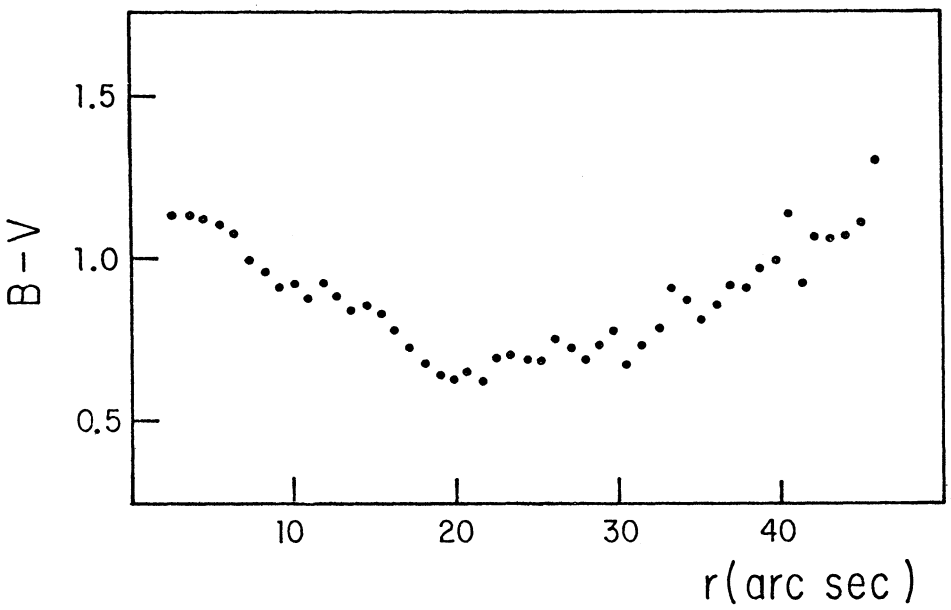

Fig. 10. (B-V) elliptically averaged profile for NGC 4507.

important. In the intermediate region appears a brighter component due to a fragmented ring and possibly to a lens component (de Vaucoulers 1980). The ring is evident in the positive directions of the major (22 arc sec) and minor (18 arc sec) axes profiles (Figs. 3 and 4). In the opposite direction the ring is not observed. In the (B-V) profiles the ring appears in the positive directions as a dip in the profile. Preceding it we can see a peak which can be identified with a absorption band internal to the ring. The B-V profiles show that the average color of the nuclear region is about $1^{m}.2$ reaching about $0^{m}.7$ in the bluer regions. The elliptically averaged B-V profile remains almost constant until about 30 arc seconds where it becames somewhat bluer. This smoothing of the variation showed in minor and major axes profiles and also observed in the other measured profiles is due to the assymetry mentioned above.

For NGC 4507 the elliptically averaged B profile appears to be composed of:

a) a nuclear bulge obeying the $r^{1/4}$ law dominating the profile out to 11 arc seconds; b) and exponential disk; c) a superposed contribution from 5 to 10 arc seconds due to the bar; d) a strong superposed contribution from 15 to 34 arc seconds due to the two spiral arms.

The bar is better defined in the V major profile (Fig. 5) while the spiral arms appear clearly is the B minor axis profile. The B-V profiles show red values in the nuclear regions which become bluer in the region of the spiral arms; in the outer regions the values become redder again reaching about the same values of the nuclear region. The elliptically averaged B-V profile (Fig. 8) gives average values of $1^{m}.12$ for the nuclear regions, $0^{m}.67$ for the spiral arms regions and a gradient with a B-V value of $0^{m}.85$ in 35 arc seconds to $1^{m}.10$ in 45 arc seconds.

For both NGC 2855 and NGC 4507 there appears an unexpected asymmetry in the inner region between opposite sides in the B-V profiles. This asymmetry is very difficult to explain, especially in the nuclear region. This effect is being further investigated in order to determine if it is real or maybe an influence of the reduction procedure.

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