

SURFACE PHOTOMETRY OF THE SCULPTOR GROUP GALAXIES: NGC 7793, NGC 247, AND NGC 300

CLAUDE CARIGNAN

Mount Stromlo and Siding Spring Observatories; and Kapteyn Laboratorium

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ABSTRACT

Surface photometry from Schmidt plates of the three nearly pure disk galaxies NGC 7793, NGC 247, and NGC 300 is presented. In each case, the luminosity profile shows an almost purely exponential decrease out to the detection limit. The three galaxies cover an exceptionally wide range of disk surface brightness, from NGC 7793 at $B(0)_c = 20.33$ mag arcsec⁻² to the faint disk of NGC 247 at $B(0)_c = 23.44$, with NGC 300 an intermediate case at $B(0)_c = 22.23$. The corresponding scale lengths are 1.1, 2.9, and 2.1 kpc respectively. The color maps reveal no color gradient.

The luminosity profiles decomposed into red and blue pixel profiles show that the surface brightness of young blue stars falls off more gradually than for the old disk, as was already seen in earlier-type spirals (Schweizer 1976). They also reveal that the type II profile in NGC 7793 is a true feature of the old disk, contrary to the suggestion by Talbot, Jensen, and Dufour (1979).

The profiles will be used in a subsequent paper, together with kinematical data, to study the mass distribution of pure disk galaxies and especially the ratio of unseen halo mass to luminous disk mass.

Subject headings: galaxies: individual — galaxies: photometry

I. INTRODUCTION

The surface photometry presented here is part of a larger study (Carignan 1983) to derive the general properties of pure disk galaxies (PDG), i.e., late-type spirals (Scd-Sd-Sdm) which show no apparent bulge or in which the bulge contributes very little (< 2%–3%) to the total luminosity. The main aim is to combine the photometry and the kinematics to construct mass models for those systems (Carignan 1985; Carignan and Freeman 1985).

It is fortunate for this project on PDGs that the nearest group of bright galaxies beyond the Local Group, the Sculptor Group (distance = 2.5 Mpc; de Vaucouleurs 1978), has all its brighter members of morphological types Sc or later. Also Sculptor is close to the south galactic pole, where galactic absorption is minimal. Of the six brighter members, the three Sd galaxies NGC 7793, NGC 247, and NGC 300 were selected for this project. Their parameters are summarized in Table 1. Figures 1–3 (Plates 1–3) show prints of a sky-limited IIIa-J plate and of an H α plate for each galaxy.

The distance estimates are discussed in § II. In § III, the photometric observations and reduction techniques are described. From an analysis of the isophotal maps, the orientation parameters are derived in § IV. In § V, the luminosity profiles are analyzed, whilst the color distribution is examined in § VI. The color maps are used in § VII to construct red and blue pixel profiles. After looking at the gas content in those systems, we discuss in § VIII the use of the light distribution as a tracer of the luminous mass component. Finally in § IX, the results are summarized.

II. DISTANCE ESTIMATES

Looking only at the radial velocities (238, 195, 102 km s⁻¹; H I systemic velocities corrected for galactic rotation for NGC 7793, NGC 247, and NGC 300 respectively) and at the angular diameters (8'.9, 14'.8, 18'.2; face-on diameters at a level of $\mu_B = 25.0$ mag arcsec⁻²), it appears that NGC 7793 is probably on the far side of the group and NGC 300 on the near side. Since the Sculptor Group is so close, a mean distance modulus for the whole group would be an inadequate estimate for the individual galaxies. Hence we review the different distance indicators for each galaxy and adopt individual distances.

The distance estimates using tertiary distance indicators (de Vaucouleurs 1979*a, b*) can be found in Table 2. The relations between the different photometric and kinematical parameters can be found in de Vaucouleurs and Davoust (1980) and Bottinelli *et al.* (1983). For NGC 7793, the adopted value for the distance modulus is 27.64, giving a distance of 3.38 Mpc (scale = 983 pc arcmin⁻¹). This agrees within the errors with de Vaucouleurs and Davoust's (1980) recent determination of 3.13 Mpc.

For NGC 300, a secondary indicator is available. Graham (1982) recently published a study on red giants resolved on CTIO prime-focus plates. His distance modulus of 26.4 is in close agreement with the adopted value of $\mu_0 = 26.39$, which puts NGC 300 at a distance of 1.90 Mpc (scale = 553 pc arcmin⁻¹).

Finally, at an intermediate distance, one finds NGC 247 with $\mu_0 = 27.01$, corresponding to a distance of 2.52 Mpc

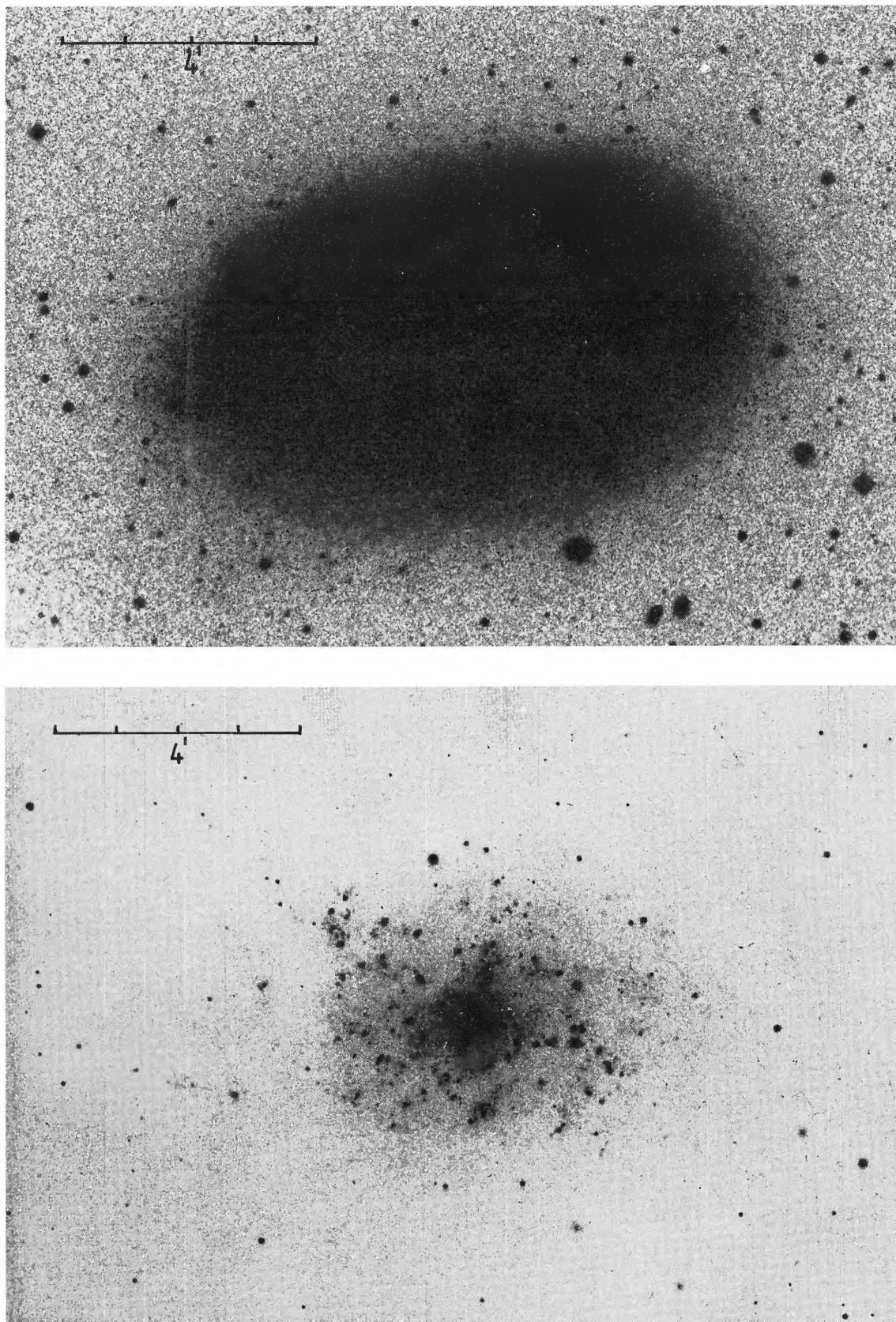


FIG. 1.—Prints of a sky-limited IIIa-J plate (*top*) and of an H α plate (*bottom*) of NGC 7793

CARIGNAN (*see* page 107)

PLATE 2

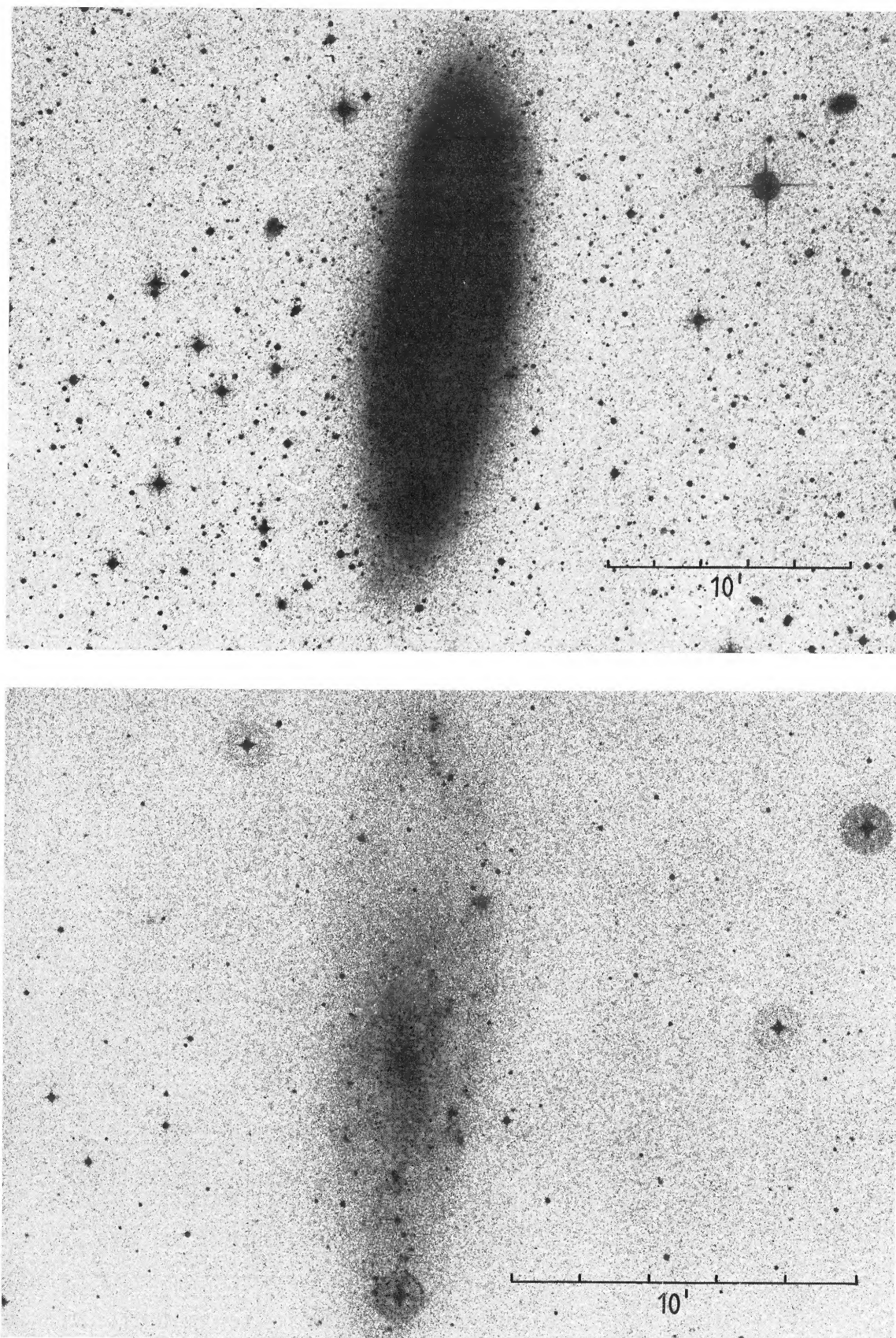


FIG. 2.—Prints of a sky-limited IIIa-J plate (*top*) and of an H α plate (*bottom*) of NGC 247

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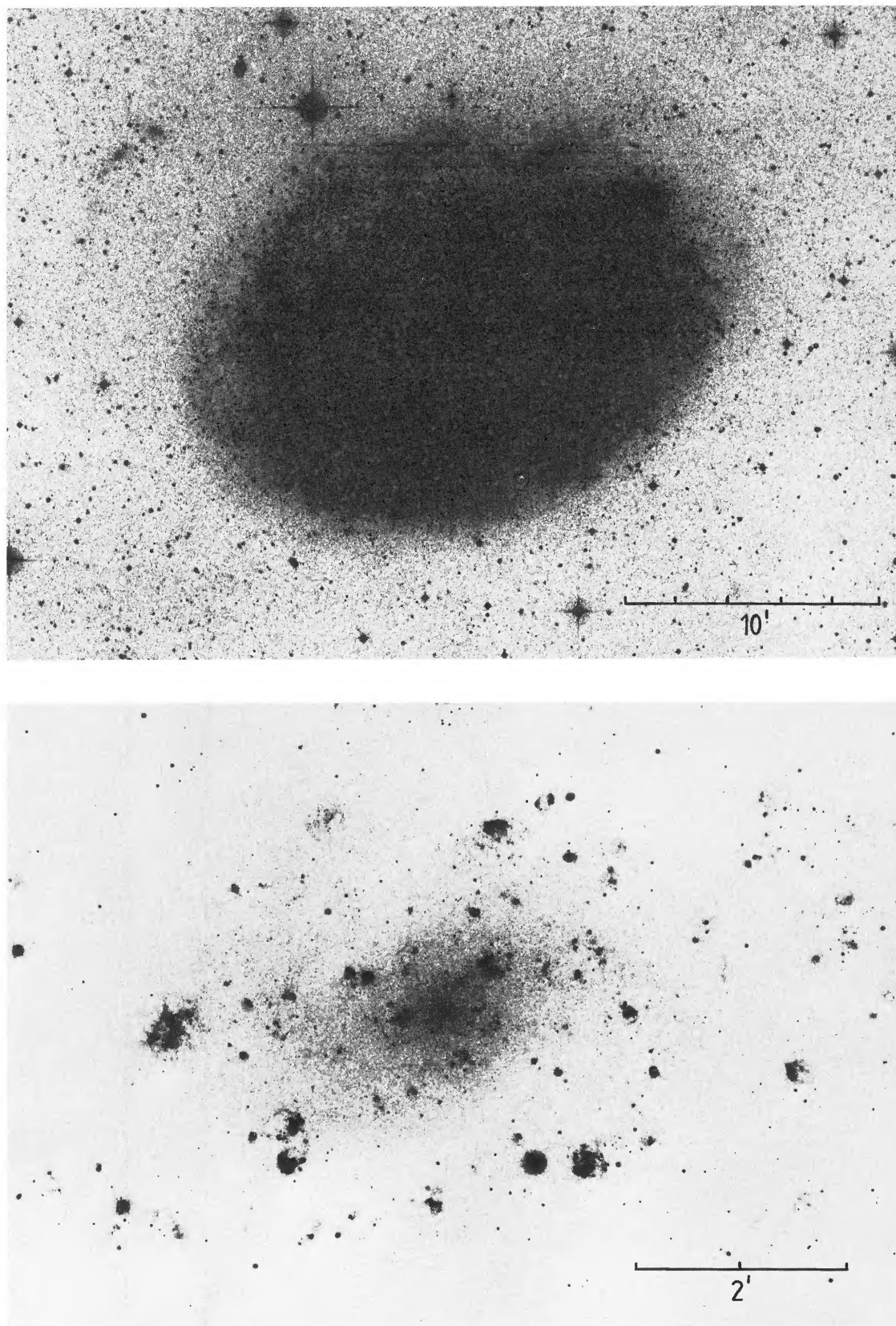


FIG. 3.—Prints of a sky-limited IIIa-J plate (*top*) and of an H α plate (*bottom*) of NGC 300

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TABLE 1
PARAMETERS OF PROGRAM GALAXIES

Name (1)	Type (2)	R.A. (1950) (3)	Decl. (1950) (4)	l (5)	b (6)	D_{25} (7)	$(b/a)_{25}^a$ (8)	V^b (km s $^{-1}$) (9)
NGC 247	SAB(s)d	0 ^h 44 ^m 66	−21°02′0	113°95	−83°56	19′9	0.27	165
NGC 300	SA(s)d	0 52 ^m 52	−37 57′4	299°23	−79°42	19′6	0.74	150
NGC 7793	SA(s)d	23 55 ^m 26	−32 52′1	4°53	−77°17	10′1	0.60	233

NOTE.—Cols. (2)–(6) from RC2 (de Vaucouleurs, de Vaucouleurs, and Corwin 1976). Cols. (7)–(9) from this study.

^aRatio b/a of minor to major axis.

^bHeliocentric radial velocities from Parkes H I observations.

TABLE 2
DISTANCE ESTIMATES

Parameters and Distance Moduli	NGC 7793	NGC 300	NGC 247
Basic parameters: ^a			
B_T^0	9.33	8.38	9.00
Log D_0	1.95	2.26	2.17
V_m (km s $^{-1}$)	95	87	108
Λ_c	1.34	1.30	1.40
Distance moduli: ^b			
$\mu_0(B_T^0, \Lambda_c)$	27.46	26.63	26.95
$\mu_0(D_0, \Lambda_c)$	27.81	26.38	26.53
$\mu_0(V_m, B_T^0)$	27.48	26.48	27.57
$\mu_0(V_m, D_0)$	27.82	26.08	27.00
μ_0 (red giants)	...	26.4 ^c	...
Adopted: ^d			
$\langle \mu_0 \rangle$	27.64	26.39	27.01
Δ (Mpc)	3.38 ± 0.30	1.90 ± 0.18	2.52 ± 0.50

^a B_T^0 : corrected apparent magnitude; D_0 : face-on diameter; V_m : maximum rotational velocity; Λ_c : luminosity index.

^b μ_0 : distance modulus.

^c(Graham 1982).

^d Δ : distance.

(scale = 733 pc arcmin $^{-1}$). However, in this case the uncertainty on the distance (0.5 Mpc) is about a factor of 2 larger than for the two previous galaxies.

III. OBSERVATIONS AND DATA REDUCTION

The surface photometry was performed using sky-limited plates kindly taken by the staff of the UKSTU on the 1.2 m Schmidt telescope at Siding Spring Observatory (scale = 67″12 mm $^{-1}$, unvignetted field radius = 2°7′). The photoelectric drift scans were all carried out on the Siding Spring 61 cm telescope (f/18, 18″8 mm $^{-1}$) in a pulse-counting mode. The photoelectric and photographic systems are presented in Tables 3 and 4.

a) Photographic Plates

The characteristics of the plates used can be found in Table 5. The U -plate of NGC 247 could not be used because of lack of calibration. The plates were digitized in density mode on a Perkin-Elmer PDS microdensitometer, using a scanning aperture of 50 μ m ^{2} (3″36 pixel $^{-1}$) with 50 μ m steps. The resulting 1024 $\times$ 1024 array covered approximately 1° $\times$ 1°.

TABLE 3
THE PHOTOELECTRIC SYSTEM

Bandpass	Filters	λ_{eff}^a	$\Delta\lambda^b$	Ref.
U	1 mm UG 1, CuSO $_4$ cell	3580 Å	750 Å	1
B_J	2 mm GG 385, 2 mm BG 28	4470 Å	1050 Å	2
R_F	3 mm RG 630, 3 mm BG 20, 1 mm BG 38	6660 Å	500 Å	2

^aCalculated for the spectral energy distribution of Sd galaxies (Coleman, Wu, and Weedman 1980).

^bFull width at half-maximum intensity.

REFERENCES.—(1) Bessell 1982 using RCA GaAs response. (2) Couch and Newell 1980 using EMI S20 response.

TABLE 4
THE PHOTOGRAPHIC SYSTEM

Bandpass	Emulsion	Filters	λ_{eff}	$\Delta\lambda$
u	IIIa-J	2 mm UG 1	3580 Å	750 Å
b_J	IIIa-J	2 mm GG 385	4560 Å	1460 Å
	IIIa-J	2 mm GG 395	4570 Å	1460 Å
r_F	IIIa-F	3 mm RG 630	6690 Å	520 Å

The first step in the photographic plate data reduction was the density-to-intensity calibration. This was done using the calibration spots available. The characteristic curve was fitted either by a third-order polynomial or by a spline curve in the log (intensity)–log (opacitance) plane (de Vaucouleurs 1968).

Once the data were in the form of an intensity array, the next step in the reduction was to map the sky background in order to be able to interpolate its value underneath the galaxy. The area used for the polynomial fit was an annulus of width 150–200 pixels at the edge of the field and centered on the galaxy. The data used for the fit were to be averaged in boxes of typically 20 $\times$ 20 pixels. Before doing this averaging, the fitting region was first examined, and all objects (stars, faint galaxies, plate defects) of size comparable to the averaging box were replaced by interpolation of a third-order polynomial fit done to the surrounding background. The adopted value for each box was the mean calculated after 2 σ rejection cycles.

TABLE 5
CHARACTERISTICS OF THE UKSTU PLATES

Object	Plate Number	Date	Emulsion	Filter	Exp. Time (min)	Fog ^a	D.S.A.F. ^b	γ^c	(S/N) _{out} ^d	Sky ^e Brightness (mag arcsec ⁻²)
NGC 247.....	BJ 5425	1979 Oct 24/25	IIIa-J	GG 385	70	0.44	1.04	3.33	58	22.66
NGC 247.....	R 5422	1979 Oct 24/25	IIIa-F	RG 630	90	0.26	0.75	3.37	77	21.16
NGC 300.....	U 7245	1981 Oct 2/3	IIIa-J	UG 1	240	0.41	0.90	2.85	54	20.95
NGC 300.....	BJ 5431	1979 Oct 25/26	IIIa-J	GG 385	70	0.54	1.04	3.09	48	22.62
NGC 300.....	R 5432	1979 Oct 25/26	IIIa-F	RG 630	90	0.30	0.76	2.83	61	21.10
NGC 7793	U 6225	1980 Aug 8/9	IIIa-J	UG 1	180	0.16	0.72	3.60	87	21.66
NGC 7793	J 5476	1979 Nov 20/21	IIIa-J	GG 395	65	0.22	1.02	3.50	70	22.68
NGC 7793	R 5479	1979 Nov 21/22	IIIa-F	RG 630	105	0.15	0.91	3.14	68	21.01

^a Chemical fog in ANSI diffuse density.

^b Density of the sky background above fog.

^c γ = slope of the linear part of the characteristic curve = $\partial D / \partial \log I$.

^d (S/N)_{out} = $0.4343\gamma/\sigma_D$, where σ_D is given for each emulsion-density combination by Furenliid 1978.

^e Zero point as determined by the photoelectric drift scans.

Because of the uniformity of the background on UKSTU plates (Malin 1981), either a three-term (plane) or a six-term (paraboloid) fit was sufficient to map the background. The intensity $I_S(x, y)$ of the sky at each point in the array was then calculated, and the final intensity of the galaxy alone was then given by

$$I_G(x, y) = [I_{G+S}(x, y) - I_S(x, y)] / I_S(x, y).$$

As noted by Pence (1978), the normalization to units of I_S takes out most of the residual local errors.

b) Photoelectric Drift Scans

In order to get the magnitude zero points, photoelectric drift scans were obtained, each consisting of a series of 400–600 channels (1 or 2 s integration). These were centered on the galaxy and extended over 10 D_{25} (as given in the RC2, de Vaucouleurs, de Vaucouleurs, and Corwin 1976) to ensure sufficient sky channels for the subtraction. There were typically around 100 galaxy channels, which was sufficient to determine the zero point and the slope.

Although this technique is very time-consuming (one night per color per galaxy), it provides, at the same time, a very good check on the density-intensity calibration. In fact, it was the drift scans which identified a problem with the calibration of the UKSTU north wedge, which was then recalibrated. Between 20 and 40 scans were obtained for each color and for each galaxy.

c) Photometry of NGC 3379

As an external check of the reduction techniques, a B_J -plate of the E1 galaxy NGC 3379 was reduced. This galaxy is often proposed as a standard for photographic photometry. The best data available for comparison are those of the mean east-west luminosity profile in the Johnson B band collated by de Vaucouleurs and Capaccioli (1979) from various authors.

The two main objectives here were, first, a verification of the density-intensity calibration by comparing the slope of the profiles over a wide range of magnitudes and, second, a check

of the sky subtraction technique (a plane fit was used here) by looking at the agreement at low light levels.

The two profiles are compared in Figure 4 (*top*) from the sky level to 1% of the sky, where a zero point has been subtracted from de Vaucouleurs and Capaccioli's data to make the two profiles coincide. The agreement between the slopes of the two profiles is excellent over the full range of 5 mag, which indicates that, at least at the faint end, there is no significant scale error introduced by the reduction procedure. The agreement at a level of $\mu_B = 27.5$ mag arcsec⁻² confirms the goodness of the sky subtraction technique. Figure 4 (*bottom*) can be used to put lower limits on the accuracy of the photometry. We can say that surface brightnesses to better than 0.05 mag arcsec⁻² and color indices to better than 0.1 mag can be derived from the sky level down to 5 mag below sky.

d) Comparison with Previous Photometry

Two of the program galaxies have been previously studied in the B band by de Vaucouleurs and his collaborators (NGC 7793: de Vaucouleurs and Davoust 1980; NGC 300: de Vaucouleurs and Page 1962). This provides another external check. Figure 5 shows the comparison between the equivalent profiles, where the magnitudes have been transformed to the B band.

For NGC 7793, the only discrepancy is around 2', where de Vaucouleurs and Davoust see a larger excess ($\Delta\mu_B \approx 0.2$ mag) above the exponential fitted to the outer parts. The comparison provides, this time, two additional checks: first, on the zero-point determination using the drift scans and, second, on the transformation between B_J and B magnitudes. The very good agreement, in this case, confirms that these reduction steps have been carried out properly.

The situation is different for NGC 300. Our profile is brighter in the inner parts and fainter in the outer parts, with differences of up to 0.4 mag arcsec⁻². This difference could indicate some problems in the density-to-intensity calibration for one of the two sets of data. The good agreement between the photoelectric and photographic scans eliminates this possi-

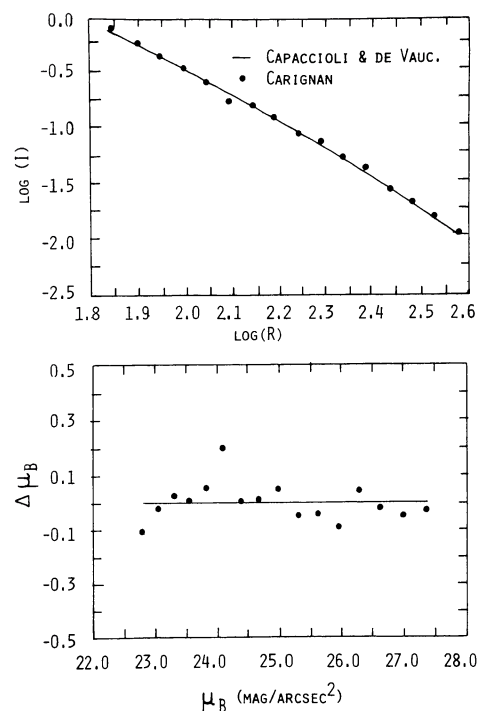


FIG. 4.—(top) Comparison of the east-west profile (dots) of NGC 3379 with de Vaucouleurs and Capaccioli's (1979) data (line). (bottom) Difference between our data and de Vaucouleurs and Capaccioli's data as a function of μ_B .

bility in our case. Because of better plate material, we believe that our profile for NGC 300 is more reliable and conclude that the good agreement for NGC 3379 and NGC 7793 is sufficient to justify our confidence in the reliability of our surface photometry.

IV. ORIENTATION PARAMETERS

Having the final galaxy arrays, the next step is to determine the following five orientation parameters by studying the galaxy isophotes: the optical center (x_0, y_0) , the semimajor and semiminor axis lengths (a, b) , and the position angle θ . Stars superposed on the galaxy image are first removed as in § IIIa. Before starting the fitting, a 9-point Gaussian beam is used to smooth the pixels with $1.00I_S \geq I_G \geq 0.01I_S$, and a 25-point beam is used for $I_G < 0.01I_S$. The fitting procedure is similar to the one used by Carter (1978).

The isophotal maps derived from the B_J -plates are shown in Figures 6–8. For NGC 7793, we also show the fitted ellipses superposed on the isophotes to show the goodness of the fit. The results are given in Tables 6–8, where X_c and Y_c are the centers of the fitted ellipses relative to the innermost isophote. The inclination is determined following Bottinelli *et al.* (1983). The adopted parameters are given in Table 9.

As can be seen, the inner isophotes are fairly irregular, being affected by numerous H II regions and the inner weak spiral structure. They are therefore not very useful for determining the orientation parameters. They also tend to have a different orientation than the more regular outer isophotes.

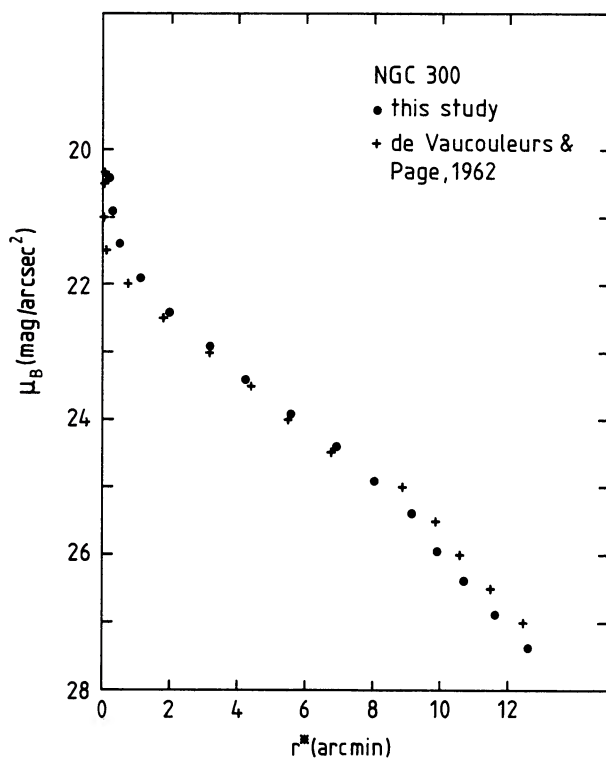
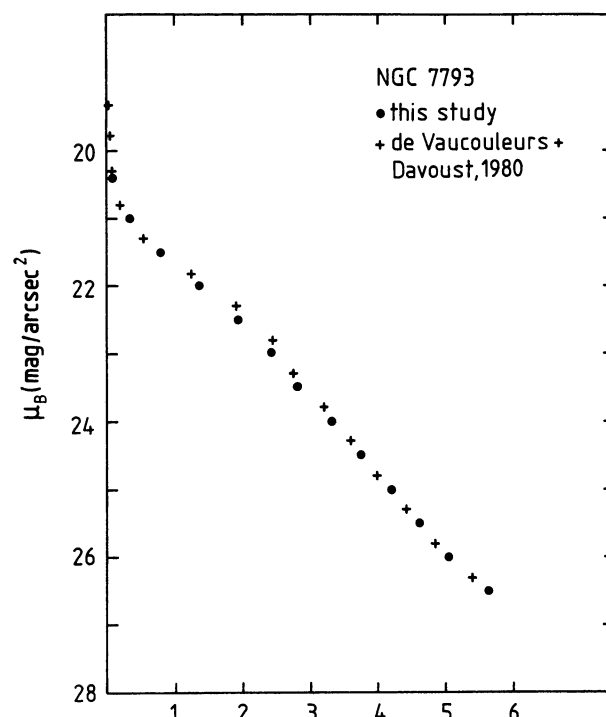


FIG. 5.—(top) Comparison between the profile (dots) and de Vaucouleurs and Davoust's (1980) B profile (crosses) for NGC 7793. (bottom) Comparison between our profile (dots) and de Vaucouleurs and Page's (1962) B profile (crosses) for NGC 300.

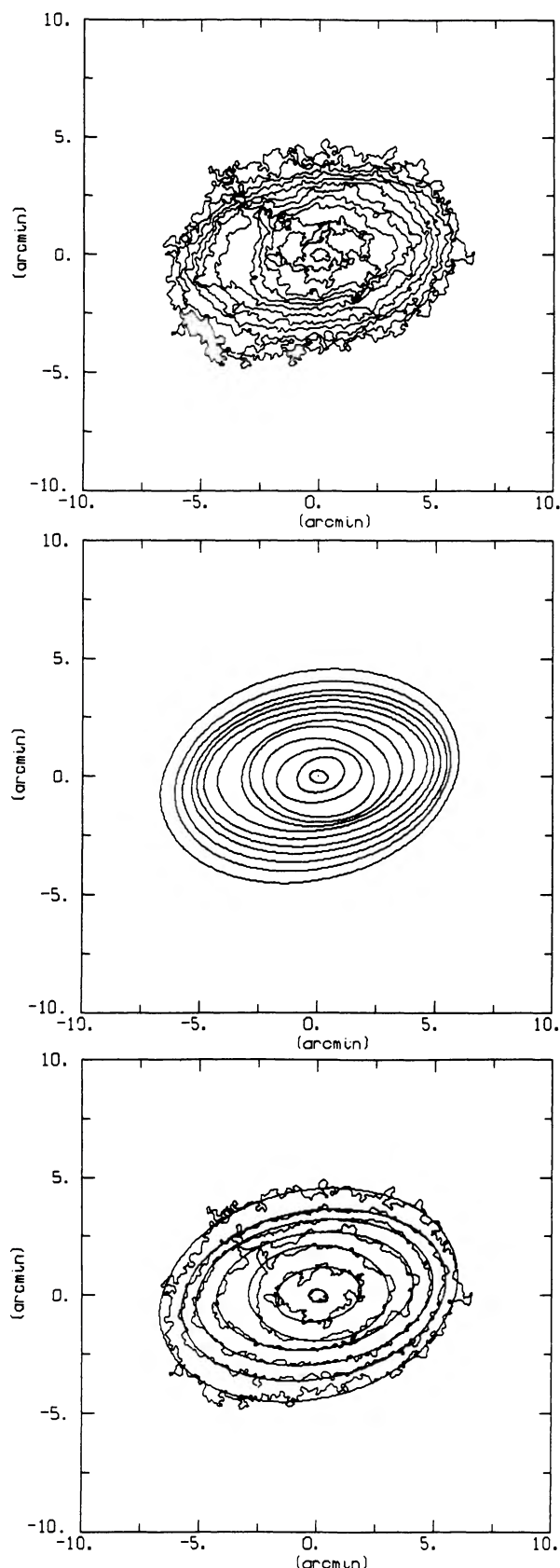


FIG. 6.—Isophotal map and fitted ellipses to the B_J data of NGC 7793 from 21.0 to 27.0 mag arcsec $^{-2}$ in steps of 0.5 mag. The bottom panel shows the fitted ellipses superposed on the isophotes in steps of 1.0 mag.

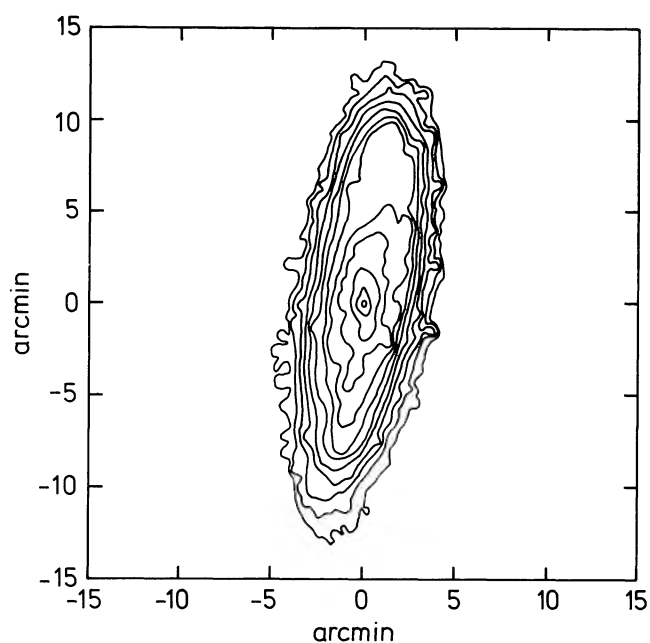


FIG. 7.—Isophotal map in B_J for NGC 247 from 21.5 to 27.0 mag arcsec $^{-2}$ in steps of 0.5 mag.

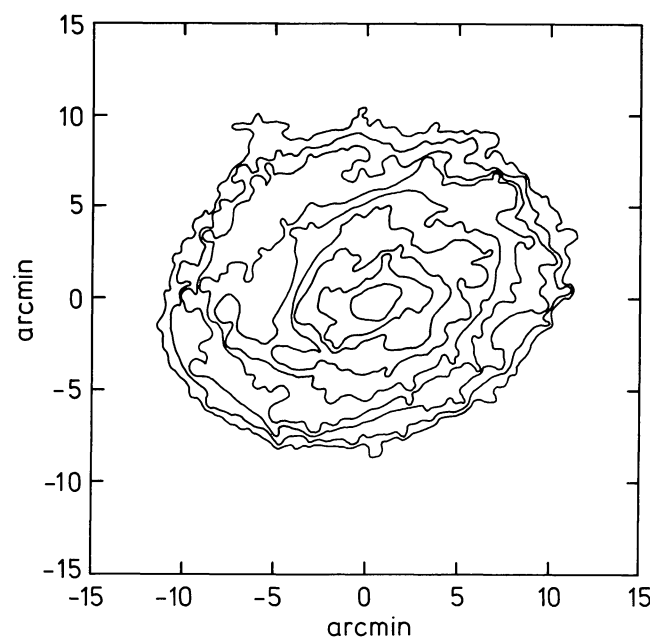


FIG. 8.—Isophotal map in B_J for NGC 300 from 22.0 to 26.0 mag arcsec $^{-2}$ in steps of 0.5 mag.

The main feature in the maps is a kind of fainter plateau on the east side of NGC 7793 and north side of NGC 247 at a level of 24.0 mag arcsec $^{-2}$. For NGC 247, which has a pronounced northern spiral arm, this region corresponds to an inter-arm region. For NGC 7793, which has no recognizable spiral pattern, it reflects either a region of higher absorption or a true departure from circular symmetry.

TABLE 6
ELLIPSE FITS TO ISOPHOTES FOR NGC 7793

μ_{B_I} (mag arcsec ⁻²)	X_c^a (arcsec)	Y_c^a (arcsec)	a (arcmin)	b/a	θ_0 (major axis)	i
21.0	0	0	0.38	0.70	79.4	46.0
21.5	-4.9	4.5	1.03	0.71	110.2	45.2
22.0	-0.1	2.7	1.82	0.62	100.2	52.2
22.5	1.5	-3.0	2.36	0.71	86.3	45.2
23.0	-1.6	5.9	2.96	0.69	90.7	46.8
23.5	-6.8	9.4	3.42	0.65	97.0	50.0
24.0	7.7	12.0	4.20	0.59	97.8	54.4
24.5	9.2	10.4	4.78	0.57	98.5	55.9
25.0	8.4	8.3	5.06	0.60	98.4	53.7
25.5	8.2	6.6	5.33	0.61	99.7	53.0
26.0	10.8	2.3	5.69	0.62	100.7	52.2
26.5	15.4	2.1	5.94	0.66	102.3	49.2
27.0	23.0	2.3	6.44	0.68	103.7	47.6

^a East and north positive.

TABLE 7
ELLIPSE FITS TO ISOPHOTES FOR NGC 247

μ_{B_I} (mag arcsec ⁻²)	X_c^a (arcsec)	Y_c^a (arcsec)	a (arcmin)	b/a	θ_0 (major axis)	i
22.00	0	0	0.71	0.57	184.6	55.9
22.50	-4.9	3.1	1.96	0.39	180.2	68.1
23.00	-2.0	-13.7	4.12	0.32	175.7	72.6
23.50	-10.0	-5.5	5.91	0.31	168.3	73.3
24.00	-17.3	67.4	8.68	0.24	171.3	77.9
24.50	-10.5	63.9	9.34	0.26	171.2	76.6
25.00	-7.4	59.6	9.96	0.27	171.0	75.9
25.50	-5.8	52.4	10.62	0.28	171.1	75.2
26.00	-7.8	45.9	11.22	0.30	171.0	73.9
26.50	-3.0	34.7	11.94	0.30	170.9	73.9
27.00	4.8	15.4	12.88	0.31	171.3	73.3

^a East and north positive.

While the parameters, derived using the outer isophotes, are fairly well defined for NGC 7793 and NGC 247, they are quite uncertain for NGC 300, which is an example of a lopsided galaxy. The centers of the ellipses fitted to the outer isophotes are offset by more than 1' to the southeast with respect to the innermost one, with both θ and i decreasing as one moves outward. We thus arbitrarily adopt the values at a level of $25 \mu_{B_I}$ except for the coordinates of the center, for which we used the brightest isophote.

V. LUMINOSITY PROFILES

Depending on the orientation of the galaxy, different types of luminosity profiles have to be used in order to find the best representation of the light distribution and hence of the mass distribution assuming a constant M/L . In the case of these Sculptor Group systems ($42^\circ \leq i \leq 75^\circ$), three types of profiles have been calculated: major and minor axis profiles, equivalent profiles, and elliptically averaged profiles.

The purpose of the major and minor axis profiles is mainly to reveal structural details that are otherwise smeared out in

TABLE 8
ELLIPSE FITS TO ISOPHOTES FOR NGC 300

μ_{B_I} (mag arcsec ⁻²)	X_c^a (arcsec)	Y_c^a (arcsec)	a (arcmin)	b/a	θ_0 (major axis)	i
22.0	0	0	1.5	0.62	116.4	52.2
22.5	12.9	-3.1	3.2	0.55	114.6	57.3
23.0	8.2	-3.6	4.1	0.66	93.5	49.2
23.5	-12.1	-22.3	5.6	0.71	116.5	45.2
24.0	21.3	-13.3	7.3	0.69	119.0	46.8
24.5	20.1	-21.9	9.1	0.65	117.0	50.0
25.0	43.5	-38.4	9.8	0.74	105.6	42.3
25.5	41.9	-46.0	10.6	0.77	105.8	40.0
26.0	50.7	-67.8	11.1	0.81	102.6	36.2

^a East and north positive.

TABLE 9
ORIENTATION PARAMETERS

Parameter	NGC 7793 ^a	NGC 247 ^a	NGC 300 ^b
R.A.(1950).....	23 ^h 55 ^m 15 ^s .2	00 ^h 44 ^m 39 ^s .6	00 ^h 52 ^m 31 ^s .2
Decl.(1950)	-32°52'10"	-20°02'00"	-37°57'24"
b/a	0.60	0.28	0.74
i^c	53.7 ^d	75.4	42.3 ^e
θ_0	99.3 ^d	171.1	105.6 ^e

^a Derived for $24.5 \leq \mu_{B_I} \leq 26.0$.

^b Derived at $\mu_{B_I} = 25.0$.

^c For $q_0 = 0.12$.

^d de Vaucouleurs and Davoust 1980: $i = 53^\circ$, $\theta_0 = 97^\circ 7$.

^e de Vaucouleurs and Page 1962: $i = 42^\circ 5$, $\theta_0 = 109^\circ 0$.

the two other types of profiles. The luminosity asymmetry curves, defined as the difference between the two sides of the major or minor axis, give some dynamical information on the galaxy, as well as pointing out some possible departures from circular symmetry.

The equivalent profiles were mainly derived for comparison with previous photometry. In doing so, we followed de

Vaucouleurs's nomenclature and definitions (de Vaucouleurs and Davoust 1980; de Vaucouleurs 1974; de Vaucouleurs and Page 1962).

The elliptically averaged profile is the one that best represents the radial light distribution for the Sculptor Group galaxies. The method is to average the surface brightness in circular rings in the plane of the galaxy (elliptical rings in the plane of the sky). As one moves toward the outer parts, more and more pixels are included in the averages, which results in an increase in signal-to-noise ratio at low light levels and in a smoothing of the sharp features. The orientation parameters used are those of Table 9.

a) NGC 7793

The B_J luminosity profiles for NGC 7793 along the major and minor axes are shown in Figure 9. The first feature is the

plateau at around 3'.5 on the east side of the major axis, which was already noticed in the isophotal map. It is very apparent in the luminosity asymmetry curve (west-east), where the east side is fainter between 150'' and 250''. As expected, no bright spiral arms are apparent, and the brightest features are only about 0.5 mag above the underlying disk. The mean folded major axis profile is well fitted by an exponential from 0'.5 to 4'.0, with a fully corrected extrapolated B central surface brightness of $21.13 \text{ mag arcsec}^{-2}$ and a scale length of 1'.40 (1.38 kpc).

The equivalent and elliptically averaged profiles in B_J are listed in Tables 10 and 11 and compared in Figure 10. As we can see, the equivalent profile is brighter in the outer parts. There are two possible reasons for the difference. First, for the elliptically averaged profile, we adopt an overall b/a , while as seen in Table 6, this ratio varies with radius. Second, the

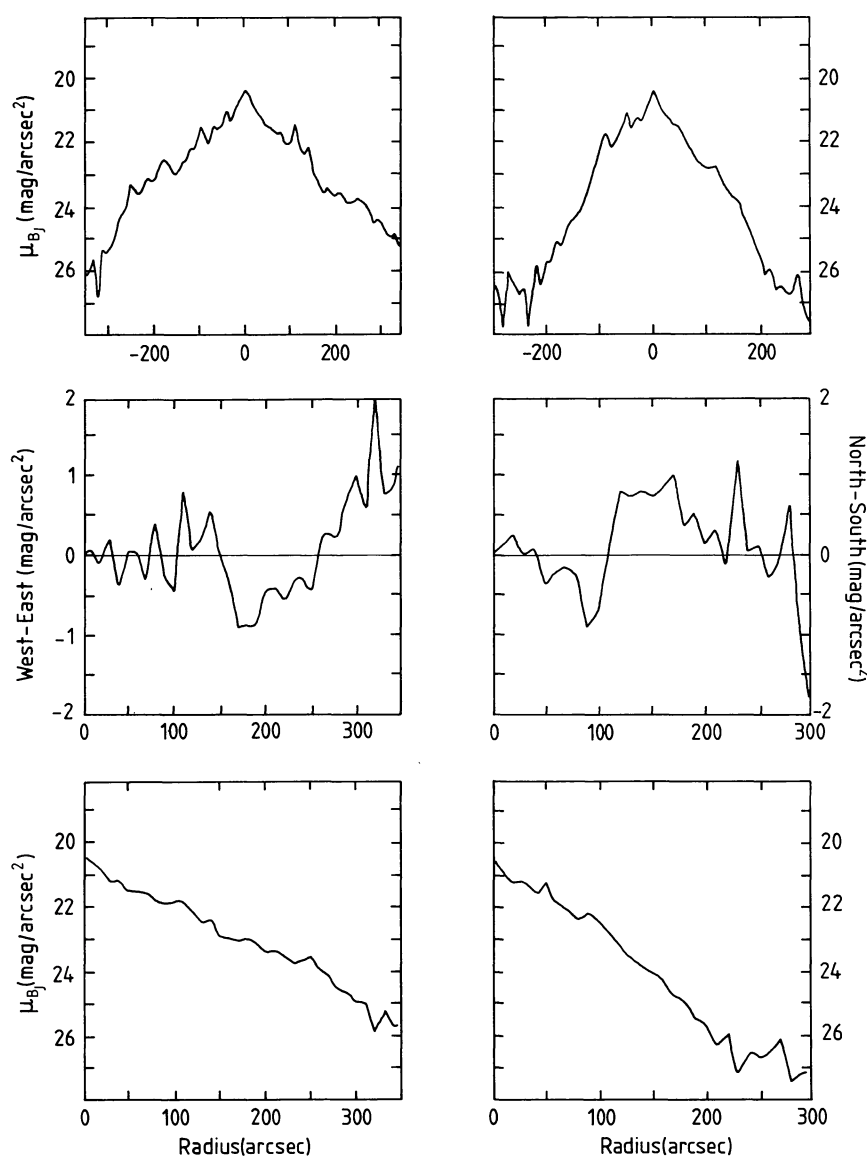


FIG. 9.—(top) Major (left) and minor (right) axis profiles in B_J for NGC 7793 (east is positive). (middle) Asymmetry curves. (bottom) Mean folded profiles.

TABLE 10
EQUIVALENT PROFILE IN B_J FOR NGC 7793

R^* (')	Log I	μ_{B_J}	μ_{tot}
0.07	0.90	20.43	15.99
0.19	0.80	20.68	13.98
0.36	0.70	20.93	12.82
0.56	0.60	21.18	12.05
0.80	0.50	21.43	11.45
1.06	0.40	21.68	11.02
1.36	0.30	21.93	10.65
1.68	0.20	22.18	10.37
1.95	0.10	22.43	10.18
2.24	0.00	22.68	10.03
2.43	-0.10	22.93	9.94
2.61	-0.20	23.18	9.88
2.79	-0.30	23.43	9.83
3.02	-0.40	23.68	9.78
3.28	-0.50	23.93	9.73
3.53	-0.60	24.18	9.69
3.77	-0.70	24.43	9.66
3.99	-0.80	24.68	9.64
4.19	-0.90	24.93	9.62
4.39	-1.00	25.18	9.61
4.59	-1.10	25.43	9.60
4.82	-1.20	25.68	9.59
5.06	-1.30	25.93	9.58
5.32	-1.40	26.18	9.57
5.63	-1.50	26.43	9.56

TABLE 11
ELLIPTICALLY AVERAGED PROFILE IN B_J FOR NGC 7793

R (')	Log I	μ_{B_J}	μ_{tot}
0.08	0.893	20.45	16.26
0.42	0.733	20.85	13.15
0.75	0.586	21.21	12.13
1.08	0.477	21.47	11.52
1.42	0.372	21.75	11.11
1.75	0.313	21.90	10.79
2.08	0.256	22.04	10.52
2.42	0.162	22.27	10.32
2.75	0.045	22.57	10.17
3.08	-0.077	22.87	10.06
3.42	-0.192	23.16	9.97
3.75	-0.317	23.47	9.90
4.08	-0.440	23.78	9.85
4.42	-0.571	24.11	9.81
4.75	-0.700	24.43	9.78
5.08	-0.853	24.81	9.76
5.42	-0.982	25.13	9.74
5.75	-1.124	25.49	9.72
6.08	-1.278	25.87	9.71
6.42	-1.421	26.23	9.71
6.75	-1.538	26.52	9.70
7.08	-1.625	26.74	9.70
7.42	-1.801	27.18	9.69

equivalent profile picks up small bright islands at large radii, which could explain this excess. Since these small islands contribute a lot of the light (e.g., OB associations) but not much of the mass, we will prefer the elliptically averaged profiles for the mass models.

Because of the smearing effect of our low-resolution Schmidt plates, the very central surface brightnesses are underestimated, and no attempt is made to decompose the profile

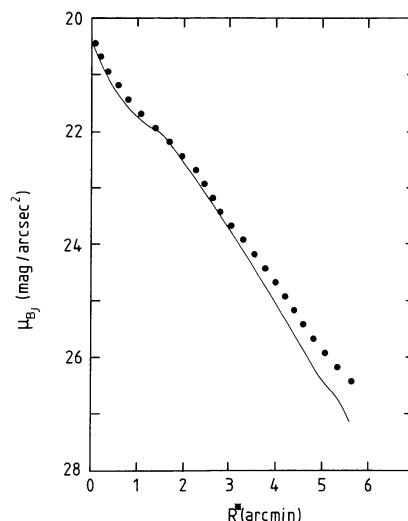


FIG. 10.—Equivalent (dots) and elliptically averaged (line) profiles in B_J for NGC 7793.

and fit the tiny bulge. The exponential fit between 2'0 and 7'0 reveals an exceptionally bright disk with $B(0)_c = 20.33$ mag arcsec $^{-2}$. Here, the B_J magnitudes were transformed on the B band and corrected for $A_B = 0.23$ (RC2) and inclination. The central surface brightness is 1.3 mag arcsec $^{-2}$ brighter than the averaged value for Freeman's sample of 21.65 (Freeman 1970). The scale length is 1'10 (1.08 kpc).

b) NGC 247

In the case of NGC 247, the major axis profile (Fig. 11) is more complicated. One of the main features is the low-luminosity inter-arm region between 5' and 8' on the north-west side, which is easily seen on a short-exposure plate and in the isophotal map. The northern arm has a fairly high contrast of more than 1 mag arcsec $^{-2}$ above the underlying disk, for which there is no equivalent on the south side.

The elliptically averaged profile in B_J is given in Table 12 and illustrated in Figure 12. Despite the asymmetric appearance of the galaxy, the luminosity profile is very regular, with an almost purely exponential behavior from 2'5 to 15'0, where the profile starts to get fainter. It is difficult, though, to establish if this decrease at large radii is real since it is at a level of 1% of the night sky.

The main feature of this profile is the very low surface brightness of the disk, with $B(0)_c = 23.44$ mag arcsec $^{-2}$. This is even fainter than Romanishin and Strom's (1979) mean of 22.88 for their sample of 12 low surface brightness spirals and is a factor of 5 in intensity smaller than Freeman's (1970) 21.65 mag arcsec $^{-2}$. While NGC 247 clearly has an intrinsically faint disk, its faintness could partly result from internal absorption, which could be quite important in view of the large inclination of this late-type spiral. The scale length from the fit between 5'0 and 11'0 is 4'0 (2.93 kpc).

c) NGC 300

NGC 300 has often been used as a prototype Sd galaxy, being the southern hemisphere equivalent of M33. It has a

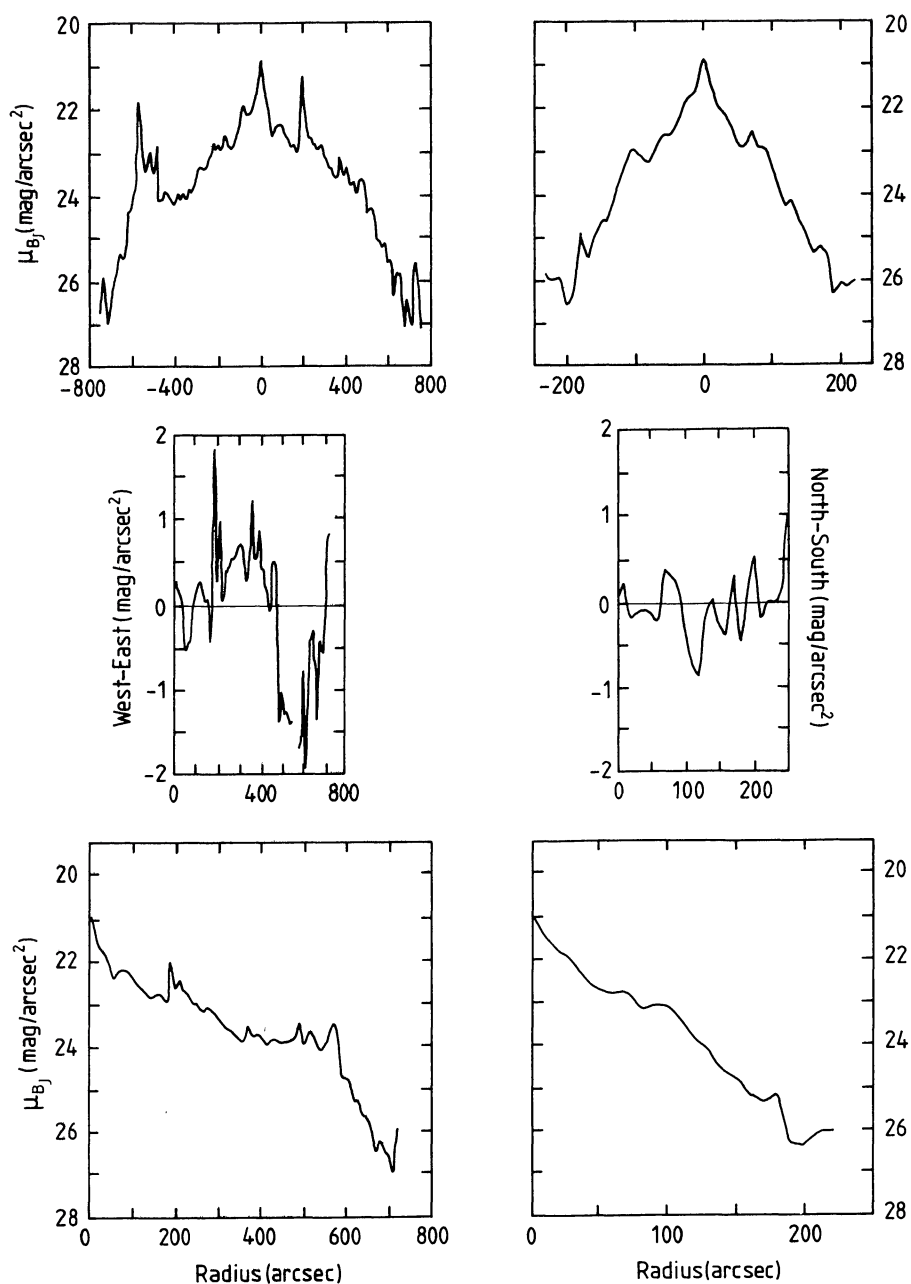


FIG. 11.—(top) Major (left) and minor (right) axis profiles in B_J for NGC 247 (east is positive). The two spikes of more than 1.5 mag at 190'' southeast and 570'' northwest are caused by bright H II regions crossing the major axis. (middle) Asymmetry curves. (bottom) Mean folded profiles.

tiny diffuse nucleus from which emerges a broad two-arm spiral pattern that fragments into many filaments at large radii. Its very numerous and bright H II regions make it an ideal candidate for chemical abundance studies (Pagel *et al.* 1979).

The major and minor axis profiles are illustrated in Figure 13. From the asymmetry curve, we see that the east side is fainter from 100'' to 400'', which is expected since the major axis follows a spiral arm on the west side and an interarm region on the east within that radius range. However, the excess beyond 400'' could indicate a departure from circular symmetry at large radii, as already suggested by the isophotes.

The mean folded major axis profile is well fitted by an exponential with $B(0)_c = 21.58$ mag arcsec $^{-2}$ and a scale length of 3'.0 (1.66 kpc).

Table 13 gives the equivalent profile in B_J , and Table 14 and Figure 14 give the elliptically averaged profile. The elliptically averaged profile is less regular than those of the two previous galaxies, which is expected in view of the galaxy's lopsided character. The profile shows two humps above the underlying exponential at $\sim 3.5'$ and $10.5'$, which correspond to the ends of the inner and outer spiral arms. The exponential fit between $4.5'$ and $10'$ gives $B(0)_c = 22.23$ mag arcsec $^{-2}$ and a scale length of $3.72'$ (2.06 kpc).

TABLE 12
ELLIPTICALLY AVERAGED PROFILE IN B_J FOR NGC 247

R (')	$\log I$	μ_{B_J}	μ_{tot}
0.08	0.591	21.18	17.83
0.58	0.459	21.51	13.92
1.08	0.307	21.89	12.84
1.58	0.182	22.20	12.23
2.08	0.111	22.38	11.78
2.58	0.022	22.60	11.46
3.08	-0.050	22.78	11.21
3.58	-0.109	22.93	10.99
4.08	-0.161	23.06	10.81
4.58	-0.205	23.17	10.66
5.08	-0.292	23.39	10.53
5.58	-0.372	23.59	10.42
6.08	-0.421	23.74	10.33
6.58	-0.487	23.88	10.25
7.08	-0.557	24.05	10.18
7.58	-0.609	24.18	10.12
8.08	-0.666	24.32	10.07
8.58	-0.718	24.45	10.02
9.08	-0.772	24.59	9.97
9.58	-0.820	24.71	9.93
10.08	-0.875	24.85	9.90
10.58	-0.921	24.96	9.87
11.08	-0.974	25.09	9.84
11.58	-0.969	25.08	9.80
12.08	-1.030	25.24	9.78
12.58	-1.075	25.35	9.75
13.08	-1.147	25.53	9.73
13.58	-1.183	25.62	9.71
14.08	-1.216	25.70	9.69
14.58	-1.344	26.02	9.68
15.08	-1.383	26.12	9.66
15.58	-1.225	25.72	9.65
16.08	-1.592	26.64	9.64
16.58	-1.716	26.95	9.63
17.08	-1.693	26.89	9.62
17.58	-1.747	27.03	9.62
18.08	-1.908	27.43	9.61
18.58	-1.949	27.53	9.61

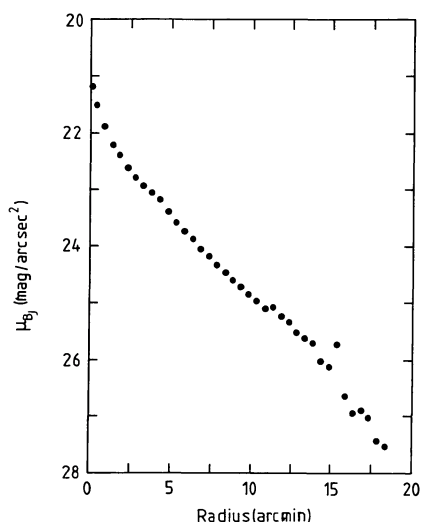


FIG. 12.—Elliptically averaged profile in B_J for NGC 247

VI. COLOR DISTRIBUTION

One of the aims in doing multicolor photometry is to check for radial color gradients in these systems. Figure 15 shows the observed colors (not corrected for absorption) for the three Sculptor Group galaxies.

We see that, if we exclude large radii where the data are noisy and the inner parts where the light is dominated by the small bulges, no significant gradient greater than 0.20 is detected. While this constancy of color does not tell us anything directly about the run of $(M/L)_{\text{disk}}$ with radius, it is at least consistent with it being constant.

VII. RED AND BLUE PIXEL PROFILES

In order to study the effect of recent star formation on the luminosity profiles, the color maps were used to sort out the data into red and blue pixels. The blue pixel profile is expected to be rather irregular, representative of the clumpy distribution of areas of recent star formation activity, whilst the red pixel profile should approximate the smoother distribution of the old disk population, which is the main contributor to the mass.

Following Talbot, Jensen, and Dufour (1979) red and blue pixel profiles were constructed adopting a separating color of $(B_J - R_F) = 1.0$, corresponding to $(B - V) \approx 0.65$. According to models of evolving clusters (Tinsley 1968; Searle, Sargent, and Bagnuolo 1973), for colors redder than 1.0, the recent birthrate must be less than about one-seventh of the mean (neglecting reddening).

However, we want to emphasize that this cannot be considered a complete decomposition, which would require a more thorough analysis (cf. Jensen, Talbot, and Dufour 1981). What we are doing here is just plotting the mean surface brightness of blue and red pixels as a function of radius. Hence, the profiles are not directly additive since there are usually more red than blue pixels in each radial bin.

One of the reasons for constructing such profiles was to investigate whether the Freeman (1970) type II profile of NGC 7793 is really a feature of the old disk, and hence dynamically significant, or whether the "hump" that defines the type II profile is solely due to the nonhomogeneous contribution to the integrated light from areas of recent star formation, as was shown to be the case for M83 (Talbot, Jensen, and Dufour 1979).

Figure 16 shows the red and blue pixel profiles in each color band. The persistence of the type II profile for the red pixels, combined with the fact that the red pixel profiles are very similar in the three bands, supports the idea that, at least for NGC 7793, the type II profile is a true feature of the old disk and hence of the mass distribution. This goes against the suggestion by Talbot, Jensen, and Dufour (1979) that most type II profiles could be due to an excess of blue light.

One ought to be careful not to overinterpret every bump and wiggle in luminosity profiles. However, if those profiles are to be used as tracers of the luminous mass distribution, one has to make sure that high surface brightness features like this hump are really significant.

Figure 17 and 18 show the red and blue pixel profiles in B_J for NGC 247 and NGC 300. The three galaxies illustrate very

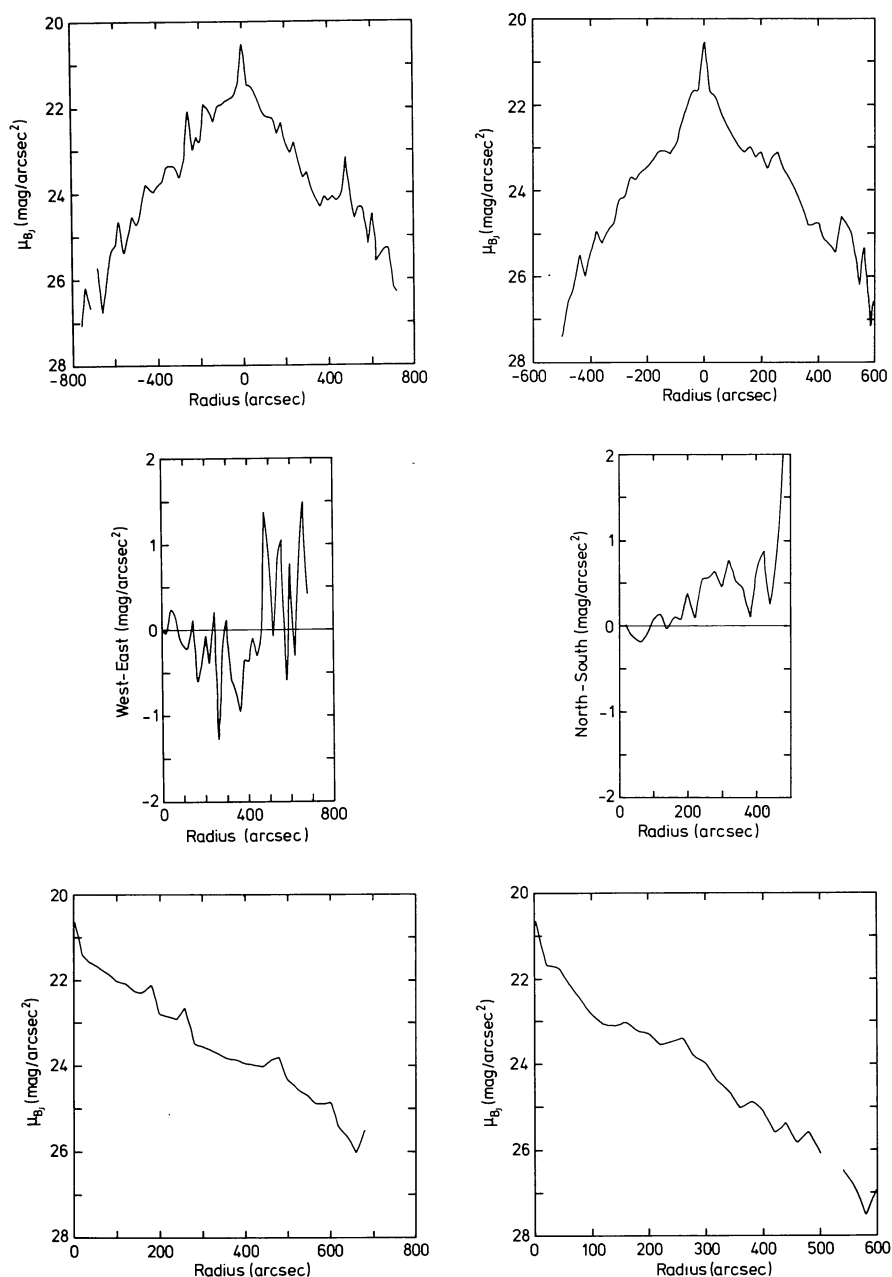


FIG. 13.—(top) Major (left) and minor (right) axis profiles in B_J for NGC 300 (east is positive). (middle) Asymmetry curves. (bottom) Mean folded profiles.

well the results that Schweizer (1976) found for earlier-type spirals, where the surface brightness of the young disk population decreased more gradually than the old disk light. Overall, the differences between the total light profile and the red pixel profile are small, with a mean ratio for the scale lengths of 1.18. This compares with the ratio of 1.16 found by Schweizer (1976) using a completely different method.

VIII. GAS CONTENT AND DISTRIBUTION

Since we want to use the luminosity profiles as tracers of the mass distribution, a last necessary step is to examine the radial

distribution of the gaseous component. Even if the gas, mainly H I and H₂, only contributes about 10% to the dynamical mass, it is important to see if its distribution follows the light distribution. For example, if the gas distribution were much flatter, then the luminosity profile could be a bad estimate of the mass distribution, especially in the outer parts.

For the molecular hydrogen, which appears (by extrapolation from CO) to be at least as abundant as H I in late-type spirals (Young and Scoville 1982), there are no data available on its radial mass distribution for the Sculptor Group galaxies. Fortunately, through CO observations of an increasing num-

TABLE 13
EQUIVALENT PROFILE IN B_J FOR NGC 300

R^* (')	$\log I$	μ_{B_J}	μ_{tot}
0.03 ...	1.00	20.12	17.48
0.14 ...	0.90	20.37	14.32
0.23 ...	0.80	20.62	13.49
0.28 ...	0.70	20.87	13.15
0.36 ...	0.60	21.12	12.75
0.51 ...	0.50	21.37	12.25
0.78 ...	0.40	21.62	11.63
1.13 ...	0.30	21.87	11.07
1.54 ...	0.20	22.12	10.60
2.02 ...	0.10	22.37	10.23
2.62 ...	0.00	22.62	9.87
3.14 ...	-0.10	22.87	9.64
3.63 ...	-0.20	23.12	9.47
4.22 ...	-0.30	23.37	9.31
4.92 ...	-0.40	23.62	9.15
5.55 ...	-0.50	23.87	9.04
6.27 ...	-0.60	24.12	8.94
6.94 ...	-0.70	24.37	8.86
7.49 ...	-0.80	24.62	8.81
8.05 ...	-0.90	24.87	8.76
8.69 ...	-1.00	25.12	8.72
9.14 ...	-1.10	25.37	8.70
9.53 ...	-1.20	25.62	8.68
9.90 ...	-1.30	25.87	8.67
10.29 ...	-1.40	26.12	8.65
10.70 ...	-1.50	26.37	8.64
11.15 ...	-1.60	26.62	8.64
11.64 ...	-1.70	26.87	8.63
12.14 ...	-1.80	27.12	8.62
12.61 ...	-1.90	27.37	8.62
13.03 ...	-2.00	27.62	8.61

TABLE 14
ELLIPTICALLY AVERAGED PROFILE IN B_J FOR NGC 300

R (')	$\log I$	μ_{B_J}	μ_{tot}
0.08	0.77	20.69	16.28
0.58	0.46	21.47	12.81
1.08	0.35	21.74	11.66
1.58	0.22	22.06	11.04
2.08	0.11	22.35	10.63
2.58	0.05	22.49	10.30
3.08	0.02	22.57	10.02
3.58	-0.03	22.69	10.02
4.08	-0.12	22.92	9.79
4.58	-0.23	23.20	9.48
5.08	-0.36	23.51	9.37
5.58	-0.42	23.66	9.28
6.08	-0.46	23.78	9.20
6.58	-0.50	23.87	9.13
7.08	-0.57	24.04	9.06
7.58	-0.65	24.24	9.01
8.08	-0.70	24.36	8.96
8.58	-0.74	24.47	8.91
9.08	-0.80	24.61	8.87
9.58	-0.87	24.80	8.83
10.08	-0.96	25.01	8.80
10.58	-0.96	25.08	8.77
11.08	-1.05	25.25	8.75
11.58	-1.17	25.54	8.73
12.08	-1.30	25.86	8.70
12.58	-1.43	26.19	8.69
13.08	-1.47	26.30	8.68
13.58	-1.67	26.79	8.67

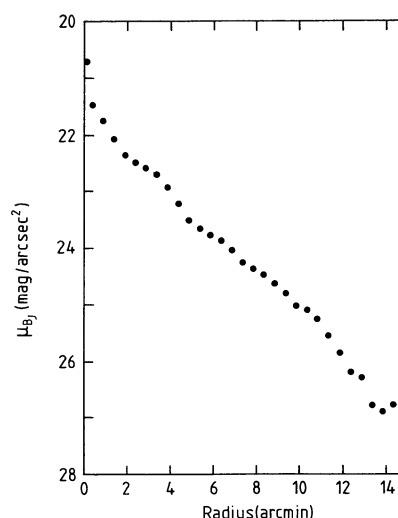


FIG. 14.—Elliptically averaged profile in B_J for NGC 300

ber of spirals (M51, M101, NGC 891, NGC 6946, IC 342, and the Milky Way), it has been shown that CO emission, and hence the H_2 distribution, follows very closely the light distribution (Young 1985; Young and Scoville 1982; Scoville and Young 1983; Solomon *et al.* 1983), with the exception of the very inner parts of NGC 891 and of the Galaxy (Sanders, Solomon, and Scoville 1984). It seems reasonable to assume that the same is probably true of most spirals.

The situation for H I is more complicated, since its radial distribution does not always follow the light distribution. A good example is M101 (Allen and Goss 1979), where the H I distribution rises between 0 and 6 kpc, then stays more or less constant out to 19 kpc before starting to decrease. In such a case, it may be necessary to take into account the H I mass in the outer parts when constructing mass models.

In order to get the values of M_{H}/L_B for the program galaxies and an estimate of the H I radial distribution, we obtained single-dish Parkes H I observations (HPBW = 15''), down to a detection limit of 0.01 K, or 16 mJy per beam, using a cooled field effect transistor receiver front-end yielding an overall T_{sys} of 45–50 K. The profiles in 7'' steps along the major and minor axes are shown in Figures 19–21. Because of beam smearing, we do not claim to be able to derive the exact H I distribution. However, Bosma (1978) showed that resolution effects mainly affect the inner parts, and thus the distribution we have derived for the outer parts is probably a good estimate. The “effective” positions of the profiles were computed using the Gaussian model of Krumm and Salpeter (1979).

If we look first at the ratio of H I mass to blue luminosity, we find values of 0.24, 0.43, and 0.61 for NGC 7793, NGC 247, and NGC 300. When compared with the values expected from the correlation between luminosity index and H I content (de Vaucouleurs 1977), we see that NGC 7793 is underabundant by a factor of 1.3, while NGC 247 and NGC 300 are overabundant by factors of 1.3 and 2.0 respectively. If we use the results of the mass models for the luminous component (Carignan 1985), we get ratios of H I mass to luminous mass of 0.12, 0.08, and 0.23 respectively.

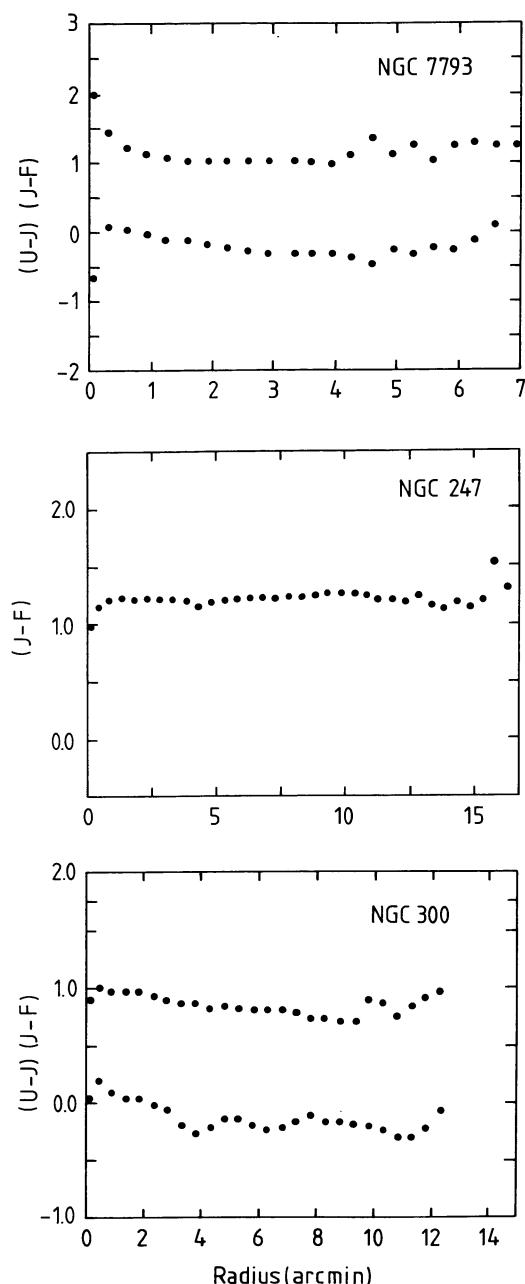


FIG. 15.—Radial color distribution for NGC 7793 (*top*), NGC 247 (*middle*), and NGC 300 (*bottom*).

It is clear that, especially in the case of NGC 300, it is important to look at the H I radial distribution. Figure 22 shows the H I distribution (in Jy km s^{-1}) plotted along with the light profile. We see that the H I distribution follows the light distribution very closely in the outer parts. For the inner parts, it is difficult to know if the flattening is due to resolution effects or to a real depletion of H I in the center, as is often seen in spirals.

In the case of NGC 247, the situation is complicated by the asymmetry of the H I distribution, with almost twice as much hydrogen on the north side as on the south side. Figure 23 shows the mean radial distribution, where the error bars

represent the values on both sides. We see that, this time, the H I seems to fall off more rapidly than the light distribution and thus cannot be a major contributor in the outer parts. Finally for NGC 7793, the H I extent is too small to get reliable data with the Parkes beam. The only reliable information we have is on the distribution of ionized hydrogen; de Vaucouleurs and Davoust (1980) have shown that for $R > 1.0$, the number density of H II regions is well represented by an exponential falloff.

IX. SUMMARY

Surface photometry for three Sd galaxies in the Sculptor Group has been presented. Tables 15–17 summarize their photometric parameters, and Table 18 compares their properties with M33. The main results are as follows:

1. From their total B_r profiles, the three galaxies exhibit an exceptionally wide range in central disk surface brightness, from the bright disk of NGC 7793 at $B(0)_c = 20.33$ mag arcsec $^{-2}$, to the low surface brightness disk of NGC 247 at 23.44. NGC 300 has a more “normal” $B(0)_c$ of 22.23 mag arcsec $^{-2}$. However, all these values are still within the observed range when one considers that in Freeman’s (1970) sample, seven galaxies had a $B(0)_c$ 1.5 mag arcsec $^{-2}$ brighter than the mean value of 21.65 ± 0.30 , and one system, IC 1613, was even fainter than NGC 247 at $B(0)_c = 23.7$ mag arcsec $^{-2}$.

2. Since the three Sd galaxies are of similar absolute magnitude ~ -18 , the fitted scale lengths vary according to their surface brightness, from 1 to 3 kpc. The mean scale length is very close to Freeman’s (1970) mean value of 2.1 ± 1.3 kpc for all morphological types, Schweizer’s (1976) value of 2.7 ± 0.5 kpc for mainly Sc galaxies, and Romanishin and Strom’s (1979) value of 2.1 ± 0.7 kpc for a sample of 12 LSB galaxies ($H_0 = 100 \text{ km s}^{-1} \text{ Mpc}^{-1}$).

3. When compared with the Scd galaxy M33, the three Sculptor Group galaxies turn out to be smaller systems with a mean face-on diameter of $\langle D(0) \rangle = 9.9 \pm 1.1$ kpc, compared with 12.0 kpc for M33, and a mean absolute magnitude of -18.11 ± 0.17 compared with -18.51 . In these respects, they are probably more similar to the LMC, which has $D(0) = 8.25$ kpc (RC2) and $M_T^0 = -18.17$ (de Vaucouleurs and Davoust 1980).

4. No significant color gradient greater than 0.20 is detected in the color maps.

5. When the profiles are sorted out into red and blue pixel profiles, it is found that blue light decreases more gradually than the old disk light, confirming Schweizer’s (1976) results for Sc galaxies. The difference between red and blue pixel profiles is mainly important in the outer parts ($r \geq 3\alpha^{-1}$).

6. The persistence of the type II profile for the red pixels of NGC 7793 goes against the suggestion by Talbot, Jensen, and Dufour (1979) that most type II profiles are probably not true features of the old disk but are mainly due to an excess of blue light.

7. Finally, concerning their H I content, we have seen that NGC 7793 and NGC 247 are normal systems, while NGC 300 seems to be overabundant by about a factor of 2. We also looked at the radial distribution of H I in NGC 247 and NGC 300 and found that H I cannot be an important contributor to the mass in the outer parts. A similar conclusion is probably true for H_2 .

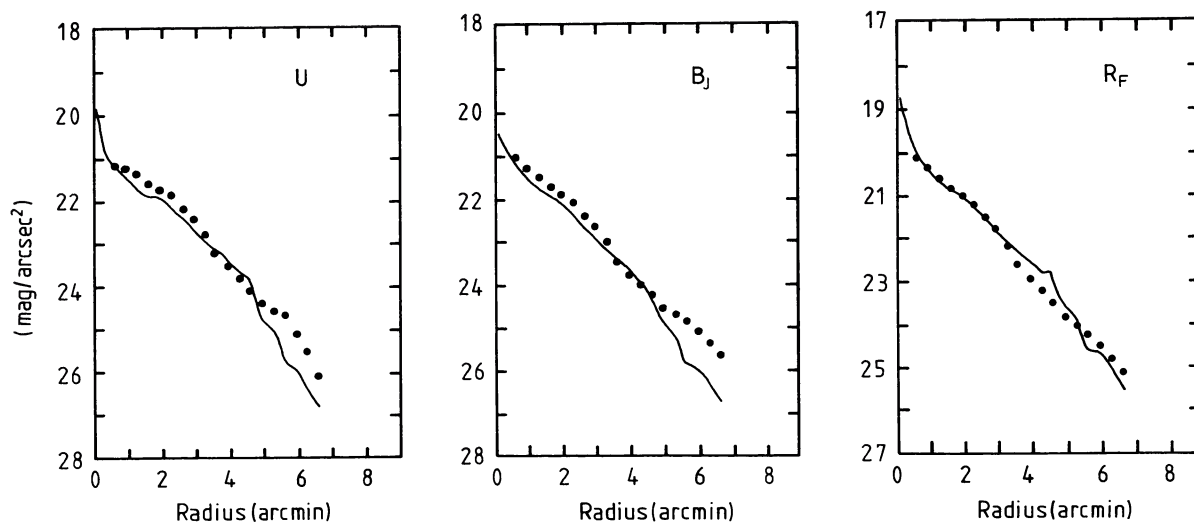


FIG. 16.—Red (line) and blue (dots) pixel profiles in U , B_J , and R_F for NGC 7793

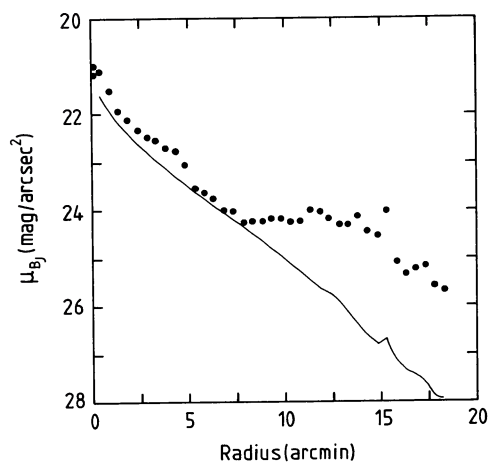


FIG. 17.—Red (line) and blue (dots) pixel profiles in B_J for NGC 247.

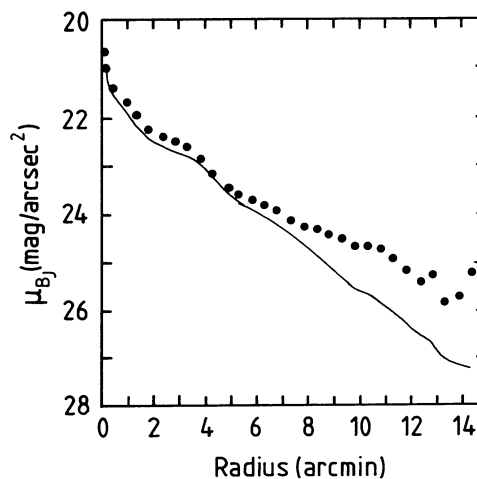


FIG. 18.—Red (line) and blue (dots) pixel profiles in B_J for NGC 300.

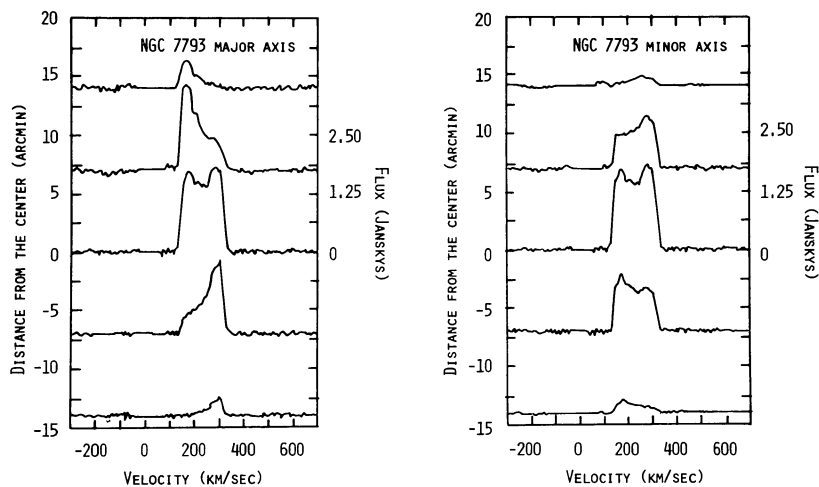


FIG. 19.—Major (left) and minor (right) axis H I profiles for NGC 7793

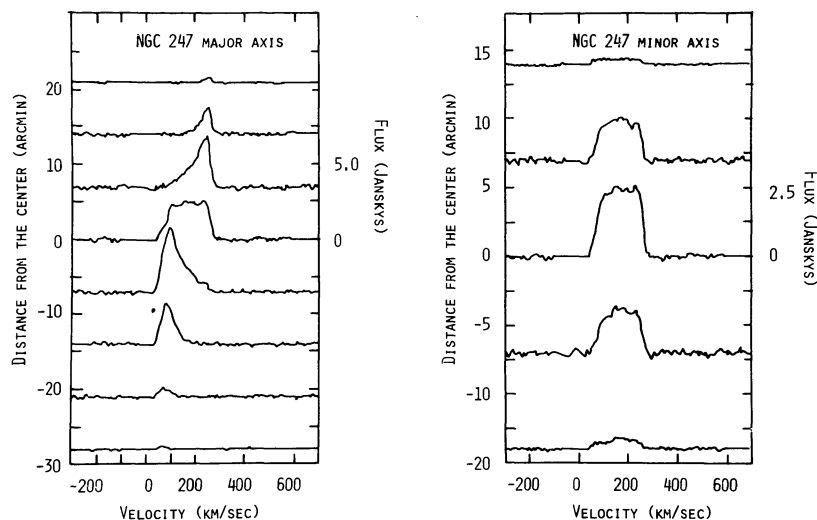
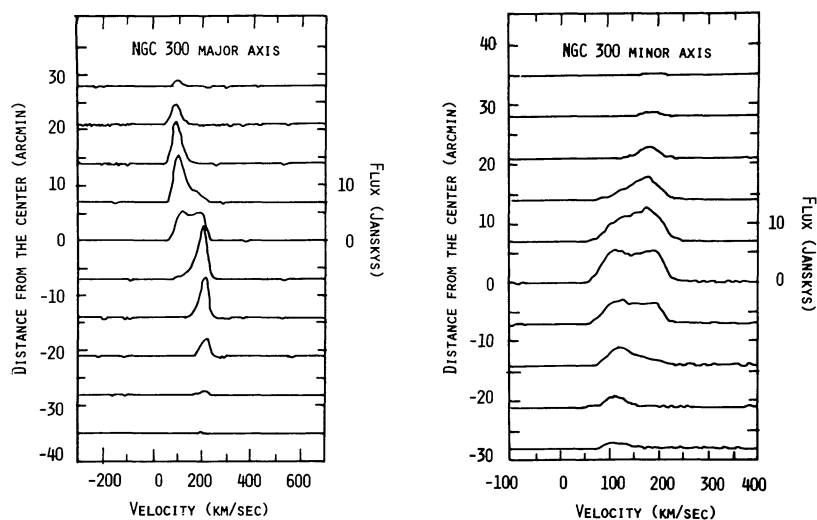
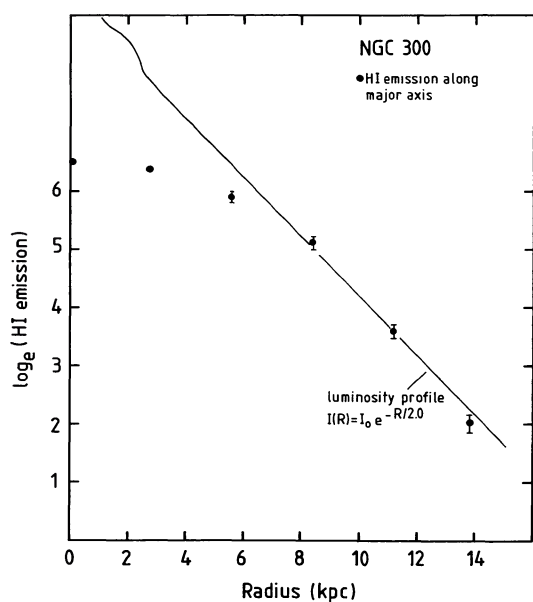
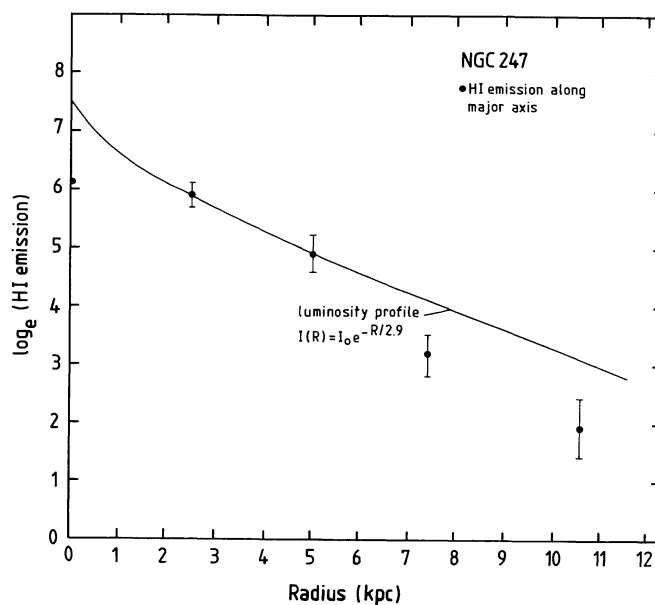
FIG. 20.—Major (*left*) and minor (*right*) axis H I profiles for NGC 247FIG. 21.—Major (*left*) and minor (*right*) axis H I profiles for NGC 300FIG. 22.—H I emission (in Jy km s^{-1}) along the major axis for NGC 300 plotted along with the luminosity profile.

FIG. 23.—H I emission along the major axis for NGC 247 plotted along with the luminosity profile.

TABLE 15
PHOTOMETRIC PARAMETERS FOR NGC 7793

Apparent distance modulus (B)	$m - M = 27.87$
Corrected distance modulus ^a	$m_0 - M = 27.64$
Distance (Mpc)	$\Delta = 3.38 \pm 0.30$
Scale (kpc arcmin ⁻¹)	$s = 0.983$
Mean axis ratio ($4/8 < r < 6/2$)	$q = 0.60 \pm 0.02$
Inclination ($q_0 = 0.12$)	$i = 53.7 \pm 1.6$
Position angle (1950)	$\theta_0 = 99.3 \pm 1.1$
Parameters at $\mu_B = 25.0$ mag arcsec ⁻² :	
Major axis	$D_{25} = 10.1$
Minor axis	$d_{25} = 6.1$
Log diameter	$\log D_{25} = 2.00$
Log axis ratio	$\log R_{25} = 0.22$
Log face-on diameter	$\log D(0)_{25} = 1.95$
Parameters at $\mu_B = 26.6$ mag arcsec ⁻² :	
Major axis	$D_{HO} = 12.2$
Minor axis	$d_{HO} = 8.1$
Exponential disk parameters:	
Total light profile:	
Corrected central surface brightness ^{a,b,c}	$B(0)_c = 20.33$
Intensity scale ^d	$I_0 = 464.5$
Scale length (kpc)	$\alpha^{-1} = 1.08$
Red pixel profile:	
Corrected central surface brightness ^{a,b,c}	$B(0)_c = 20.28$
Intensity scale ^d	$I_0 = 486.4$
Scale length (kpc)	$\alpha^{-1} = 1.04$
Intensity scale ratio ^e	$I_D/I_T = 1.05$
Scale length ratio ^e	$\alpha_D/\alpha_T = 1.04$
Total apparent magnitude (B) ^c	$B_T = 9.74 \pm 0.10$
Corrected apparent magnitude ^{a,f}	$B_T^0 = 9.33$
Corrected absolute magnitude	$M_T^0(B) = -18.31$
Corrected absolute luminosity ^d	$L_T(B) = 3.13 \times 10^9$
H I mass to blue luminosity ratio	$M_H/L_B = 0.24^g$
H I mass to luminous mass ratio	$M_H/M_{lum} = 0.12^h$

^aGalactic extinction $A_B = 0.23$ (RC2).

^bLine-of-sight integration correction = $2.5 \log R_{25} = 0.55$.

^cTransformation $B = B_J + 0.06(B_J - R_F) = B_J + 0.06$.

^dIn solar units, where $M_\odot(B) = +5.43$.

^eRatio between red pixel profile and total profile.

^fInternal extinction $A(i) = 0.8 \log R_{25} = 0.18$.

^g $M_{H\text{ I}}$ from Parkes observations.

^hCarignan 1985.

The main aim of this surface photometry program is to use the luminosity profiles in conjunction with kinematical data to study, in a subsequent paper, the mass distribution of pure disk galaxies, and especially the ratio of unseen halo mass to luminous disk mass. But is the light profile a good representation of the luminous component mass distribution? And if so, which profile should be used?

Before answering these questions, it should be kept in mind that the basic assumption underlying all this is that M/L is constant in the stellar disk. While nothing in what we have done can establish the radial dependence of M/L , the absence of a significant color gradient on a large scale is at least consistent with constant M/L . If it were shown unambiguously that $(M/L)_{\text{disk}}$ varies with radius, it is clear that the idea of using the light distribution as a tracer of the luminous mass distribution would lose its significance, unless the exact radial dependence could be derived.

TABLE 16
PHOTOMETRIC PARAMETERS FOR NGC 247

Apparent distance modulus (B)	$m - M = 27.22$
Corrected distance modulus ^a	$m_0 - M = 27.01$
Distance (Mpc)	$\Delta = 2.52 \pm 0.50$
Scale (kpc arcmin ⁻¹)	$s = 0.733$
Mean axis ratio ($9/3 < r < 11/2$)	$q = 0.28 \pm 0.02$
Inclination ($q_0 = 0.12$)	$i = 75.4 \pm 1.2$
Position angle (1950)	$\theta_0 = 171.1 \pm 0.1$
Parameters at $\mu_B = 25.0$ mag arcsec ⁻² :	
Major axis	$D_{25} = 19.9$
Minor axis	$d_{25} = 5.4$
Log diameter	$\log D_{25} = 2.30$
Log axis ratio	$\log R_{25} = 0.57$
Log face-on diameter	$\log D(0)_{25} = 2.17$
Parameters at $\mu_B = 26.6$ mag arcsec ⁻² :	
Major axis	$D_{HO} = 24.3$
Minor axis	$d_{HO} = 7.3$
Exponential disk parameters:	
Total light profile:	
Corrected central surface brightness ^{a,b,c}	$B(0)_c = 23.44$
Intensity scale ^d	$I_0 = 26.7$
Scale length (kpc)	$\alpha^{-1} = 2.93$
Red pixel profile:	
Corrected central surface brightness ^{a,b,c}	$B(0)_c = 23.22$
Intensity scale ^d	$I_0 = 32.7$
Scale length (kpc)	$\alpha^{-1} = 2.58$
Intensity scale ratio ^e	$I_D/I_T = 1.22$
Scale length ratio ^e	$\alpha_D/\alpha_T = 1.13$
Total apparent magnitude (B) ^c	$B_T = 9.67 \pm 0.10$
Corrected apparent magnitude ^{a,f}	$B_T^0 = 9.00$
Corrected absolute magnitude	$M_T^0(B) = -18.01$
Corrected absolute luminosity ^d	$L_T(B) = 2.38 \times 10^9$
H I mass to blue luminosity ratio	$M_H/L_B = 0.43^g$
H I mass to luminous mass ratio	$M_H/M_{lum} = 0.09^h$

^aGalactic extinction $A_B = 0.21$ (RC2).

^bLine-of-sight integration correction = $2.5 \log R_{25} = 1.43$.

^cTransformation $B = B_J + 0.06(B_J - R_F) = B_J + 0.07$.

^dIn solar units, where $M_\odot(B) = +5.43$.

^eRatio between red pixel profile and total profile.

^fInternal extinction $A(i) = 0.8 \log R_{25} = 0.46$.

^g $M_{H\text{ I}}$ from Parkes observations.

^hCarignan 1985.

So if we assume that $(M/L)_{\text{disk}}$ is constant, the obvious answer is that the red pixel profiles, which represent the old disk light, probably better approximate the mass distribution. On the other hand, we have seen that, at least for NGC 7793 and NGC 247, the total light profiles and the red pixel profiles are very similar out to at least 3 scale lengths; the difference is important only at large radii.

Since for an exponential disk, $\sim 85\%$ of the mass is enclosed within 3 scale lengths, using the total light profile does not introduce a large error. If anything, it can be considered an upper limit to the luminous light component in the outer parts. The error introduced is thus in the right sense, since we want to put lower limits on the importance of a dark halo component.

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TABLE 17
PHOTOMETRIC PARAMETERS FOR NGC 300

Apparent distance modulus (B)	$m - M = 26.61$	Exponential disk parameters:	
Corrected distance modulus ^a	$m_0 - M = 26.39$	Total light profile:	
Distance (Mpc)	$\Delta = 1.90 \pm 0.18$	Corrected central surface brightness ^{a,b,c}	$B(0)_c = 22.23$
Scale (kpc arcmin ⁻¹)	$s = 0.553$	Intensity scale ^d	$I_0 = 80.8$
		Scale length (kpc)	$\alpha^{-1} = 2.06$
Mean axis ratio ($r = 9/8$)	$q = 0.74 \pm 0.07$	Red pixel profile:	
Inclination ($q_0 = 0.12$)	$i = 42.3 \pm 3.0$	Corrected central surface brightness ^{a,b,c}	$B(0)_c = 21.77$
Position angle (1950)	$\theta_0 = 105.6 \pm 1.8$	Intensity scale ^d	$I_0 = 123.4$
		Scale length (kpc)	$\alpha^{-1} = 1.52$
Parameters at $\mu_B = 25.0$ mag arcsec ⁻² :		Intensity scale ratio ^e	$I_D/I_T = 1.53$
Major axis	$D_{25} = 19'.6$	Scale length ratio ^e	$\alpha_D/\alpha_T = 1.36$
Minor axis	$d_{25} = 14'.5$		
Log diameter	$\log D_{25} = 2.29$	Total apparent magnitude (B) ^c	$B_T = 8.70 \pm 0.10$
Log axis ratio	$\log R_{25} = 0.13$	Corrected apparent magnitude ^{a,f}	$B_T^0 = 8.38$
Log face-on diameter	$\log D(0)_{25} = 2.26$	Corrected absolute magnitude	$M_T^0(B) = -18.01$
		Corrected absolute luminosity ^d	$L_T(B) = 2.38 \times 10^9$
Parameters at $\mu_B = 26.6$ mag arcsec ⁻² :		H I mass to blue luminosity ratio	$M_H/L_B = 0.61^g$
Major axis	$D_{HO} = 23'.4$	H I mass to luminous mass ratio	$M_H/M_{lum} = 0.25^h$
Minor axis	$d_{HO} = 19'.0$		

^aGalactic extinction $A_B = 0.22$ (RC2).

^bLine-of-sight integration correction = $2.5 \log R_{25} = 0.33$.

^cTransformation $B = B_T + 0.06(B_T - R_T) = B_T + 0.05$.

^dIn solar units, where $M_\odot(B) = +5.43$.

^eRatio between red pixel profile and total profile.

^fInternal extinction $A(i) = 0.8 \log R_{25} = 0.10$.

^g $M_{H\,I}$ from Parkes observations.

^hCarignan 1985.

TABLE 18
COMPARISON OF THE SCULPTOR GROUP GALAXIES WITH M33

Parameter	M33 ^a	NGC 7793	NGC 247	NGC 300
Morphological type	SA(s)cd	SA(s)d	SAB(s)d	SA(s)d
Distance (Mpc)	0.72	3.38	2.52	1.90
Face-on diameter $D(0)_{25}$ (kpc)	12.0	8.8	10.8	10.1
Corrected total magnitude B_T^0	5.79	9.33	9.00	8.38
Absolute magnitude	-18.51	-18.31	-18.01	-18.01
Exponential disk parameters:				
Central surface brightness $B(0)_c$	21.05	20.33	23.44	22.23
Scale length α^{-1} (kpc)	1.65	1.08	2.93	2.06
Maximum rotational velocity V_{max}	107	95	108	87
Hydrogen mass to luminous mass ratio M_H/M_{lum}	0.05	0.12	0.09	0.25
Luminous mass to B luminosity ratio M_{lum}/L_B	5.0 ^b	2.0 ^c	5.0 ^c	2.5 ^c

^aParameters from de Vaucouleurs and Caulet 1982; de Vaucouleurs 1959.

^bKalnajs 1983.

^cCarignan 1985.

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CLAUDE CARIGNAN: Kapteyn Laboratorium, Postbus 800, 9700 AV Groningen, The Netherlands