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Revised photometric distances to nearby dwarf galaxies in the IC 342/Maffei complex

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Abstract. The results of DAOPHOT photometry of several hundred stars in five irregular galaxies are presented using V and I CCD frames, obtained with the Nordic Optical Telescope under a 0.6 arcsec seeing. Based on the brightest blue and red stars we estimate the following distances to the galaxies: 3.2 Mpc for UGCA 105, 2.6 Mpc for UGCA 86, 1.8 Mpc for UGCA 92, 1.7 Mpc for NGC 1569, and 1.7 Mpc for Cas 1. The problem of membership of the galaxies to the IC 342/Maffei complex is briefly discussed[1].

Key words: galaxies: irregular — galaxies: distances — galaxies: stellar content

1. Introduction

At the intersection of the Local Supergalactic plane and the Milky Way zone and in the vicinity of the bright spiral IC 342 there are 12 galaxies with radial velocities below 500 km/s. Judging by the amplitude of internal motions, some of them (Maffei 1, Maffei 2, Dwingeloo 1) are massive galaxies, which have escaped notice until recently because of strong interstellar absorption. In addition to the galaxies known previously (NGC 1560, NGC 1569, UGCA 86, UGCA 92, UGCA 105) new objects have been found in the region: Cas 2 = Dwingeloo 1 (Kraan-Korteweg et al. 1994), Cas 1 (Huchtmeier et al. 1995), MB 1 (McCall & Buta 1995; Huchtmeier & van Driel 1996), Dwingeloo 2 (Burton et al. 1996), Cam A (Karachentsev 1994), and Cam B (Huchtmeier et al. 1997). The surveys of the region, which have been undertaken with the Tautenburg 2-meter telescope plates (Börngen & Karachentseva 1985) and also with POSS-II films (Karachentseva & Karachentsev 1997) have revealed some other candidates to be probable members of this nearby complex of galaxies. The distribution of the galaxies is presented in Fig. 1 in galactic coordinates. The galaxies with corrected radial velocities V_0 below 500 km/s are indicated with open circles, and other possible new members of the complex are noted with crosses.

Except for Maffei 1, Dwingeloo 1, Dwingeloo 2, and MB 1, situated in the strongest absorption zone, the rest of the galaxies with $V_0 < 500$ km/s have already been resolved into stars. Based on the luminosity of the brightest blue and red stars the following distance have been estimated: 3.3 Mpc for UGCA 105 (Tikhonov et al. 1992), 2.1 Mpc for IC 342 and 1.9 Mpc for UGCA 86 (Karachentsev & Tikhonov 1993), 3.8 Mpc for NGC 1560 (Karachentsev et al. 1991), 1.8 Mpc for NGC 1569 and 2.2 Mpc for UGCA 92 (Karachentsev et al. 1994), 2.3 Mpc for Maffei 2 (Tikhonov & Karachentsev 1994), and 0.8 Mpc for Cas 1 (Tikhonov 1996). The mean distance of the IC 342/Maffei complex $< D >= 2.3$ Mpc derived from these data agrees well with the earlier estimates made by Spinrad et al. (1973) and McCall (1989), but disagrees significantly with the value $D = 4.2 \pm 0.5$ Mpc, obtained by Luppino & Tonry (1993) for Maffei 1 via surface brightness fluctuation method.

The problem of the distance to the IC 342/Maffei $1 + 2$ group was discussed recently by Krismer et al. (1996). Estimating distance moduli to NGC 1560 and UGCA 105 by the Tully-Fisher method, these authors obtained a distance of $< D >= (3.6 \pm 0.5)$ Mpc, and ascribed it to the rest of the galaxies in the group. However, this suggestion is not at all evident in the case of the scattered association of galaxies which is seen along the Local Supercluster plane.

It should be stressed that if it is sufficiently nearby the IC 342/Maffei $1 + 2$ group might affect the trajectories of galaxies in the Local Group (Zheng et al. 1991; Valtonen

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[1] Tables 2 to 6 are only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

et al. 1993; Peebles 1994). Therefore, it is important to obtain precise distances to the galaxies in question.

2. Observations and reductions

The galaxies UGCA 86, UGCA 92, UGCA 105, NGC 1569, and Cas 1 were observed in February 5–7, 1995 at the Nordic 2.5-meter telescope in the V and I bands of the Kron-Cousins system. The observations were carried out with a TK 1024A CCD chip having 1024 by 1024 pixels each 24 microns in size. It provided a $3\farcm0 \times 3\farcm0$ field of view with the resolution of $0\farcs176$ per pixel. The CCD quantum efficiency is about 70% in each of the bands, and the read-out noise is 6.5 e. The frames of the galaxies were obtained under quite good photometric conditions with a seeing of FMHM $= 0\farcs5 - 0\farcs7$. Table 1 describes the exposures.

After subtracting dark frame, flat-fielding and cleaning of cosmic ray events the photometric processing of the frames was performed with DAOPHOT and ALLSTAR packages (Stetson 1987). Equatorial photometric standards from Landolt (1992) were observed in order to transform instrumental magnitudes into the standard V and I system. According to our estimate the total error in the zero-point does not exceed 0.05 mag for any of the galaxies.

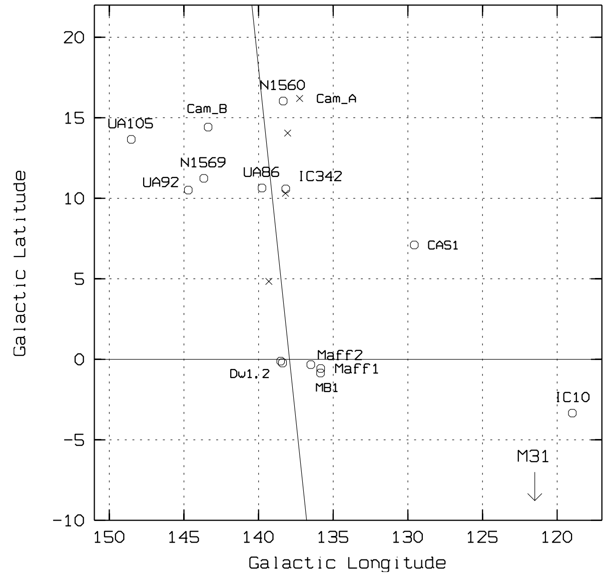

Fig. 1. The distribution of galaxies in the IC 342/Maffei complex in galactic coordinates. The open circles represent galaxies with radial velocities $V_0 < 500$ km/s, the crosses correspond to other probable members of the complex. The inclined solid line is the Supergalactic equator

3. The results of the photometry and the distance moduli

Following the traditional approach developed by Sandage & Tammann (1974) and de Vaucouleurs (1978), we use the brightest blue ($V - I < +0.5$) and red ($V - I > +2.0$) stars as distance indicators to the galaxies. The photometric distance modulus, $\mu_0(B)$, was derived via the mean apparent magnitude of three the brightest blue stars, $< B(3B) >$, from the relation

$$\mu_0(B) = 1.51 < B(3B) > -0.51 B_{\rm T} - A_B + 4.14, \qquad (1)$$

where $B_{\rm T}$ is the total apparent magnitude of the galaxy, and A_B is the foreground galactic extinction. Relation (1) reflects well the known correlation between the luminosity of blue supergiants and the luminosity of their parent galaxy. Its numerical coefficients were calibrated by Piotto et al. (1992) and Karachentsev & Tikhonov (1994) using galaxies with known distances from Cepheids. To derive B magnitudes we use the empirical relation.

$$B - V = 0.80(V - I), \qquad (2)$$

which is valid in general for Landolt's stars.

For deriving a modulus from red supergiants de Vaucouleurs (1978) recommended the use of their magnitude $< M_v(3R) > = -7\fm7$, irrespective of the luminosity of the parent galaxy. We applied this rule to all five galaxies observed.

3.1. UGCA 105

According to RC 3 (de Vaucouleurs et al. 1991) this irregular galaxy of Sm type has a standard angular diameter of 5.5 arcmin. A reproduction of its central part in the I-band is presented in Fig. 2. Applying the ALLSTAR programme, we carried out the photometry of 568 stars seen on both CCD frames and having the image parameters: |SHARP|< 2, |CHI|< 2, and $\sigma(V) < 0.20$ mag, where $\sigma(V)$ is a formal error of the V-magnitude. SHARP and CHI are measures of the starts shape and the goodness of fit, respectively, in the reductions. SHARP is a measure of the difference beetween the observed width of the object and the width of the psf model. The results of our photometry are given in Table 2. Its columns contain: (1) — the star number, (2) and (3) — the star coordinates expressed in pixels, (4) — the V magnitude, (5) — the colour index $V - I$, (6) — the image parameter, SHARP.

Figure 3 shows the "Colour–Magnitude" diagram derived from these data. The brightest stars with $V < 20.5$ and "neutral" colour $0.7 < V - I < 2.2$ are evidently foreground stars. The population of the brightest blue stars of the galaxy itself appears in the region of $V > 22.5$ and $V - I < 0.6$ in good agreement with the data by Tikhonov et al. (1992). Among them we select stars ##459, 226, and 261 as the brightest blue supergiant candidates, excluding from the consideration two cases, ##20 and 449 which have not sharp stellar images. Their mean apparent

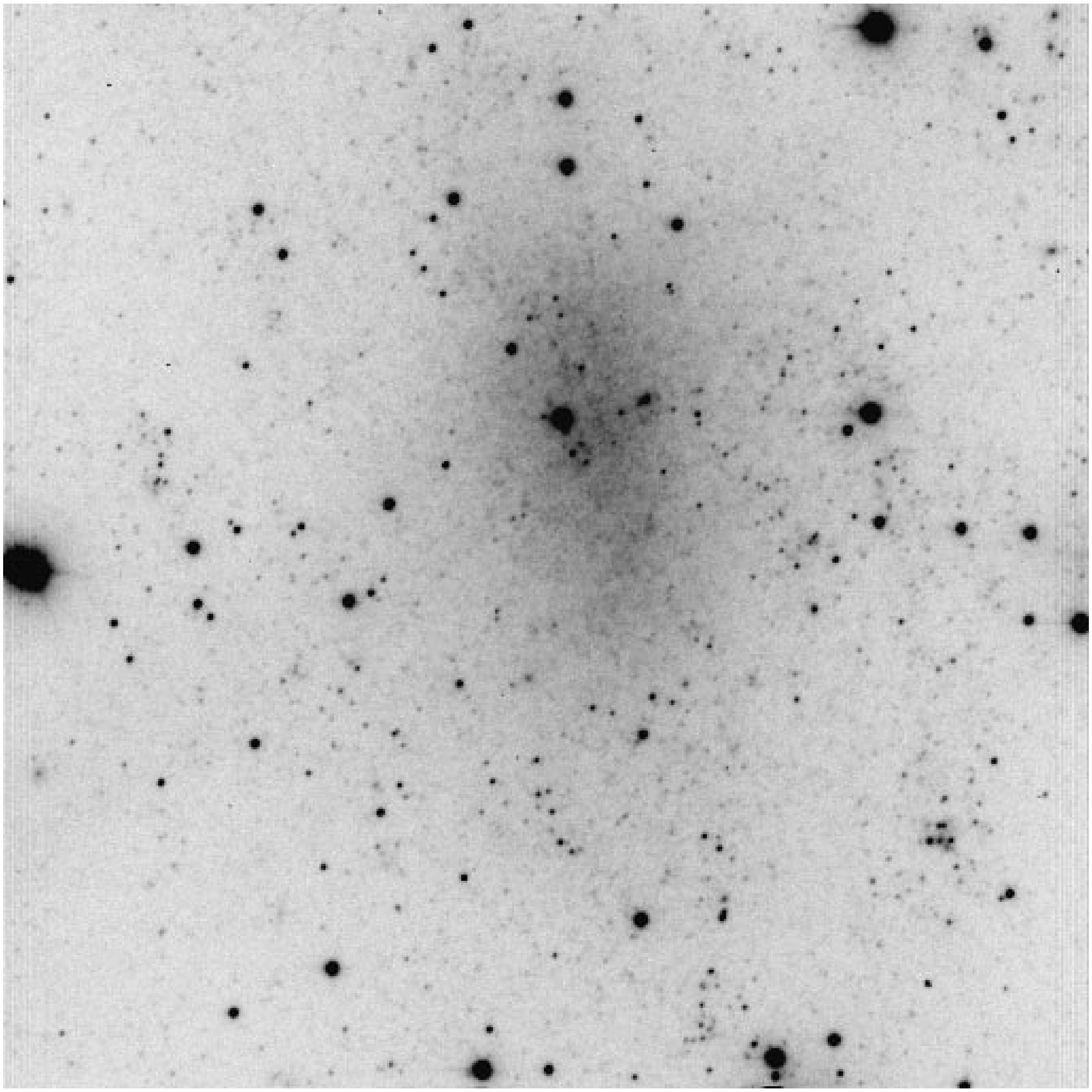

Fig. 2. The central part of UGCA 105 in the I band. The size of the CCD frame is 3.0 by 3.0 arcmin. North at top, East on the left

magnitude and colour are $< V(3B) >= 20.68$, $< V-I >$ $= +0.11$ or $< B(3B) >= 20.77$ and $< B-V >= +0.09$.

To determine the distance modulus from relation (1), we adopted $B_{\rm T} = 13\overset{\rm m}{.}24$ for the total magnitude of the galaxy (Huchtmeier & Richter 1986), and $A_B = 1\overset{\rm m}{.}42$ for the galactic extinction (Burstein & Heiles 1984).

Note, UGCA 105 is quoted to be fainter in the RC3 ($B_{\rm T} = 13\overset{\rm m}{.}95$). However, the photometric data by Krismer et al. (1995) and also our measurements fit well the previous magnitude. With our adopted parameters the distance modulus of UGCA 105 from blue stars is $\mu_0(B) = 27\overset{\rm m}{.}27$.

Among the red stars with $V-I > 2.5$ the three brightest ones, #149, 322 and 227, have $< V(3R) >= 21\overset{\rm m}{.}46$, that gives us the modulus of $\mu_0(R) = 27.82$. The mean of the two estimates, 27.54 ± 0.28, corresponds to a galaxy distance of $D = 3.2$ Mpc in agreement with the earlier value of 3.31 Mpc given by Tikhonov et al. (1992). Comparing new (CCD) and old (photographic) measurements of the individual stars, we obtain the average difference in their zero-point $< V_{\rm new} - V_{\rm old} >= -0\overset{\rm m}{.}05 \pm 0\overset{\rm m}{.}04$.

3.2. UGCA 92

This irregular dwarf system with an angular diameter of $2\overset{\prime}{.}0$ has the lowest radial velocity among all the galaxies of the complex. Figure 4 reproduces its CCD frame

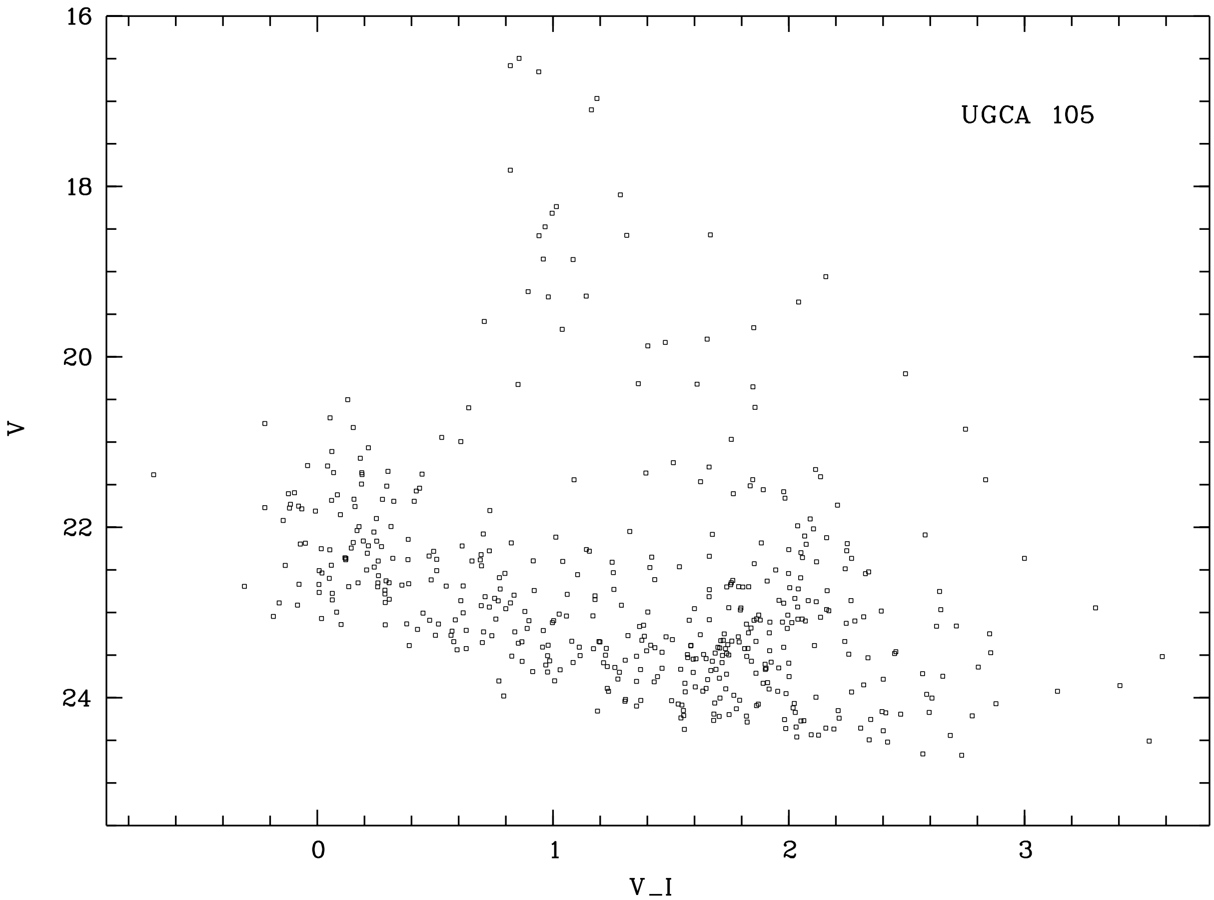

Fig. 3. Colour–Magnitude diagram for 568 stars in UGCA 105

obtained in the I band. The total magnitude of UGCA 92 is rather controversial. The catalog RC3 gives an apparent magnitude of $13\overset{m}{.}8$, but in the catalog of Karachentseva & Sharina (1987) its magnitude is $16\overset{m}{.}4$. According to the CCD photometry by Karachentseva et al. (1996) the galaxy has $B_{\rm T} = 15.22$ and $(B-V)_{\rm T} = 1.34$. From present measurements after corrections for the Galactic stars the total magnitude and total colour of UGCA 92 are $V_{\rm T} = 15\overset{m}{.}42$, $(V-I)_{\rm T} = 1.58$, or $B_{\rm T} = 16\overset{m}{.}15$ and $(B-V)_{\rm T} = 1.26$.

The results of our photometry of 184 stars are presented in Table 3, which is structured in the same way as Table 2. Among them 100 stars, situated inside the visible boundary of the galaxy, are indicated by "1" in the last column. Figure 5 shows the Colour-Magnitude diagram based on these data. The red colour of many stars is caused obviously by the strong interstellar extinction. We estimated the absorption value, A_B, from the galaxy colour. Adopting for an irregular type galaxy the mean true colour, $< B-V >_0 = 0.36 \pm 0.02$ (RC3), we obtain a colour excess of $E(B-V) = 0.90 \pm 0.05$ or $A_B = 4.2\ E(B-V) = 3\overset{m}{.}78$. The brightest blue stars belonging to the galaxy itself are easily distinguished from the foreground stars. For the three brightest, # 82, 57 and 117 we obtain from relation (2) the mean:$< B(3B) > = 22.60$ and $< B-V > = +0.98$, which gives the distance modulus of $\mu_0(B) = 26\overset{m}{.}25$ or $D = 1.78$ Mpc.

From the C−M diagram it appears that the brightest red supergiants of the galaxy may have $V \simeq 23^{\rm m}$, $V-I \simeq 3.0$. However, to distinguish them from foreground stars is a difficult task. Comparing the present photometry of individual stars with our old CCD data (Karachentsev et al. 1994), we find a systematic difference, $< V_{\rm new} - V_{\rm old} > = +0.42 \pm 0.05$, the reason of which remains unclear to us.

3.3. UGCA 86 = VIIZw9

The dwarf galaxy UGCA 86 with its radial velocity $V_{\rm h} = +67$ km/s and standard angular diameter $a_{25} = 4\overset{\prime}{.}5$ remains still the only indisputable satellite of the spiral IC 342. Figure 6 reproduces a CCD frame in the I band, covering the central part of UGCA 86 and also its bright southern concentration (= VIIZw9). According to Huchtmeier & Richter (1986) the total magnitude of

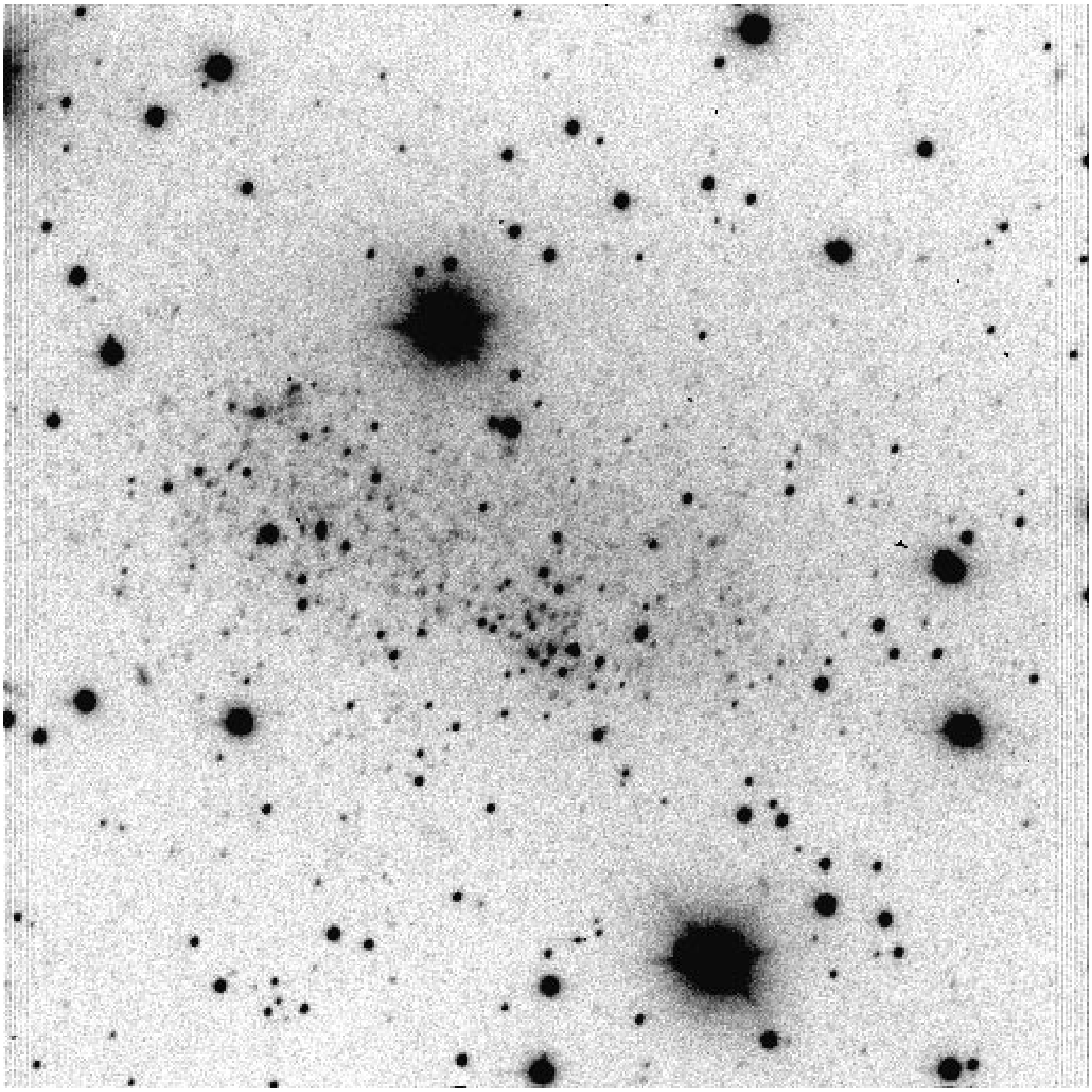

Fig. 4. UGCA 92 in the I band. The size and the orientation of the frame are the same as previously

UGCA 86 is known with a low accuracy and corresponds to $B_{\rm T} = 14.2$.

To estimate the interstellar extinction in the direction to UGCA 86 we measured the colours of the two brightest parts: the central one and the southern. The mean value for them, $< V - I >= 1.58 \pm 0.04$ corresponds to $< B - V >= 1.27$, that yields the colour excess $E(B - V) = +0.91$ and $A_B = 3\overset{\rm m}{.}82$ assuming a the typical intrinsic colour for an irregular galaxy, $< B - V >_0 = 0.36$.

The results of ALLSTAR photometry for 444 stars are presented in Table 4 and in Fig. 7. The stars which are situated within the region of the bright southern knot are indicated in the last column with the number "0", and by open circles in the C−M diagram. It is evident from Fig. 7 that the majority of the brightest "blue" stars are concentrated just toward the southern complex. After avoiding some stars with $V - I < 0.5$, whose photometry is affected by neighbouring diffuse objects, we selected the stars #401, 400 and 226 as the brightest blue supergiant candidates. Their mean apparent magnitude and colour are $< B(3B) >= 22.64$ and $< B - V >= 0.84$. Then the galaxy distance modulus is 27.26 assuming $B_{\rm T} = 14\overset{\rm m}{.}2$ and $A_B = 3\overset{\rm m}{.}82$.

Unlike blue stars, the red ones with colour $V - I > 3.1$ are scattered more or less randomly over the whole galaxy body which makes it difficult to distinguish them from foreground stars. Adopting the stars #180, 94 and 40 with $< V(3R) >= 22.17$ and $< V - I >= 3.35$ as the red

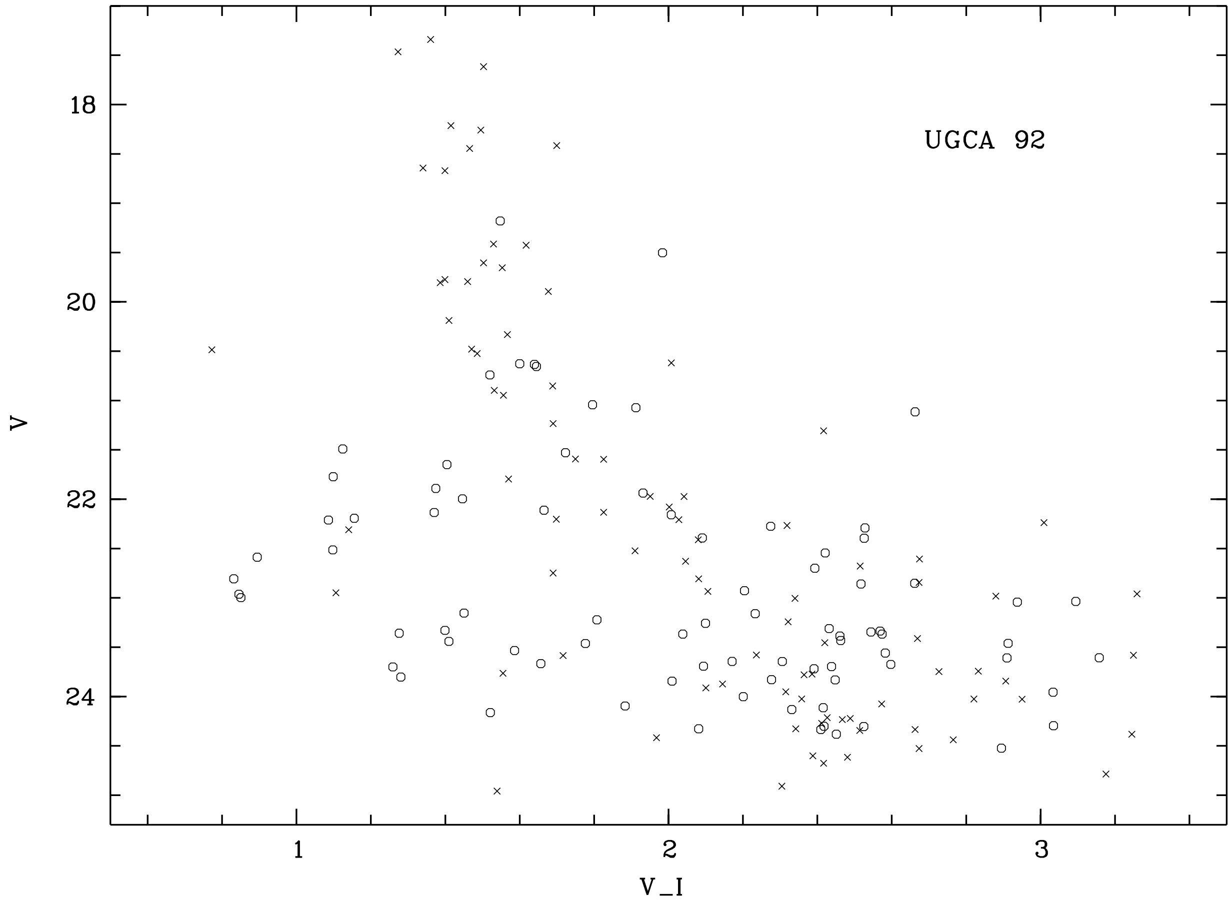

Fig. 5. Colour–Magnitude diagram for UGCA 92. the stars inside and outside the galaxy body are indicated by open circles and crosses, respectively

Table 1. Journal of observations

Object	Filter	Exposure	Date
UGCA 86	*V*	600 s	Feb. 6, 1995
	I	600 s	
UGCA 92	*V*	600 s	Feb. 6, 1995
	I	600 s	
UGCA 105	*V*	600 s	Feb. 6, 1995
	I	600 s	
NGC 1569	*V*	300 s	Feb. 7, 1995
	I	300 s	
	R	60 s	
Cas 1	*V*	600 s	Feb. 5, 1995
	I	600 s	

supergiant candidates we obtain a modulus of $\mu_0(R) = 26.97$. The mean of the two estimates, $27^{\mathrm{m}}.12 \pm 0^{\mathrm{m}}.15$, corresponds to a distance of $D = 2.65$ Mpc, which exceeds appreciably the old estimate, 1.86 Mpc, by Karachentsev & Tikhonov (1993). Both these estimates agree quite well with the mean distance of IC 342 ($D = 2.3$ Mpc). The difference between the new and the old photometric zero-points is negligible, $+0^{\mathrm{m}}.08 \pm 0^{\mathrm{m}}.06$, but the increase of the distance estimate is rather caused by a new selection of blue and red stars for the supergiants of the galaxy.

3.4. NGC 1569 = UGC 3056 = Arp 210 = VIIZw16

This peculiar galaxy with $V_{\mathrm{h}} = -89$ km/s has been studied by many authors (Ables 1971; Arp & Sandage 1985; Karachentsev et al. 1994; Krismer et al. 1995). The high brightness gradient across NGC 1569 and a presence of dusty furrows in its body make stellar photometry very hard. The galaxy image in the *I* band is shown in Fig. 8. Its upper part reproduces one half of the original frame, and the lower one shows the same part of the galaxy after subtracting a frame smoothed with a window of $10 \times$(FWHM), allowing a filtering of extended emission or unresolved stars. An application of the ALLSTAR package allowed us to perform the photometry of more than 500 stars inside the galaxy as well as arround it. However, a lot of stars, especially within its central part, were excluded due to the condition $|\mathrm{SHARP}| > 2$. The results of

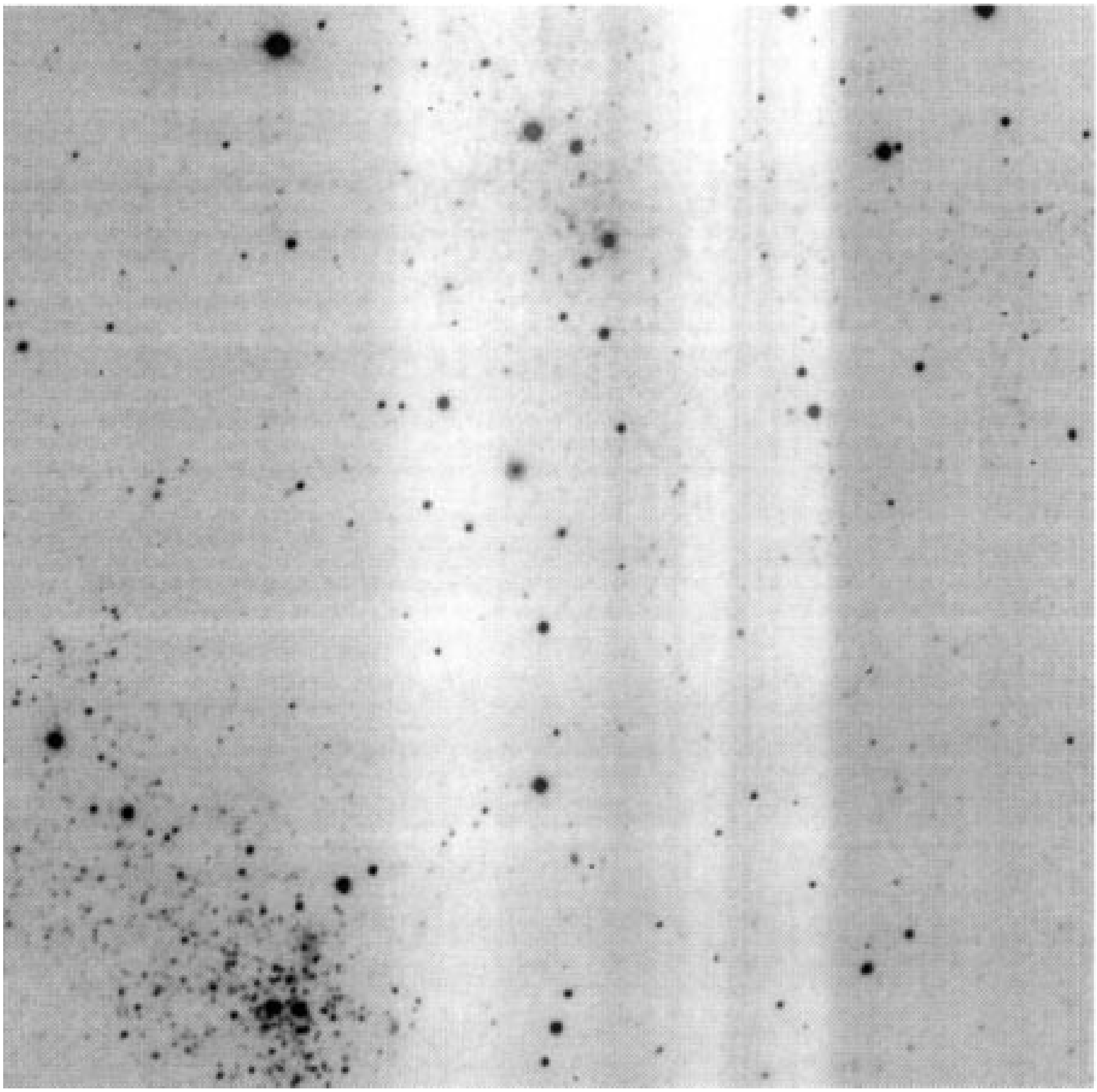

Fig. 6. The central part of UGCA 86 (above) and the bright southern superassociation (the lower left corner) in the I band

the photometry for the remaining 173 stars are given in Table 5, which contains also R magnitudes measured from a short exposure frame. Foreground stars, situated on the opposite (southern) half of the CCD frame, are indicated by the number "1". The distribution of stars in the plane V vs. $V-I$ is shown in Fig. 9. The stars from the northern and southern halfs of the CCD frame are noted by open circles and crosses, respectively. In this diagram we plot also 113 stars from the central part of NGC 1569, measured with the Hubble Space Telescope (O'Connel et al. 1994). These data fit each other quite well.

In contrast to the galaxies considered previously, NGC 1569 has no sharp left "shoulder" in its C−M diagram, caused by a population of blue supergiants. Because of this, a distance modulus of the galaxy cannot be derived accurately.

Adopting the stars #18, 50 and 70 as the three brightest blue supergiant candidates, we obtain for them $< V(3B) >= 19\overset{\rm m}{.}85$ and $< V-I >= +0.25$ or $< B(3B) >= 20\overset{\rm m}{.}05$. Using the total magnitude of the galaxy, $B_{\rm T} = 11\overset{\rm m}{.}86$, and an extinction of $A_B = 2\overset{\rm m}{.}18$ (RC3) this magnitude gives a modulus of $\mu_0(B) = 26.19$ in a good agreement with the estimate of $< \mu >= 26.27$ by Karachentsev et al. (1994). It should be noted, however, that we did not find suitable red supergiant candidates based on their colour ($V - I > 2.6$) and magnitude ($V \simeq 20^{\rm m}$). In comparison with the results of aperture photometry (Karachentsev et al. 1994), the ALLSTAR

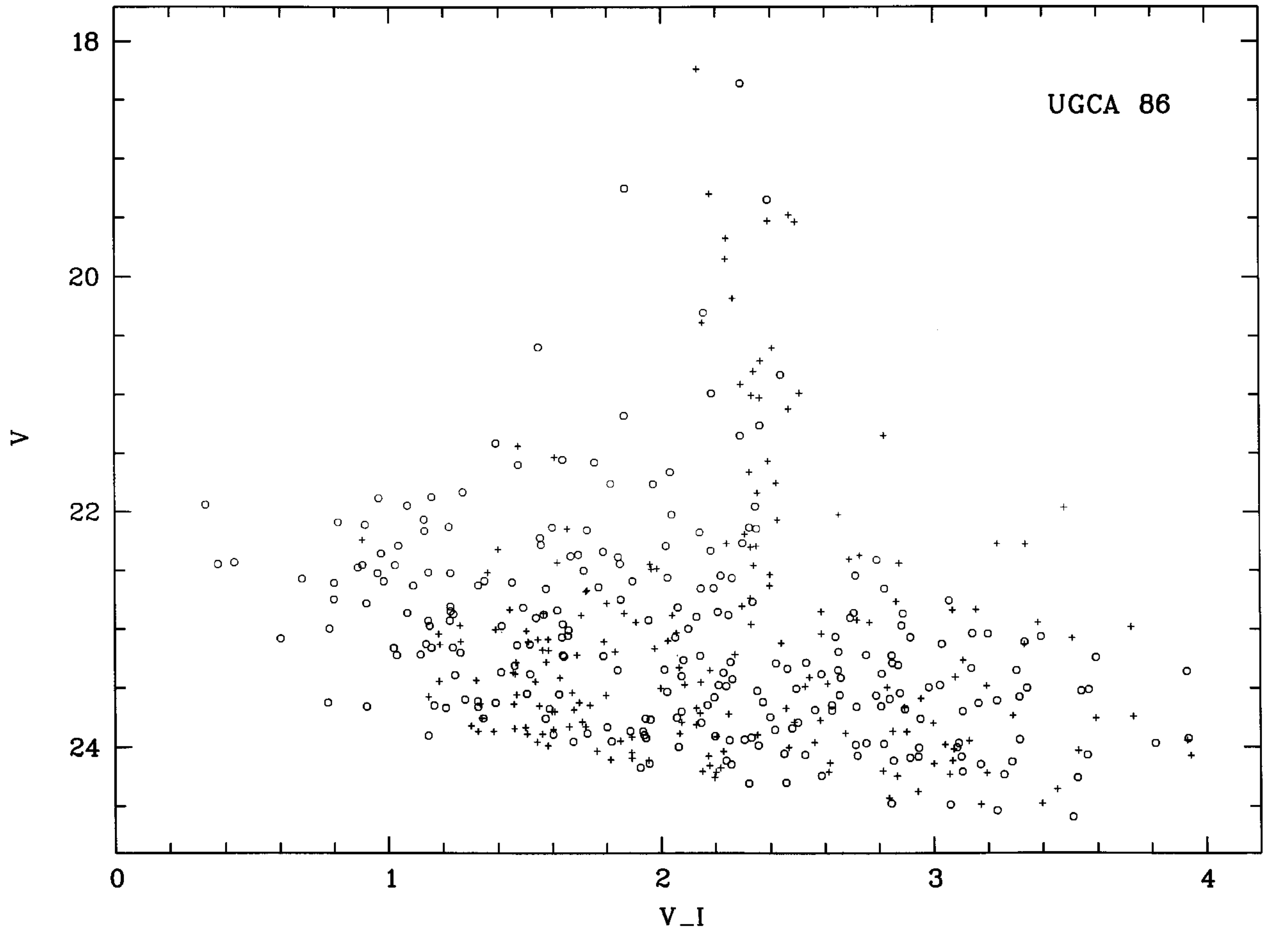

Fig. 7. Colour-Magnitude diagram for the southern concentration (open circles) and for the rest of the field of UGCA 86 (crosses)

photometry data for NGC 1569 reveal a systematic difference on faint magnitudes, which is probably related to significant brightness inhomogeneities over the galaxy.

3.5. Cas 1 = A0202+6846

This irregularly shaped galaxy with a low radial velocity of $V_h = +35$ km/s (Huchtmeier et al. 1995) is situated in a zone of strong galactic absorption. Figure 10 shows its CCD image in the I band. The results of our ALLSTAR photometry for 231 stars in the whole CCD frame are presented in Table 6. The colour-magnitude diagram, V versus $(V-I)$, is shown in Fig. 11. The stars, which are located within the galaxy boundary, are indicated by number "1" in the last column of Table 6 and by open circles in Fig. 11.

It is evident from the C–M diagram that most moderately bright stars with $V < 22^{\rm m}$ are foreground stars affected by galactic reddening. In fact, a stellar population of Cas 1 itself can only be recognized with confidence in the region of $\{V > 22^{\rm m},\ V - I < 1.7\}$. Taking as the brightest blue supergiant candidates the stars #138, 89 and 73, we obtain for them $< V(3B) > = 22\overset{\rm m}{.}67$ and $< V - I > = 1.36$ or $< B(3B) > = 23\overset{\rm m}{.}75$ and $< B - V > = 1.09$.

Based on the CCD aperture photometry of the galaxy in V and I bands we obtain for Cas 1 a total apparent magnitude, $V_{\rm T} = 14.71$, and $(V-I)_{\rm T} = 2.09$ or $B_{\rm T} = 16.38$ and $(B-V)_{\rm T} = 1.67$. If the intrinsic colour of irregular type galaxies is adopted for cas 1, $(B-V)_0 = 0.36$, we obtain a galactic extinction of $A_B = 4.2E(B-V) = 5\overset{\rm m}{.}50$. Note that these data agree well with the quantities, $V_{\rm T} = 14\overset{\rm m}{.}62$, $(V-R)_{\rm T} = 0.89$, and $A_B = 5\overset{\rm m}{.}25$, derived for Cas 1 by Tikhonov (1996). A substitution of the measured parameters into Eq. (1) gives us the distance modulus of Cas 1, $\mu_0(B) = 26\overset{\rm m}{.}15$ or $D = 1.70$ Mpc.

4. Some optical and HI parameters of the galaxies

As was mentioned in introduction, the problem of the membership of galaxies in the IC 342/Maffei complex remains unresolved due to the strong absorption in this

Table 7. Some global properties of the galaxies

Name	$V_{\rm h}$	a_{25}	$B_{\rm T}$	A_B	W_{50}	μ_0	A_{25}	M_{25}/L	Notes
	V_0	b/a	Type	$b°$	$\log S$(HI)	D	M_B	$M_{\rm HI}/M_{25}$	
UGCA 92	−99	2.0	16.15	3.78	61	26.25	2.0	3.7	present
	+89	.48	Im	10.5	3.44	1.78	−14.3	0.17	paper
NGC 1569	−89	3.6	11.86	2.18	74	26.19	2.5	0.6	present
	+102	.49	Ip	11.2	3.67	1.73	−16.9	0.15	paper
NGC 1560	−36	9.8	12.16	1.13	125	27.37	7.7	2.8	(KTGBS, 91)
	+170	.15	Sd	16.0	4.14	2.98	−17.3	0.19	1)
Maffei 2	−2	3.8:	16.0	8.2	305	26.77	11.9	5.2	(TK, 94)
	+226	.49	SBb	−0.3	4.18	2.26	−19.4	0.01	
IC 342	+33	20.9	9.1	2.56	151	27.29	29.7	1.9:	(KT, 93)
	+247	.95	Scd	10.6	5.34	2.87	−20.8	0.17:	2)
Cas 1	+35	2.2	16.38	5.50	49	26.15	3.1	2.8	present
	+283	.77	Im	7.1	3.31	1.70	−15.3	0.06	paper
UGCA 86	+67	4.5	14.2	3.82	99	27.12	7.1	4.2	present
	+275	.68	Sm	10.6	4.41	2.65	−17.0	0.26	paper
Cam B	+75	2.2	16.1	1.5:	20	–	1.9	0.9	(HKK, 97)
	+265	.50	Im	14.4	2.20	(3.0)	−13.2	0.32	
Dwing 2	+94	1.0:	20.5:	9:	100	–	6.2	3.4	(BVKH, 96)
	+314	.36	Im	−0.2	3.13	(4.2)	−16.9	0.05	
Dwing 1	+110	2.0	19:	10:	188	–	16.1	2.8	(BVKH, 96)
	+330	.63	SBb	−0.1	3.95	(4.4)	−19.6	0.03	(HLSSW, 95)
UGCA 105	+111	5.5	13.24	1.48	118	27.54	6.3	11.0	present
	+279	.62	Sm	13.7	3.97	3.22	−16.0	0.12	paper
MB 1	+189	2.4	20.5:	9:	60	–	21.4	1.5	(MB, 95),
	+420	.42:	Sd	−0.8	2.59	(5.7)	−17.7	0.03	(HD, 96)

Footnotes: 1) The original estimate, $D = 3.84$ Mpc, is reduced to 2.98 Mpc because of a new value of A_B; 2) The original distance estimate, $D = 2.1$ Mpc, is corrected for a contamination of brightest blue stars from compact HII regions.

region and the lack of reliable direct estimates of distance to some of the galaxies. To judge the completeness of the present data, we collect in Table 7 some basic parameters of the galaxies around IC 342. In addition to the galaxies considered above, we include in the Table several objects whose distance and other parameters are presently known with low accuracy. In Table 7 such parameters are marked by "(:)". For 12 galaxies, ranked according to their radial velocities, the following data are presented in Table 7:

(1) — the galaxy name;

(2) — the measured radial velocity (km/s) and the radial velocity reduced to the centroid of the Local Group (Karachentsev & Makarov 1996);

(3) — the standard angular diameter (arcmin) and apparent axial ratio;

(4) — the total blue magnitude of the galaxy and its morphological type;

(5) — the estimated absorption correction, A_B, and the galactic latitude (degrees);

(6) — the HI line width (km/s) at a level of 50% of the line peak and the log of integrated HI flux ($10^{-24}\cdot$W/m^2);

(7) — the photometric distance modulus (mag) and the corresponding distance in Mpc; the distances estimated via radial velocity with $H = 75$ km/s/Mpc are put in brackets;

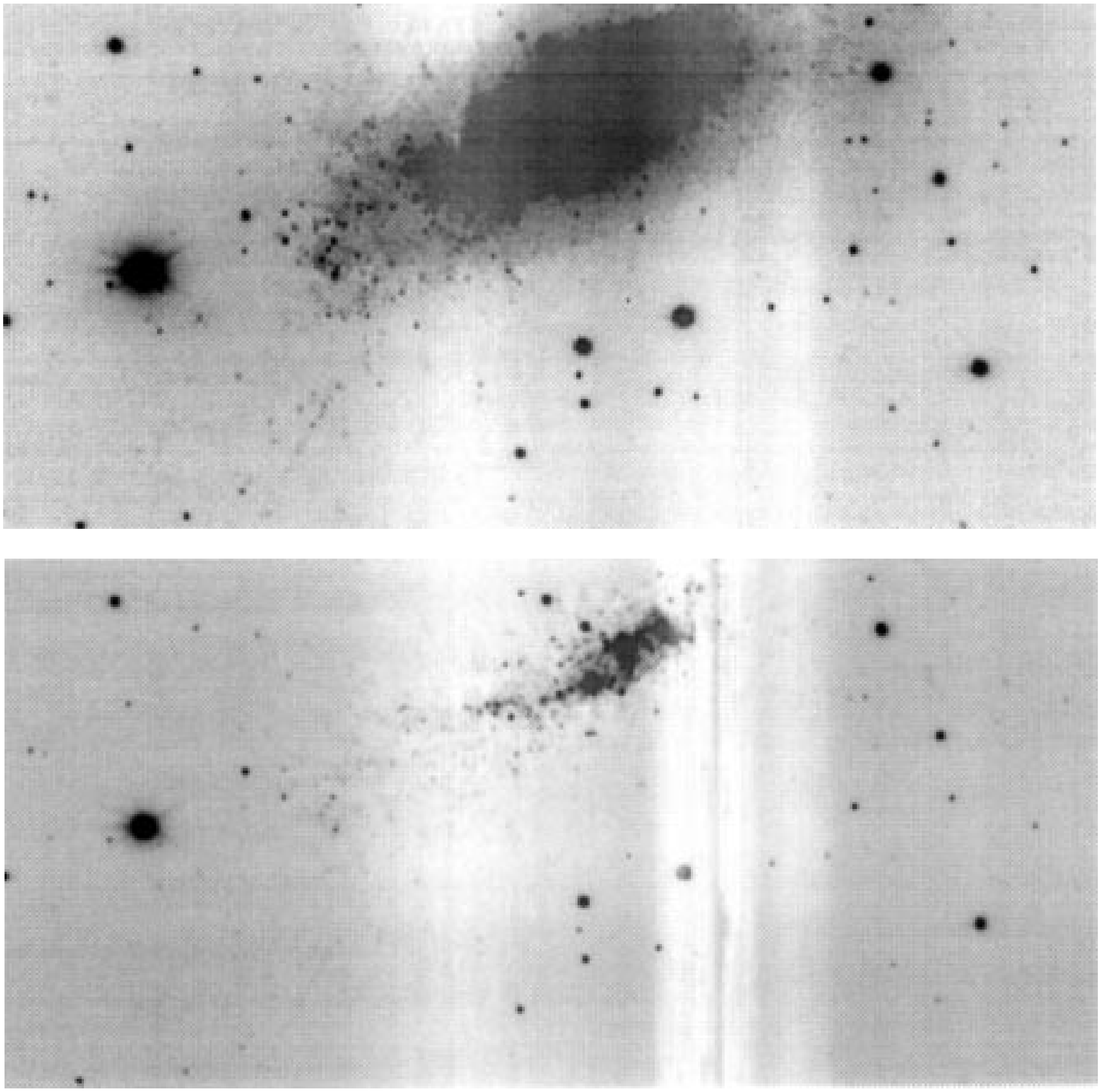

Fig. 8. NGC 1569 in the I band. **a)** Southern half of the original frame, **b)** the same part after subtracting the frame smoothed with a window of $10 \times$ (FWHM)

(8) — the standard linear diameter (kpc) and the absolute total magnitude corrected for inclination according to RC3;

(9) — the total mass (inside the standard diameter) - to total luminosity, and the total HI mass - to - the total mass (in the solar units);

(10) — notes concerning the source of the data on distance, magnitude and absorption.

The data presented in Table 7 may be useful for an analysis of the dynamical situation in the IC 342/Maffei complex of galaxies. Without going into a detailed discussion of the membership of the galaxies of the complex, we discuss here two items only.

(a) In spite of possible systematic errors in the determination of the distance to the galaxies, as well as absorption estimates, the integral parameters of the galaxies considered are in a general agreement with their morphological type. A possible exception is NGC 1569 which has an abnormally low mass-to-luminosity ratio. this peculiarity leads to a biased estimate of its distance ($D = 0.78$ Mpc) from the Tully-Fisher relation (Krismer et al. 1995).

(b) When going from normal spirals to irregular dwarfs, the standard error of distance estimate via the brightest stars remains constant, $\sigma(\mu) \simeq 0\overset{\mathrm{m}}{.}4$ (Karachentsev & Tikhonov 1994). However, the

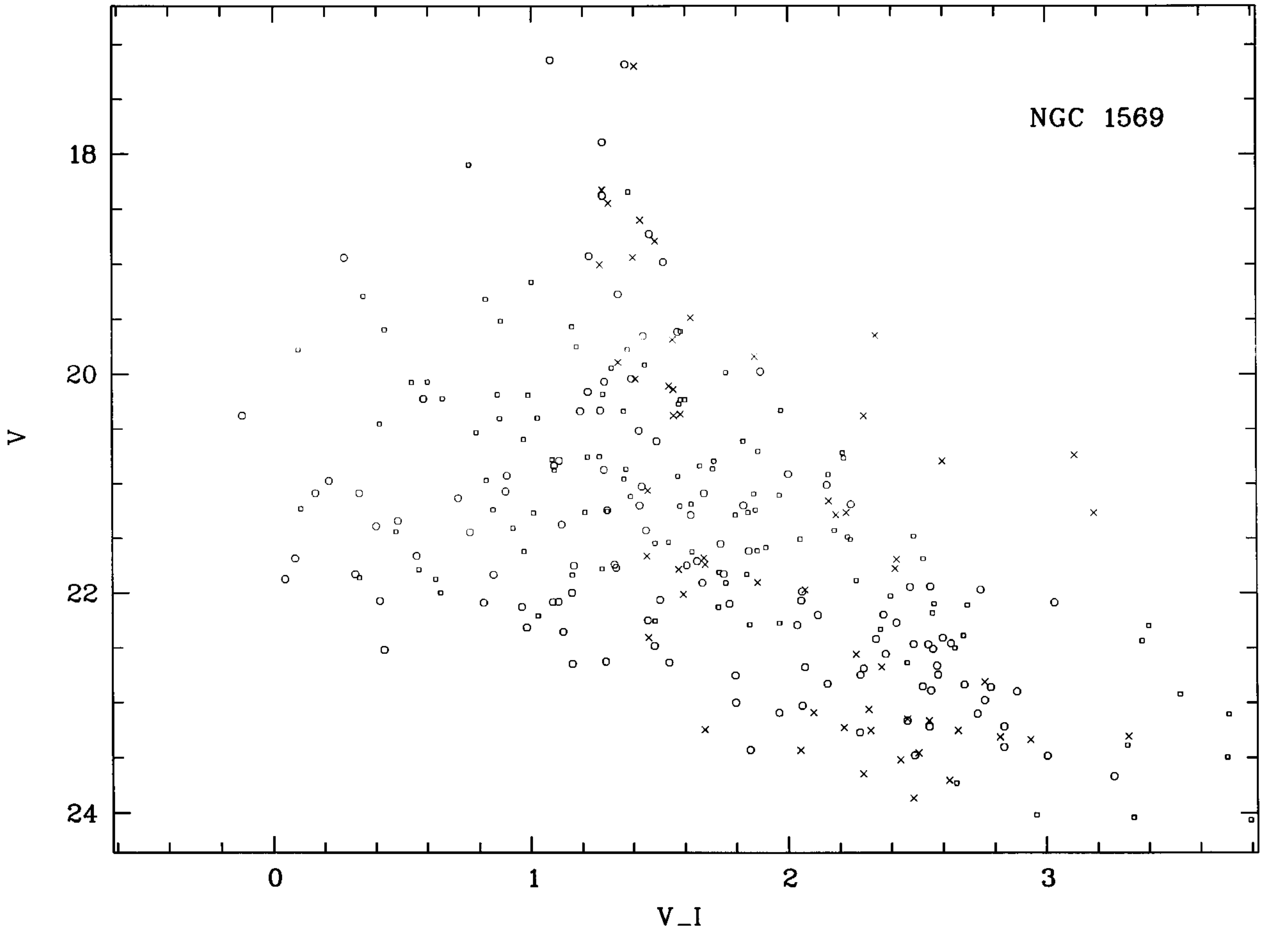

Fig. 9. V vs. $(V-I)$ diagram for NGC 1569. Open circles corresponde to stars measured in the main body of the galaxy, crosses indicate foreground stars, open squares represent the stars in the central region of the galaxy measured with the Hubble Space Telescope by O'Connel et al. (1994)

accuracy of the Tully-Fisher (1977) method falls when it is applied to a dwarf galaxy whose rotation amplitude is comparable to the internal turbulent motions of its HI clouds. The problem is further amplified by the strong absorption in the Milky Way zone. Because of this, the brightest stars method has a major advantage over the Tully-Fisher relation in the region of IC 342/Maffei.

5. Concluding remarks

Based on the CCD photometry of the brightest stellar population in the galaxies UGCA 105, UGCA 92, UGCA 86, NGC 1569, and Cas 1, we determined their distances to be in the range of [1.7 − 3.3] Mpc. A comparison of new distance estimates with older ones (Tikhonov et al. 1992; Karachentsev & Tikhonov 1993; Karachentsev et al. 1994) does not reveal a significant difference: $< \mu_{\rm new} - \mu_{\rm old} >= +0\overset{\rm m}{.}07 \pm 0\overset{\rm m}{.}26$. The mean square difference of the modulis for the two independent sequences of measurements is $< \Delta\mu^2 >= (0\overset{\rm m}{.}45)^2$, which corresponds to a standard error $\sigma(\mu) = (< \Delta\mu^2 > /2)^{1/2} = 0\overset{\rm m}{.}32$. This value is consistent with the result of the analysis by Karachentsev & Tikhonov (1994), i.e. $\sigma(\mu) \simeq 0\overset{\rm m}{.}4$, based on the membership of galaxies in the nearby groups. The present estimate looks less pessimistic than the conclusion by Rozanski & Rowan-Robinson (1994), who considered predominantly the data of old photographic photometry.

The existing data on a distance of IC 342 and surrounding neighbours (see Col. 7 in Table 7) does not allow yet to reach a conclusion concerning the spatial structure of the complex of galaxies. We may argue that only the pair of NGC 1569 + UGCA 92 is in the foreground of the complex. The other dwarf objects UGCA 86, NGC 1560, Cam B, and UGCA 105 are probably associated with the massive spiral IC 342, whereas Maffei 1 + 2 represents a second subcenter of the common extended group with a total dimension of about 1 Mpc. The situation here recalls that in another nearby "group" in Sculptor, seen also in

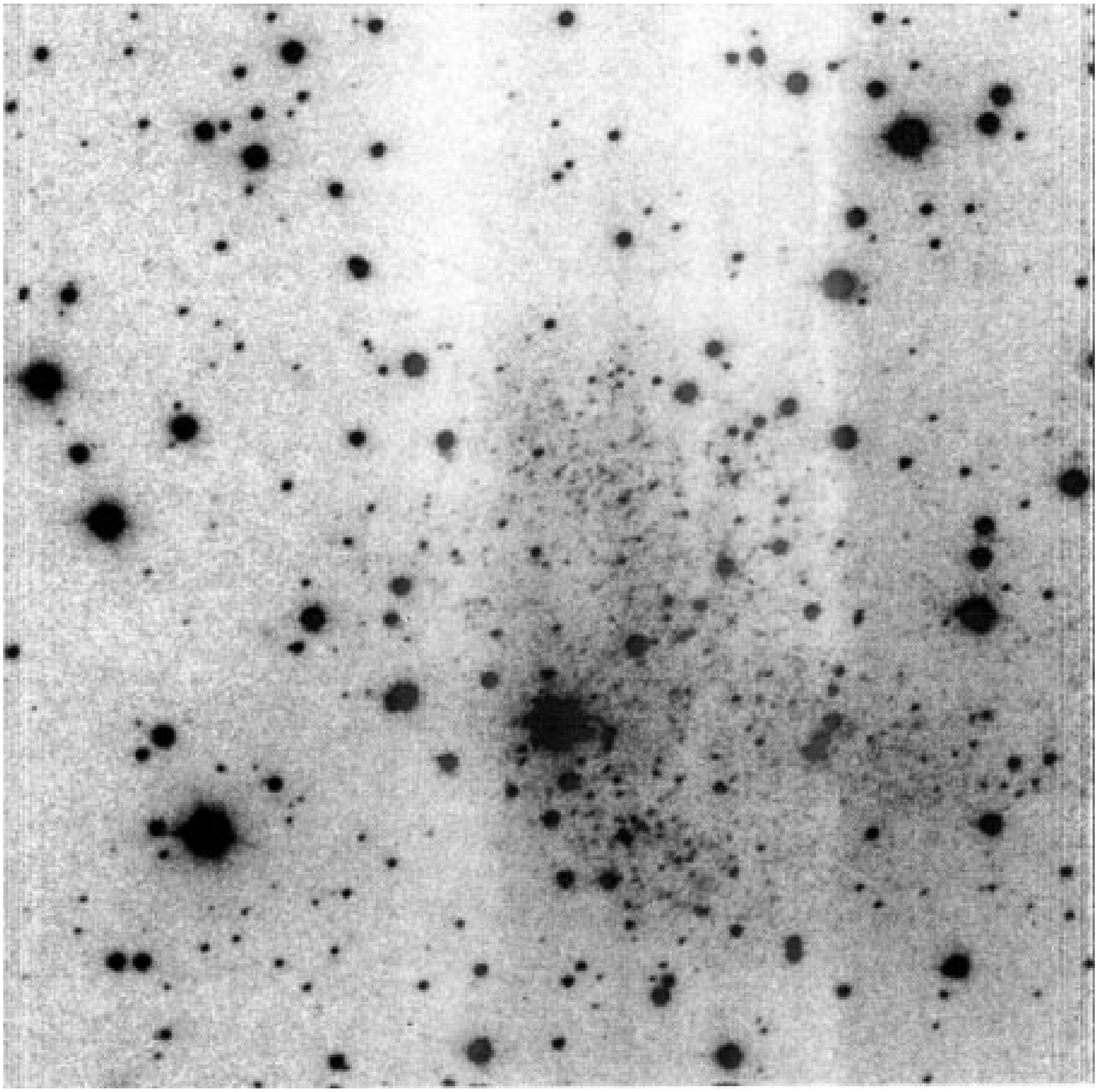

Fig. 10. CCD image of Cassiopeia 1 in the I band

the Supergalactic plane, where the pair of galaxies NGC 55 + NGC 300 is projected into a triple system, NGC 253 + NGC 247 + PGC 2902. An application of the virial theorem to estimate the mass of such false groups usually leads to a significant overestimation of their mass.

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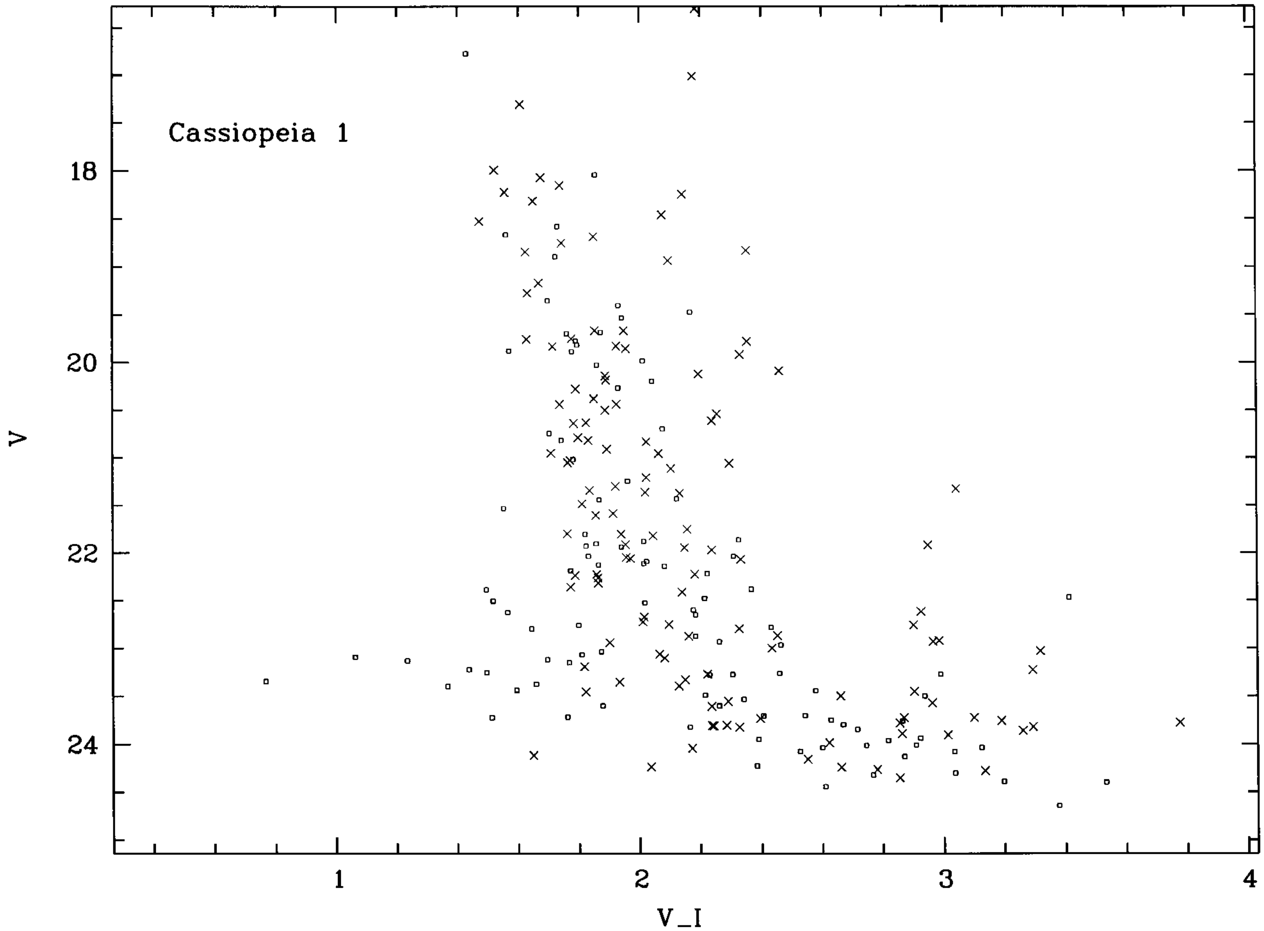

Fig. 11. V vs. $(V - I)$ diagram for Cas 1. Stars within the galaxy body are indicated by open squares the remainder of the frame stars are noted by crosses

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