Astron. Astrophys. 352, L63–L68 (1999)

ASTRONOMY AND ASTROPHYSICS

LETTER

Letter to the Editor

A new investigation on the Antlia Dwarf Galaxy*

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Received 1 September 1999 / Accepted 19 September 1999

Abstract. We present deep $(I, V-I)$ and $(I, B-I)$ color-magnitude diagrams (CMDs) of the Antlia dwarf galaxy, based on Science Verification (SV) data collected with the FORS I camera on the ESO Very Large Telescope (VLT). The CMDs present two key features: a well-defined Red Giant Branch (RGB), and a sample of bright blue stars, belonging to a young stellar component. The comparison between theory and observations confirms that the bright stars are consistent with the occurrence of a star formation episode ≈ 0.1 Gyr ago. In agreement with Sarajedini et al. (1997) and Aparicio et al. (1997), we find that the young stars are more centrally concentrated than the old ones.

By adopting the new calibration of the Tip of the RGB (TRGB) provided by Salaris & Cassisi (1998) we estimated that the Antlia distance modulus is $(m-M)_0 = 25.89 \pm 0.10$ mag, and therefore a distance $D = 1.51 \pm 0.07$ Mpc. This distance determination is $\approx 13\%$ larger than the values suggested in previous investigations. We estimated that the mean metallicity of Antlia is of the order of $[Fe/H] \approx -1.3$. This estimate is at least 0.3 dex more metal-rich than similar evaluations available in the literature. The disagreement both in the distance and in the metallicity determinations are mainly due to difference in the calibration of the TRGB method and in the $(V-I)$ color index vs. metallicity relation. The differential RGB luminosity function shows an excess in the observed counts -at the 2σ level- when compared with theoretical predictions. This discrepancy might be due to a stellar component with an age approximately equal to 0.7 Gyr.

Key words: stars: luminosity function, mass function – galaxies: distances and redshifts – galaxies: individual: Antlia – galaxies: Local Group – galaxies: stellar content

* Based on observations collected with VLT-UT1 telescope of ESO in Paranal, during the Science Verification Program

1. Introduction

The global properties of Local Group (LG) galaxies play a key role for understanding both galaxy formation and evolution. Among them the dwarf galaxies (DGs) are particularly interesting since they are a unique laboratory to address several open questions on low-luminosity galaxies, and to estimate how their fundamental parameters depend on the global luminosity, and in turn on the total mass of the DGs (Grebel 1998; Mateo 1998; van den Bergh 1999a). Moreover, since the LG contains both fairly isolated galaxies and dwarfs in subgroups, it allows us to investigate the environmental effects on the galactic evolution. As a consequence a detailed analysis of the evolutionary properties of their stellar component(s) can shed new light on distant unresolvable stellar systems such as the very low surface brightness galaxies (Whiting, Irwin, & Hau 1997, hereinafter WIH; Grebel 1998). The observational scenario on nearby DGs was further enriched by the evidence that the Antlia-Sextans clustering may be the nearest group of galaxies not bound to the LG (van den Bergh 1999b, hereinafter VDB).

Ground based data provided several deep and accurate CMDs for not-too-distant DGs (Marconi et al. 1998), while data collected with the Hubble Space Telescope (HST) were crucial for distant LG galaxies (Buonanno et al. 1999; Gallart et al. 1999, and references therein). However, in the near future the use of 8–10m telescopes can substantially improve our knowledge of their global properties. In fact, the large collecting area and the evidence that DGs are only marginally affected by crowding problems make this class of instruments particularly useful for investigating the stellar content in the LG galaxies. In this paper, we present the results of an investigation on the Antlia dwarf galaxy based on B,V,I data collected with FORS I on VLT during the SV program. These photometric data are a plain evidence of the VLT capability to investigate DGs in the LG (see also Tolstoy 1999).

In Sect. 2 we present the observations and describe the procedures adopted for the reduction and the calibration of data. In Sect. 3 we discuss the main features of the CMDs, together with the distance and metallicity estimates, while the Antlia-

Sextans grouping is addressed in Sect. 4. A brief summary and the conclusions are outlined in Sect. 5.

2. Observations and data reduction

The data for Antlia have been requested and retrieved electronically from the ESO archive in Garching. The galaxy was observed through the standard Bessell B,V,I filters during the VLT-UT1 SV Program in January 1999 using the FORS I camera which covers a 6.8×6.8 arcmin field of view at 0.2 arcsec per pixel resolution. The seeing was excellent (0.45–0.75 arcsec). We used the standard reduction procedure reported on the Data Reduction Notes listed in the VLT web pages and the Daophot II package (Stetson, Davis, & Crabtree 1990, and references therein). To improve the detection limit we coadded all the frames taken with the same filter and then we selected the I coadded frame (5400 sec) to create a master catalogue of stellar objects. The stars identified in this search were used as a template to fit both the B and the V coadded frames.

By adopting a SHARP parameter of ± 0.5, we detected in the coadded frames 3711 (B), 2958 (V), and 4583 (I) stars down to $B \approx 27.0$ mag, $V \approx 25.7$ mag, and $I \approx 25.5$ mag respectively. The calibration was derived by using a standard field observed during the same night and by adopting the average extinction coefficients. Completeness tests were performed by randomly adding in each magnitude bin (0.2 mag) 15–20% of the original number of stars to the coadded frames. Only stars that were detected in the same position and within a magnitude bin of ± 0.1 mag were considered as recovered. The simulations suggest that a completeness of the order of 50% was reached at $I \approx 24.0$ mag and $B \approx 25.1$ mag respectively.

3. The color-magnitude diagram

The Antlia dwarf galaxy was originally noted by Corwin, de Vaucouleurs & de Vaucouleurs (1985) and by both Feitzinger & Galinski (1985) and Arp & Madore (1987) who also suggested that this stellar system could be a nearby galaxy. This finding was subsequently confirmed by Fouqué et al. (1990) who found, in a detailed HI survey of southern late-type galaxies, that Antlia has a small radial velocity ($V_{\rm r} = 361 \pm 2\,{\rm km\,s^{-1}}$). However, a firm identification of Antlia was only recently provided by WIH in a systematic search for VLSB galaxies in 894 ESO-SRC IIIaJ plates covering the entire southern sky, who also suggested that this galaxy is probably gravitationally bound to the dwarf irregular (dIrr) galaxy NGC3109. After its rediscover the global properties of this galaxy were investigated by Aparicio et al. (1997, hereinafter ADGMD) and by Sarajedini, Claver & Ostheimer (1997, hereinafter SCO). These investigations brought out the following characteristics: a) low-mass, metal-poor stars are the main stellar component of the galaxy; b) evidence of an age gradient within the galaxy with the young stellar component located close to the center; c) no evidence of an ongoing star formation process.

A peculiar feature of Antlia is the amount of gas still present in this galaxy, and indeed WIH have inferred a total $H\,I$ mass

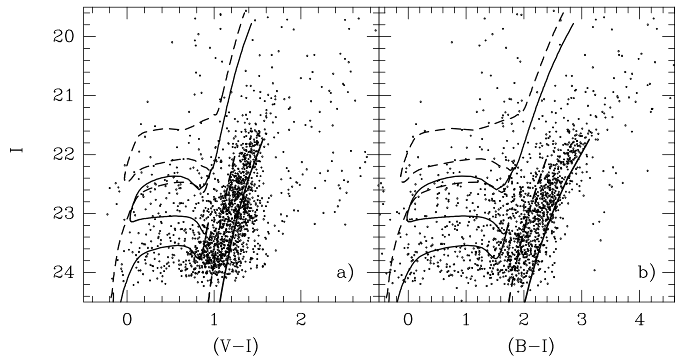

Fig. 1. **a**: The $(I, V-I)$ CMD of Antlia. **b**: Same as panel **a** but for the $(I, B-I)$ CMD. The two redder RGB loci refers to stellar population with an age of 14 (solid line) and 0.8 Gyr (dashed line) respectively. The two isochrones plotted in the blue region refer to stellar ages of 150 (solid line) and 80 Myr (dashed line) respectively. Theoretical prescriptions were plotted in the observative plane by assuming a distance modulus of $(m-M)_0 = 25.89$ mag and a metallicity equal to $[M/H] = -1.3$.

of $8 \times 10^5 M_{\odot}$. Following the classification suggested by Da Costa (1997), which is based on the ratio between total mass of gas and B integrated luminosity, Antlia should be classified as a dusty dIrr rather than as a dwarf spheroidal (dSph) galaxy, since according to SCO it should also contain interstellar dust. Oddly enough, it also shows a smooth elliptical morphology and a very low stellar concentration in the innermost regions. These features are quite similar to other isolated dSph galaxies in the LG such as the Tucana dwarf. However, Tucana does not show a significant amount of gas and therefore Mateo (1998) classified Antlia as a *transitional galaxy* (dIrr/dSph) together with LGS3, Phoenix, DDO210, and Pegasus.

Panels a) and b) of Fig. 1 show the CMD of Antlia in the $(I, V-I)$ and in the $(I, B-I)$ CMD respectively. In these diagrams were only plotted stars (≈ 1700) located within 2.5 arcmin from the center of the galaxy. We selected the stars whose centroids in B, V, and I frames were matched in one pixel (0.2 arcsec) and which satisfy tight constraints on photometric accuracy, namely $\sigma_{\rm I} \leq 0.2$, $\sigma_{\rm B-I} \leq 0.3$, $\sigma_{\rm V-I} \leq 0.3$, and SHARP parameter $\leq \pm 0.5$.

Fig. 1 discloses several interesting features. It is noteworthy the well-populated RGB, extending from $I \approx 24$ to $I \approx 21.5$ mag, and the sizable number of stars brighter than the TRGB. SCO identified the latter objects as a not-negligible population of Asymptotic Giant Branch stars, progeny of an intermediate-age population. On the basis of stellar counts in nearby fields (ADGMD), and of the evidence that these bright stars are not particularly concentrated toward the center of the galaxy -they appear at distances larger than 1 arcmin- the possibility that they are foreground objects cannot be ruled out.

By accounting for the RGB intrinsic width, SCO suggested that Antlia could contain a sizable amount of interstellar dust. This suggestion was mainly based on the slope of the RGB upper portion which in their $(I, V-I)$ CMD mimic the slope of objects affected by increasing reddening. This feature seems not confirmed by present photometry. The $(I, B-I)$ CMD is particularly compelling since in this plane the slope of the reddening vector is steeper than in the $(I, V-I)$ CMD (see also ADGMD). Even though the origin of such a discrepancy cannot firmly established, we suggest that the photometric error (the FWHM of SCO data is roughly a factor of two larger than in our data) and the contamination with foreground objects might have introduced a spurious trend (see Sect. 4.2 in SCO).

The sample of stars located in the blue region of the CMDs -$(V-I) < 0.7$, $(B-I) < 1$- plotted in Fig. 1 is quite interesting. This feature already found by SCO and by ADGMD suggest the presence of a young stellar population. Moreover, their radial distribution clearly shows that this sample is strongly concentrated in the innermost regions of the galaxy. Therefore we confirm the difference in the radial distribution between the young and the old stellar component found by SCO and by ADGMD. The presence of young stars and the evidence of sizable amount of gas are the most clear indications that Antlia should be classified as a dIrr rather than as dSph galaxy.

In order to supply an estimate of the age of the blue stars we plotted in the CMDs of Fig. 1 evolutionary prescriptions (Cassisi 1999) for H and He-burning phases at two different stellar ages, namely $t = 80$ Myr and $t = 150$ Myr. At the same time, we also plotted the location of the RGB for two old stellar populations at $t \approx 14$ Gyr and $t \approx 0.8$ Gyr respectively. Theoretical predictions were transformed into the observational plane by adopting the bolometric corrections and the color-temperature relations provided by Green (1988). The adopted distance modulus, metallicity and reddening are discussed in the next section. The comparison between theory and observations clearly shows that the position of bright blue stars in Antlia is finely reproduced by an isochron with an age ranging from 100 to 150 Myr. This age range implies that the TO masses of blue stars range from 3.5 to 4.5 $M_\odot$ and therefore that in this galaxy should be present classical Cepheids with periods of the order of few days.

3.1. Distance and metallicity

When dealing with composite stellar population systems for which only the bright end of the CMD is well sampled, as in the case of Antlia, the TRGB method turns out to be a valuable distance indicator. In fact, the absolute I-Cousins magnitude of the TRGB presents a negligible dependence on metal content at least for $[M/H] < -0.5$. After the first semi-empirical calibration by Lee, Freedman & Madore (1993, hereinafter LFM), Salaris & Cassisi (1997, 1998, hereinafter SC97 and SC98) provided a new theoretical calibration of the TRGB method, characterized by a magnitude shift of ≈ 0.15 -toward brighter magnitudes- in the absolute I magnitude of the tip. Note that Antlia distance estimates available in the literature are based on the TRGB calibration provided by LFM, while we here adopt the SC98 calibration.

To estimate the apparent magnitude of the TRGB we use the differential luminosity function (LF) of RGB stars. We have not performed any correction since as clearly shown by ADGMD the stars located close to the tip are only marginally affected by foreground contamination. The top panel of Fig. 2 shows the differential LF evaluated by adopting a magnitude bin of 0.20 mag. The error bars for each bin were estimated taking into account both the statistical fluctuations and the corrections for completeness. In order to obtain a robust determination of the RGB tip discontinuity, the LF was convolved with an edge-detecting Sobel filter $[-1, 0, +1]$. This function shows a sharp peak at $I_{\rm TRGB} = 21.7 \pm 0.10$ mag which marks the appearance of the RGB tip. The error was estimated on the basis of the adopted magnitude bin. This value is, within current observational uncertainties, in good agreement with the values obtained by SCO ($I_{\rm TRGB} = 21.63 \pm 0.05$) and ADGMD ($I_{\rm TRGB} = 21.64 \pm 0.04$). Thus supporting *a posteriori* the negligible effect of foreground contamination on the LF of RGB stars. Our determination is ≈ 0.2 mag fainter than the estimate provided by WIH, i.e. $I_{\rm TRGB} = 21.4 \pm 0.1$. This discrepancy was already noted by ADGMD who suggested that it could be due to crowding problems at the limiting magnitude in the WIH's photometry.

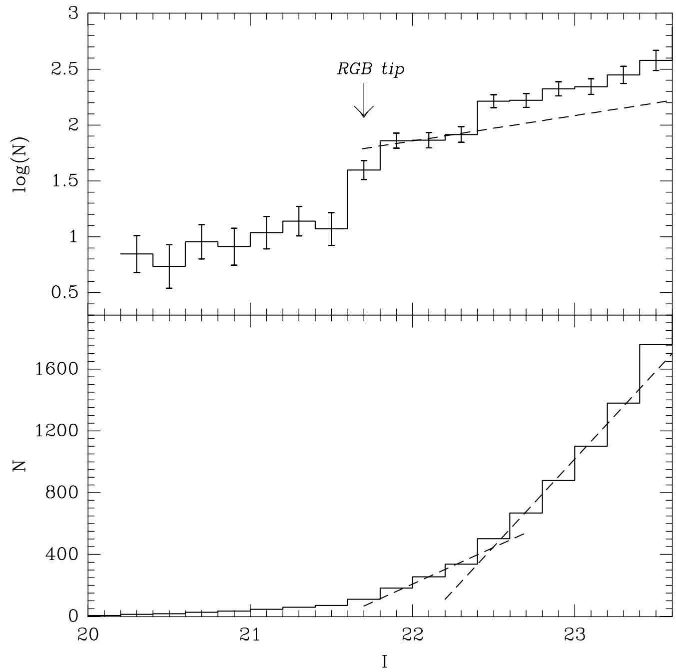

Fig. 2. Logarithmic differential LF of RGB stars (solid line) in Antlia. The arrow marks the position of the bin where the TRGB discontinuity was detected. A theoretical LF (dashed line) for an age of 14 Gyr is also shown by adopting a distance modulus equal to $(m-M)_0 = 25.89$ mag. The theoretical LF was normalized to the observed one, at $I \approx 21.9$ mag. *Bottom panel*: The cumulative LF of RGB stars. The dashed lines show the two different slopes of the LF.

By interpolating the maps of Burstein & Heiles (1982) we estimated $E(B-V) = 0.03 \pm 0.02$, which implies a foreground reddening of $E(V-I) = 0.04 \pm 0.03$. By using the extinction relation provided by Cardelli et al. (1989), this reddening implies an extinction $A_{\rm I} = 0.04 \pm 0.03$ mag. As a consequence, the uncertainty on the I magnitude of the RGB tip is dominated by photometric and completeness errors since the reddening correction for this band is significantly smaller ($I_{TRGB,0} = 21.66 \pm 0.10$ mag). This notwithstanding, our estimate of $I_{TRGB,0}$ is in good agreement with the values suggested by SCO ($I_{TRGB,0} = 21.57$ mag) and by ADGMD ($I_{TRGB,0} = 21.57 \pm 0.05$ mag).

The TRGB method (see LFM, SC97 and SC98) is an iterative procedure which simultaneously gives both the distance and the mean metallicity of the old stellar population in the galaxy. The metallicity evaluations are based on the calibration of the dereddened color index $(V - I)$ of the RGB half a magnitude below the tip, $(V - I)_{-3.5,0}$, as a function of the metal content. By adopting the SC98 calibrations we find a distance modulus of $(m - M)_0 = 25.89 \pm 0.10$ mag, i.e. $D = 1.51 \pm 0.07$ Mpc and $(V - I)_{-3.5,0}$=1.36 mag, which in turn translates into a mean metallicity of $[M/H] \approx -1.3 \pm 0.15$. This distance modulus is roughly 13% larger than the values found both by SCO ($(m - M)_0 = 25.62 \pm 0.12$ mag) and by ADGMD ($(m - M)_0 = 25.6 \pm 0.1$ mag). As far as the mean metallicity is concerned, our estimate is ≈ 0.3 dex higher than the ADGMD evaluation ($[M/H] \approx -1.6 \pm 0.1$) and ≈ 0.6 dex higher than SCO determination ($[M/H] \approx -1.9 \pm 0.13$).

As expected the disagreement is mainly due to the calibration of the TRGB method and of the RGB color index vs. metallicity provided by LFM and by SC98. A thorough discussion of the differences between these calibrations was already provided by SC98. However, the discrepancy with the metallicity evaluation provided by SCO is mainly due to the different approach adopted by these authors for estimating the metallicity along the RGB. In passing we note that our metallicity estimate is in fair agreement with the metallicity obtained by comparing the RGB in Antlia directly with the RGB loci of galactic globular clusters provided by Da Costa & Armandroff (1990).

3.2. Some hints on RGB stars

The observed color width of the Antlia RGB at $I \approx 22.1$ mag -i.e. ≈ 0.5 mag below the RGB tip is $\Delta(V - I) \approx 0.25$ mag. However, since at $I \approx 22.1$ mag our mean photometric error is $\sigma_{V-I} = 0.05$ mag, it turns out that the intrinsic color width of the RGB is roughly equal to 0.2 mag. If we assume that this color dispersion is due to a spread in metallicity, the metal content of Antlia should be in the range $-1.8 < [M/H] < -1.0$. However, stellar models supply important information to figure out this problem. In fact, at fixed metal content an increase in age moves the RGB loci toward redder colors, while a decrease in age causes a decrease in the TRGB luminosity (SC98; Caputo et al. 1999). Fig. 1 shows the theoretical prescriptions at fixed metallicity -$[M/H] = -1.3$- for the RGB loci of an old (14 Gyr, solid line) and a young (0.8 Gyr, dashed line) stellar population. As a result, the RGB color dispersion in Antlia could be due to a mix of an old and of a young/intermediate-age stellar population.

The LF shows a further interesting feature: for magnitudes dimmer than $I \approx 22.3$ mag one can notice a significant increase in the number of RGB stars. This evidence is supported by the substantial change in the slope of the cumulative LF plotted in the bottom panel of Fig. 2, and can also be identified in the CMDs plotted in Fig. 1. To assess the nature of this feature, Fig. 2 shows the comparison between the observed differential LF and the theoretical LF for an age of 14 Gyr. We find that for magnitudes fainter than $I \approx 22.4$ mag, the observed stellar counts are, at the 2σ level, larger than the theoretical counts expected for an old stellar population.

This finding could be interpreted as the evidence of a secondary sample of RGB stars connected with a stellar population younger than the main RGB stellar component. In fact, for stellar ages lower than $\approx 1 Gyr$, the TRGB luminosity becomes quite sensitive to the age. To constrain the age of such a population we take into account the I magnitude difference between the RGB tip associated with the oldest component, located at $I_{TRGB} = 21.65$ mag, and the LF discontinuity located at fainter magnitudes i.e. $I \approx 22.4$ mag. By adopting this approach and by assuming for the younger population, the same metallicity of the oldest one, we estimate that its age is ≈ 0.7 Gyr.

4. Some hints on the Antlia-Sextans grouping

One of the main reason why the global properties of Antlia are so interesting is because it should be located beyond the zero-velocity surface of the LG, and therefore its motion can be used for providing independent estimates of both the LG dark matter halo and the age of the Universe (Lynden-Bell 1981). However, the location of this galaxy within the LG is still controversial. In fact, SCO suggested on the basis of its position in the heliocentric radial velocity versus apex angle diagram that it is located near the outer edge of the LG. At the same time, it was pointed out by ADGMD on the basis of the relative velocity between Antlia and NGC3109 that it is unlikely that this pair of galaxies is gravitationally bound. On the other hand, Yahil, Tammann, & Sandage (1977), Lynden-Bell & Lin (1977) and, more recently, VDB in a detailed analysis of the nearest group of galaxies brought out that Antlia together with Sextans A/B and NGC3109 forms a small cluster of galaxies which is not bounded to the LG, and therefore that it is expanding with the Hubble flow. He also suggested that Antlia is probably a satellite of NGC3109 and that this pair to be gravitationally stable should contain a sizable amount of dark matter.

By adopting the distance moduli with the relative errors estimated by SC98 (see their Table 2, column 9 and Table 3, column 2) by means of the TRGB method for the other three members of this group we find that the corresponding distances are: D(Sextans A)=1.51 ± 0.1 Mpc, D(Sextans B)=1.45 ± 0.09 Mpc, and D(NGC3109)=1.37 ± 0.09 Mpc. Taken at face values these distances together with the Antlia distance suggest that within the errors these four galaxies are probably located at the same distance, thus supporting the finding by VDB that they form a small nearby clustering. Note that with the exception of NGC3109 these distance estimates are systematically larger than those adopted by VDB. The discrepancy ranges from 5% for Sextans A up to 13% for Antlia. The reason for the disagreement is partially due to the difference in the TRGB calibration and partially to the different standard candles adopted by VDB (classical Cepheids and TRGB method). The main advantage of our distance determinations is that they are based on the same standard candle and on the same TRGB calibration. However, distance determinations based both on the LFM and on the SC98 calibration agree within their errors with the distance scale based on Cepheid Period-Luminosity relation. This problem might be resolved by a detailed comparison between Cepheid distance determinations which account for the metallicity dependence and TRGB distances (Bono, Marconi, & Stellingwerf 1999).

In order to disentangle this thorny problem we estimated the distance of NGC3109 by adopting the sample of classical Cepheids observed in this galaxy by Musella, Piotto, & Capaccioli (1998) and the theoretical $PL_{\rm I}$ and $PL_{\rm V}$ relations for Z=0.004 provided by Bono et al. (1999). Interestingly enough, we find that the reddening corrected distance moduli in these two bands are 25.8 ± 0.1 mag and 25.82 ± 0.08 mag respectively. Within the errors, which account only for the intrinsic dispersion, these distance determinations seem to support more the SC98 than the LFM calibration of the TRGB method. In fact, SC98 derived a distance modulus for NGC3109 of 25.69 ± 0.14 mag which is in good agreement with the Cepheid distance, while Lee (1993) by adopting the LFM calibration found a distance modulus of 25.45 ± 0.15 mag and the corresponding distance is 15% smaller than the Cepheid distance. On the basis of this finding, it goes without saying that DGs which host both young and old stellar populations can play a key role to settle down the dependence of Cepheid distance scale on metallicity since these systems are characterized by a much smaller metallicity gradient when compared with large spiral galaxies (Mateo 1998).

By taking into account the TRGB distances of NGC3109 and Antlia and their separation on the sky ($\approx 1^{\circ}.18$) we estimated that the projected distance between these galaxies is ≈ 140 kpc. The projected distance decreases to ≈ 70 kpc if we use the new NGC3109 distance based on Cepheid distance. By adopting these two different projected distances and the equation (4) given by VDB we find that this system should have a total mass larger than $7.8 \times 10^{10} M_{\odot}$ (TRGB distances) and $4.0 \times 10^{10} M_{\odot}$ (Cepheid distance to NGC3109) to be bound. These values translates, by assuming $m_{\rm V,0}(Antlia) = 15.58$ (ADGMD) and $m_{\rm V,0}(NGC3109) = 9.63$ (Carignan 1985; Minniti et al. 1999), into total mass-to-light ratios of $(M/L_{\rm V})_0 \geq 350$ and 170 in solar units. Taken at face value these ratios imply that this system should contain an amount of dark matter which is at least a factor of 2–4 larger than in any other dwarf in the LG (see Table 4 in Mateo 1998). Therefore, it is seems unlikely that these two galaxies are gravitationally bound. Finally, we mention that the increase in the mean distances supports the evidence brought out by VDB that the Ant-Sex clustering is located beyond the zero-velocity surface of the LG.

5. Summary and conclusions

Two CMDs $(I, V-I)$ and $(I, B-I)$- together with the LF in the I band, based on photometric data collected with FORS I during the SV program of the VLT were used for constraining the global properties of Antlia. The new data confirm, as originally suggested by SCO and ADGMD, that low-mass, metal-poor stars with an age of the order of 10 Gyr are the main stellar component of this galaxy and that young blue stars are located close to the center. The presence of interstellar dust suggested by SCO is not confirmed by current photometric data.

The comparison between theory and observations suggests that the young stellar component is characterized by an age ranging from 100 to 150 Myr, and in turn that in this galaxy should be present classical Cepheids with periods of the order of few days. By adopting the calibrations of the TRGB method and of the color index $V-I$ vs. metallicity suggested by SC98 we estimated that the distance modulus of Antlia is $(m-M)_0 = 25.89 \pm 0.10$ mag -i.e. $D = 1.51 \pm 0.07$ Mpc-, while its mean metallicity is $[M/H] = -1.3 \pm 0.15$. This distance estimate is 13% larger than the distance determinations provided by SCO and ADGMD, while the mean metallicity is 0.3 dex more metal-rich than the value suggested by ADGMD. The disagreement with previous estimates available in the literature is mainly due to systematic differences in the calibration of the TRGB method and of the color index vs. metallicity relation provided by LFM and SC98.

Interestingly enough, we find that the differential LF shows a secondary peak at $I \approx 22.5$ mag which is at 2σ level larger than theoretical predictions. We suggest that this feature could be due to a secondary young/intermediate-age stellar component. By assuming that this sample of RGB stars presents the same metallicity of the old component we estimated that its age should be ≈ 0.7 Gyr. This evidence and the appearance of the blue stars suggest that after the initial burst who took place ≈ 10 Gyr ago this galaxy experienced two further star formation episodes ≈ 0.7 and ≈ 0.1 Gyr ago.

Finally by using the TRGB method we derived in a homogeneous context the distances of Sextans A/B, and NGC3109 we find that these three galaxies together with Antlia are located within the errors at the same distance. Thus supporting the finding by VDB that these galaxies form a small nearby clustering. The new distances also support the evidence that this grouping could be located beyond the zero-velocity surface of the LG (VDB). Obviously new observations aimed at detecting both horizontal branch stars and RR Lyrae stars as well as at detecting and measuring classical Cepheids can supply fundamental constraints on the intrinsic distance and on the global properties of this intriguing neighborhood.

Acknowledgements. It is a pleasure to thank V. Castellani and M. Marconi for many interesting discussions on an early draft of this paper. We also warmly acknowledge M. Salaris for many stimulating suggestions on the content of the paper. Detailed comments from the referee, S. van den Bergh, have contributed to improving the content of this paper.

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