DWARF ELLIPTICAL GALAXIES IN THE CEN A AND SCULPTOR GROUPS

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1. The "missing" dEs

Côté (1995) surveyed the nearby Centaurus A (Cen A) and Sculptor (Scl) group regions in the search for gas-rich, dwarf irregular galaxies (Irr) which are associated with these galaxy aggregates. 36 Irrs have been found and confirmed as new group members via 21cm/H_α redshifts. In finding this large number of Irrs, the question rises whether systems from the other dwarf galaxy family, the gas-poor dwarf ellipticals (dE), also exist in the two groups. So far nothing is known about dE membership but taking into account the morphology-density relation for dwarfs (Binggeli et al. 1990) a number ratio Irr/dE$\approx 1-2$ would be expected. Prompted by these "missing" dEs we started a large program to identify and study dEs in Cen A and Scl. The main scientific goals are (1) to find dE candidates and to establish group membership via velocity or distance and (2) to estimate the luminosity function (LF) of dwarf galaxies to the faintest possible luminosities. For the two groups, being respectively at a mean distance of 4.0 Mpc and 2.5 Mpc, we will be able to reach dwarf galaxies 4–5 magnitudes fainter than in the previous studies in the Virgo and Fornax clusters and the five groups Leo I, Dorado, NGC1400, NGC5044, and Antlia (Sandage et al. 1985, Ferguson & Sandage 1990). We briefly outline here first results from the Cen A group. All details about the complete survey including Scl will be presented in Jerjen et al. (1997)

2. How to find them

A list of 13 dE candidates in the Cen A group was compiled based on a visual inspection of 45 SERC IIIa-J films covering the entire group area. The galaxies were selected based on the characteristic dE morphology, namely a low surface brightness light distribution without gas or star formation features. We did CCD imaging of all objects in the B and R-band at the 2.3m telescope at Siding Spring. A total integration time per galaxy and per filter of 3600s was required to obtain photometric and structure parameters. Côté used radial velocities as distance indicators for her gas-rich dwarfs. This is not applicable to our gas-poor dEs with $SB_{B,eff} \sim 24\,\mathrm{mag\,arcsec^{-1}}$. Alternative distance determinations for dEs in general necessitate resolving the system into stars. We decided to explore the surface brightness fluctuation (SBF) method developed by Tonry & Schneider (1988) which has been proven to be very efficient and reliable in obtaining distances to giant elliptical galaxies. However, our application differs from previous ones, in that we are working on low surface brightness objects and are photon-limited by the sky rather than by the galaxy itself. Therefore we worked in the R-band instead of the generally prefered I-band. The sky is significantly redder in R-I than the red giants causing the fluctuation and this choice of filter avoids the fringing that occurs with thinned CCDs in the I-band. Five Cen A candidates were selected for the analysis. They have been observed under good seeing conditions ($\sim 1.5''$) and cover a range in mean effective surface brightness ($23^m < SB_{B,eff} < 25^m$) and effective radius ($15'' < r_{B,eff} < 35''$). The SBF analysis followed in main parts the procedure described in Tonry & Schneider. After preparing the image

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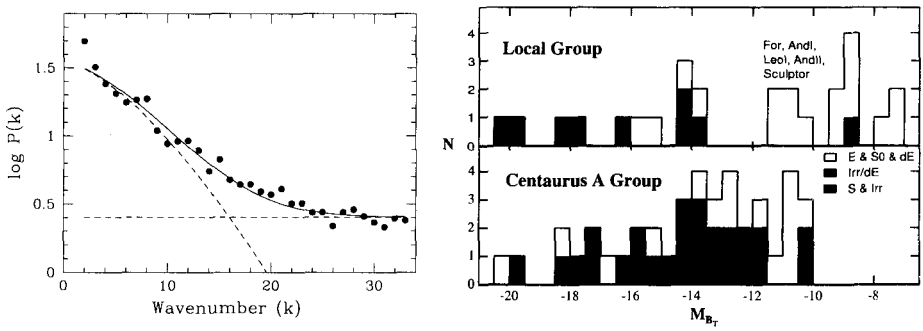

Figure 1. (a) Observed power spectrum of the dE candidate ESO384-016. The solid line is the best fit to the data, which is the sum of a PSF convolved and a scale free noise component (dashed lines). (b) LFs of the Cen A group and the LG. Some faint dEs of the LG are indicated to illustrate the luminosity limit of our survey.

of each galaxy its spatial power spectrum (PS) was derived (see Fig. 1a). The PS consists of a PSF convolved component (fluctuation power) and a scale free white noise component (photon and RON noise). The amplitude of the fluctuation power gives the magnitude of a "typical star" in the galaxy, $\bar{m}_R$. All five galaxies yielded strong signals corresponding to $26.6 < \bar{m}_R < 27.1$. Most of the published SBF studies are carried out in the I-band (e.g. Tonry et al. 1997) and no empirical calibration of $\bar{M}_R$ exists yet. We estimate this quantity with the theoretical isochrones from Worthey's models (1994). For a typical [Fe/H]=−1.4 and allowing for different star formation histories (Da Costa 1997) we get $\bar{M}_R = -1.15(\pm 0.03)$. Four galaxies turned out to be Cen A group members covering the distance range 3.6 <D(Mpc)< 4.4. The other dE is slightly behind the group at D=7.3 Mpc. An independent proof of group membership came from redshifts we measure for the two brightest sample galaxies. For instance, the dE candidate ESO384-016 has $v_\odot = 561\,km\,s^{-1}$ and $D_{SBF} = 4.1$ Mpc which is in perfect agreement with data for well-known Cen A group galaxies: NGC5253 ($v_\odot = 404\,km\,s^{-1}$; D= 4.1 Mpc, Saha et al. 1995) and NGC5128 ($v_\odot = 562\,km\,s^{-1}$; D= 3.7 Mpc, Soria et al. 1996). Even though five dE distances only are available now, there is strong qualitative evidence from the morphological similarity between confirmed and unconfirmed dEs that the eight remaining candidates are likely to be Cen A group members too. Fig. 1b shows the LF of all known Cen A group galaxies, assuming all dEs but one (for which we have the distance) are associated with the group. If true, we have found dwarf systems as faint as the Fornax or Leo I dwarfs in the Local Group.

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