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Low surface brightness star clusters of the Large Magellanic Cloud outer regions

João F. C. Santos Jr.[1,⋆], Francisco Maia[1], Leandro Kerber[2,3], Bruno Dias[4], Eduardo Bica[5], Andres E. Piatti[6]

[1] UFMG, [2] IAG-USP, [3] UESC, [4] ESO, [5] IF-UFRGS, [6] UNC

Abstract. *BVI*-band images obtained with instrument SAMI@SOAR for 56 Large Magellanic Cloud (LMC) outer disk star clusters – in the scope of the VISCACHA Survey – were analysed aiming at determining their structural parameters. Preliminary results show that the outer clusters' core radius is in average larger than that for inner clusters.

Resumo. Imagens nos filtros *BVI* obtidas com o instrumento SAMI@SOAR para 56 aglomerados de estrelas das regiões externas da Grande Nuvem de Magalhães – no escopo do projeto VISCACHA – foram analisadas com o objetivo de determinar seus parâmetros estruturais. Resultados preliminares mostram que o raio nuclear de aglomerados mais externos é em média maior que o dos aglomerados mais internos.

Keywords. galaxies: star clusters: general – Magellanic Clouds

1. Introduction

We are building a large photometric database of star clusters (SCs), mostly located in the outskirsts of the Magellanic Clouds, aiming at a comprehensive study of their properties in connection with the galaxies' evolution. This work focuses on 56 Large Magellanic Cloud (LMC) clusters, for which we have collected *BVI* images with SAMI@SOAR in the scope of the VISCACHA (VIsible Soar photometry of star Clusters in tApii and Coxi HuguA[†]) Survey. Results on structural parameters obtained from King model fittings to the clusters' surface brightness profiles (SBPs) are presented in this study. We intend to explore the significance of tidal effects from the Clouds and the Milky Way on the clusters' structure. A VISCACHA review is presented by Maia et al. in this proceedings.

2. Deprojected distance to the LMC center

SCs deprojected distances from the LMC dynamical center (α=5^{h} 19^{m} 31^{s} and δ= -69° 35′ 24″) were computed according to $d = s\left[1 + \sin^2(PA - \theta)\tan^2 i\right]^{1/2}$ (Elmegreen 1998), where s is the projected distance, PA is the position angle of the SC, θ is the position angle of the line of nodes and i the tilt of the LMC plane. The values of $\theta = 139°.1$ and $i = 34°$ were based on a model built from proper motion and radial velocities of the disk old population (van der Marel & Kallivayalil 2014). The sample SCs were separated in four groups at distinct locations (green, blue, yellow and red symbols) throughout the outer LMC (Fig. 1).

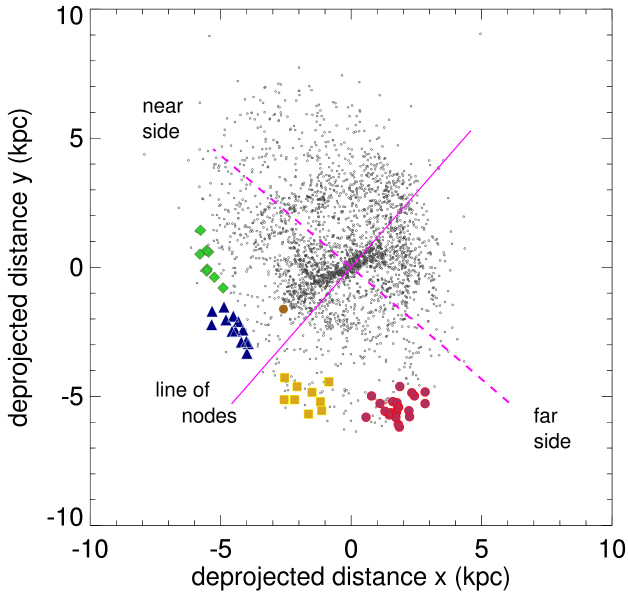

FIGURE 1. Deprojected distribution of LMC SCs. Black dots are clusters from Bica et al. (2008) catalogue. Colored symbols identify azimuthally distinct SC groups in our sample. The brown dot marks the control cluster SL 788. The line of nodes separating the closer and far away sides of the LMC are also indicated.

3. King model fit to surface brightness profiles (SBPs)

The SC center was determined iteratively by the average position of the stars within the SC visual radius. The SBPs were built from the calibrated V and I images in annular bins divided in eight sectors for which the flux median was calculated. The sky level, obtained from the whole image, was subtracted before the fitting procedure. Although the I band provide the best image quality compared to the V band, its enhanced background makes the resulting profiles noisier, therefore smaller uncertainties were achieved for the V band, which was preferred in this analysis.

The King model structural parameters central surface brigthness ($\mu_\circ$), core radius (r_c) and tidal radius (r_t) were estimated by fitting the King (1962) model to the clusters' SBPs. The model fittings were performed from the cluster center to the limiting radius, where the flux of field stars starts to overcome the flux of the cluster stars. From the limiting radius outward, the flux was

⋆ e-mail: jsantos@fisica.ufmg.br

† Tupi-guarani names for the LMC and SMC

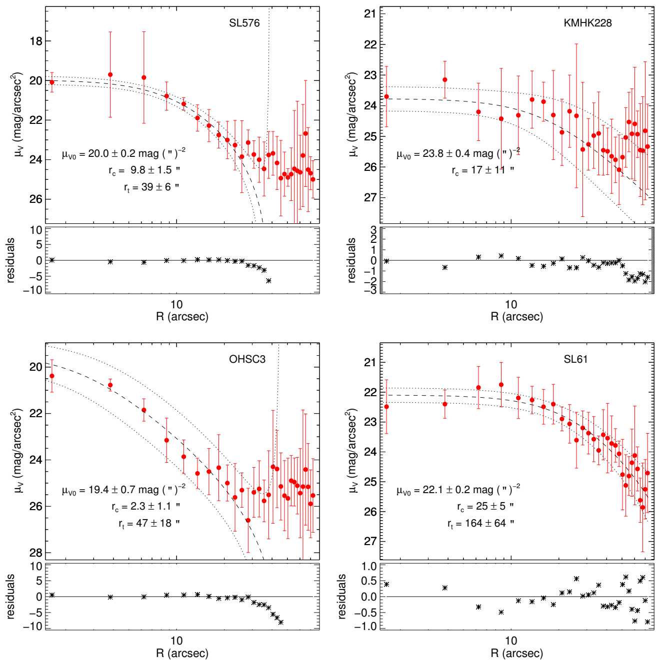

Figure 2. Selected King model fittings to SBPs. Top: The brightest (integrated M_V) cluster (left) and the faintest one (right) in our sample. Bottom: SCs with the smallest core radius (left) and the largest one (right).

used to compute the stellar background/foreground, which was then subtracted from the profile. For most of the clusters it was not possible to obtain r_t because field contamination dominates the outer profile. King model fittings are shown in Fig. 2.

SCs with large core radius tend to have lower central surface brightness and are fainter in integrated V light, as expected (Fig. 3). Fig. 4 shows that there is a large spread in r_c for SCs located at greater distances from the LMC center. More significantly, the two westernmost SC groups (red and yellow symbols) have median r_c and their dispersions above those for the eastern groups (blue and green).

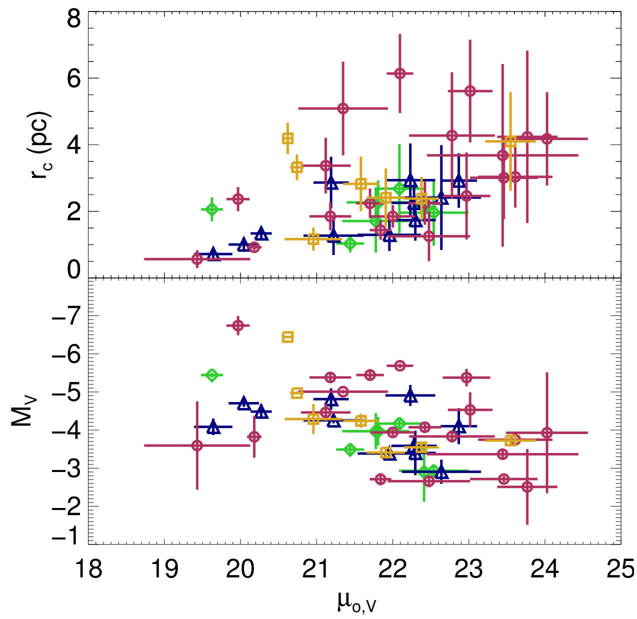

Figure 3. Distribution of core radius and integrated magnitude with the central surface brightness for the four SC groups.

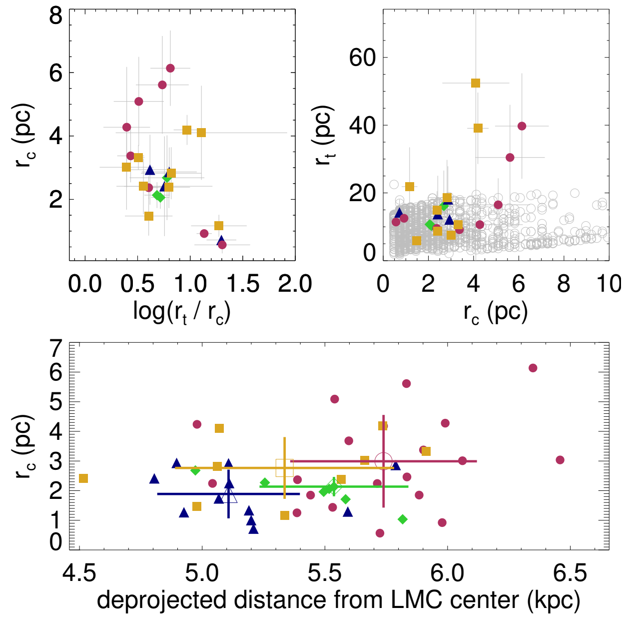

Figure 4. Top: Relations between core radius and tidal radius for our sample compared to that analysed by Werchan & Zaritsky (2011) (gray circles). Bottom: core radius vs deprojected distance from the LMC center for the four SC groups.

4. Conclusions and perspectives

Although the SCs have deprojected distances to the LMC center that do not differ by more than 2 kpc, they are distributed azimuthally from east to southwest throughout ~130°, making different dynamical effects expected among the groups. Indeed, the westernmost SCs (red dots), that are closer to the SMC, seem to have r_c more scattered with relation to the other SCs. This group is also in the farther side of the LMC from us and contains the lowest surface brightness members of our sample. A comparison between r_t and r_c for our sample and that of inner SCs studied by Werchan & Zaritsky (2011) shows that, in average, the latter are smaller than most SCs in our sample, which may reflect tidal effects. In the near future, we will obtain age and metallicity for the sample and study their gradients in connection with the structural parameters. Such investigation shall provide new findings on the LMC cluster population more strongly affected by the interaction between the Clouds and may reveal interesting aspects of the galaxies' evolution.

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