Contrib. Astron. Obs. Skalnaté Pleso **49**, 444 – 446, (2019)

Deep optical photometry of two nearby elliptical galaxies: NGC 4473 and NGC 4697

A. Vudragović and S. Samurović

Astronomical Observatory Belgrade, Serbia (E-mail: ana@aob.rs)

Received: October 17, 2018; Accepted: January 23, 2019

Abstract. We present deep optical photometry of two nearby elliptical galaxies, NGC 4473 and NGC 4697, obtained with a new 1.4m Milanković telescope, mounted at the Astronomical Station Vidojevica (Serbia). For both galaxies we derive surface brightness profiles up to 7 and 3 effective radii, respectively (limited solely by our field of view) to obtain deep color (B-V) gradients. Also, we perform 2D decomposition of galaxy images into Sersic components.

Key words: galaxies – photometry

1. Introduction

The problem of dark matter (DM) emerged from studies of galaxies and in the past decades a lot of effort has been put into constraining the amount of this invisible matter. In our paper (Samurović, S. and Vudragović, A. 2018, MNRAS, in press), we test Newtonian and MOND methodologies on two nearby early-type galaxies (ETGs, hereafter): NGC 4473 and NGC 4697. The motivation for obtaining deep photometry came from the fact that galaxy color can be used to compare the mass-to-light ratio from the stellar population synthesis (SPS) models to the estimated dynamical mass-to-light ratio. To that end, we obtained the images of NGC 4473 and NGC 4697 in the B- and V-band to infer their colors as far from the centre as possible.

2. Observations and data reduction

Observations of two targeted galaxies NGC 4473 and NGC 4697 were carried out in two wavelength bands (B and V) on three consecutive nights (19 - 21 April 2018) using an Apogee U42 CCD camera attached to the 1.4 m Milankovic telescope mounted at the Astronomical Station Vidojevica. We took 24 (22) images and 26 (23) images in B (V) band of NGC 4473 and NGC 4697 galaxy, respectively. Exposure time was 180s in most of the images and occasionally 300s.

Data reduction was done in IRAF, following the standard procedure. Astrometric solution was obtained using the Astrometry software (Lang et al., 2010). The mosaic creation was done with mscred package in IRAF, based on the astrometric solution. A list of stars was generated from mosaics in both B- and

V-band using Sextractor (Bertin & Arnouts, 1996). Aperture photometry was measured in IRAF with the phot task from the apphot package. Matching stars from The Fourth U.S. Naval Observatory CCD Astrograph Catalog (UCAC4: Zacharias et al., 2013) to the stars in our list, we have found 5 and 9 stars in common for NGC 4473 and NGC 4697, respectively and calculated magnitude zero-points.

3. Results

We obtained deep photometry in the B- and V-bands for NGC 4473 and NGC 4697 (Fig 1.). Previous (B-V) colors of these two galaxies were measured up to $\sim 3R_e$ for NGC 4473 (Idiart et al., 2002) and $\sim 1R_e$ for NGC 4697 (Poulain & Nieto, 1994). We have measured color of NGC 4473 and NGC 4697 up to $\sim 7R_e$ ($= 218''$) and $\sim 2.7R_e$ ($= 263''$), respectively.

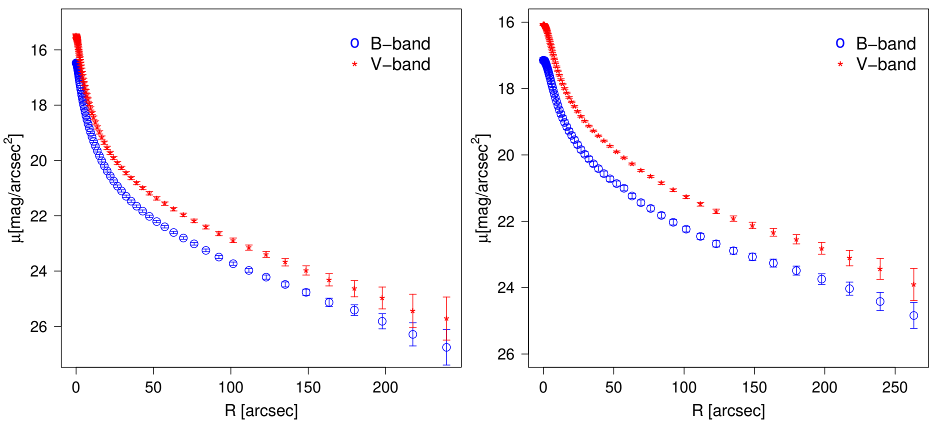

Figure 1. Surface brightness profiles of NGC 4697 and NGC 4473, from left to right. The B-band is marked with blue circles and the V-band with red stars.

Further, we used the Galfit code (Peng et al., 2010) to study the structure of these two galaxies in detail. Both galaxies are fitted with multicomponent Sersic profiles: NGC 4473 was successfully fitted with three Sersic components (two disks and a pseudo-bulge), while for NGC 4697 two Sersic components were sufficient to describe all the structure. Fitted parameters are listed in Table 1.

The interesting case of NGC 4473 requires further investigation: two Sersic components are aligned and this is often the case for fast rotators, but the third component that is orthogonal to these two components came as a surprise. This structure may be the ongoing merger and it would be interesting to analyze its chemical composition with respect to the other two components to see if it is of external origin.

Table 1. Best-fitting parameters in the V-band are given for both galaxies. Columns: (1) multiple Sersic components labeled with 1, 2 and 3 (the third component is presented only for NGC 4473), (2) effective surface brightness, (3) effective radius, (4) Sersic index, (5) minor-to-major axis ratio and (6) position angle of the galaxy measured in the counter-rotating direction from the vertical axis (north is up in the images).

Component	$\mu_{\rm eff}$ [mag/$''^2$]	$R_{\rm eff}$ [$''$]	n	b/a	PA
NGC 4473					$\chi^2 = 199$
Sersic1	19.00	12.8	2.71	0.51	94.51
Sersic2	22.20	67.8	0.99	0.59	92.79
Sersic3	20.18	6.5	1.05	0.87	176.09
NGC 4697					$\chi^2 = 12$
Sersic1	22.32	106.16	0.86	0.51	59.65
Sersic2	19.92	23.72	1.95	0.61	69.72

Acknowledgements. This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia through project no. 176021, “Visible and Invisible Matter in Nearby Galaxies: Theory and Observations”. We acknowledge the financial support by the European Commission through project BELISSIMA (BELgrade Initiative for Space Science, Instrumentation and Modelling in Astrophysics, call FP7-REGPOT-2010-5, contract No. 256772). We thank the technical operators at the Astronomical Station Vidojevica (ASV), Miodrag Sekulić and Petar Kostić for their excellent work.

References

Bertin, E. & Arnouts, S., SExtractor: Software for source extraction. 1996, *Astron. Astrophys., Suppl.*, **117**, 393, DOI: 10.1051/aas:1996164

Idiart, T. P., Michard, R., & de Freitas Pacheco, J. A., New UBVRI colour distributions in E-type galaxies . I. The data. 2002, *Astron. Astrophys.*, **383**, 30, DOI: 10.1051/0004-6361:20011699

Lang, D., Hogg, D. W., Mierle, K., Blanton, M., & Roweis, S., Astrometry.net: Blind Astrometric Calibration of Arbitrary Astronomical Images. 2010, *Astron. J.*, **139**, 1782, DOI: 10.1088/0004-6256/139/5/1782

Peng, C. Y., Ho, L. C., Impey, C. D., & Rix, H.-W., Detailed Decomposition of Galaxy Images. II. Beyond Axisymmetric Models. 2010, *Astron. J.*, **139**, 2097, DOI: 10.1088/0004-6256/139/6/2097

Poulain, P. & Nieto, J.-L., UBVRI photoelectric photometry of bright southern early-type galaxies. 1994, *Astron. Astrophys., Suppl.*, **103**, 573

Zacharias, N., Finch, C. T., Girard, T. M., et al., The Fourth US Naval Observatory CCD Astrograph Catalog (UCAC4). 2013, *Astron. J.*, **145**, 44, DOI: 10.1088/0004-6256/145/2/44