Boletim da Sociedade Astronômica Brasileira, **31**, no. 1, 106-107

Nuclear activity and stellar population in the BCG IC4765

P. C. da Rocha-Poppe[1,2], V. A. Fernandes-Martin[1,2], M. Faúndez-Abans[3], M. de Oliveira-Abans[3,4], G. A. Silva[1,2,5], P. Freitas-Lemes[6,7], C. Lima-Dias[1,2,8]

[1] UEFS, Departamento de Física, Av. Transnordestina S/N, Novo Horizonte, CEP 44036-900, Feira de Santana, BA, Brazil
[2] UEFS, Observatório Astronômico Antares, Rua da Barra 925, Jardim Cruzeiro, CEP 44024-432, Feira de Santana, BA, Brazil e-mail: paulopoppe@uefs.br,vmartin@uefs.br
[3] MCTIC/Laboratório Nacional de Astrofísica, Rua Estados Unidos, 154, Bairro das Nações, CEP 37504-364, Itajubá, MG, Brazil e-mail: mfaundez@lna.br
[4] UNIFEI, Instituto de Engenharia de Produção e Gestão, Av. BPS, 1303, Pinheirinho, CEP 37500-903, Itajubá, MG, Brazil e-mail: mabans@lna.br
[5] UNIFEI, Instituto de Física e Química, Av. BPS, 1303, Pinheirinho, CEP 37500-903, Itajubá, MG, Brazil e-mail: giuanafisica@gmail.com
[6] ITA, Departamento de Física, Instituto Tecnológico de Aeronáutica, CEP 12228-900, São José dos Campos, SP, Brazil
[7] UNIVAP, Universidade do Vale do Paraíba, Av. Shishima Hifumi, 2911, CEP 12244-000, São José dos Campos, SP, Brazil e-mail: priscila@univap.br
[8] ULS, Departamento de Física, Universidad de La Serena, Av. Cisternas 1200, La Serena, Chile; e-mail: ciriafisica@gmail.com

Abstract. The main goal of this work is to investigate the nuclear activity and stellar population in the BCG IC4765, a prominent cD galaxy in the center of the poor cluster Abell S0805. We find compelling evidence for the presence of a narrow-emission-line AGN (i.e. a LINER) in the nuclear region, revealed by the observations of low-ionization lines [N II]λ6584 Å and [S II]$\lambda\lambda$6717,6731 Å with respect to Hα. Using the spectral synthesis code STARLIGHT, we find that in the nuclear 3″× 3″ region, the contributions from the old, intermediate and young components are 0.0%, 33.0% and 67.0%, respectively. Although surrounded by several satellite galaxies, no evidence of interaction was observed in this spectroscopic study.

Resumo. O principal objetivo deste trabalho consiste em investigar a atividade nuclear e a população estelar presente na BCG IC4765, uma proeminente galáxia cD pertencente ao aglomerado pobre Abell S0805. Encontramos provas convincentes da presença de uma LINER na região nuclear, revelado pelas observações das linhas de baixa-ionização [N II]λ6584 Å and [S II]$\lambda\lambda$6717,6731 Å em relação a linha do Hα. Usando o código STARLIGHT de síntese espectral, encontramos na região nuclear de 3″ ×3″ as contribuições de componentes estelares de idades velhas (0.0%), intermdiárias (33.0%) e jovens (67.0%), respectivamente. Embora cercada por várias galáxias satélites, nenhuma evidência de interação foi observada neste estudo espectroscópico.

Keywords. Galaxies: clusters: general — Galaxies: elliptical and lenticular, cD — Techniques: spectroscopic

1. Introduction

The cluster Abell S0805 was discovered by Sérsic in 1968 for astrometric purposes (Sérsic 1974) and has been receiving attention ever since. It has a prominent cD galaxy in the centre[1], IC 4765 (ESO 104- G006), surrounded by several satellite galaxies (labelled as 1 in Fig. 1). It is classified as S0 (Lauberts 1982) and as cD4 (de Vaucouleurs et al. 1991), with magnitude B (Cousins) estimated in 12.33 ± 0.09 (Lauberts 1982). According to Hudson et al. (2001) and Lin & Mohr (2004), this particular object is a BCG (Brightest Cluster Galaxy). Although the cluster has been relatively studied through X-ray observations (e.g with the Einstein Monitor Propotional Counter (MPC, David et al. 1993), the ROSAT-ESO Flux Limited X-ray (REFLEX, Böhringer et al. 2004), and also with the XMM-Newton (Lovisari et al. 2015), the nuclear analysis in the optical range for the individual members are still limited and therefore insufficient to describe aspects related with the kinematic, activity and stellar population of the cluster. As no detailed spectroscopy has been published yet (although optical emission lines have recently been published by Hamer et al. 2016), BCG IC 4765 makes this study ideal for investigating their particular nature. A forthcoming paper will discuss the results for the other galaxies in Fig. 1, observed in the program OP2012A-LP12 with Cassegrain spectrograph in the OPD/LNA-MCTIC.

[1] The projected distance between the object and the clusterX-ray peak is $R_{off} = 0.007$ Mpc (see Böhringer et al. 2004)

2. The Starlight Code

STARLIGHT is a code used to fit an observed spectrum (O_λ) with a model (M_λ) in terms of a linear combination of simple stellar populations (SSPs). We use a base of N* = 150 elements of 25 different ages between 1Myr and 18 Gyr, and 6 metallicities: Z* = 0.005, 0.02, 0.2, 0.4, 1.0 and 2.5 $Z_\odot$, summing up 150 SSPs (see Mateus et al. 2006; Cid et al. 2007; Asari et al. 2007). We use Calzetti reddening-law (Calzetti et al. 994, 995) to model the extinction in a multi-dimensional chi-square fit.

3. Results and Conclusions

The long-term observational program OP2012A-LP12 aims to study the properties of peculiar galaxies in the local universe ($z < 0.1$). IC 4765 (ESO 104- G006) is the BCG of the poor cluster Abell S0805, a cD galaxy with spectral characteristics of LINER in our analysis (Fig. 2,3). Our value of $4\,495 \pm 14$ km s^{-1} is in good agreement ($\pm 1\sigma$) with the literature, nuclear redshift ($z = 0.015$) and distance (~62 Mpc). The radial velocity profile for this galaxy reveals a central rotation which is possibly rotational substructure (as reported by Loubser et al. 2008). Our nu-

Table 1. Stellar-population synthesis. Given are the ID number, the galaxy name, the condensed population vector, the mean stellar age and metallicity components, the extinction, the quality of the STARLIGHT fit (χ^2 and adev), and the respective extinction law.

ID	Galaxy	x_Y (%)	x_I (%)	x_O (%)	$<\log t_\star>_L$ (yr)	$<Z^\star>_L$	A_V (mag)	χ^2	adev (%)	law
1	IC 4765	0.0	33.0	67.0	9.80 ± 1.58	0.028 ± 0.015	0.00	2.03	3.80	Calzetti

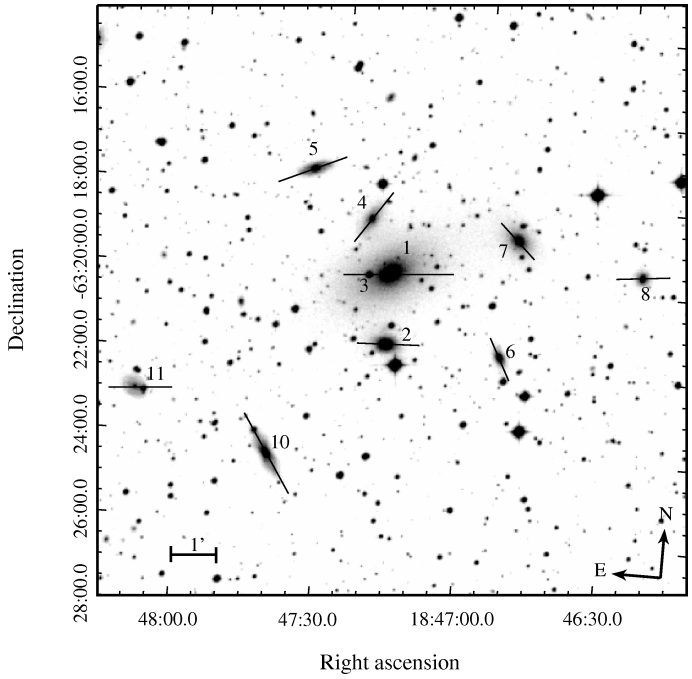

Figure 1. Spectroscopic targets in the central region of the BCG IC 4765 (ID = 1). The field-of-view is 10′×10′ (1′ = 179 kpc). We have adopted the same numbers (ID, see Table 1) proposed by Fairall (1979) to identify the galaxies in the host cluster A S0805. The black lines show the approximate slit positions of the spectrograph. Image taken from Aladin Sky Atlas.

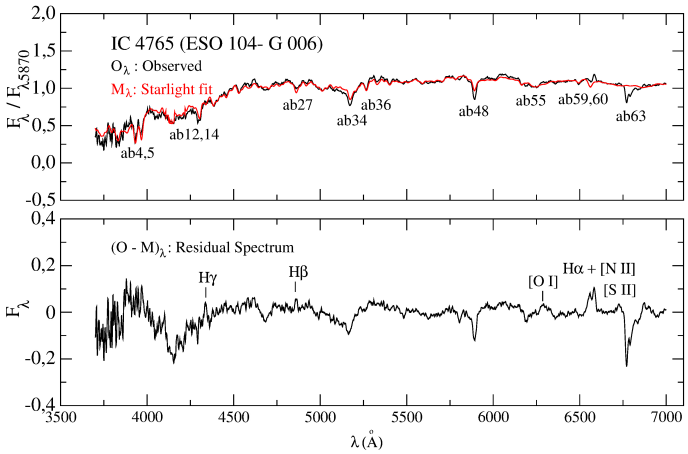

Figure 2. Spectral synthesis. Top panel: observed spectrum (O_λ, black line, corrected by redshift and Galactic reddening) and synthesized spectrum (M_λ, red line, the 'best fit' population synthesis model) normalized to unit at 5870 Å. Overplotted is the identification of the most probable contributors (see Bica & Alloin 1986). Bottom panel: residual spectrum after starlight subtraction. O_λ and M_λ are given in units of erg cm^{-2} s^{-1} Å^{-1}.

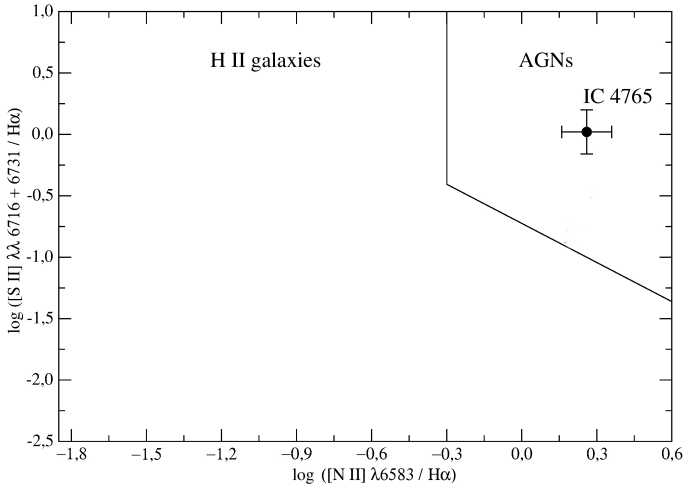

Figure 3. Diagnostic diagram (Pérez-Montero et al. 2013) with the emission line ratios of the residual spectrum (see Fig. 2). The solid black line is the criteria used to distinguish only star-forming objects from AGNs (Seyfert 2 galaxies and LINERs).

clear spectral synthesis indicates only the existence of old populations (67%) and intermediate components (33%). The Calzetti law (CAL, Calzetti et al. 994, 995 provided the best spectral fit.

Acknowledgements. The authors are also very grateful to the staff of Observatório do Pico dos Dias (LNA/MCTIC), Brazil, for their assistance during the observations. We acknowledge UEFS/PPPG (Editais 001/2009 UEFS and 001/2012 UEFS/FAPESB) which provided financial support for this research. G. A Silva thanks the Brazilian agency FAPEMIG. P. Freitas-Lemes thanks the Brazilian funding agency CAPES.

References

Asari, N. V., Cid Fernandes, R., Stasińska, G., Torres-Papaqui, J. P., Mateus, A., Sodré, L., Schoenell, W., Gomes, J. M., 2007, MNRAS, 381, 263
Bica E., Alloin D., 1986, A&A, 162, 21
Böhringer, H., Schuecker, P., and 12 co-authors, 2004, A&A, 425, 367
de Vaucouleurs, G., de Vaucouleurs, A., Corwin, and 3 co-authors, 1991, Book-Review - Third Reference Catalogue of Bright Galaxies, 82, 621
Calzetti, D., Kinney, A. L., Storchi-Bergmann, T., 1994, ApJ, 429, 582
Calzetti, D., Bohlin, R. C., Kinney, A. L., Storchi-Bergmann, T., Heckman, T. M., 1995, ApJ, 443, 136
Cid Fernandes, R., Asari, N. V., Sodré, L., Stasinska, G., Mateus, A., Torres-Papaqui, J. P., Schoenell, W., 2007, MNRAS, 375, 16
David L. P., Slyz A., Jones C., Forman W., Vrtilek S. D., Arnaud K. A., 1993, ApJ, 412, 479
Fairall, A. P., 1979a, MNRAS, 188, 343
Hamer, S. L., Edge, A. C., and 10 co-authors, 2016, MNRAS, 460, 1758
Hudson, M J., Lucey, J. R., Smith, R. J., Schlegel, D. J., Davies, R. L., 2001, MNRAS, 327, 265
Lauberts, A., 1982, ESO/Uppsala survey of the ESO(B) atlas
Loubser, S. I., Sansom, A. E., Sánchez-Blázquez, P., Soechting, I. K., Bromage, G. E., 2008, MNRAS, 391, 1009
Lovisari L., Reiprich T. H., Schellenberger G., 2015, A&A, 573, 118
Lin, Y. T., Mohr, J. J., 2004, ApJ, 617, 879
Mateus, A., Sodré, L., Cid Fernandes, R., Stasińska, G., Schoenell, W., Gomes, J. M., 2006, MNRAS, 370, 721
Pérez-Montero E., Contini T., Lamareille F., Maier C., Carollo C.M., Kneib J.P., and 32 co-authors, 2013, A&A, 549, 25
Sérsic, J. L., 1974, Ap&SS, 28, 365