2D Analysis of physical properties in a sample of LCBGs: UCM1648+2855 case study

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Local LCBGs are the closest counterpart of the high z outburst population. These objects are crucial as a local reference for compact star-forming galaxies observed at cosmological distances. We have obtained 2-D spectroscopy in the 3700-7000Å range with PPAK instrument (at 3.5m CAHA) for a sample of 22 local Luminous Compact Blue Galaxies.

In this poster we show the results derived from the 2D analysis of different physical properties in UCM1648+2855, a case study LCBG. It was chosen as a prototype of one of the three kinematic classes observed by Pérez-Gallego, et al. (2011): perturbed rotation (PR). Our study shows that this galaxy has a smooth metallicity distribution, a disc-supported velocity map and a enhanced dust distribution outside the star-forming regions. Therefore the massive star formation in UCM1648+2855 seems to be not driven by merging, but by a genuine starburst, with a SFR of ~9 $M_{\odot}$/year.

UCM1648+2855 General Properties

RA (2000)	16h50m47.9s
DEC(2000)	+28d50m45s
z	0.032969
d_a (Mpc)	134.6
M(B)	-20.32
m(B)	15.69
SB_e (mag/arsec^2)	20.32
B-V	0.26
R_e (arsec)	3.9
R_e (kpc)	2.4

Table I: General properties from Pérez-Gallego et al. 2011.

UCM1648+2855 (aka Mrk 1108) is a Luminous Compact Blue Galaxy, prototype of the sample chosen from SDSS and UCM databases according to observational criteria that ensure that LCBGs we observe locally are analogous to those observed in deep images of distant galaxy populations: *MB*<-18.5, and SB_e<21 mag arcsec^{-1}, and *B-V*<0.6 mag. (Werk et al. 2004). It is kinematically classified with *perturbed rotation* (Pérez-Gallego et al, 2011) according to the groups defined by Yang et al, 2008. It has a morphological classification type Sa.

Data reduction and Analysis

The data reduction consists of three main steps: (1) the standard reduction of two-dimensional fiber spectra using IRAF environment, R3D and E3D software following Sánchez S. (2006) . Absolute flux calibration was done comparing SDSS-DR8 images in g and r bands, with a synthetic photometry obtained from the PPAK cube. The absolute flux calibration is accurate within 10% with respect to SDSS.

(2) the line fitting procedure: the emission lines in each spectrum of the data cube were fitted by single gaussian profiles using our own software tools.

(3) The generation of maps of spectral features from the calibrated spectra.

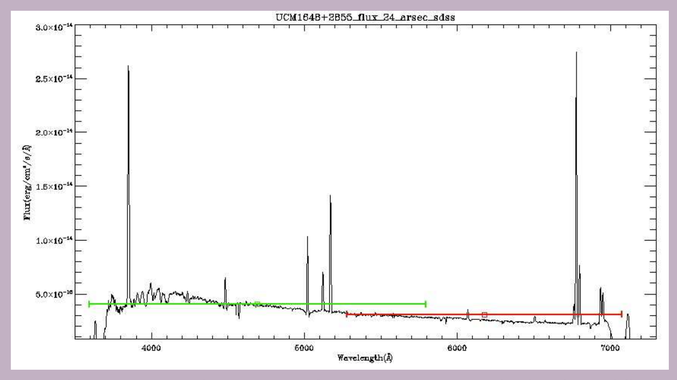

Fig. I: Integrated spectrum of UCM1648+2855, obtained coadding all individual spectra of PPAK dataset over the a 24 arsec diameter field-of-view centered on the galaxy. Green and red squares are the synthetic g and r photometriy obtained from the SDSS-DR8 images.

Table II: Summary of the absolute values calculated for UCM1648+2855 corrected of internal extinction (see Hα extinction map, Fig II).

$L_{H\alpha}$	$1.081 \cdot 10^{42}$ erg/s
SFR	8.5 $M_{\odot}/yr$
$F_{H\alpha}$	$4.9 \cdot 10^{-13}$ erg/s/cm^2
AHα (mag)	0.76

Results and discussion

The goal of this project is to understand the mechanism driving the burst of star formation in local Luminous Compact Blue Galaxies studying the spatial distribution of different physical and kinematical properties.

- The lowest Hα extinction is located in the star forming regions.
- Metallicity shows a non-significant change across the galaxy, 8.4 < (12+log(O/H) < 8.6 (±0.2dex)
- Velocity map shows a rotation-supported disc with no sign of merging process, although the peak in the velocity width map is shifted away from the dynamical center (see Fig.II)

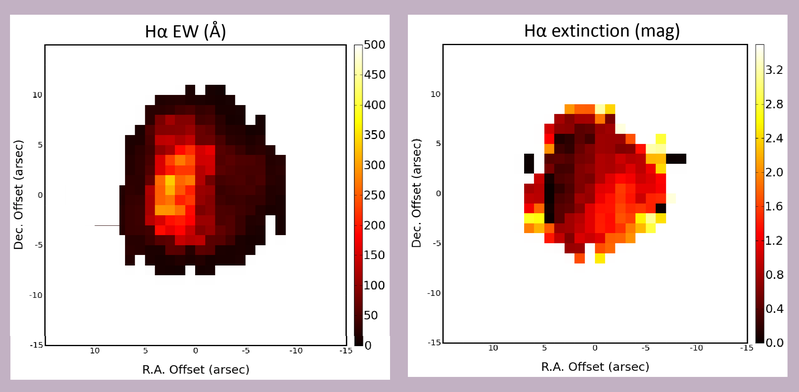

Fig. II: **(a)** PPAK Hα emission equivalent width in Ångstroms. The two starburst regions are not resolved with PPAK resolution. **(b)** PPAK total Hα extinction map (in magnitudes) computed from the Balmer emission lines ratio F(Hα)/F(Hβ) using Cardelli extinction law. **(c)** PPAK map of the metallicity estimated with the ratio O3N2 calibrated by Pettini & Pagel (2004), O3N2 = log(([OIII]λ5007/Hβ) / (NIIλ6583/Hα)) obtained from the reddening-corrected fluxes. **(d) & (e)**PPAK [OIII]λ5007 velocity map and velocity width map derived using v1200 configuration (from Pérez-Gallego et al., 2011).

In the light of these results we conclude that no merging process seems to be behind this starburst. We are currently working on the stellar population synthesis to study the SFRH of the different regions in this galaxy.

2D Analysis: four different regions observed

UCM1648+2855 is a prototypical LCBG at 135 Mpc with no near companion. This is the first time this galaxy has been fully spectroscopically mapped in the optical. UCM1648+2855 is quite compact, and shows 3 different star forming knots in the galactic disc with different stellar continuum characteristics. We analyze in detail the spatial distribution of physical properties such as extinction, metallicity and SFR. In particular the computed properties for the selected regions are shown in Table III.

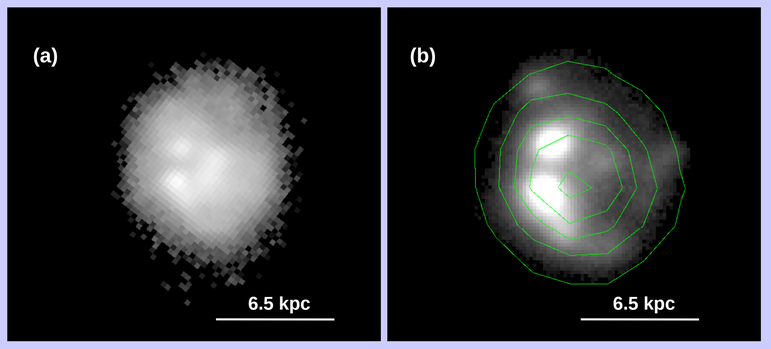

Fig.III: Morphological analysis shows a complex distribution of Hα emission in this galaxy, with two large star forming regions of the centre.

(a) SDSS g-band image shows UCM1648+2855 as a very compact circular object with a nucleus and two bright knots.

(b) Hα image (ALFOSC/NOT) with continuum PPAK contours in green. Star forming regions are ~2" off the centre of the galaxy.

We focus on the study of the physical properties of the gas through the analysis of the observed emission lines. In the V300 setup configuration the main emission lines observed are: [OII]λ 3727, Hβ, [OIII]λλ4959,5007, [HeI]λ5876, [OI] λ6300, Hα , [NII]λ6548,6584, [SII]λλ6717,6731. The wide wavelength range of this configuration allows us to derive not only line emission fluxes maps but line emission ratios in a consistent way.

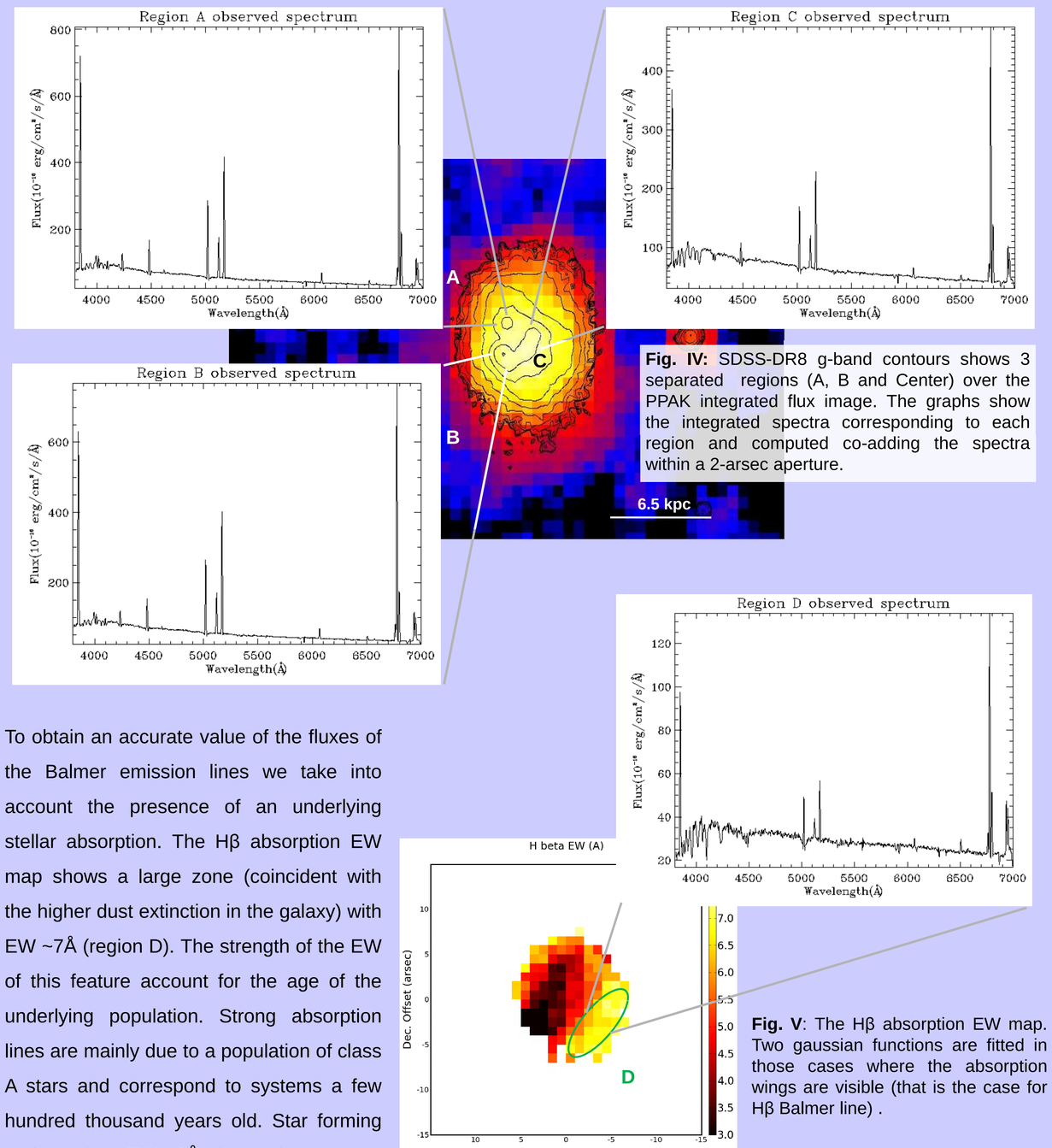

Fig. IV: SDSS-DR8 g-band contours shows 3 separated regions (A, B and Center) over the PPAK integrated flux image. The graphs show the integrated spectra corresponding to each region and computed co-adding the spectra within a 2-arsec aperture.

To obtain an accurate value of the fluxes of the Balmer emission lines we take into account the presence of an underlying stellar absorption. The Hβ absorption EW map shows a large zone (coincident with the higher dust extinction in the galaxy) with EW ~7Å (region D). The strength of the EW of this feature account for the age of the underlying population. Strong absorption lines are mainly due to a population of class A stars and correspond to systems a few hundred thousand years old. Star forming regions show EW ~3Å , in good agreement with young starbursts.

Fig. V: The Hβ absorption EW map. Two gaussian functions are fitted in those cases where the absorption wings are visible (that is the case for Hβ Balmer line) .

BPT diagram computed for all the spaxels in the PPAK datacube shows no evidence of nuclear activity. The values are in good agreement with a pure star forming galaxy with ½ solar metallicity.

	A	*B*	*C*	*D*
$L_{H\alpha}$ (10^{41} erg/s)	2.7	2.8	2.4	0.8
SFR ($M_{\odot}/yr$)	2.1	2.2	1.9	0.6
$F_{H\alpha}$ ($\cdot 10^{-14}$ erg/s/cm^2)	6.6	6.2	3.7	1.0
AHα (mag)	0.66	0.76	1.14	1.34

Table III: Summary of the properties for the selected regions of UCM1648+2855 .

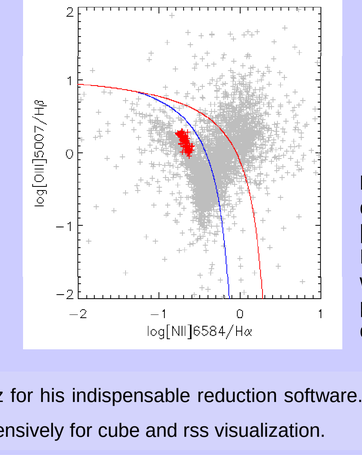

Fig. VI: Emission-line diagnostic diagram [OIII]λ5007/Hβ vs [NII]λ6584/Hα adapted from Brinchmann et al. 2004 (SDSS) with the line ratio values for each pixel in PPAK UCM1648+2855 datacube plotted in red crosses.

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