67

Self-consistent photometric and spectroscopic Star Formation Histories in Dwarf Galaxies

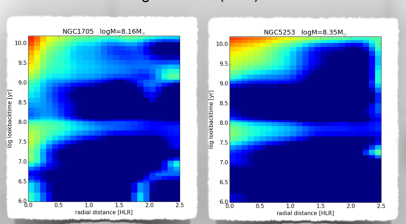
R. García-Benito, E. Pérez, E. Pérez-Montero, R. González Delgado, J. M. Vílchez

Abstract

This project aims to unify the spectroscopic and stellar photometric views by performing a comprehensive study of a sample of the nearest Blue Compact Dwarf Galaxies (BCDs). We plan to derive Star Formation Histories (SFH) both by means of Color-Magnitude Diagrams (CMDs) from extant Hubble Space Telescope (HST) optical imaging and with spectral fitting methods techniques using **MUSE**, allowing us to obtain state-of-the-art 2D stellar properties and abundances of the gas in BCDs.

SFH

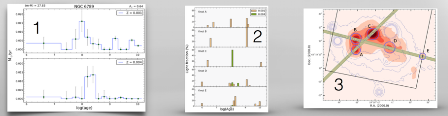
Star Formation History 2D maps derived from the fossil record analysis for NGC1705 (left) and NGC5253 (right). Vertical axis represents log(lookbacktime) and horizontal axis radial distance to the center in Half Light Radius (HLR) units.



The star formation histories will be compared with their corresponding CMDs results derived from the HST data.

Pilot Project

Very few attempts have been made to combine both spectroscopic and photometric techniques for galaxy evolution studies, in particular for BCDs. The SFH can be analyzed, both by means of deep CMDs and by stellar population spectral synthesis, that should provide a consistent view of the SFH and other stellar properties.



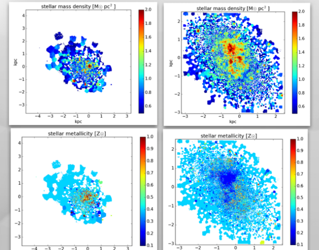
In García-Benito & Pérez-Montero (2012, MNRAS, 423, 406), we used optical HST data to derive the SFH of the BCD NGC 6789 by means of the CMD (1) and by fitting the optical spectrum (2) of the five brightest knots observed using long-slit spectroscopy (3). The combination of several observational and model techniques lead to a better and self-consistent study of BCDs.

Future Work

We plan to derive all stellar and gas 2D properties to perform a comprehensive analysis of this sample of BCDs. We will also derive the stellar classification of the most relevant stars both using spectral and photometric data.

This work will forward our understanding of the nature and properties of local BCD, and also provide a detailed test for the two most mature techniques to derive star formation histories, namely, through CMD photometry and spectral fitting.

Stellar Properties



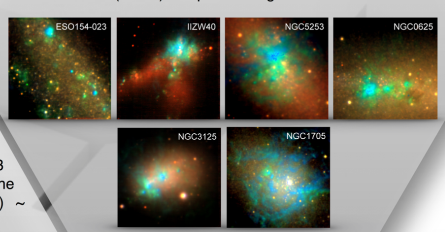
Stellar mass density (top) and stellar metallicity (bottom) for NGC 1705 (left) and NGC 5253 (right). Stellar properties derived from spectral synthesis techniques using STARLIGHT code and Charlot and Bruzual (2007) models (see González-Delgado et al. 2015)

Sample

We observed 6 nearby (< 10Mpc) BCDs galaxies with MUSE (P.I. R. García-Benito, Cycle 94A) that have already HST counterpart in at least three broad band filters.

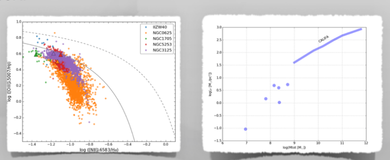
7400 Å 6550 Å 5000 Å

RGB broad band (800 Å) composite image of the MUSE data cubes

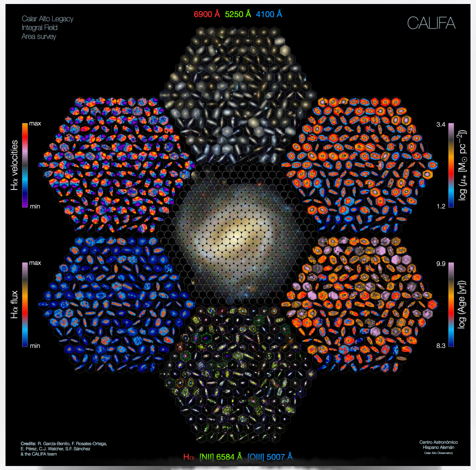


Physical Properties

Thanks to the MUSE wavelength coverage, we can derive the physical conditions of the gas. In average, for all the galaxies (except ESO154-023, because low S/N), the extinction (from Hα/Hβ) is $A_V \sim 0.3$ mag, the density 100 cm^{-3} (from [SII] λ6716/λ6731) and the average [SIII] electron temperature (from λ6312/λ9069) ~ 10000K.



BPT diagram (left) for the spaxels with S/N > 3 for each involved line. Total mass vs mass surface density (right) derived from the stellar population analysis together with the low end curve for CALIFA.



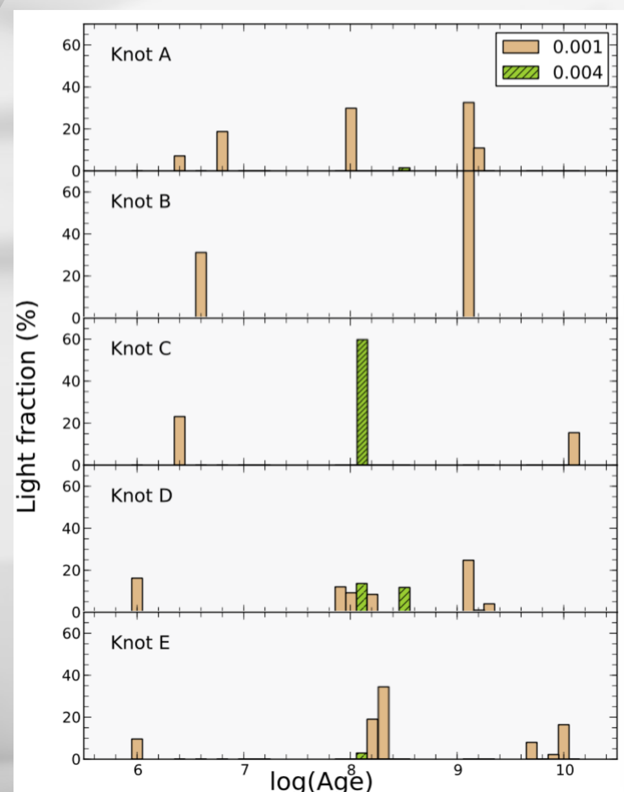
CALIFA DR2

García-Benito et al. (2015)

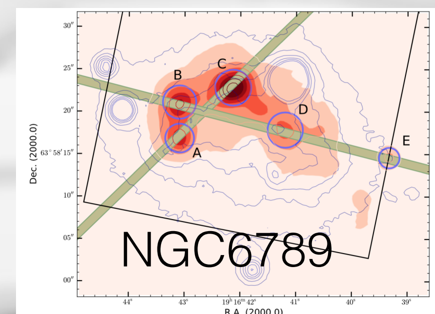
Self-consistent photometric and spectroscopic Star Formation Histories in Dwarf Galaxies

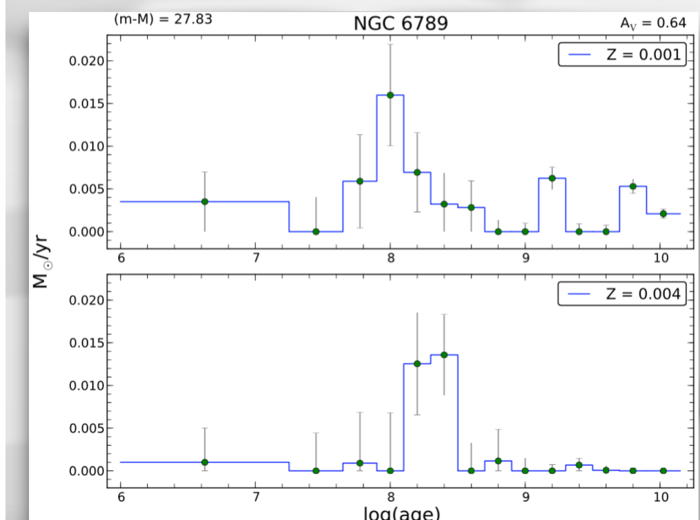
R. García-Benito, E. Pérez, E. Pérez-Montero, R. González Delgado, J. M. Vílchez

Pilot Project



Spectral fitting





CMD

García-Benito & Pérez-Montero

2012, MNRAS, 423, 406

Self-consistent photometric and spectroscopic Star Formation Histories in Dwarf Galaxies

R. García-Benito, E. Pérez, E. Pérez-Montero, R. González Delgado, J. M. Vílchez

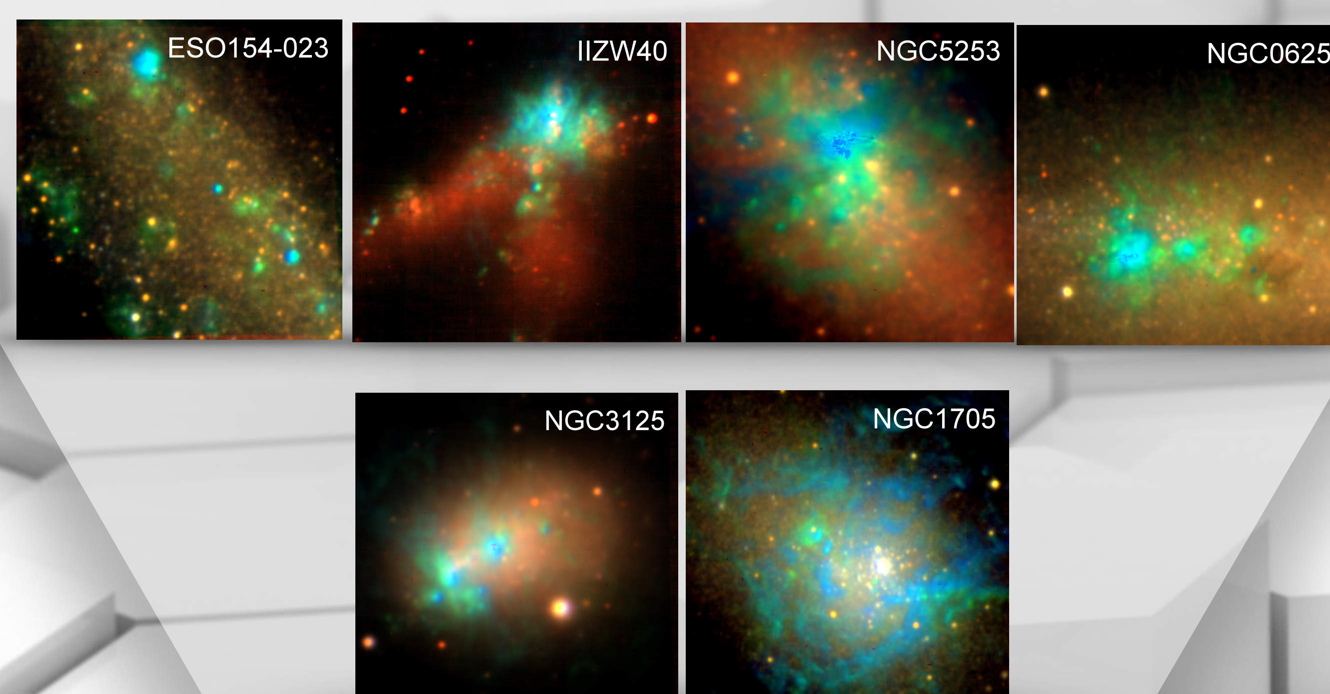
Sample

+ 6 with PPAK

6 nearby (< 8 Mpc) BCDs galaxies with **MUSE** (P.I. R. García-Benito) that have already **HST** counterpart in at least three broad band filters.

7400 Å 6550 Å 5000 Å

RGB broad band (800 Å) composite image of the MUSE data cubes

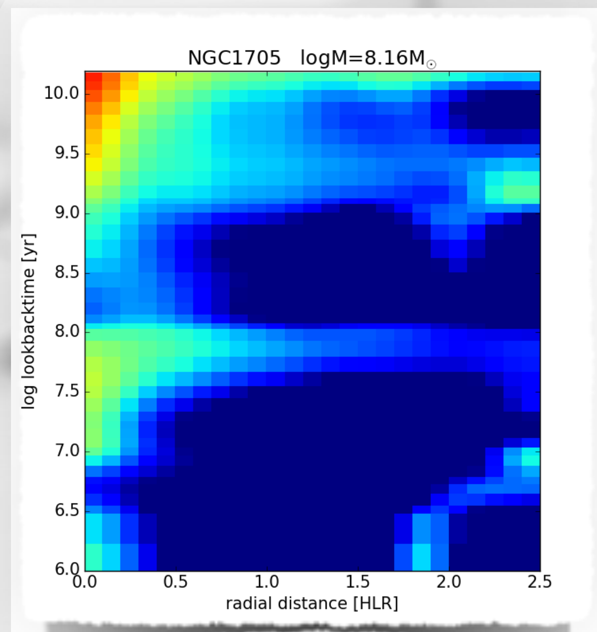


Self-consistent photometric and spectroscopic Star Formation Histories in Dwarf Galaxies

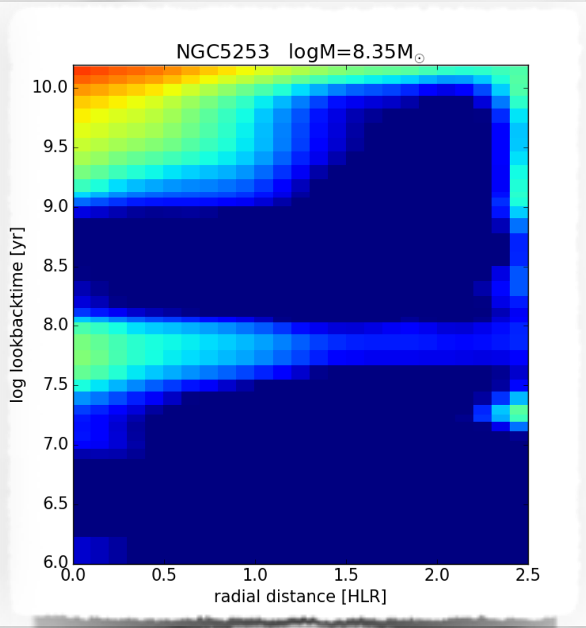
R. García-Benito, E. Pérez, E. Pérez-Montero, R. González Delgado, J. M. Vílchez

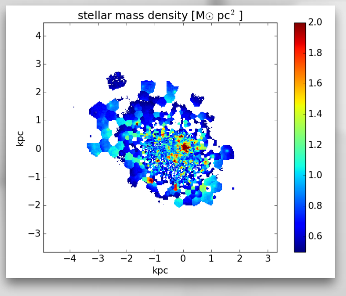
SFH (spectral)

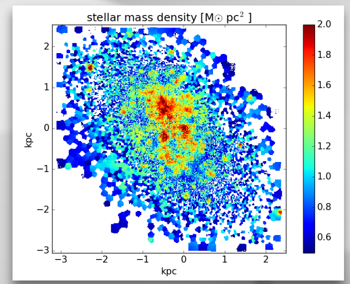
NGC1705

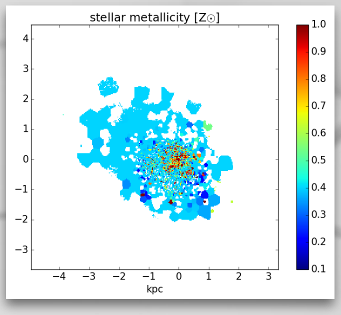


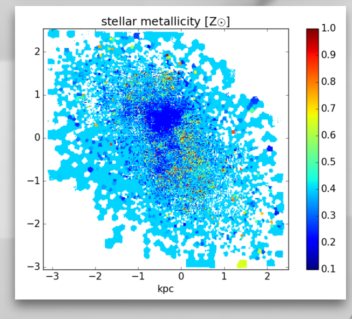
NGC5253











The dependence of oxygen and nitrogen abundances on stellar mass from the CALIFA survey

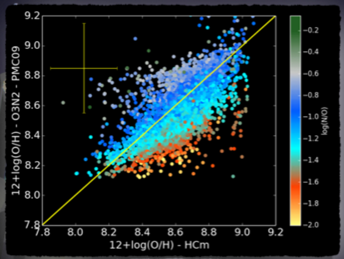
E. Pérez-Montero[1], R. García-Benito[1], J.M. Vílchez[1], S.F. Sánchez[2], C. Kehrig[1]
& the CALIFA collaboration

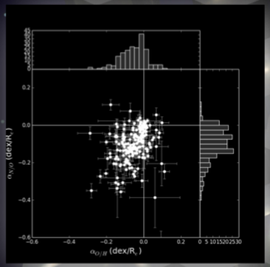
INTRODUCTION

We use the optical spectra of emission-line regions of 350 galaxies taken in CALIFA (Calar Alto Legacy Integral Field Area survey, Sánchez et al. 2012) to study the spatial distribution of O/H and N/O chemical abundances. The observations were taken with the Integral Field Unit PMAS in the 3.5 m. CAHA telescope covering the 3750 – 7100 AA spectral range with gratings V500 and V1200. The data were reduced using the pipeline v. 1.5, the underlying stellar population and the emission lines were fitted using FIT3D and the emission-line regions were extracted using HIIExplorer.

O/H AND N/O CHEMICAL ABUNDANCES

We selected star-forming HII regions and derived O/H and N/O chemical abundances using the code HII-CHI-mistry (Pérez-Montero 2014). This is based on a chi-square weighted mean of observed reddening corrected relative optical emission lines [OII], [NII] and [SII] compared to a grid of photoionization models consistent with the direct method. When N/O is previously calculated, we can use [NII] emission lines to predict O/H with more confidence (Pérez-Montero & Contini 2009) obtaining non-negligible differences with respect to to the assumption of a traditional O/H vs. N/O relation.



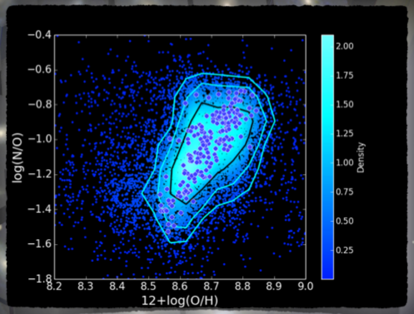


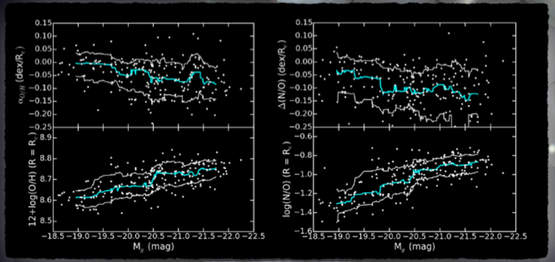
GRADIENTS OF METALLICITY

We performed robust error-weighted linear fittings to all non-interacting galaxies with at least 10 selected HII regions (201 objects) in the whole radial range. Mean slopes for O/H (alpha = -0.053 dex/Re) and N/O (-0.102 dex/Re) are negative, but no clear correlation is found between them. The fraction of objects with flat or inverted gradient (10% for O/H and 5% for N/O) is kept when inclined galaxies are ruled out or the radial range is restricted.

O/H AND N/O CHARACTERISTIC VALUES

The O/H and N/O values of the fittings at the effective radius can be taken as a characteristic abundance value for the whole galaxy. The dispersion in the O/H vs. N/O relation (magenta points) for these values presents a much lower dispersion than for individual HII regions (blue points) regardless of the slopes, inclinations or fitted radial range.





RELATION WITH INTEGRATED PROPERTIES

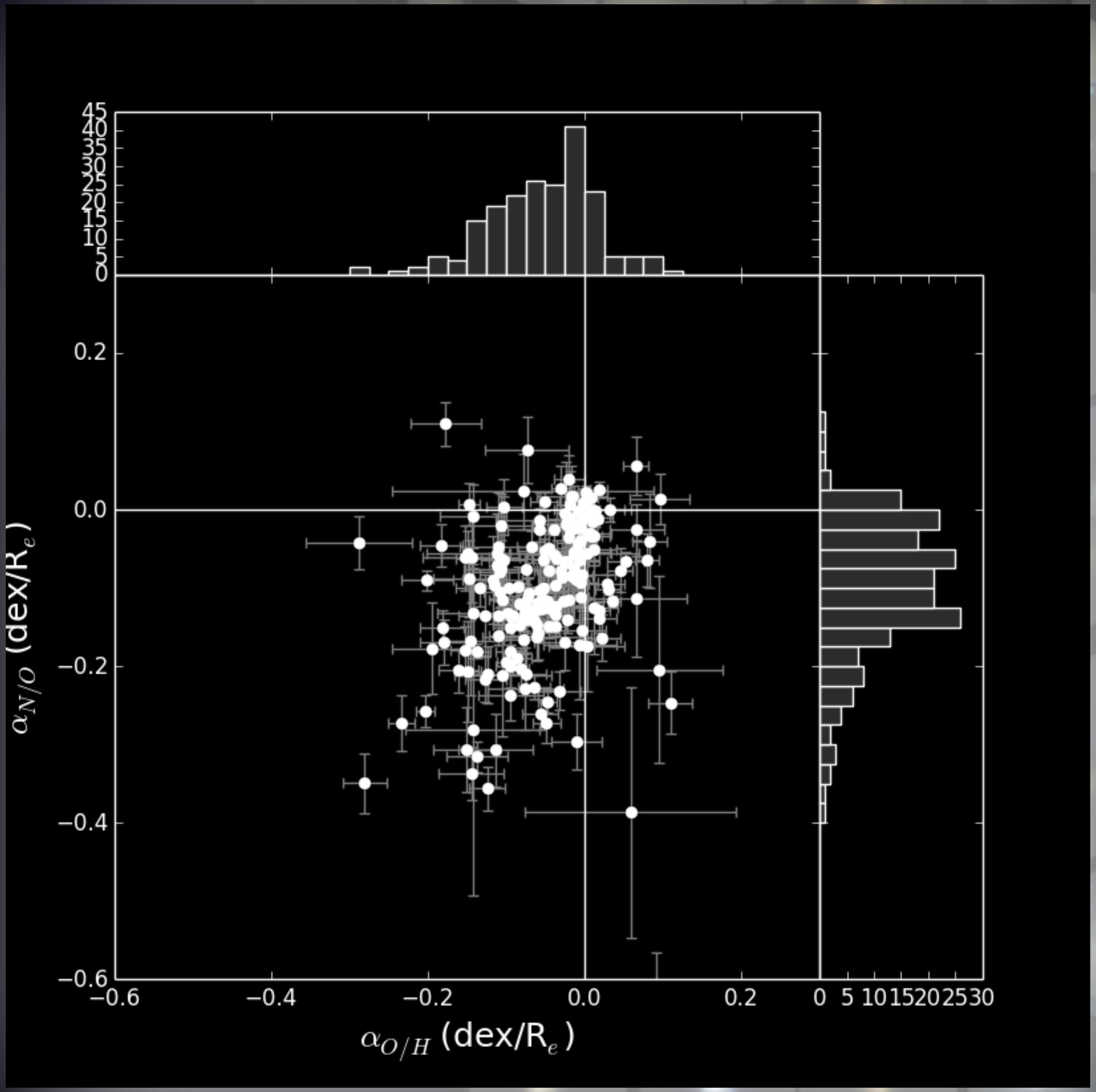
The relation between the characteristic O/H and N/O values has a very tight correlation with the stellar mass of the galaxies, but no trend is seen with the obtained slopes (as in Sánchez et al. 2014). The mass-metallicity relation dominates all the relations with other integrated properties (star formation rate, integrated color, morphology)

CONCLUSIONS

Although galaxies present a wide variety of spatial chemical distributions both for O/H and N/O, a characteristic value at the effective radius can be obtained that tightly correlates with stellar mass. No other dependences are found with other integrated properties such as SFR, morphology or presence of a bar.

The dependence of oxygen and nitrogen abundances on stellar mass from the CALIFA survey

E. Pérez-Montero, R. García-Benito, J.M. Vílchez, S.F. Sánchez, C. Kehrig
& the CALIFA collaboration



HII regions

O/H and N/O chemical abundances using HII-CHI-mistry (Pérez-Montero 2014).

* Non-interacting galaxies
* > 10 HII regions (201 objects)

* Mean slope N/O: -0.102 dex/Re

* No clear correlation between them

68

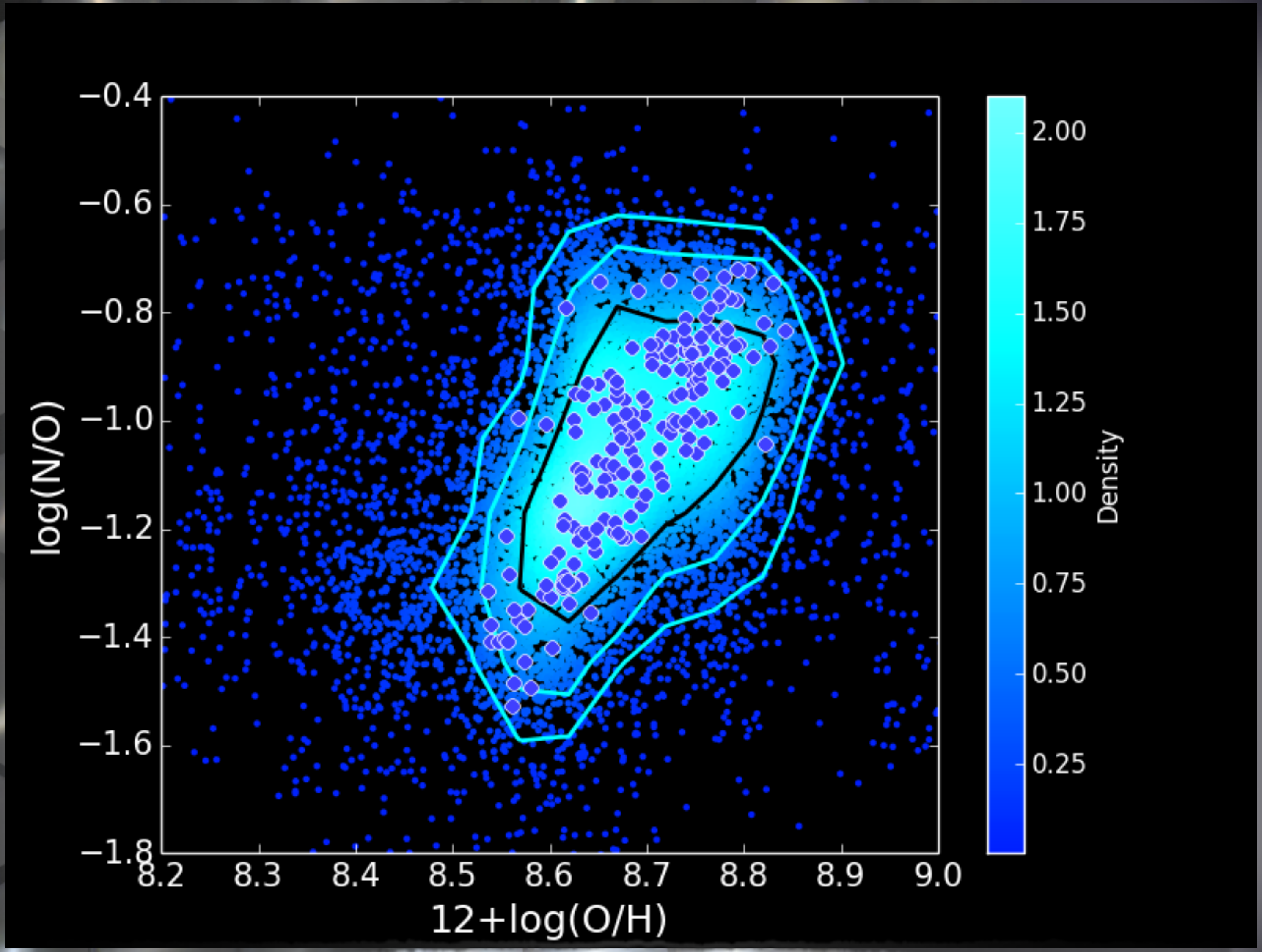
The dependence of oxygen and nitrogen abundances on stellar mass from the CALIFA survey

E. Pérez-Montero, R. García-Benito, J.M. Vílchez, S.F. Sánchez, C. Kehrig
& the CALIFA collaboration

O/H AND N/O CHARACTERISTIC VALUES

O/H and N/O @ R_e ➜ characteristic abundance value for the whole galaxy

Dispersion in the O/H vs. N/O relation (magenta points) much lower than for individual HII regions (blue points)



68

The dependence of oxygen and nitrogen abundances on stellar mass from the CALIFA survey

E. Pérez-Montero, R. García-Benito, J.M. Vílchez, S.F. Sánchez, C. Kehrig
& the CALIFA collaboration

CONCLUSIONS

Characteristic value at the effective radius correlates with stellar mass

No other dependences are found with other integrated properties such as SFR, morphology or presence of a bar.