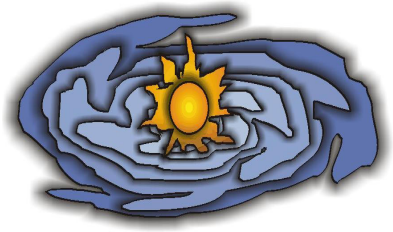
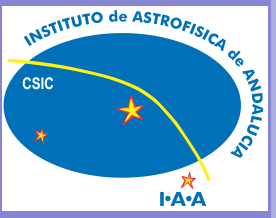
Physical and chemical properties of galaxies with star formation at different environments

Salvador Duarte Puertas

Instituto de Astrofísica de Andalucía (IAA-CSIC)
Departamento de Astronomía Extragaláctica



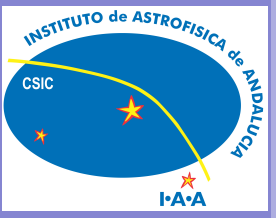
Supervisors: José M. Vilchez Medina & Jorge Iglesias Páramo



Overview

1 Introduction

2 Aims



Overview

1 Introduction

2 Aims

Motivation

Open question

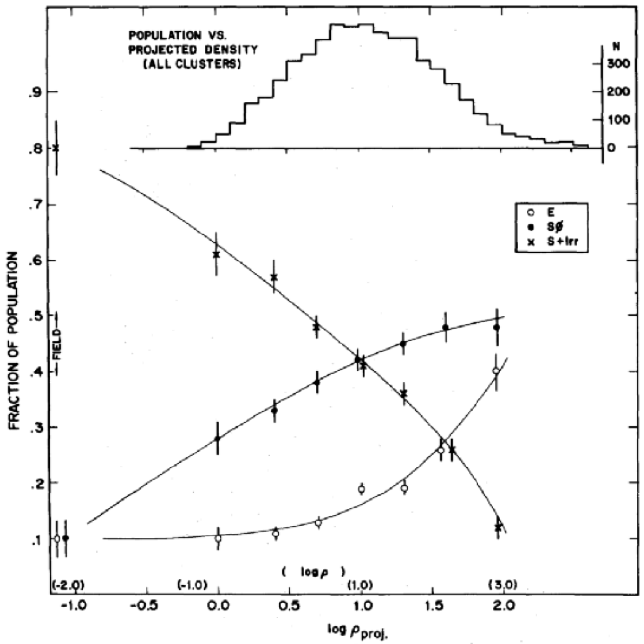
- How star formation and metal content of galaxies are evolving with redshift, environment, and mass?

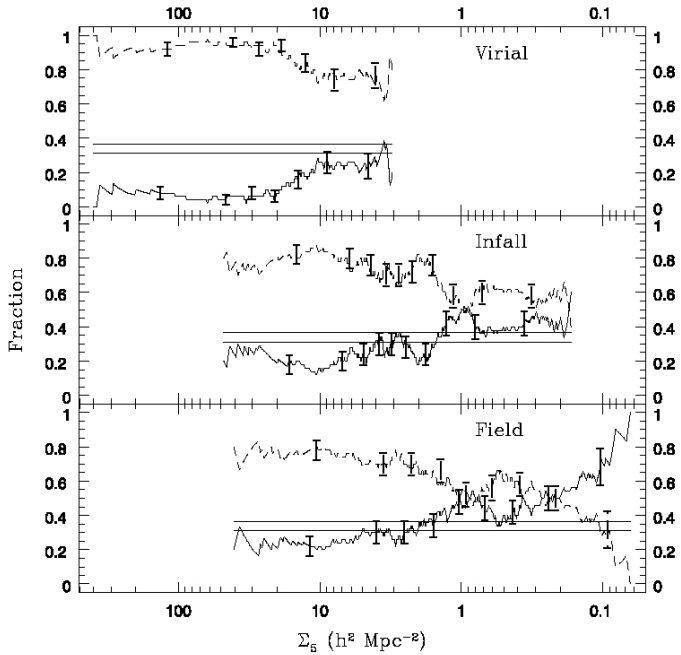
How the emission of $\mathrm{H}\alpha$ and the HII regions (i.e. present star formation rate, SFR) are distributed through the galactic disk?

How is the distribution and the evolution of the star formation activity and metallicities in galaxies in different environments: from galaxy clusters to the field?

Project background

Morphology-density relation (e.g. [Dressler 1980]) and **Star formation-density relation** (e.g. [Rines et al. 2005])

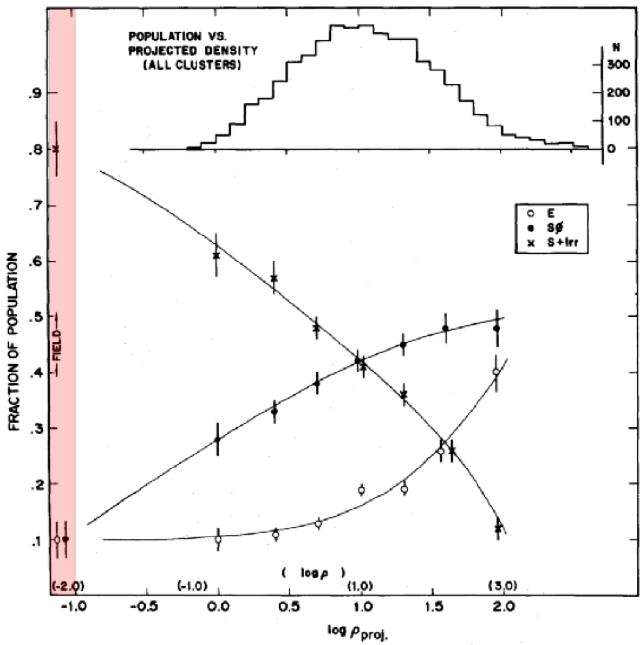




Both properties are strongly affected in galaxies located in dense environments (e.g. groups and clusters).

Project background

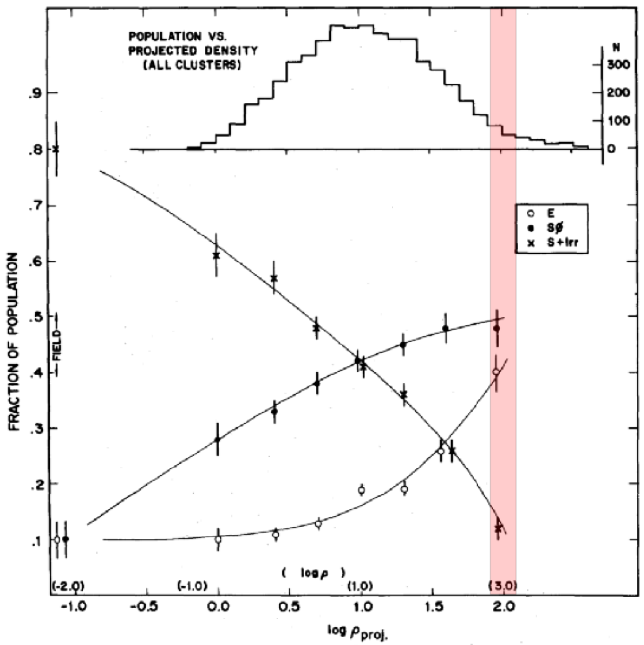
Morphology-density relation (e.g. [Dressler 1980]). Isolated environments. SIG 7551 [Argudo-Fernández et al. 2015]



The fraction of late type galaxies decreases when the density of galaxies increases.

Project background

Morphology-density relation (e.g. [Dressler 1980]). Dense environments. Coma cluster

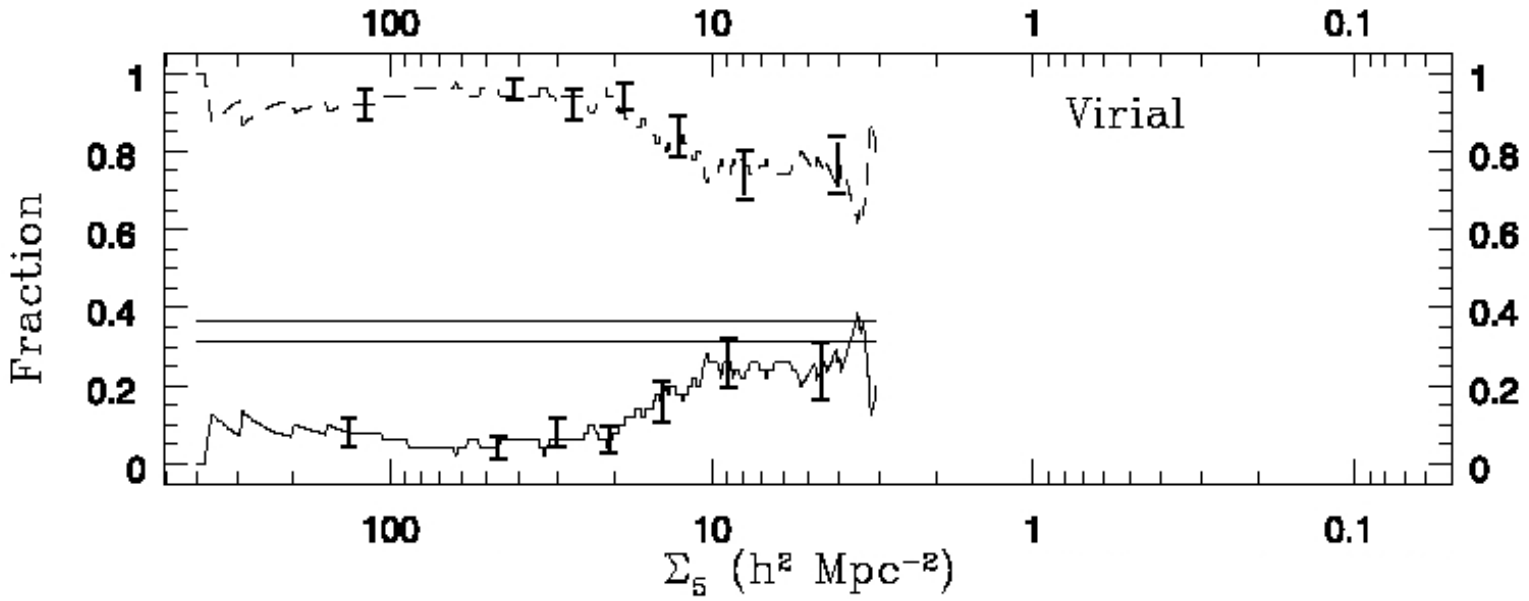


As a conclusion:

Environment affects to their galactic structure.

Project background

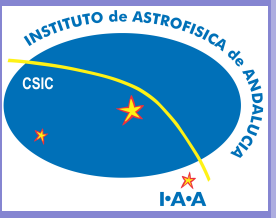
Star formation-density relation (e.g. [Rines et al. 2005]).



Star formation activity is strongly affected in galaxies located in dense environments (e.g. groups and clusters). Wrt the field.

As a conclusion:

Dense environment reduce galactic star formation activity.



Overview

1 Introduction

2 Aims
- Main goal
- Samples
- Step by step

Main goal

What do we want to know?

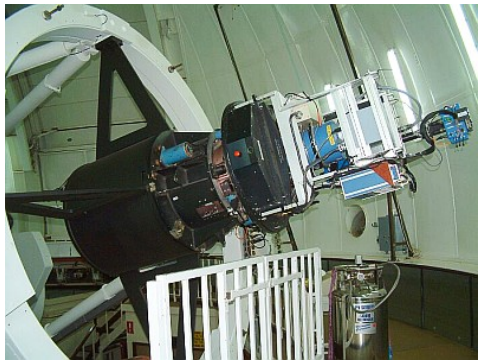
The evolution of star formation and chemical properties on galaxies depending on different environments.

How are we going to do that?

$\mathrm{H}\alpha$ line luminosity (tracing the SFR, improve [Kennicutt et al. 2009]).
Emission line spectroscopy information to derive metallicities.

Now available

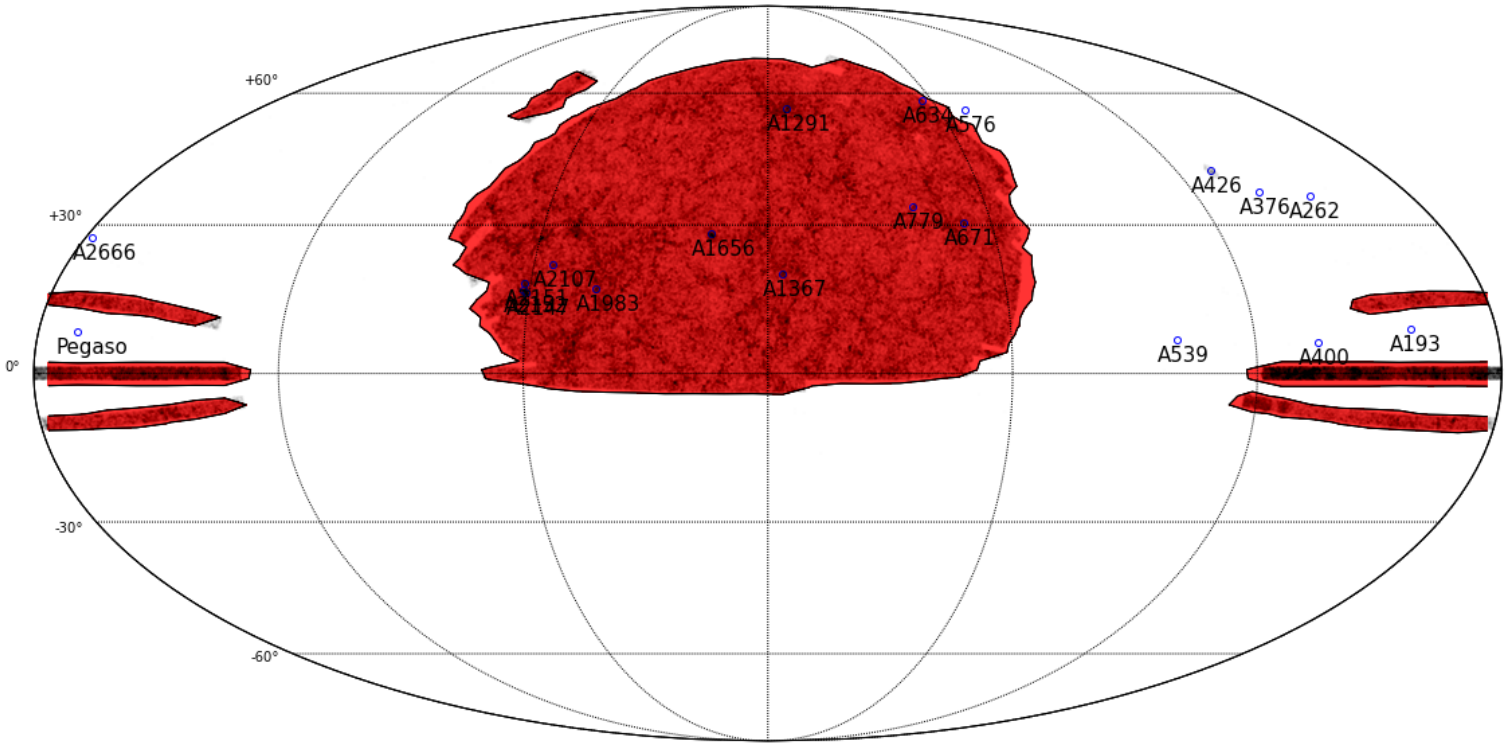
- $H\alpha$, broad-band, and spectrophotometry in the **entire galaxy**.
- Representative samples of galaxy groups and clusters from Northern hemisphere of the **local Universe**.
- Observed with WFC, INT2.5m from La Palma.



We will include

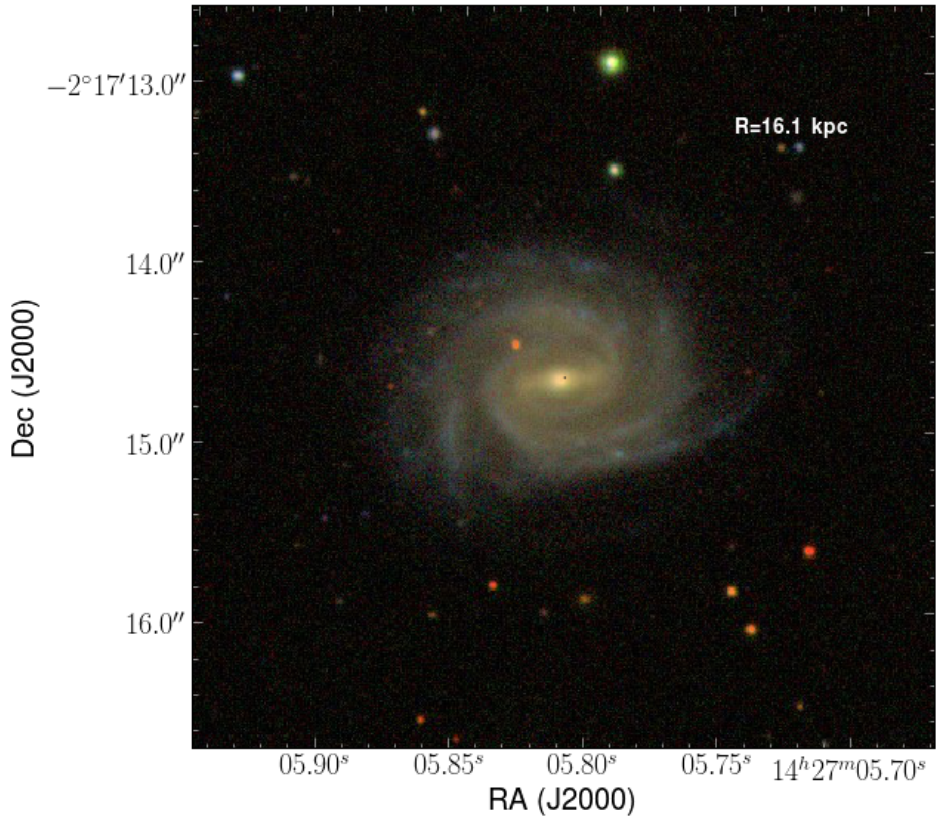
SFR and metallicity in a SDSS spectrophotometric data until **z∼0.35** to all the environments. Aperture of a spectroscopic fiber (**3" in diameter**).

We will include



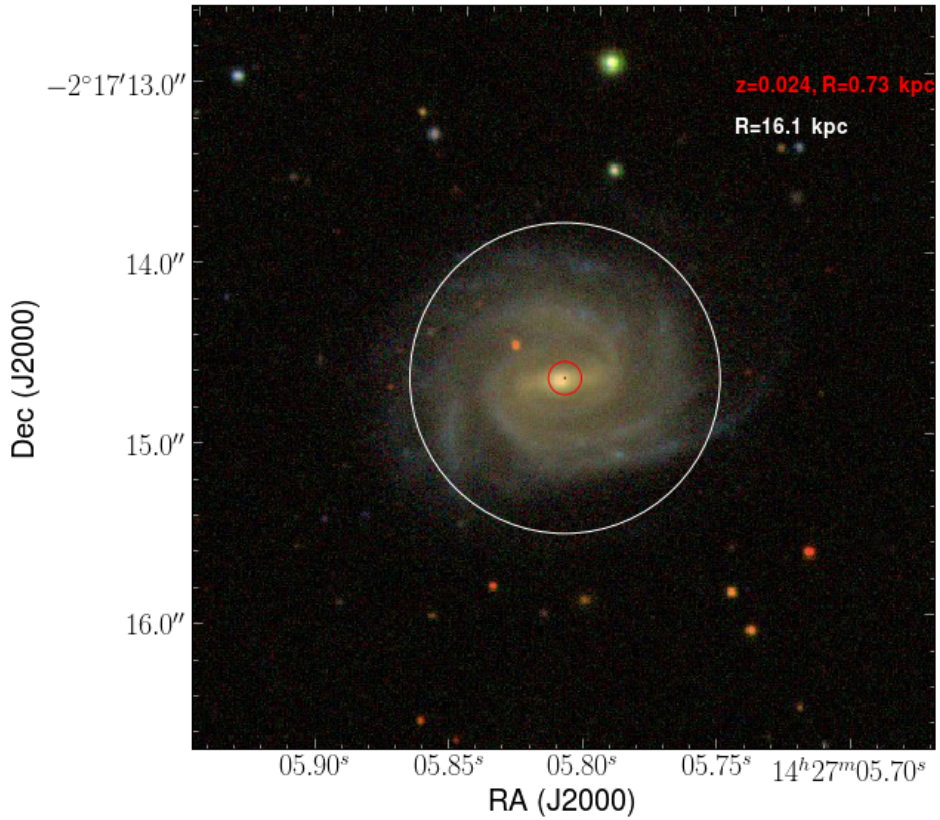
Problem

Can SDSS spectroscopic fiber observe the entire galaxy?



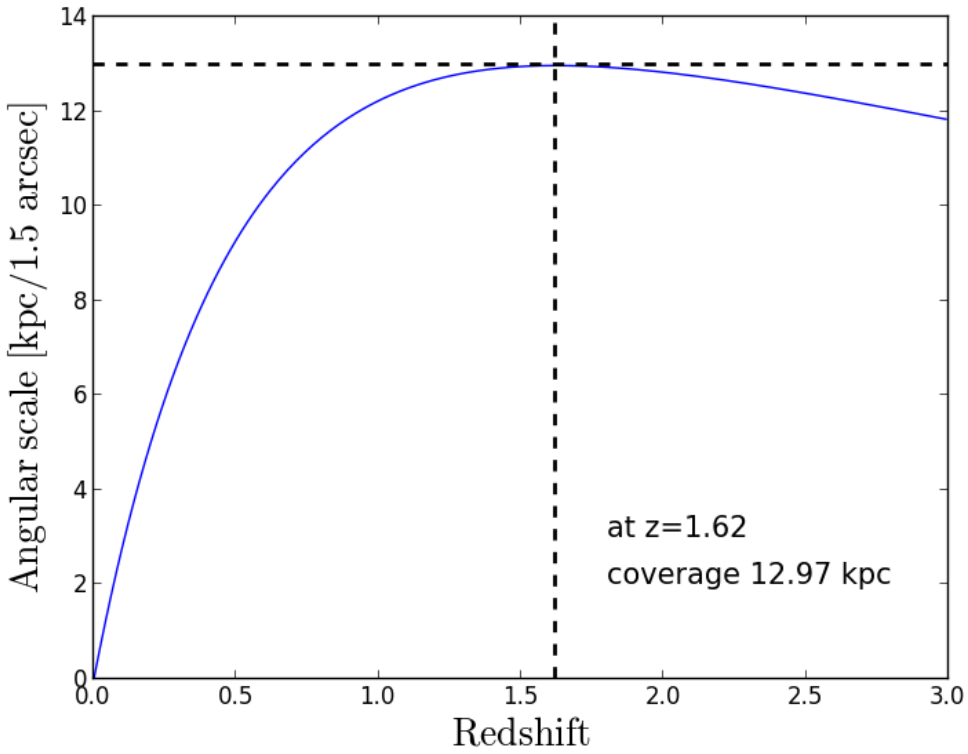
Problem

SDSS cannot observe the entire galaxy.



Problem

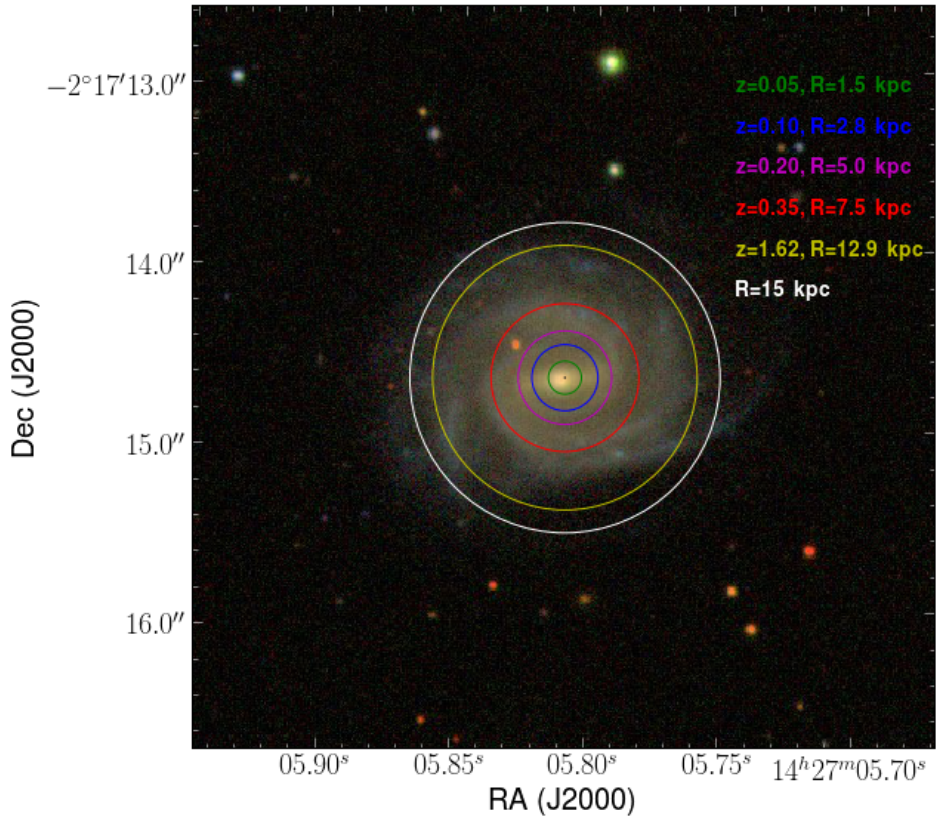
SDSS cannot observe **never** the entire galaxy.



Is the unobserved fraction of galaxy representative?

Problem

SDSS cannot observe **never** the entire galaxy.



Is the unobserved fraction of galaxy representative? Yes. We need to apply coverage corrections.

1. Empirical coverage relations from CALIFA to SDSS galaxies

[**Duarte Puertas, S. et al. in prep.**; Cid-Fernandes et al. 2012; Kew+2001; Kauff+2003]

Estallidos 2015

May 12th, 2015

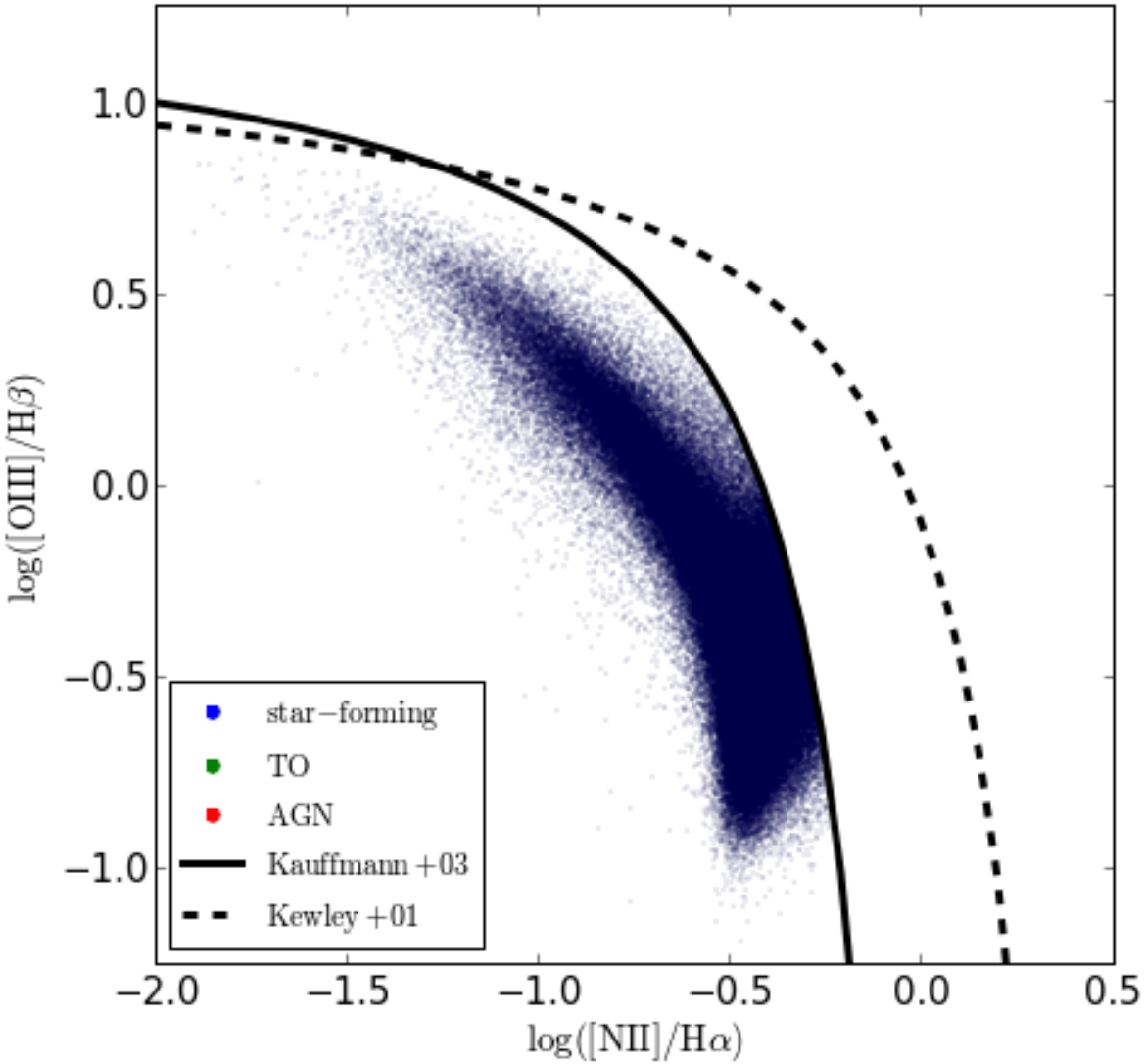
Introduction

Aims

Main goal

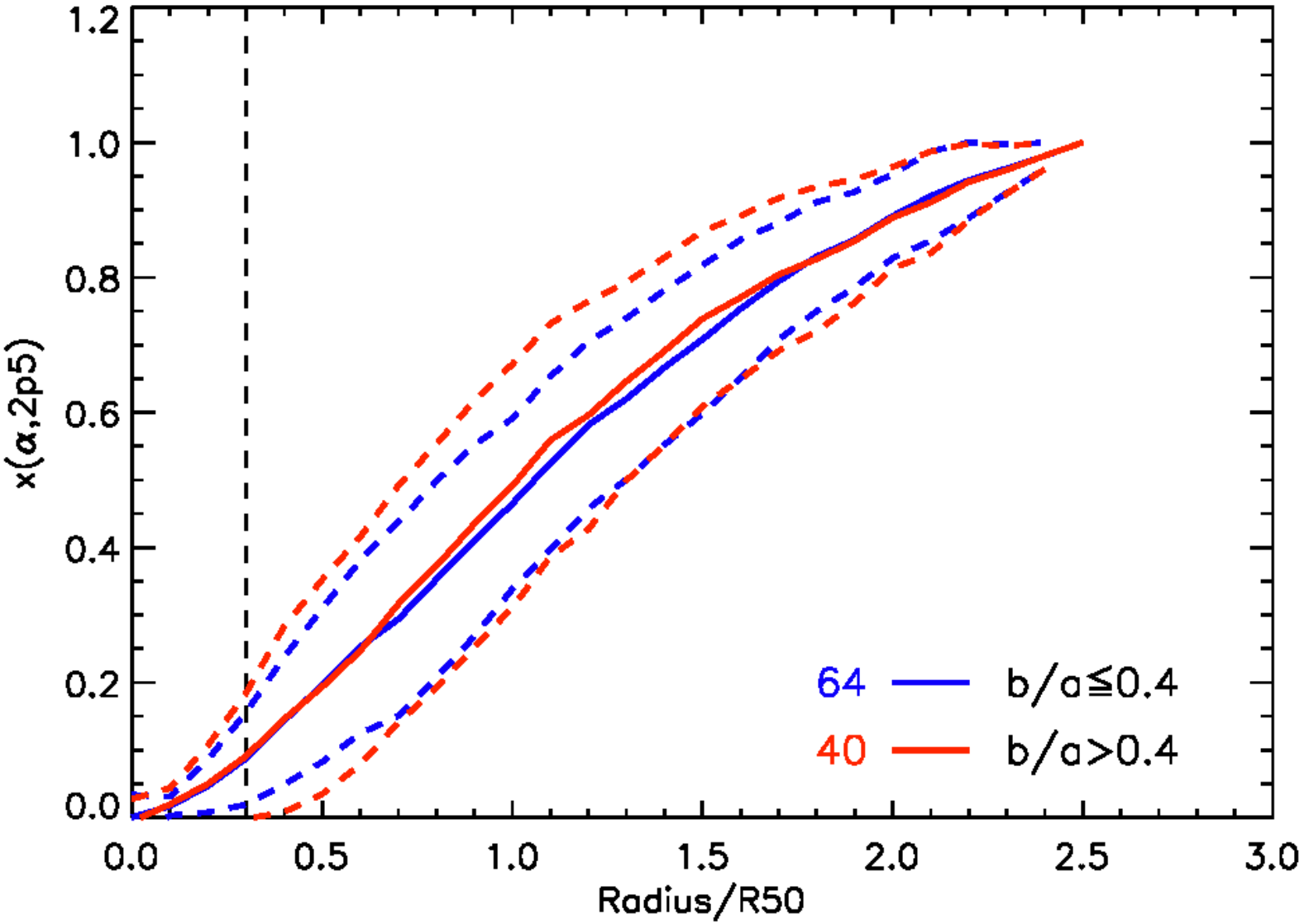
Samples

Step by step



1. Empirical coverage relations from CALIFA to SDSS galaxies

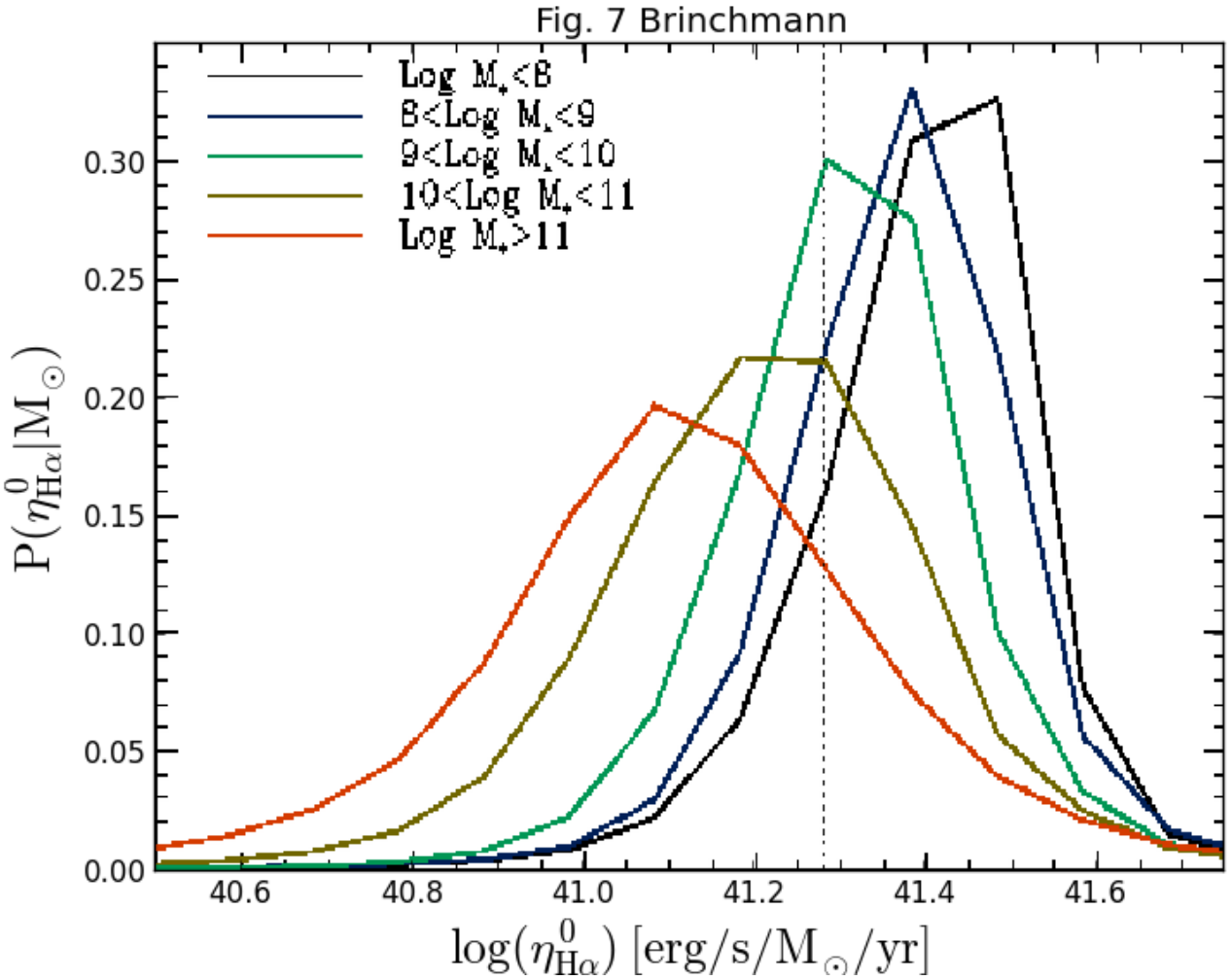
[Iglesias, J. et al. 2013]



1. Empirical coverage relations from CALIFA to SDSS galaxies

[Duarte Puertas, S. et al. in prep.; Brinchmann et al. 2004]

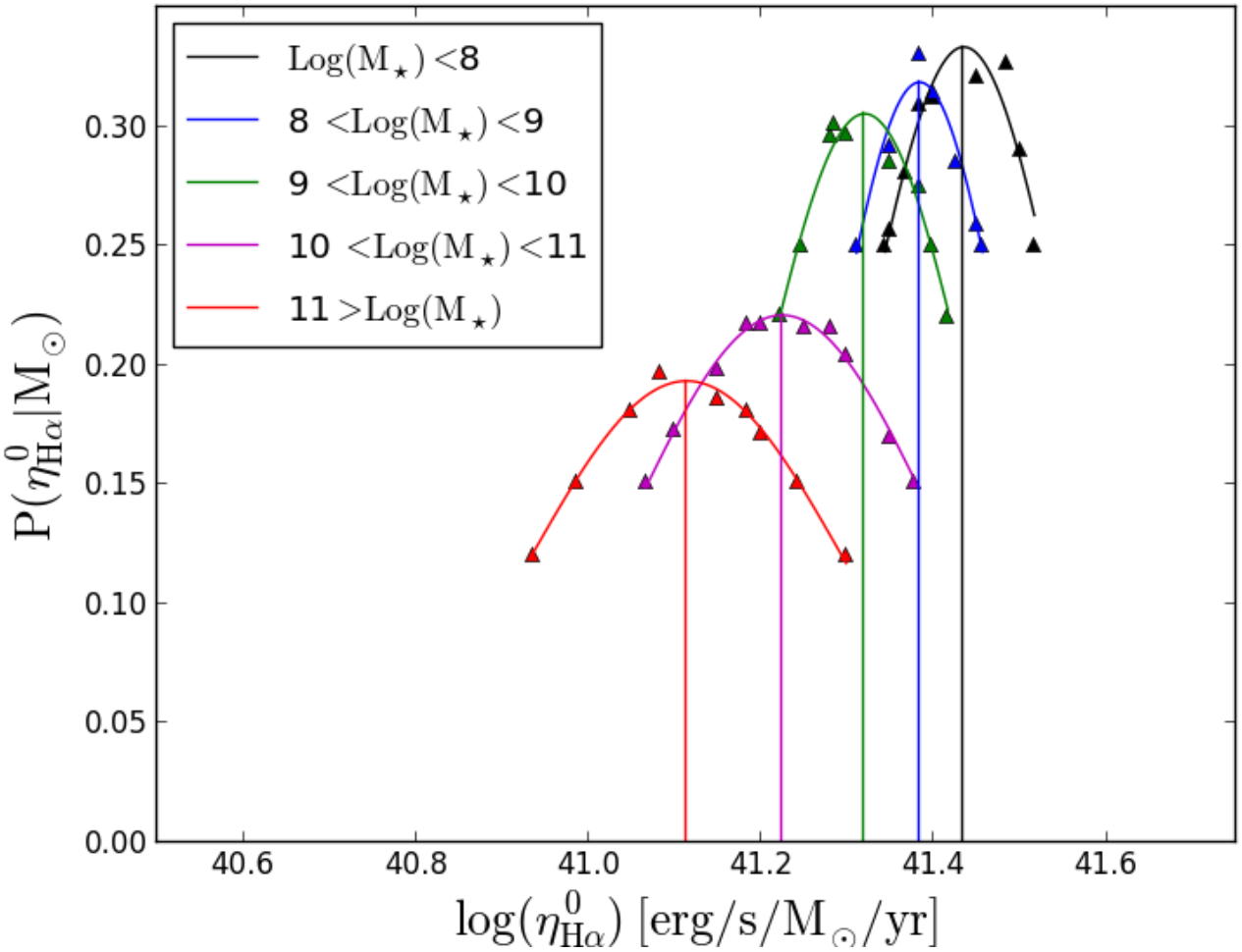
$$\eta^0_{H\alpha} = L(H\alpha)/SFR = f(M_\star)$$



1. Empirical coverage relations from CALIFA to SDSS galaxies

[Duarte Puertas, S. et al. in prep.; Brinchmann et al. 2004]

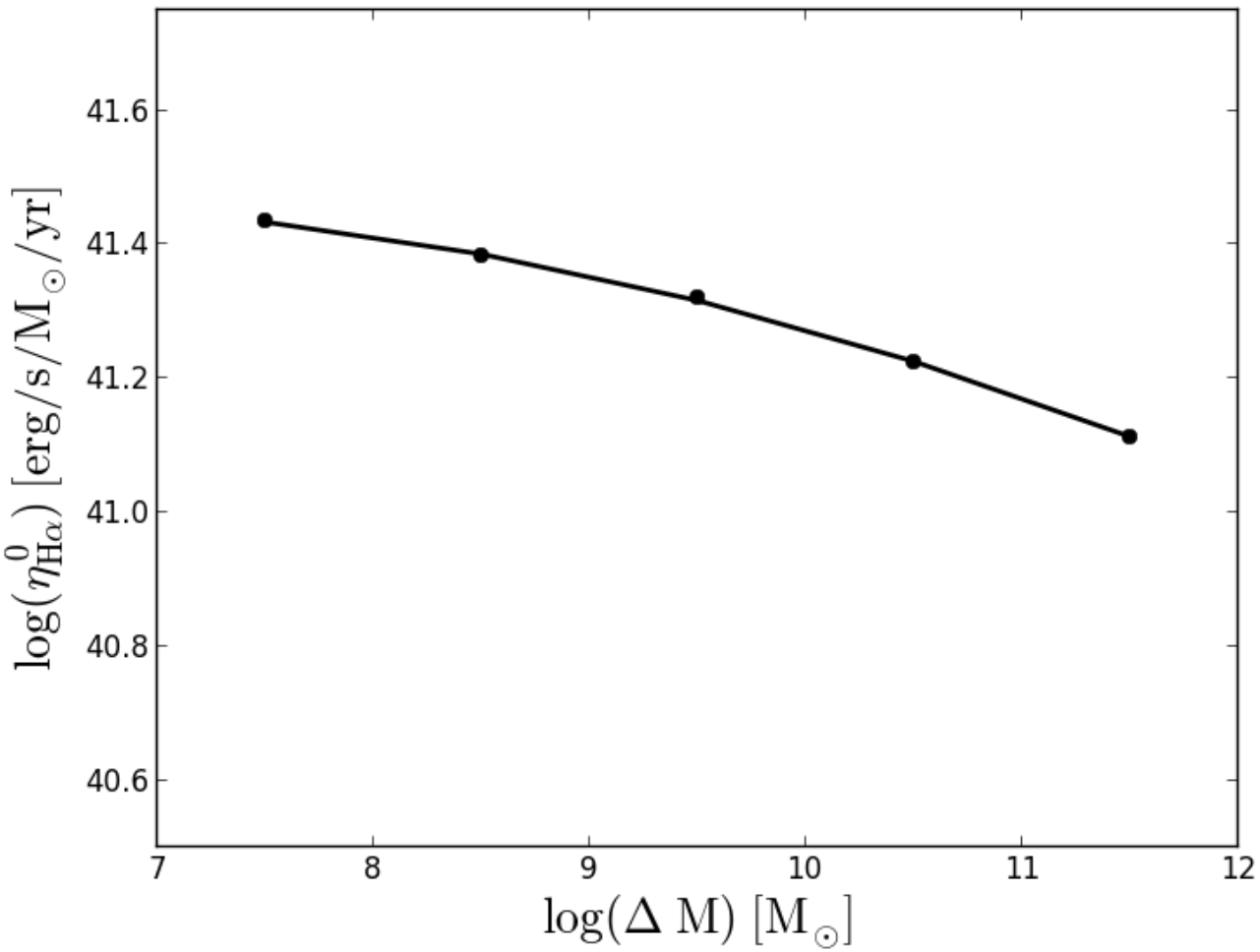
$$\eta^0_{H\alpha} = L(H\alpha)/SFR = f(M_\star)$$



1. Empirical coverage relations from CALIFA to SDSS galaxies

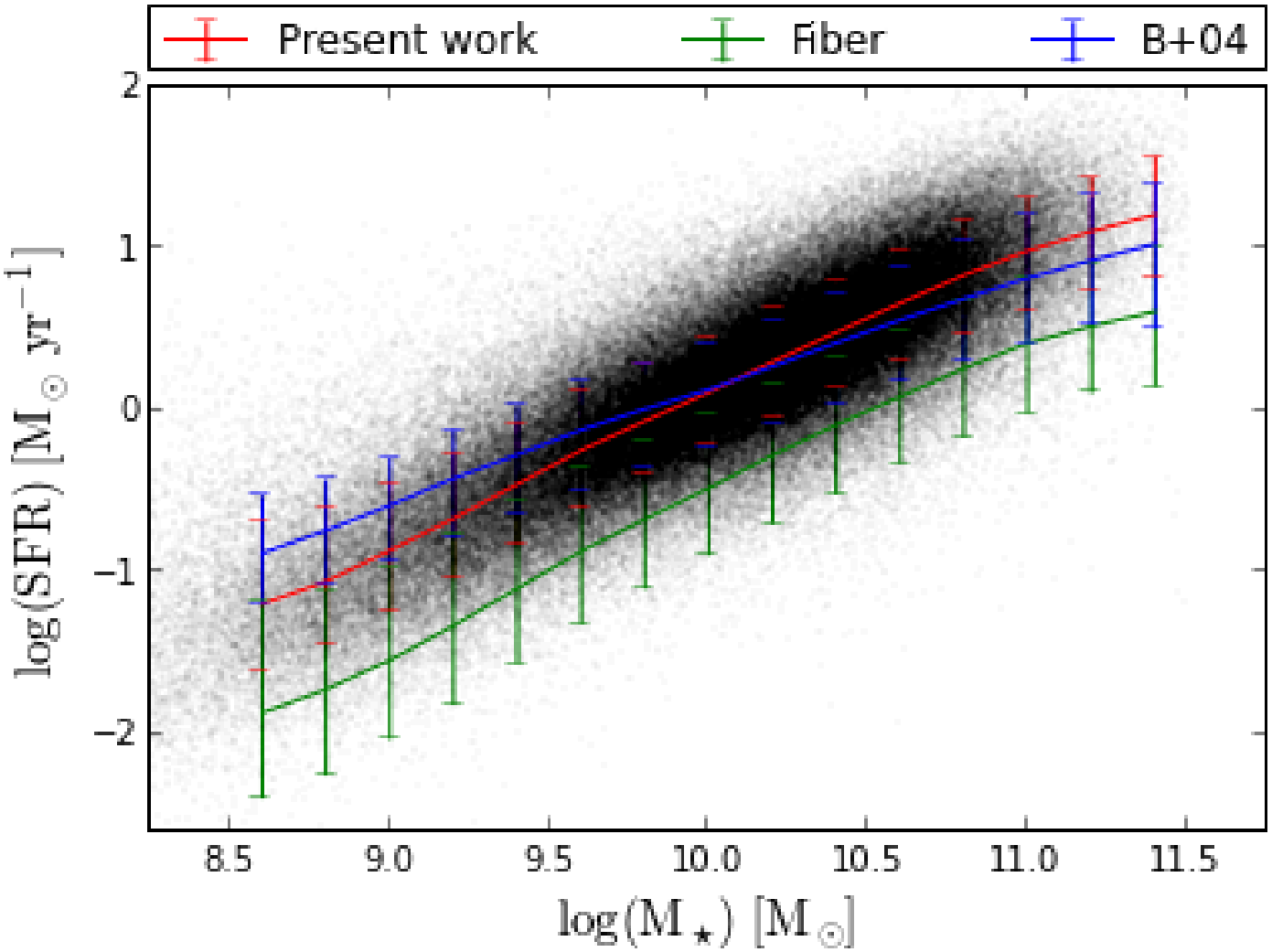
[Duarte Puertas, S. et al. in prep.]

$$\eta^0_{H\alpha} = L(H\alpha)/SFR = f(M_\star)$$



1. Empirical coverage relations from CALIFA to SDSS galaxies

[Duarte Puertas, S. et al. in prep.]

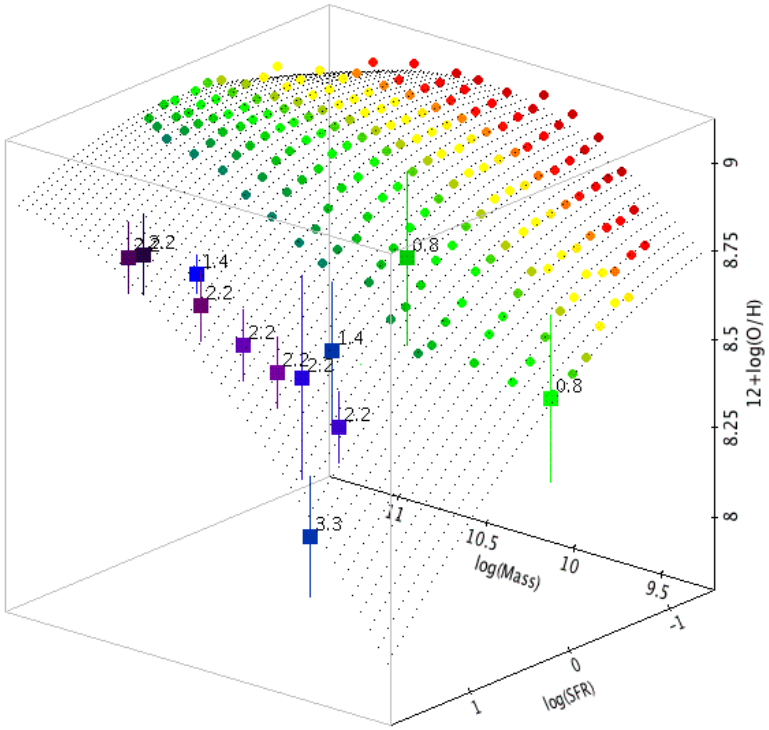


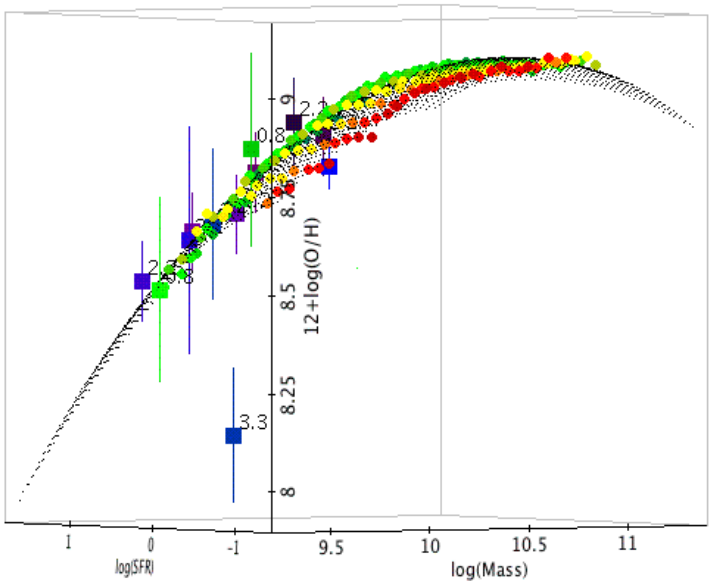
2. Star formation in galaxies in differents environments combining several bands

[Cortese 2006]. A1367

3. Mass-metallicity-SFR relation. Environment and coverage effects

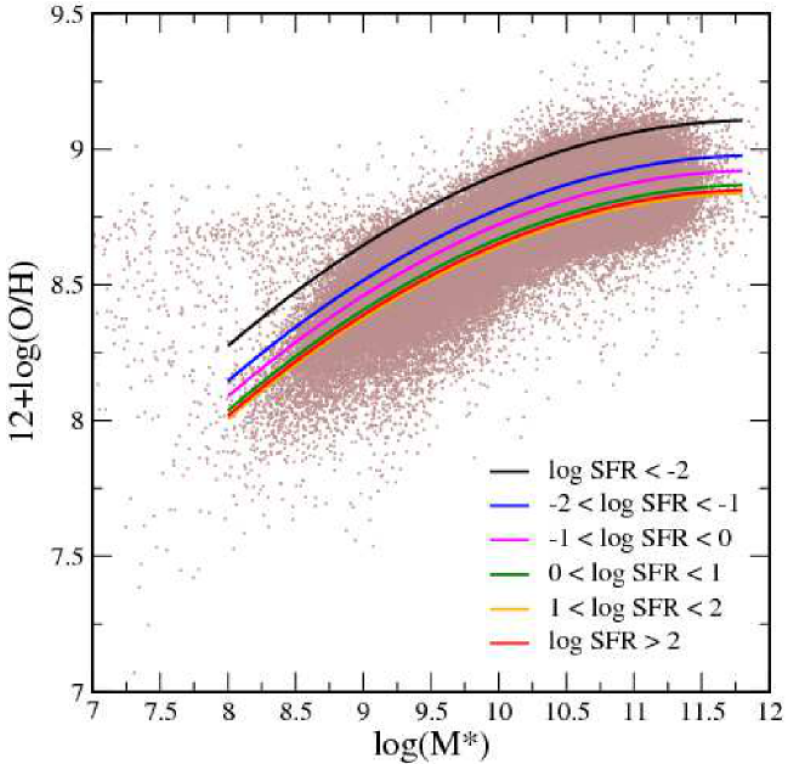
[Mannucci et al. 2010; Petropoulou, V., Vilchez, J., & Iglesias, J. 2012]

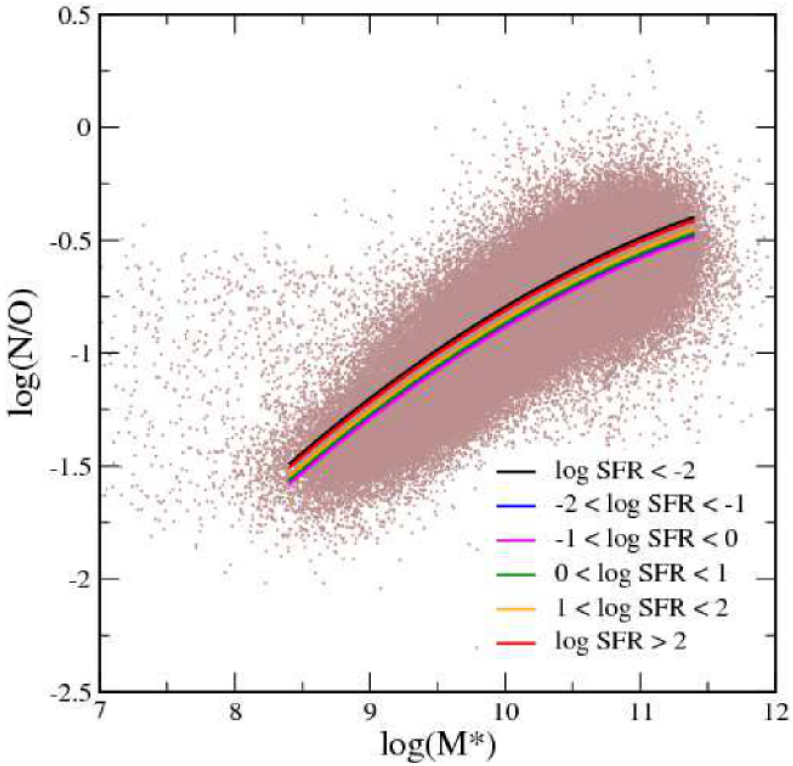


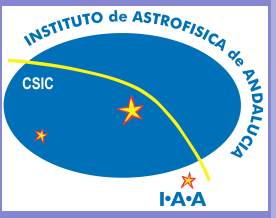


4. Evolution of the mass-metallicity relation

[E. Pérez-Montero et al. 2013]







Thesis structure

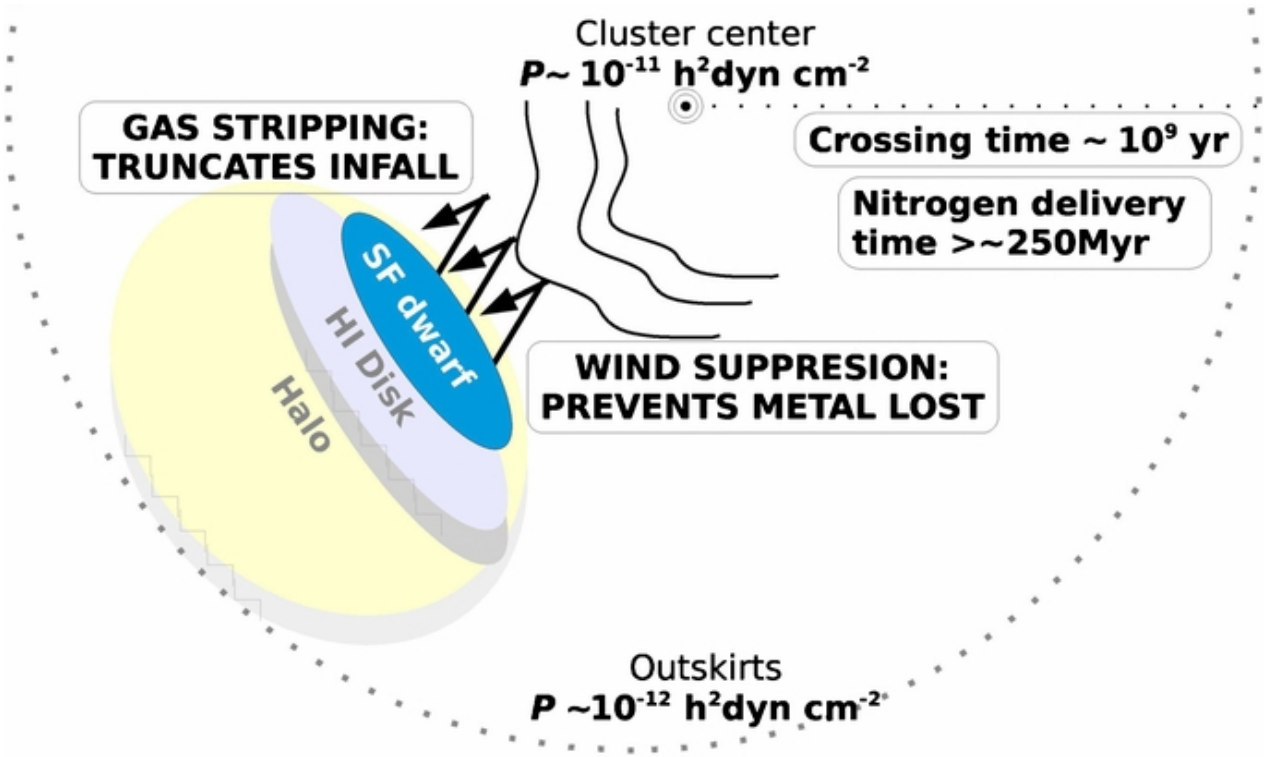
- Empirical coverage relations from CALIFA to SDSS galaxies.
- Star formation in galaxies in differents environments combining several bands.
- Mass-metallicity-SFR relation. Environment and coverage effects.
- Evolution of the mass-metallicity relation.
- Comparing experimental results vs. simulation predictions.

References

- *Dressler, A. 1980, ApJ, 236, 351*
- *Postman, M. & Geller, M. J. 1984, ApJ, 281, 95*
- *Balogh, M. et al. 2004, MNRAS, 348, 1355*
- *Hogg, D. W. et al. 2004, ApJ, 601, L29*
- *Blanton, M. R. et al. 2005, ApJ, 629, 143*
- *Peng, Y. et al. 2010, ApJ, 721, 193*
- *Iglesias, J. et al. 2013, A&A, 553, L7*
- *Elbaz, D. et al. 2007, A&A, 468, 33*
- *Stott, J. P. et al. 2014, MNRAS, 443, 2695*
- *Rines, K. et al. 2005, ApJ, 130, 1482*
- *Kennicutt, JR, R. C. et al. 2009, ApJ, 703, 1672*
- *Petropoulou, V. Vilchez, J. & Iglesias, J. 2012, ApJ, 749, 133*
- *Finlator & Davé 2008, MNRAS, 385, 2181*
- *Argudo-Fernández et al. 2015, A&A, Aceptado*
- *E. Pérez-Montero et al. 2013, A&A, 549, A25*

5. Comparing experimental results vs. simulation predictions

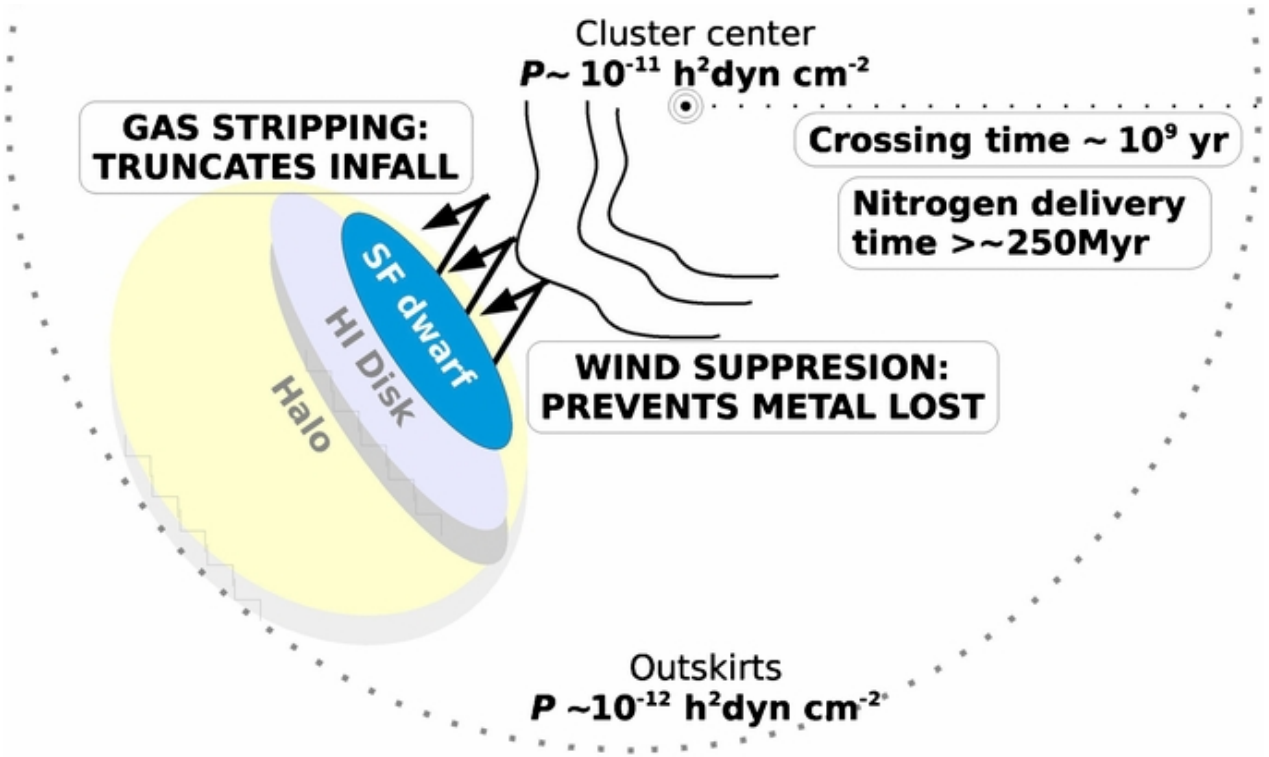
[Finlator & Davé 2008; Petropoulou, V., Vilchez, J., & Iglesias, J. 2012]



In agreement with state-of-the-art hydrodynamic simulations that introduce an equilibrium model between inflows and momentum-driven gas outflows to describe galaxy chemical evolution.

5. Comparing experimental results vs. simulation predictions

[Finlator & Davé 2008; Petropoulou, V., Vilchez, J., & Iglesias, J. 2012]



The enhanced metal enrichment could be produced by the combination of effects such as wind reaccretion, due to pressure confinement by the ICM, and the truncation of gas infall.

Plan de trabajo

- Construcción bases de datos $\mathrm{H}\alpha$ y espectofotométricas para cúmulos.

- Análisis estructuras galaxias en cada entorno.
- Determinación SFR para cada galaxia.

- Corrección de apertura espectro muestra SDSS.
- SFR, propiedades físicas y metalicidades muestras SDSS.

- Análisis FE y evolución química de galaxias para diferentes entornos.