Spatially Resolved Star Formation Main Sequence of Galaxies

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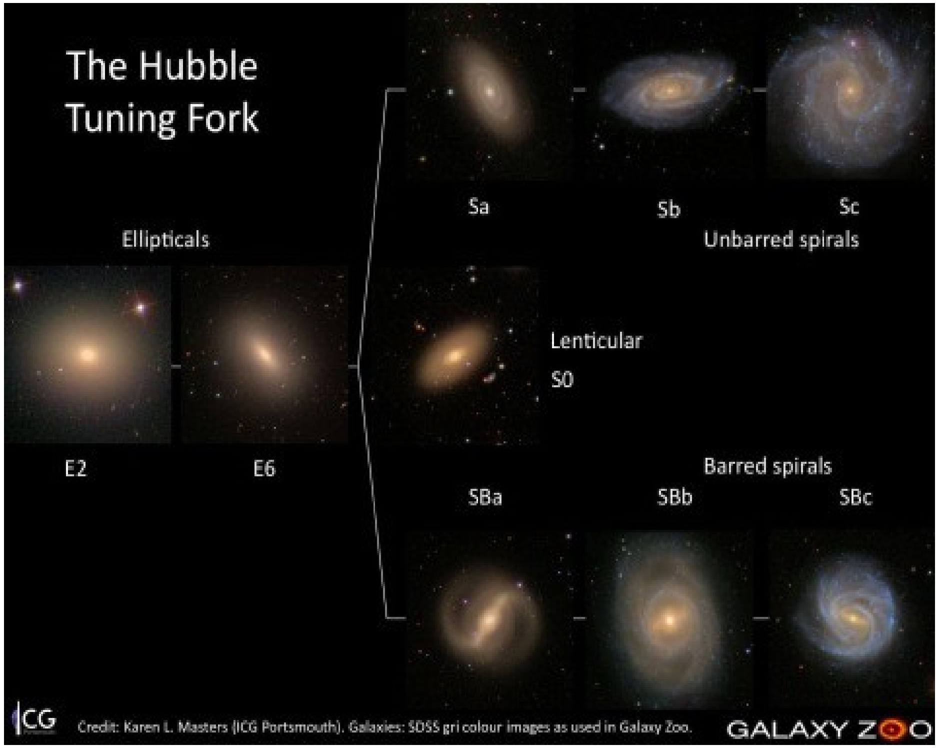
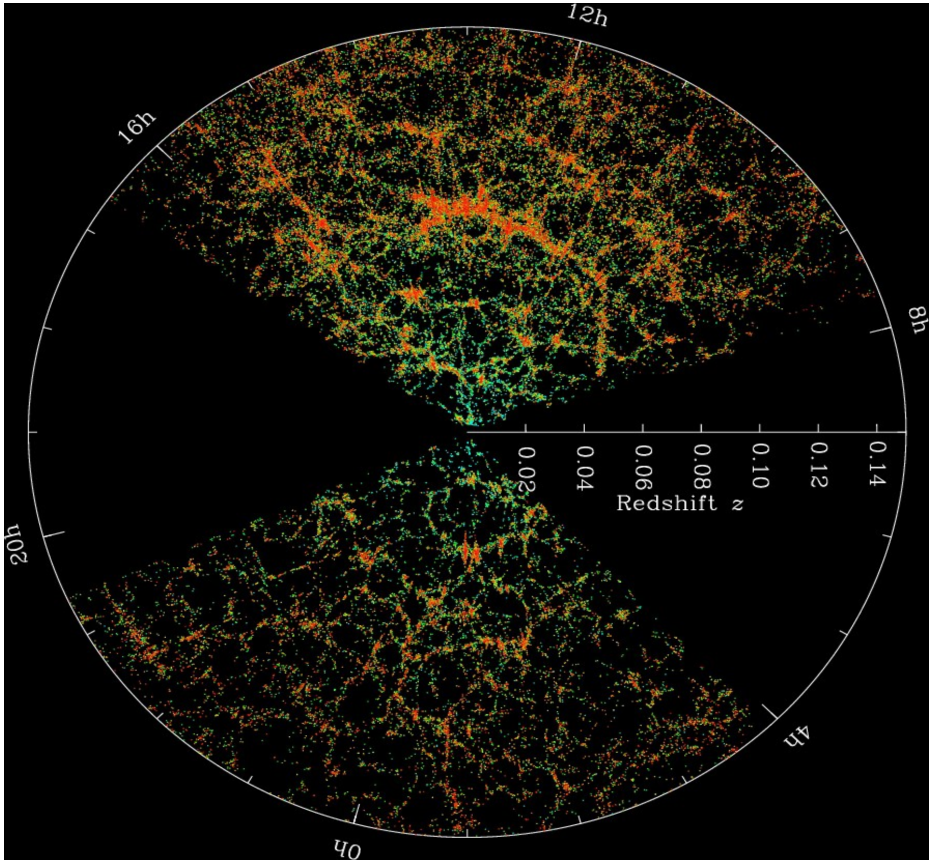
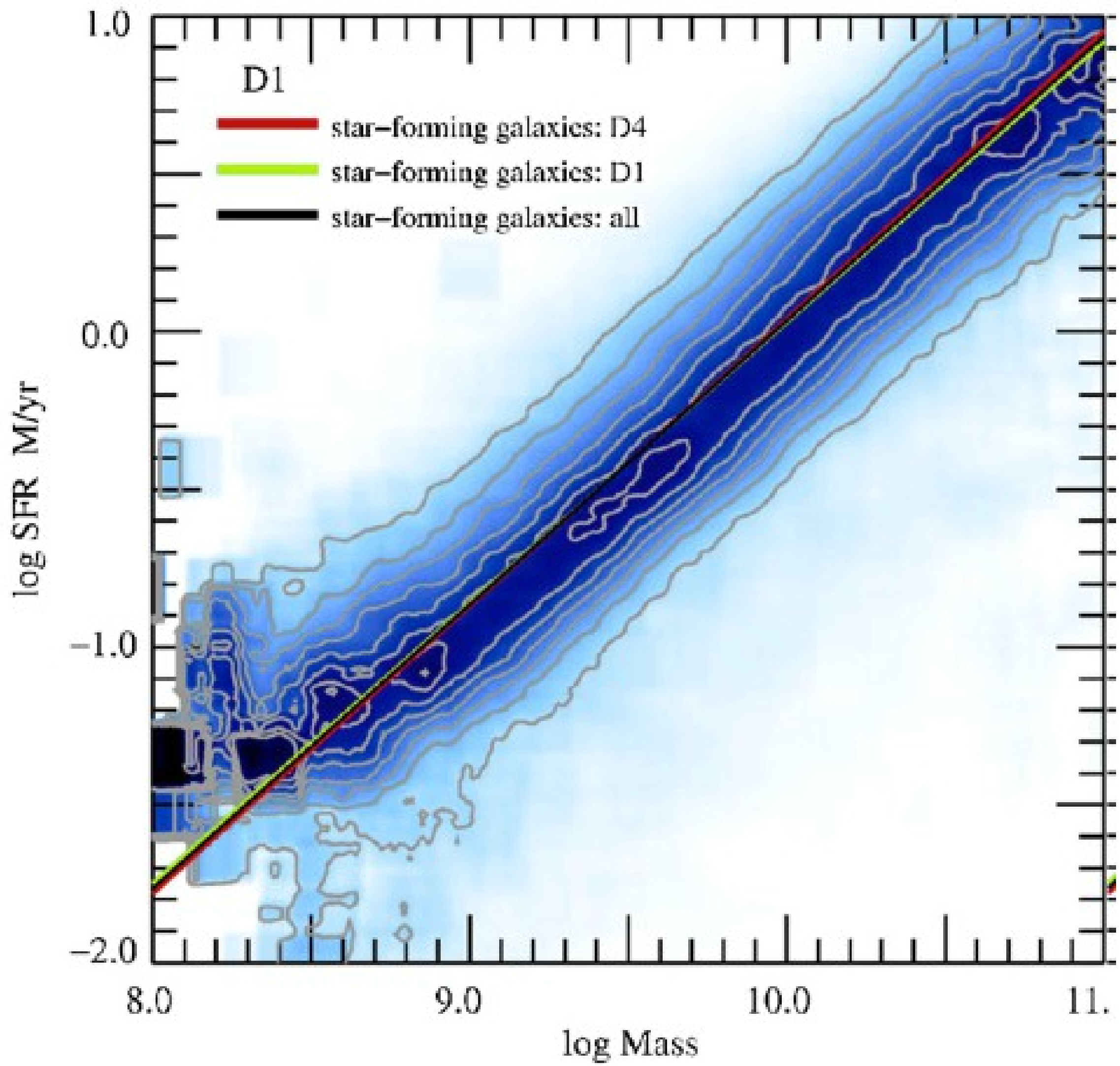


The study of galaxies with large samples result in the derivation of statistical systematic studies.



Scaling relations

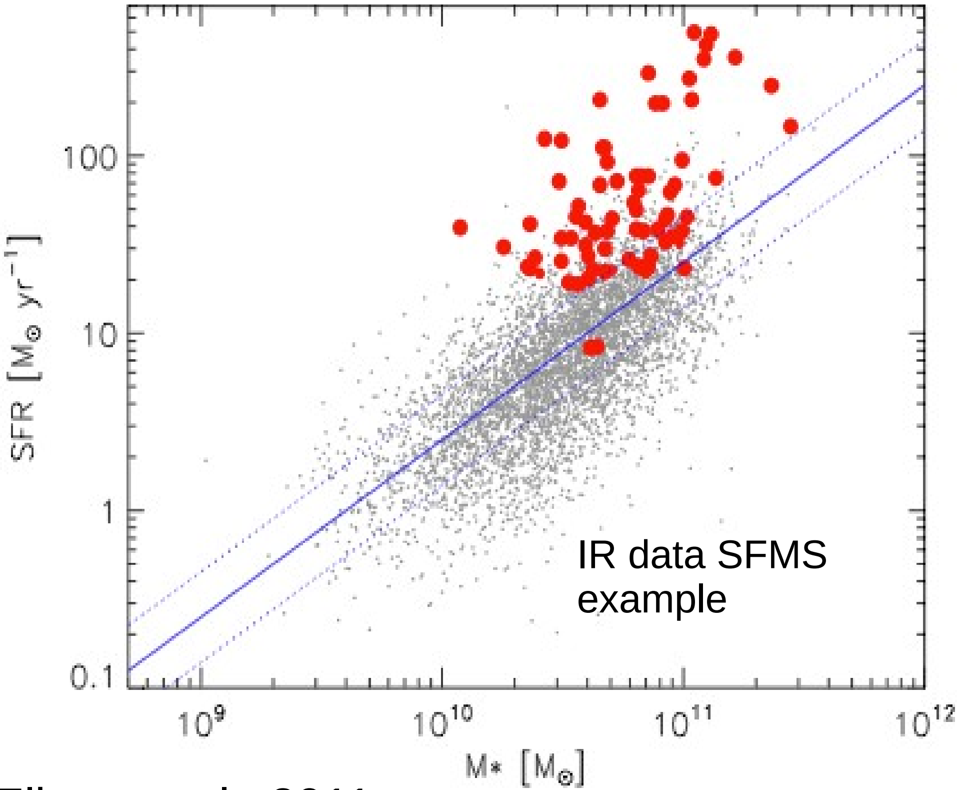
Star Formation Main Sequence (SFMS) Relation for Galaxies



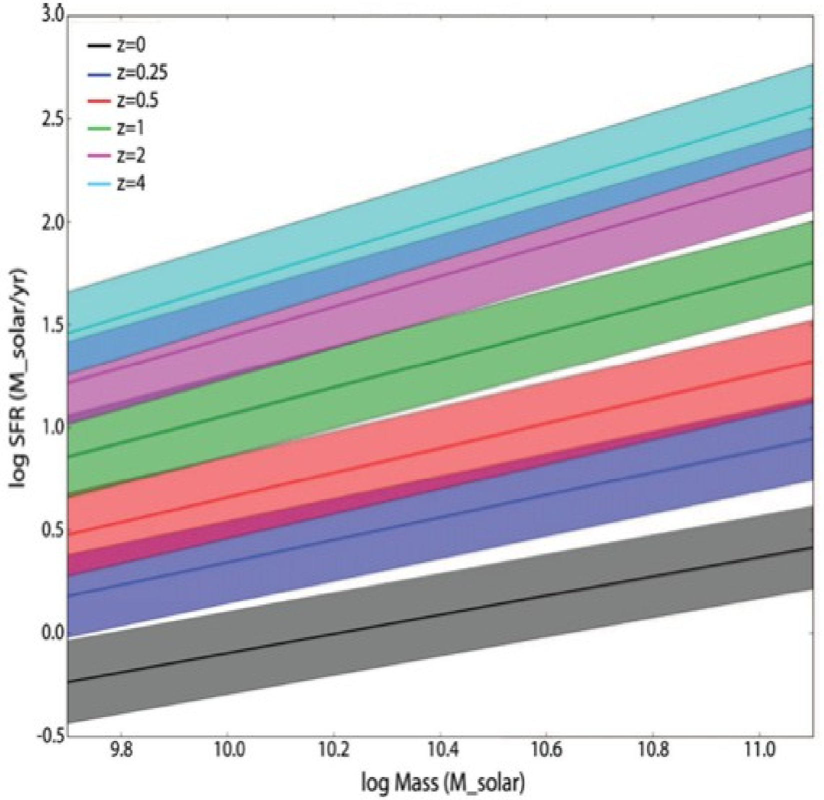
Peng, et.al., 2010

The SFMS

It has shown to exist for SFR indicators in several wavlenghts (e.g. IR: Elbaz, et.al., 2011, radio: Karim, et.al. 2011), and at different redshifts (e.g. Speagle, et.al. 2014).



Elbaz, et.al., 2011



Speagle, et.al. 2014

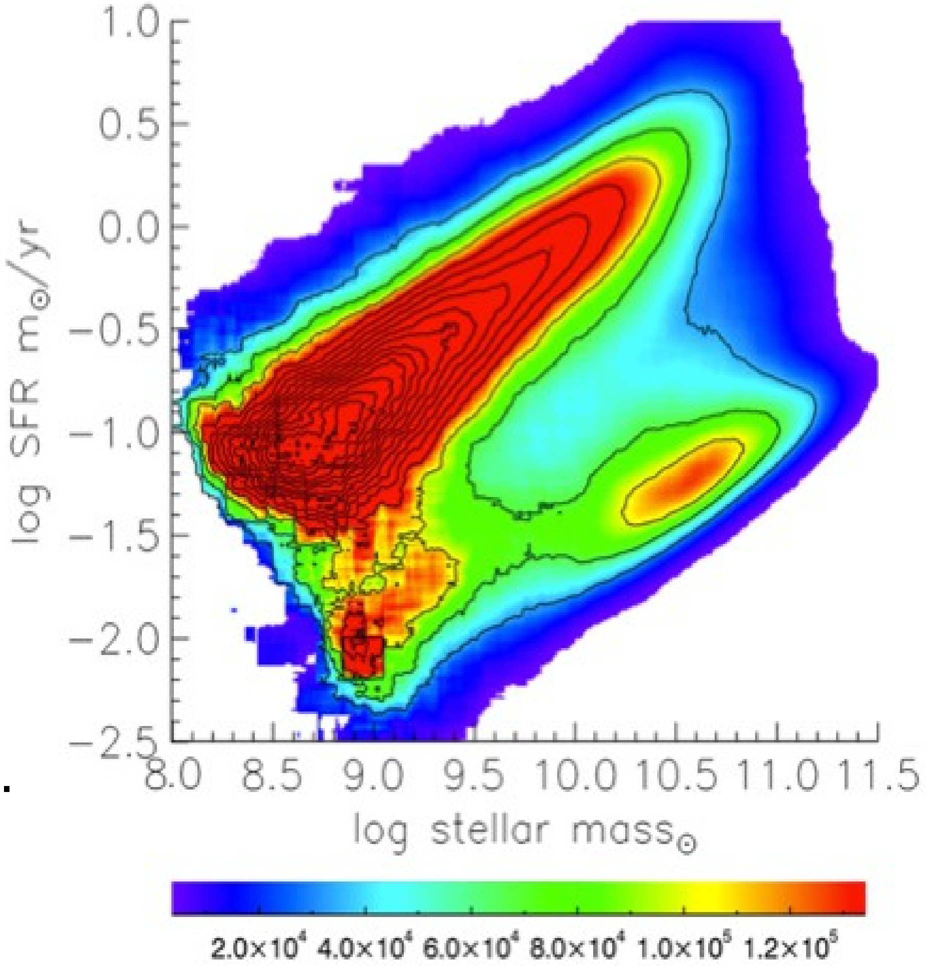
General characteristics of the SFMS

The SFMS, defined in terms of the stellar mass and the SFR is considered to be linear of the form:

$M_* = a + SFR * b$

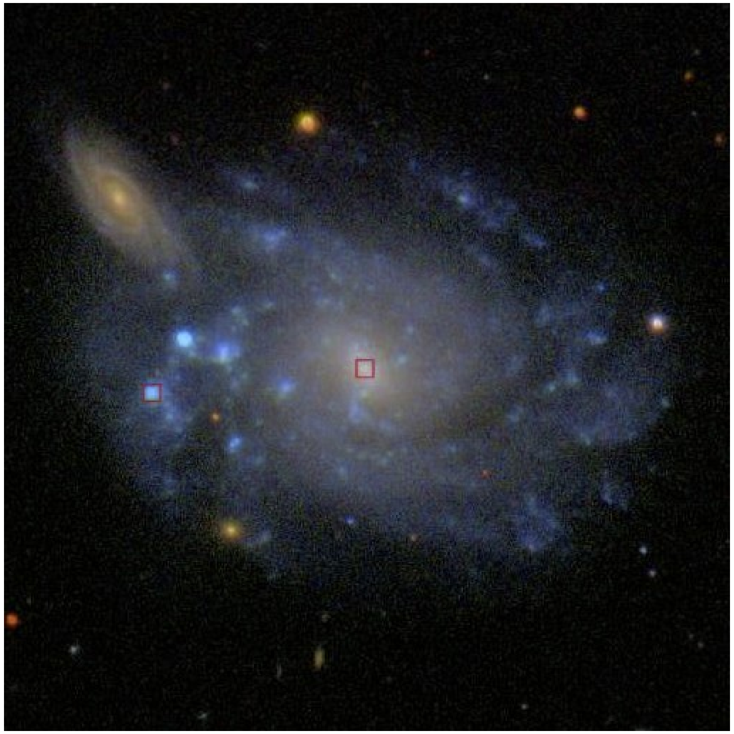
Where the values of *a* and *b* may vary considerably: *a*~ -(4-10) and *b*~ 0.4-1.

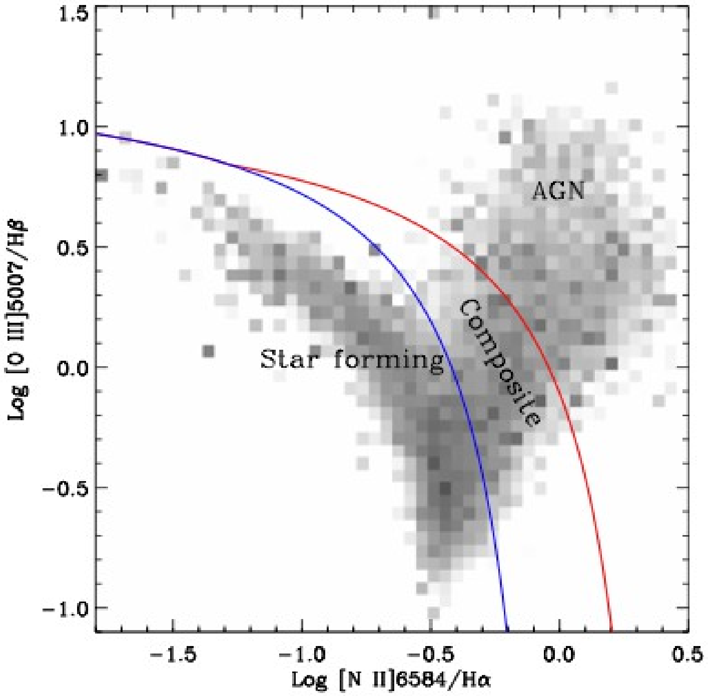
However most recent studies have reduced this range e.g.: *a*~ -(-6.78-7.64) and *b*~ 0.71-0.77 (See Zahid, et.al. 2012, Elbaz, et.al. 2007, Renzini & Peng, 2015).



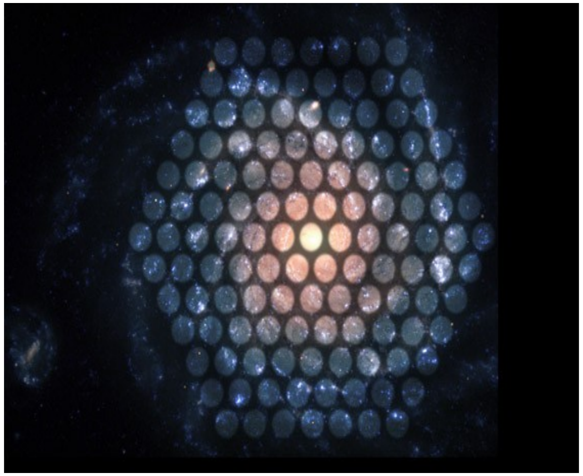
Renzini & Peng, 2015

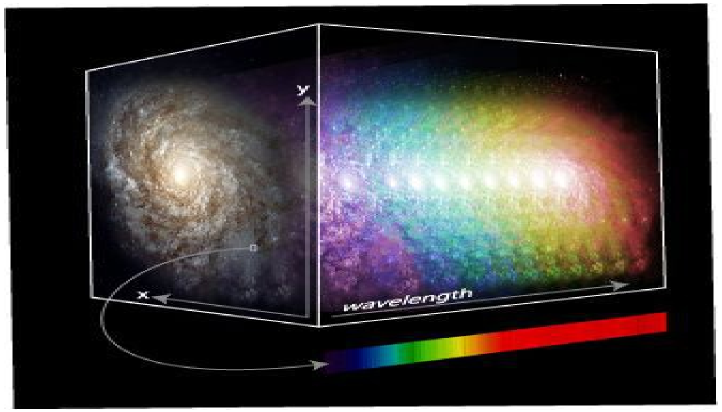
“Usual” classification of star-forming glaxies Methods rely on some observational caveats





With Integral Field Spectroscopy (IFS) we may be able to reduce some of these caveats





For this work:

CALIFA survey:

* CALIFA sample: ~600 galaxies: $0.005 < z < 0.03$. Homogeneous sample in morphology and inclination. Masses: $10^{9.7}<M_*<10^{11.4}$ M_{sun}.

* 2.7 arcsec fibers: 3 dithering positions with a final 1 arcsec sampling.

* Observing setup V500: R~850.

Our sample:

* 306 galaxias with i <60º

* Our sample comprises galaxies in a wider mass range, as we are using the “extended” CALIFA sample as well ~ $10^{8}<M_*<10^{12}$ M_{sun}.

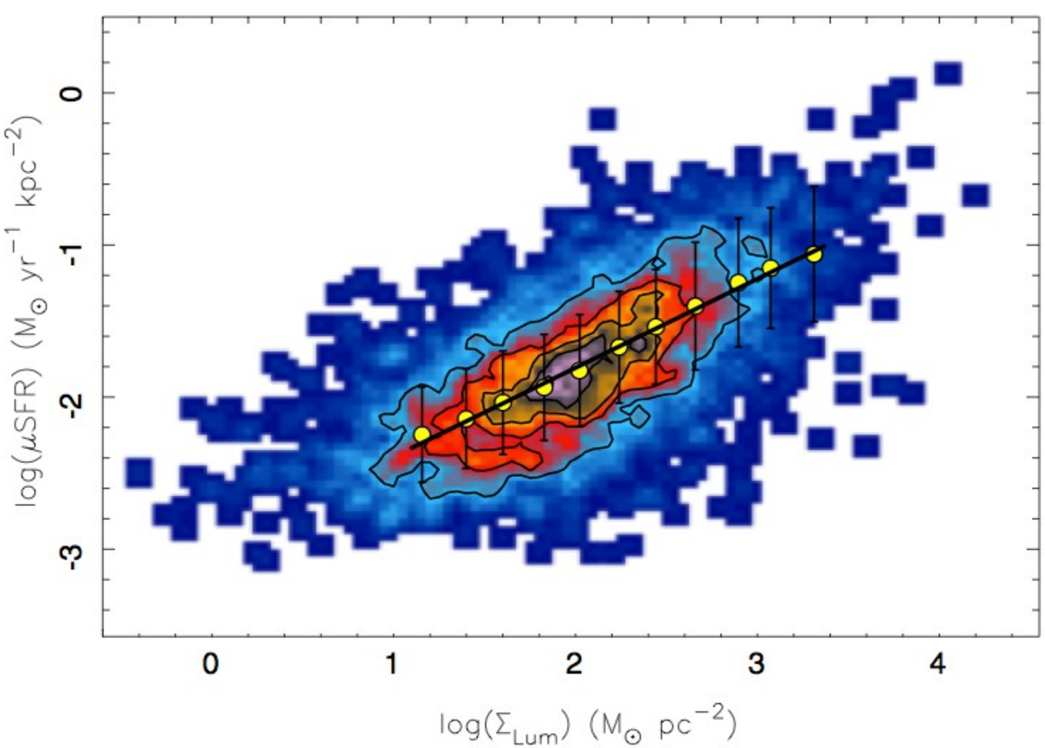
Data analysis:

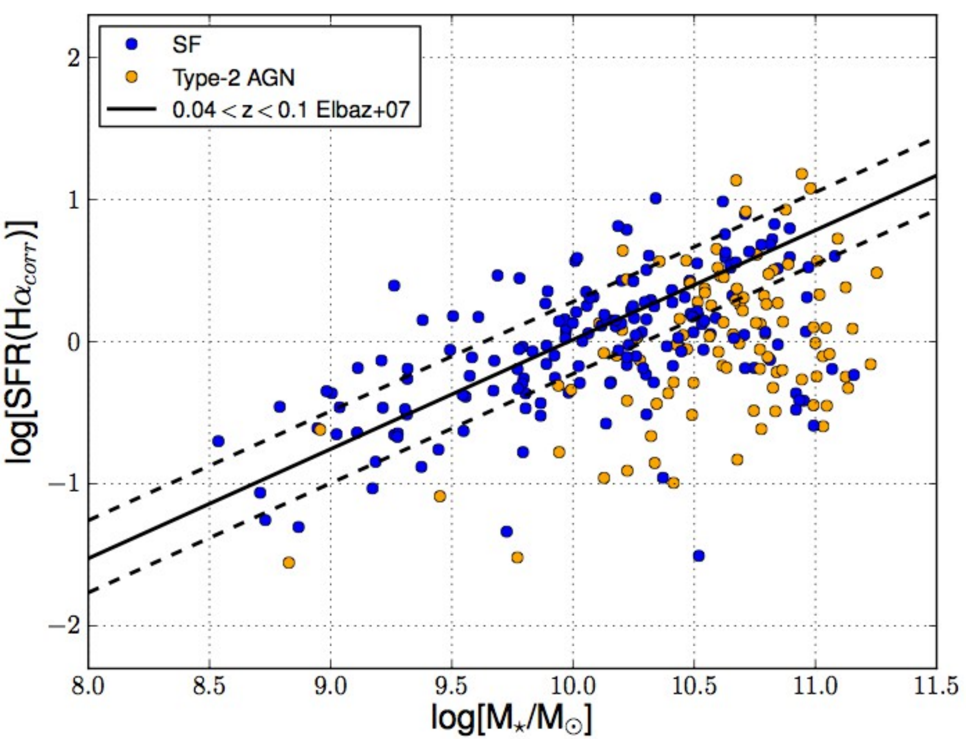
* Stellar masses and emission lines flux maps were derived with Pipe3D.

* SFRs were derived through the Halpha emission, using Kennicutt 1998.

SFMS for CALIFA

Previous results in the literature for the SFMS in CALIFA:





Slope: 0.66 +/- 0.18

Slope: 0.77

S.F. Sánchez, et.al., 2013

Catalán-Torrecilla, et.al., 2015

Integrated SFMS in CALIFA

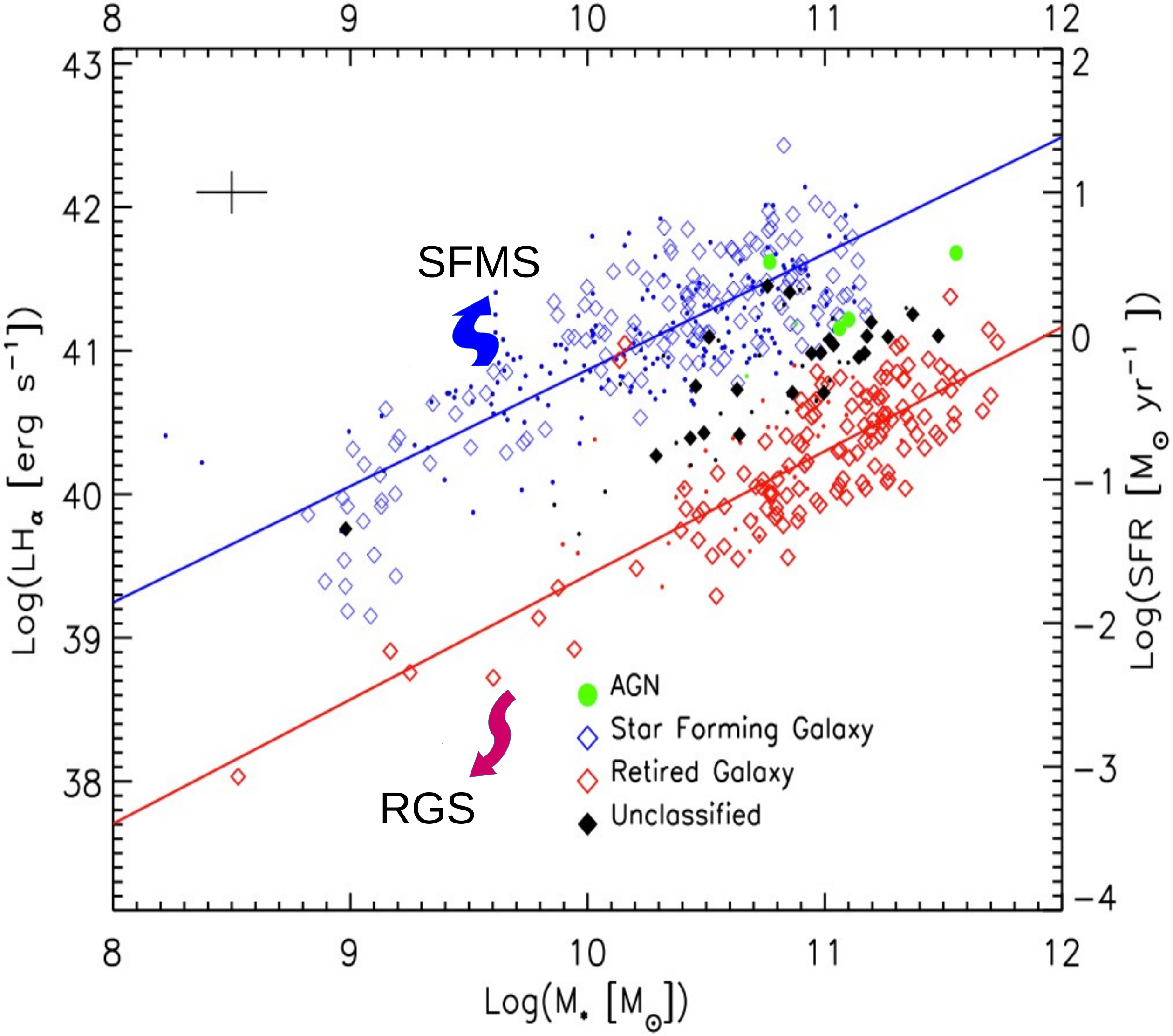
AGN: Galaxies that lie above the Kewely demarcation limit (KL) in The BPT diagram, and whose EW(Halpha) are > 6 Angstroms.

Star-forming: Galaxies that lie Below the KL, and whose EW(Halpha) are > 6 Angstroms. (S.F. Sánchez, et.al., 2014).

Retired: Galaxies whose EW(Halpha) are < 3 Angstroms. (Cid Fernandes, et.al., 2011).

Unclassified: Galaxies whose EW(Halpha) are (3 < EW < 6) Angstroms.

RGS = Retired Galaxies Sequence



Cano-Díaz, et.al.,2016 (accepted) in ApJL

General Characteristics of the integrated SFMS and RGS

	SFMS	RGS
Slope	0.81 +/- 0.02	0.86 +/- 0.02
Zero Point [$\log(M_{Sun}\ yr^{-1})$]	-8.34 +/- 0.19	-10.32 +/- 0.24
Standard Deviation (dex)	0.20	0.22

Cano-Díaz, et.al.,2016 (Accepted in ApJL)

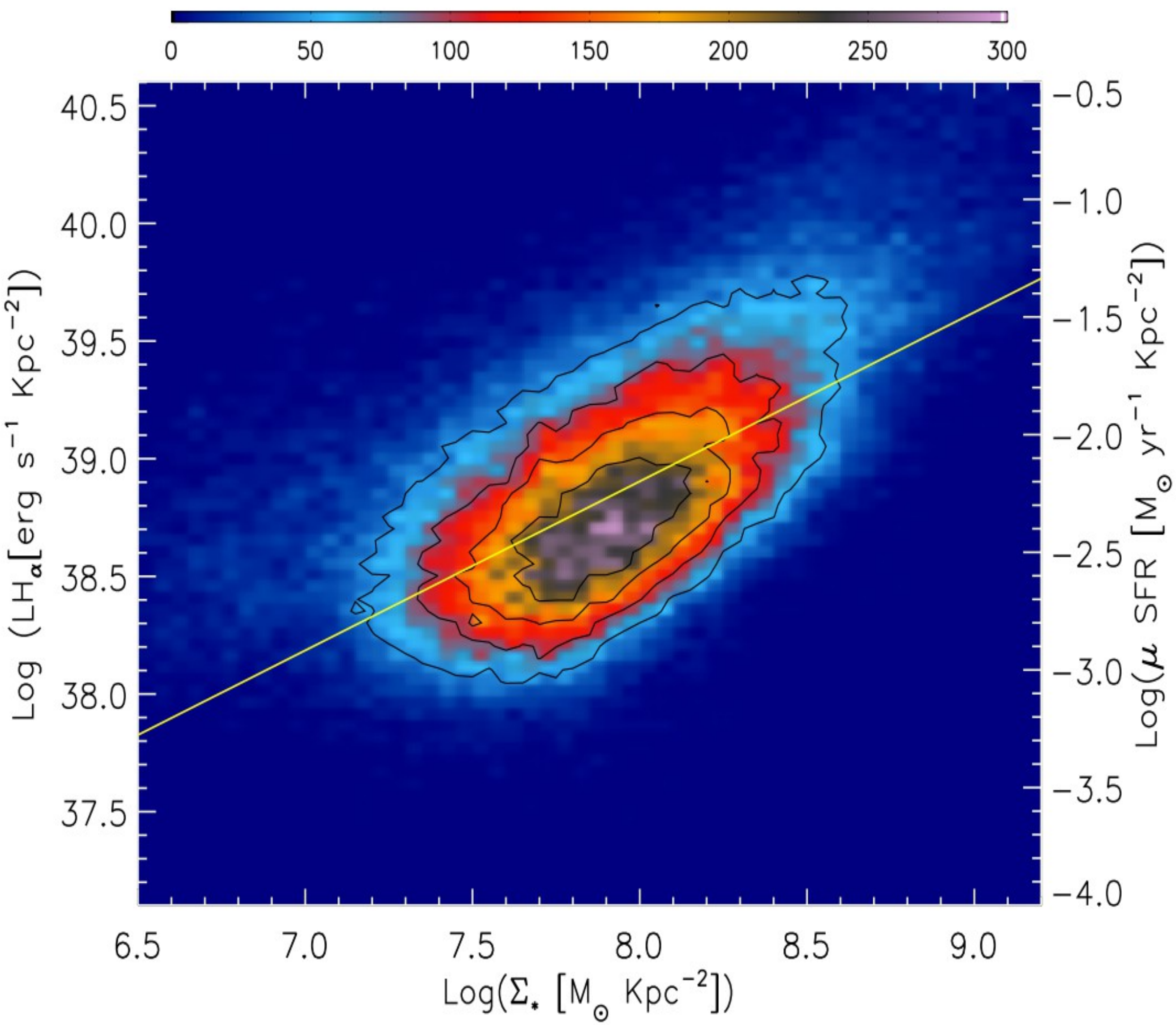
Typical dispersions for the reported SFMS in the literature: ~0.2-0.35 (dex)

Spatially Resolved SFMS in CALIFA

Star-forming: Regions that lie
Below the KL, and whose
EW(Halpha) are > 6 Angstroms.
(S.F. Sánchez, et.al., 2014),
Regardless of the position of
Its host galaxy in the previous
Plot.

11% of the points of this plot come
From galaxies, whose global
Ionization process is not dominated
By SF.

We used 90,786 individual spectra.



Cano-Díaz, et.al.,2016 (Accepted in ApJL)

General Characteristics of the Spatially-Resolved SFMS

	SFMS 100% data	SFMS 80% data
Slope	0.68 +/- 0.04	0.72 +/- 0.04
Zero Point [$\log(M_{Sun}\ yr^{-1}\ Kpc^{-2})$]	-7.63 +/- 0.34	-7.95 +/- 0.29
Standard Deviation (dex)	0.23	0.16

Cano-Díaz, et.al.,2016 (Accepted in ApJL)

We performed tests to try to find dependance with the total M_* of the galaxies and found no substantial differences in the main results

The Standard Deviation for the integrated relation: 0.20 dex

Conclusions

Due to our ionization classification method we were able to highlight two trends in the integrated SFR-M_* diagram: the SFMS and the RGS.

We explored further the spatially resolved counterpart of the SFMS with the CALIFA survey, and found that a very similar relation holds for local (Kpc) scales.

This local relation suggests that indeed the SF processes are local and are related to the gravitational potential.

Future Work

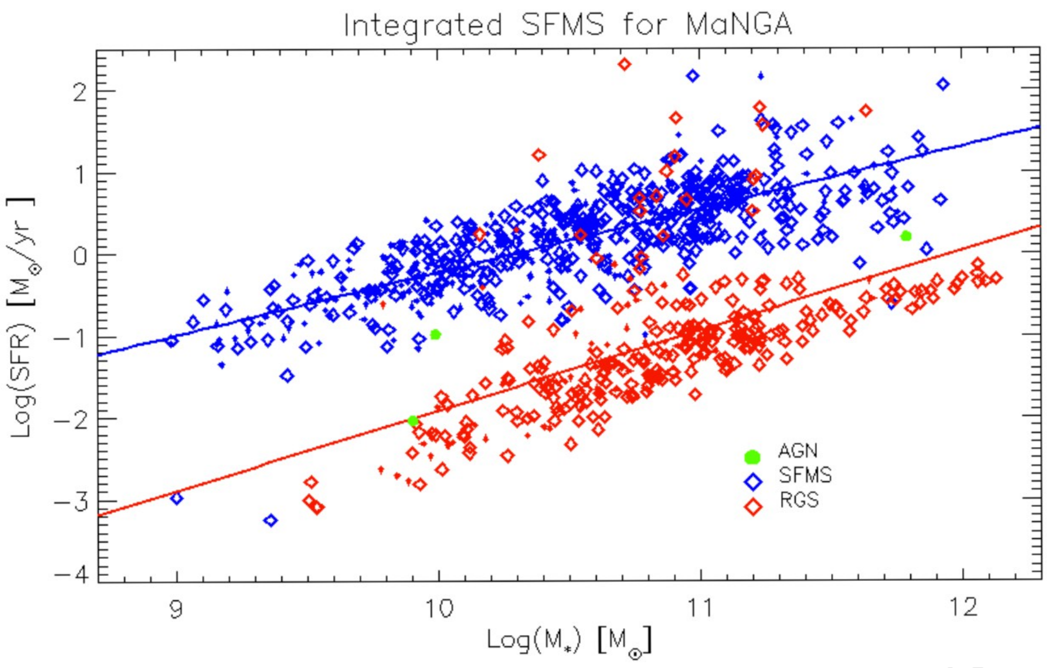
* Does the spatially resolved SFMS has a dependance on: morphology or environment?

* Study the spatially resolved RGS.

* Use larger samples to confirm results.

* Study the spatially resolved SFMS at higher redshifts.

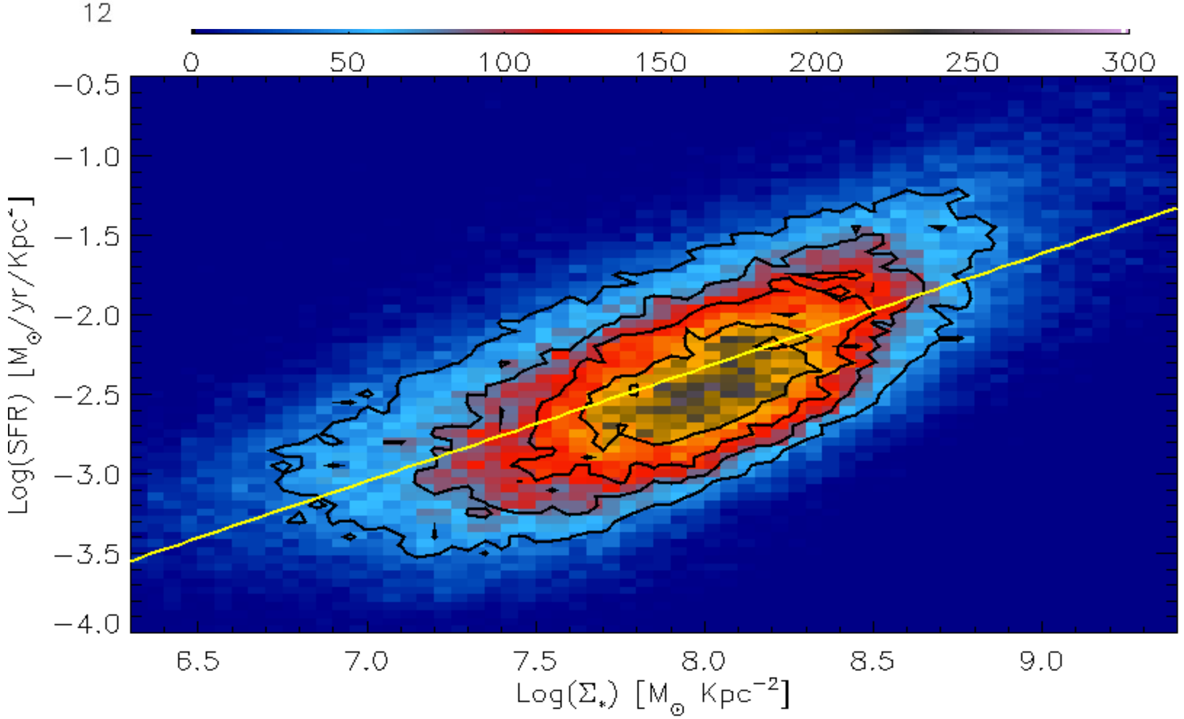
Work in progress



* Integrated and spatially resolved SFMS, for the MaNGA survey.

* sample of 923 galaxies

* i < 60º



Integrated	SFMS	RGS
Slope	0.77	0.98
Zero Point [log(M_{Sun} yr^{-1})]	-7.89	-11.68
Standard Deviation (dex)	0.33	0.54

Spatially Resolved	SFMS 100% data	SFMS 80% data
Slope	0.73	0.65
Zero Point [log(M_{Sun} yr^{-1} Kpc^{-2})]	-8.19	-7.58
Standard Deviation (dex)	0.26	0.19