2D SFR properties of nearby galaxies with J-PLUS DR1

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Measuring Hα emission-line fluxes

- *Javalambre Photometric Local Universe Survey (Cenarro et al. 2018)*

- **Several thousands** deg² from OAJ, with the 0.83 meter **JAST/T80** telescope and the panoramic camera **T80Cam**.

- The system offers a **2 deg² FoV**, with **12** broad, intermediate, and narrow band optical **filters**.

Filter	Central wavelength (nm)	Pivot wavelength (nm)	FWHM (nm)	Spectral Feature
u	348.5	352.3	50.8	–
J0378	378.5	378.6	16.8	[OII]
J0395	395.0	395.1	10.0	CaH+K
J0410	410.0	410.1	20.0	H_δ
J0430	430.0	430.0	20.0	G-Band
g	480.3	474.5	140.9	–
J0515	515.0	515.0	20.0	Mgb Triplet
r	625.4	623.0	138.8	–
J0660	660.0	660.0	13.8	Hα+[NII]
i	766.8	767.7	153.5	–
J0861	861.0	860.3	40.0	Ca Triplet
z	911.4	892.2	140.9	–

Measuring Hα emission-line fluxes

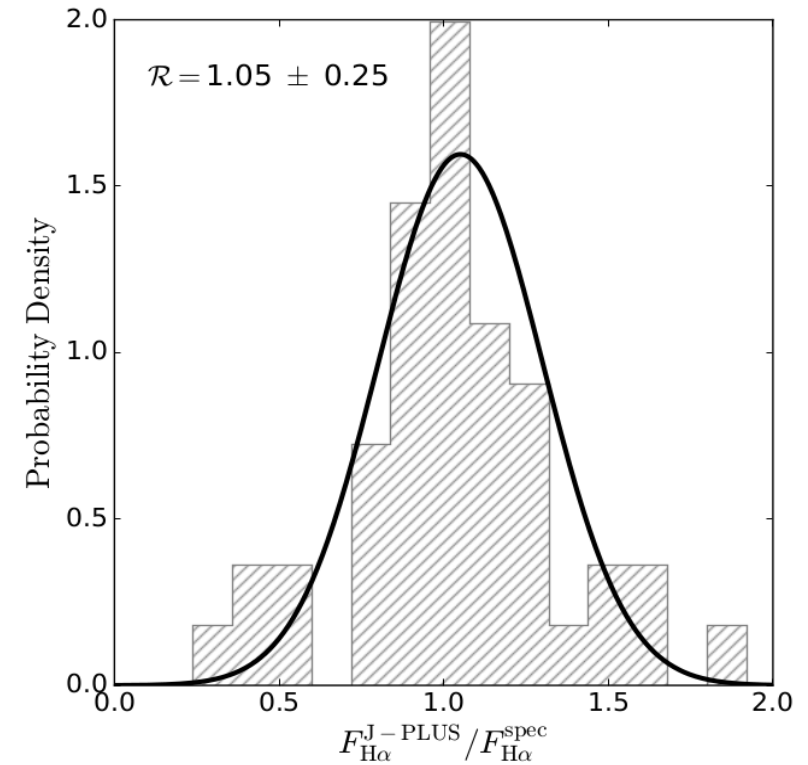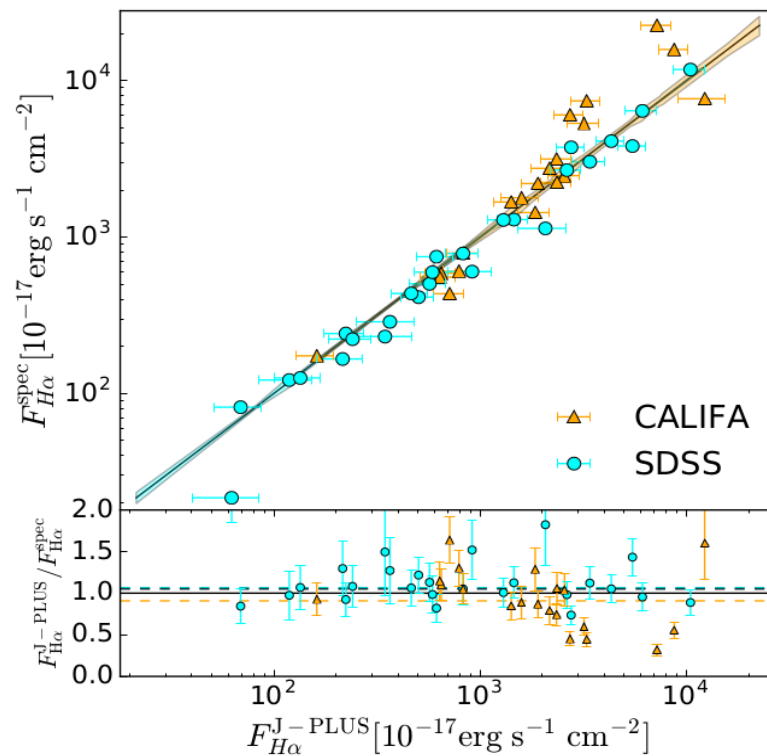- *Vilella-Rojo et al. 2015*: An **unbiased** estimator of **Hα** emission-line flux @ **z<0.017** with J-PLUS synthetic data.
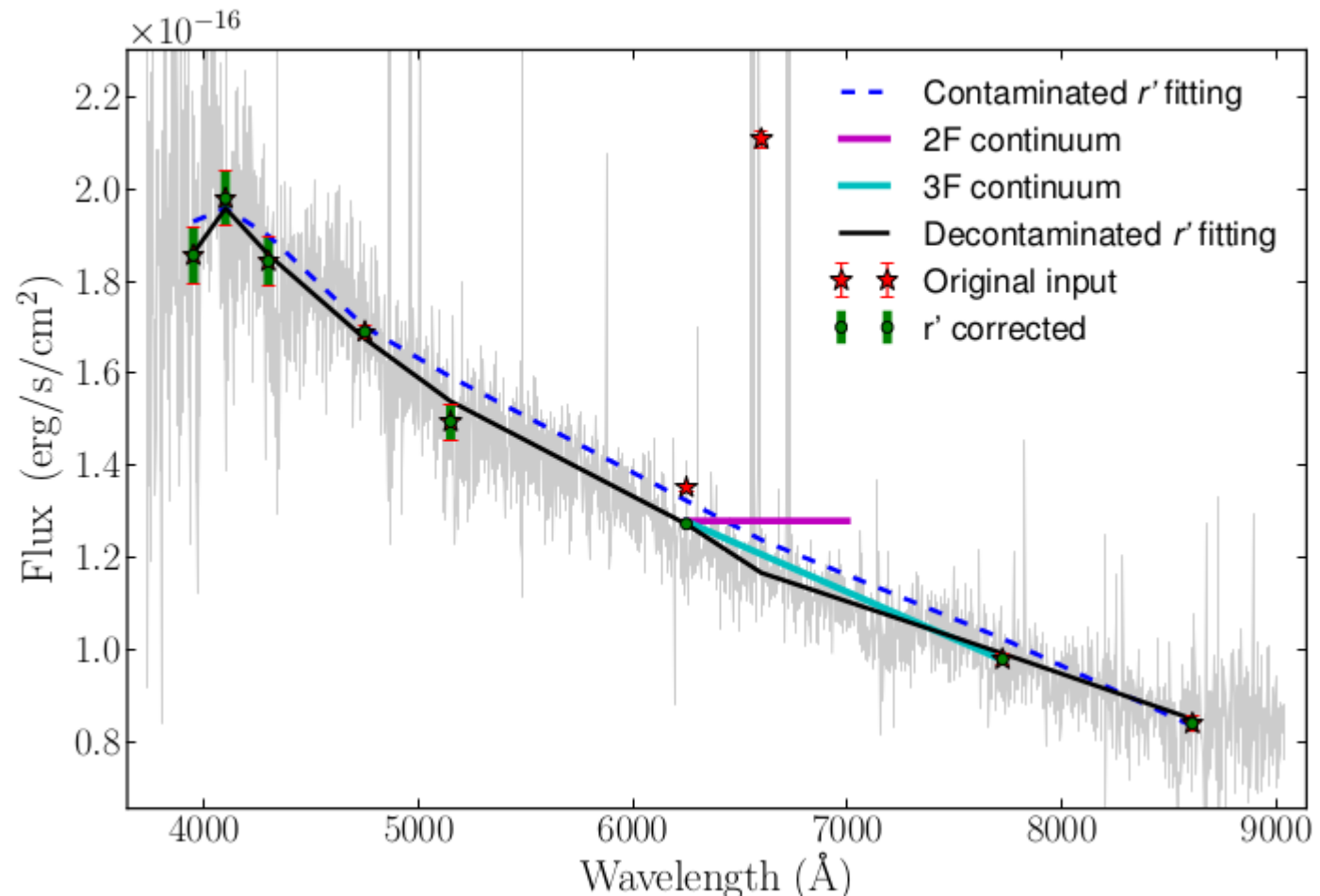
Methods to measure Hα emission-line fluxes (Vilella-Rojo et al. 2015)

Measuring Hα emission-line fluxes

Results of the comparison (SVD + EDR)

Unbiased estimations of Hα emission line flux at z < 0.017.
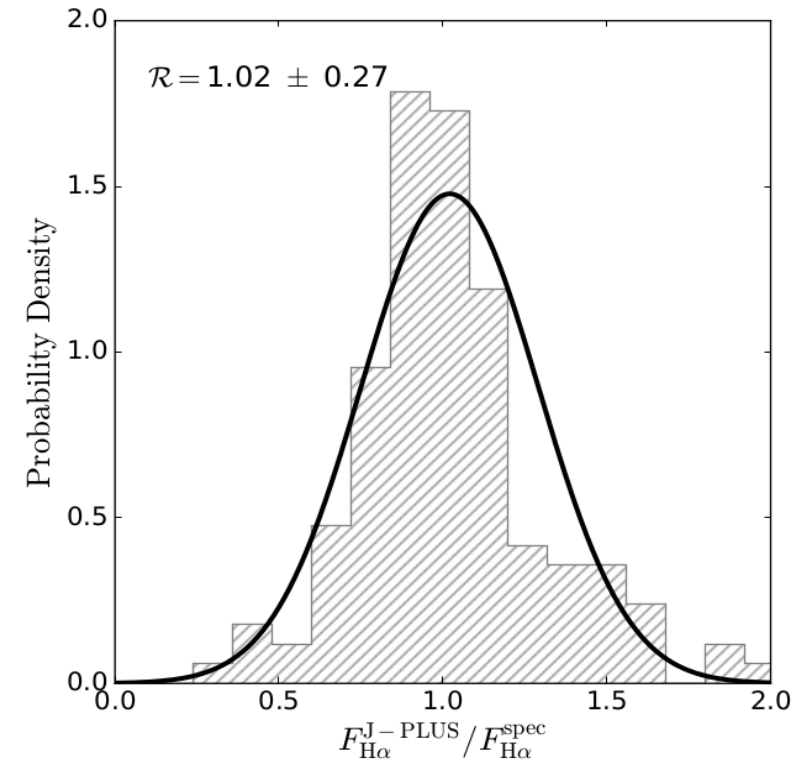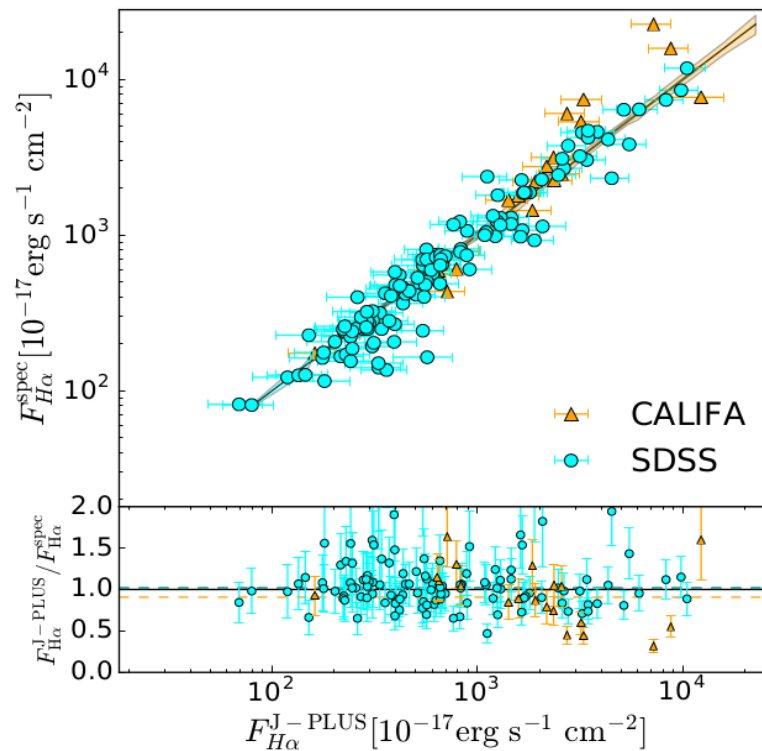
R = 1.05 and an error in the mean of 0.03

Logroño-García et al. 2018: A&A in press.

Measuring Hα emission-line fluxes

Results of the comparison (SVD + EDR + DR1)

First science case with **DR1**: Check the comparison.

DR1: **1022 deg²**, **+95** regions

R = 1.02 and an error in the mean of 0.02
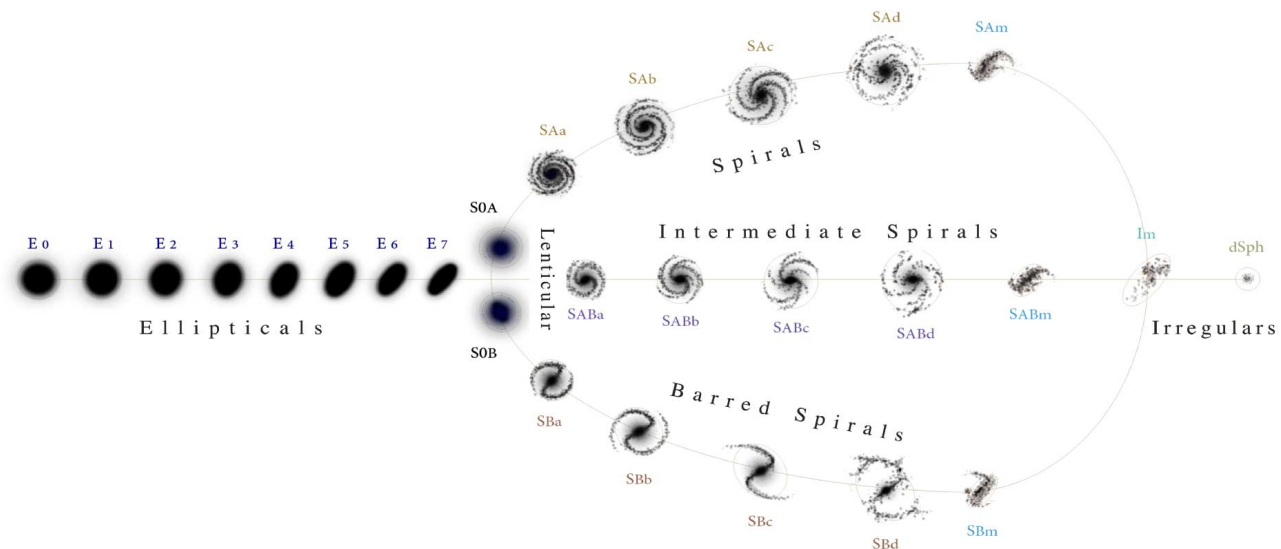
2D SFR: Introduction

- We know:

  - There is a clear correlation between star formation and morphology.

HUBBLE-DE VAUCOULEURS DIAGRAM

Less recent SF
Lower SFR ——————————————→ *More recent SF*
Higher SFR

The Hubble - de Vaucouleurs diagram.
By Antonio Ciccolella / M. De Leo – https://en.wikipedia.org/wiki/File:Hubble-Vaucouleurs.png.

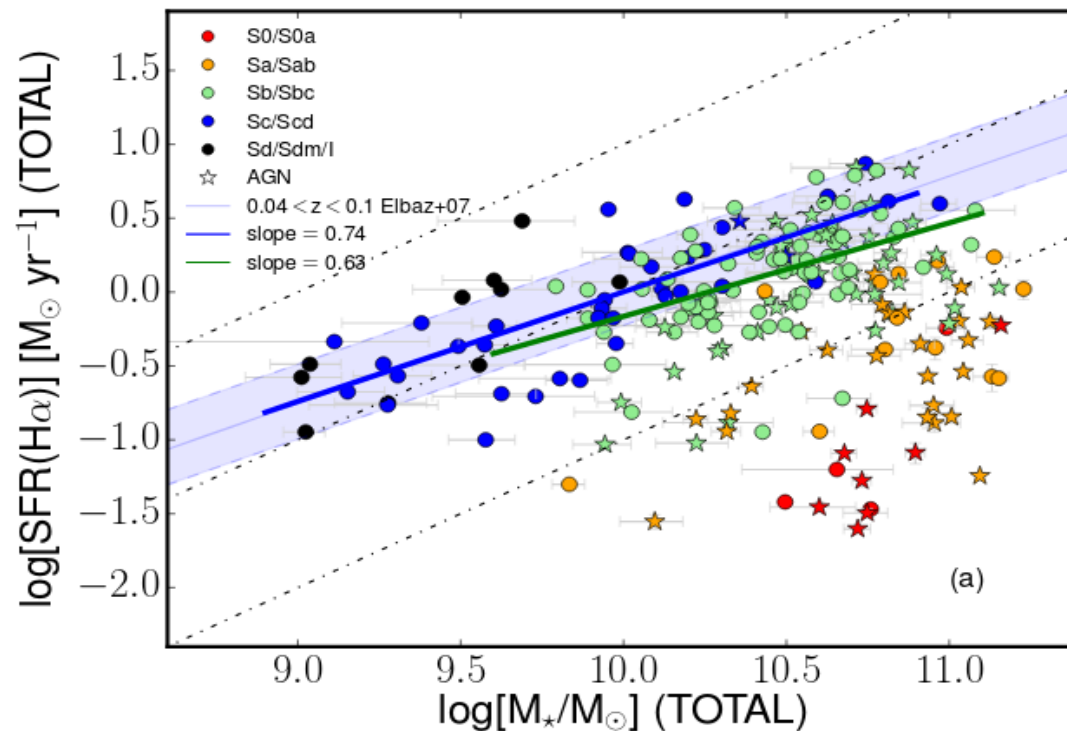# 2D SFR: Introduction

- We know:

    - There is a clear correlation between star formation and morphology, **and stellar mass.**

    - **Star formation main sequence** *(Brinchmann et al. 2004).*

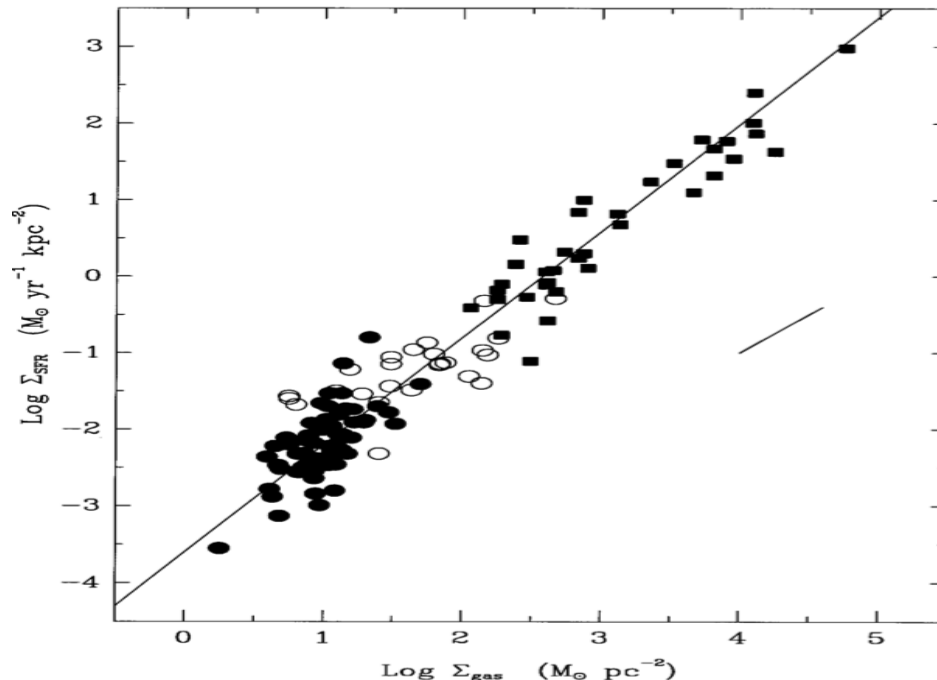*SFMS and morphology in CALIFA galaxies (Catalán-Torrecilla et al. 2017) .*

2D SFR: Introduction

- We know:

  - There is a clear correlation between star formation and morphology, and stellar mass, **and gas.**

  - The star formation rate (SFR) surface density in a given region correlates with the **local gas** surface density *(Kennicutt et al. 1998)*.

Kennicutt-Schmidt law (Kennicutt et al. 1998)

2D SFR: Introduction

- Studying **Star Formation** and its correlation and evolution with **stellar mass, morphology** and **gas content,** as a first stage to study the **physical processes behind.** (Secular evolution, AGN Feedback, environment, close interactions, etc …)

- **Up to now:**

  - Studies in distant galaxies with long-slit/fiber **spectroscopy.**

  - Studies in the **nearby universe** with **integral field units** in a **reduced sample** of galaxies.
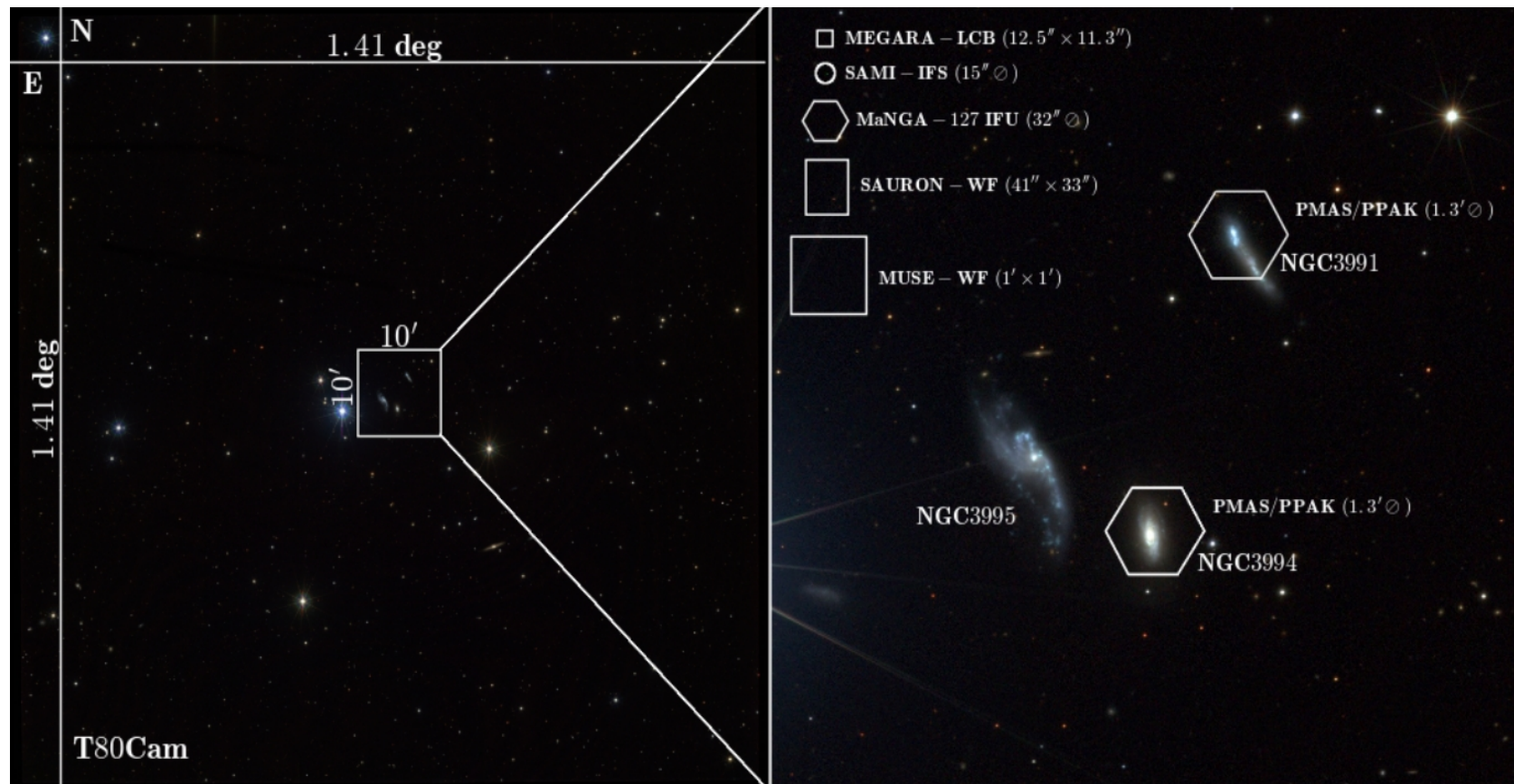
2D SFR: Introduction

Multi-filter photometric surveys: Intermediate and narrow band filters provide the required spectral information while still covering a large contiguous area.

FoV comparison with Arp313 (right)

2D SFR: Introduction

- Studying **Star Formation** and its correlation and evolution with **stellar mass, morphology** and **gas content,** as a first stage to study the **physical processes behind.** (Secular evolution, AGN Feedback, environment, close interactions, etc ...)

- **Up to now:**

  - Studies in distant galaxies with long-slit/fiber **spectroscopy.**

  - Studies in the **nearby universe** with **integral field units** in a **reduced sample** of galaxies.

- **What we intend to add:**

  - SFR studies in the **nearby** universe with **multifilter photometry** (J-PLUS) in a **larger and size unrestricted sample** of galaxies.

  - Relationship among 2D SFR, stellar mass, morphology and **gas to study the physical processes behind.**
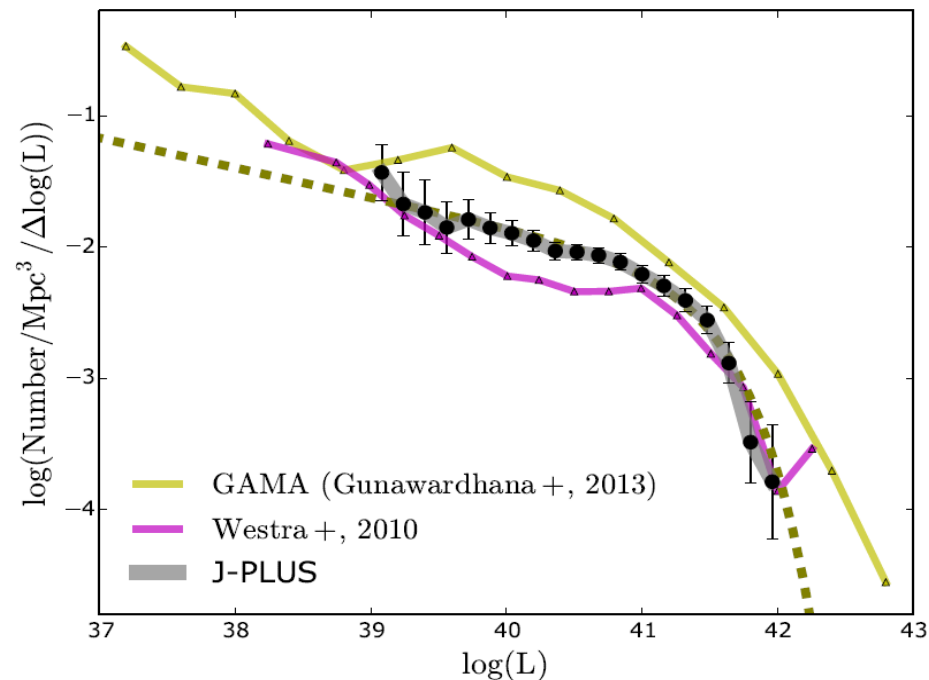
2D SFR studies with J-PLUS

- **SFR in the nearby universe:**
  (Vilella-Rojo et al. 2018, in prep.)

- **Hα luminosity function @ z<0.017 (73 Mpc) :**

$$\log_{10}(L^*) = 41.49 \left[\frac{\text{erg}}{\text{s}}\right] \quad \alpha = -1.22 \quad \log_{10}(\phi^*) = -2.55 \left[\text{Mpc}^{-3}\right]$$

2D SFR studies with J-PLUS

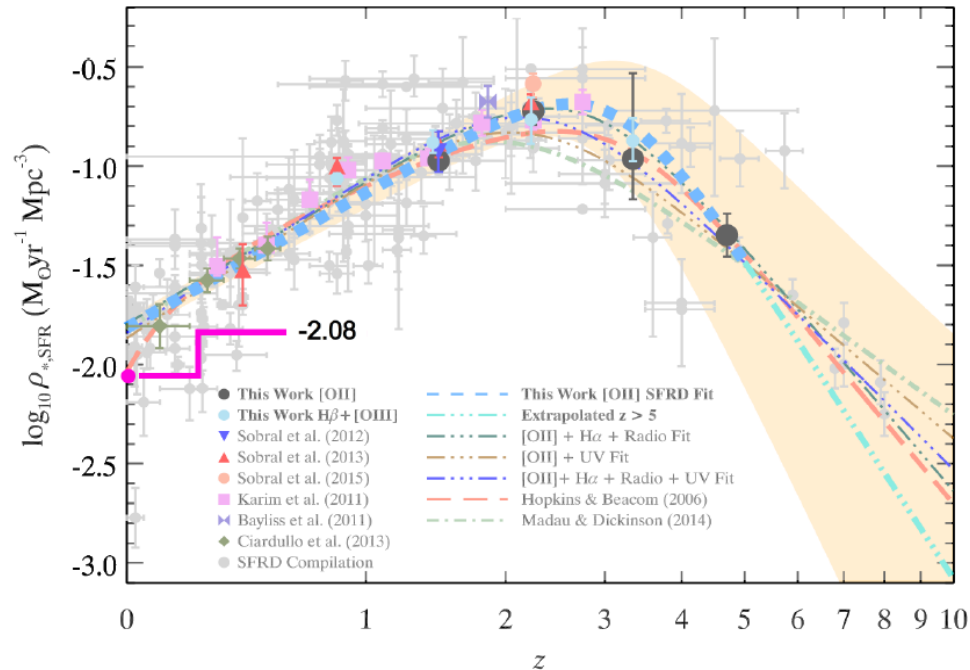- **SFR in the nearby universe:**
  (Vilella-Rojo et al. 2018, in prep.)

Figure from Khostovan et al., 2015

$$\mathcal{L} = \int \phi^* \frac{L}{L^*} \exp\left(-\frac{L}{L^*}\right) \frac{\mathrm{dL}}{L^*} = \phi^* L^* \Gamma(\alpha + 2) \qquad \mathrm{SFR} = 7.9 \times 10^{-42} \mathcal{L}$$
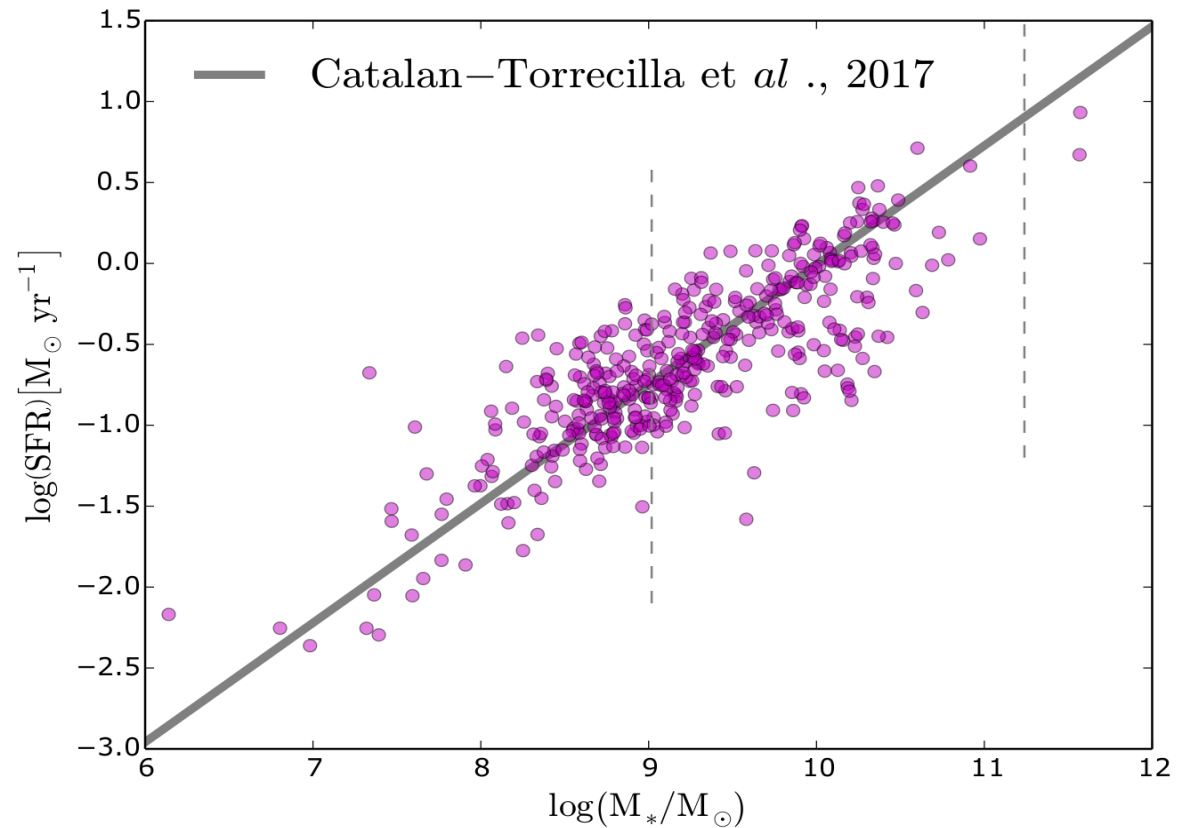
2D SFR studies with J-PLUS

- **SFR in the nearby universe:**
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- **SFR main sequence @ z<0.017 (73 Mpc):**

2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :**
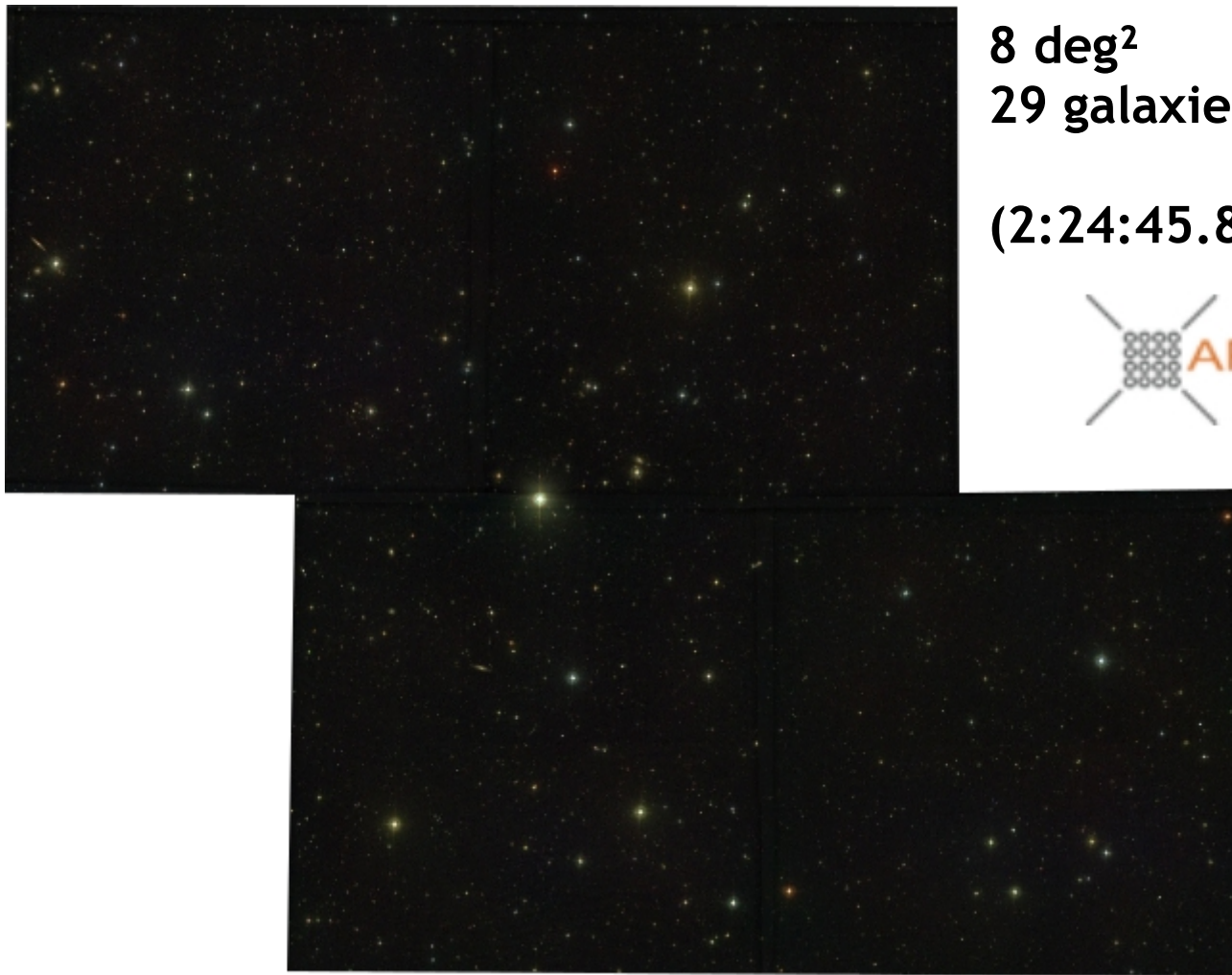
8 deg²
29 galaxies @ z < 0.017

(2:24:45.86, 31:48:17.06)

Color image of 4 J-PLUS pointings
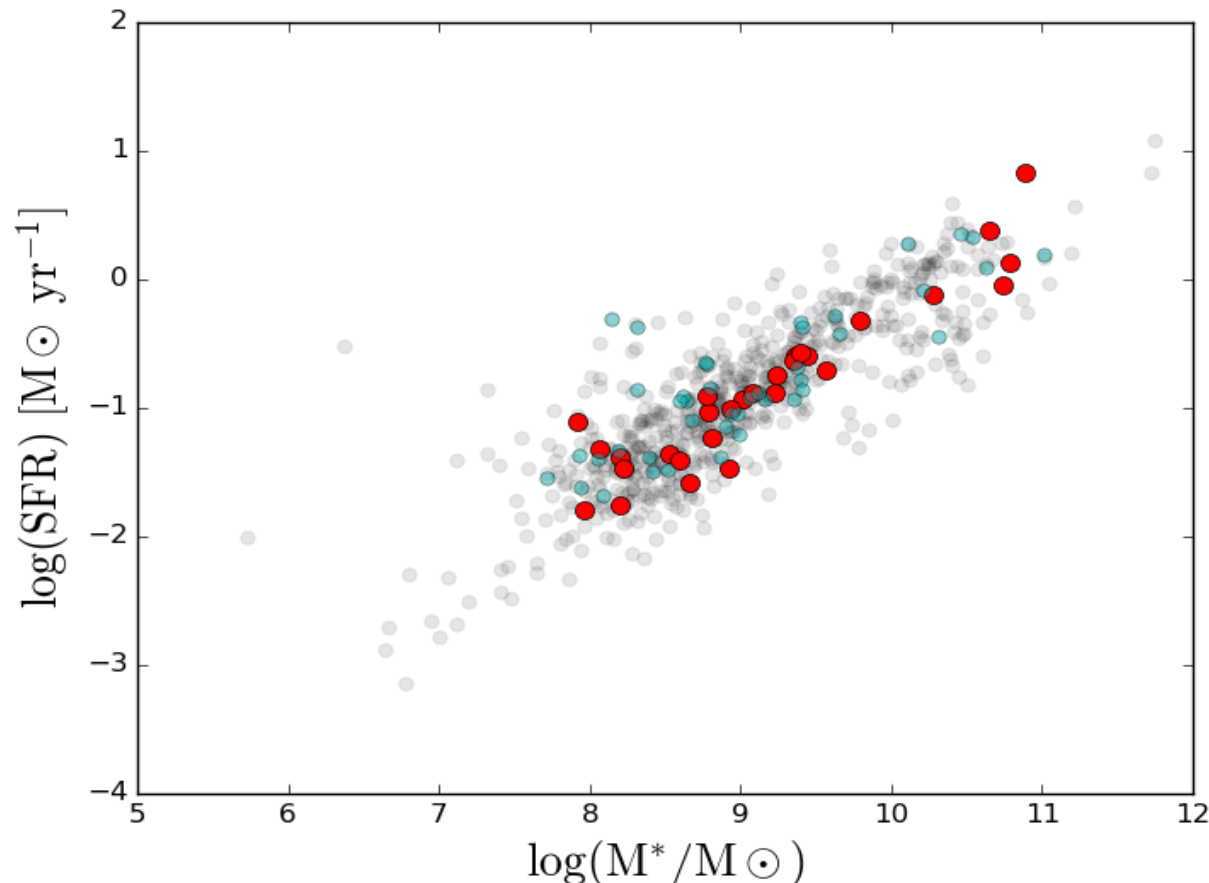
2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :**

8 deg²
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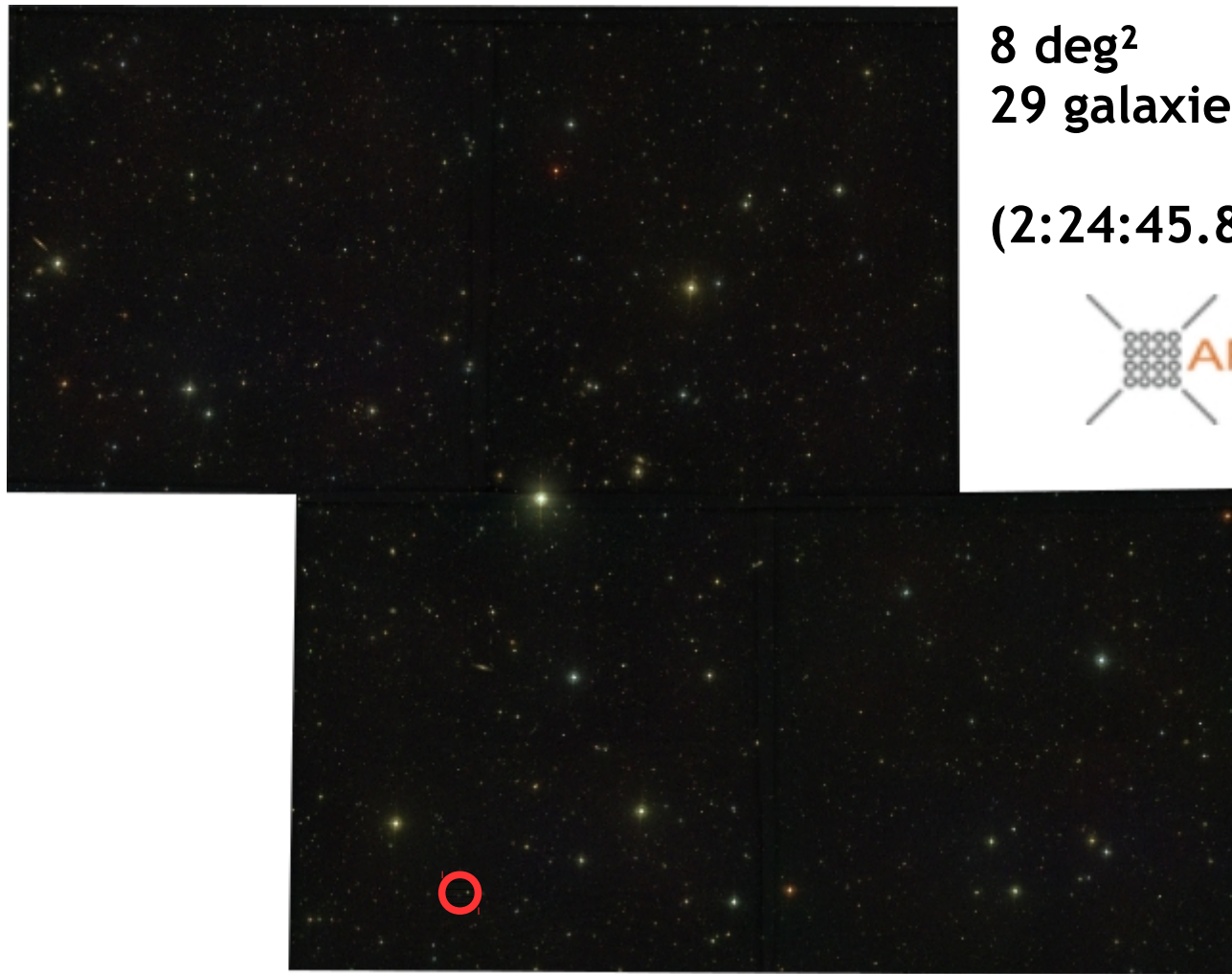*SFR main sequence (red) of the 29 galaxies with the DR1 sample in the background*

2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :**

Color image of 4 J-PLUS pointings

8 deg²

29 galaxies @ z < 0.017

(2:24:45.86, 31:48:17.06)

APERTIF
APERture TIle In Focus

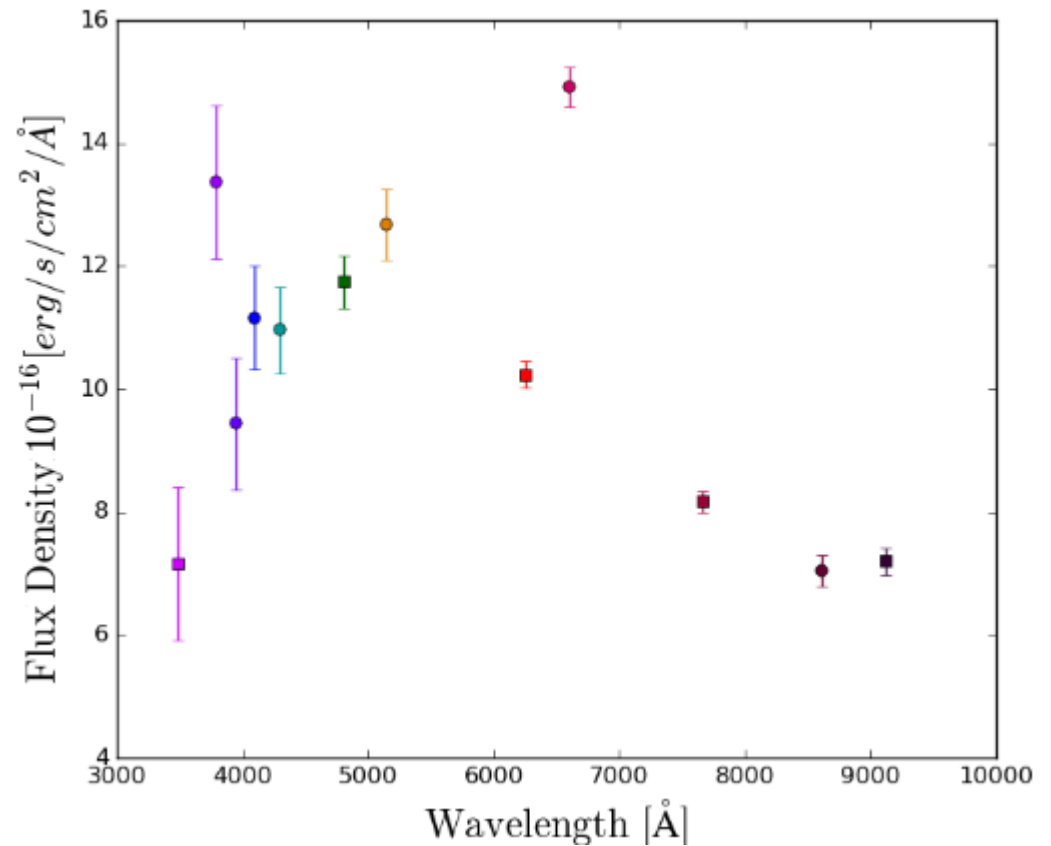# 2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :**

Color image of JPLUS-26488-6588

- **JPLUS-26488-6588**
- **z=0.0094**

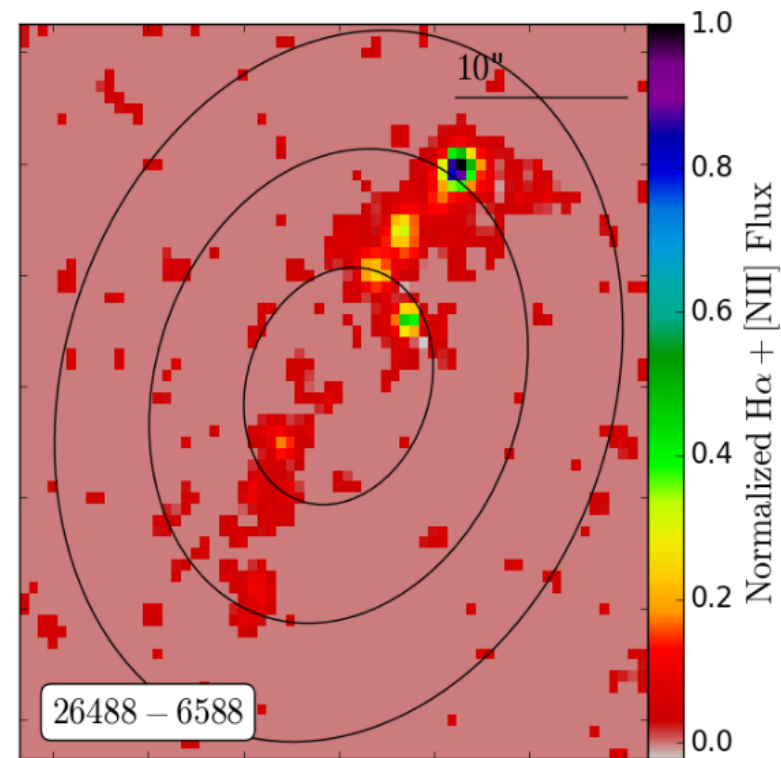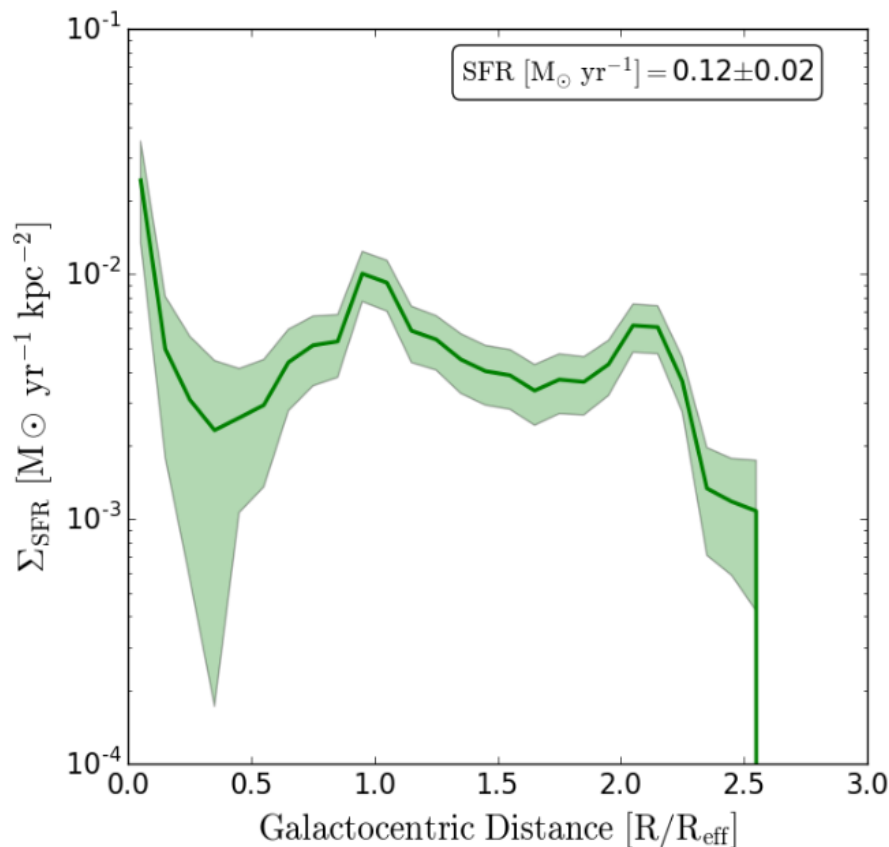

Spectral Energy Distribution of JPLUS-26488-6588

2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :**

SFR radial profile and Hα map of JPLUS-26488-6588

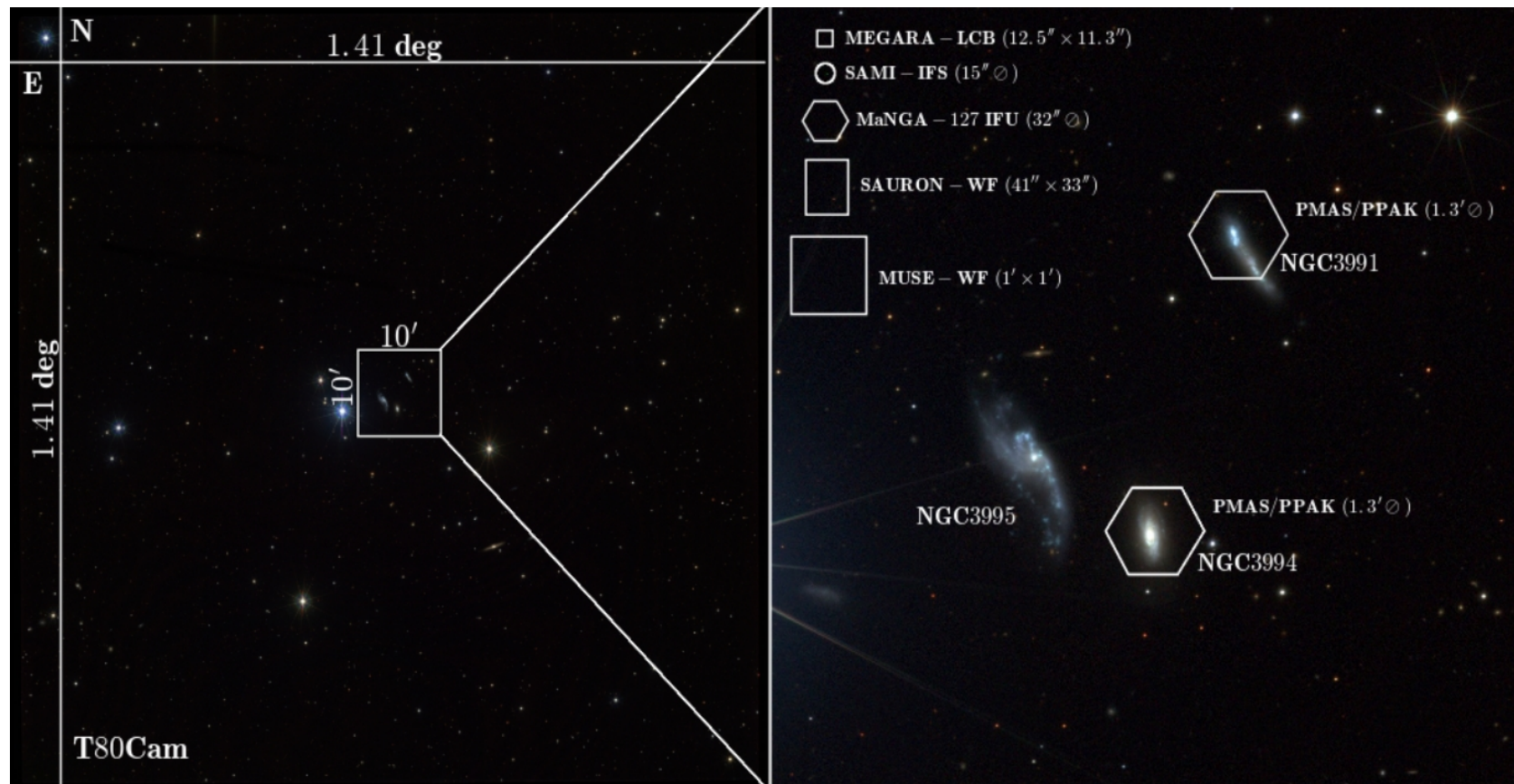# 2D SFR studies with J-PLUS

- **2D SFR studies with J-PLUS :** *Logroño-García et al. 2018: A&A in press.*

FoV comparison with Arp313 (right)

2D SFR studies with J-PLUS
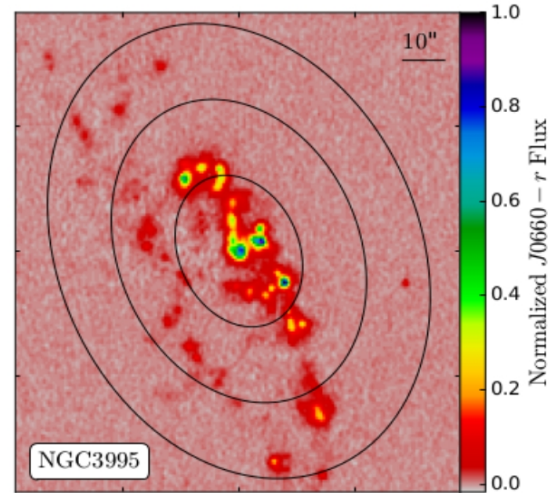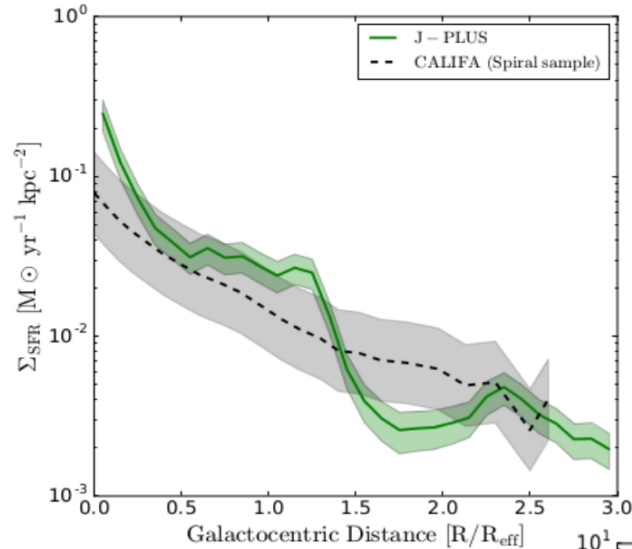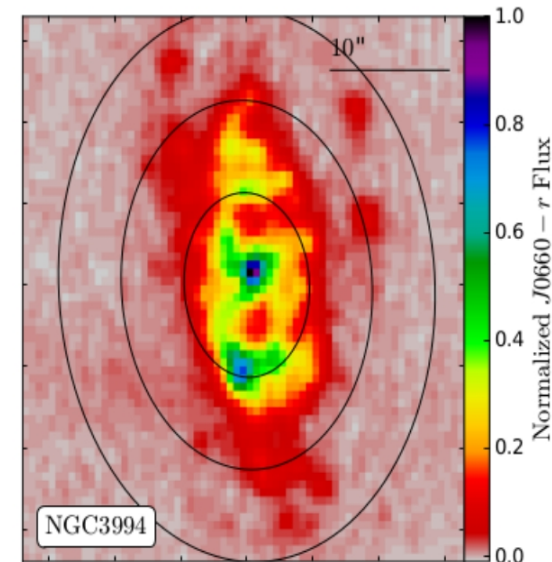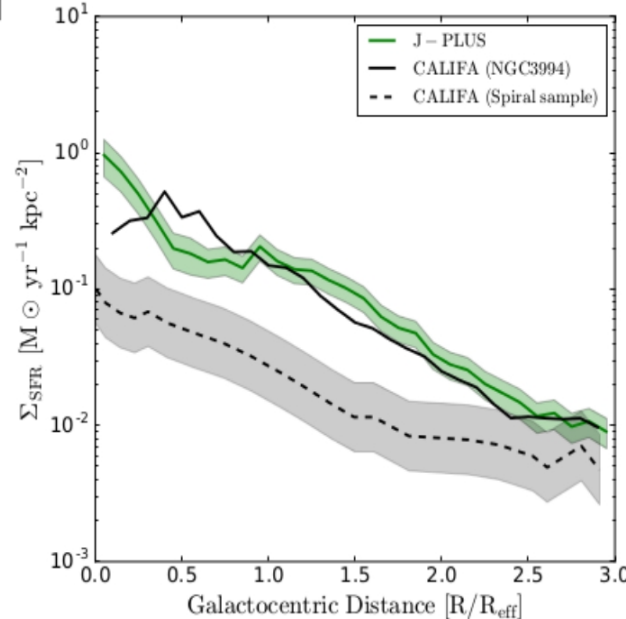
- **2D SFR studies with J-PLUS :** *Logroño-García et al. 2018: A&A in press.*

SFR radial profile and Hα map of NGC3995
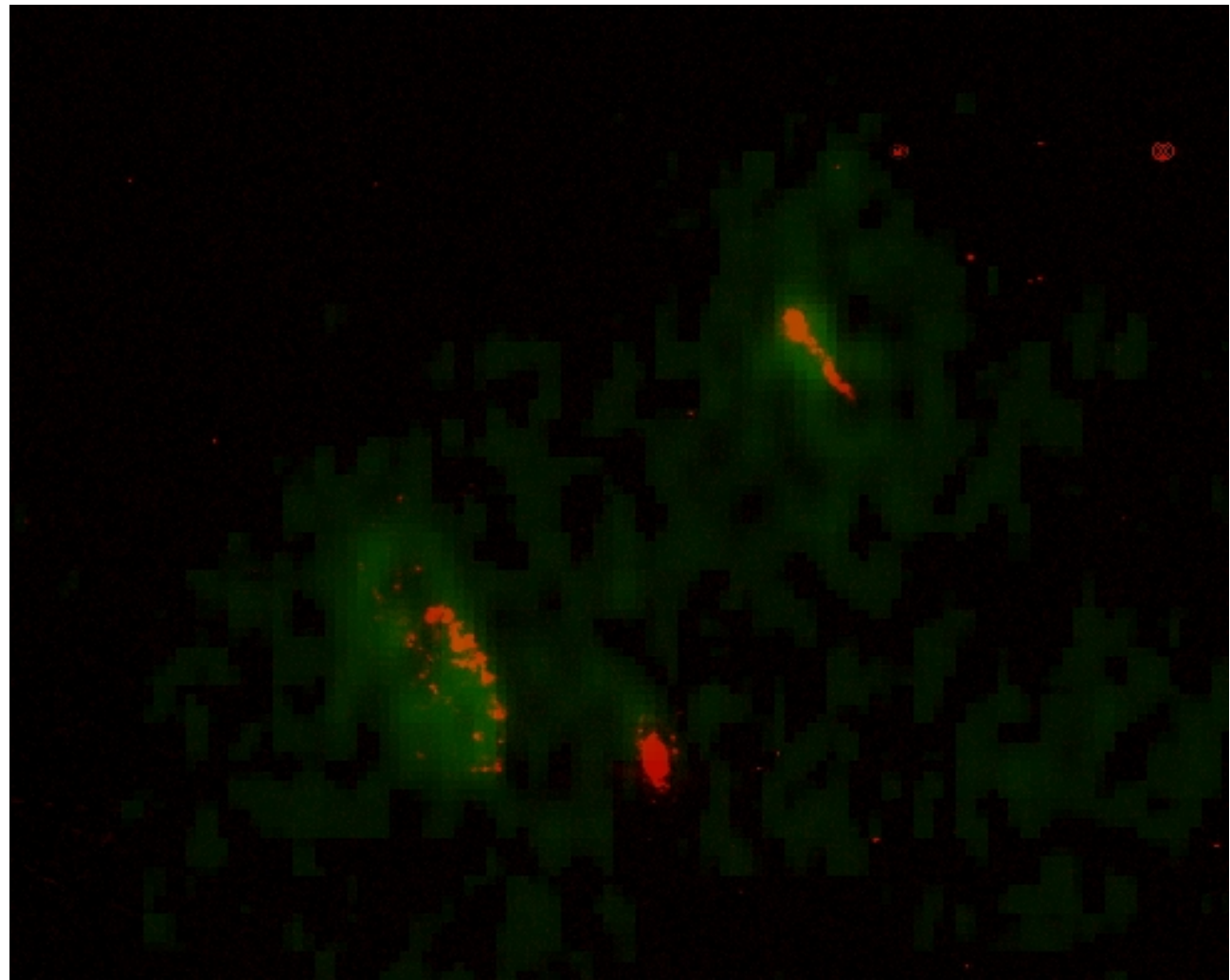
SFR radial profile and Hα map of NGC3994

J-PLUS: 2D SFR properties of nearby galaxies

- **2D SFR studies with J-PLUS :**

Arp 313 in HI (green) and Hα (red). Westerbork HI images by courtesy of Tom Osterloo

Summary and conclusions

- We have **demonstrated** that is possible to retrieve unbiased **Hα** emission line **fluxes** from **J-PLUS** data at z<0.017.

- **J-PLUS** is **suitable** to study the **SFR** in the **nearby universe,** as we have shown with the first **DR1 results**: The **Hα luminosity function,** and the **SFR main sequence.**

- We have developed a methodology to study the **2D SFR** in **nearby galaxies** and its **correlation** and **evolution** with **stellar mass** and **morphology**, as a first stage to disentangle the **physical processes** behind.

- **HI observations** would provide a very valuable information related to the **neutral gas** content of galaxies, its relation with the other parameters and the physical processes responsible.

- Integrated **SFR** of **higher-z** galaxies could be studied with **tracers** based on the **continuum.**

Feel free to ask any question!

S-PLUS