

Preliminary results of the study of low-mass dwarf galaxies from the ITP Dwarfs4MOSAIC project

María Chillarón Víctor

PhD Thesis supervised by:
Nicolás Cardiel López
Jesús Gallego Maestro

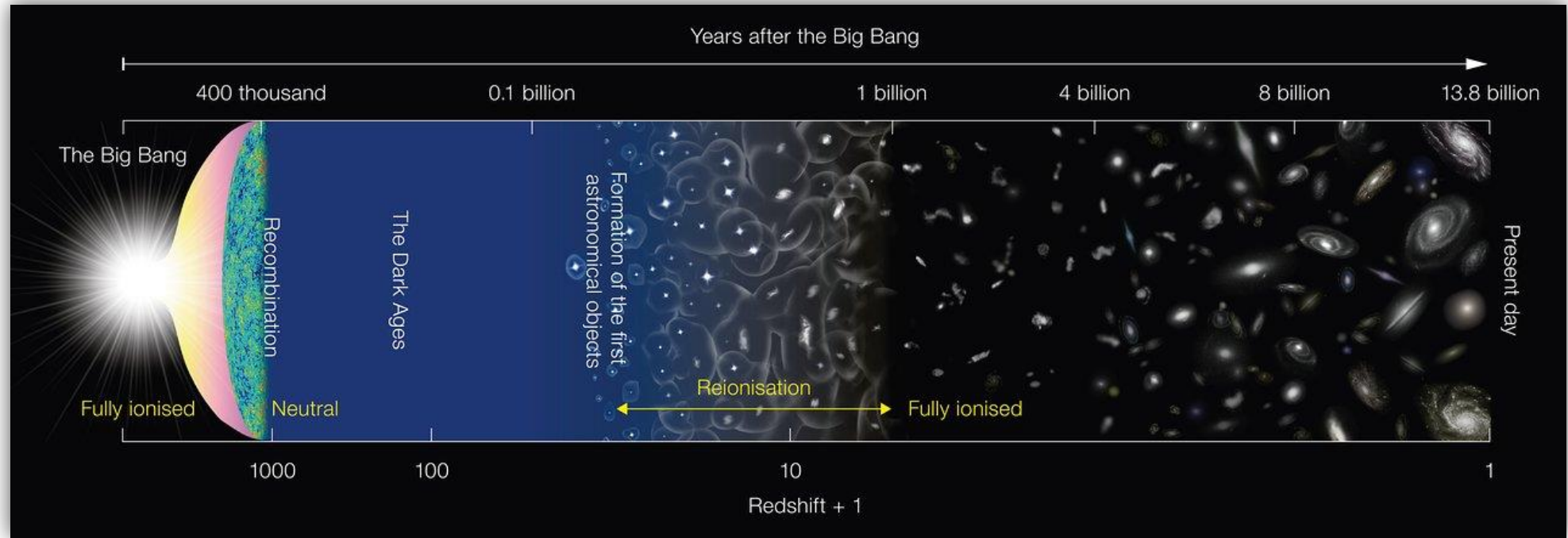
“Ayuda de IPARCOS para estudiantes de doctorado 2024/25”



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The interest in dwarf galaxies



How did cosmic reionization take place?

One of the contributors were dwarf galaxies ([Hakim Atek et al. 2024](#))

Image credit: NAOJ

Study local counterparts

The interest in dwarf galaxies

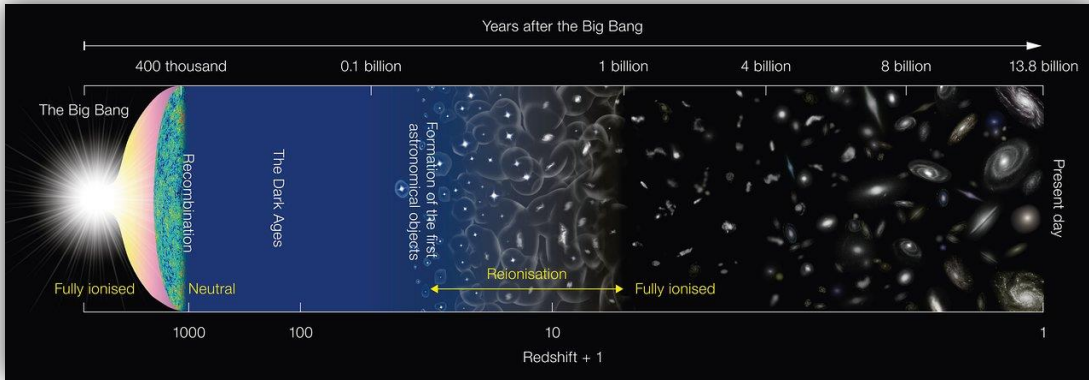


Image credit: NAOJ

How did cosmic reionization take place?

One of the contributors were dwarf galaxies ([Hakim Atek et al. 2024](#))

Study local counterparts

Dwarfs4MOSAIC ITP

La Palma International Time Program (ITP)

*A pilot study for MOSAIC at ELT
A 2D study of low-mass star-forming galaxies
as low-redshift analogs to reionization-epoch
primeval galaxies.*

PI: [J.Gallego](#) (UCM)

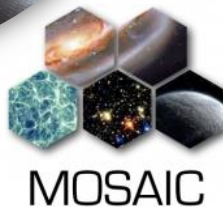
Dwarfs4MOSAIC ITP

La Palma International Time Program (ITP)

ELT webcam
7th December

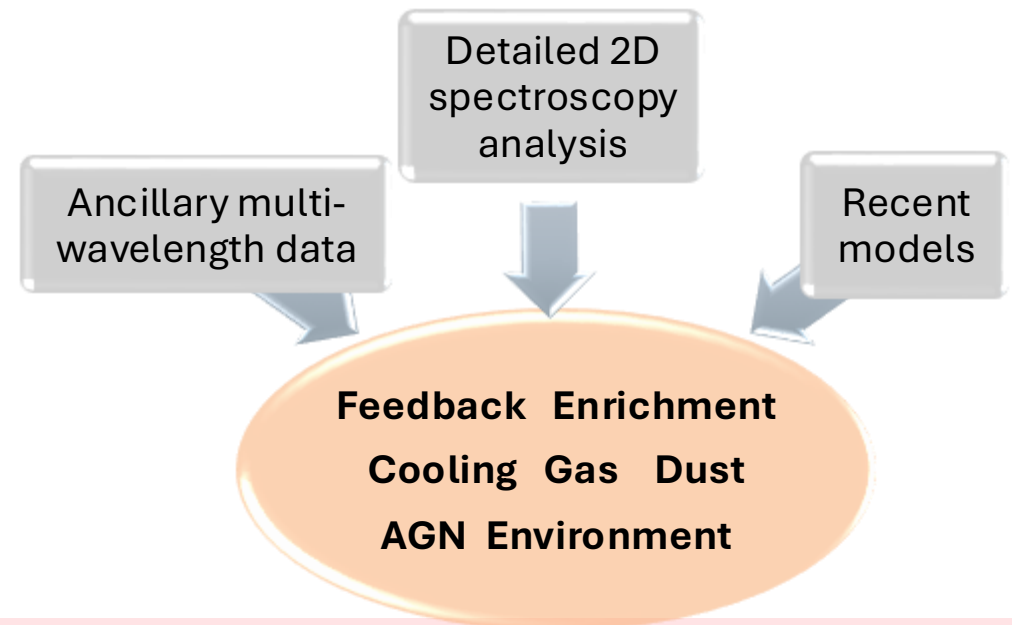


ESO 39m - Extremely Large Telescope (ELT) and MOSAIC Instrument. Images credit:ESO



A pilot study for MOSAIC at ELT
A 2D study of low-mass star-forming galaxies
as low-redshift analogs to reionization-epoch
primeval galaxies.

PI: [J.Gallego](#) (UCM)



Dwarfs4MOSAIC ITP

MEGARA@GTC
40h + 40h



WEAVE@WHT
57.3h + 32h



WFC@INT
7N



IO:O@LT
2.5 N



Dwarfs4MOSAIC ITP

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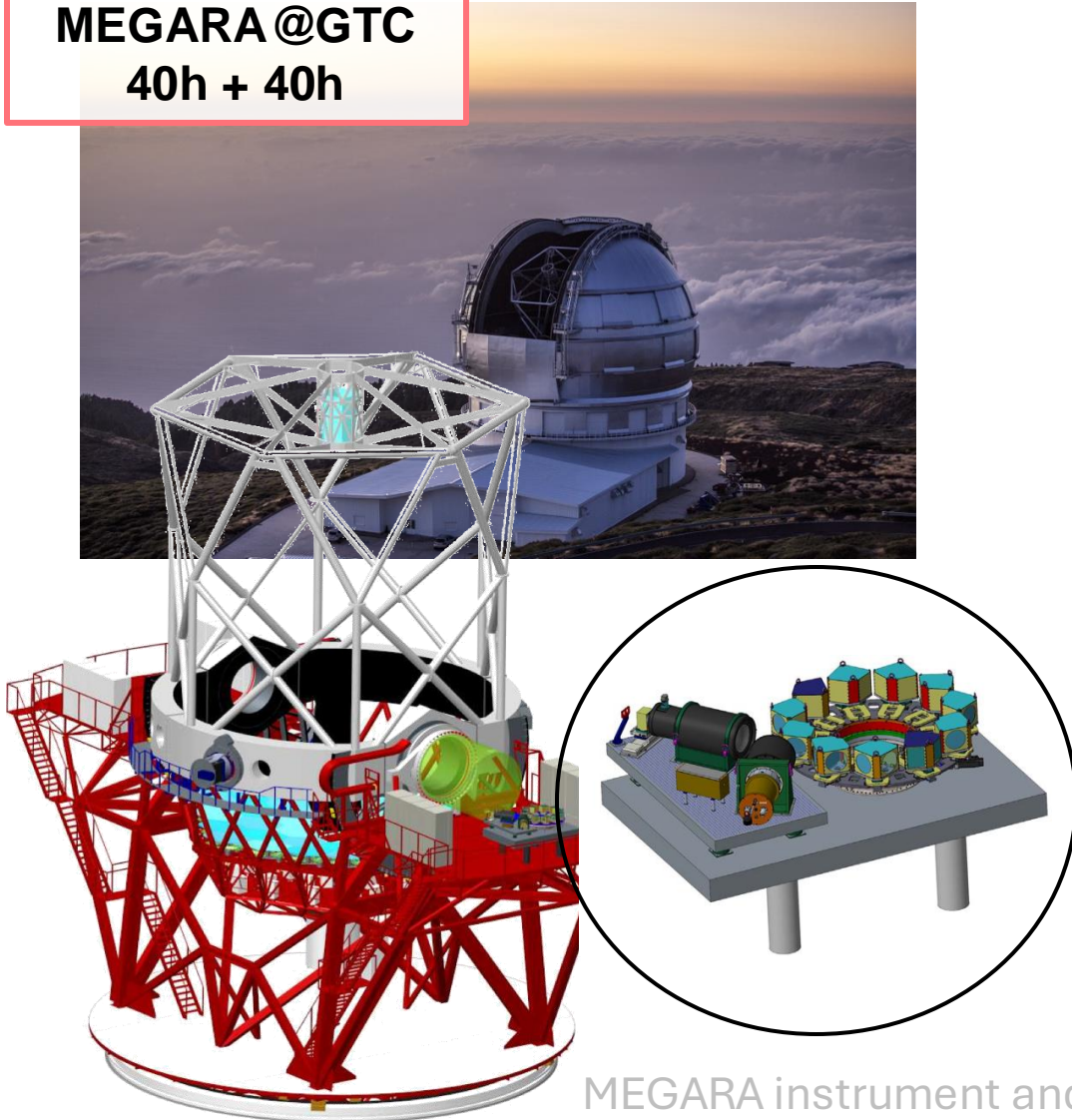
10.4m Gran Telescopio Canarias

MEGARA

Spectrograph based on fibers

- MOS
- **IFU** → Large Compact Bundle (LCB)

623 spaxels (567 LCB + 56 sky) of 0.62''



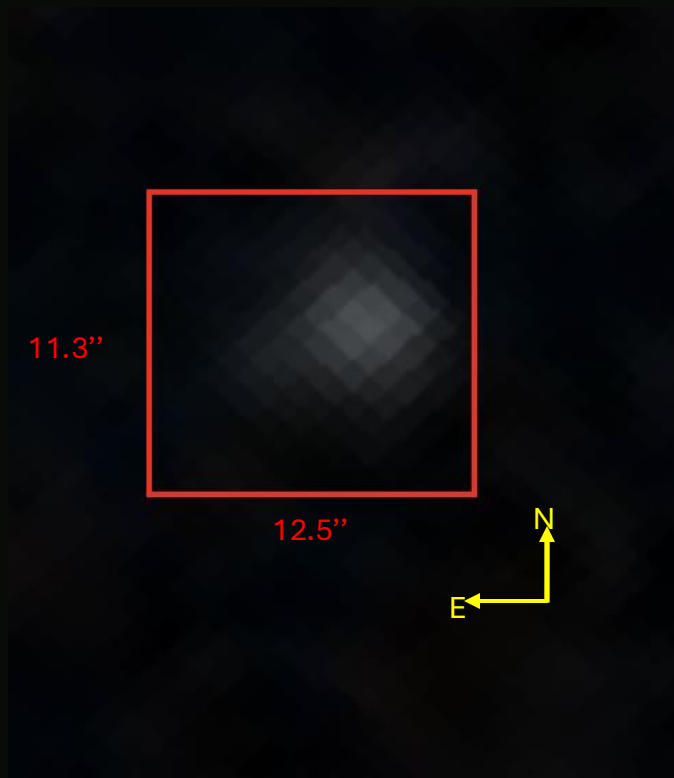
VPH Name	Setup	R_{FWHM}	$\lambda_1 - \lambda_2$ (\AA)	λ_c (\AA)
VPH405-LR	LR-U	6028	3653 - 4386	4051
VPH480-LR	LR-B	6059	4332 - 5196	4800
VPH675-LR	LR-R	6099	6094 - 7300	6747

MEGARA instrument and GTC.

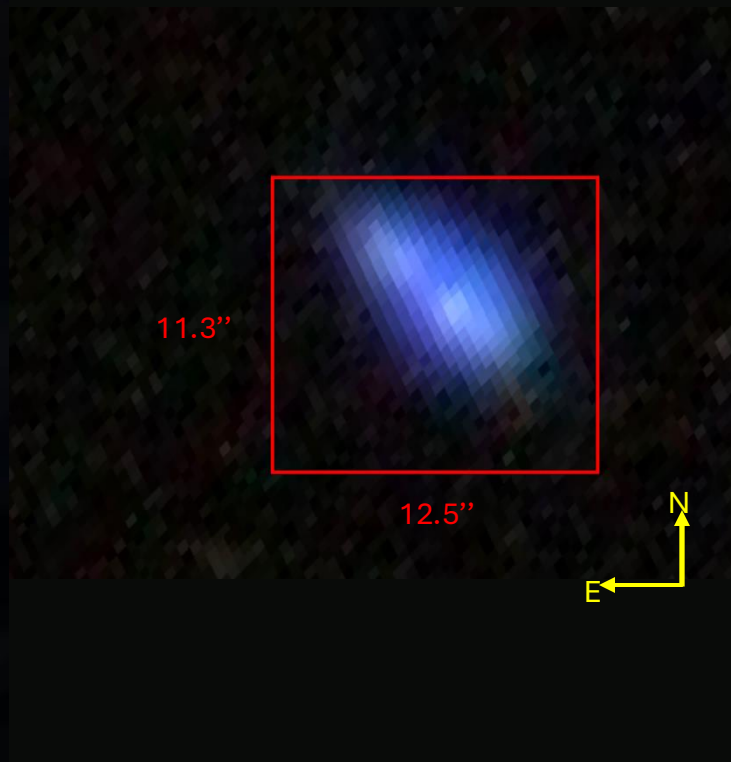
Image credits: Gran Telescopio Canarias GTC

Three observed galaxies with MEGARA so far

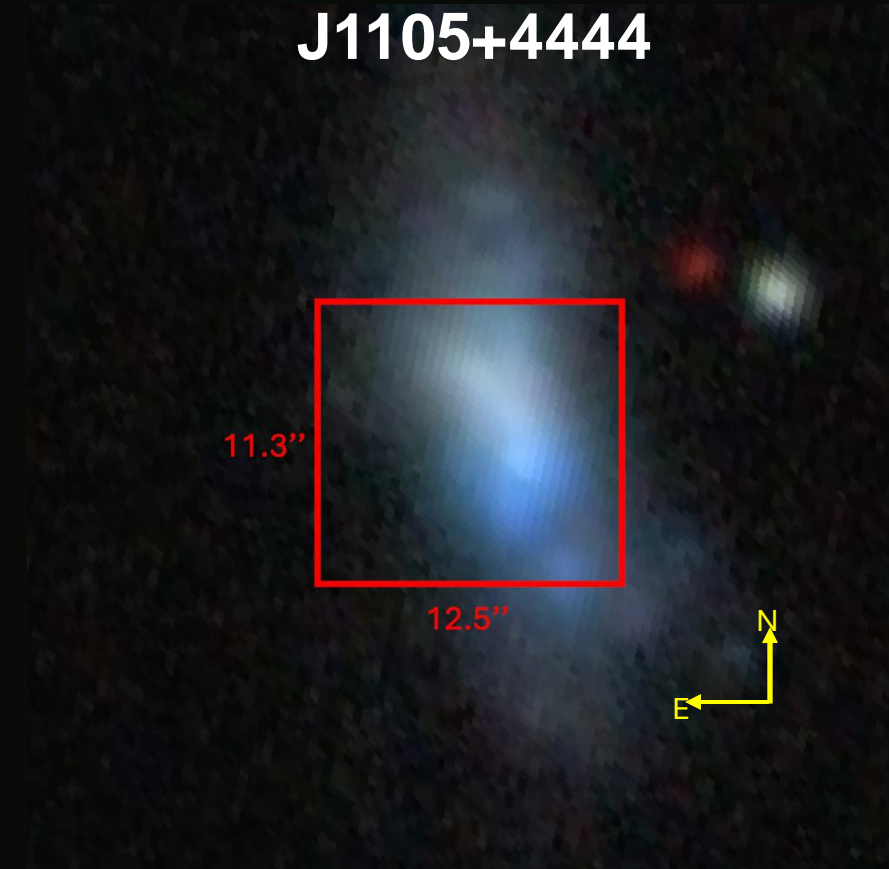
SBS 0335-052 W



Mrk1486



J1105+4444



All cutouts from Aladin - SDSS

SBS 0335-052 W: an Extremely Metal-Poor galaxy



ICRS coord. (*ep=J2000*):

03 37 44.06

-05 02 40.2

z_spec: 0.013585

SBS 0335-052 W: an Extremely Metal-Poor galaxy

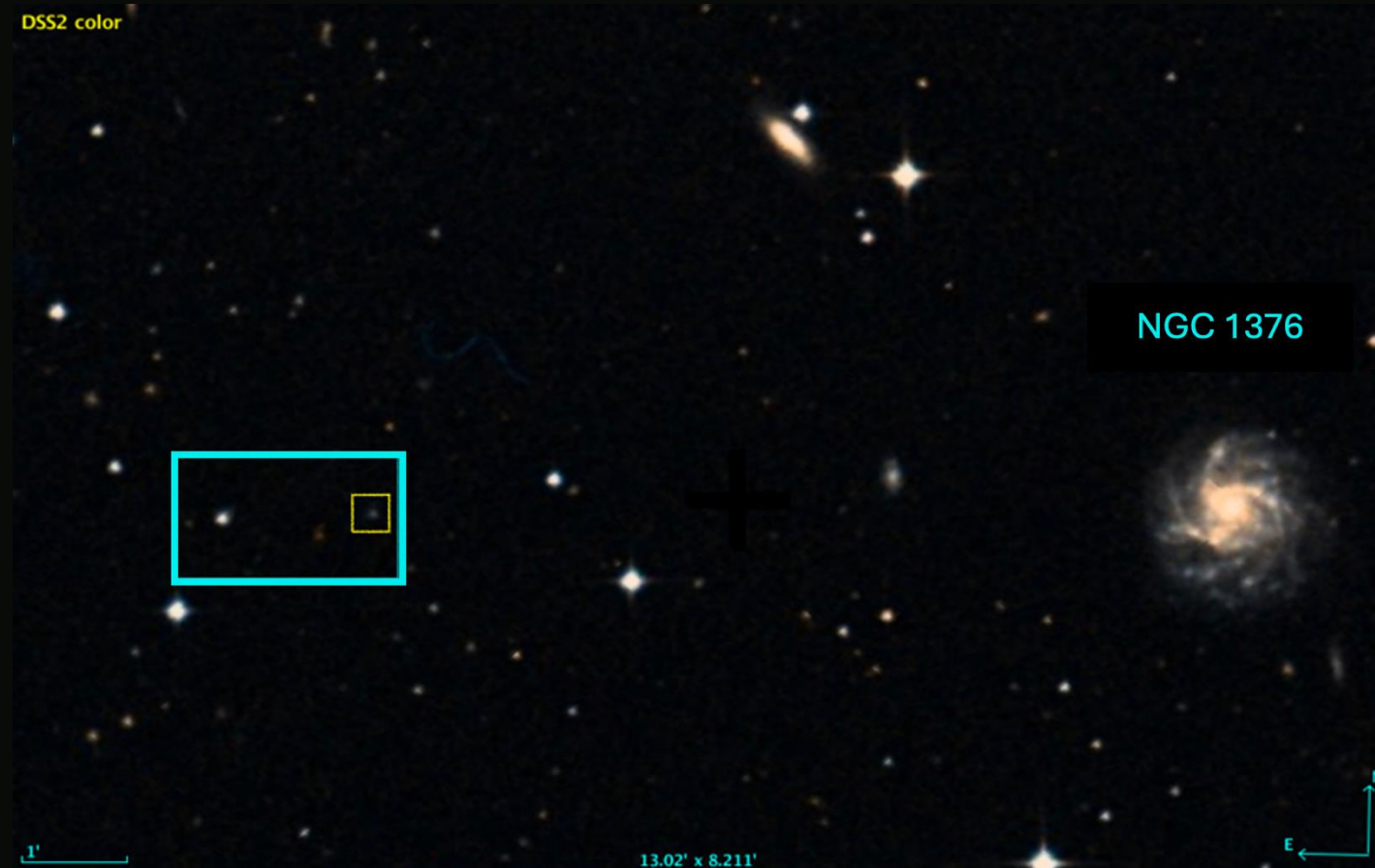
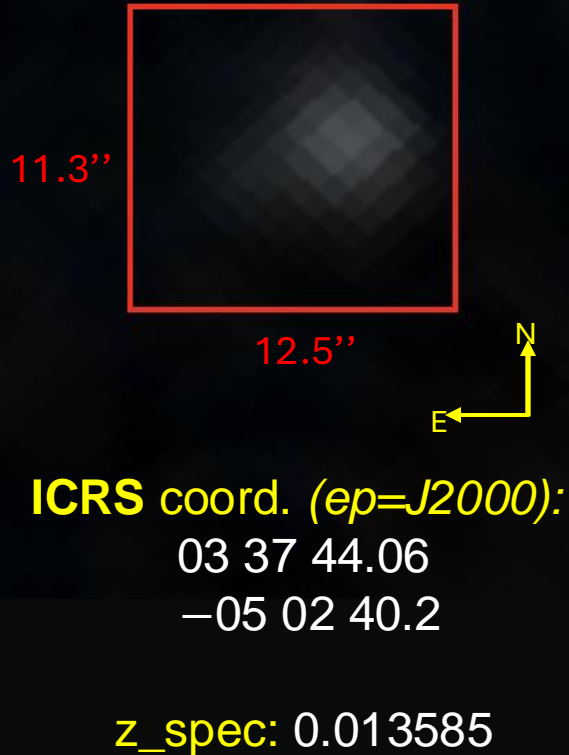


Figure 2a from TFM M.Chillaron: Environment of the SBS 0335 – 052 system and NGC 1376. The blue box contains both SBS 0335 – 052 E and W (Size: 13.02' x 8.211').

SBS 0335-052 W: an Extremely Metal-Poor galaxy

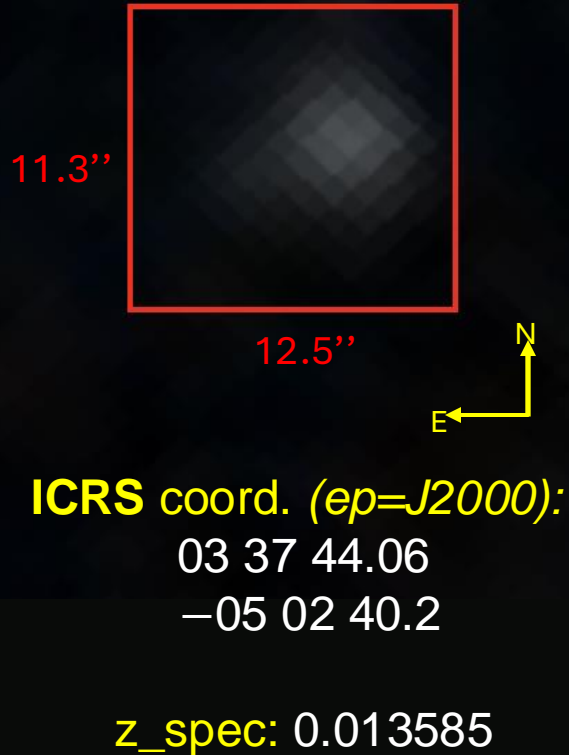


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SBS 0335-052 W: an Extremely Metal-Poor galaxy



ICRS coord. (ep=J2000):
03 37 44.06
-05 02 40.2

z_spec: 0.013585



Figure 2b from TFM M.Chillaron: Zoom of the SBS 0335 - 052 system from the previous image. (Size: 2.116' x 1.335'). Orientation: North is up and east is to the left. Images from Aladin.

SBS 0335-052 W: an Extremely Metal-Poor galaxy

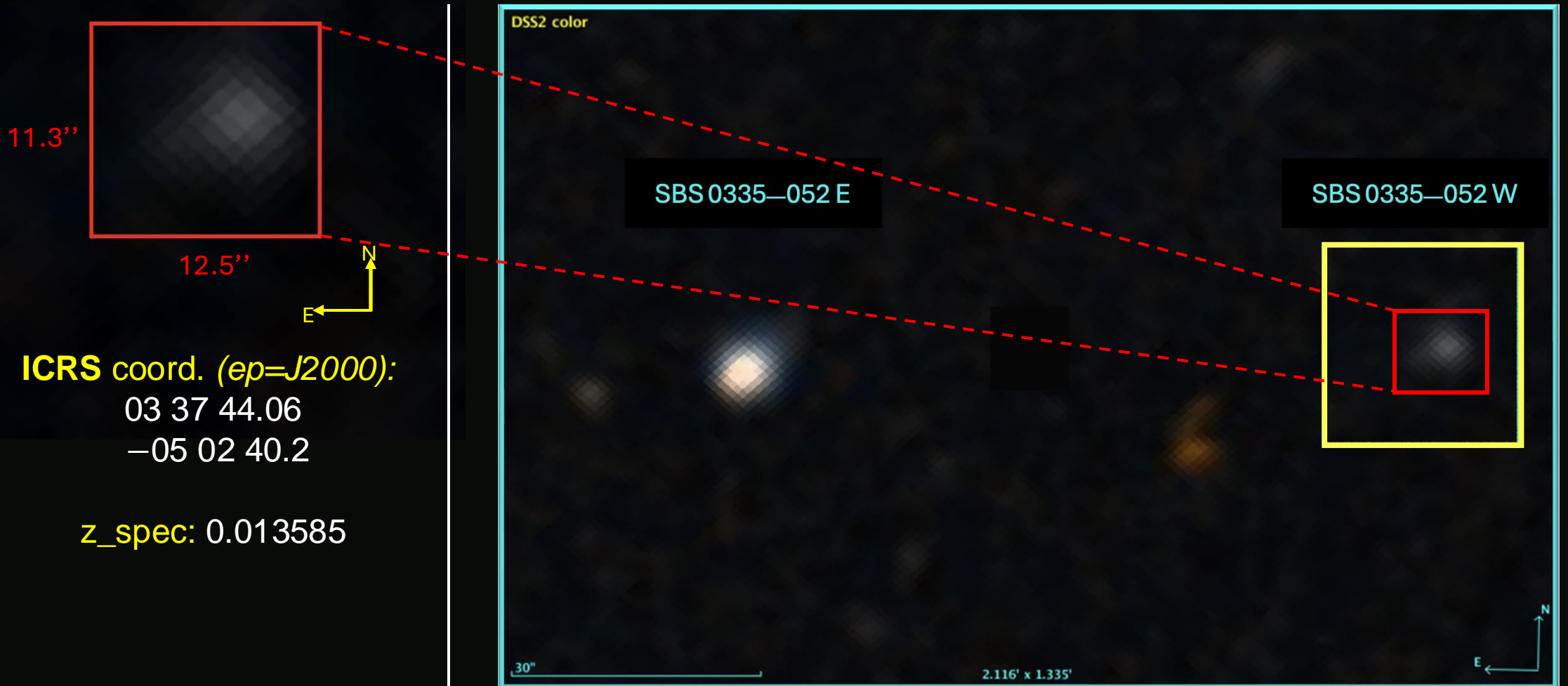


Figure 2b from TFM M.Chillaron: Zoom of the SBS 0335 – 052 system from the previous image. (Size: 2.116' × 1.335'). Orientation: North is up and east is to the left. Images from Aladin.

SBS 0335-052 W: an Extremely Metal-Poor galaxy



ICRS coord. (ep=J2000):

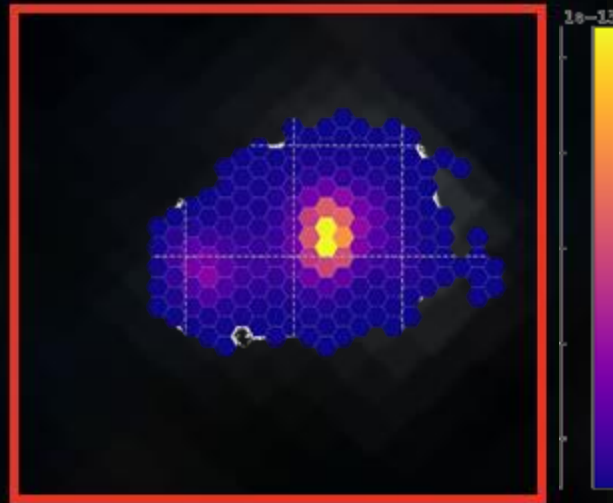
03 37 44.06

-05 02 40.2

z_spec: 0.013585

H α

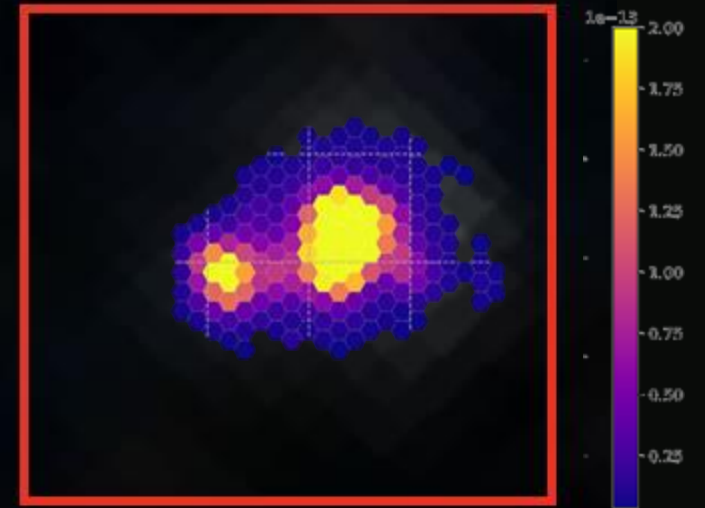
Flux ($\text{erg s}^{-1} \text{cm}^{-2} \text{A}^{-1}$)



Velocity (km/s)



Flux ($\text{erg s}^{-1} \text{cm}^{-2} \text{A}^{-1}$)



Velocity dispersion (km/s)



SBS 0335-052 W



ICRS coord. (ep=J2000):

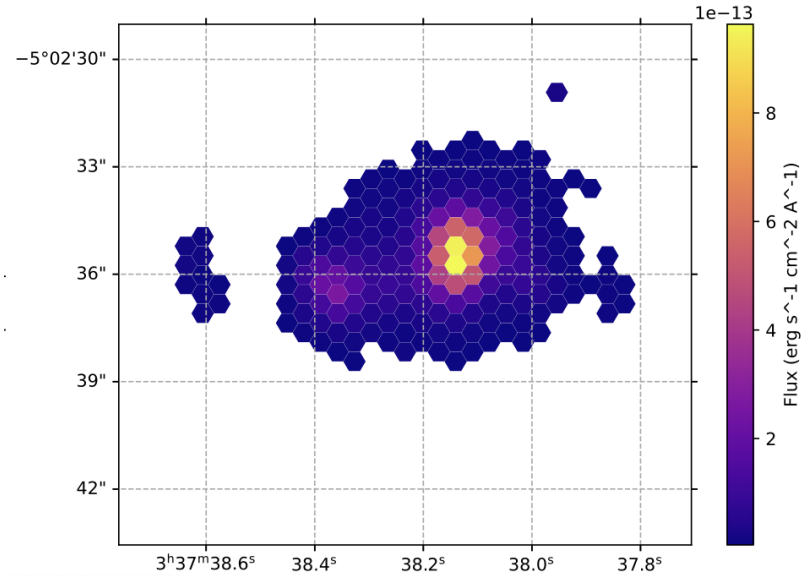
03 37 44.06

-05 02 40.2

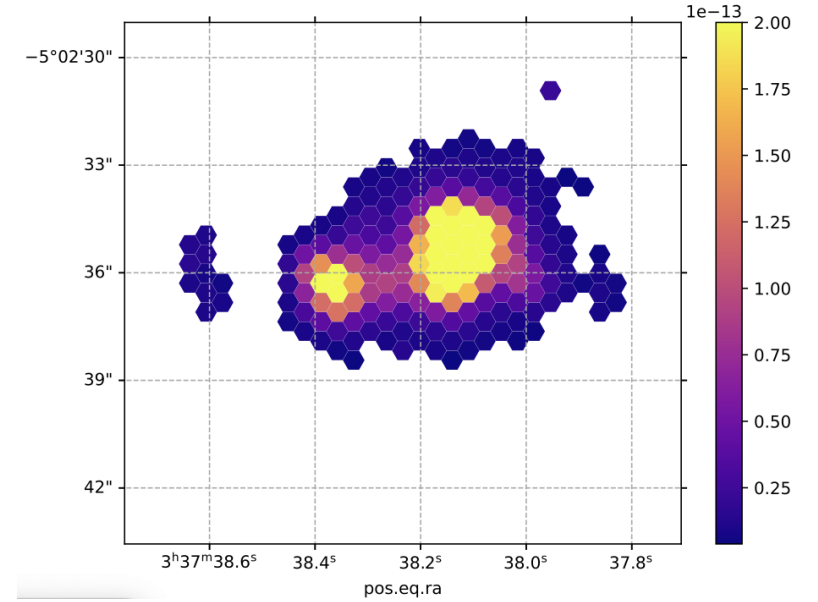
z_{spec} : 0.013585

H α

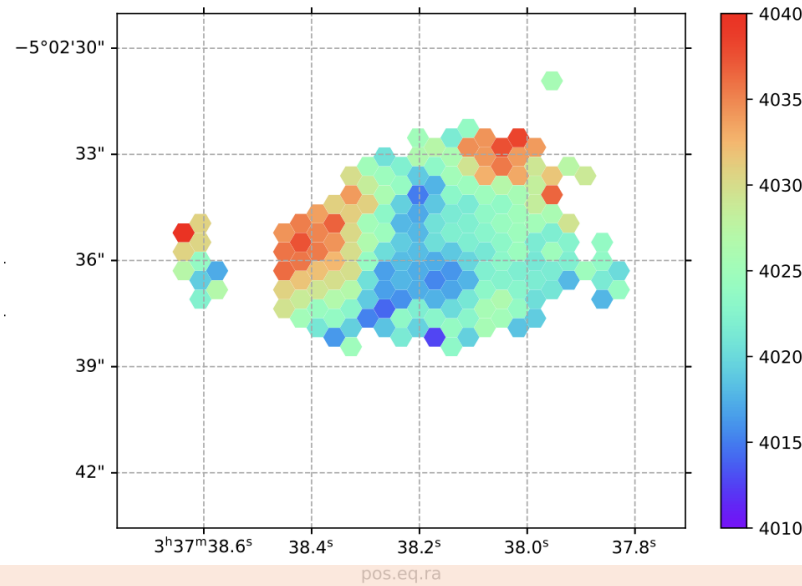
Flux (erg s⁻¹ cm⁻² Å⁻¹)



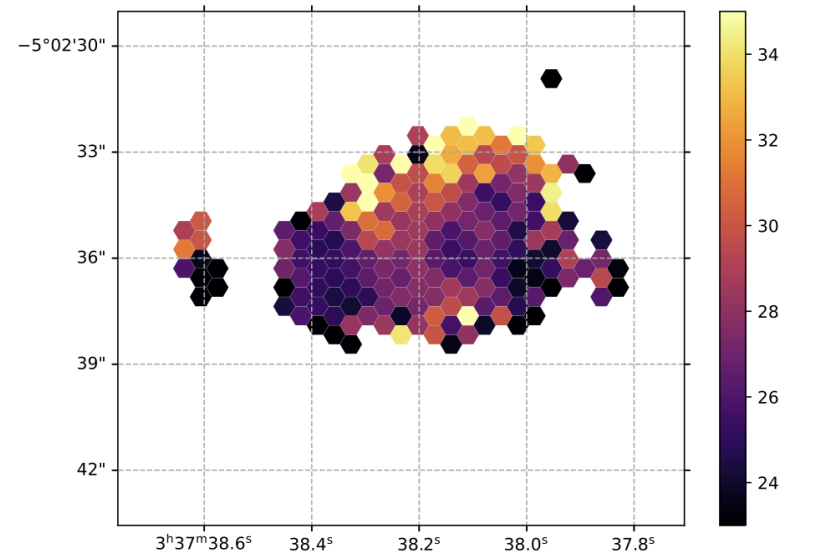
Flux (erg s⁻¹ cm⁻² Å⁻¹)



Velocity (km/s)



Velocity dispersion (km/s)



SBS 0335-052 W



ICRS coord. (*ep*=J2000):

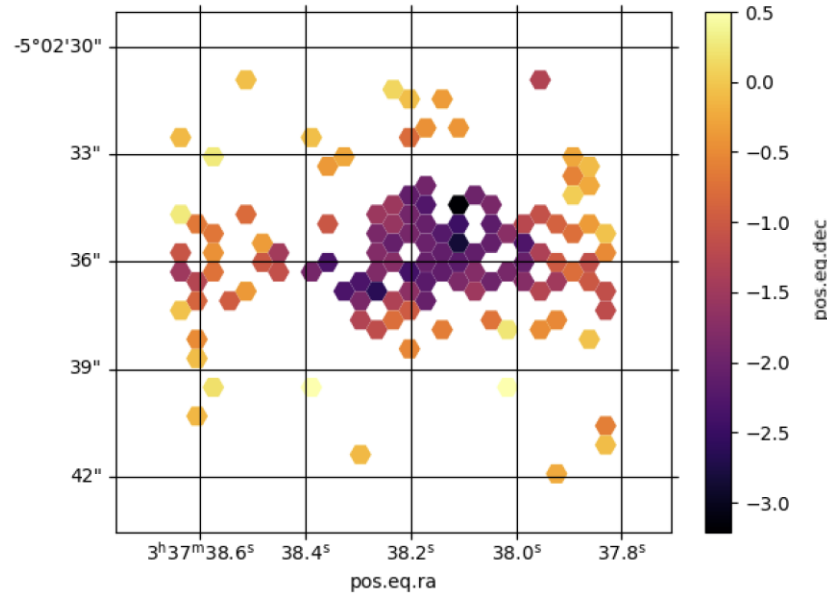
03 37 44.06

-05 02 40.2

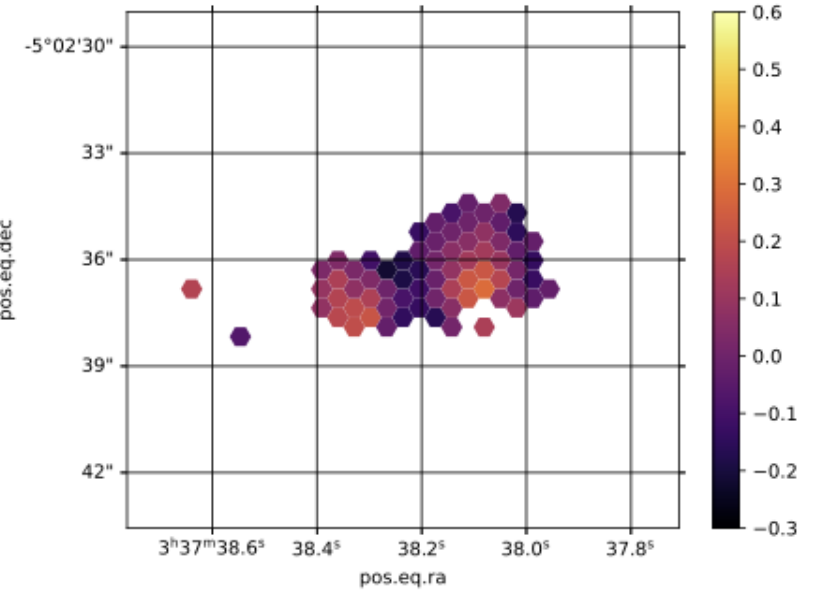
*z*_{spec}: 0.013585

Line-ratio
maps

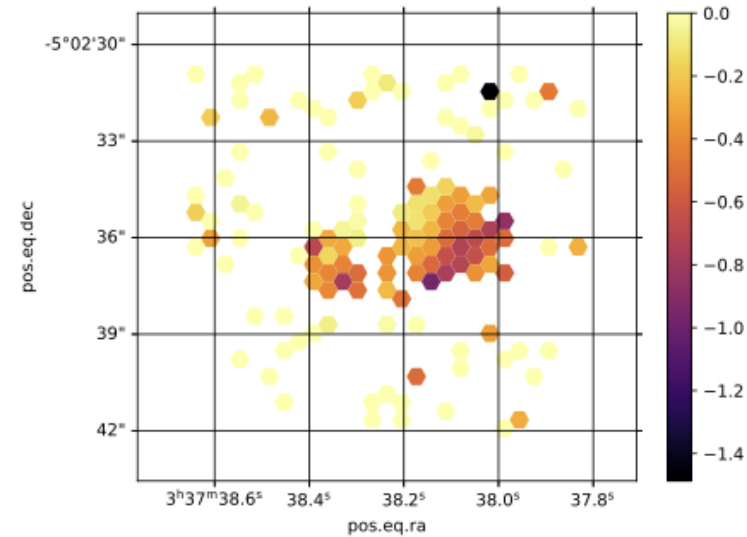
$\log_{10}([\text{NII}]\lambda 6584/\text{H}\alpha)$



$\log_{10}([\text{OIII}]\lambda 5007/\text{H}\beta)$



$\log_{10}(\text{H}\gamma/\text{H}\beta)$



SBS 0335-052 W



ICRS coord. (ep=J2000):

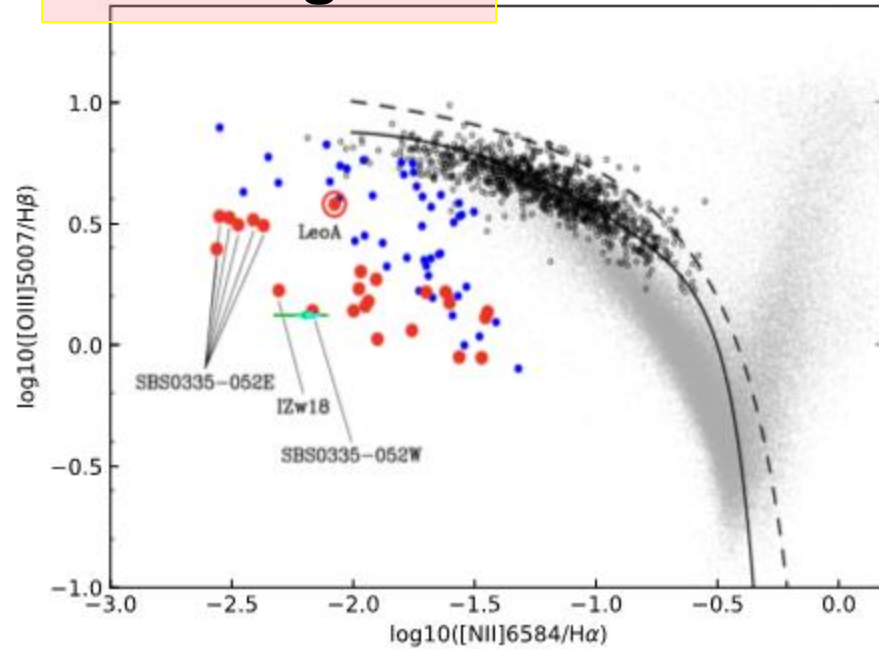
03 37 44.06
-05 02 40.2

z_spec: 0.013585

Master's thesis results
June 2024

“Ayuda de IPARCOS para la
realización de TFMs 2023/24”

BPT diagram



Legend from Izotov, Y. and Thuan, T. and Guseva, N. (2012)

- Emission-line galaxies observed in this paper
- The most-metal deficient starforming galaxies known
- A sample of 803 luminous compact galaxies
- 100 000 emission-line galaxies from SDSS DR7

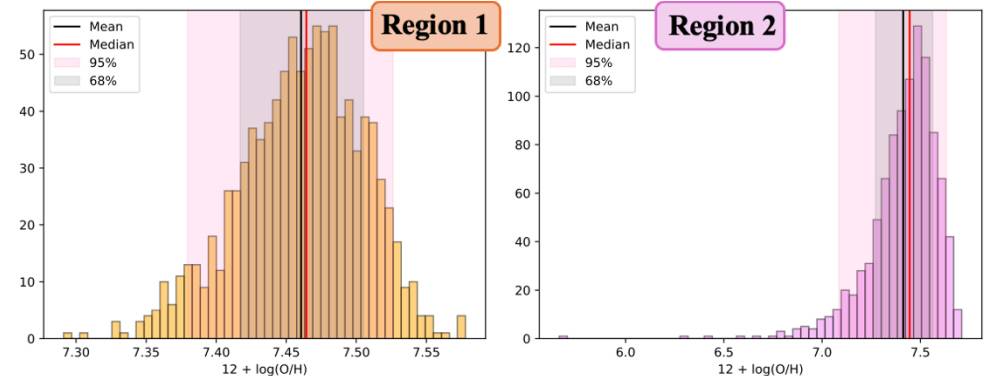
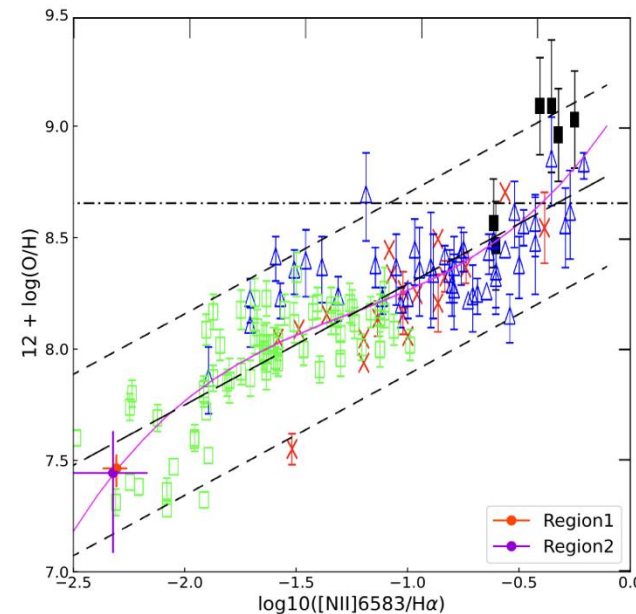
	$\log([\text{NII}]6584/\text{H}\alpha)$	$\log([\text{OIII}]5007/\text{H}\beta)$
$\pm 1\sigma$	$-2.181^{+0.034}_{-0.031}$	$0.1223^{+0.0025}_{-0.0570}$
$\pm 2\sigma$	$-2.181^{+0.053}_{-0.057}$	$0.1236^{+0.0029}_{-0.0042}$

	$\log([\text{NII}]6584/\text{H}\alpha)$	$\log([\text{OIII}]5007/\text{H}\beta)$
$\pm 1\sigma$	$-2.197^{+0.098}_{-0.130}$	$0.1236^{+0.0052}_{-0.0062}$
$\pm 2\sigma$	$-2.20^{+0.15}_{-0.23}$	$0.1236^{+0.0090}_{-0.0110}$

N2 index

Eq. (2) from Pettini & Pagel (2004)

$$12 + \log(\text{O}/\text{H}) = 9.37 + 2.03 \times \text{N2} + 1.26 \times \text{N2}^2 + 0.32 \times \text{N2}^3$$

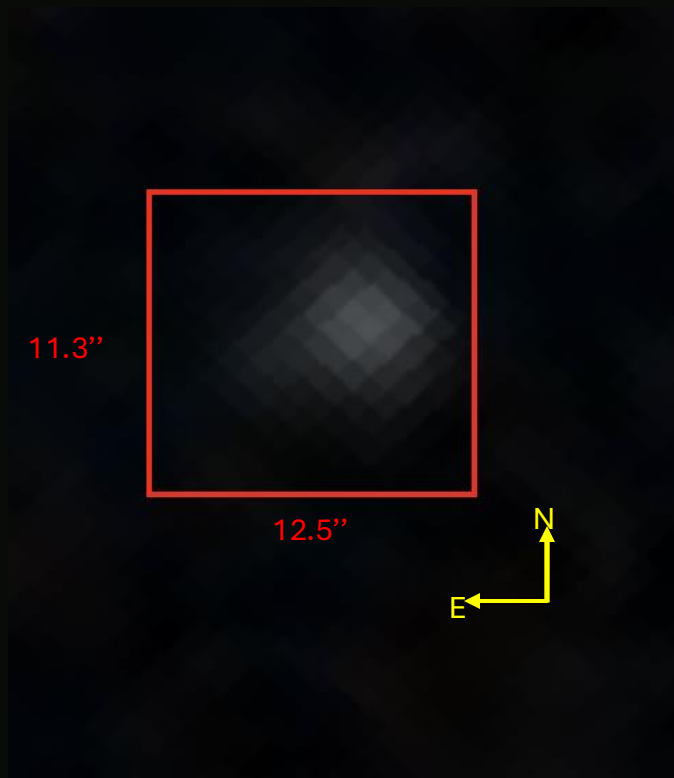


	$12 + \log(\text{O}/\text{H})$ (N2)
$\pm 1\sigma$	$7.464^{+0.041}_{-0.047}$
$\pm 2\sigma$	$7.464^{+0.062}_{-0.085}$

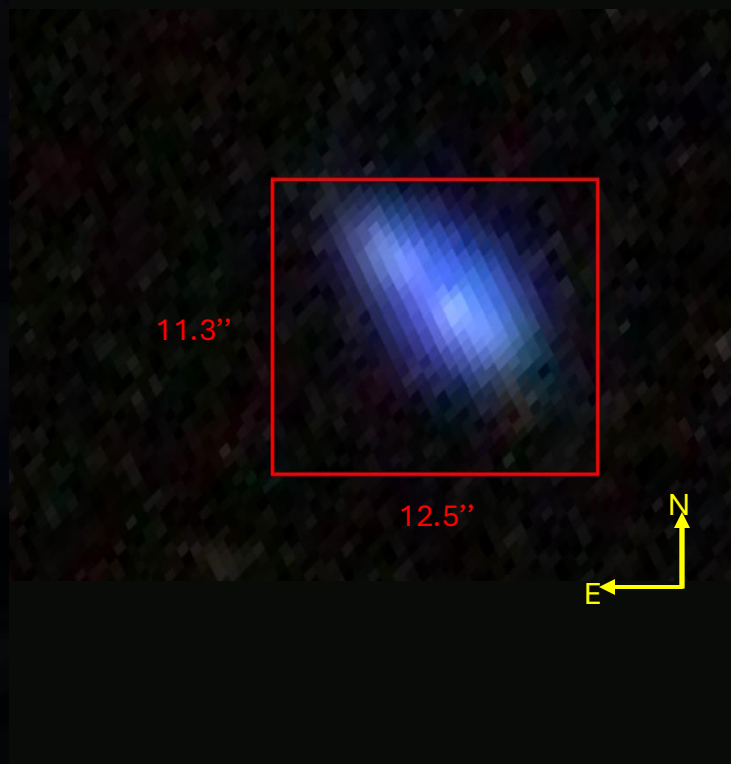
	$12 + \log(\text{O}/\text{H})$ (N2)
$\pm 1\sigma$	$7.44^{+0.12}_{-0.17}$
$\pm 2\sigma$	$7.44^{+0.19}_{-0.36}$

Three observed galaxies with MEGARA so far

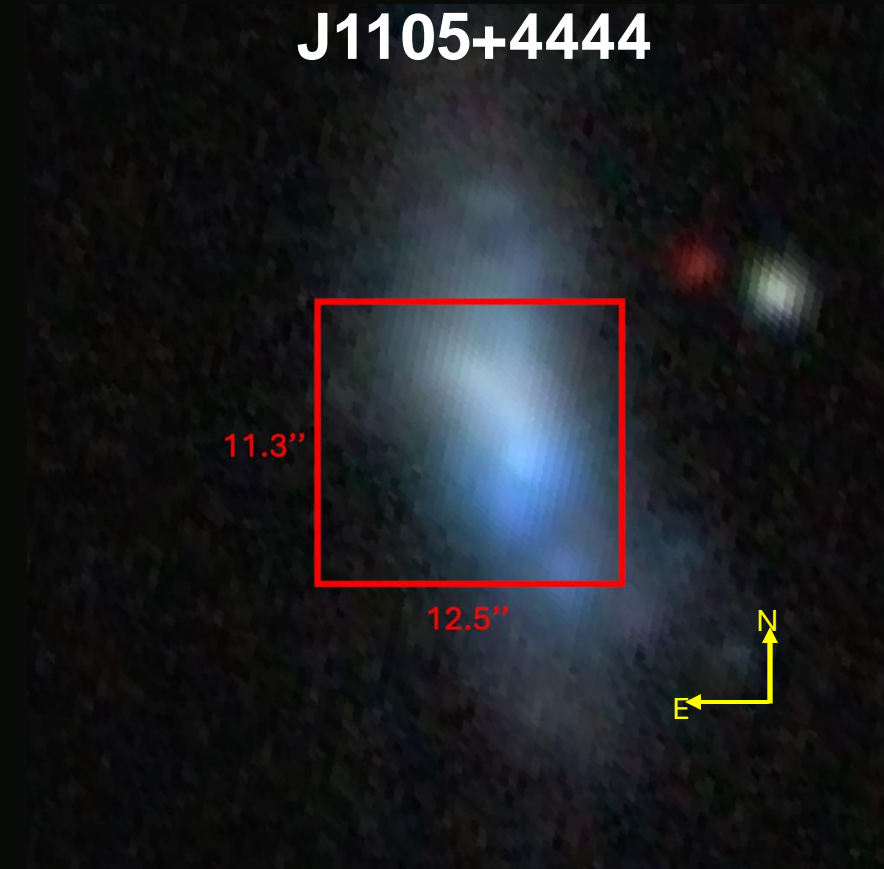
SBS 0335-052 W



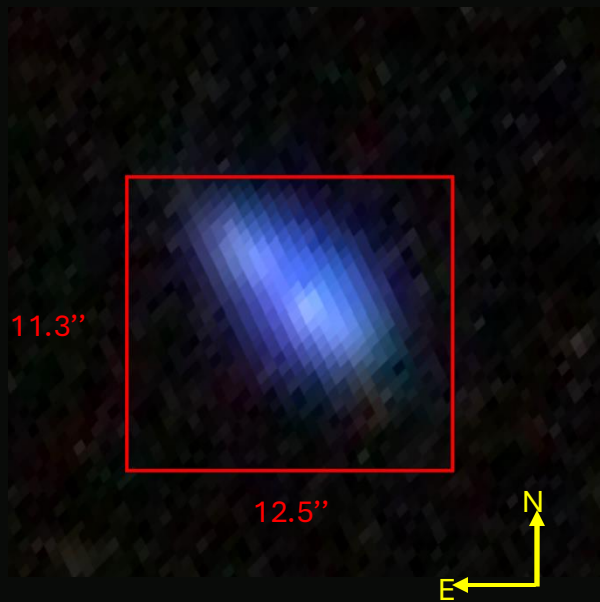
Mrk1486



J1105+4444



Mrk1486: a metal-poor starburst edge-on disc galaxy with strong outflows



ICRS coord. (*ep=J2000*):

13 59 50.90

+57 26 22.9

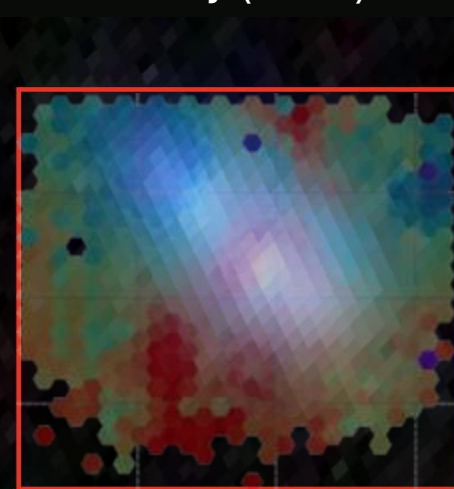
*z*_{spec}: 0.03386

H α

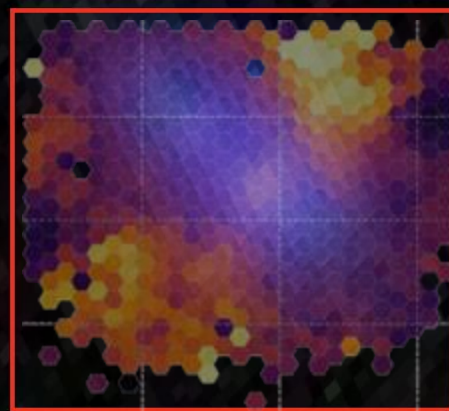
Flux ($\text{erg s}^{-1}\text{cm}^{-2} \text{ \AA}^{-1}$)



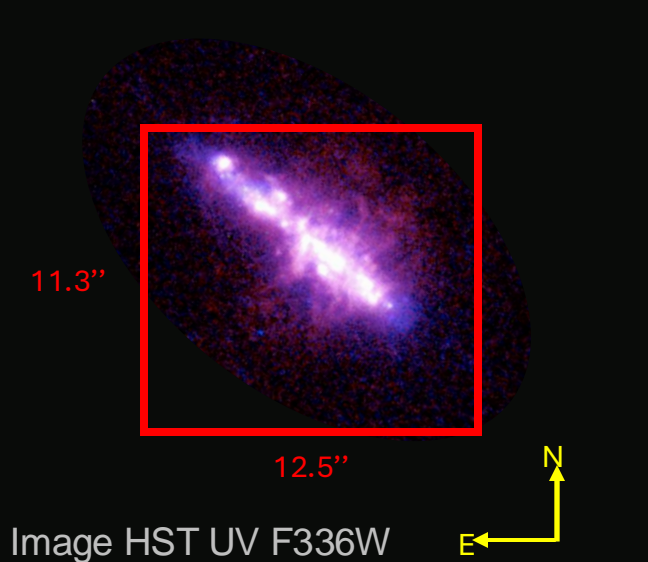
Velocity (km/s)



Velocity dispersion (km/s)



Mrk1486: a metal-poor starburst edge-on disc galaxy with strong outflows



ICRS coord. (*ep*=J2000):

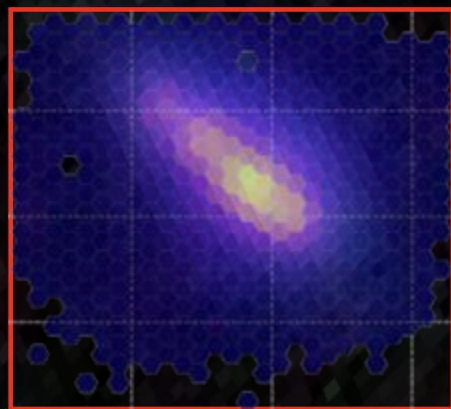
13 59 50.90

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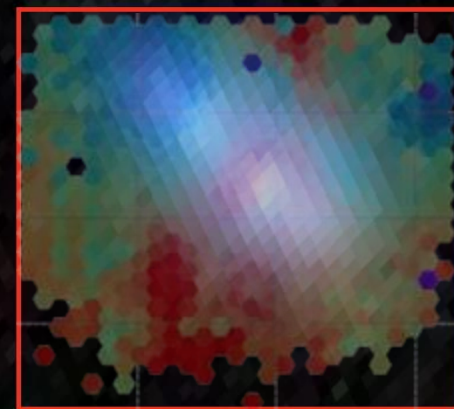
***z*_{spec}:** 0.03386

H α

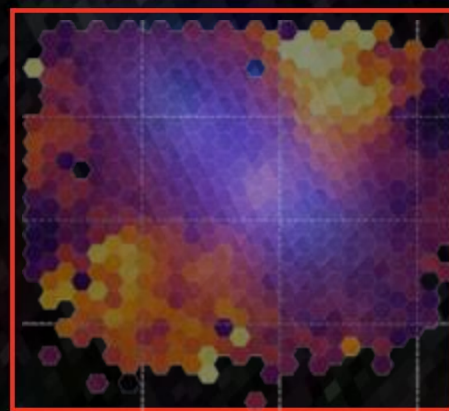
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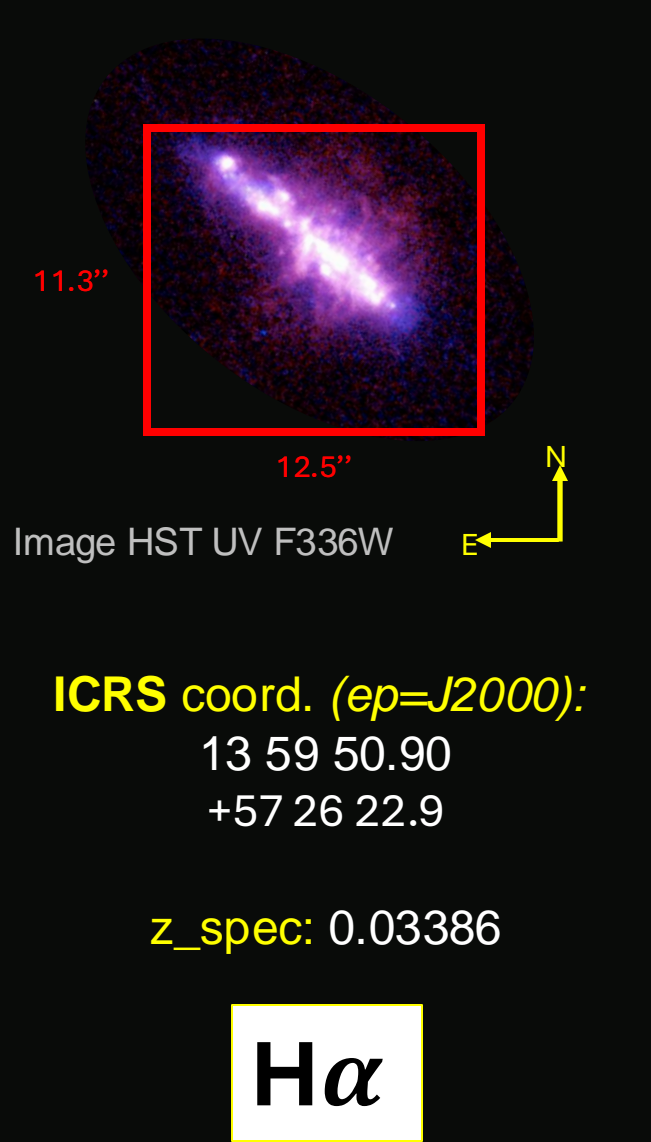
Velocity (km/s)



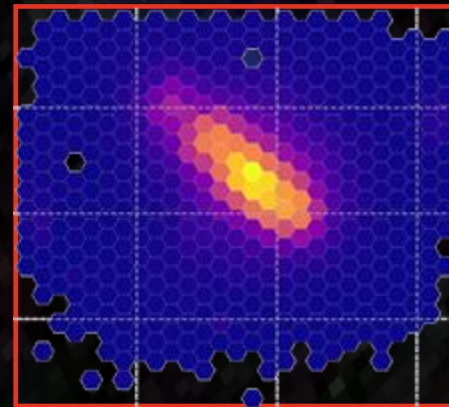
Velocity dispersion (km/s)



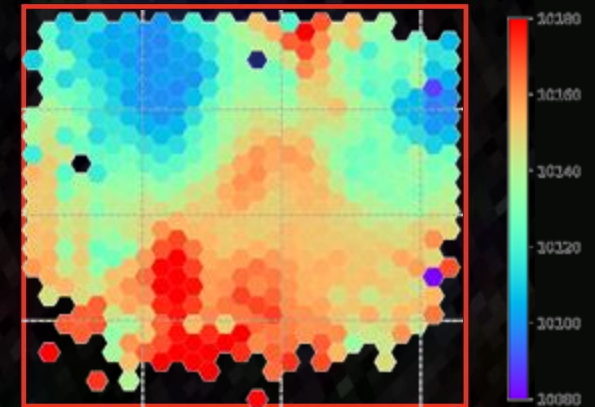
Mrk1486: a metal-poor starburst edge-on disc galaxy with strong outflows



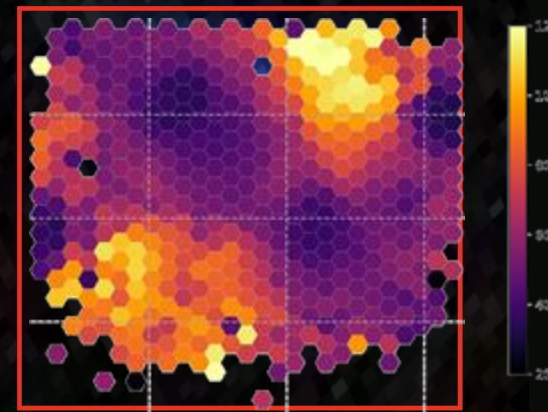
Flux ($\text{erg s}^{-1}\text{cm}^{-2} \text{ \AA}^{-1}$)



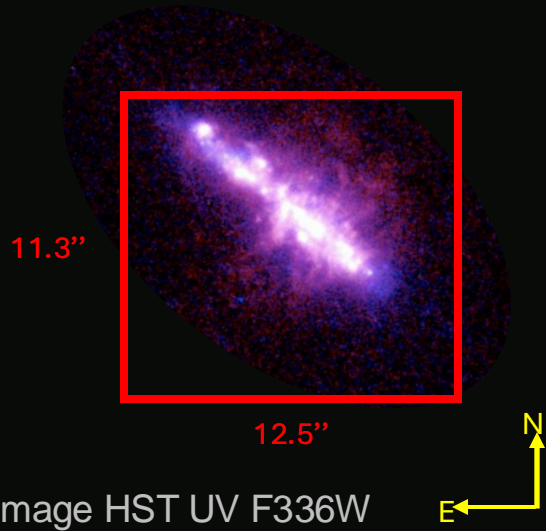
Velocity (km/s)



Velocity dispersion (km/s)



Mrk1486



ICRS coord. (*ep*=J2000):

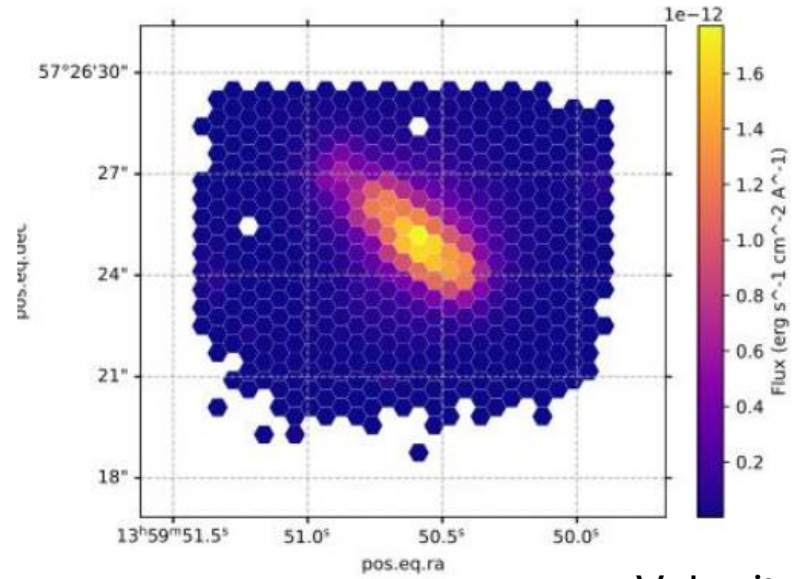
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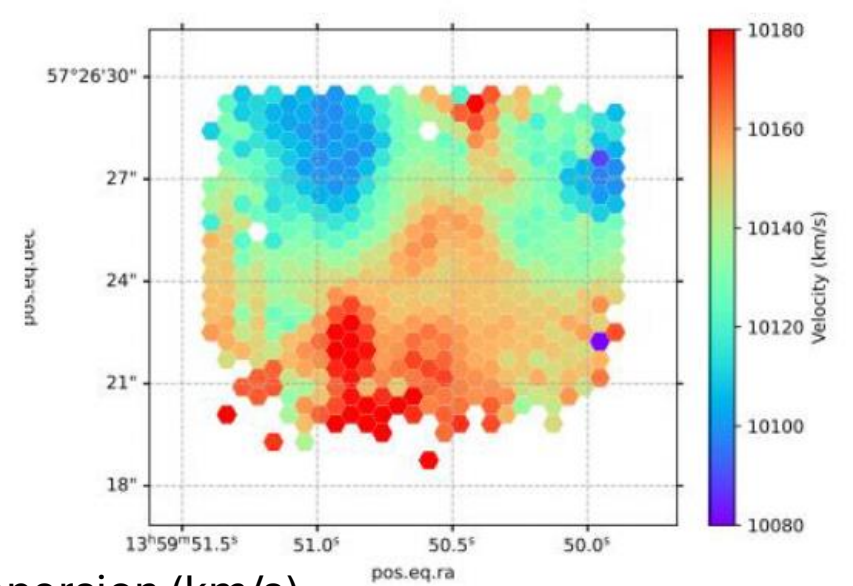
*z*_{spec}: 0.03386

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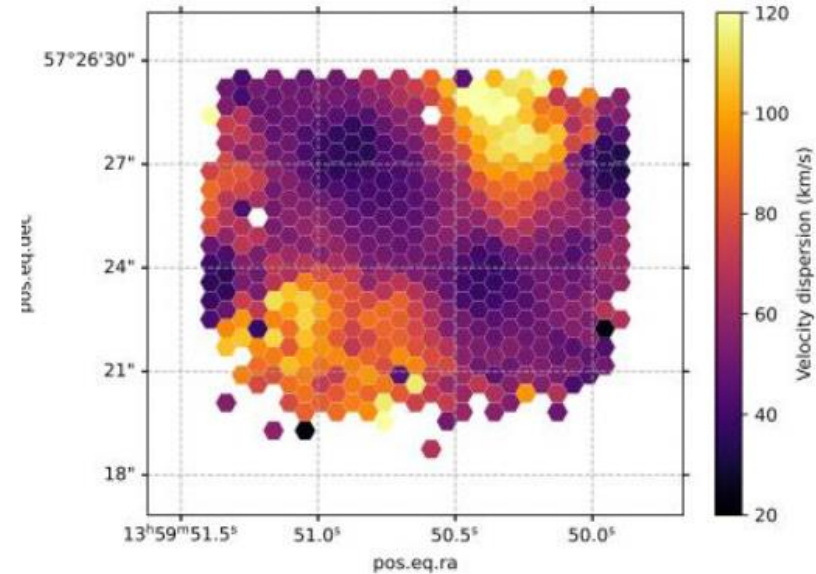
Flux ($\text{erg s}^{-1} \text{cm}^{-2} \text{A}^{-1}$)



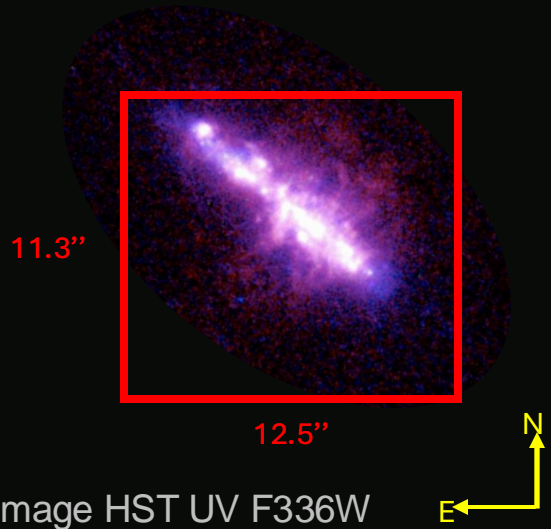
Velocity (km/s)



Velocity dispersion (km/s)



Mrk1486



ICRS coord. (*ep*=J2000):

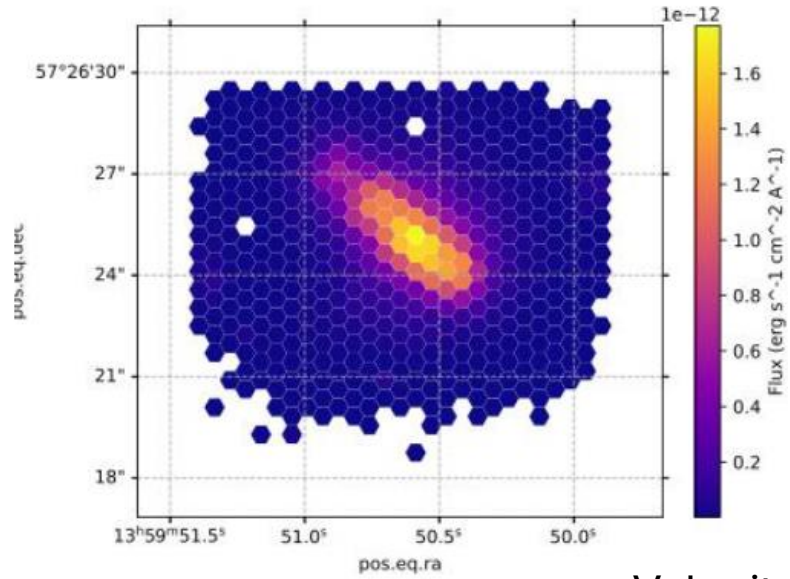
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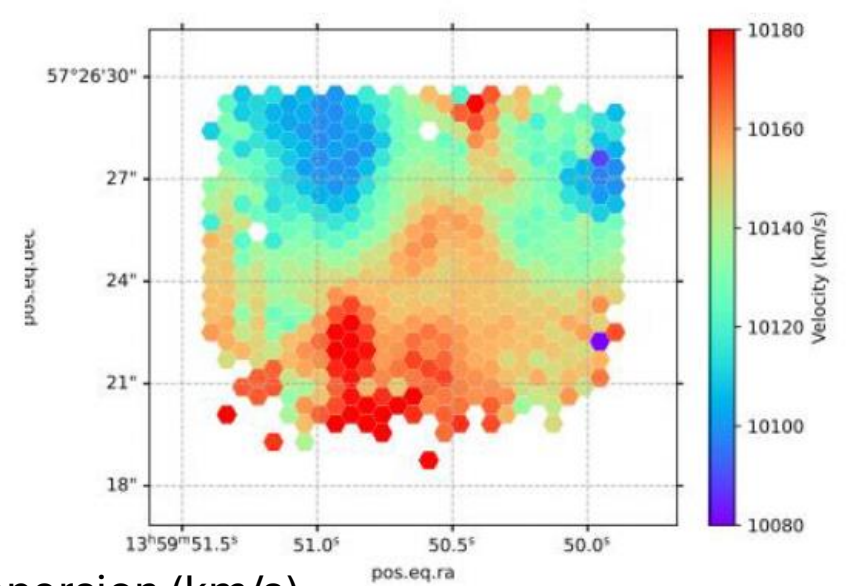
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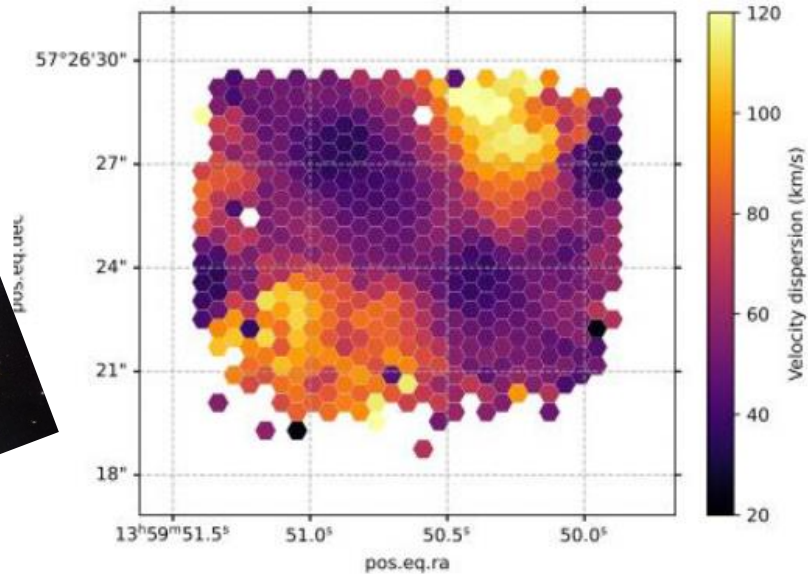
Flux ($\text{erg s}^{-1} \text{cm}^{-2} \text{A}^{-1}$)



Velocity (km/s)

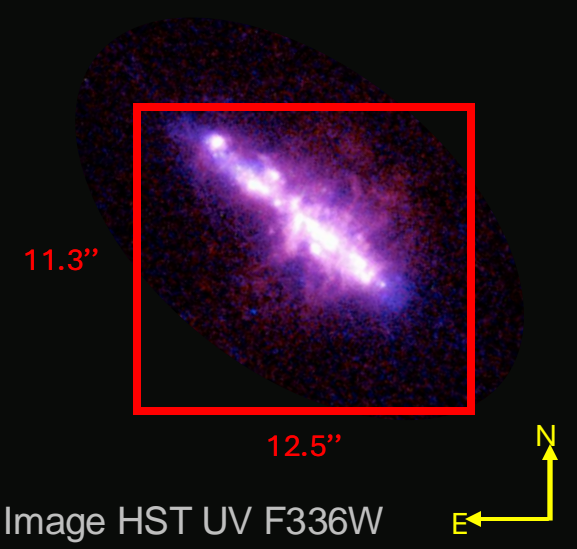


Velocity dispersion (km/s)



M82 galaxy.
Credit: ESA

Mrk1486

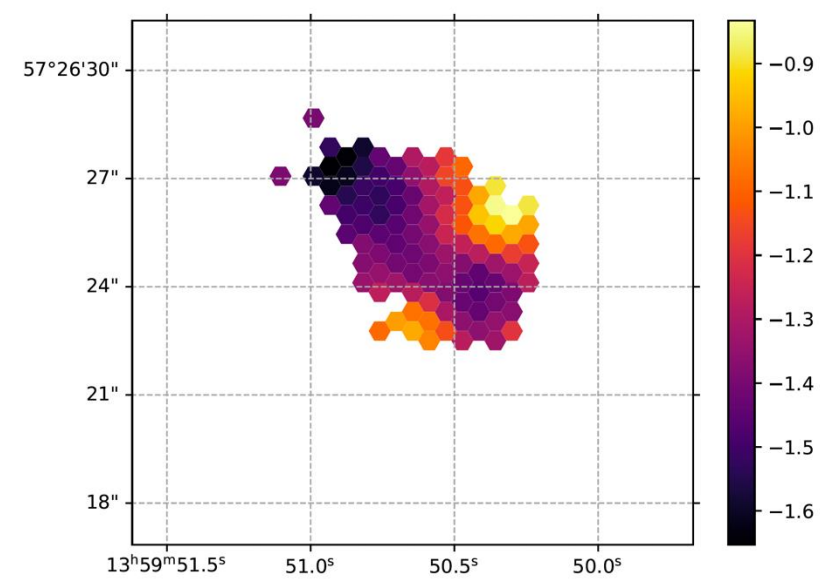


ICRS coord. (ep=J2000):
13 59 50.90
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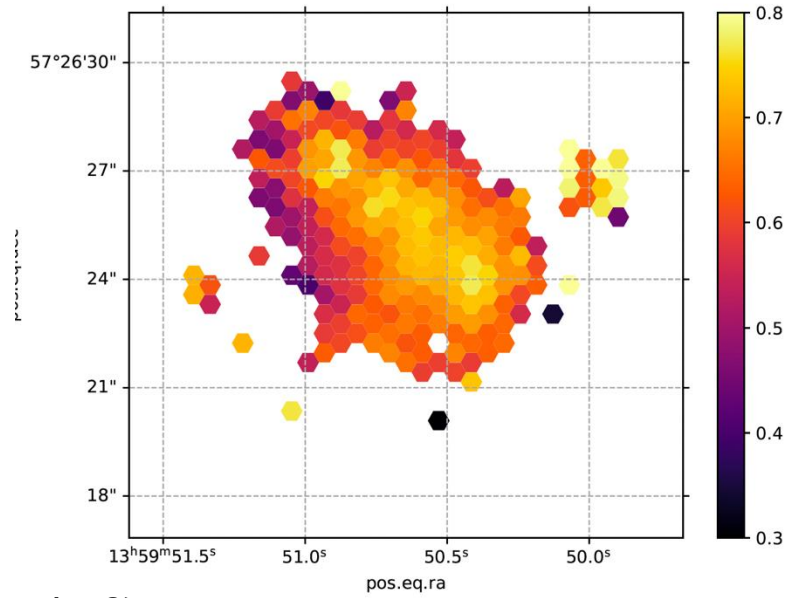
z_spec: 0.03386

**Line-ratio
maps**

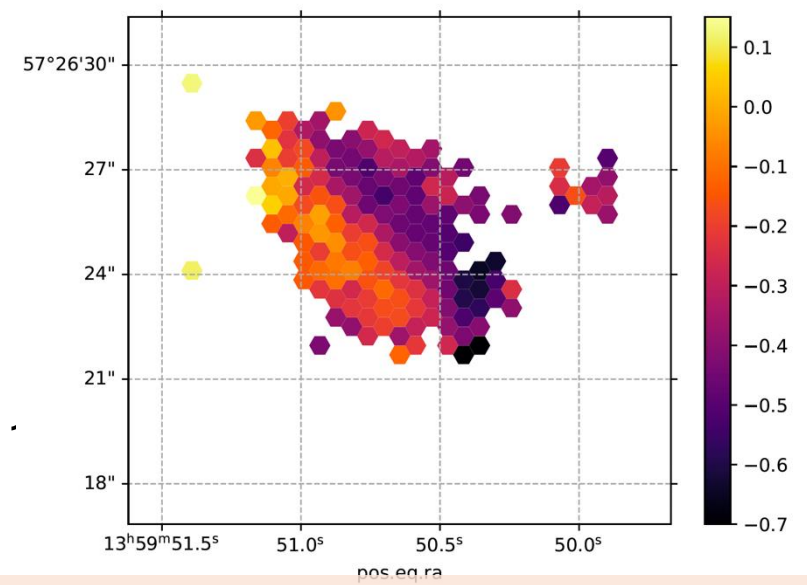
$\log_{10}([\text{NII}]6584/\text{H}\alpha)$



$\log_{10}([\text{OIII}]5007/\text{H}\beta)$

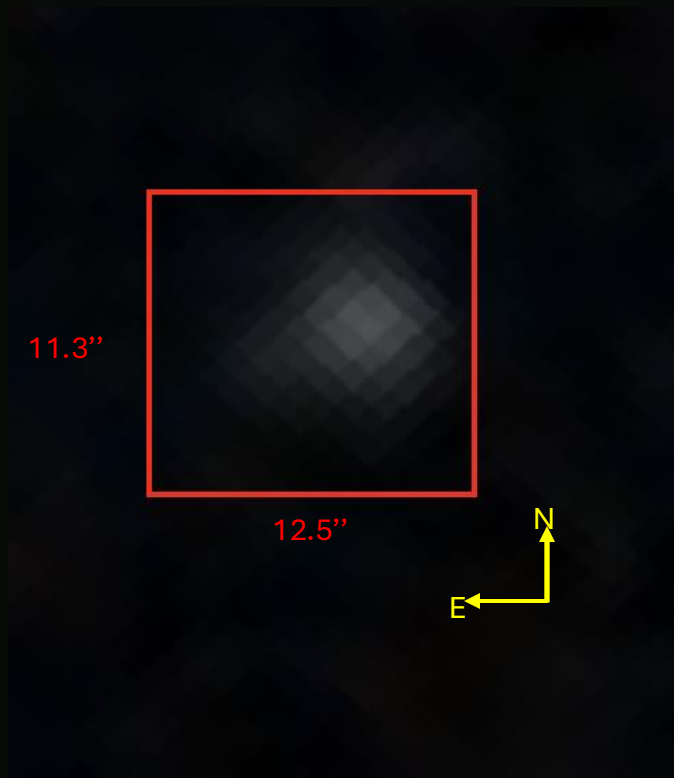


$\log_{10}(\text{H}\gamma/\text{H}\beta)$

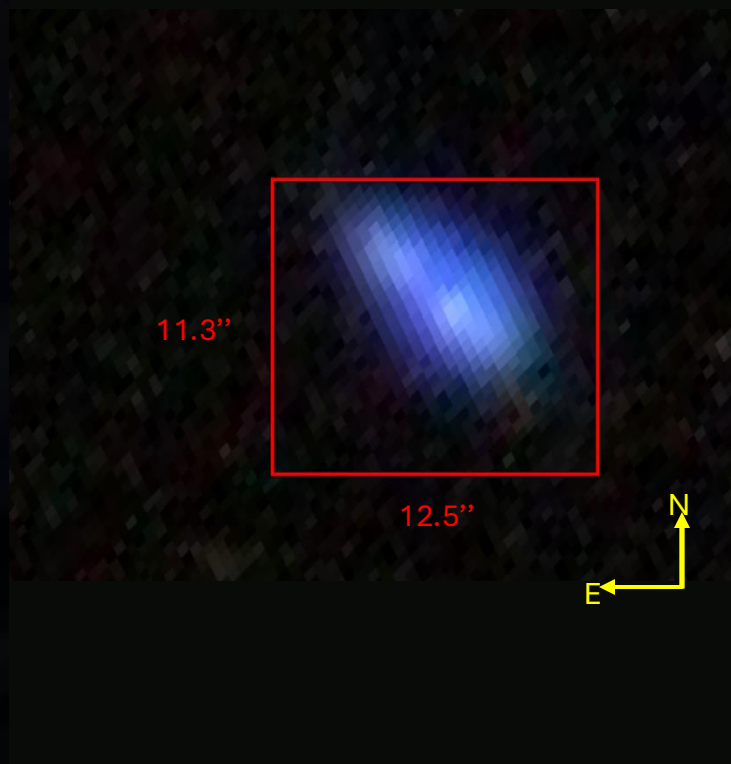


Three observed galaxies with MEGARA so far

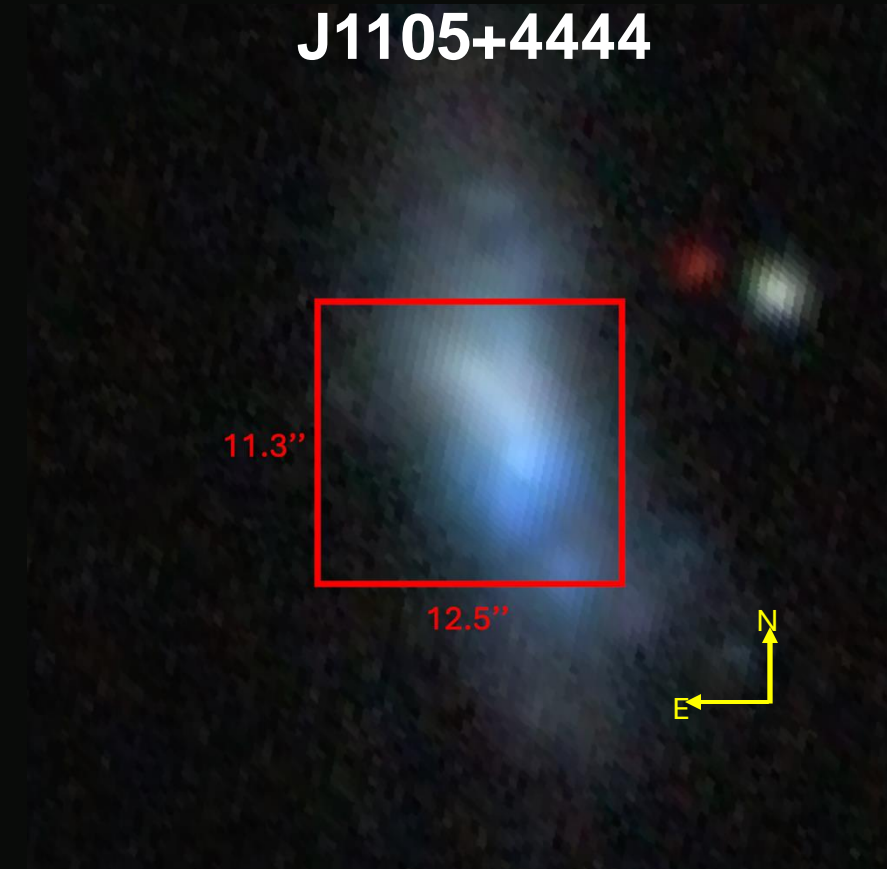
SBS 0335-052 W



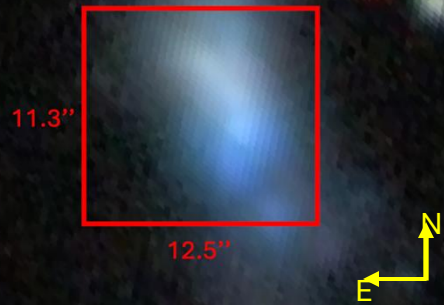
Mrk1486



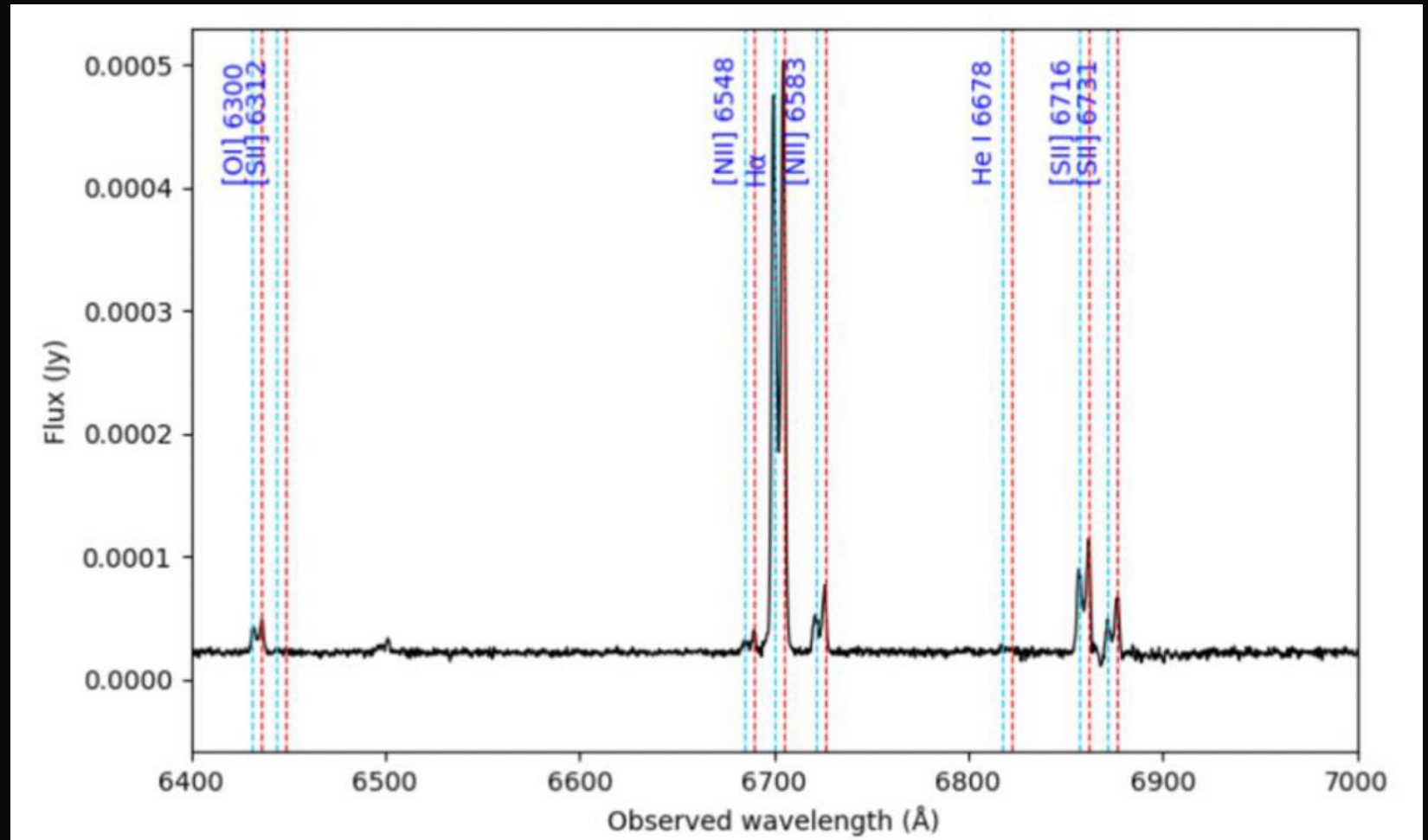
J1105+4444



J1105+4444: two interacting dwarf galaxies

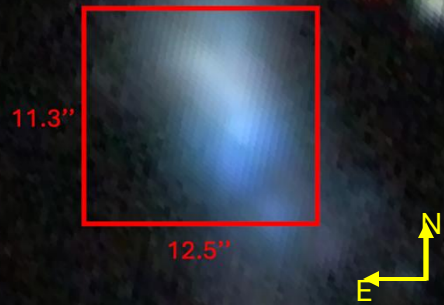


ICRS coord. (ep=J2000):
11 05 08.11
+44 44 47.1
z_spec: 0.02154



Spectrum with double-peaked lines in LR-R (spaxel 429)

J1105+4444: two interacting dwarf galaxies



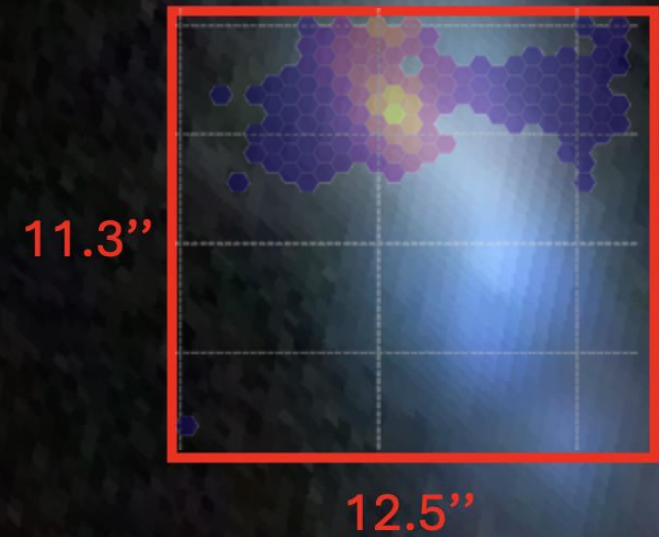
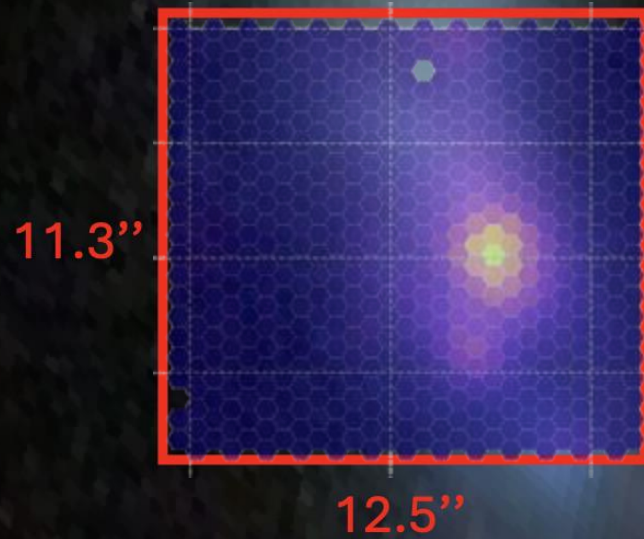
ICRS coord. (ep=J2000):

11 05 08.11

+44 44 47.1

z_{spec} : 0.02154

H α



J1105+4444: two interacting dwarf galaxies



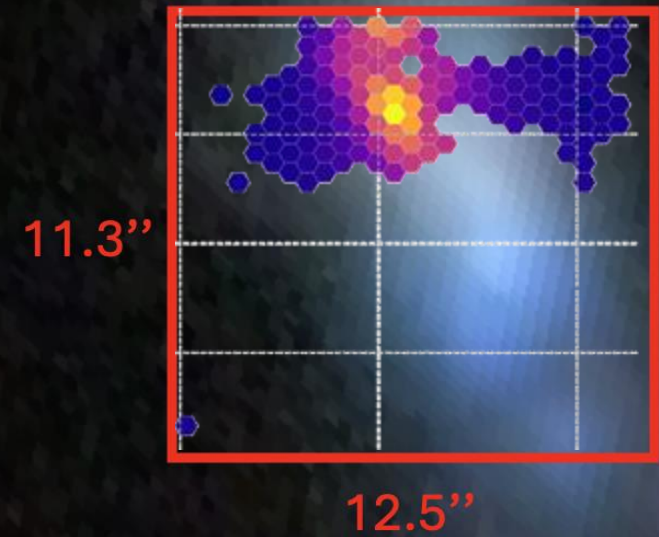
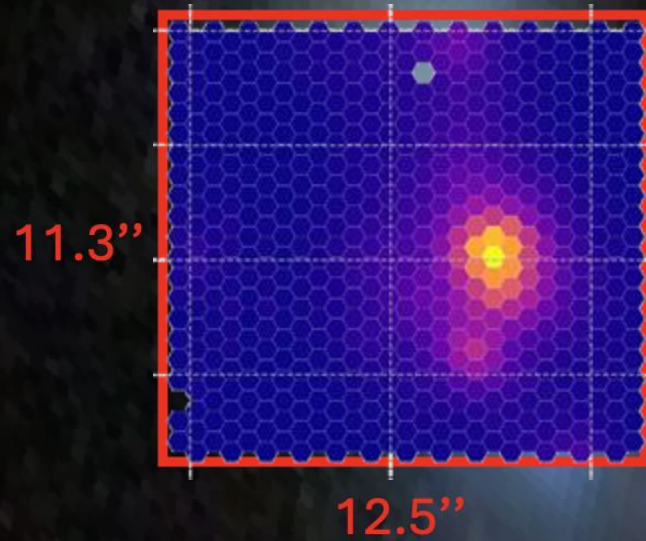
ICRS coord. (ep=J2000):

11 05 08.11

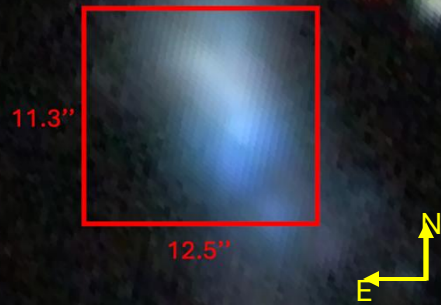
+44 44 47.1

z_{spec} : 0.02154

H α



J1105+4444: two interacting dwarf galaxies



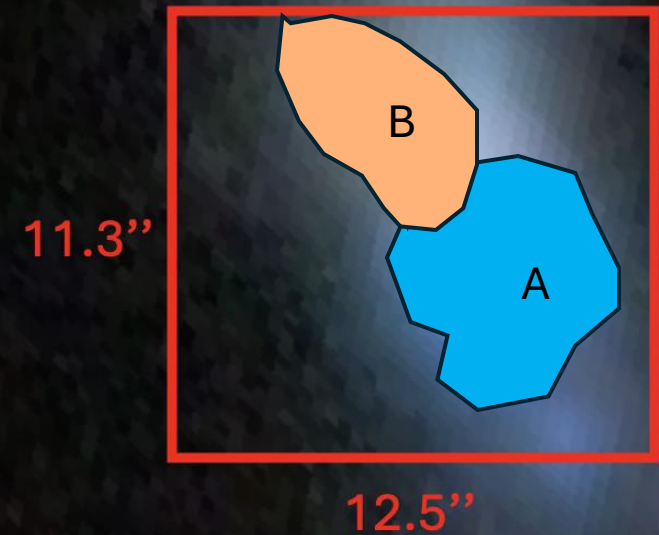
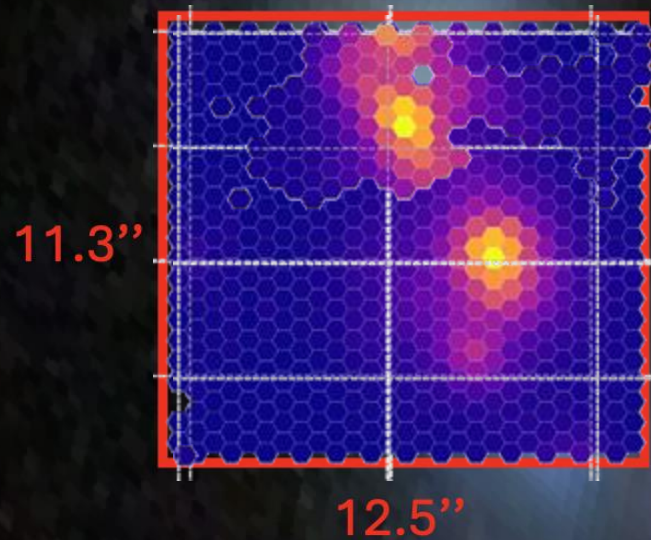
ICRS coord. (ep=J2000):

11 05 08.11

+44 44 47.1

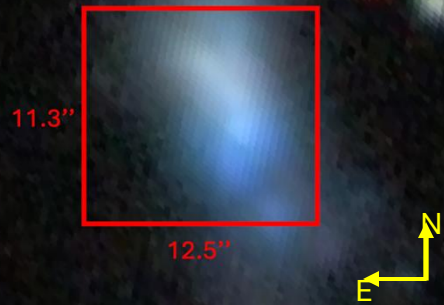
z_{spec} : 0.02154

H α



2D spectroscopy allows us to distinguish both systems!

J1105+4444

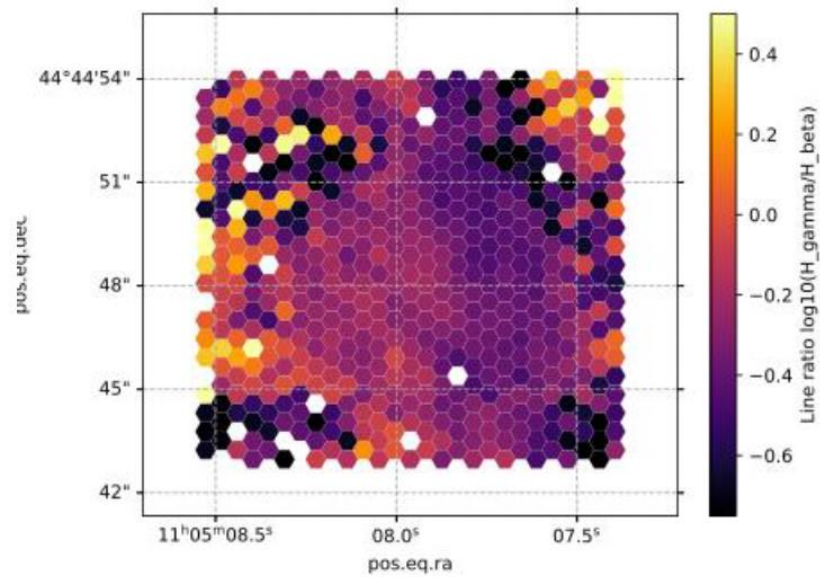


ICRS coord. (ep=J2000):
11 05 08.11
+44 44 47.1
z_spec: 0.02154

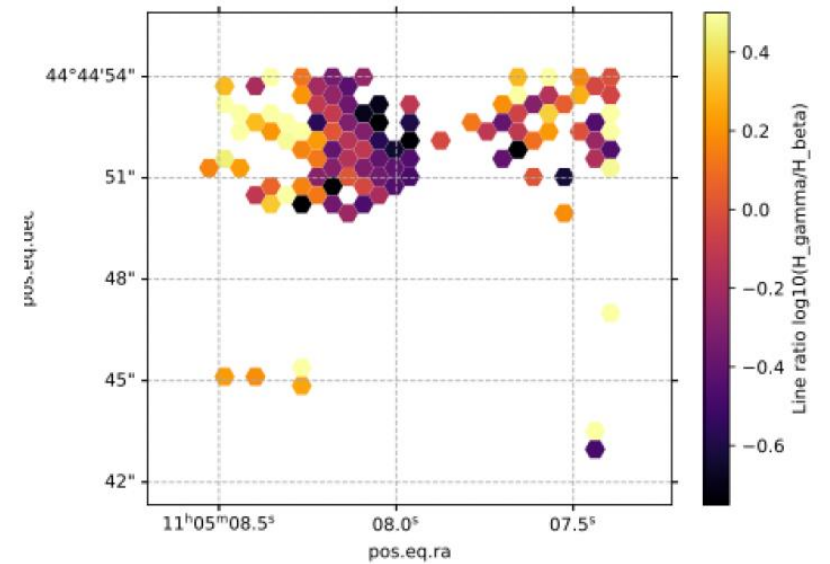
Line-ratio
maps

$\log_{10}(H\gamma/H\beta)$

A system



B system



Overview

- We are interested in studying **local low-mass star-forming galaxies** which behave as **counterparts** of primeval galaxies.
- Data from **Dwarfs4MOSAIC ITP**
- Three galaxies observed with MEGARA so far and analysed:
 - * **SBS 0335-052 W**: an extremely metal poor Galaxy
 - * **Mrk1486**: a metal-poor starburst disc edge-on Galaxy with strong outflows.
 - * **J1105+4444**: two interacting dwarf galaxies

Preliminary results of the study of low-mass dwarf galaxies from the ITP Dwarfs4MOSAIC

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“Ayuda de IPARCOS para estudiantes de doctorado 2024/25”

