

RIOJA:

Optical and Far-Infrared Comprehensive Picture of
a Galaxy Over-Dense Core at $z = 7.88$ and
a Major Merger at $z = 7.15$

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RIOJA

The Reionization and the ISM/Stellar Origins with JWST and ALMA

Medium size GO1 program #1840

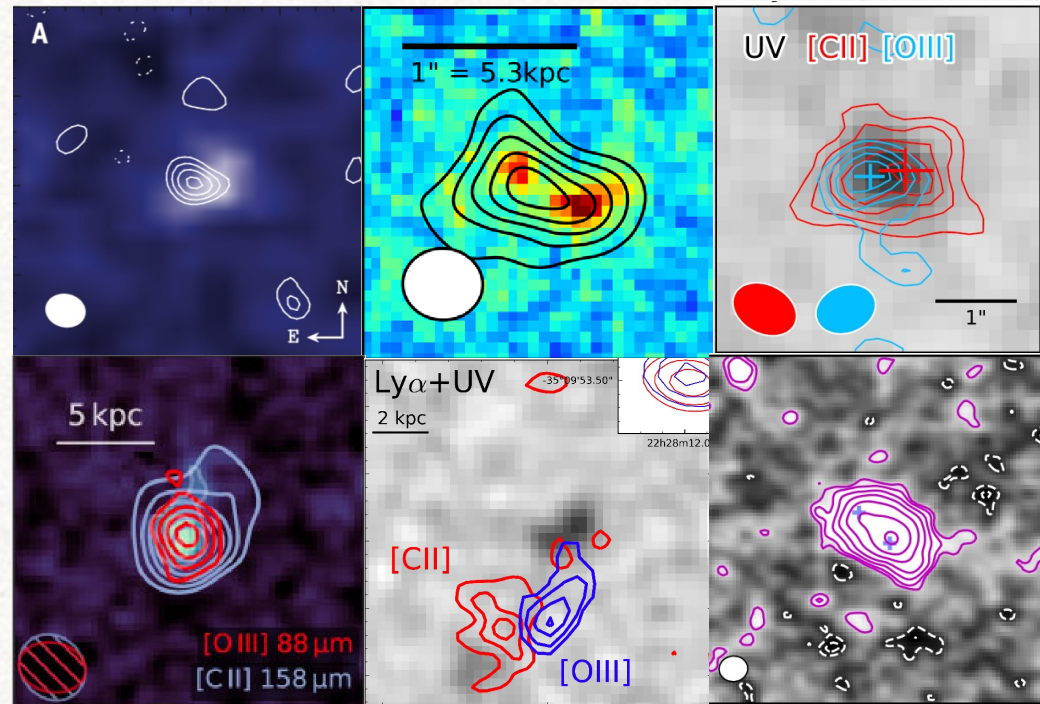
- PIs: J. Álvarez-Márquez & T. Hashimoto
- Allocated time: 33.9h
- NIRCcam (1.15–4.4 μm)
F115W, F150W, F200W, F277W, F356W, F444W
(or medium filters for 2.5–3.5 μm)
- NIRspec IFU (2.9–5.1 μm)
G395H (R~2700) or G395M (R~1000)



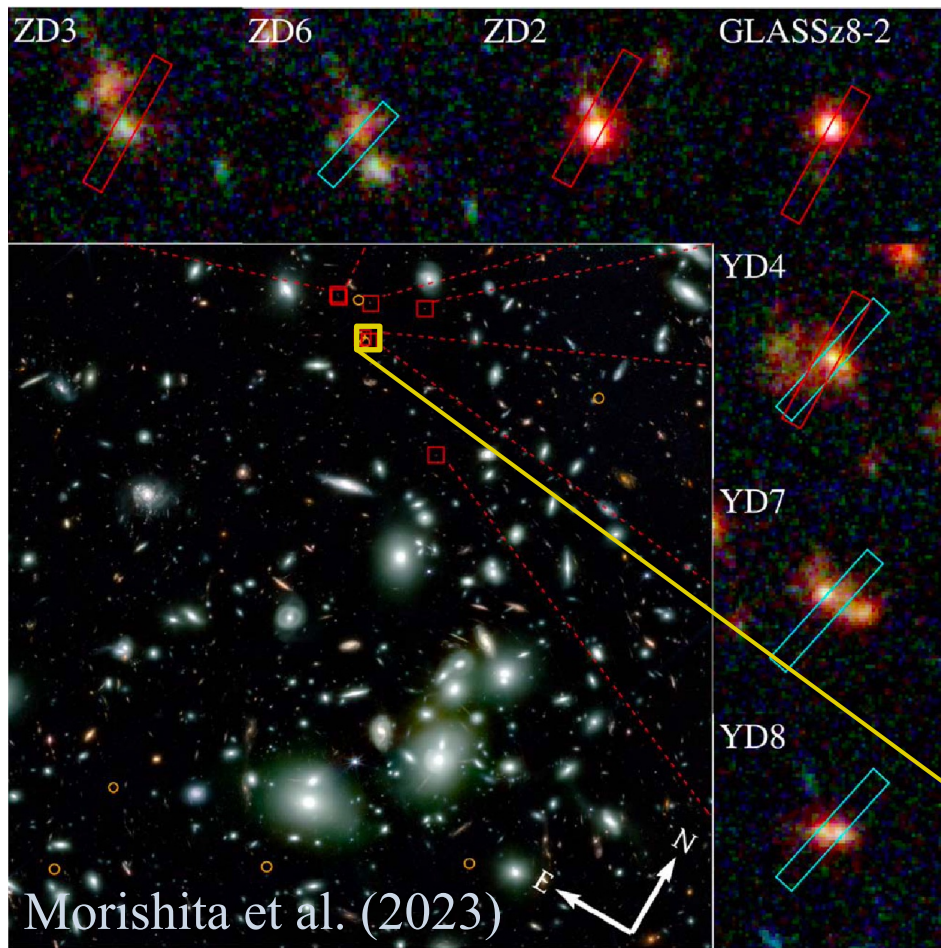
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The Reionization and the ISM/Stellar Origins with JWST and ALMA

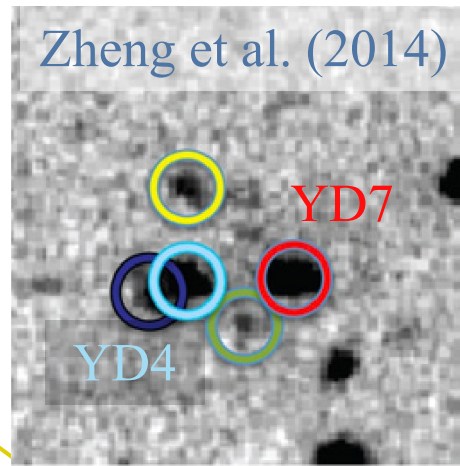
Targets: 12 [OIII]88 μ m emitters at $z > 6$



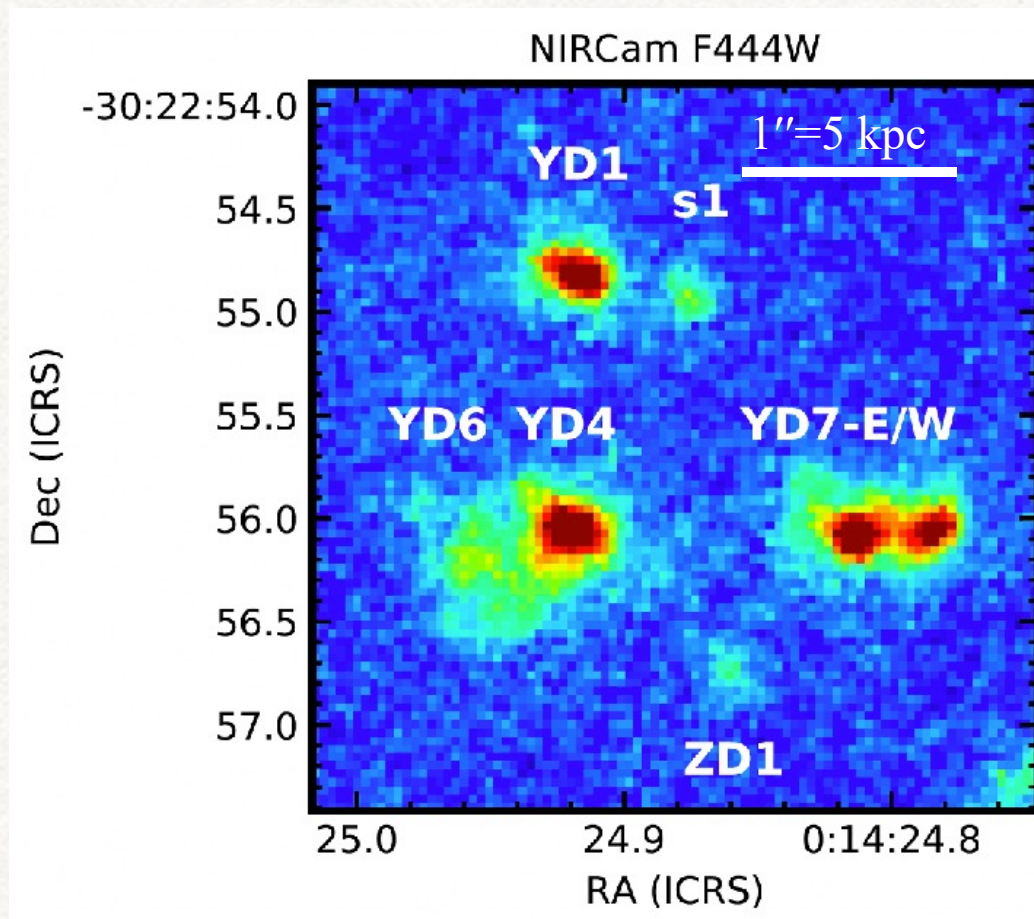
A2744-z7p9OD Overdensity at $z=7.9$



- Confirmed at $z_{\text{spec}} \sim 7.9$ by GLASS-JWST Morishita+2023 ($z_{\text{photo}} \sim 8.3$ at first)
- Most overdense region with “quintet” core at highest- z

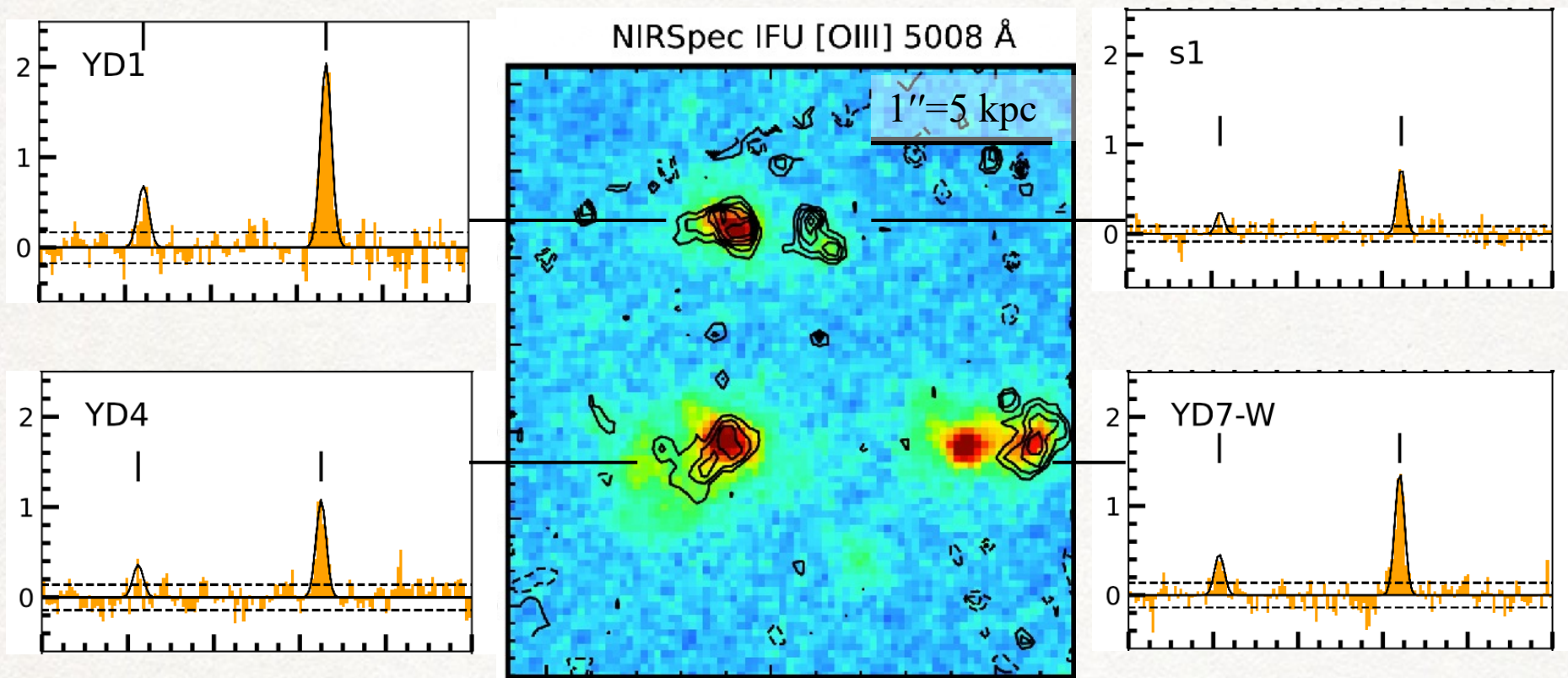


A2744 Overdensity Core at $z=7.9$



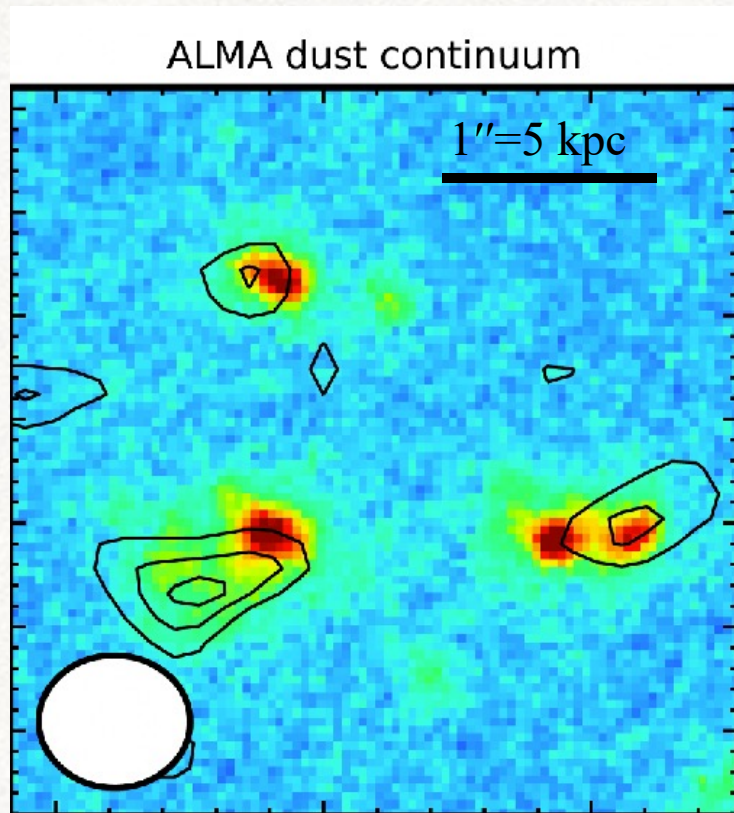
- NIRCam F444W (UNCOVER)
- “quintet” resides in 11 kpc x 11 kpc, after lensing correction of $\mu=2$

Power of NIRSpec IFU for Overdensity



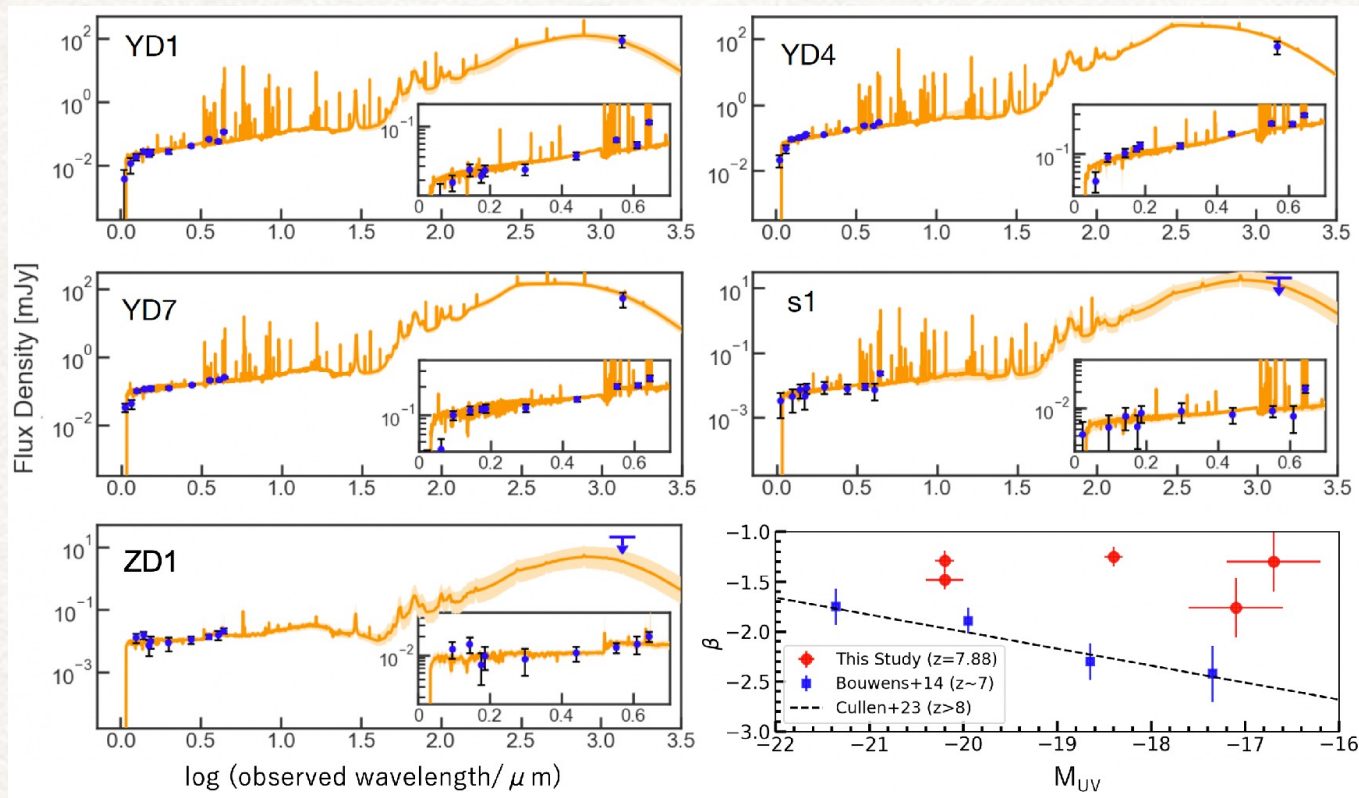
○ 4 galaxies (*serendipitous finding of s1*) are confirmed at $z=7.9$

Tentative Dust Detections with ALMA



○ Tentative $\sim 3\sigma$ dust detections at galaxy locations

Dusty, Red SED



$$\beta_{UV} = -1.2 \text{ to } -1.8$$

$$A_V = 0.2 \text{ to } 0.8 \text{ mag}$$

(median = 0.6)

$$\log(M^* / M_{\odot})$$

$$\sim 7.6 - 9.2$$

○ Dusty and matured galaxies with property variations

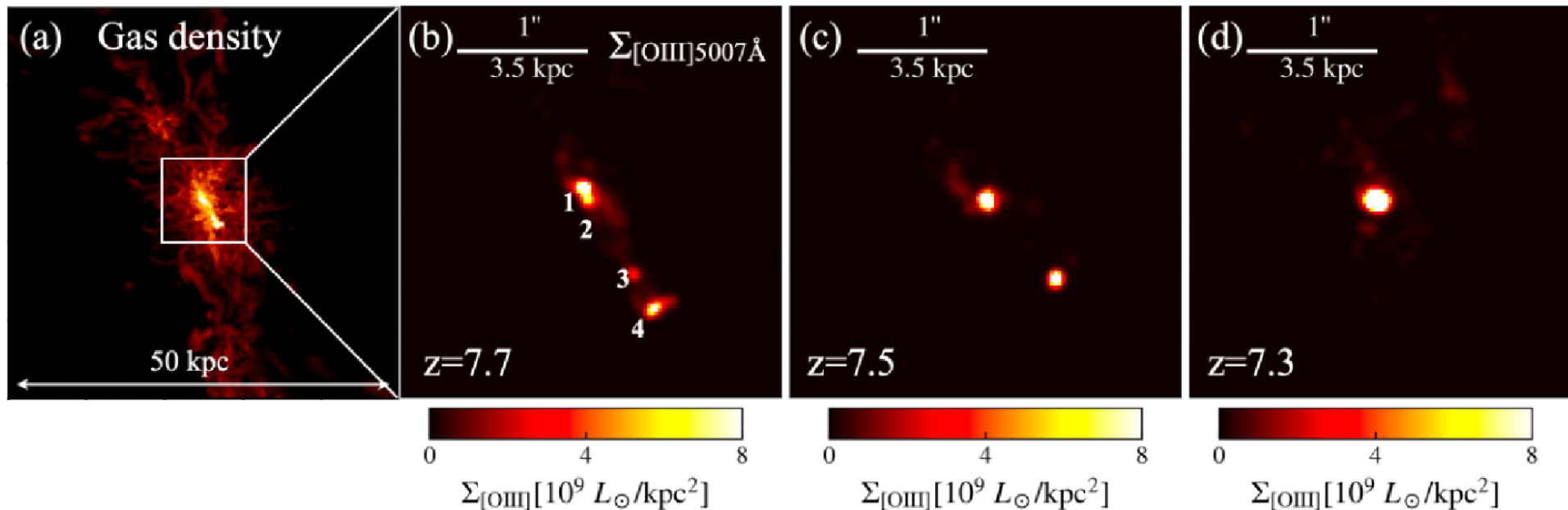
Fudamoto et al. in prep.

Dense cluster found in FirstLight

○ FirstLight zoom-in simulations Ceverino et al. (2017)

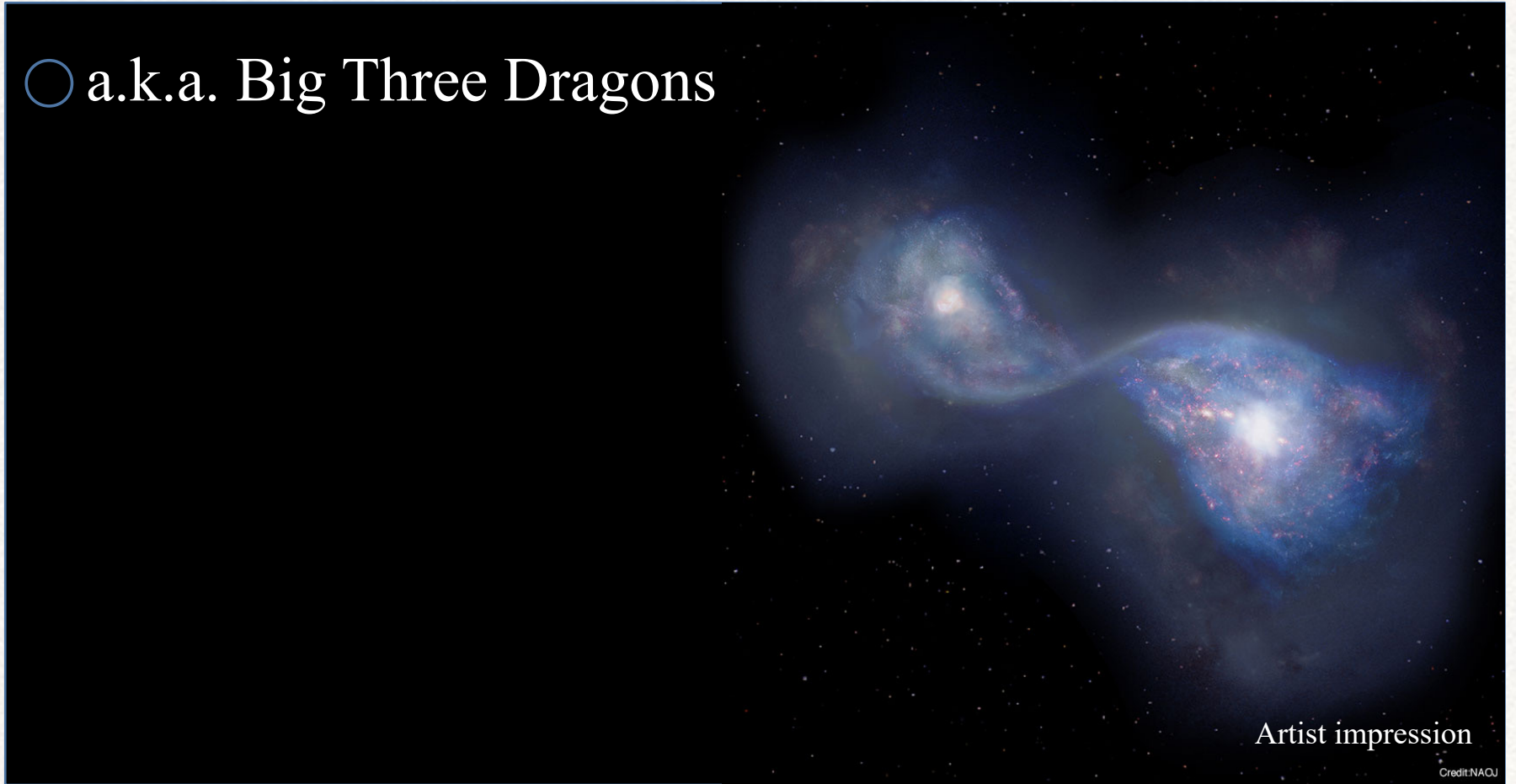
□ Bright in [OIII] 5007 Å

□ Merging into one object within several 10 Myrs Nakazato+ in prep.



B14-65666: Major Merger at $z=7.15$

○ a.k.a. Big Three Dragons

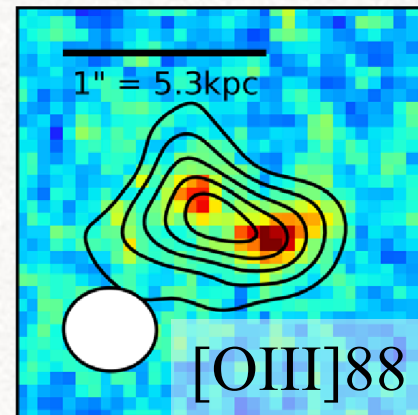
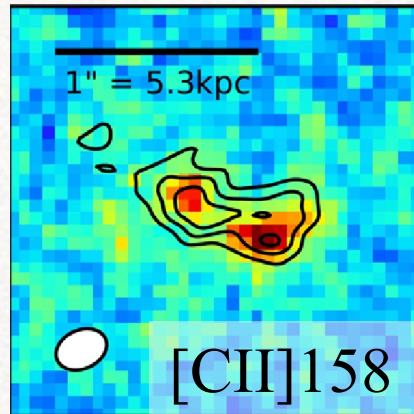


Artist impression

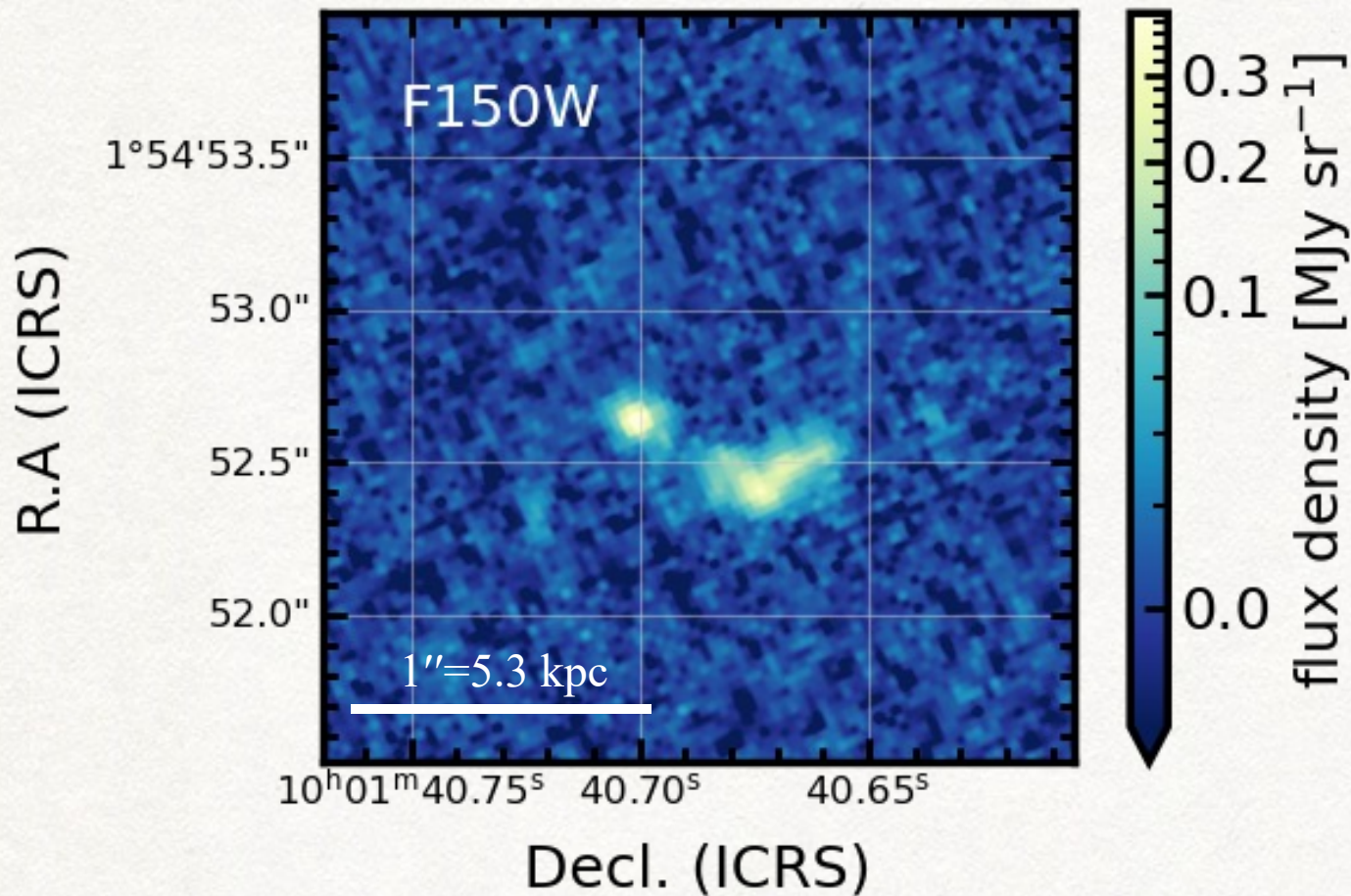
Credit: NAOJ

B14-65666: Major Merger at $z=7.15$

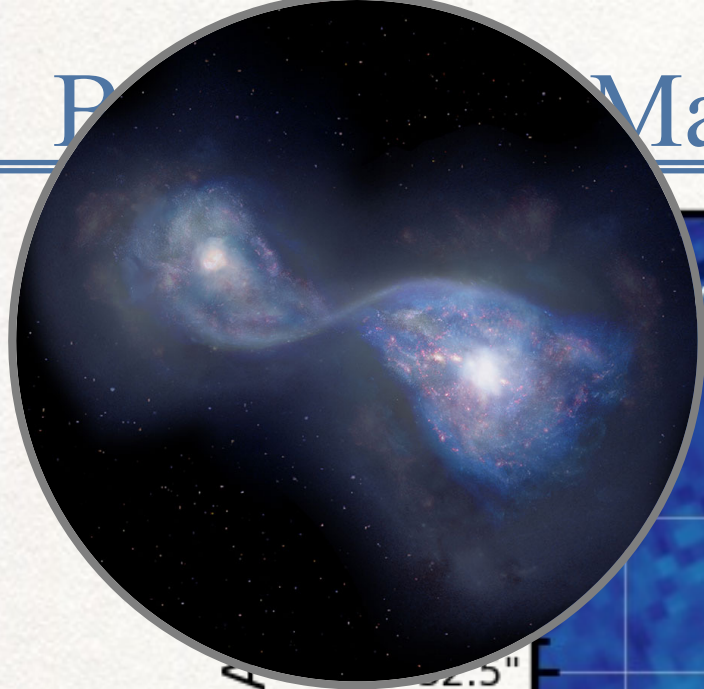
- Bright Lyman break galaxy ($M_{UV} \sim -22.4$) Bowler et al. 2014
 - SFR $\sim 200 M_{\odot}/\text{yr}$
- [CII] 158 μm and [OIII] 88 μm contours w/ HST backgrounds
- Only NIRCcam data available in RIOJA



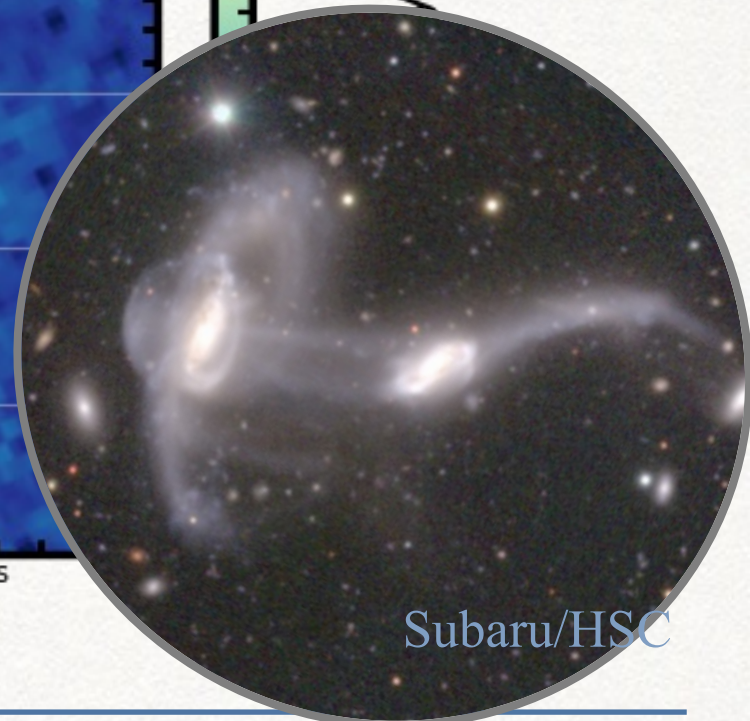
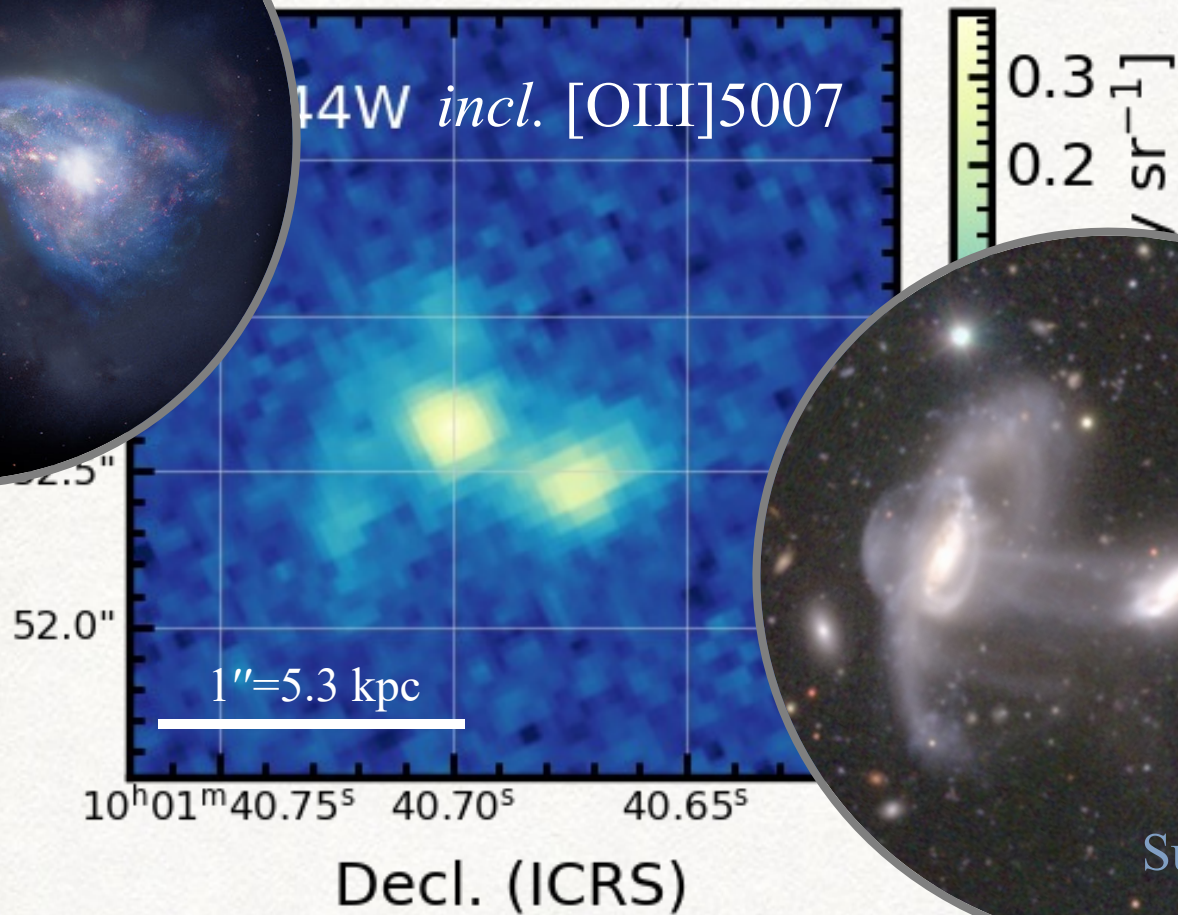
B14-65666: Major Merger at $z=7.15$



Major Merger at $z=7.15$

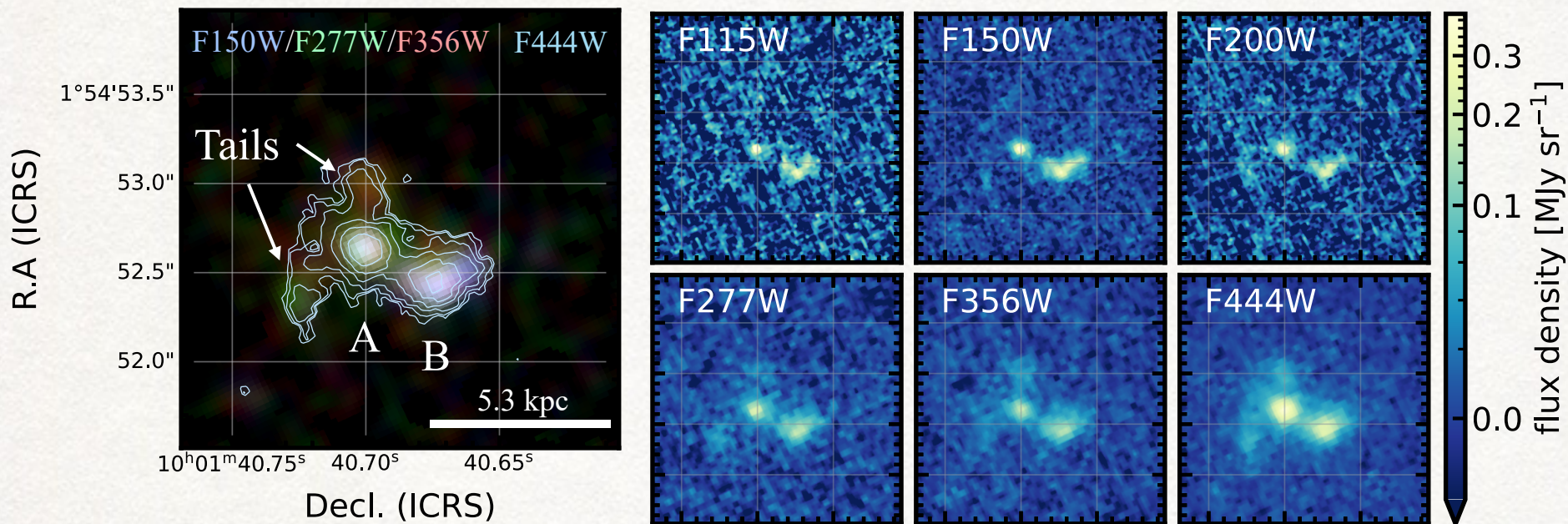


R.A.



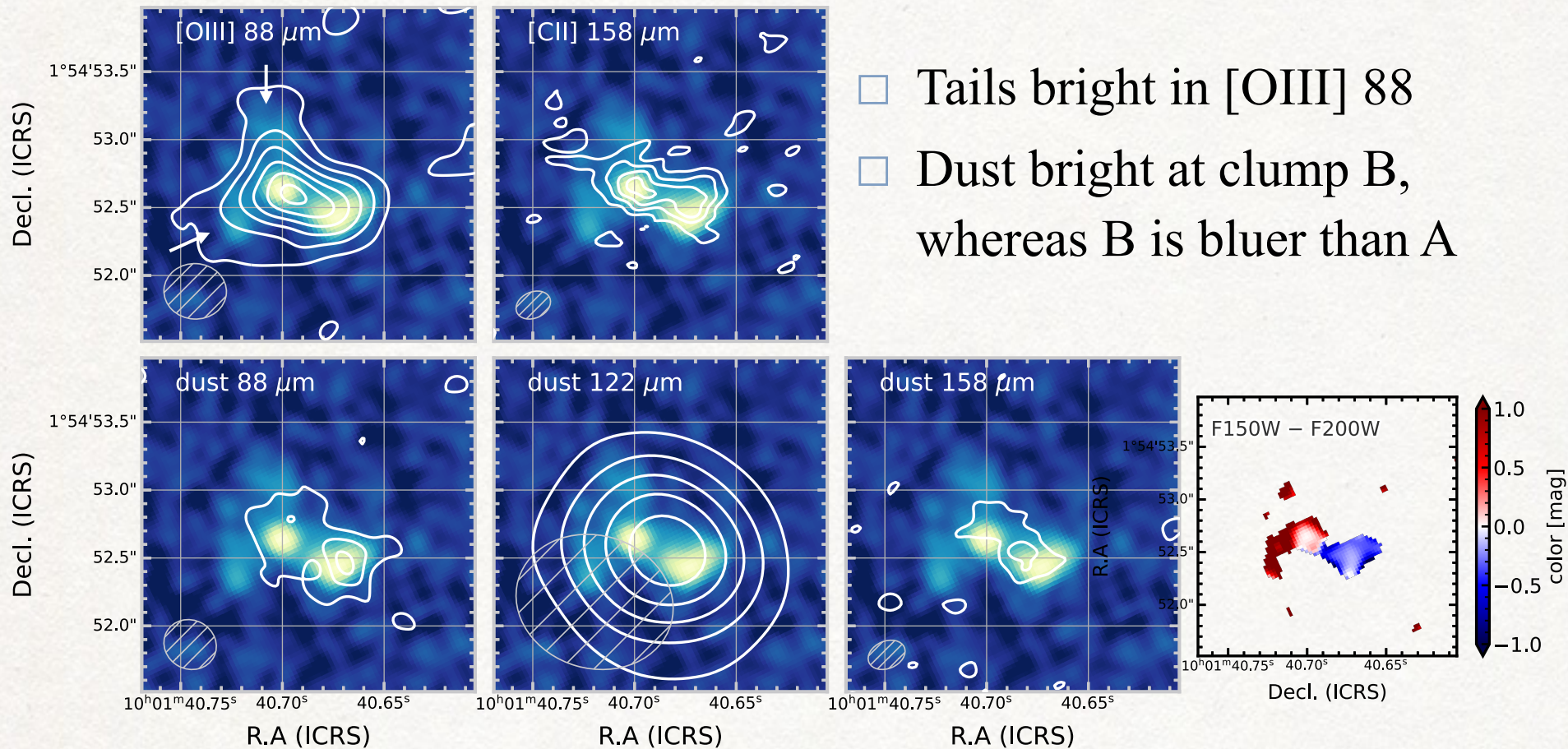
Subaru/HSC

B14-65666: Major Merger at $z=7.15$

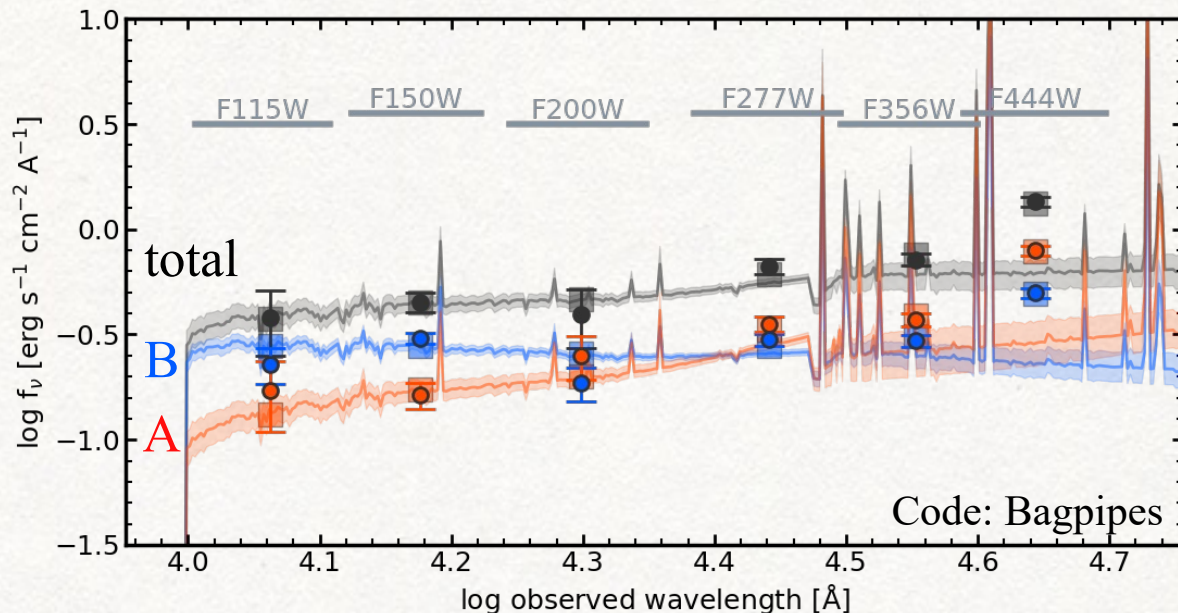
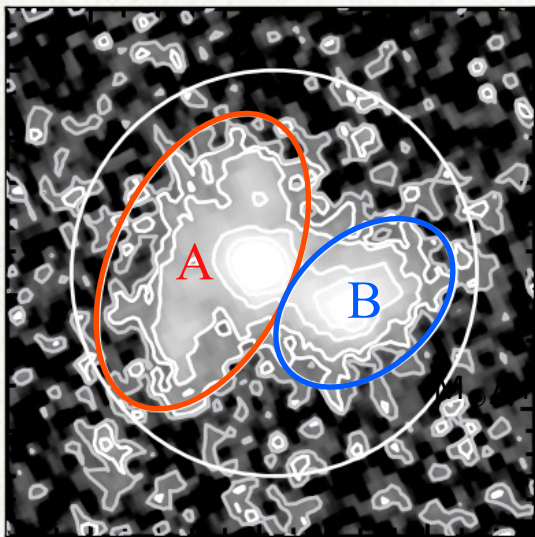


- Clump A: compact and surrounded by red tidal tails
- Clump B: elongated and clumpy in UV

Comparison with ALMA observations



SED fitting to clumps A and B



○ Young (< 10 Myr) clumps A and B

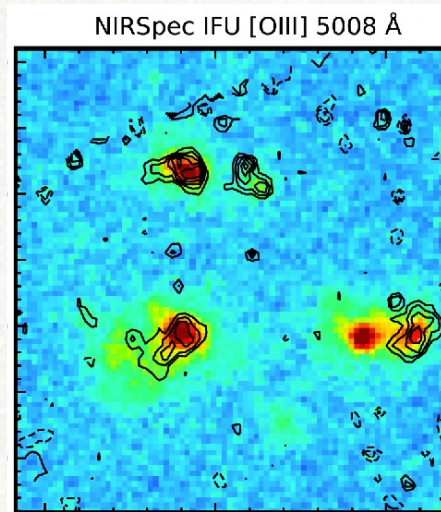
□ A: dusty starbursts ($\text{SFR}_{10\text{Myr}} = 125 M_\odot/\text{yr}$, $A_v \sim 1$, age~5 Myr)

□ B: un-obscured SF ($\text{SFR}_{10\text{Myr}} = 57 M_\odot/\text{yr}$, $A_v \sim 0.3$, age~10 Myr)

RIOJA: ALMA [OIII]88 emitters targeted by JWST

○ A2744z7p9 over density

- Four [OIII] detections in FoV
- Dusty & matured proto-cluster
- Merging within ~ 10 Myrs



○ B14-65666

- Tidal tails around clump A
- Young starbursts caused by dusty and un-obscured merger
- Complex dust–star morphology

