

Resolving the Giant Ly α Emitters Himiko & CR7 at $z=6.6$ with JWST+Subaru+ALMA

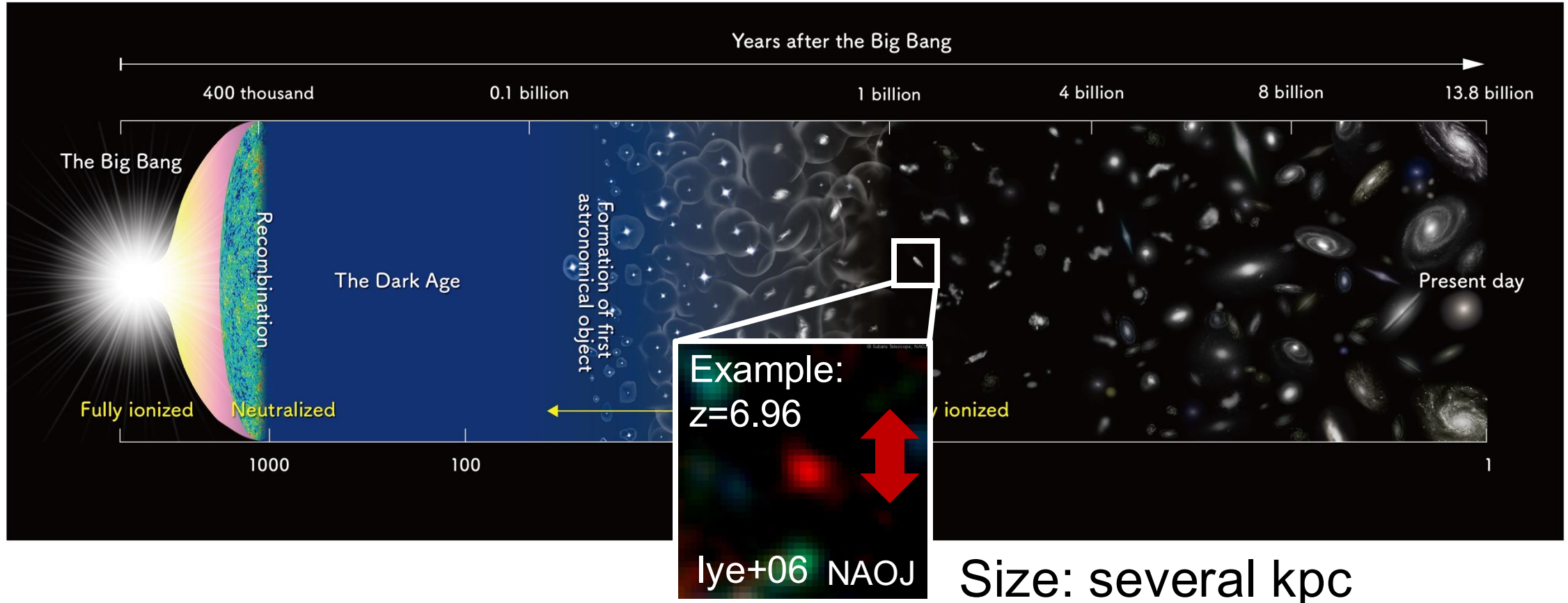
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Collaborators

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Kiyota+25b, submitted to ApJ, arXiv:2504.03156

Insight into galaxy evolution



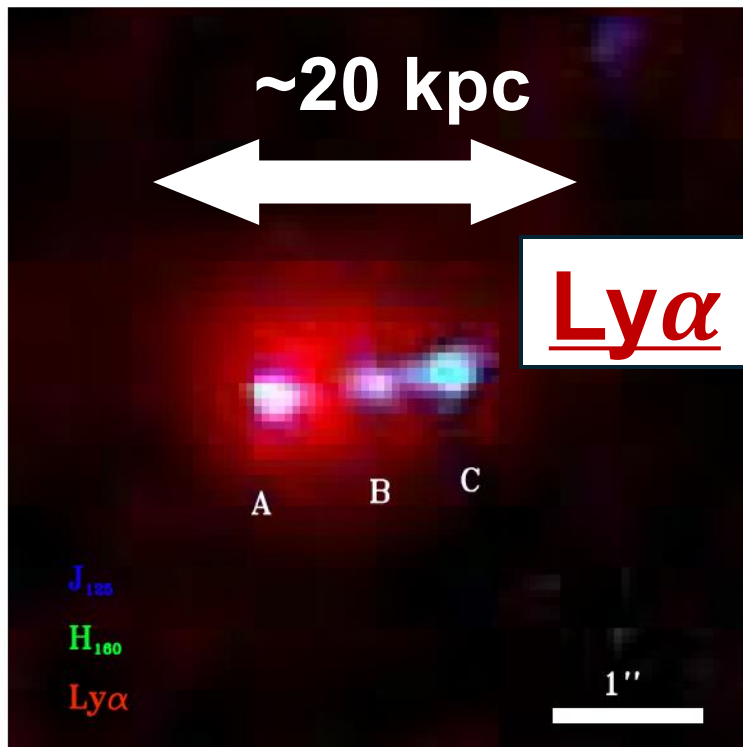
Different types of galaxies were found ~15 years ago.

'Himiko' and 'CR7'

What are Himiko and CR7?

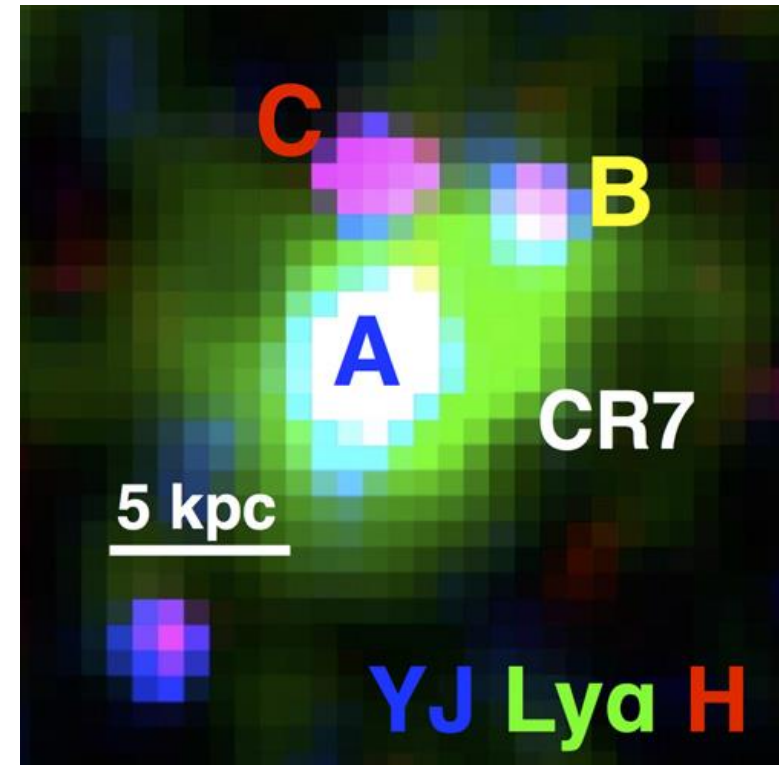
- Identified using Subaru narrow-band imaging (NB921)
- **Extended** (~ 20 kpc), UV bright ($M_{UV} \sim -22$) $Ly\alpha$ emitters at $z=6.6$
- Three clumps

Himiko



Ouchi et al. (2013)

CR7



Sobral et al. (2015)

several kpc
(typical size)

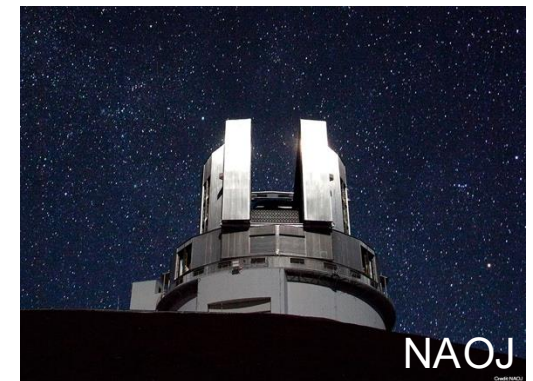
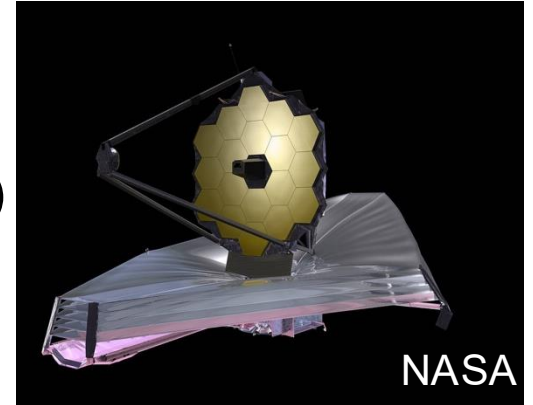
What are Himiko and CR7?

Goals

Uncovering the Physical Origins of
the Extended Ly α Emission

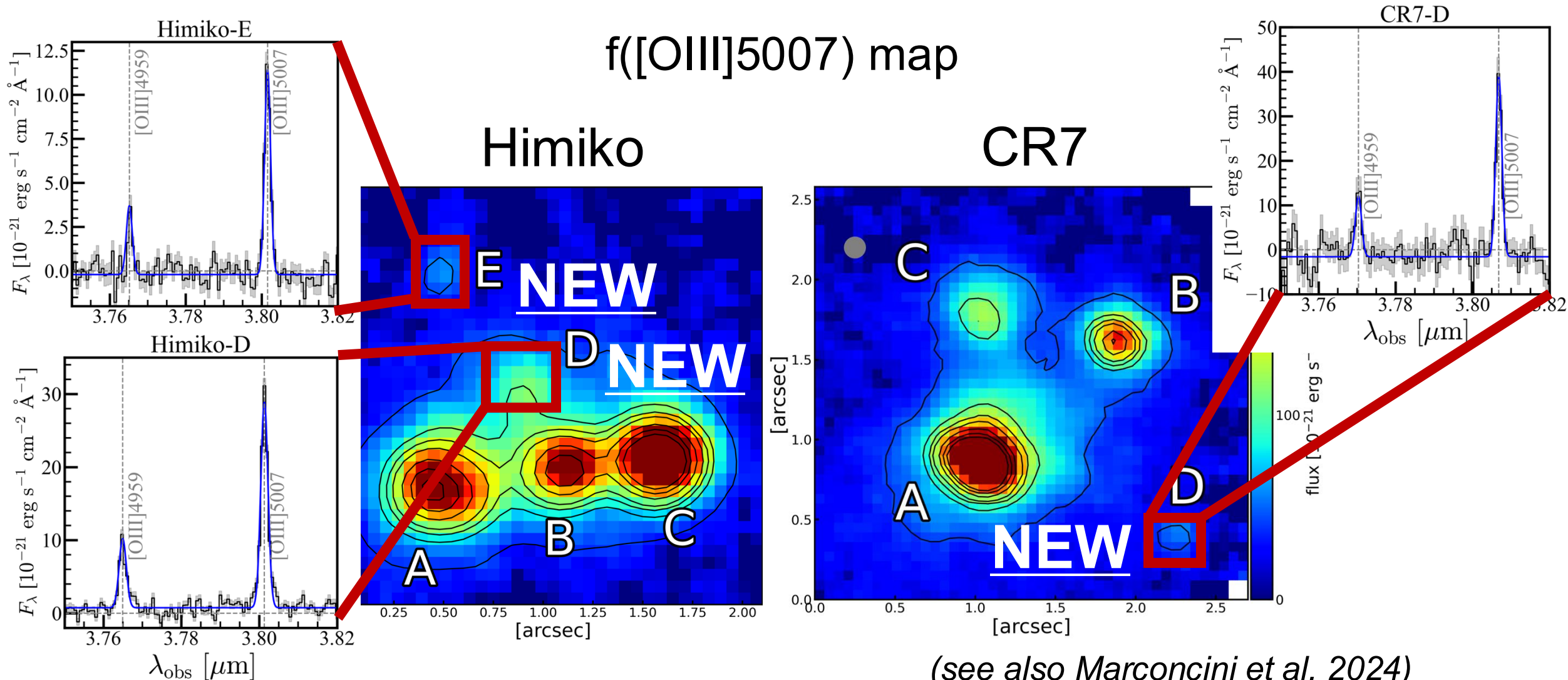
Data

- **JWST** (0.6-5 μ m, rest-frame UV to optical at $z \sim 6$)
 - Spectroscopy: NIRSpec IFU (~ 5 hrs, PID:1215, 1217, $R \sim 2700$, 100)
 - Great thanks: GTO GA-NIFS Team incl. Luetzgendorf+
 - Photometry: NIRCам (PRIMER, COSMOS-Web)
- **ALMA** (Band 6, [CII]158 μ m, dust cont.)
 - Himiko: ~ 6 hrs, #2011.0.00115.S, #2012.1.00033.S
 - CR7: ~ 6 hrs, #2015.1.00122
- **Subaru** ($\text{Ly}\alpha$ at $z=6.6$)
 - HSC SSP ultra-deep imaging (~ 14 hrs)
 - Narrowband NB921 ($\sim 9215\text{\AA}$)



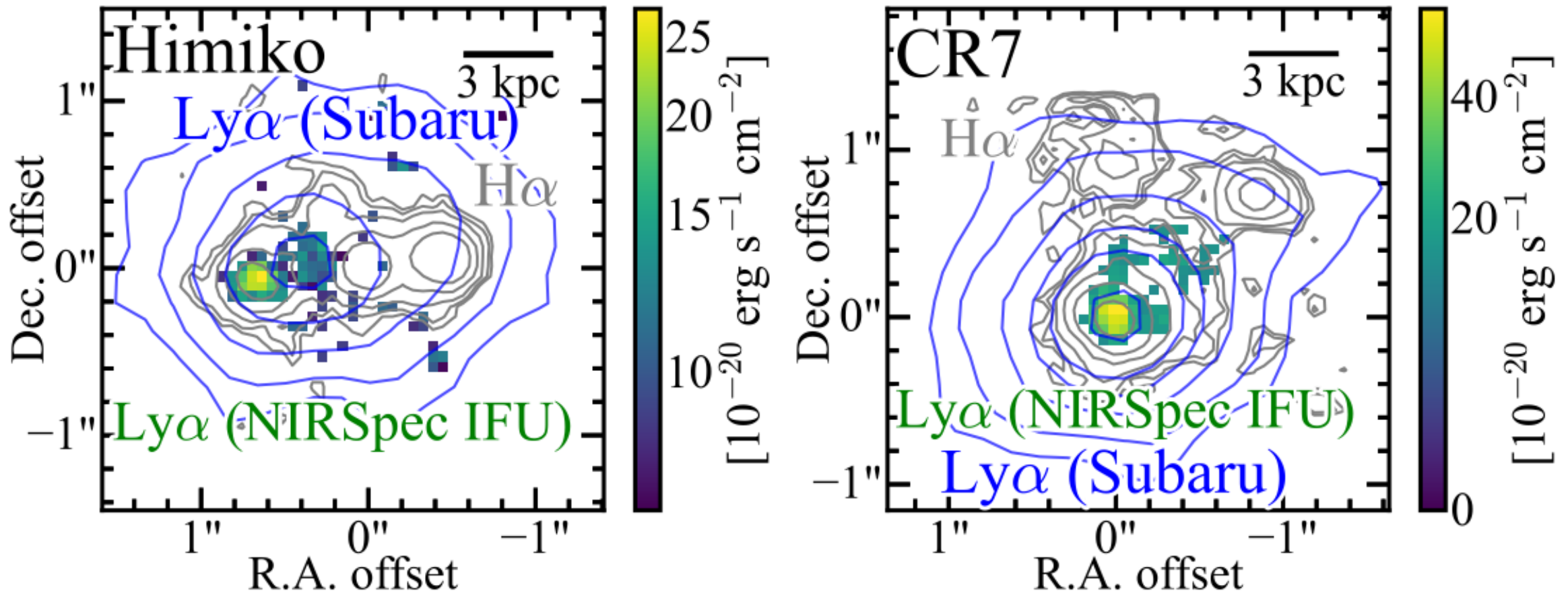
Multiple clumps

- 5 clumps (Himiko), 4 clumps (CR7) → Complex structures



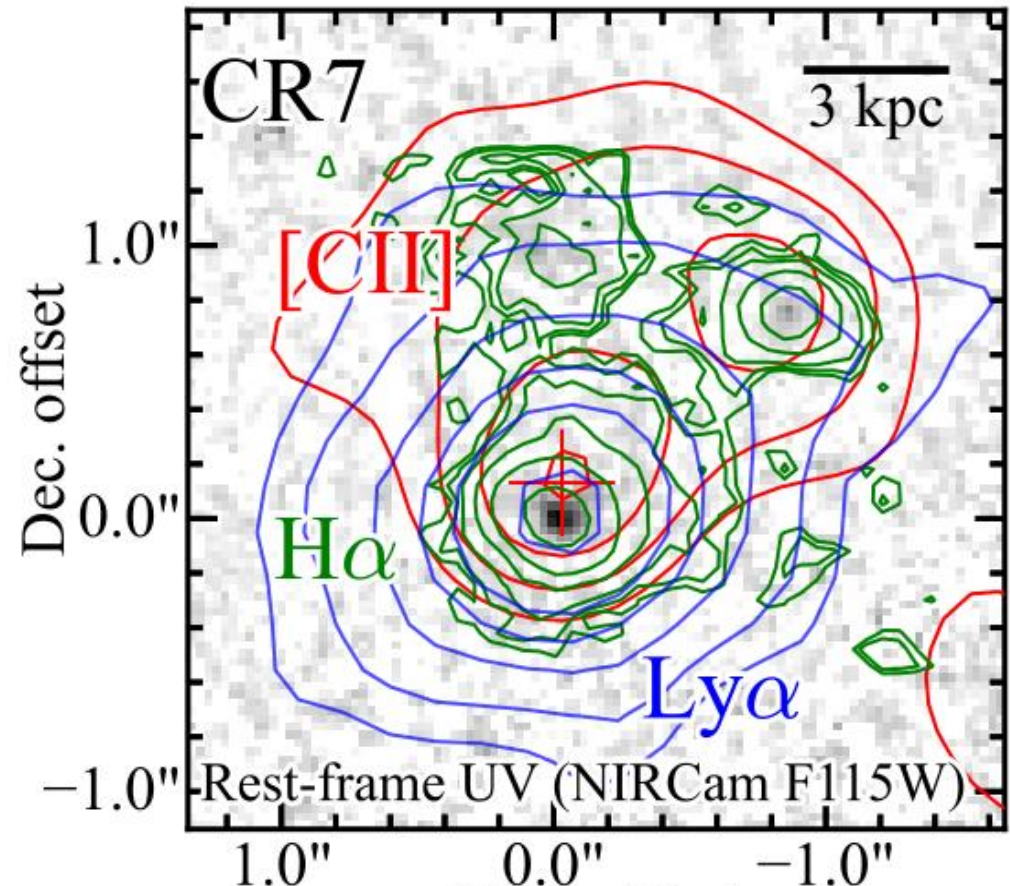
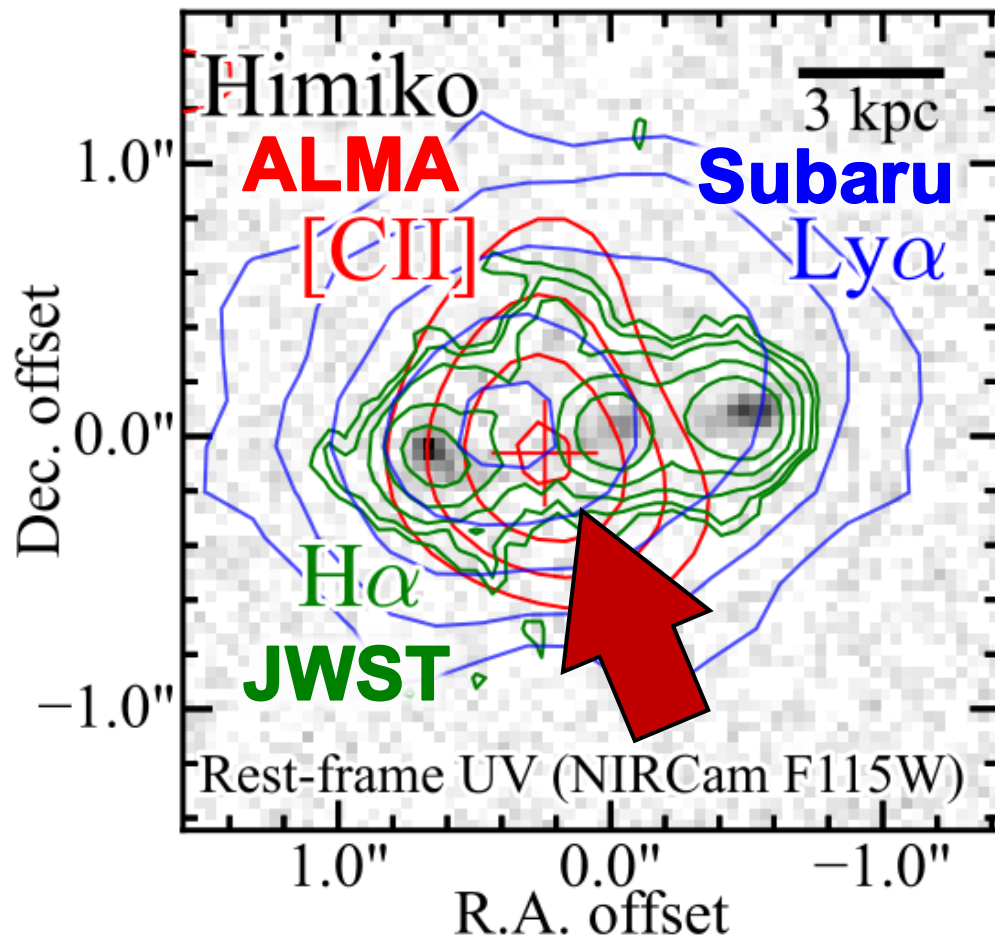
Ly α emission (JWST+Subaru)

- Ly α is strong around Himiko-A and CR7-A.
- Subaru NB: powerful in tracing the extended Ly α



Multiwavelength view (JWST+ALMA+Subaru)

- Himiko: **Offset** between [CII], Ly α and UV, H α
→ extended gas distribution beyond stellar clumps?

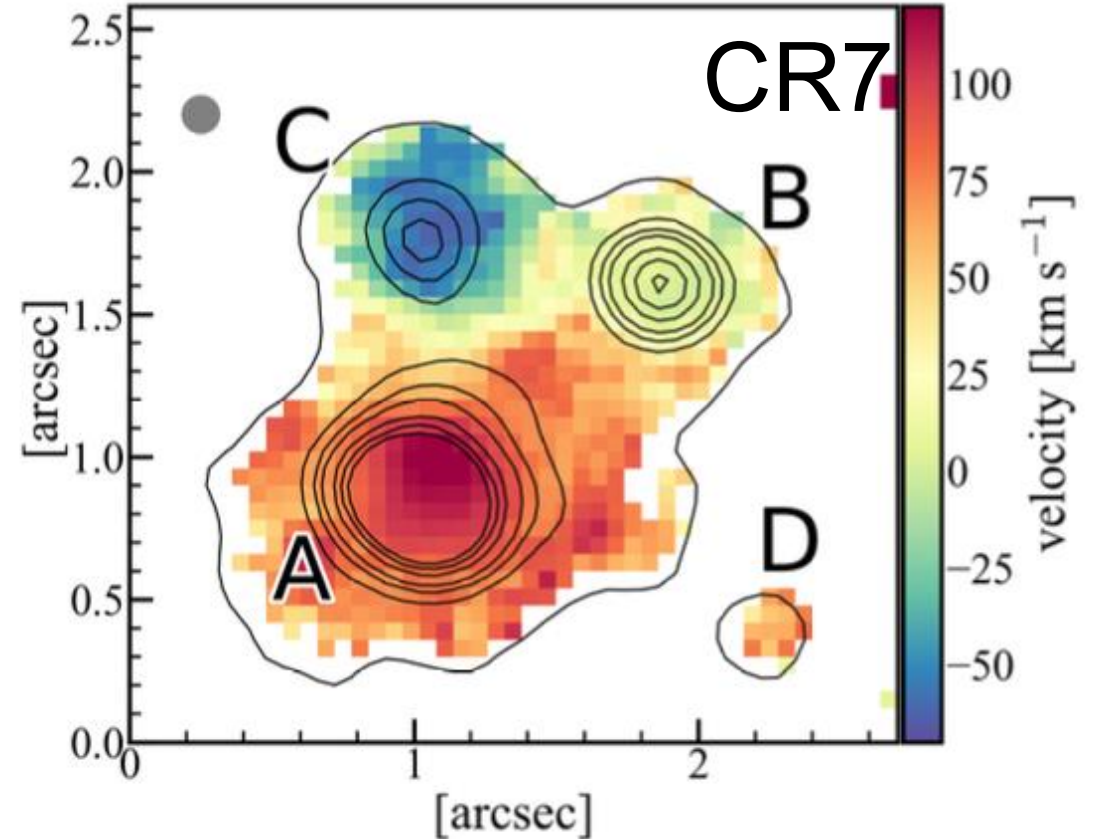
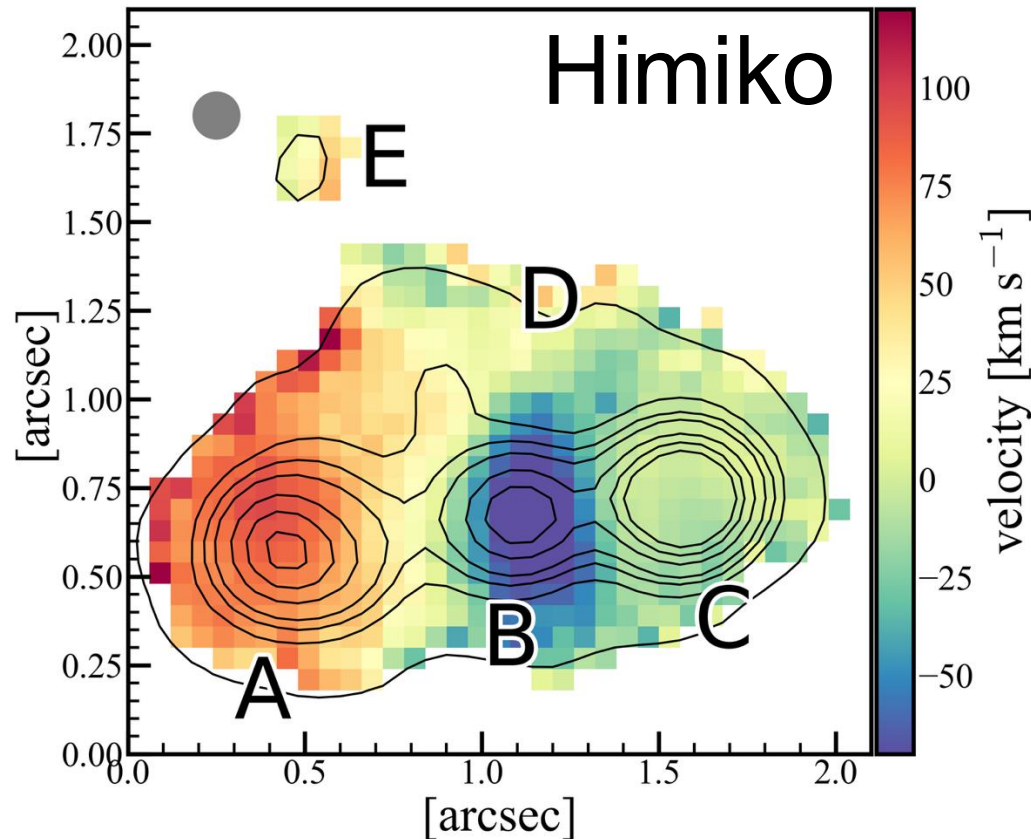


(see also Carniani+18, Matthee+17, Sobral+19)

Velocity map

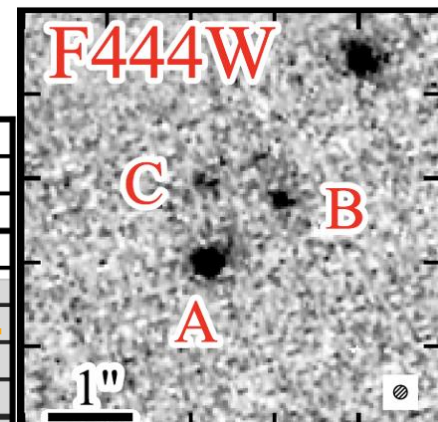
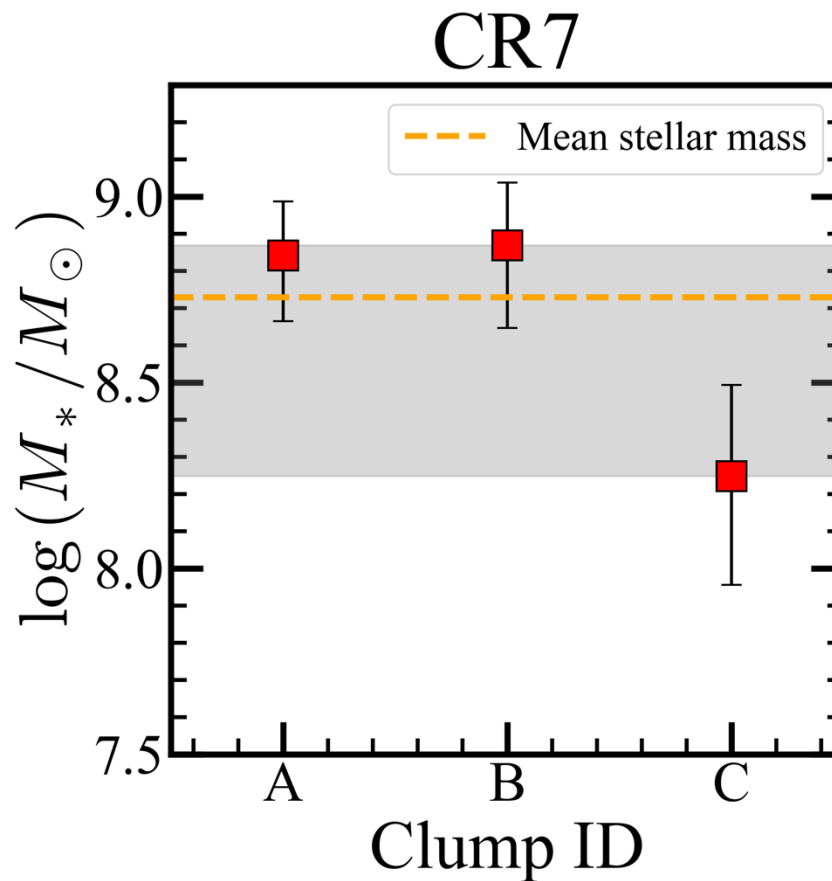
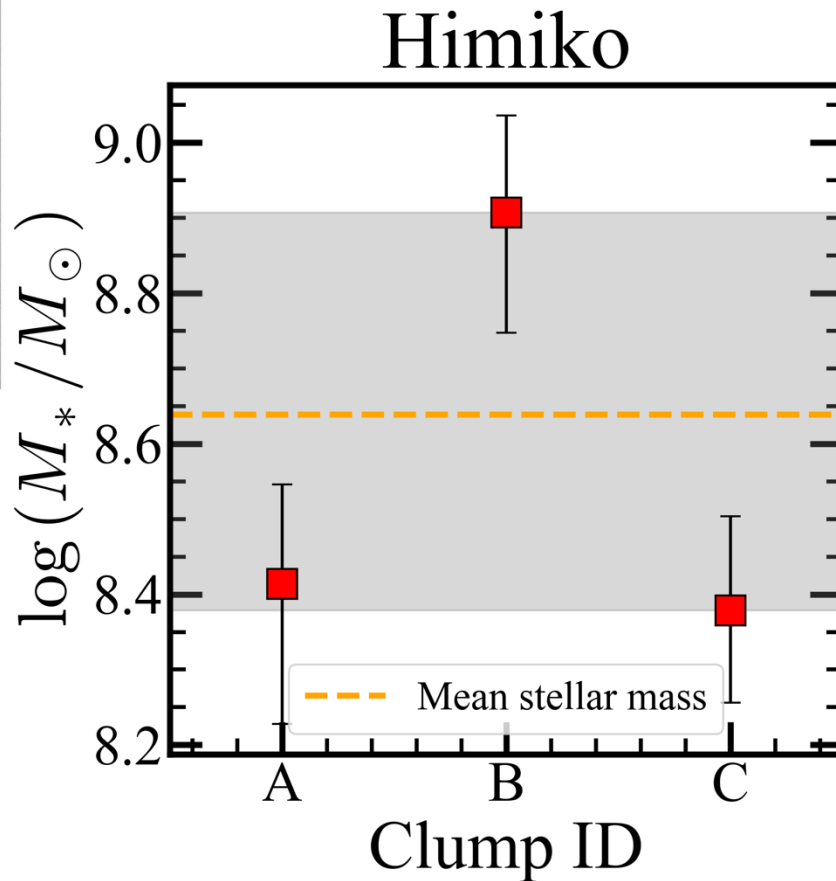
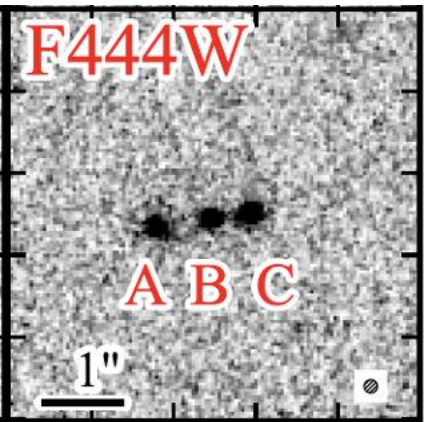
- Small spatial/velocity offset (<7 kpc, <200 km/s) $\rightarrow$ mergers

[OIII]5007 velocity map



Stellar mass

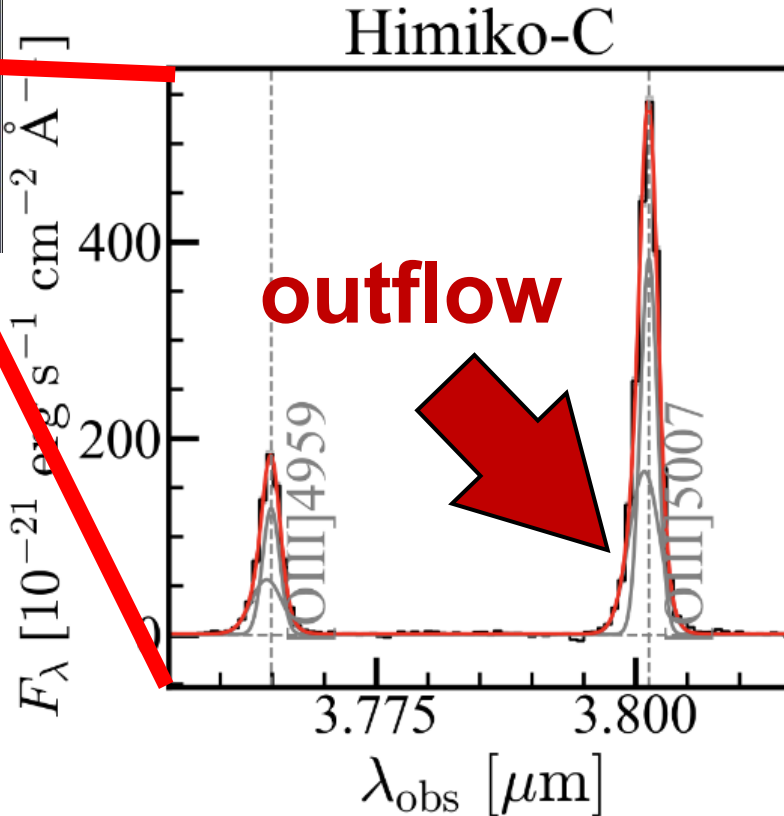
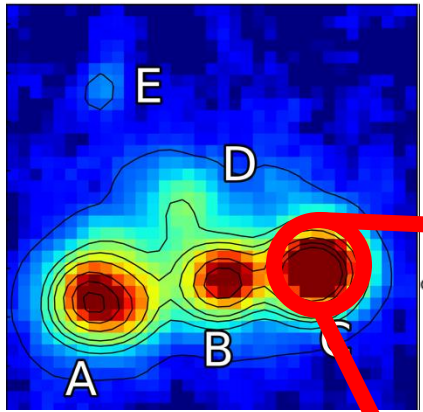
- Small spatial/velocity offset (<7 kpc, <200 km/s) $\rightarrow$ mergers
- Each clump: comparable M_* ($\sim 10^{8.5} M_\odot$) $\rightarrow$ **Major mergers**



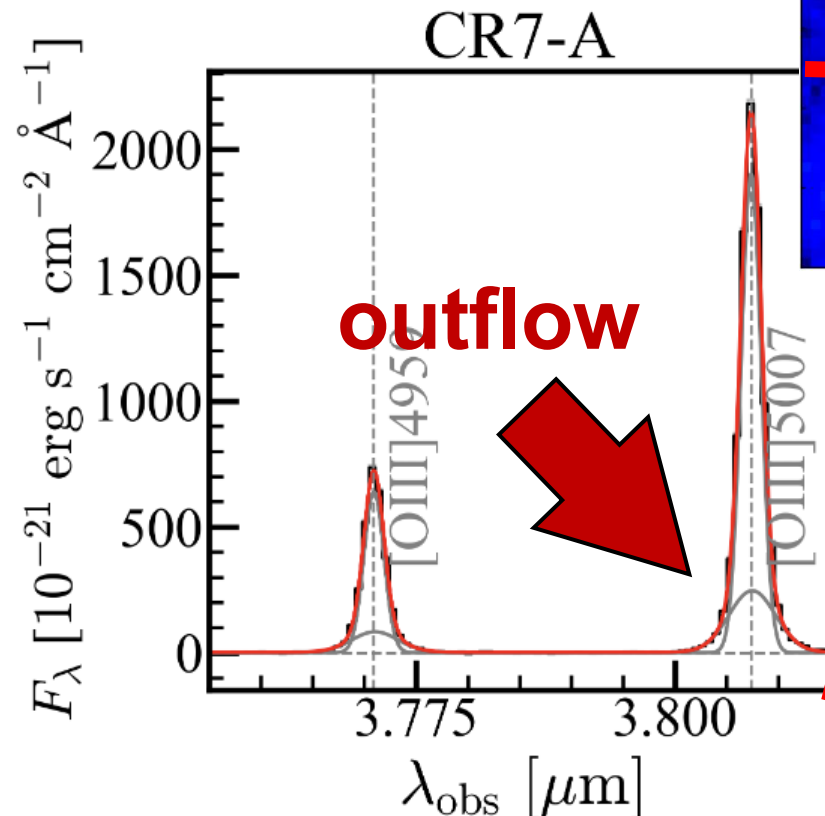
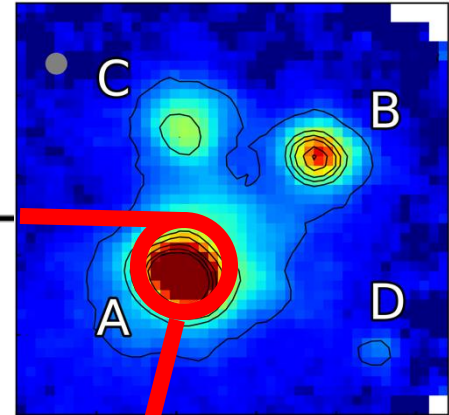
Outflow components

- [OIII] lines $\rightarrow$ broad component (FWHM $\sim$ 250-400 km/s) $\rightarrow$ outflow

Himiko



CR7

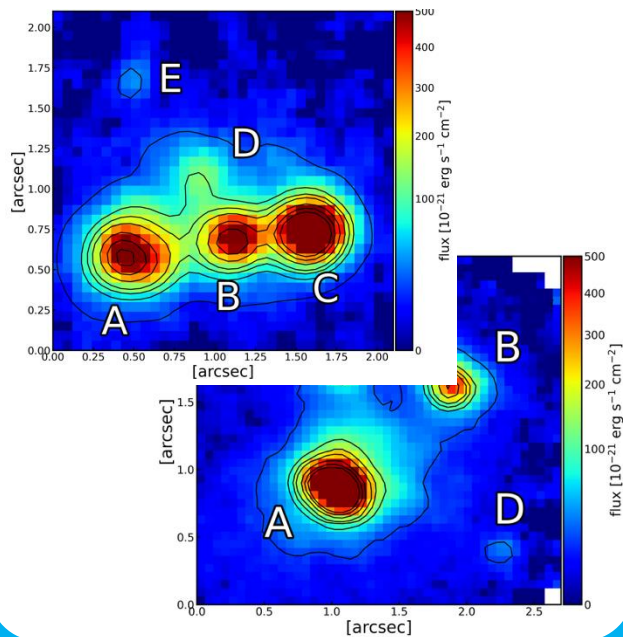


Discussion

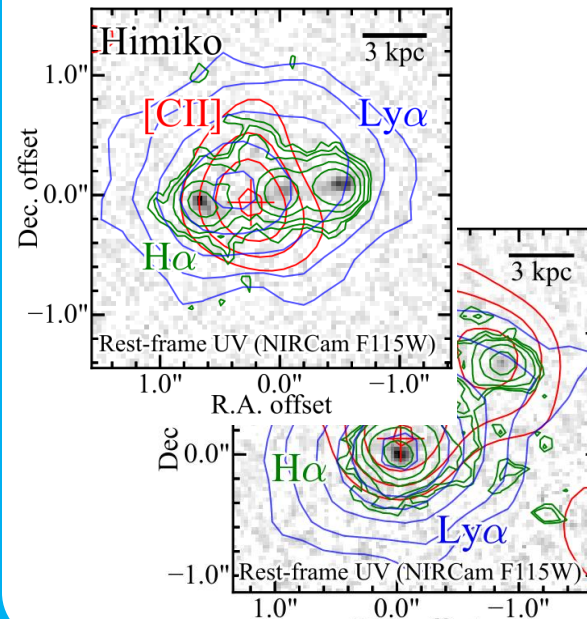
- Q: Why do Himiko and CR7 have extended Ly α emission?

Suggestions from the data

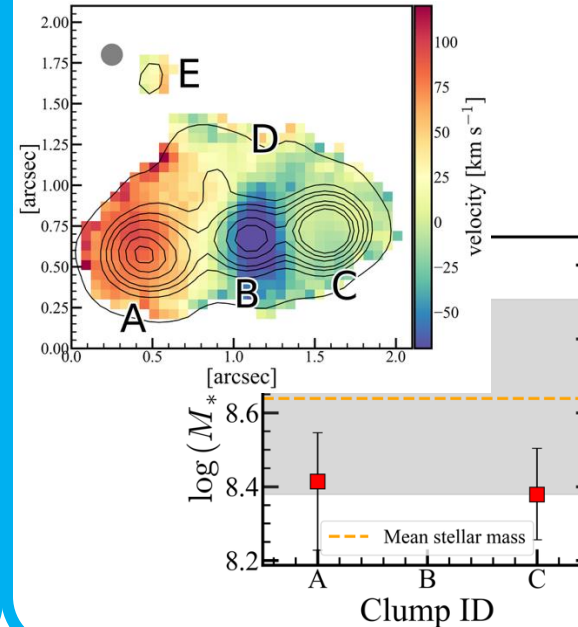
Multiple clumps



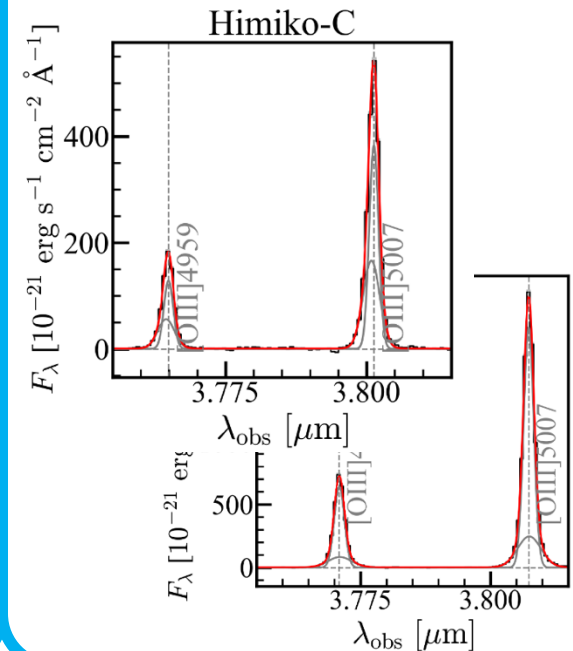
Extended gas



Major mergers



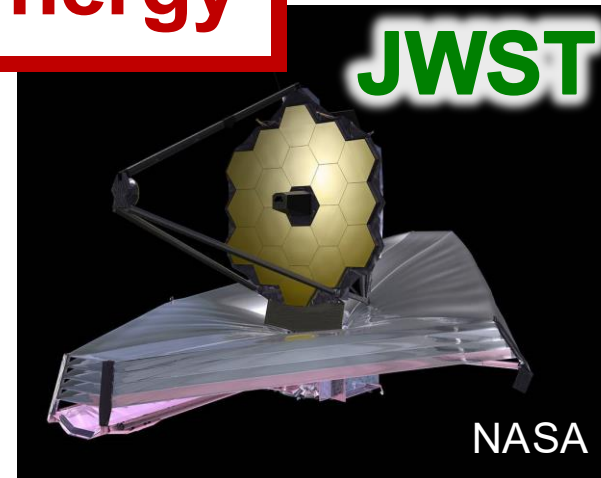
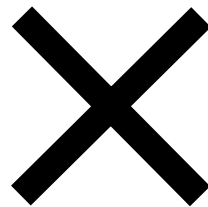
Outflows



Summary

- Exploring Himiko & CR7 with JWST+ALMA+Subaru
- Why extended Ly α ?
 1. Multiple clumps
 2. Extended gas distribution
 3. Major mergers
 4. Outflows from clumps

Subaru-JWST Synergy



Future Studies

- Subaru/Keck Time Exchange Program
- S25B-066 (PI: T. Kiyota) Keck/KCWI in November
- **Thank you for the Waimea on-site observation opportunity and the Student PI Program.**

