SWIMSとALMAの分光観測で探る近傍衝突銀河の星形成

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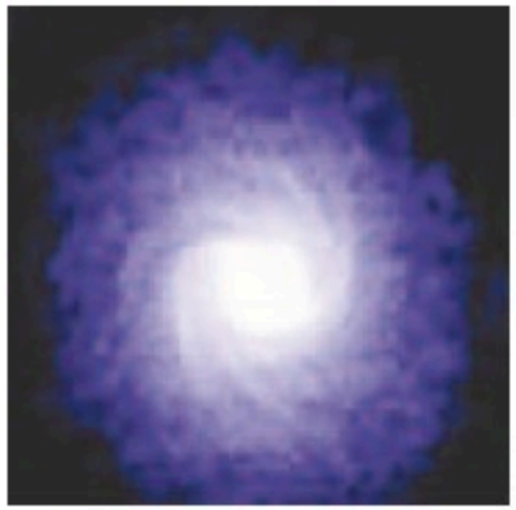
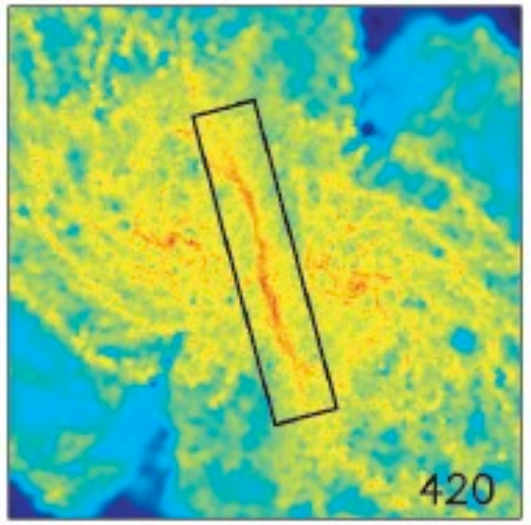
Major merger evolution



Galaxy Collision
(early stage)

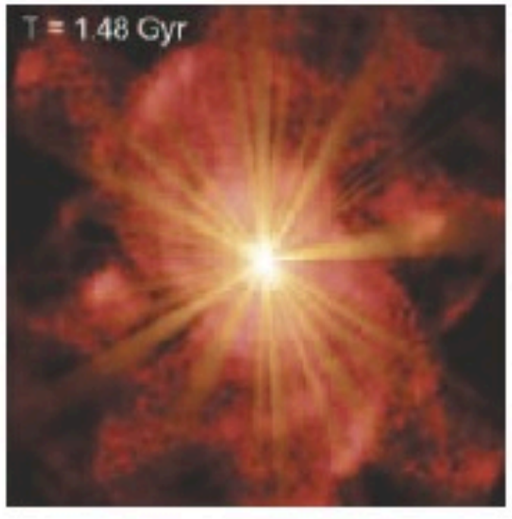
Saitoh et al. (2009)



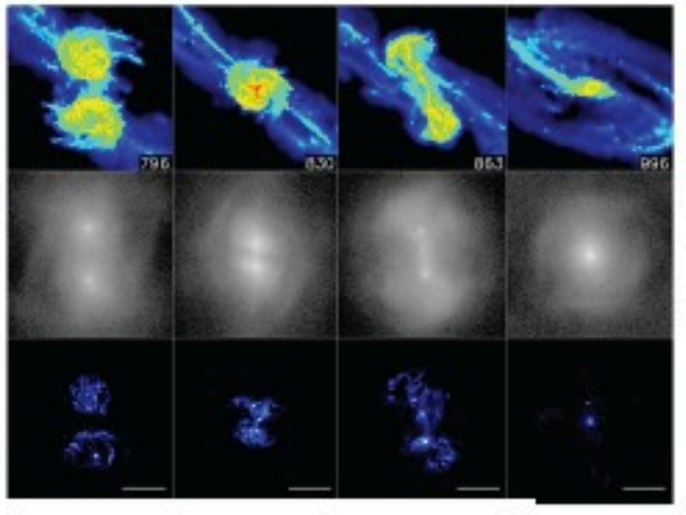
Merging
(merger remnant)

Formation
&
Evolution

Active Star Formation
(intermediate stage)



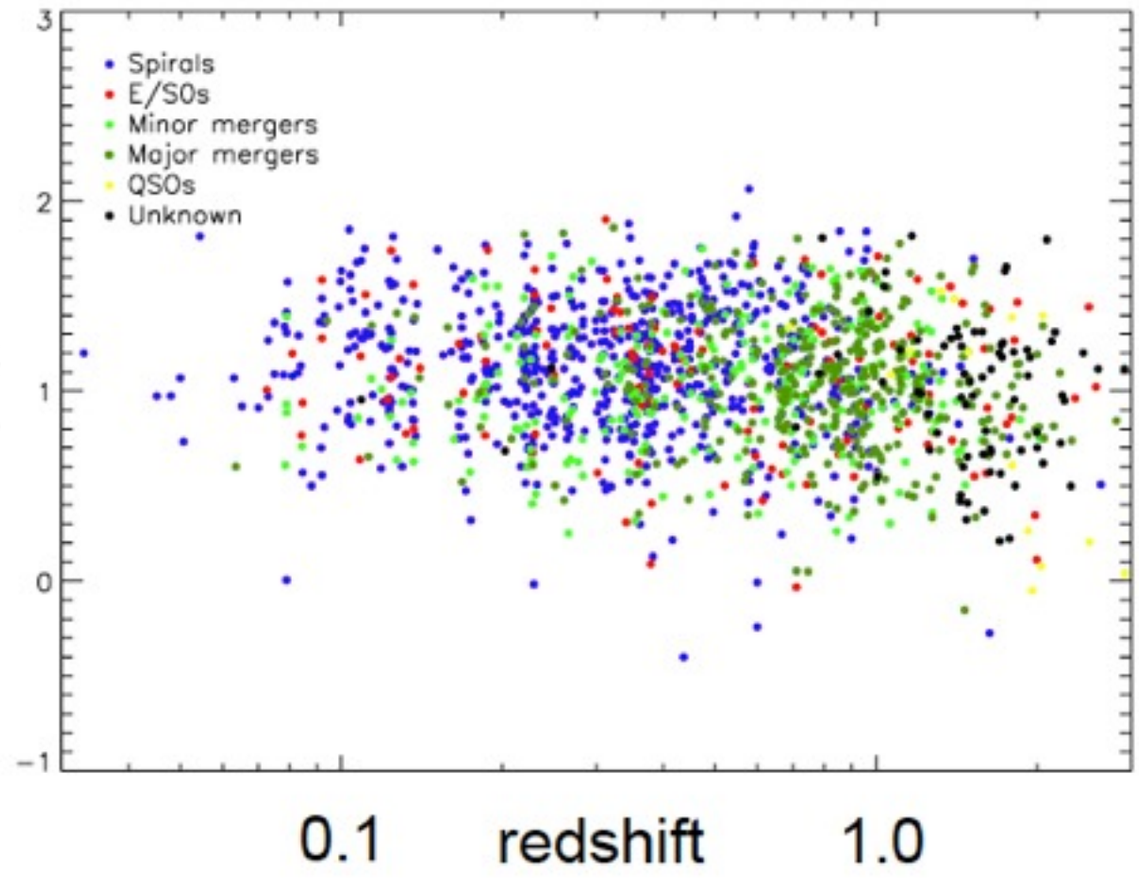
Growth of Black Hole
(late stage)

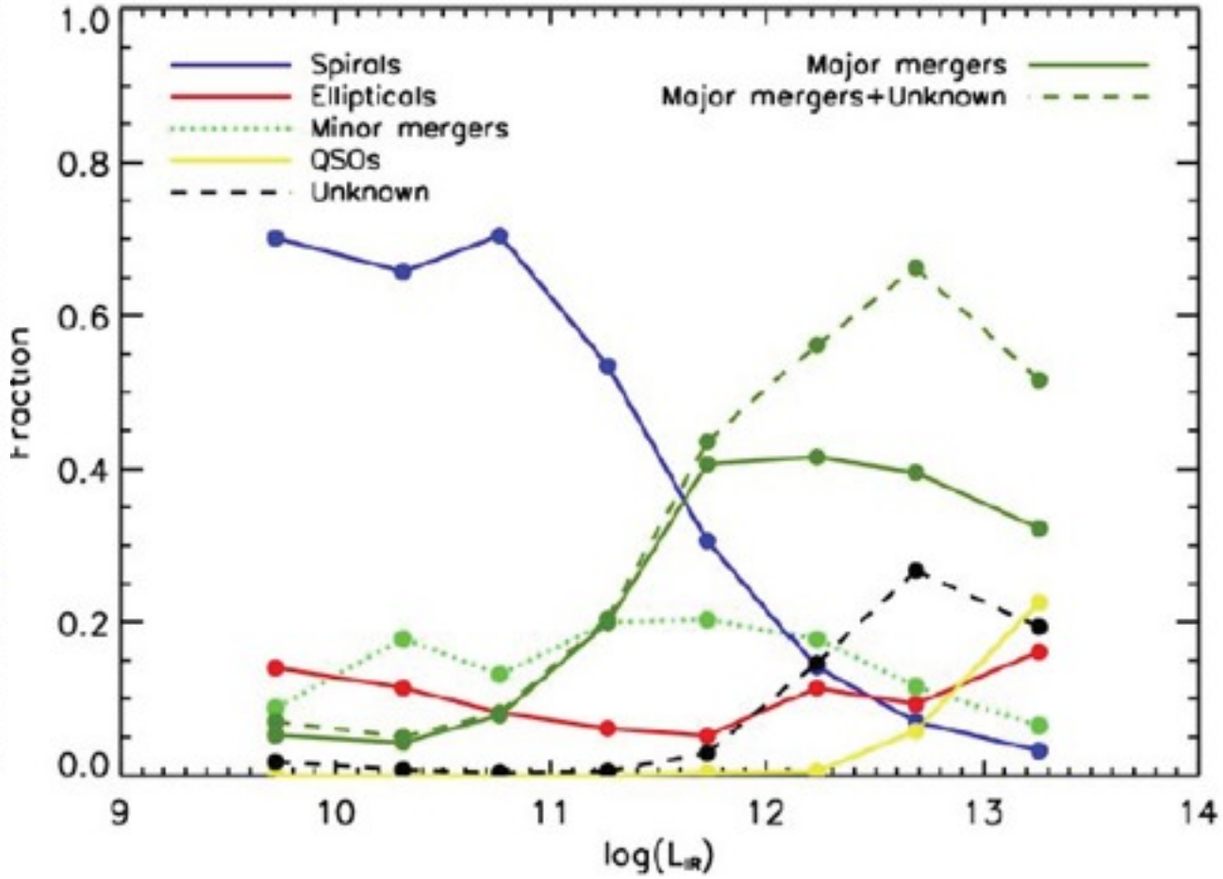


Hopkins et al. (2006)

Matsui et al. (2012)

Pair fraction in the Universe



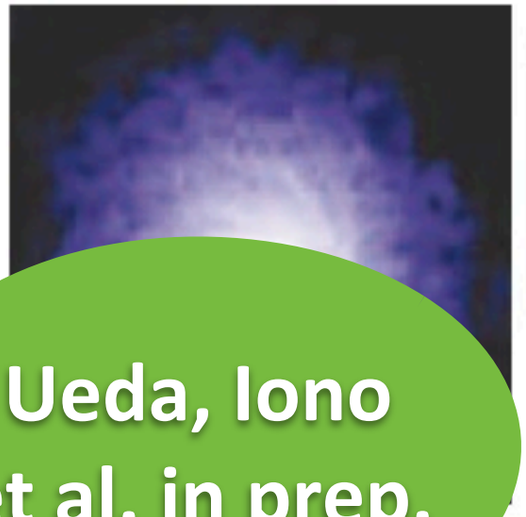


1503 galaxies (70 micron selected) in the 0.1 < z < 3.5 universe using COSMOS (Kartaltepe et al. 2010)

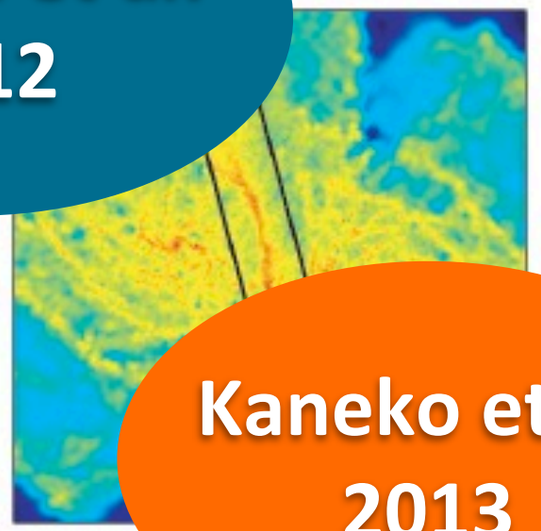
Major merger evolution

Komugi et al. 2012

al. (2009)



Galaxy Collisio
(early stage)



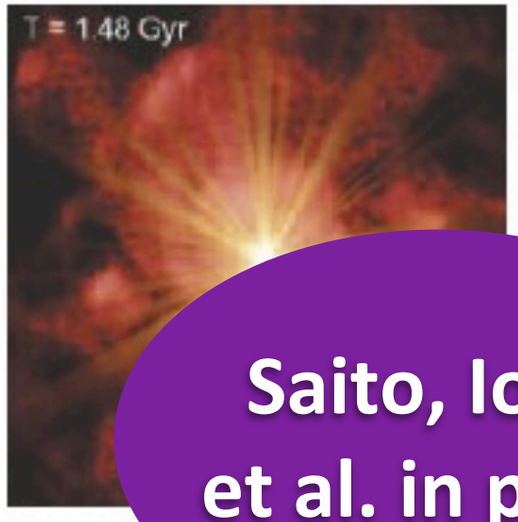
Ueda, Iono et al. in prep.

Kaneko et al. 2013

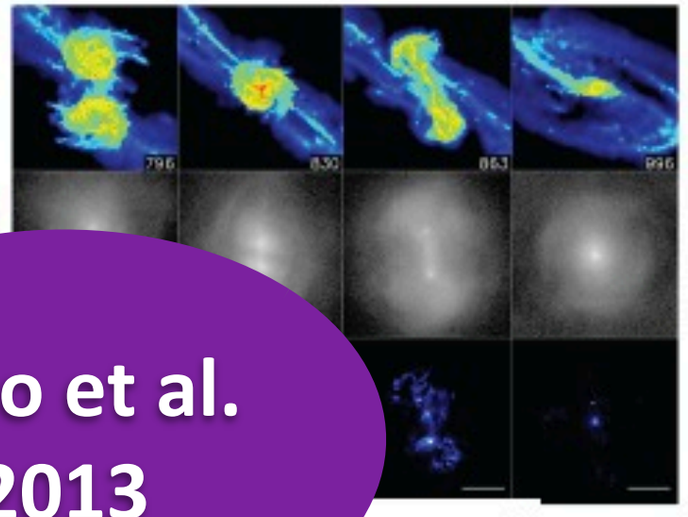
Merging
(merger remnant)

Formation
&
Evolution

Active Star Formation
(intermediate stage)



Growth of Black Hol
(late stage)



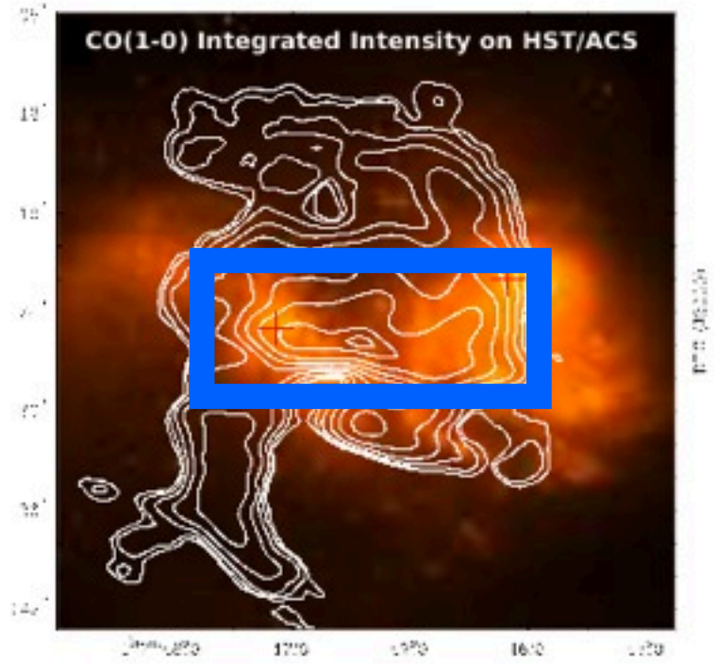
Saito, Iono et al. in prep.

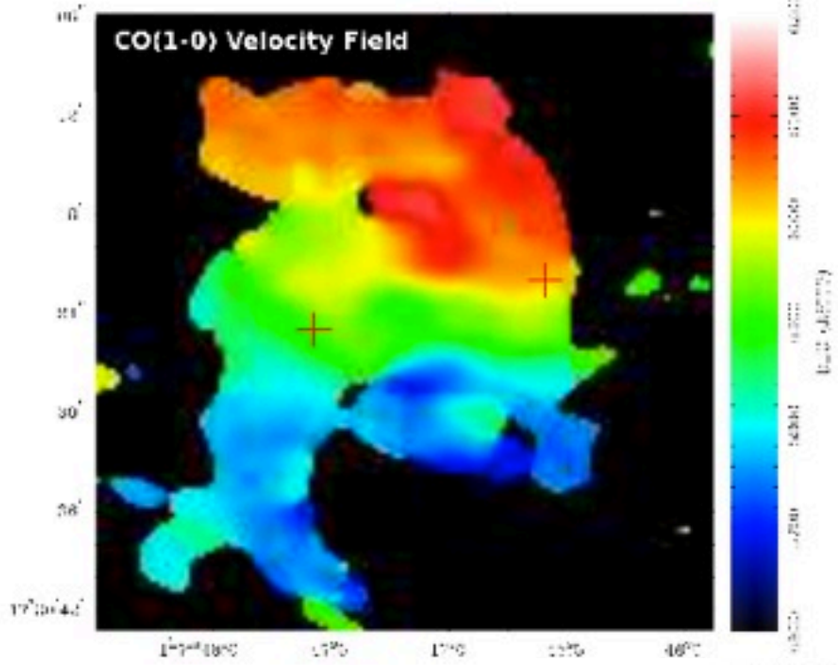
Iono et al. 2013

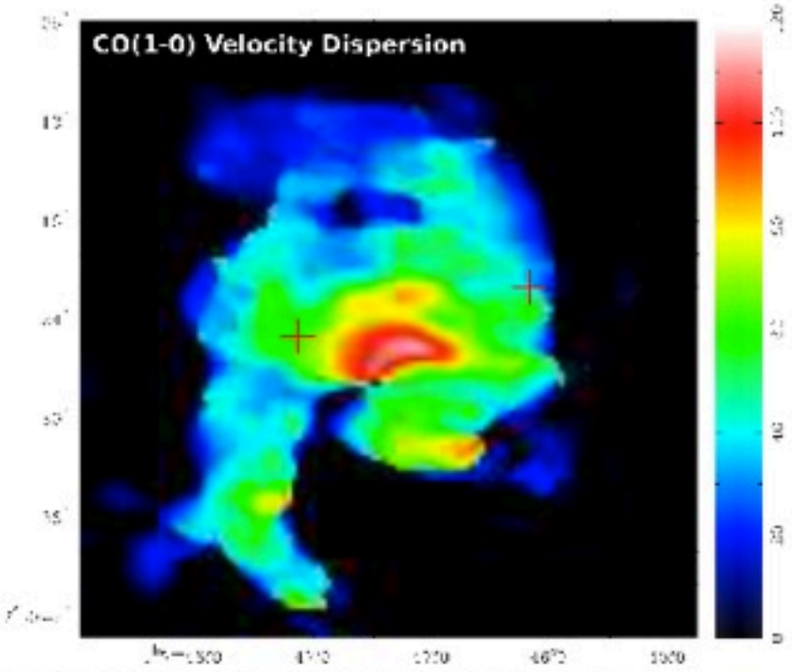
Hopkins et a (2012)

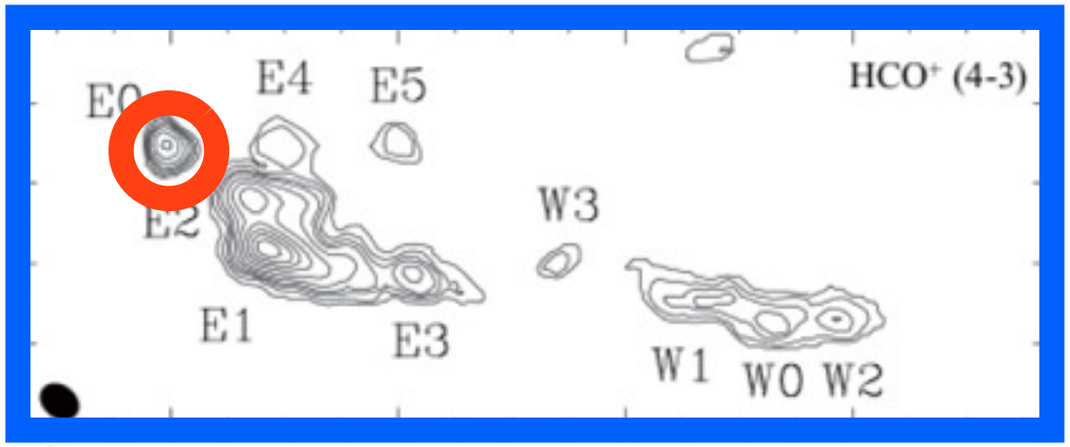
The late-stage LIRG VV114

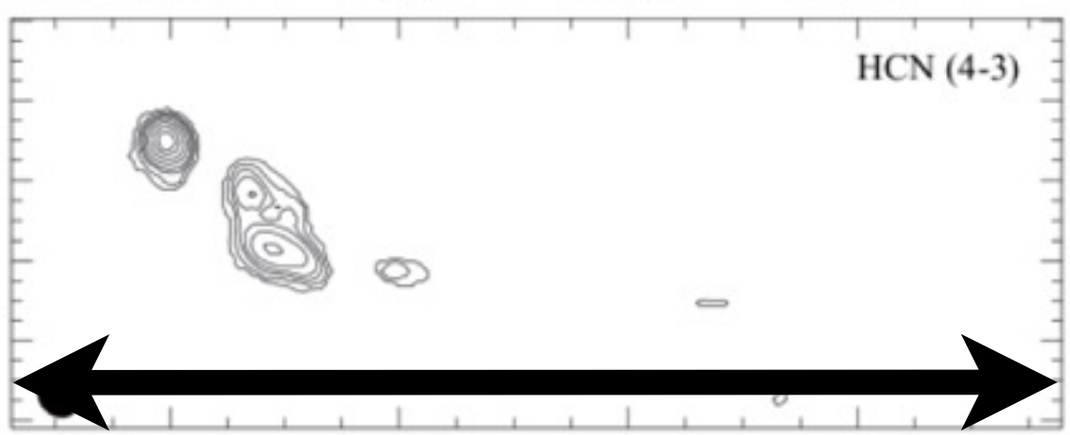
VV114: CO(1-0) & HCN(4-3)/HCO+(4-3)



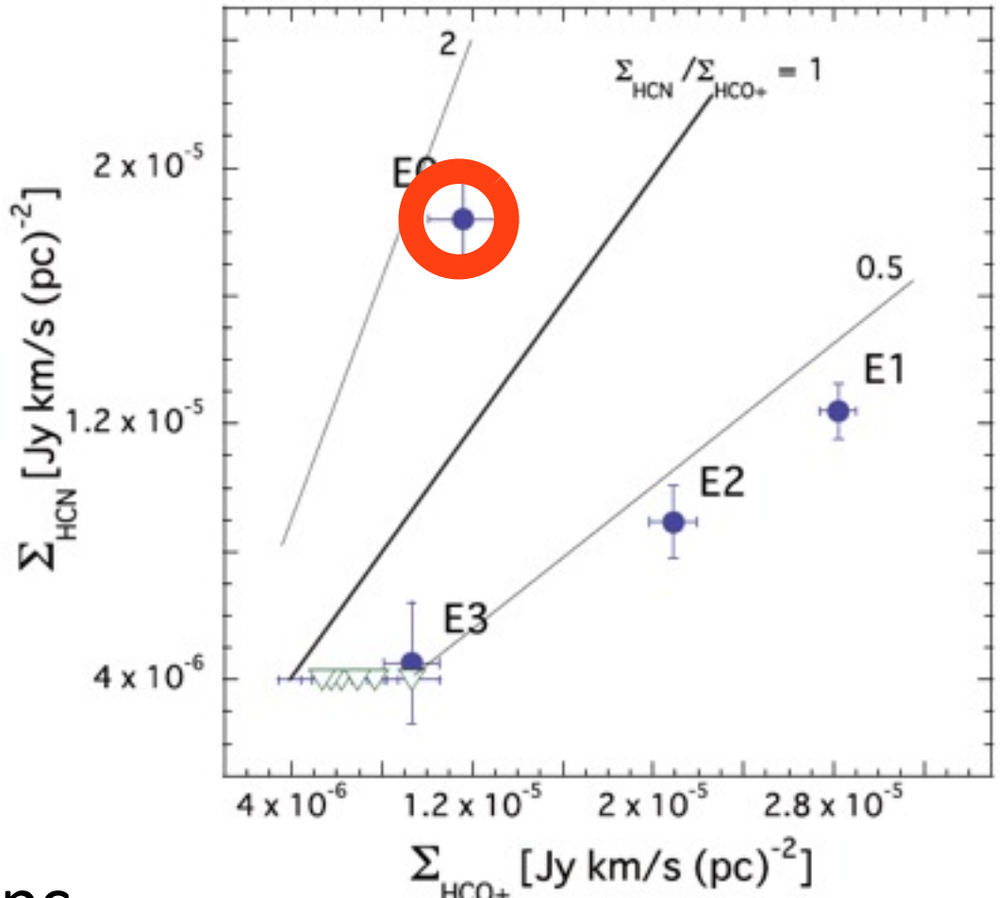






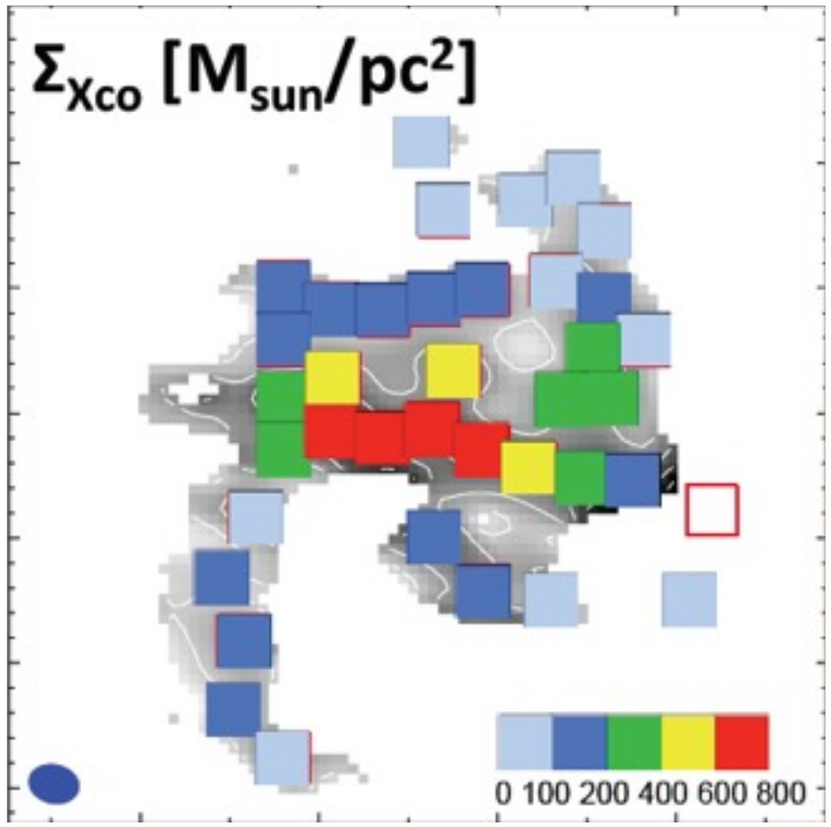


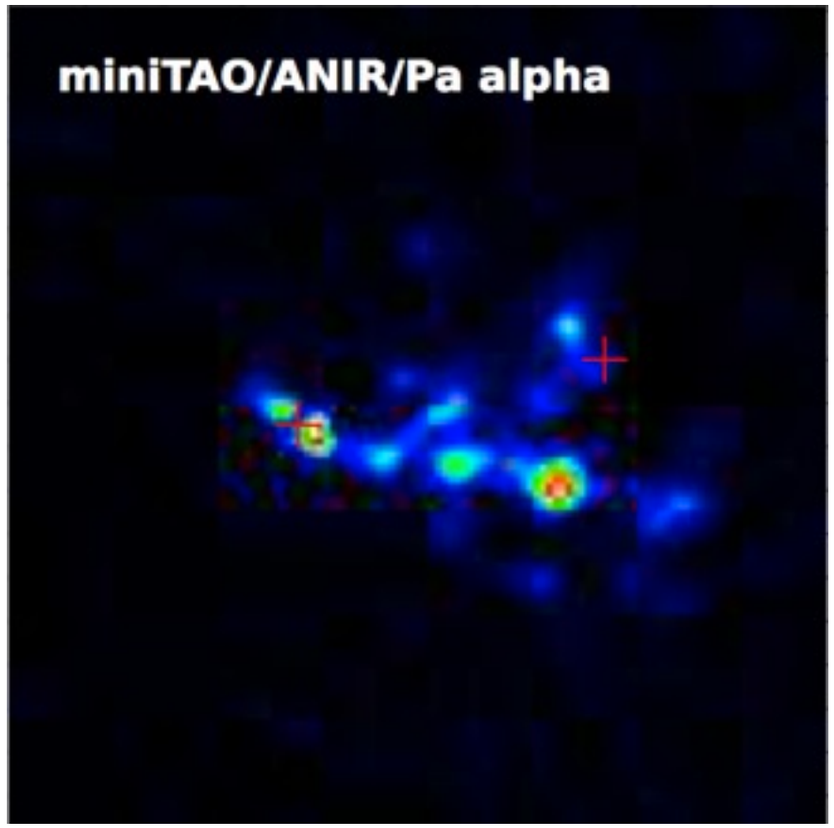
~ 6 kpc

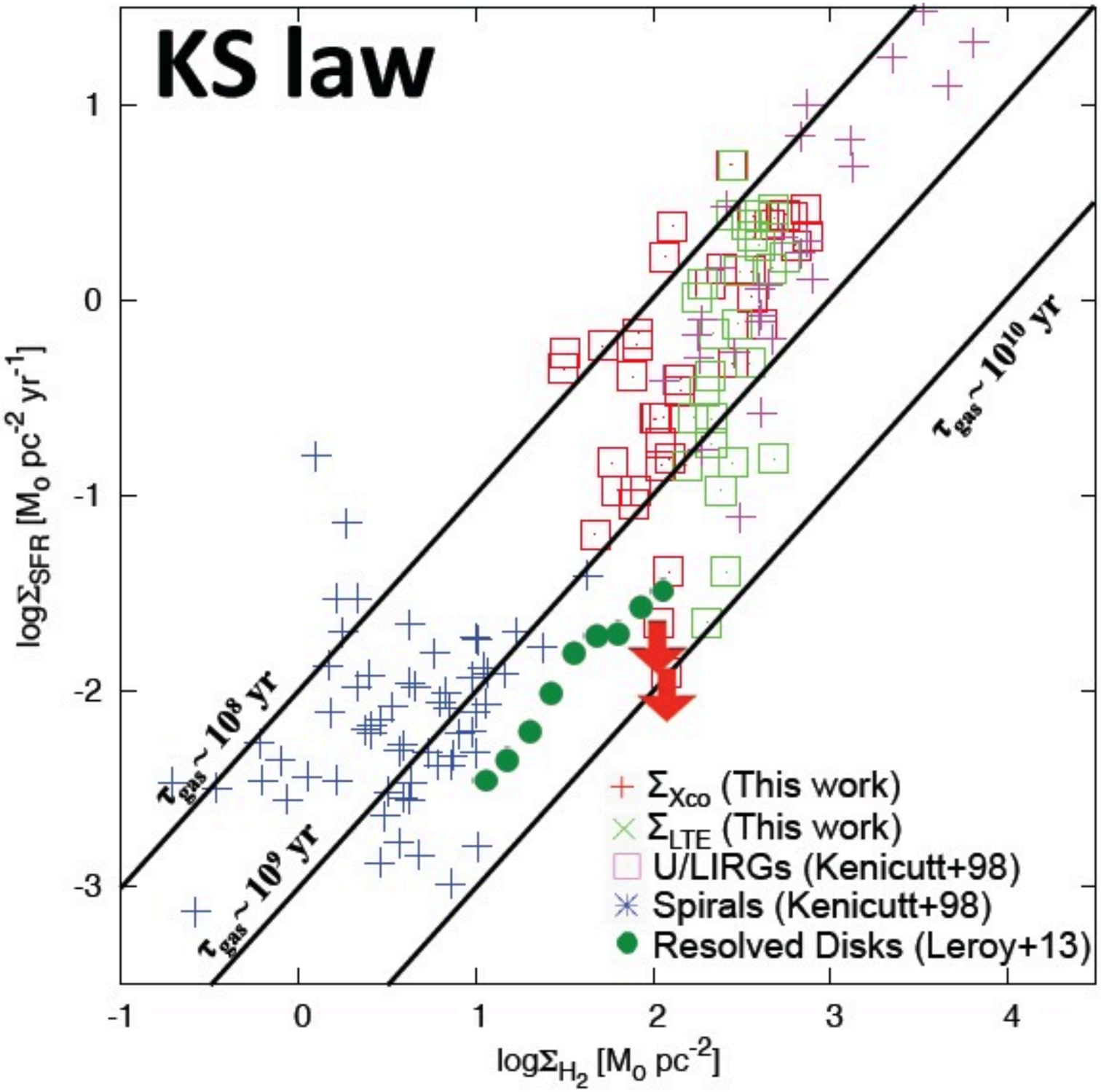


Iono et al. 2013

VV114: KS law (800 pc box)

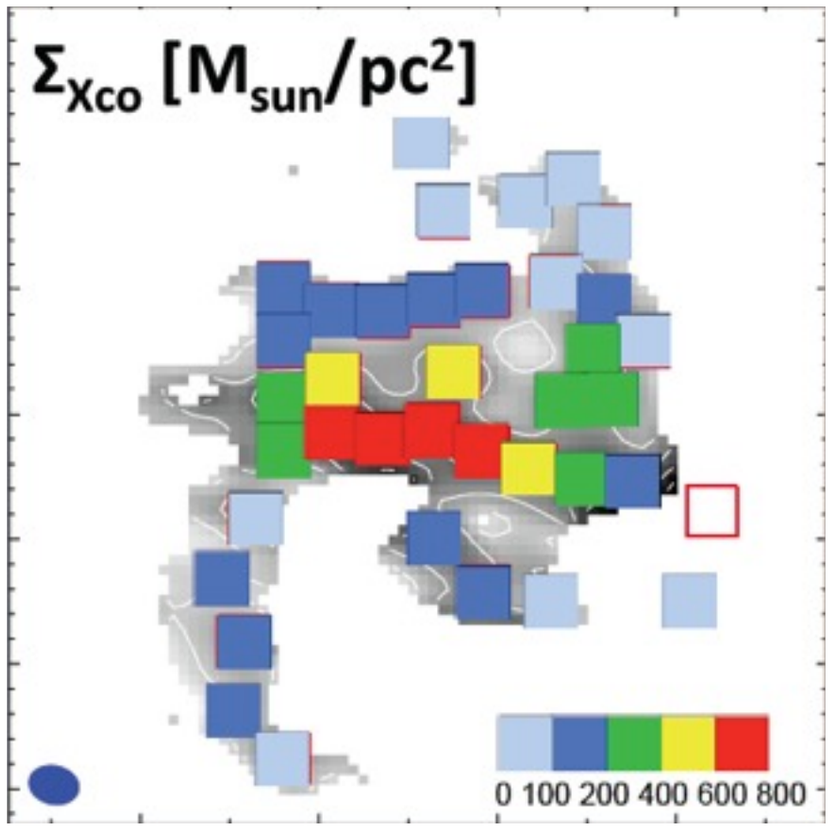


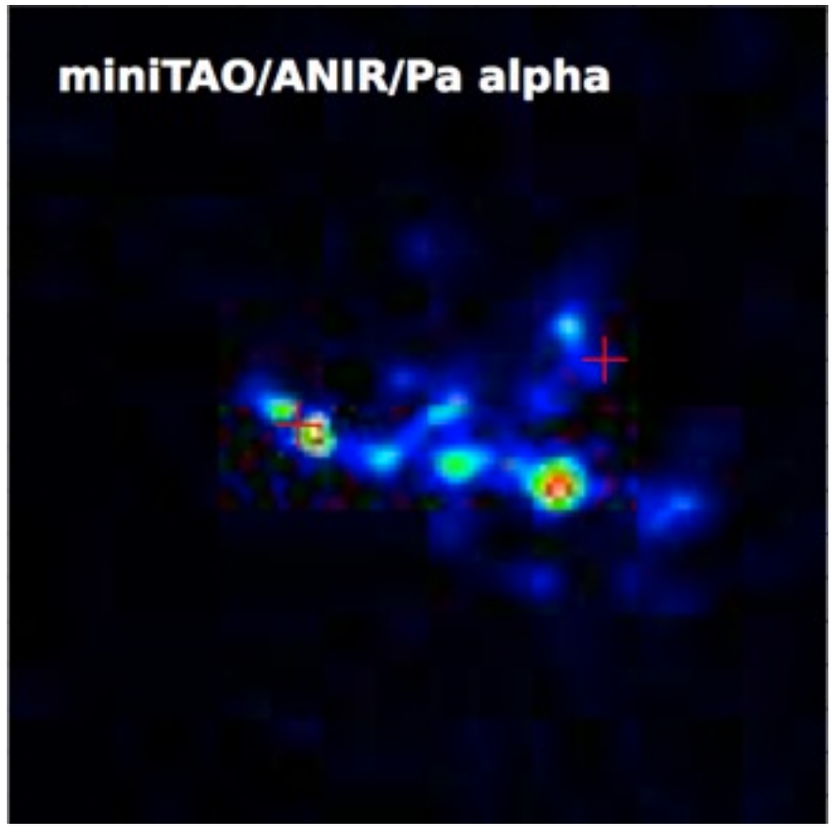


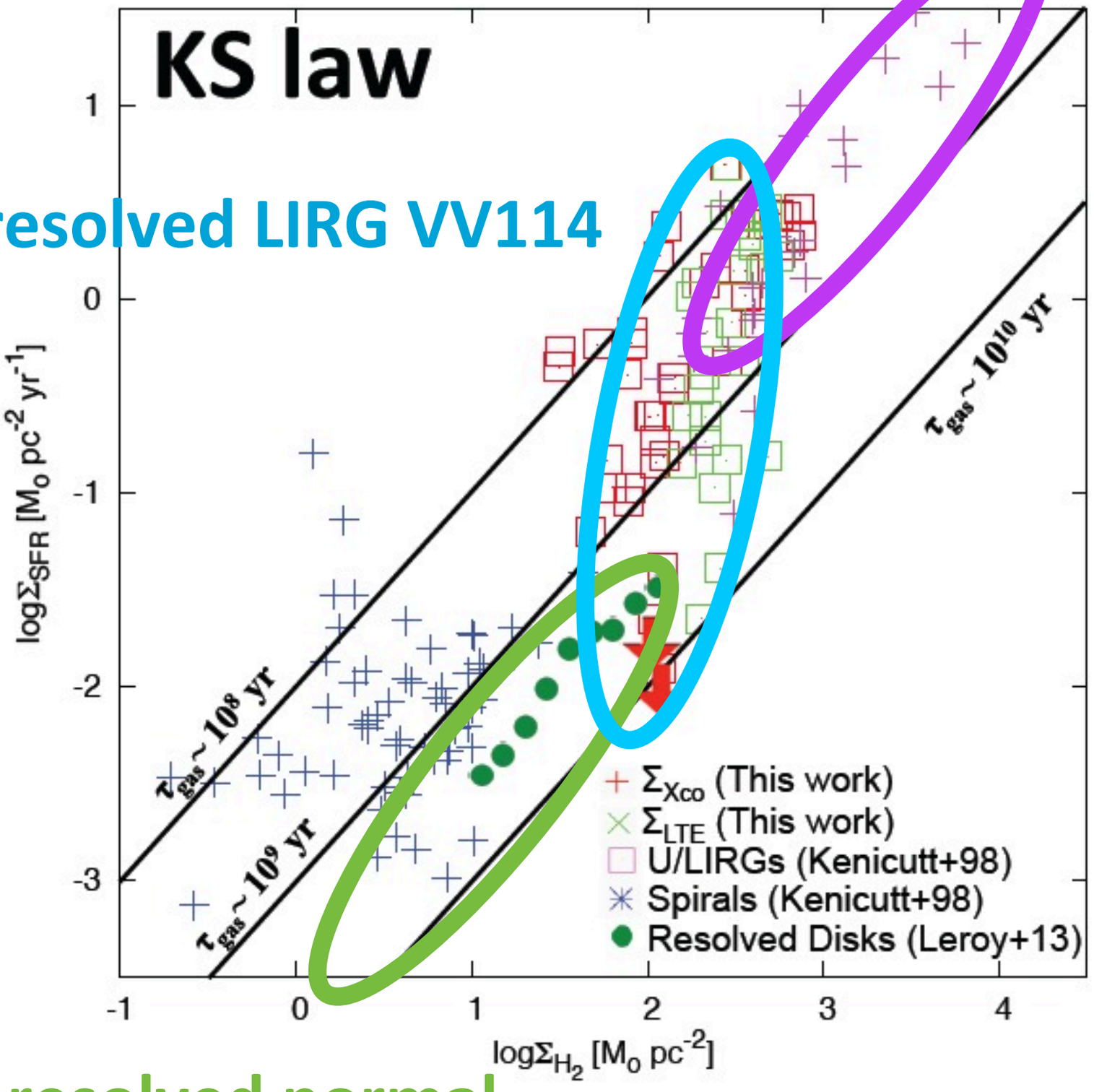


Saito, Iono et al. in prep.

VV114: KS law (2" resolution)

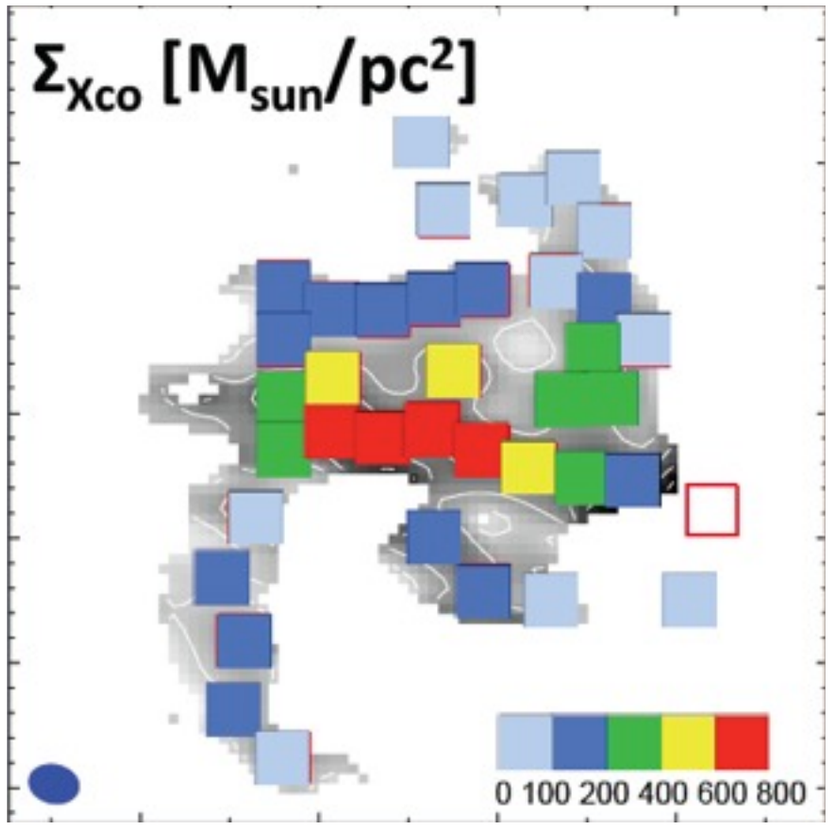


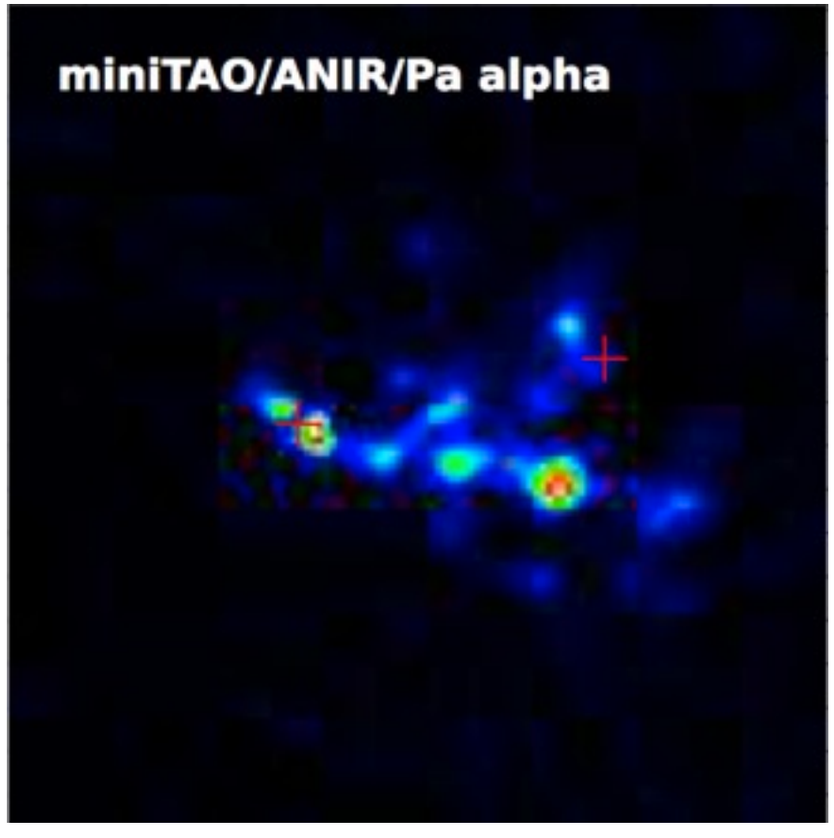


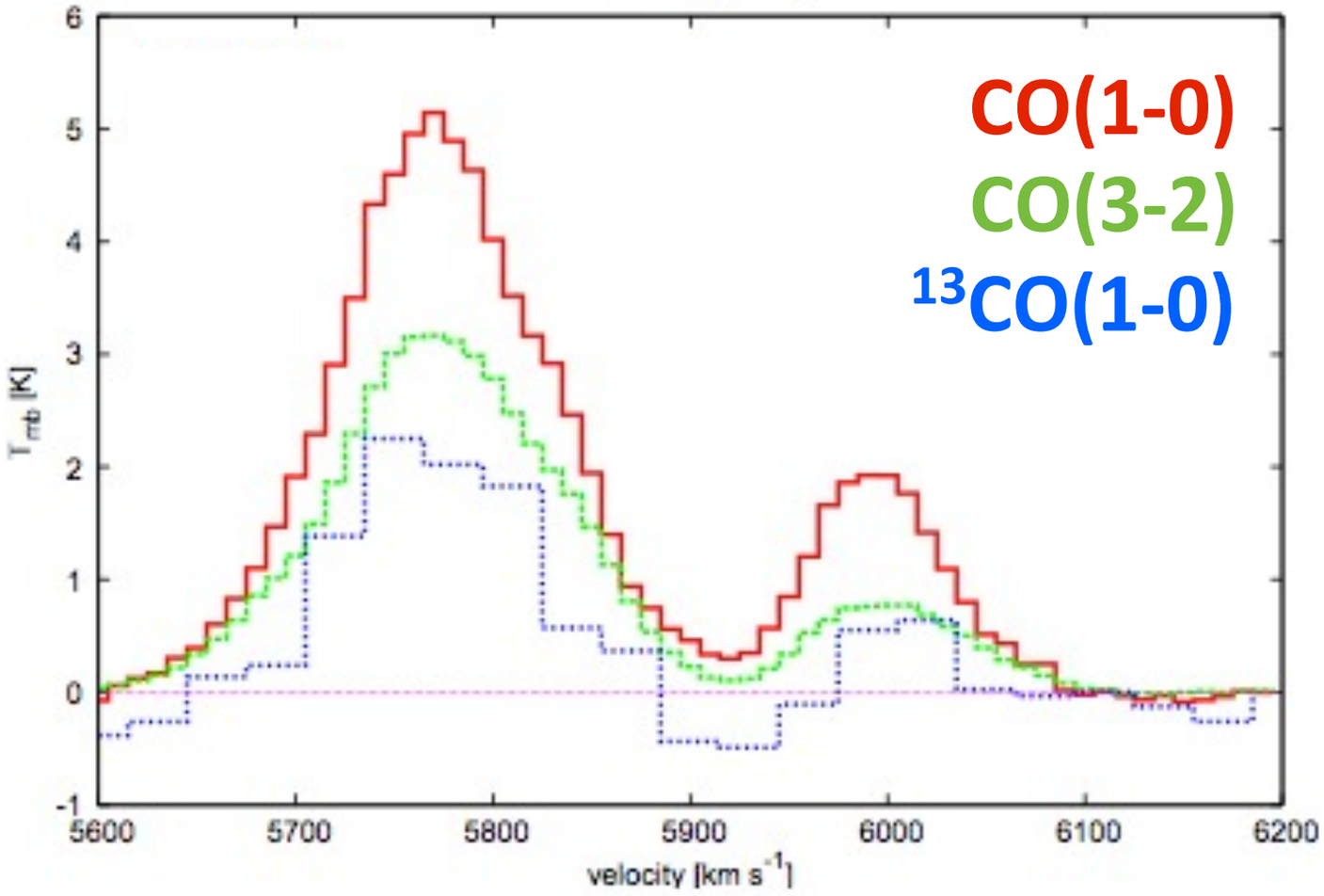


Saito, Iono et al. in prep.

VV114: KS law (2" resolution)







Which peak is associated with SF?

The late-stage mergers show very complicated kinematics.

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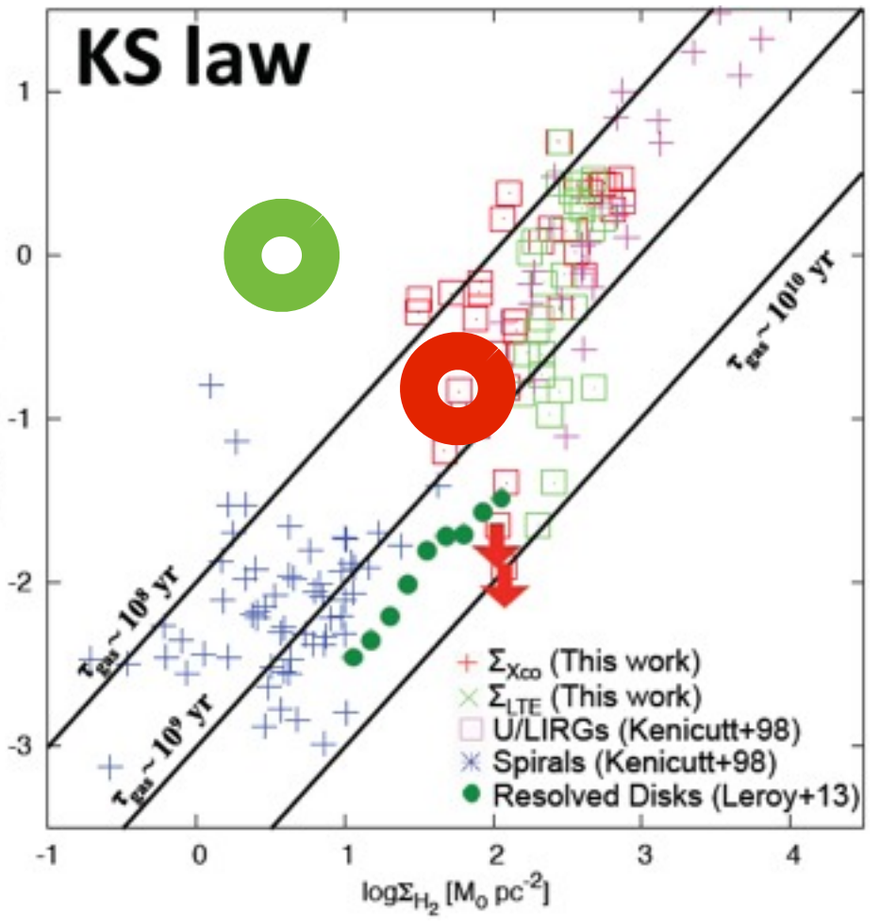
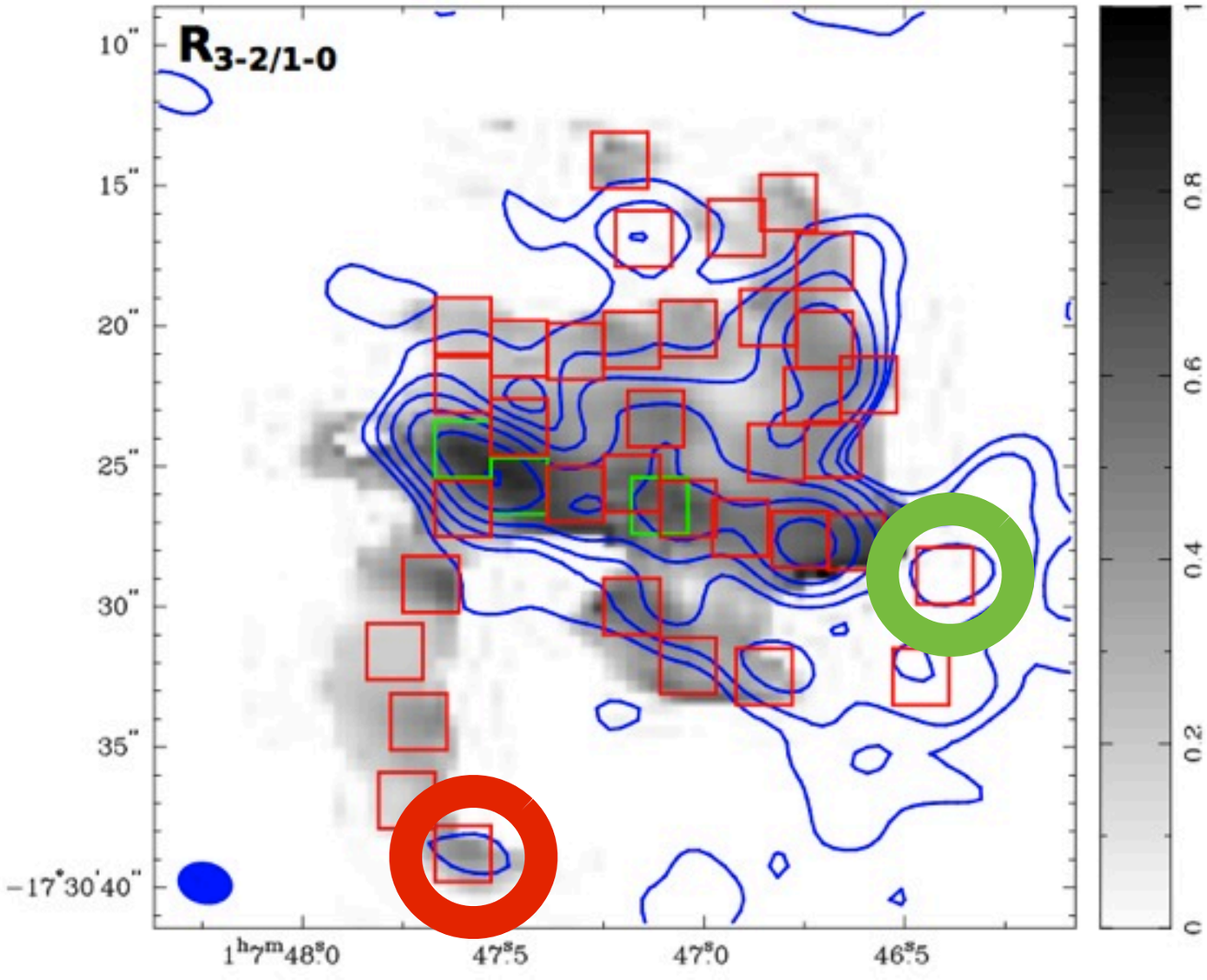
VV114: Specific Pa alpha peaks





- Tidal dwarf galaxy formation at the edge of tidal tail?
- molecular gas poor/exhausted SF region?

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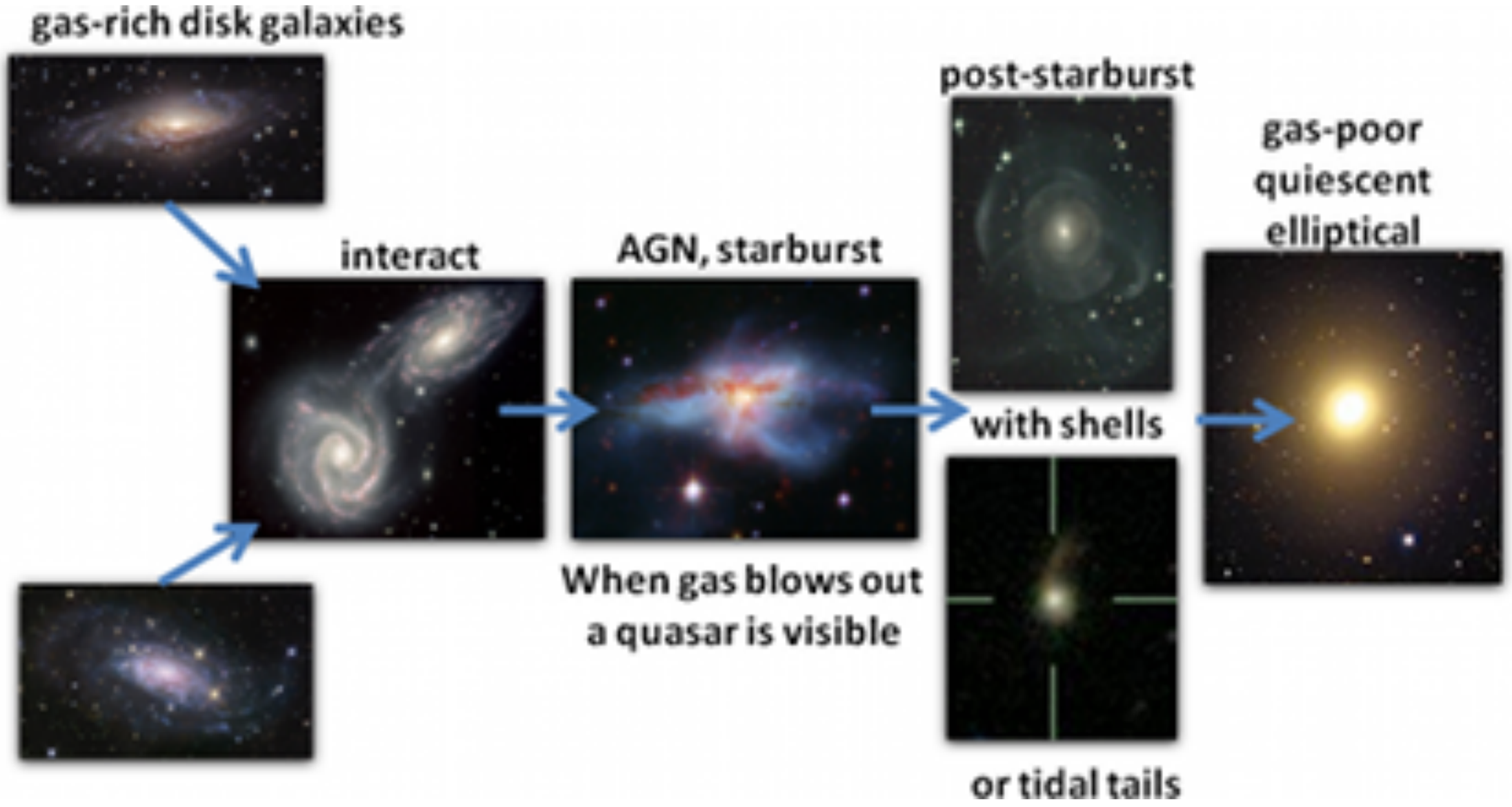
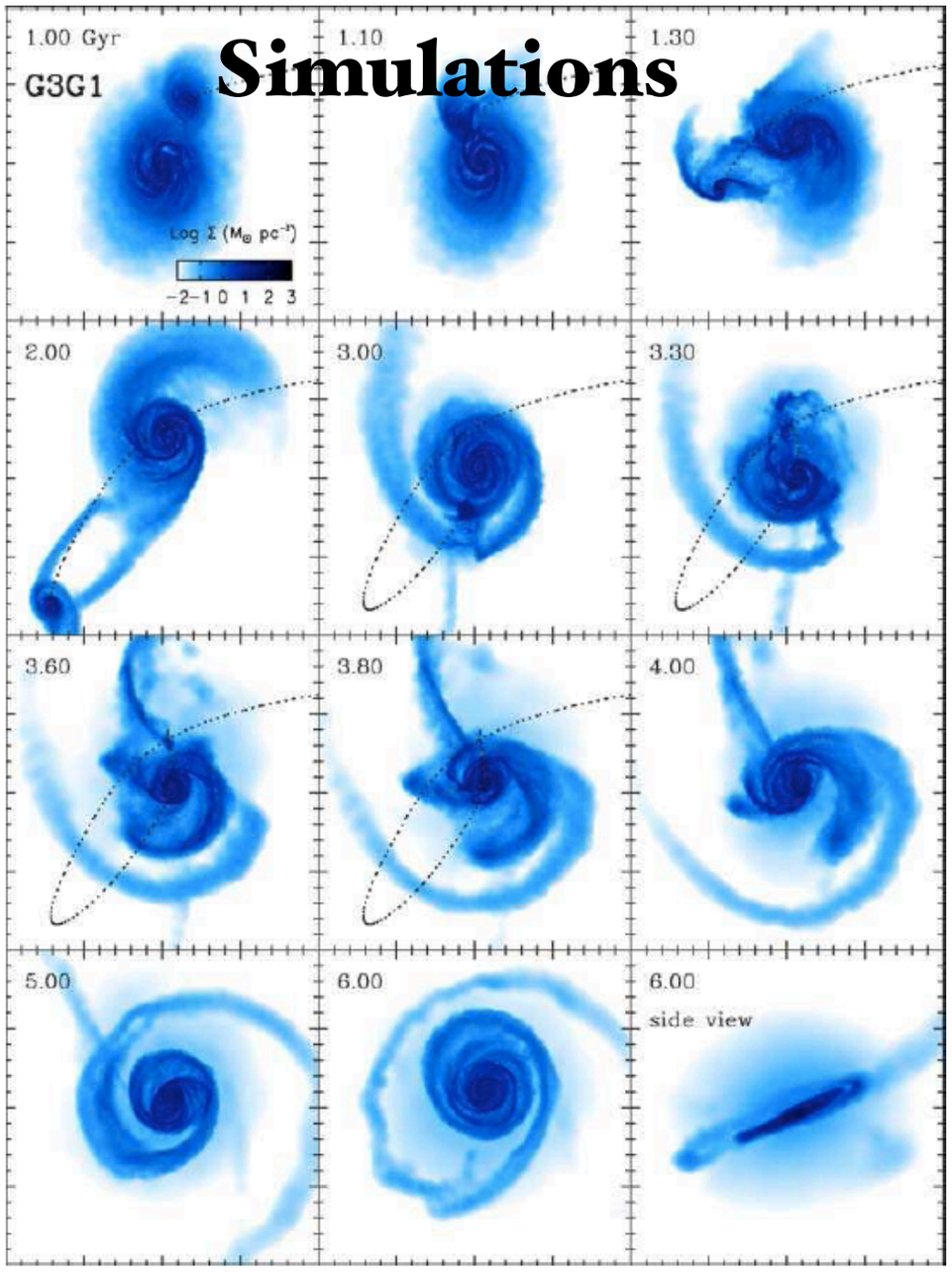
Cold molecular gas and ionized gas in merger remnants

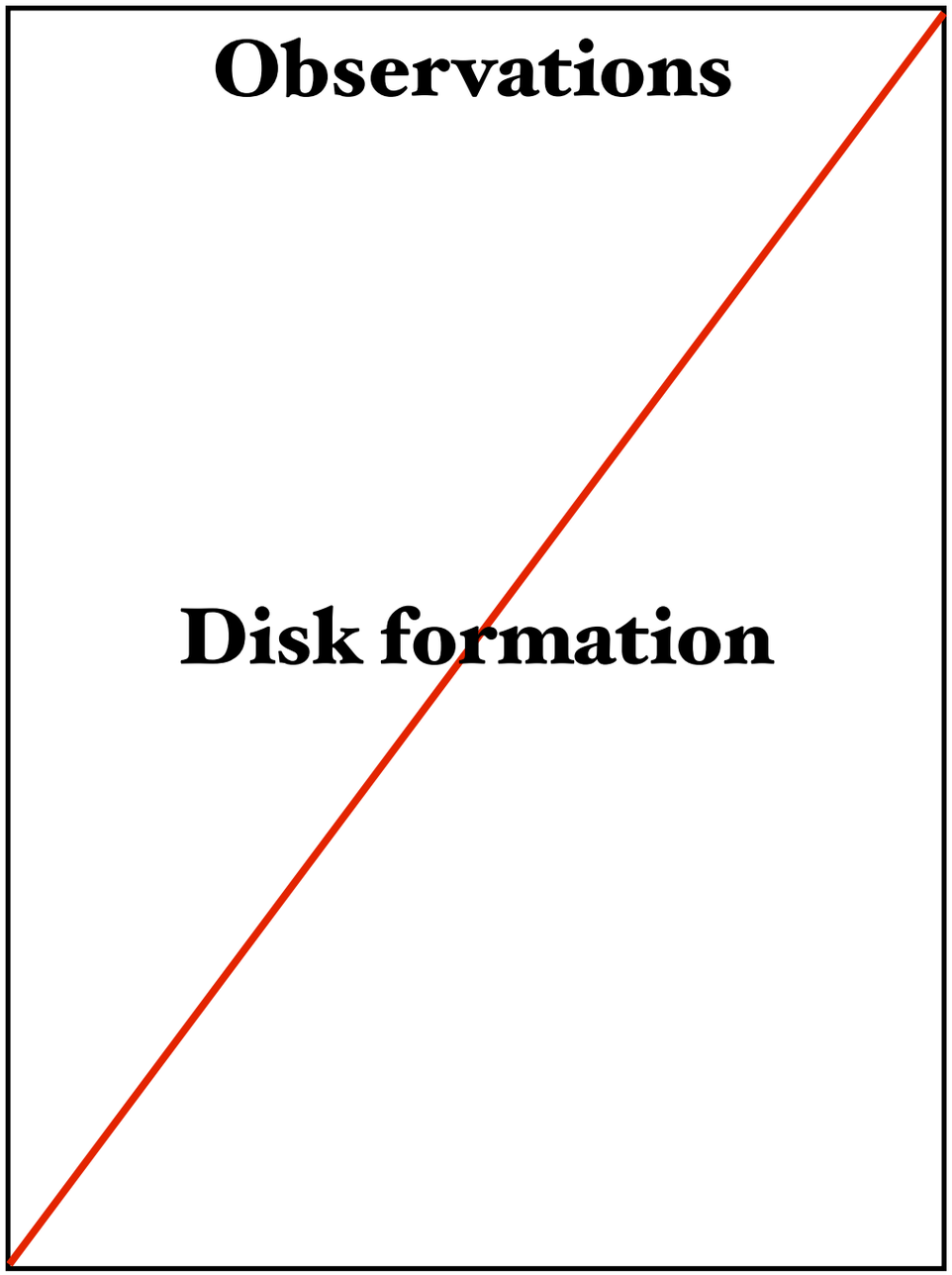
Previous Observations vs. Simulations



(Simulations) Toomre77, Barnes&Hernquist92, Naab&Burkert03
(Observations) Schweizer&Seitzer92, Schweizer+96

Recent Observations vs. Simulations



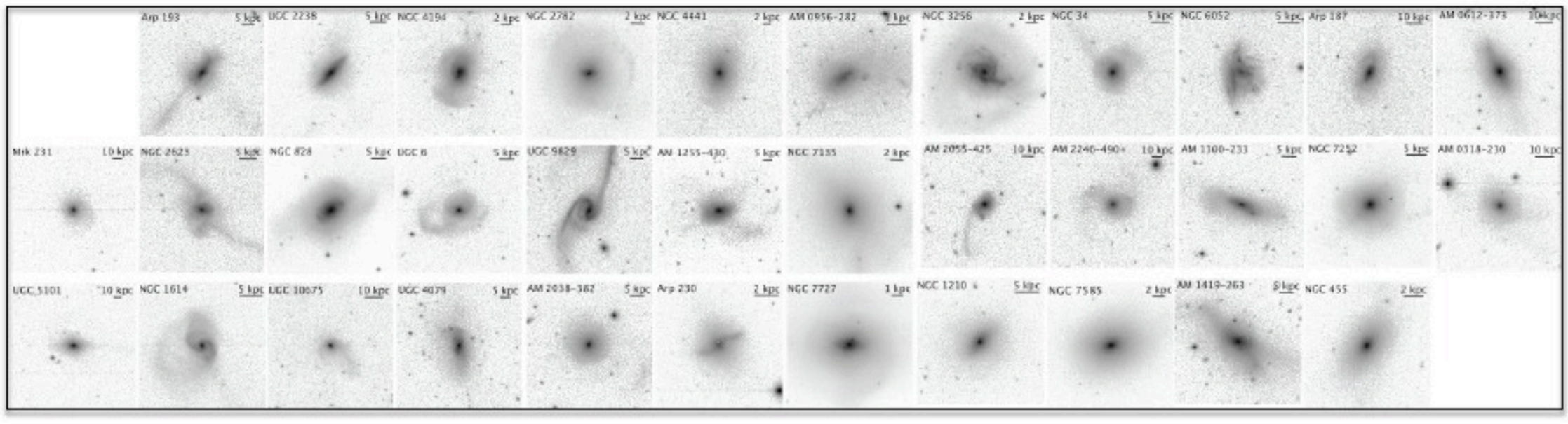


(Simulations) Cox+08, Barnes+02, Springel&Hernquest05

(Observations) Rothberg&Joseph04

Merger remnant sample

- 37 galaxies out of Rotheberg & Joseph (2004) catalog
- Rotheberg & Joseph (2004) is a catalog of 51 merger remnants compiled from 4 catalogs of peculiar galaxies (e.g., Arp, VV,..), and then selected based on K-band
    1. Optical morphology (tidal tails, loops)
    2. Single nucleus + No nearby companion



Summary

1) **The late-stage LIRG VV114 has complicated kinematics.**

a. Which peak is associated with star-formation activity?
b. Does the TDG have same velocity as the tidal arm?
c. Why is there the Pa alpha peak without molecular gas at the western edge?

2) **CO of merger remnants show disk-like rotation.**

a. Is ionized gas kinematics consistent with the gas kinematics?
b. Do stars born in the gas disks?
e.g. counterrorating galaxies NGC5898, 7097 (Bettoni+84, Caldwell+86)

=> The SWIMS is important to develop our studies with ALMA.