



Catching quenching galaxies: how WISE follows the road less traveled from blue spirals to red ellipticals

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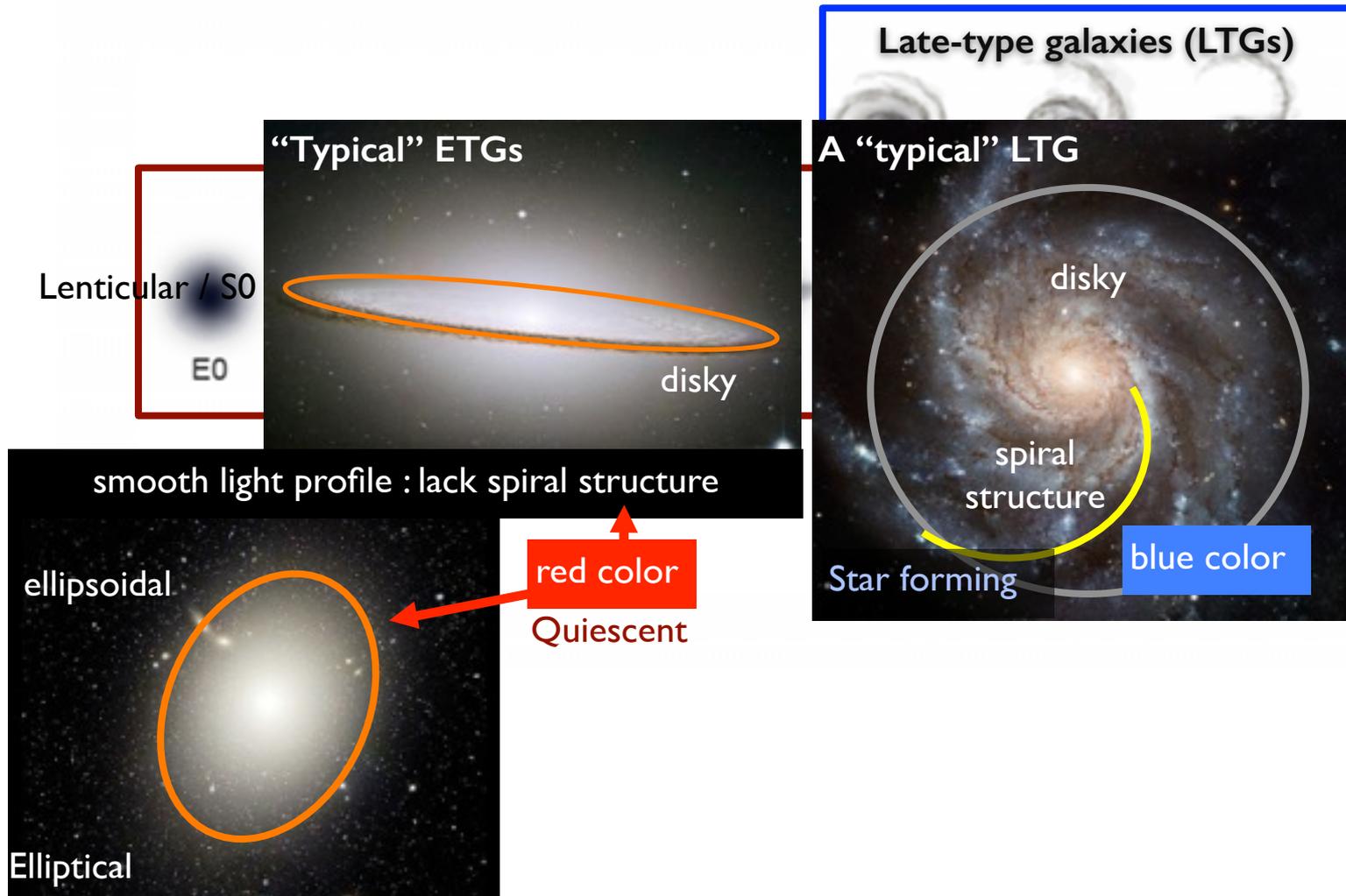
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The Hubble sequence

a morphological classification



Paths to transition

late-type

mergers



falling into a cluster



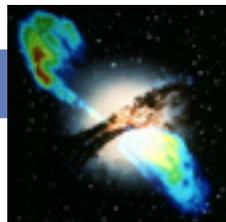
secular evolution



group interactions



other



early-type



Quenching SF

other



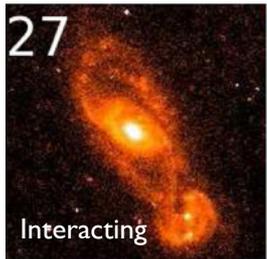
Poststarburst Phase

~1 Gyr in duration

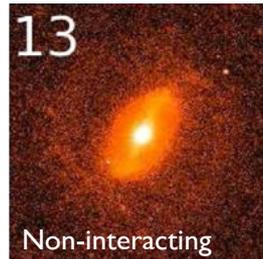
Signs of young stars but no recent star formation

Likely to be found in the green valley (between blue cloud and red sequence)

Found both to be merger remnants and non-interacting galaxies



Cales et al. 2010

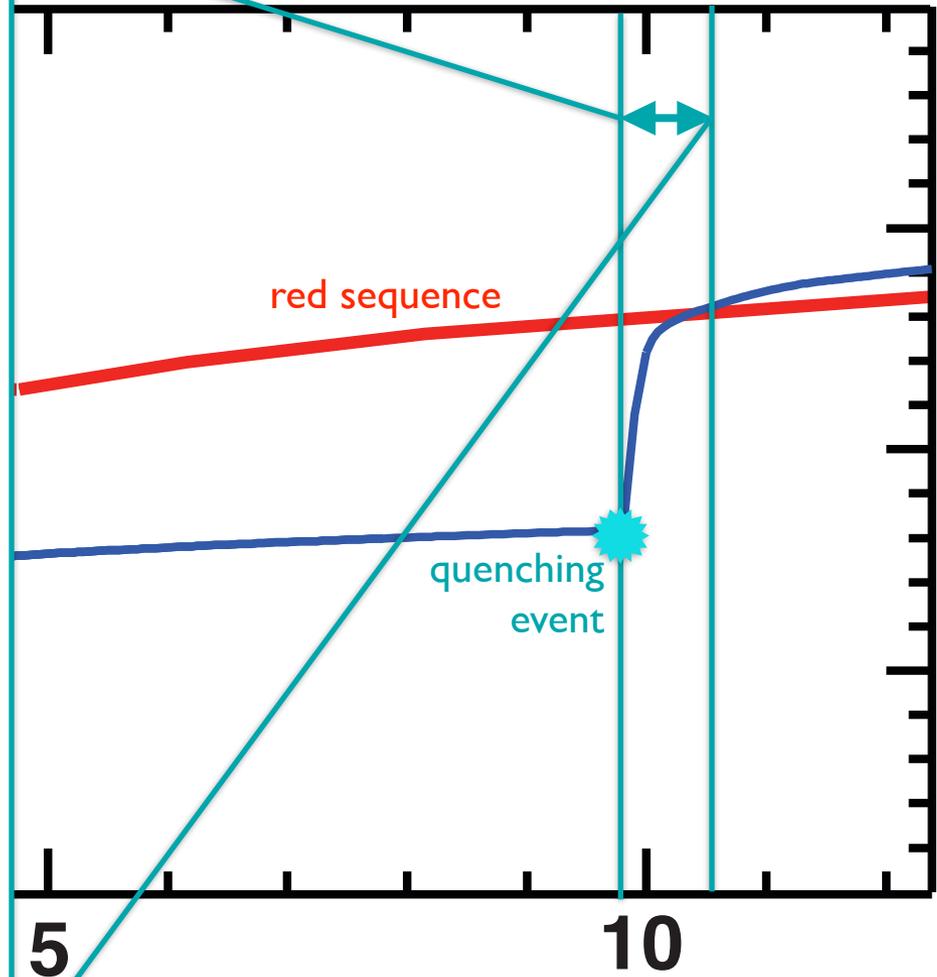


Non-interacting

Quenching Event

Much shorter duration

Mechanism less well understood



5

10

Age (Gyr)

NGC 1266

NGC 1266 appears to be a “quiescent” S0

NGC 1266 hosts a massive molecular disk ($>10^9 M_{\odot}$) and a massive ($>10^8 M_{\odot}$) molecular outflow that is multiphase

NGC 1266 contains an AGN

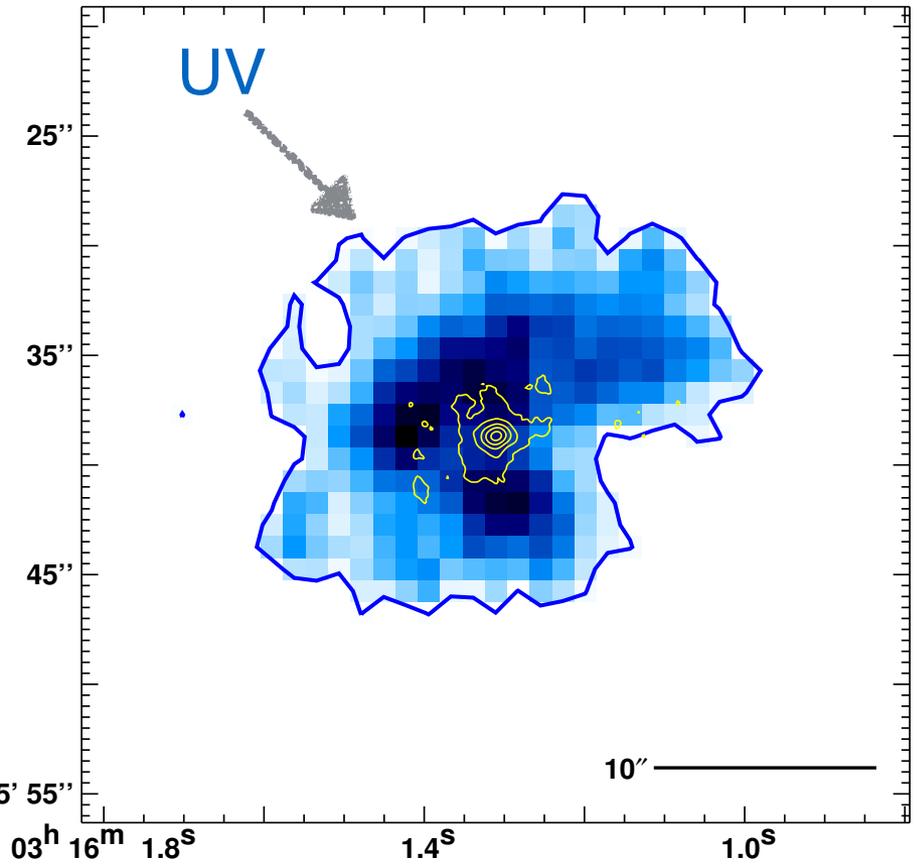
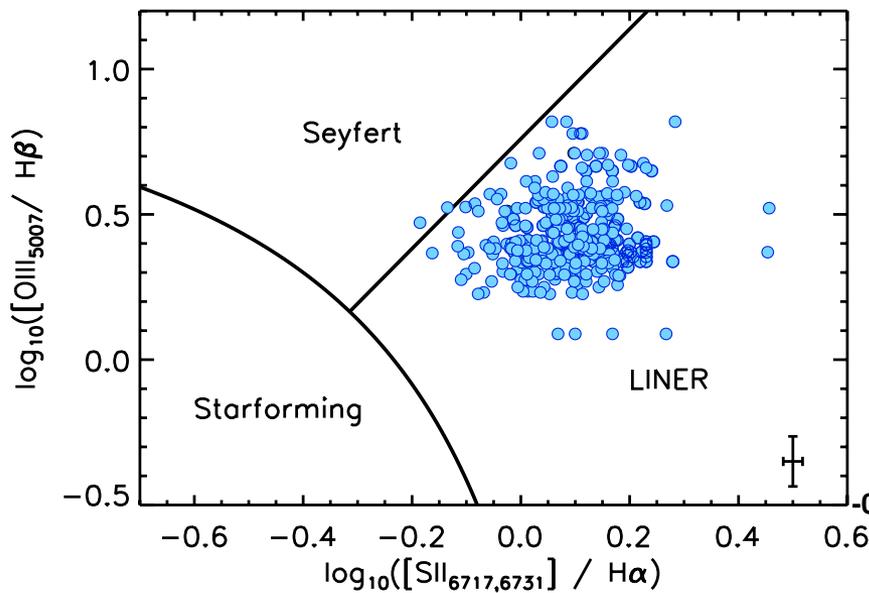
A young (1/2 Gyr) stellar population outside the nucleus points to a gravitational interaction causing the molecular gas to move to the center

Star formation is suppressed by a factor of 50-150 seen in the nucleus



Finding the needle in the haystack

NGC 1266 hosts an AGN-driven outflow, but also contains a unique set of optical features



shocked ionized gas (Davis et al 2012)

young(ish) stellar population (Alatalo et al. 2014a)

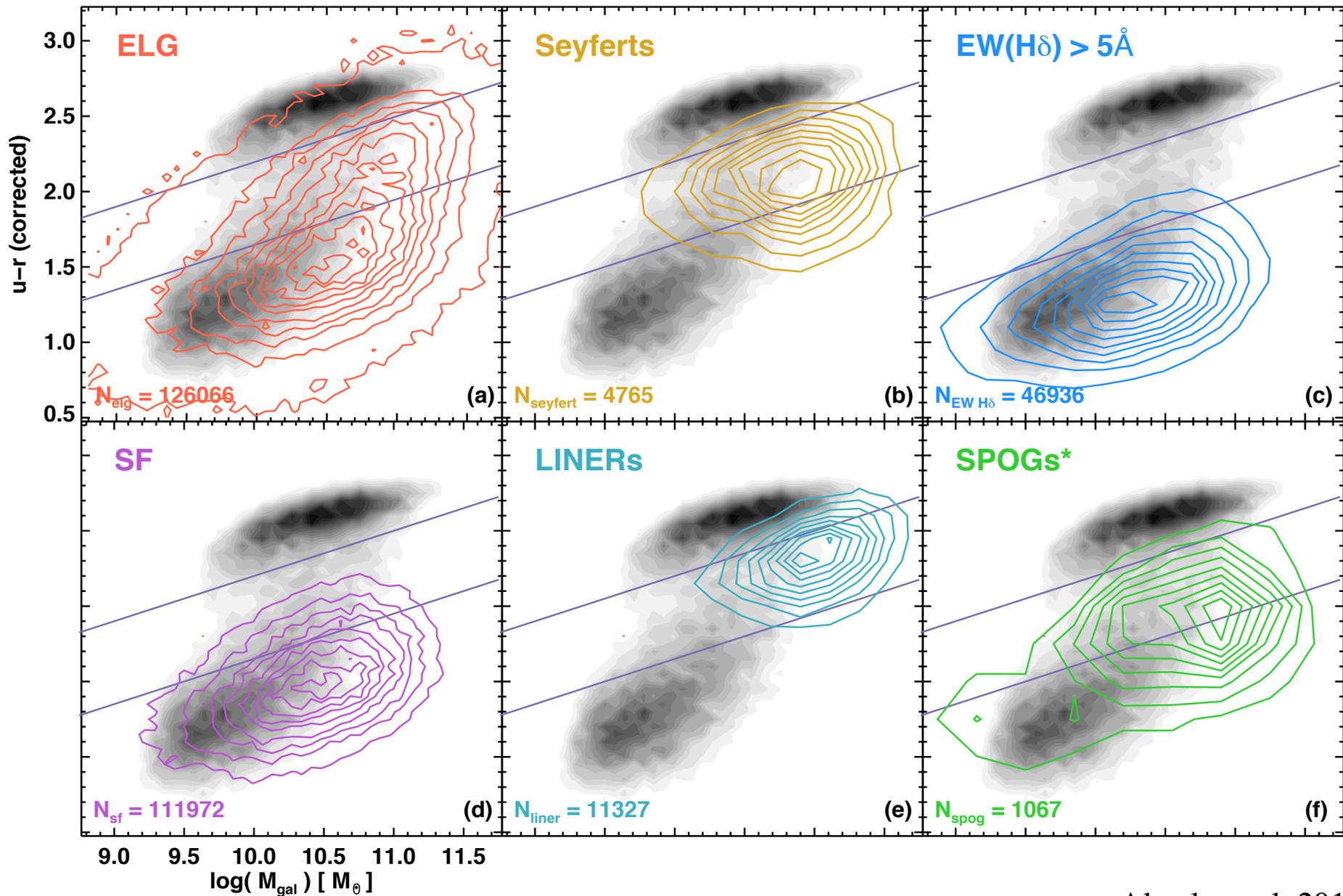
shocked ionized gas ratios + poststarburst stellar population

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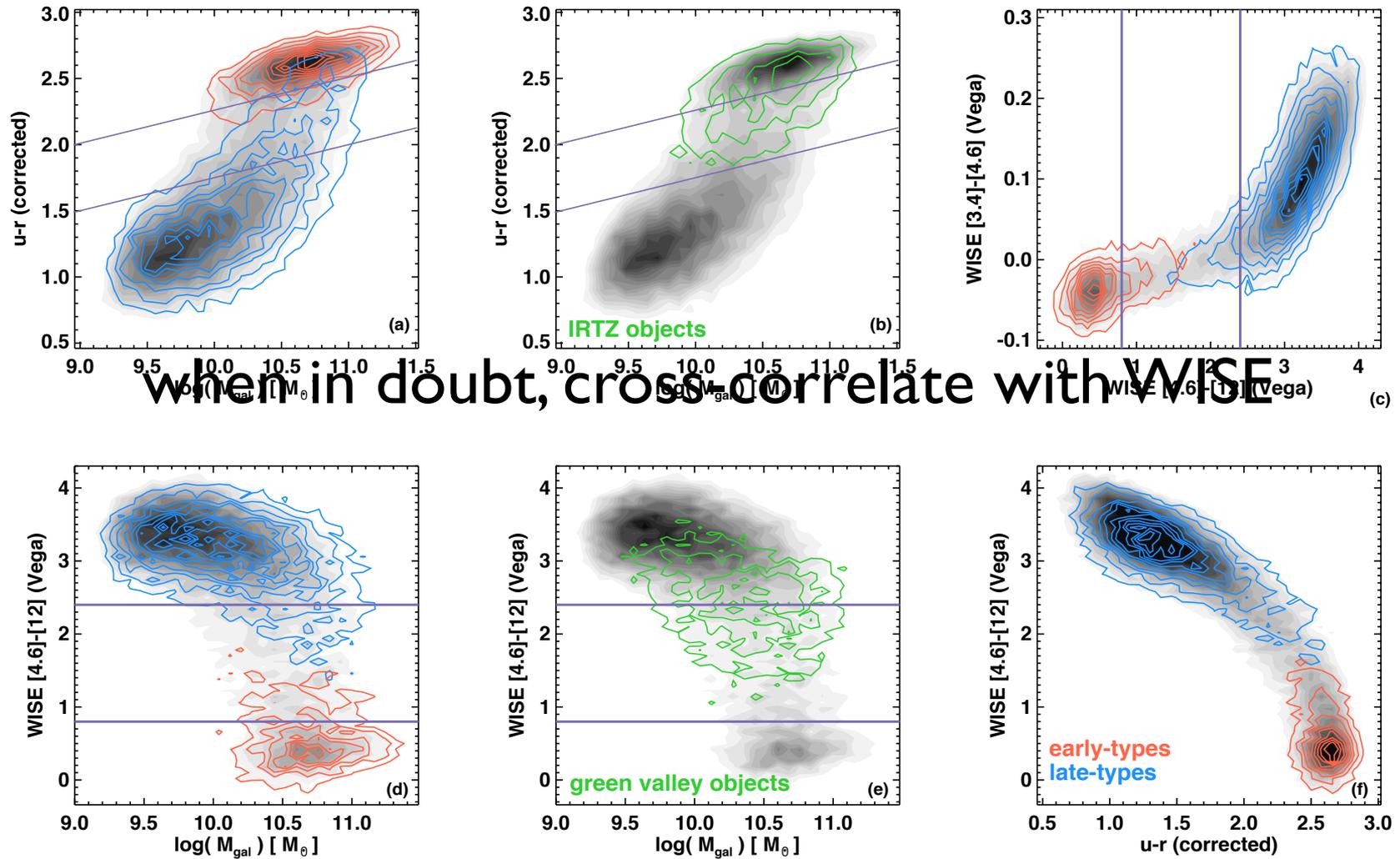
a Shocked Poststarburst Galaxy (SPOG)

NGC 1266 is a SPOG.

SPOGS: the first results

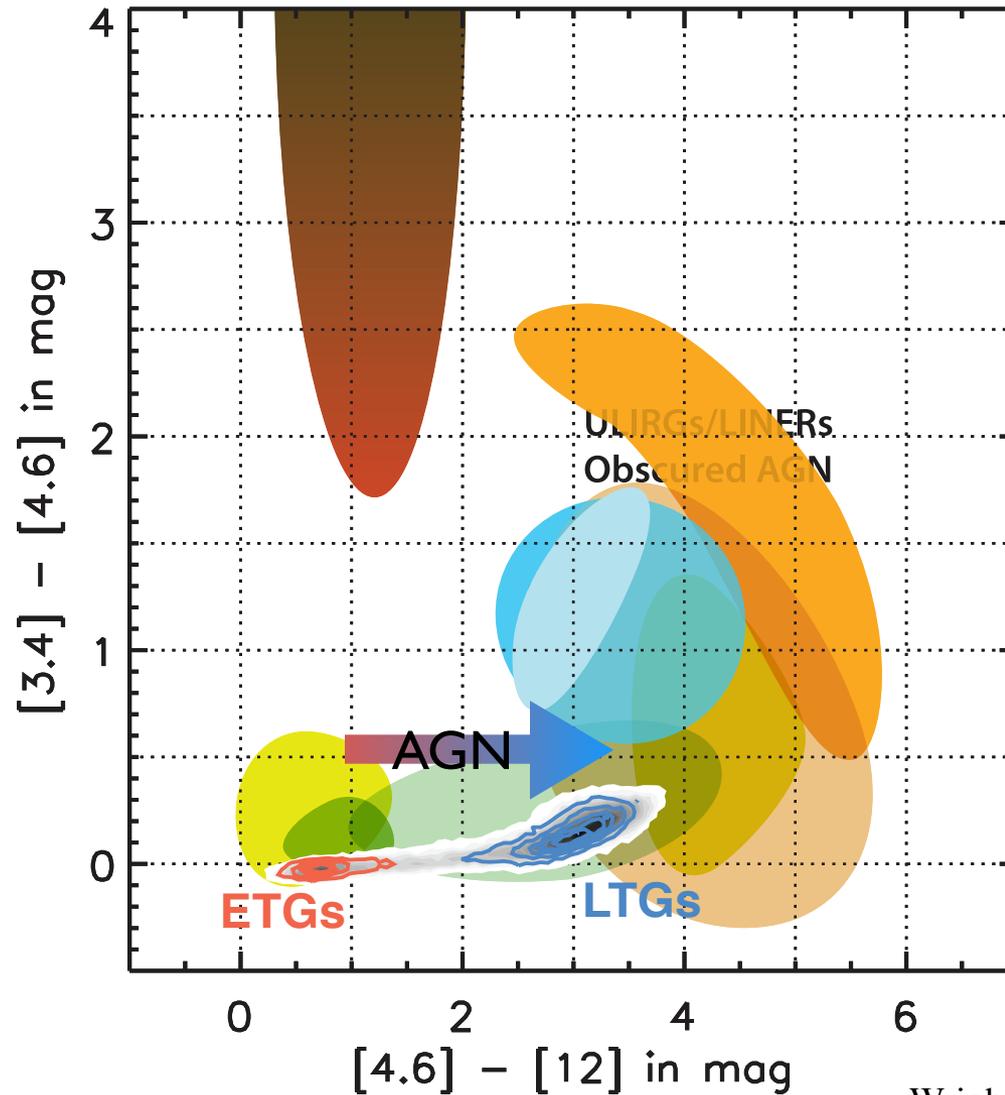


The unexpected



The WISE Infrared Transition Zone (IRTZ); Alatalo et al. 2014b, Schawinski et al. 2014

What do these WISE colors mean?



Hickson Compact

Groups:

*Galaxy evolution on
steroids*

group interactions



Introducing: Hickson Compact groups

HCGs have bimodal IR colors

Color-color plot from Lacy et al. (2004)

Lower left: red ETG HCGs

Upper right: blue spiral HCGs

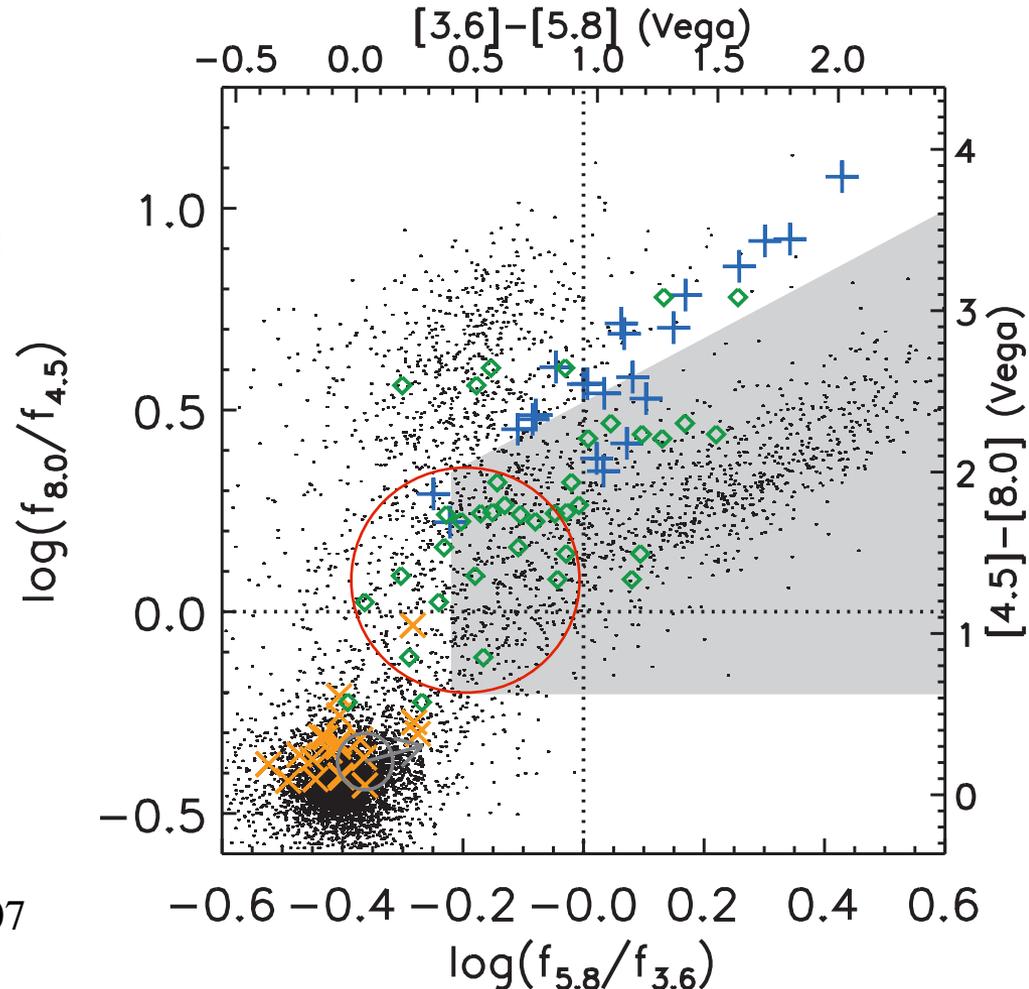
Green: star-forming (non-HCG) galaxies

HCGs show bimodality between red colors (X) and blue colors (+) with very few in the gap

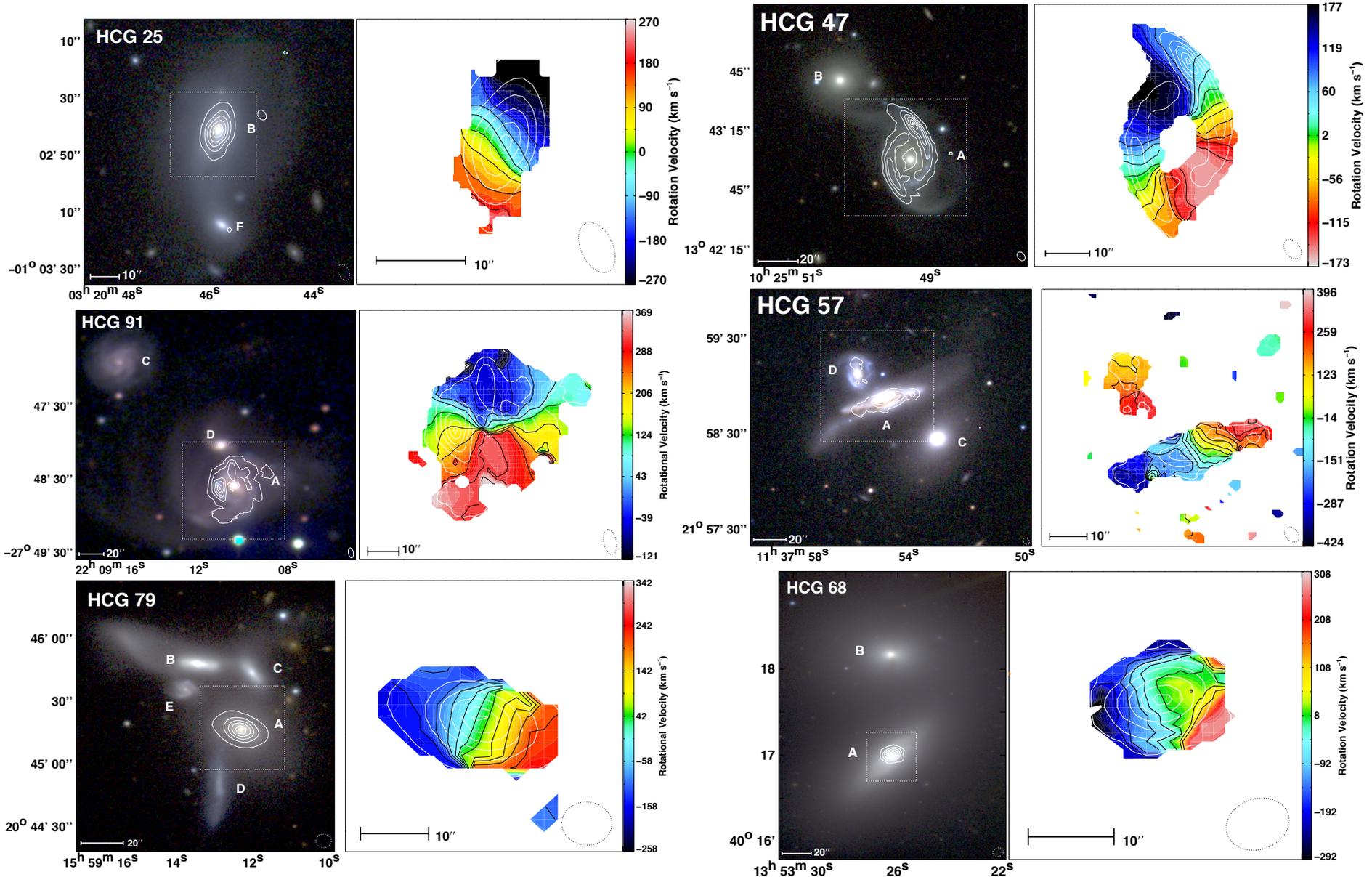
This gap is not as obvious in underlying population

=> rapid evolution in HCGs

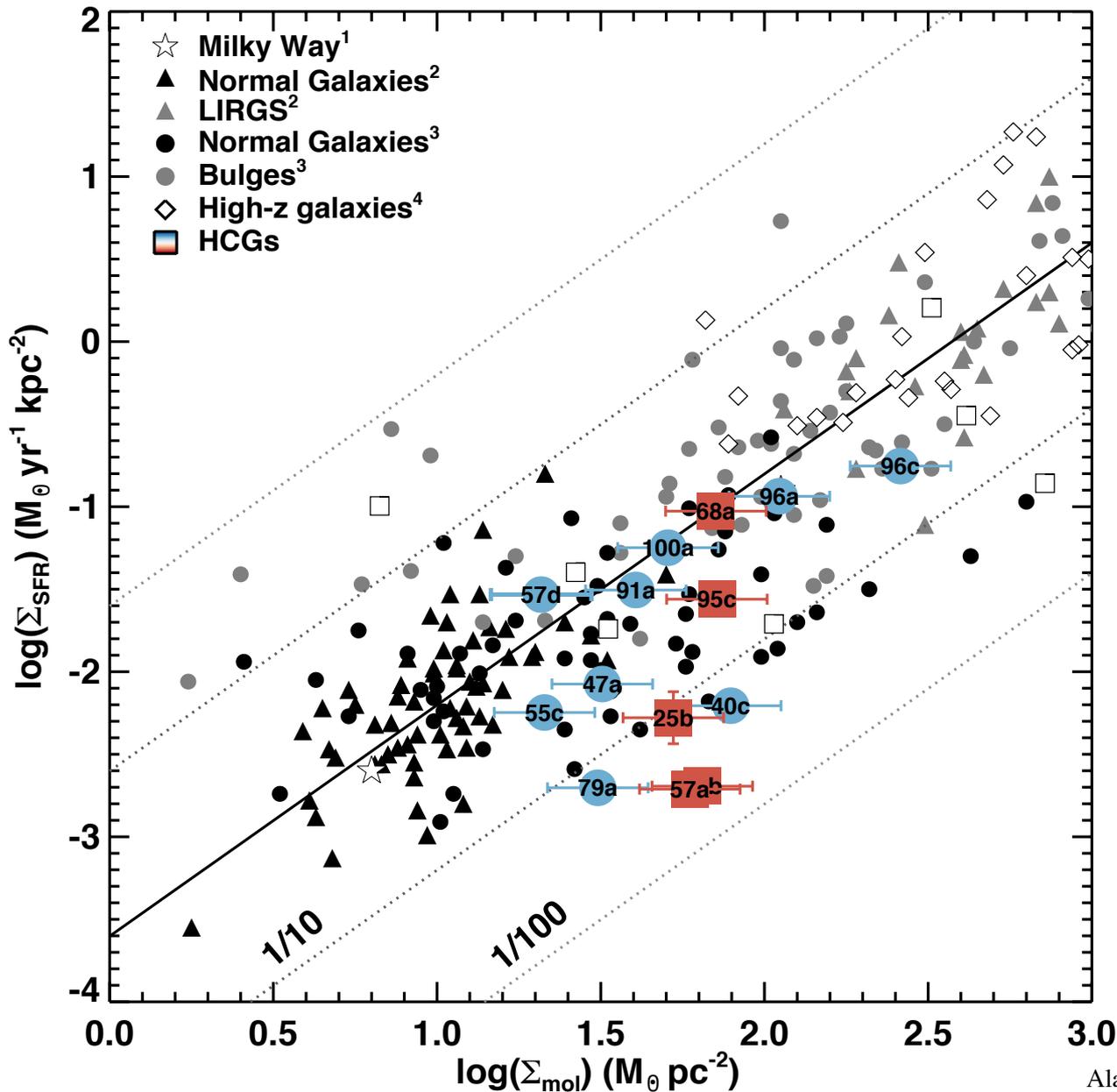
Johnson et al. 2007



CO(I-0) imaging in HCGs

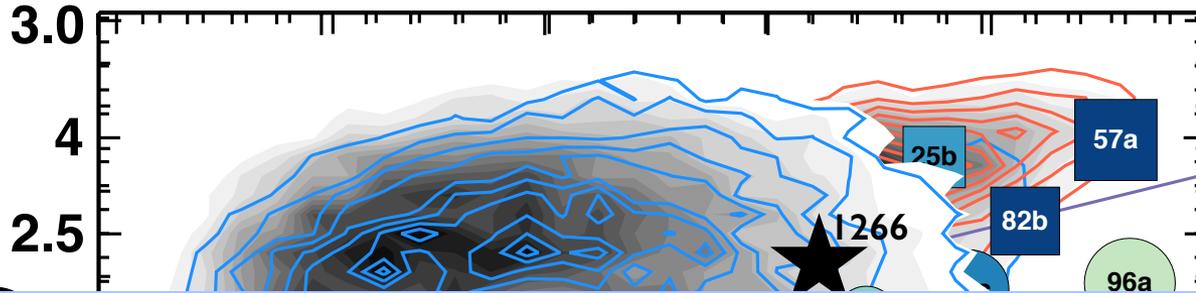


Inhibited star formation?



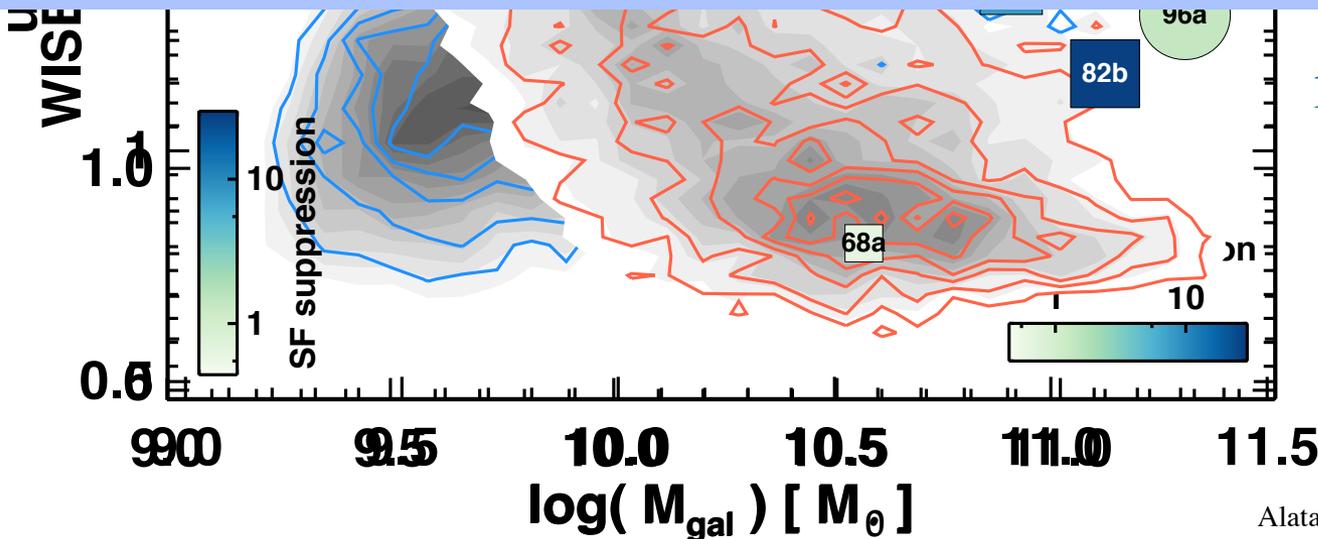
HCG galaxies in our sample seem to be under-producing stars for the amount of existing molecular gas.

SF suppression & a connection to the IRTZ



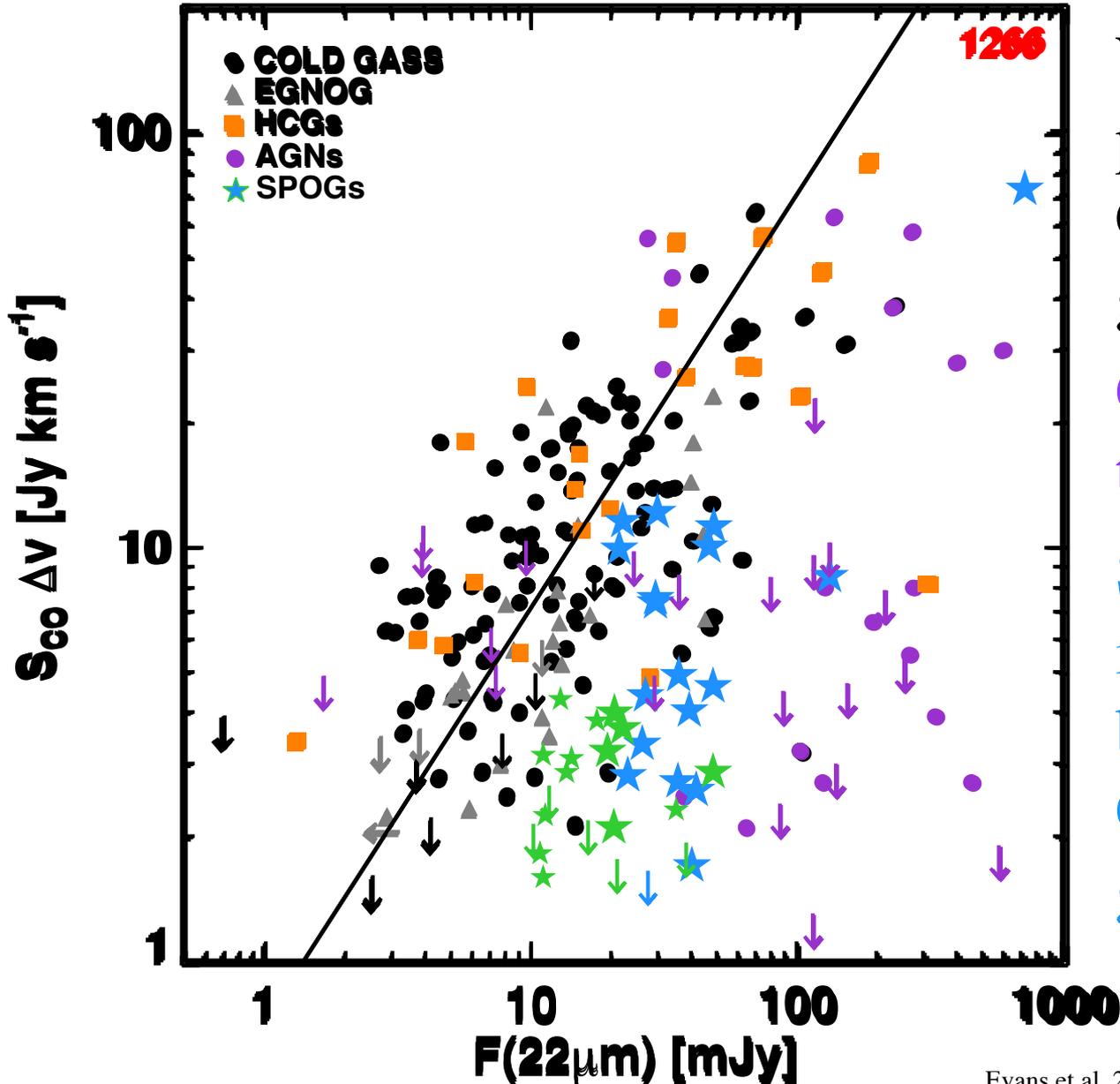
SF suppression in HCGs correlates with WISE colors.

Suggestion of perturbed gas in these transitioning systems?



total amount of molecular gas

WISE in the ALMA era



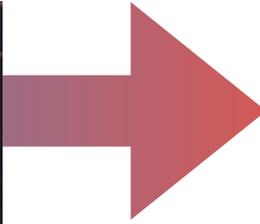
WISE 22 μm can predict the total CO flux for SF galaxies

QSOs fall off of this relationship

SPOGs seem to lie in the region between pure QSOs and SF galaxies

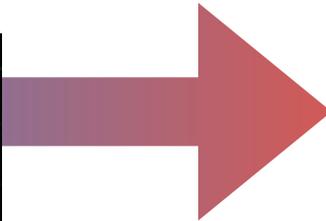
WISE and transitioning galaxies

group interactions



WISE is able to identify objects with SF suppression in HCGs through the W2-W3 color, and is best correlated with that suppression

other



W4 ($22\mu\text{m}$) can predict the molecular gas quite well in star forming galaxies except in AGNs, but can also identify the intermediate objects between SF and QSOs in a $22\mu\text{m} - S_{\text{CO}}$ plane

conclusions

When searching for new types of paths from spiral to ETG, serendipity helps (NGC 1266)

We are able to use the presence of a poststarburst stellar population plus shocked molecular gas to identify other galaxies like NGC 1266: spogs.

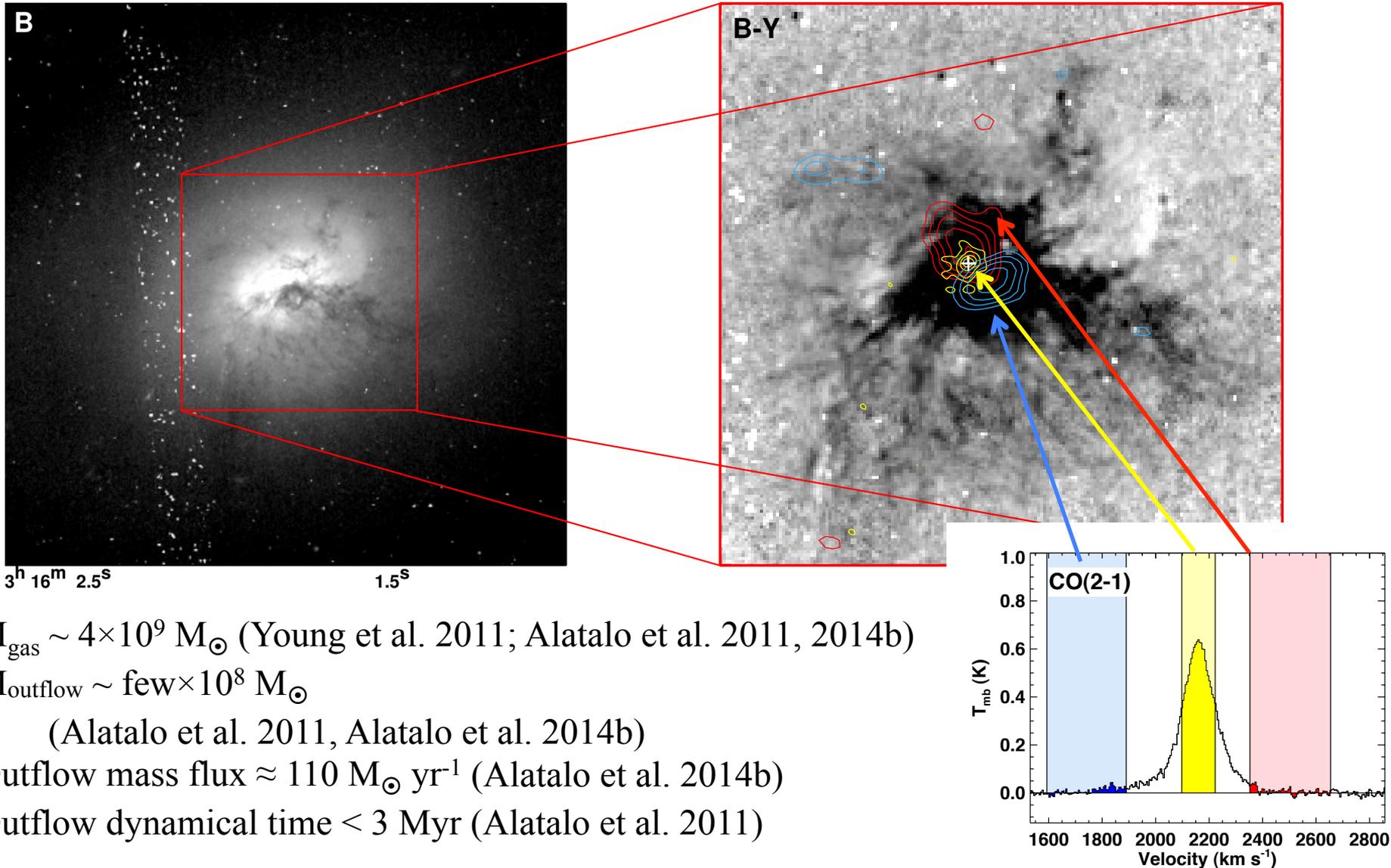
The selection from SPOGS identified transitioning objects, but also showed us a new lens through which to view transitions (the WISE IRTZ)

The IRTZ seems to identify galaxies in HCGs with suppressed SF, independent of the molecular gas mass

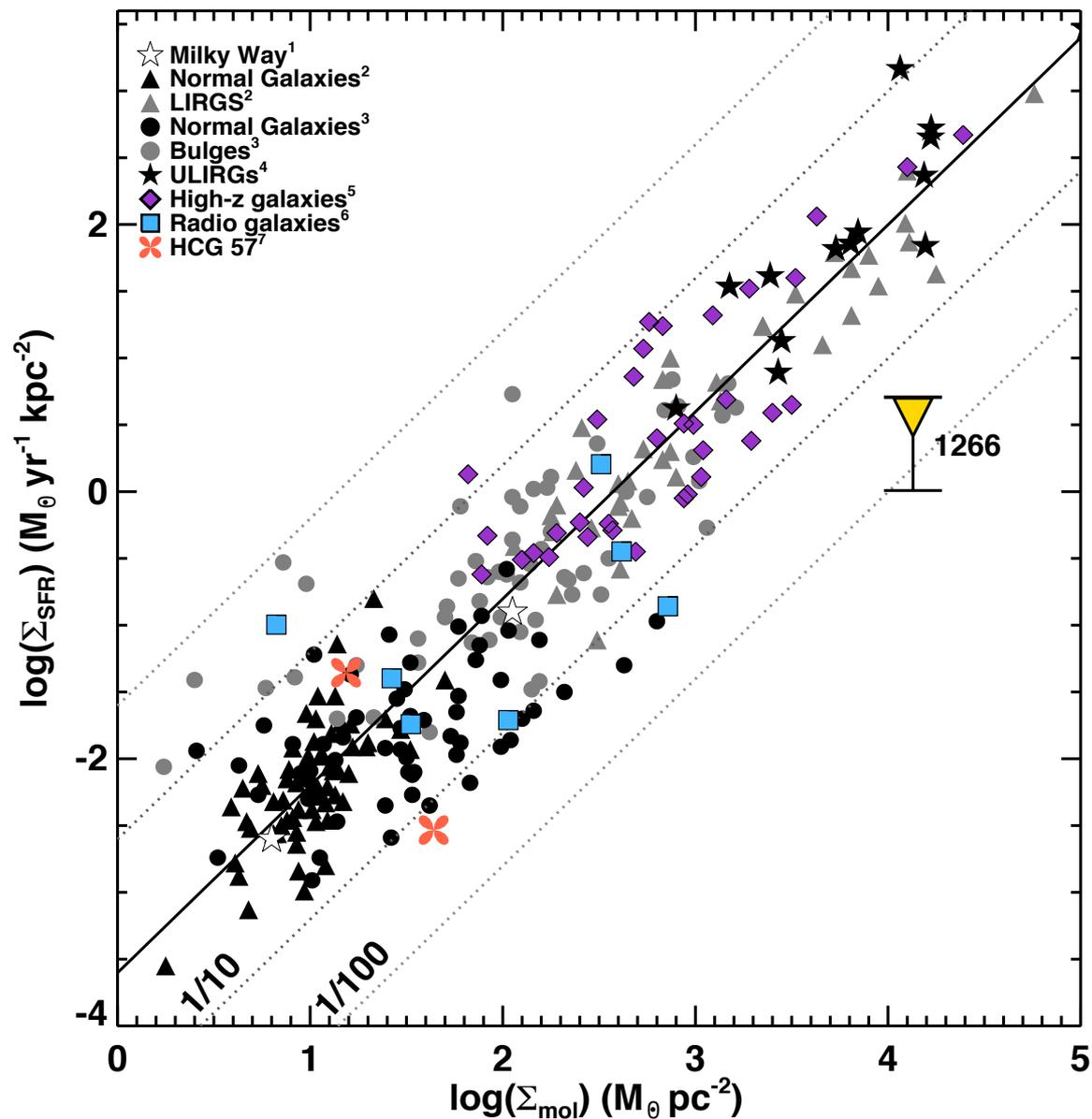
The WISE 22 μ m emission is able to predict the total CO flux in SF galaxies and identify those that are undergoing a transition (as SPOGs are predicted to be undergoing), or have intermediate luminosity AGNs.

WISE data has only just begun to be mined in search of new discoveries, and this is just a small window into them through a transitioning galaxy lens.

NGC 1266: a massive molecular outflow host



In NGC 1266, SF is suppressed



Hickson Compact Groups

“By *compact group*, we mean a small, relatively isolated system of typically four or five galaxies in close proximity to one another.”

Hickson 1997 ARA&A 35, 357

High fraction of E/S0

Evidence of tidal interactions

High density, low σ_v

Generally deficient in H I

