

Do AGN Lurk in Special Galaxies Caught in the Early Stages of Transition?



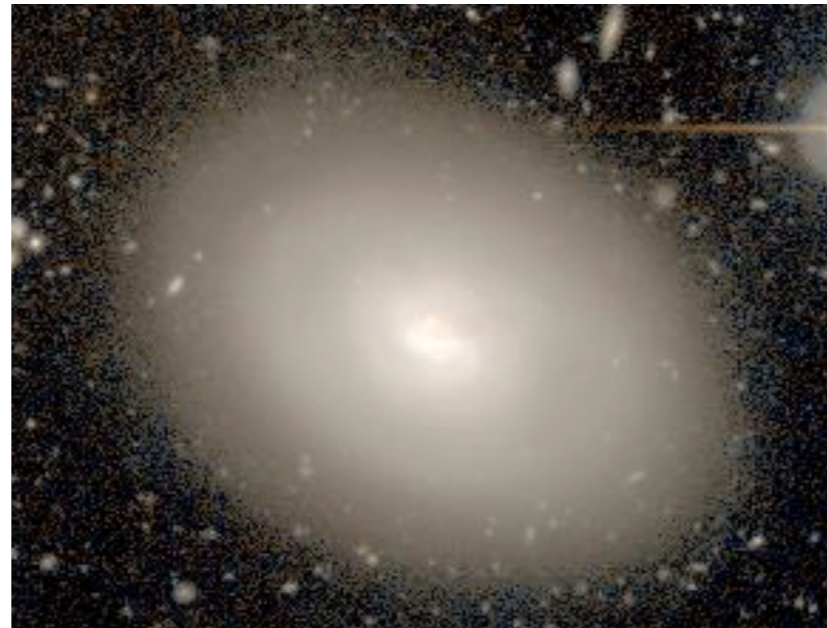
Lauranne Lanz
Dartmouth College

In Collaboration with: Katherine Alatalo, Ryan Hickox
Andy Goulding, Phil Appleton, Patrick Ogle, Kristina Nyland, Murray Brightman, Mark Lacy

Catching Galaxies in Transition



**Actively
Star-forming**



**Transition
Mergers and
Secular Evolution**



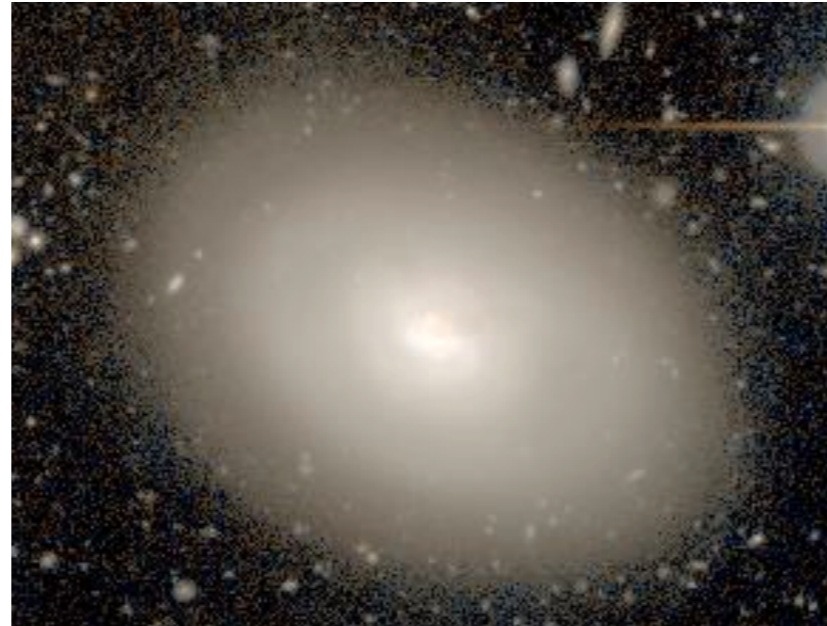
Quiescent

Are there AGN during this Phase?

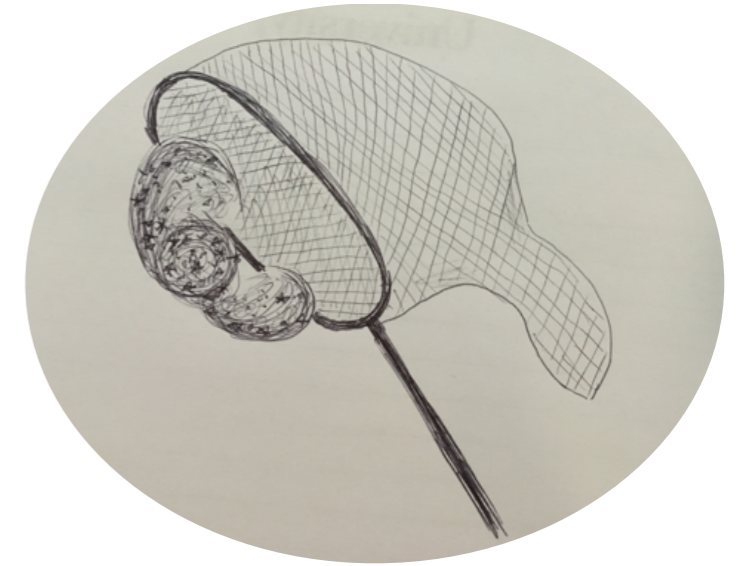
Does the Activity of these AGN Matter?

Under what Conditions are there AGN that Matter?

Catching Galaxies in Transition



Credit: APOD/ATLAS3D



Credit: McKinley Brumback

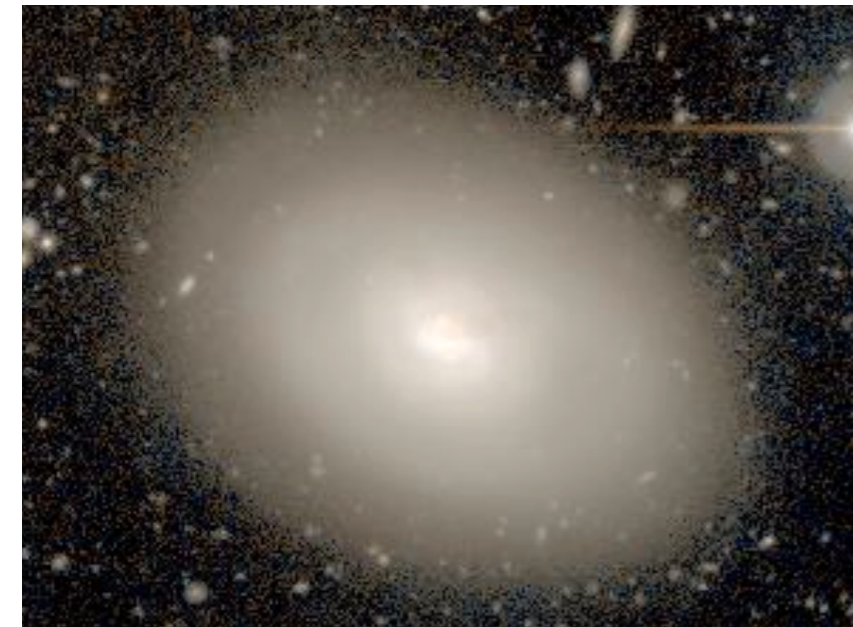
Transition
Mergers and
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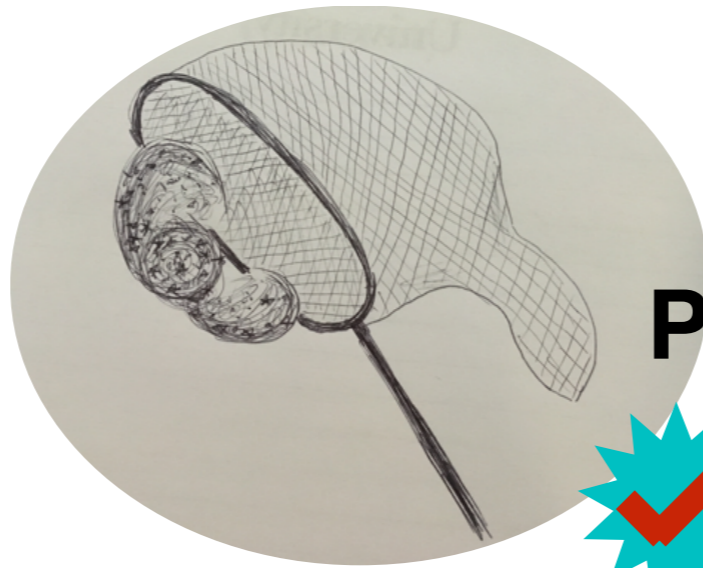
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Catching Galaxies in Transition

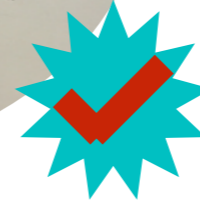


Credit: APOD/ATLAS3D



Credit: McKinley Brumback

Post-Starburst Galaxies



A-star stellar population

+



E+A: Absence of SF emission lines

Catching Galaxies in Transition

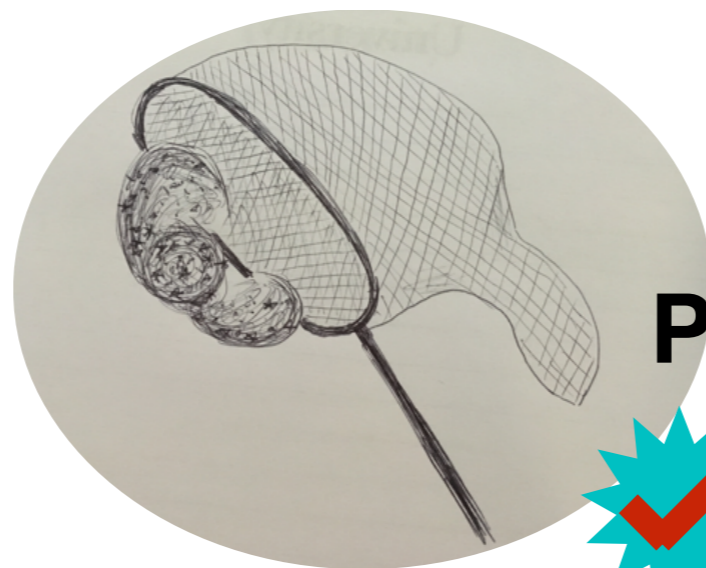
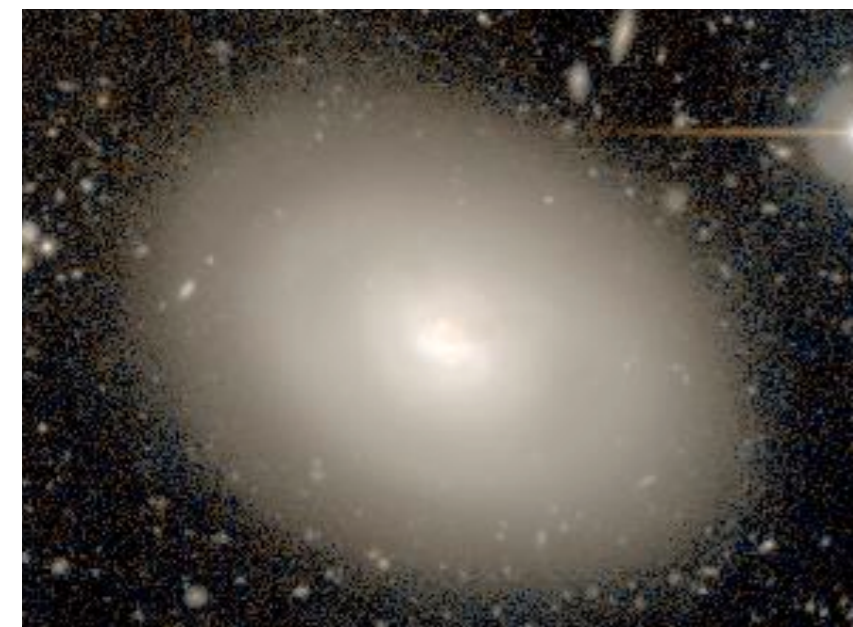
SPOGs

**Shocked
Post-Starburst Galaxies**

A-star stellar population

+

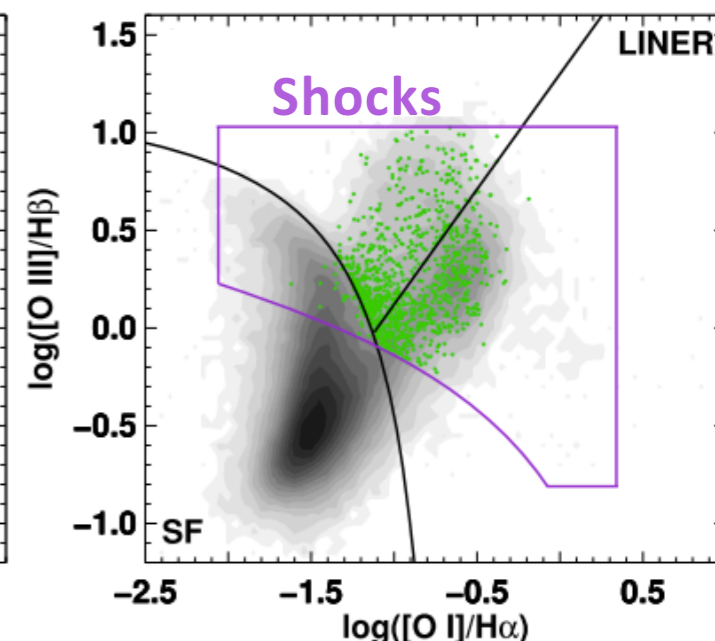
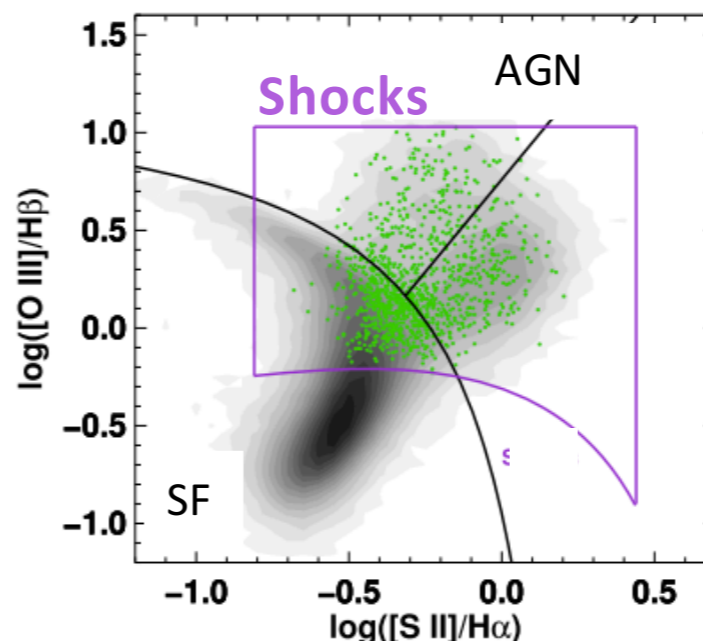
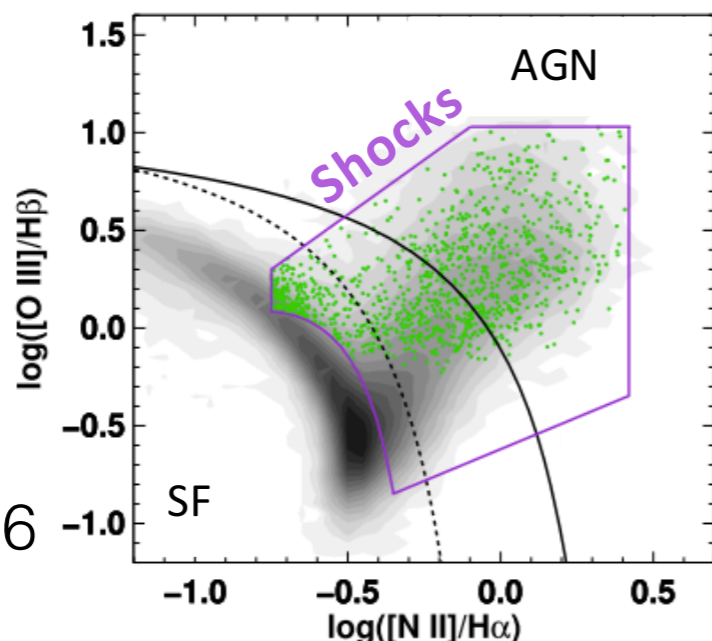
Larger Range of Ionized Gas Emission



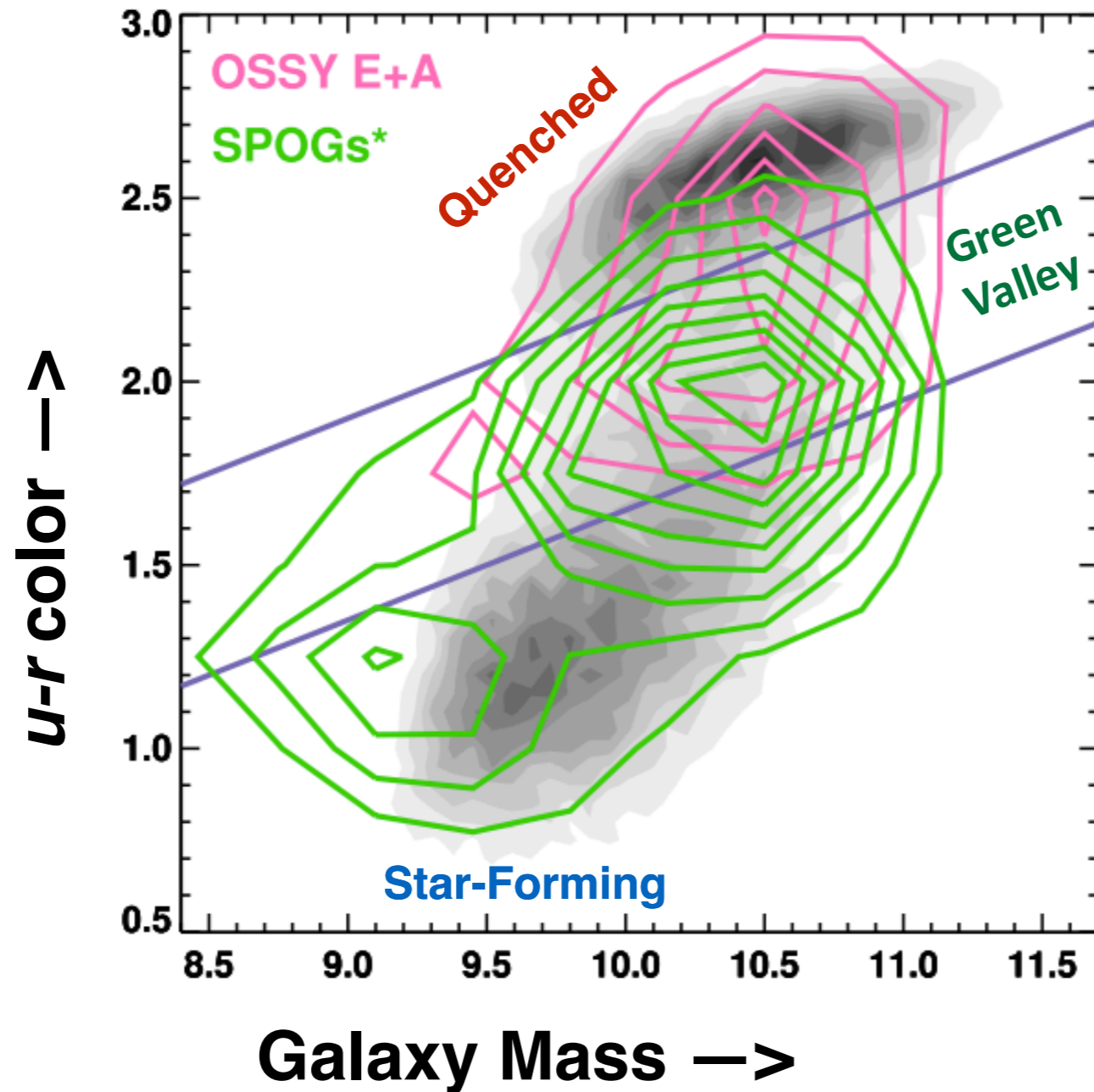
Credit: McKinley
Brumback



Alatalo, ...,
Lanz et al. 2016



SPOGs: Young Post-Starbursts



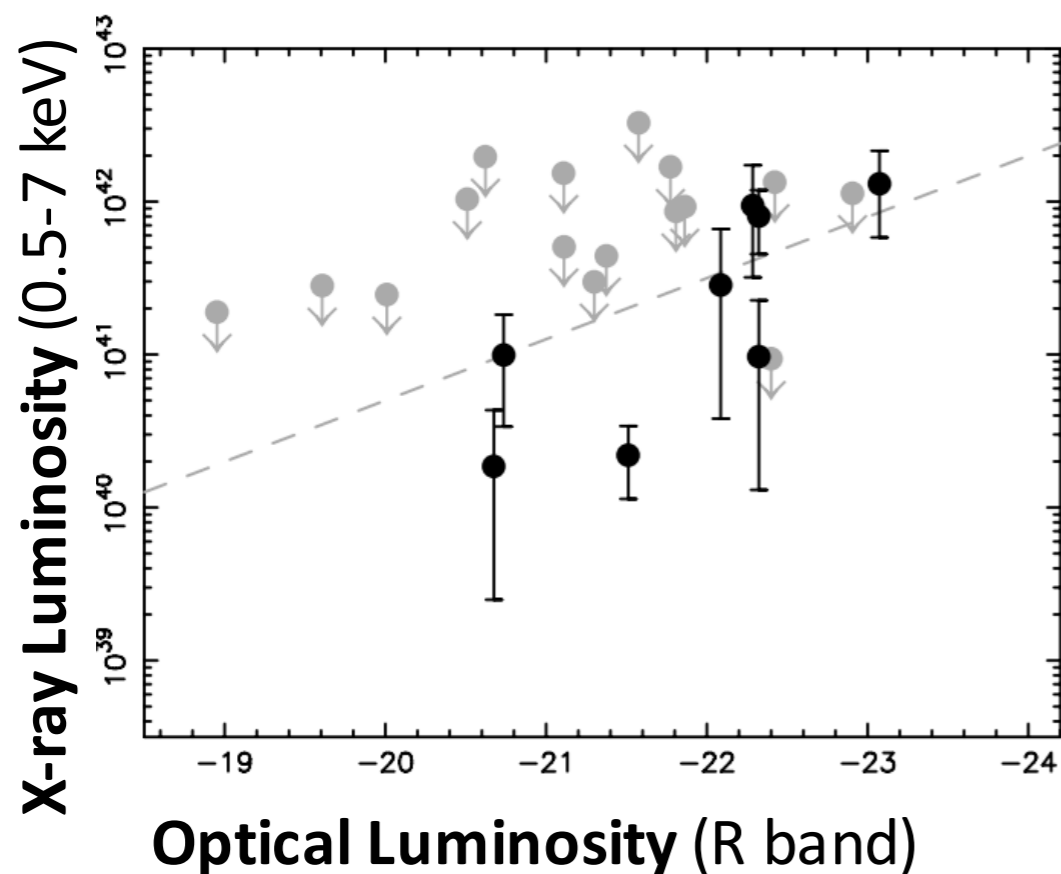
Alatalo, ..., **Lanz** et al. 2016

But am I active???



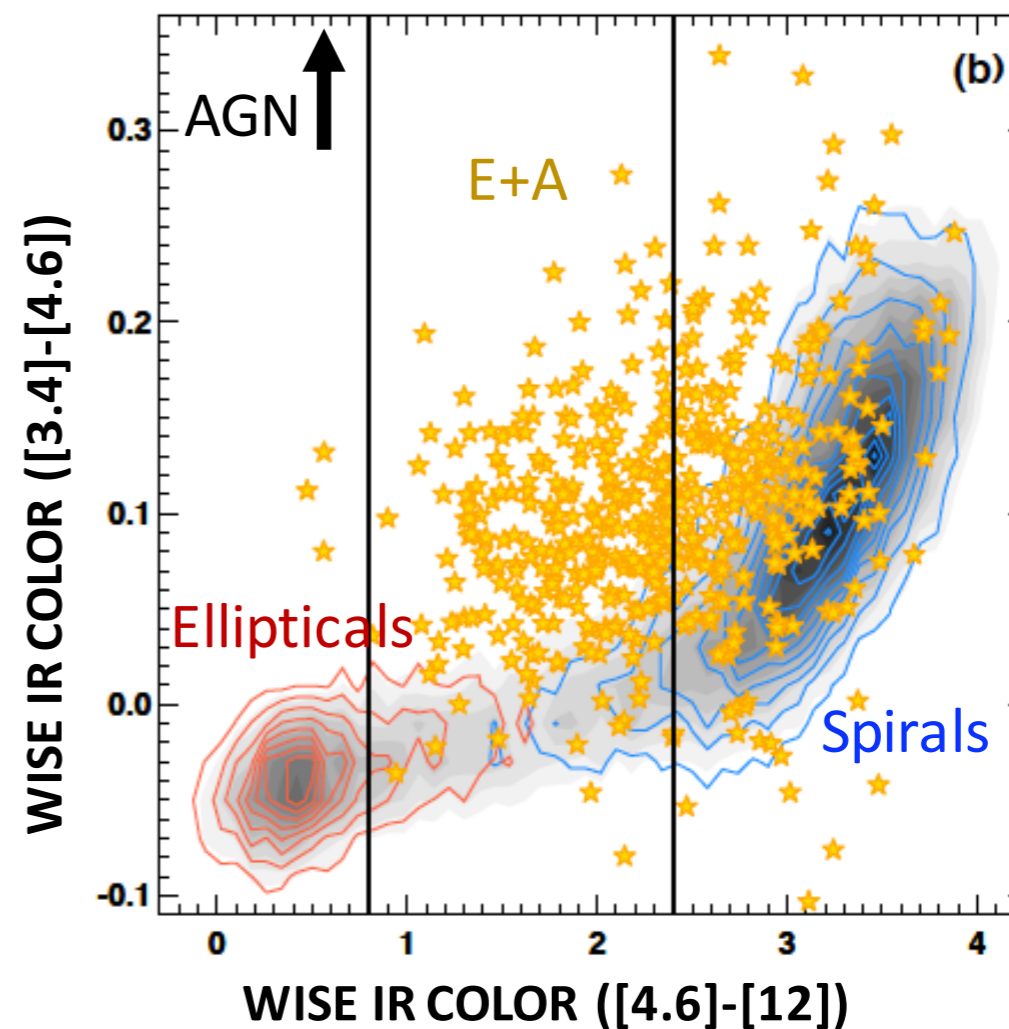
Credit: [butterflyLove1.etsy.com](https://www.etsy.com/shop/butterflyLove1)

AGN in Post-Starburst Galaxies



Brown et al. 2009

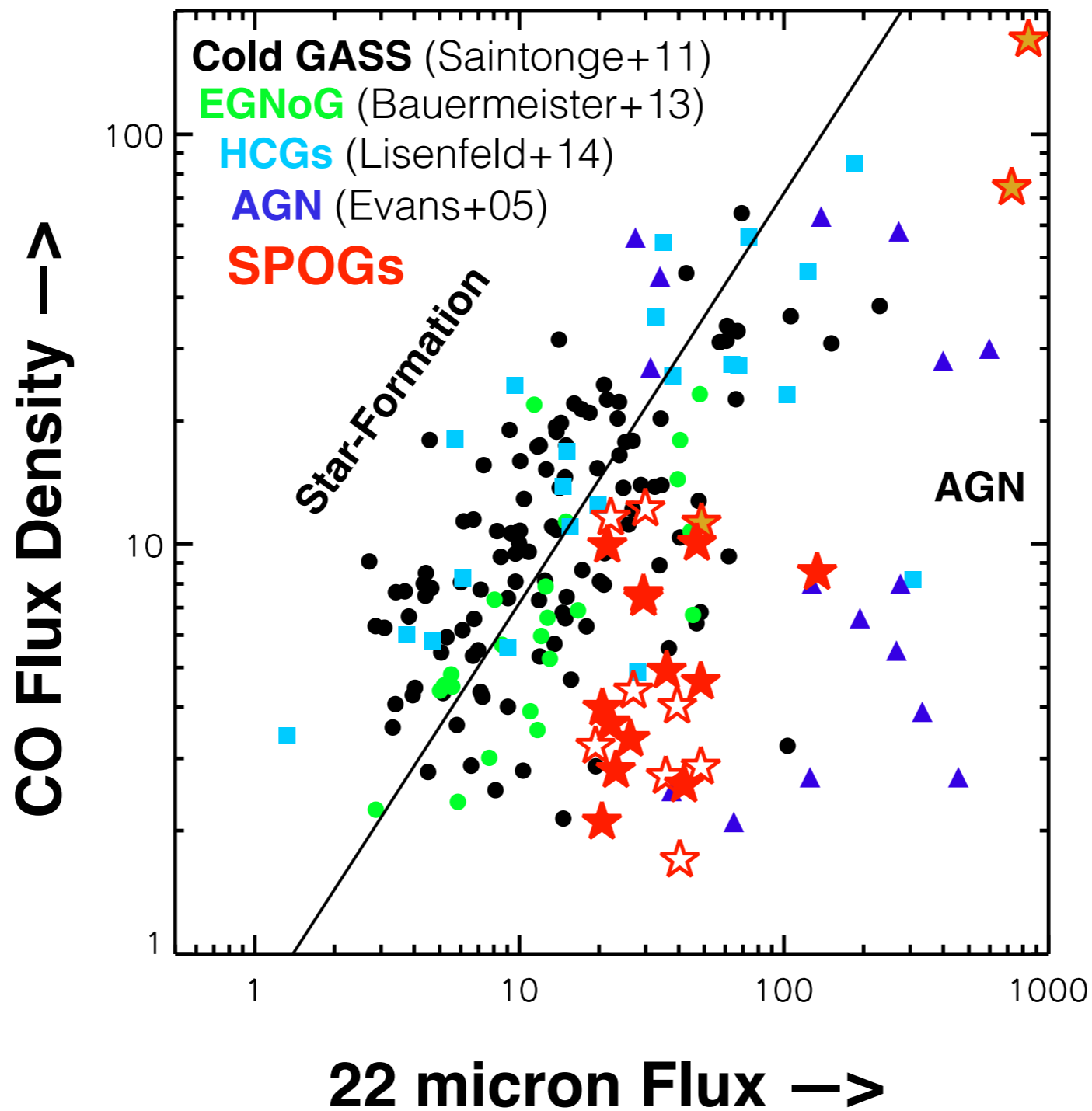
AGN in Post-Starbursts
are common!



Alatalo, Bitsakis, **Lanz**, et al. 2017

AGN in Post-Starbursts
are rare!

AGN in Post-starburst Galaxies

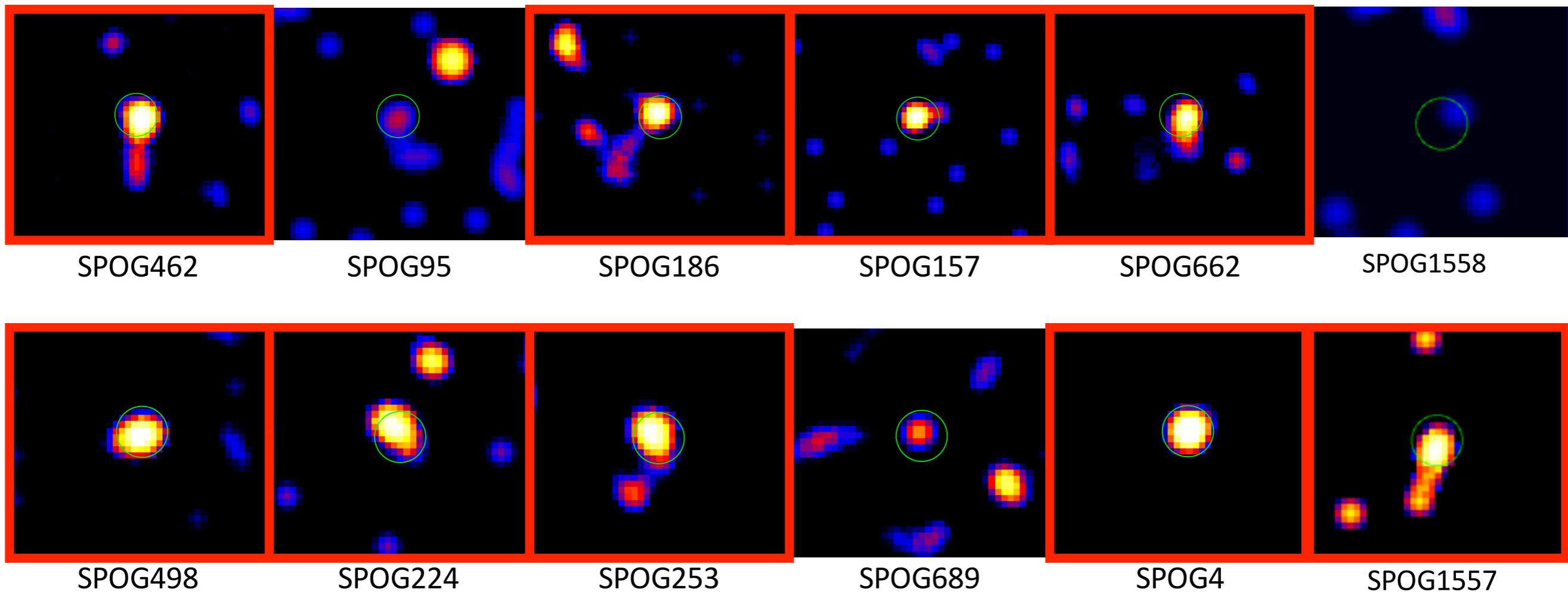


Alatalo, Lisenfeld, Lanz et al. (2016)

AGN in Post-starburst Galaxies



3-10 photons per detection in 10 ks!



Lanz et al. (in prep.)

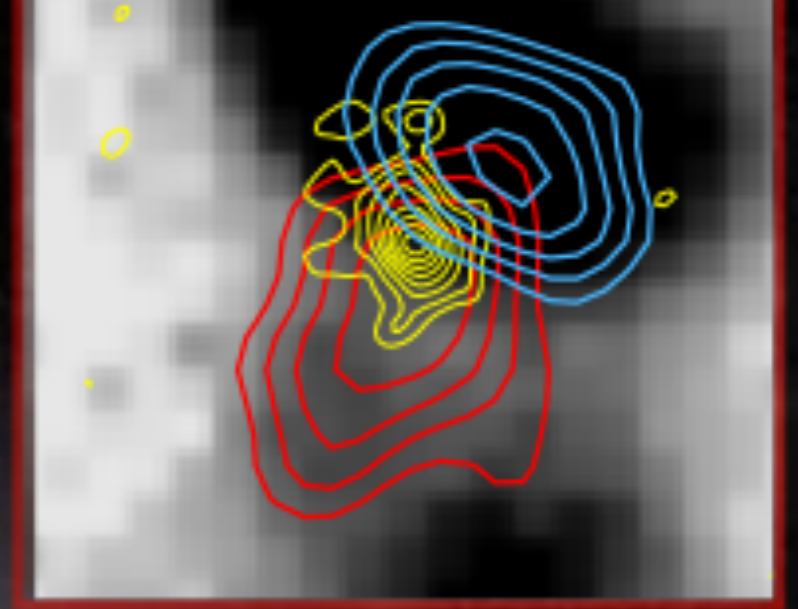
NGC 1266



Alatalo et al. (2011),
Duc et al. (2015)

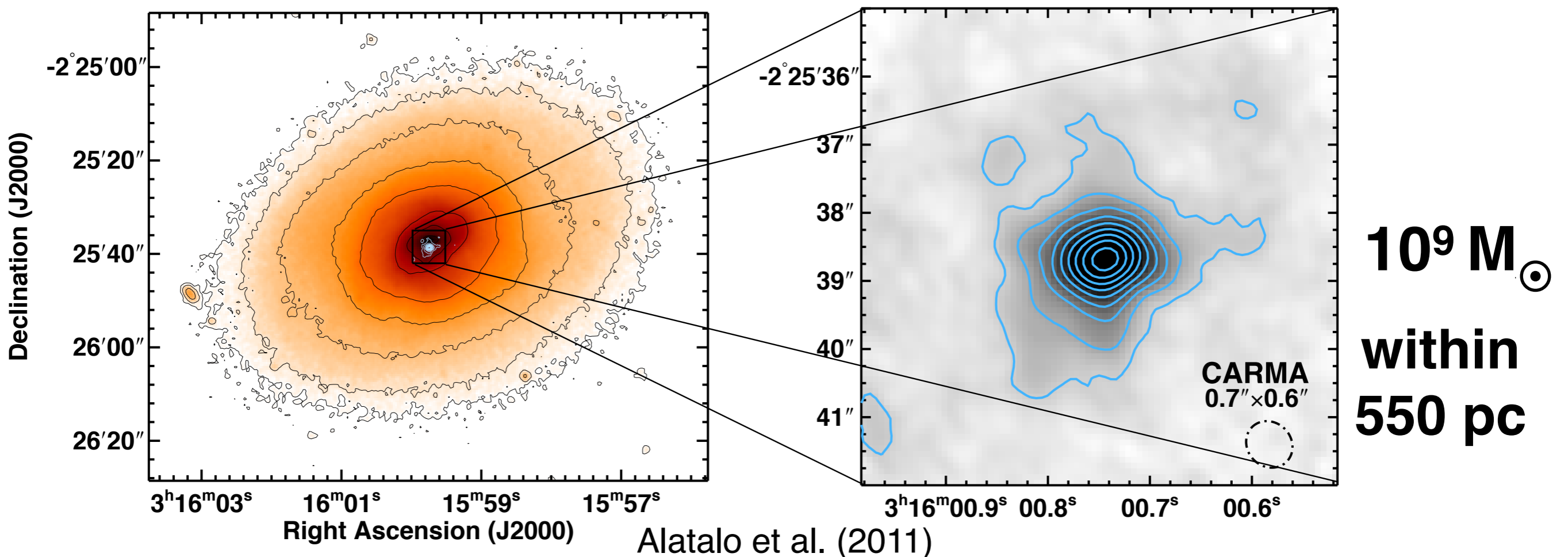
NGC 1266

Outflow-driving,
low-luminosity AGN
with a compact nuclear starburst
surrounded by a very infertile
molecular disk

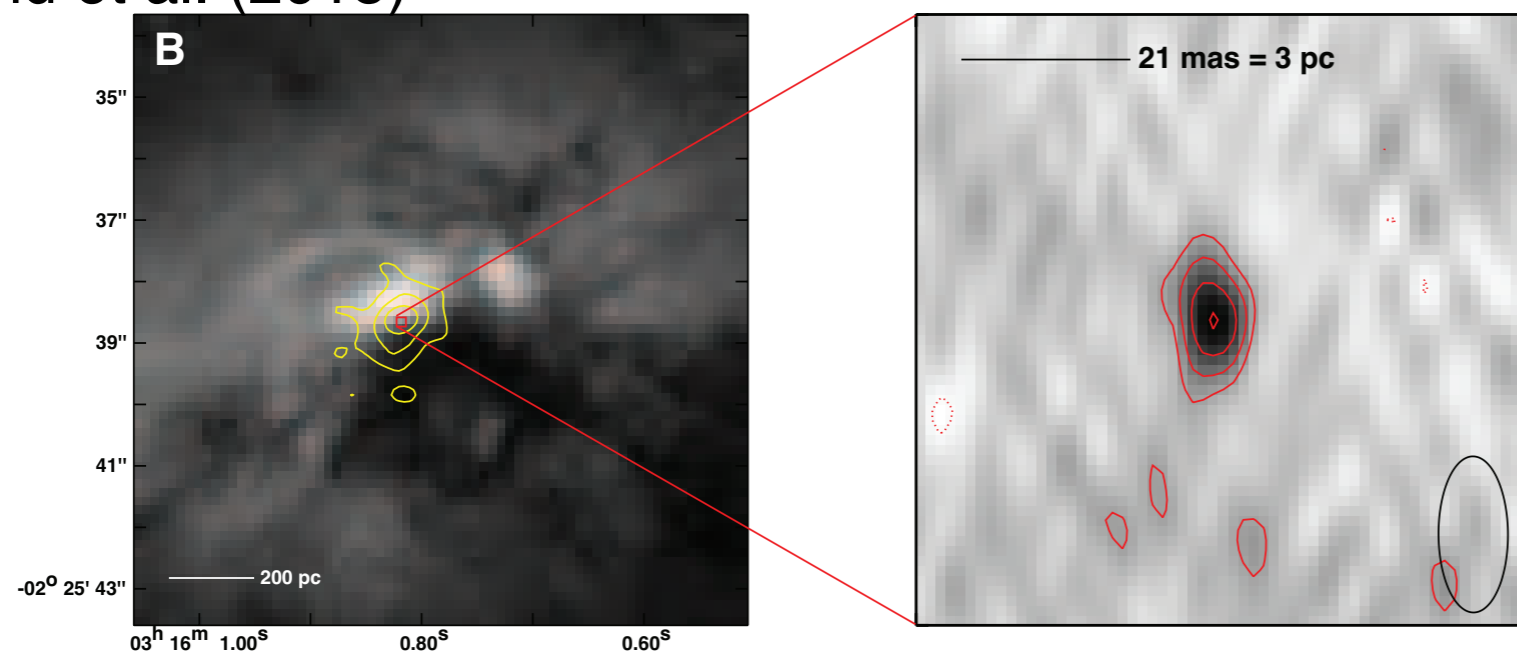


Alatalo et al. (2011),
Duc et al. (2015)

ATLAS-3D: Concentrated Molecular Gas



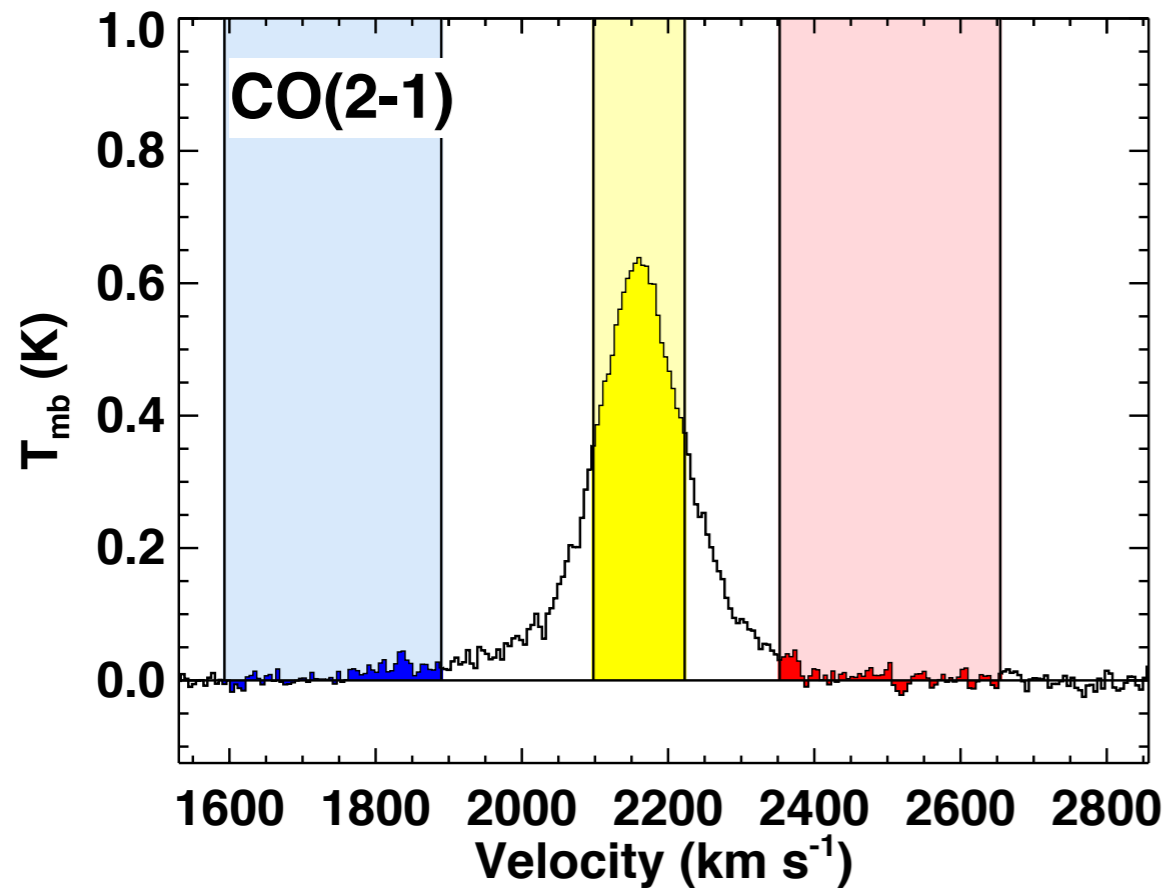
Nyland et al. (2015)



**Average N_H
 $3 \times 10^{24} \text{ cm}^{-2}$**

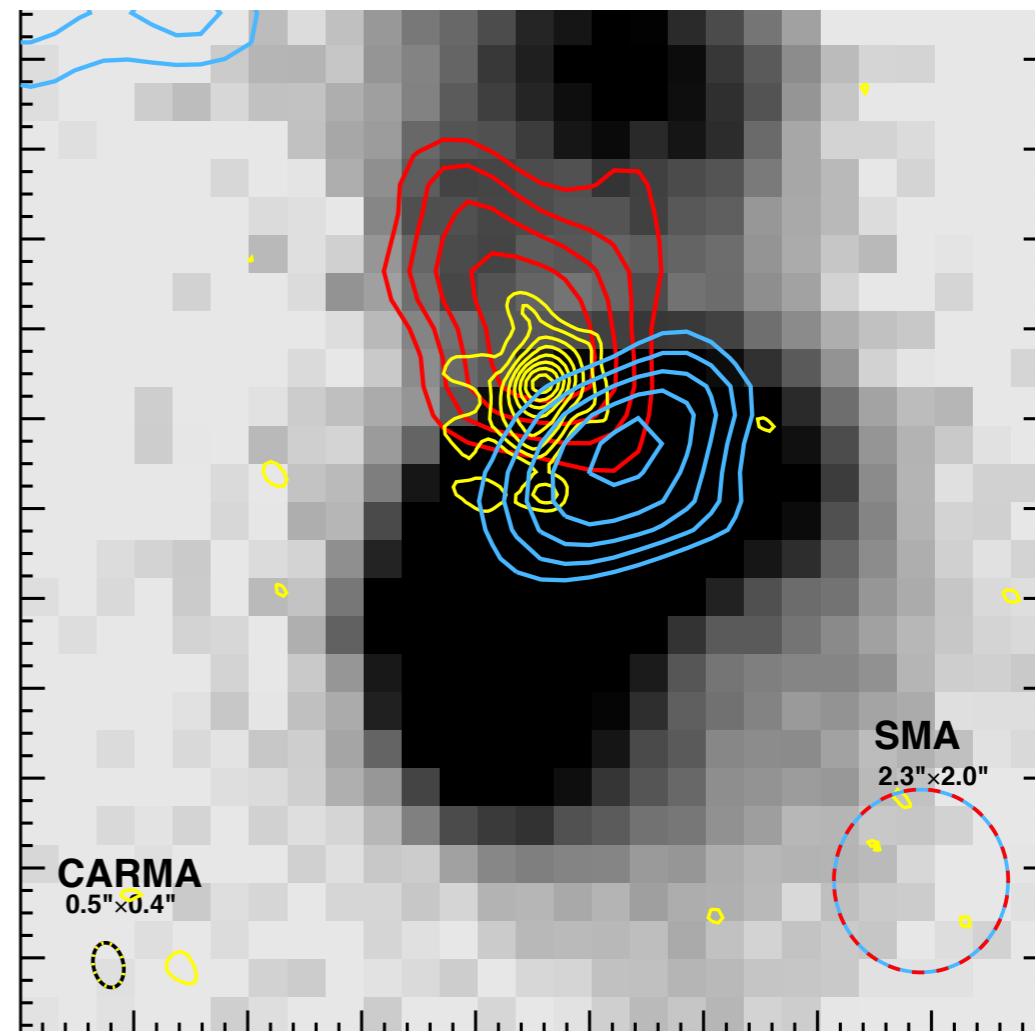


A Massive Outflow, but Very Little Escape



Does the outflow have to be AGN-driven?

YES!

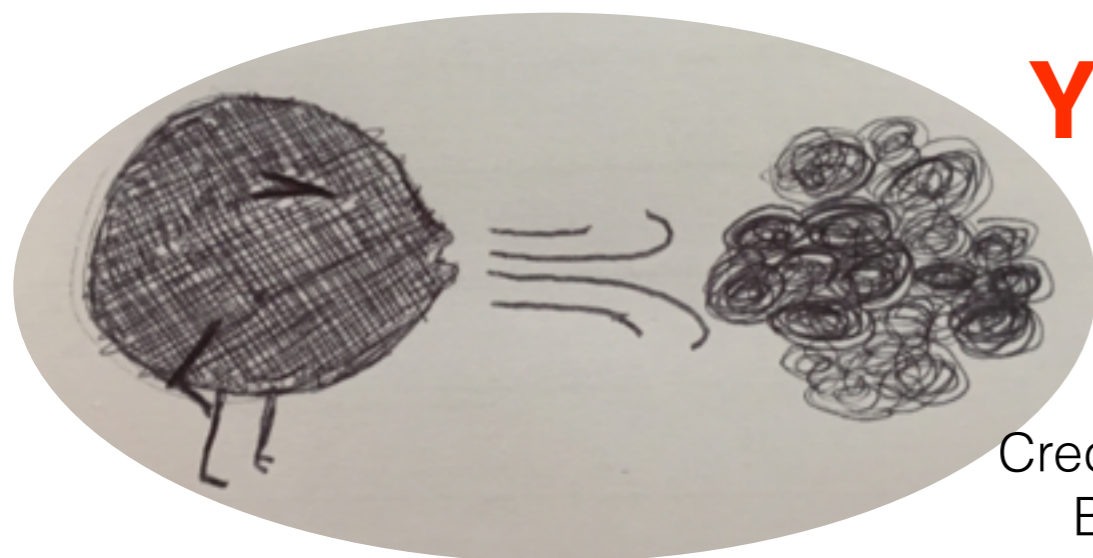


Alatalo, Lacy, Lanz et al. (2015)

Outflow rate: $110 M_{\odot} \text{ yr}^{-1}$

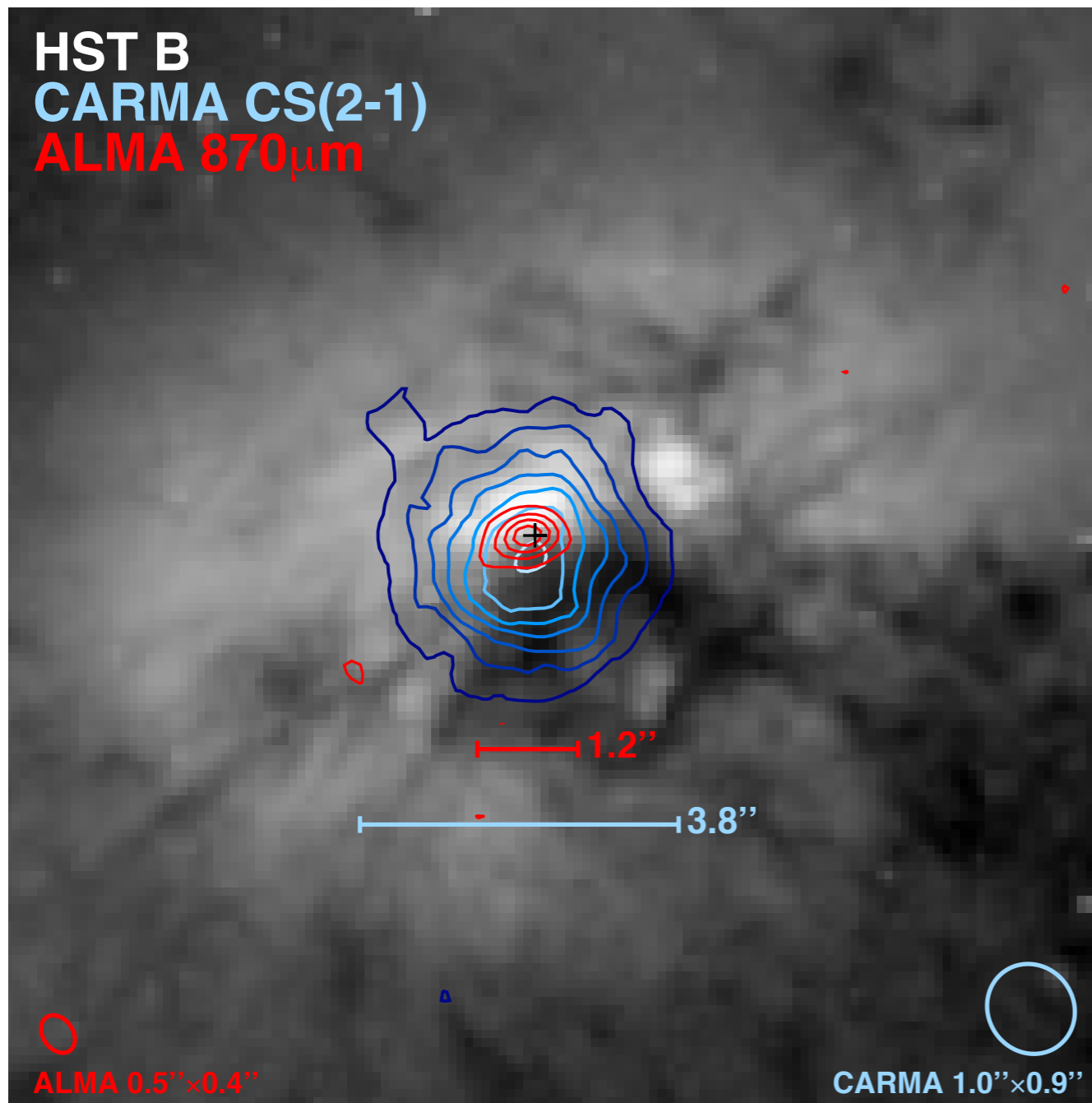
Escape rate: $2 M_{\odot} \text{ yr}^{-1}$

SFR: $1-2 M_{\odot} \text{ yr}^{-1}$

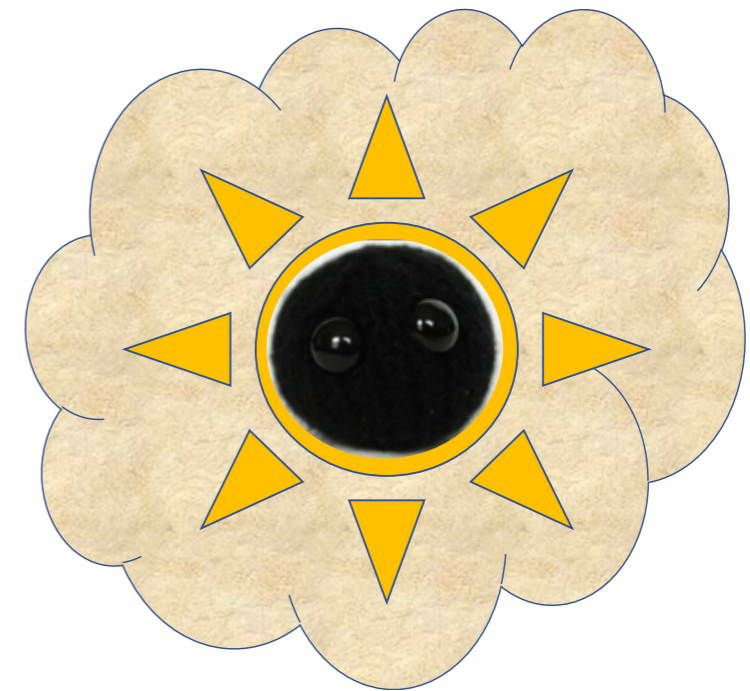


Credit: McKinley Brumback

ALMA resolves much of the FIR emission



Alatalo, Lacy, Lantz et al. (2015)



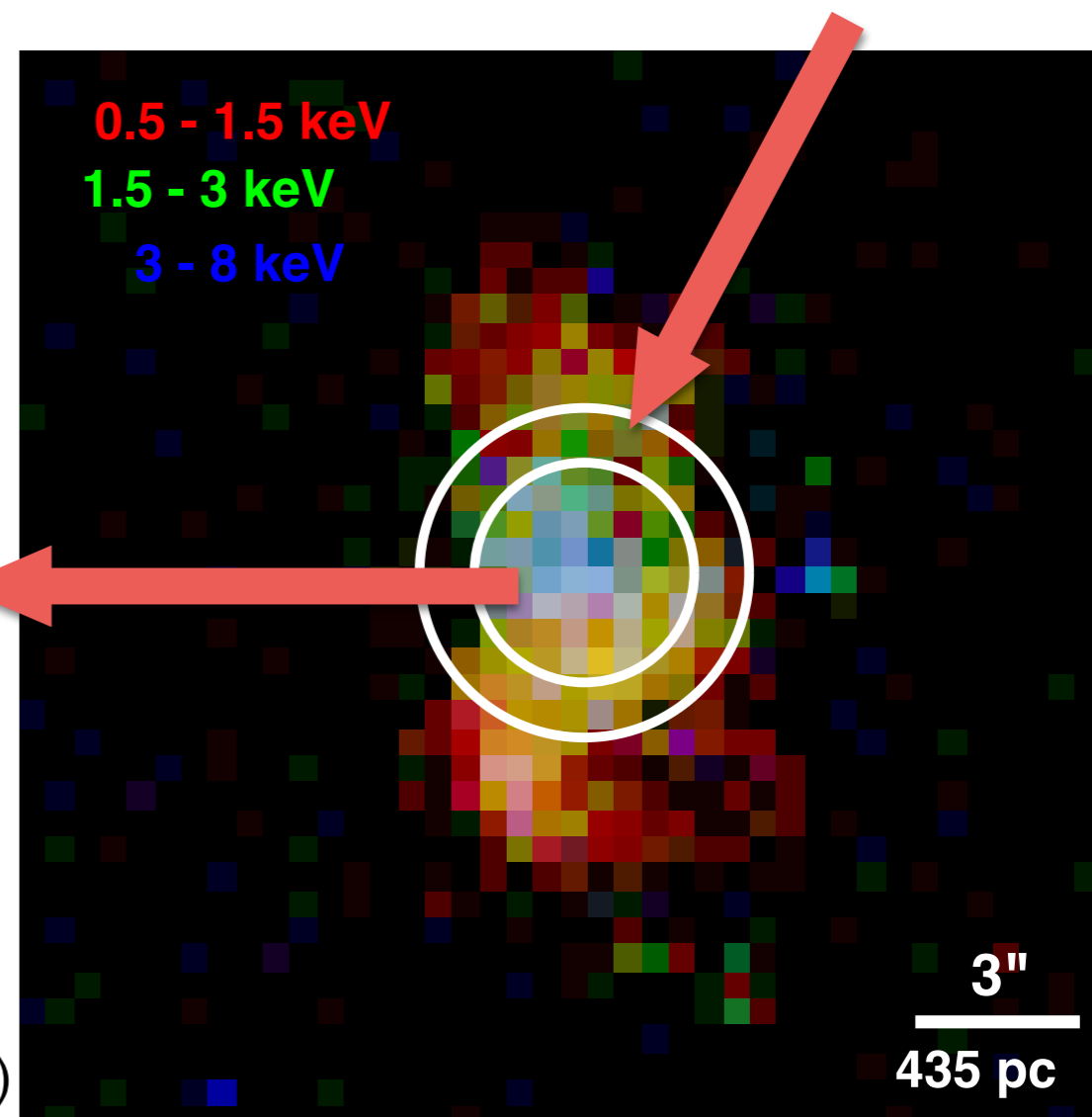
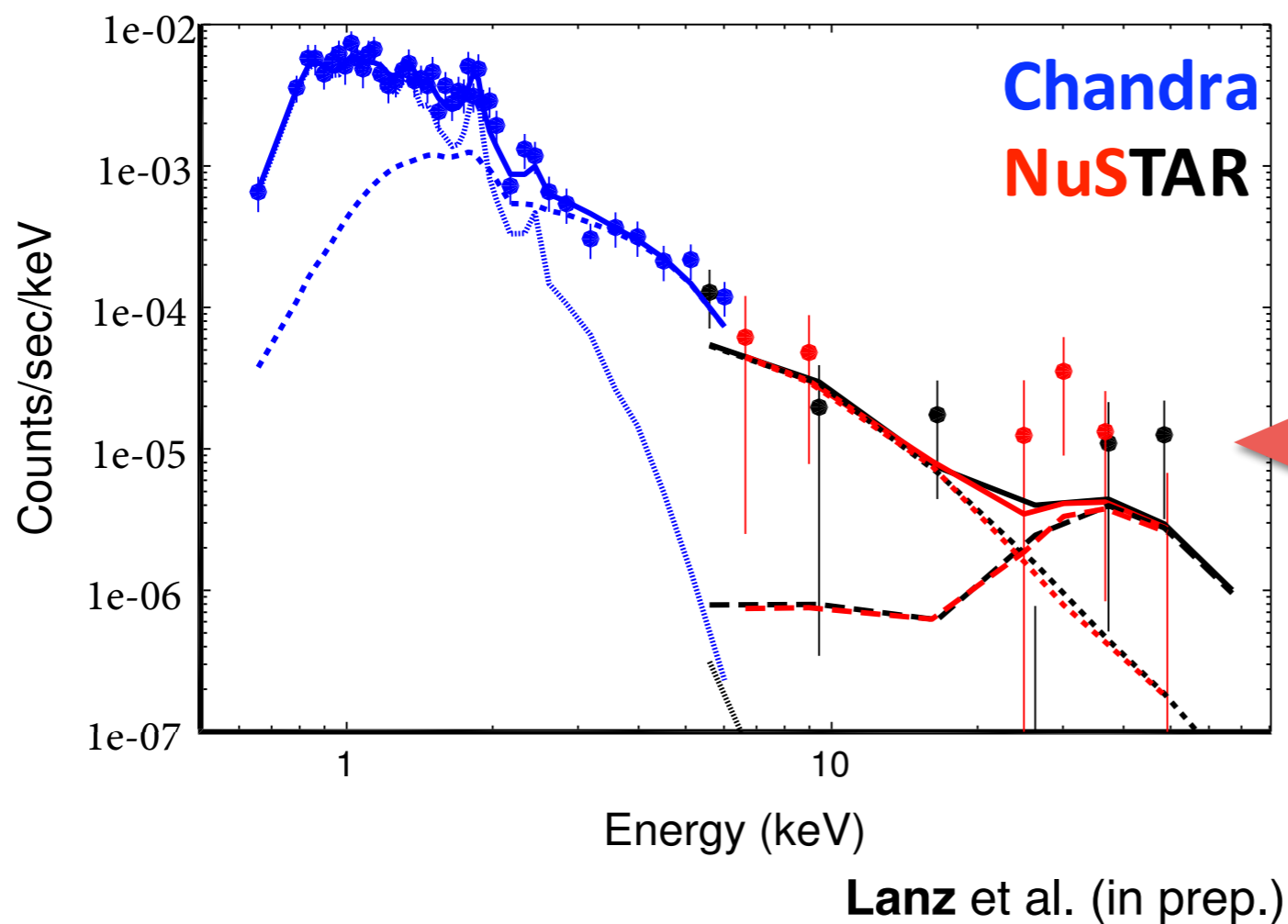
OR

Not to scale!



Chandra and NuSTAR measure the AGN Luminosity

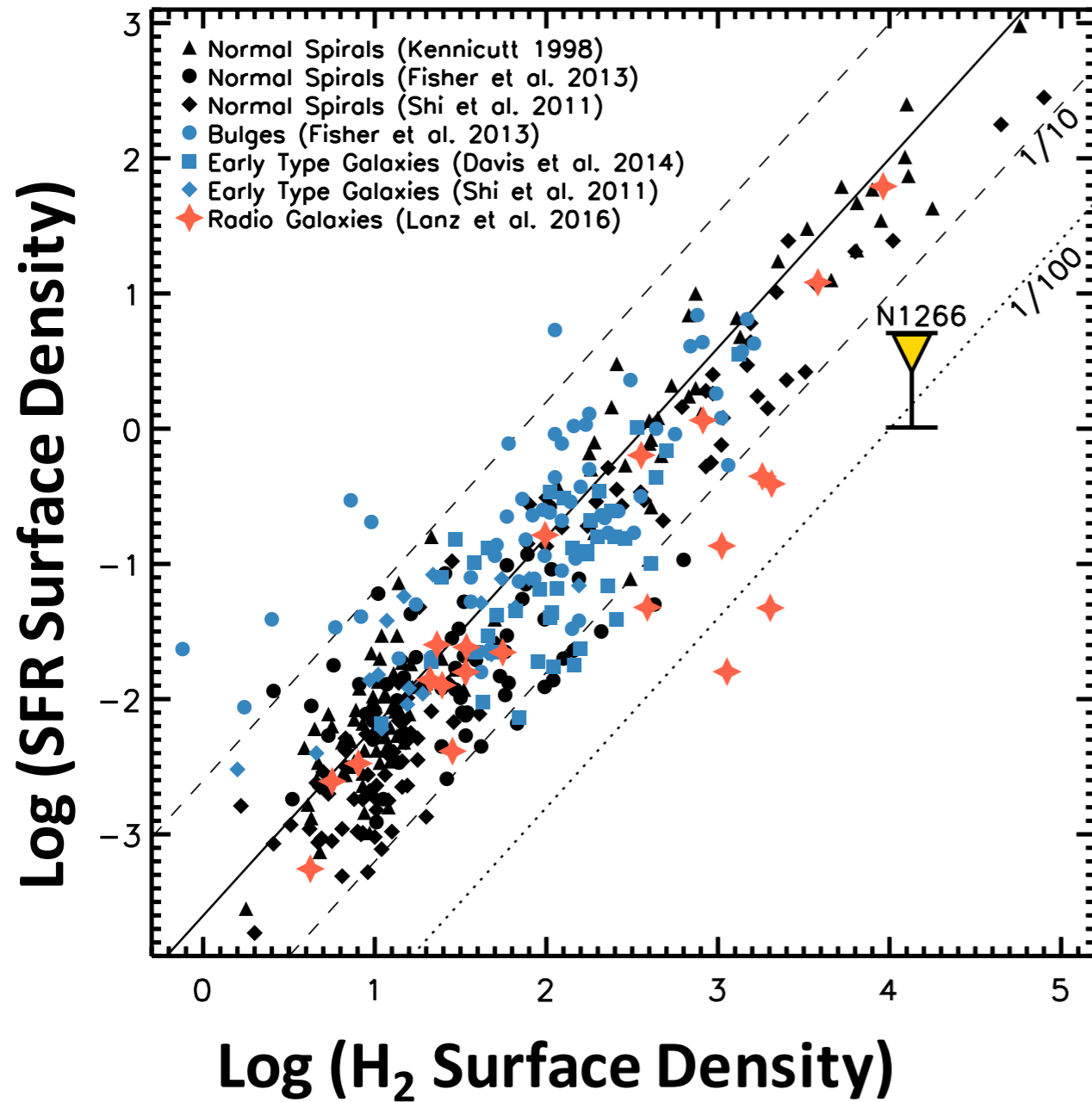
Determine host/outflow parameters



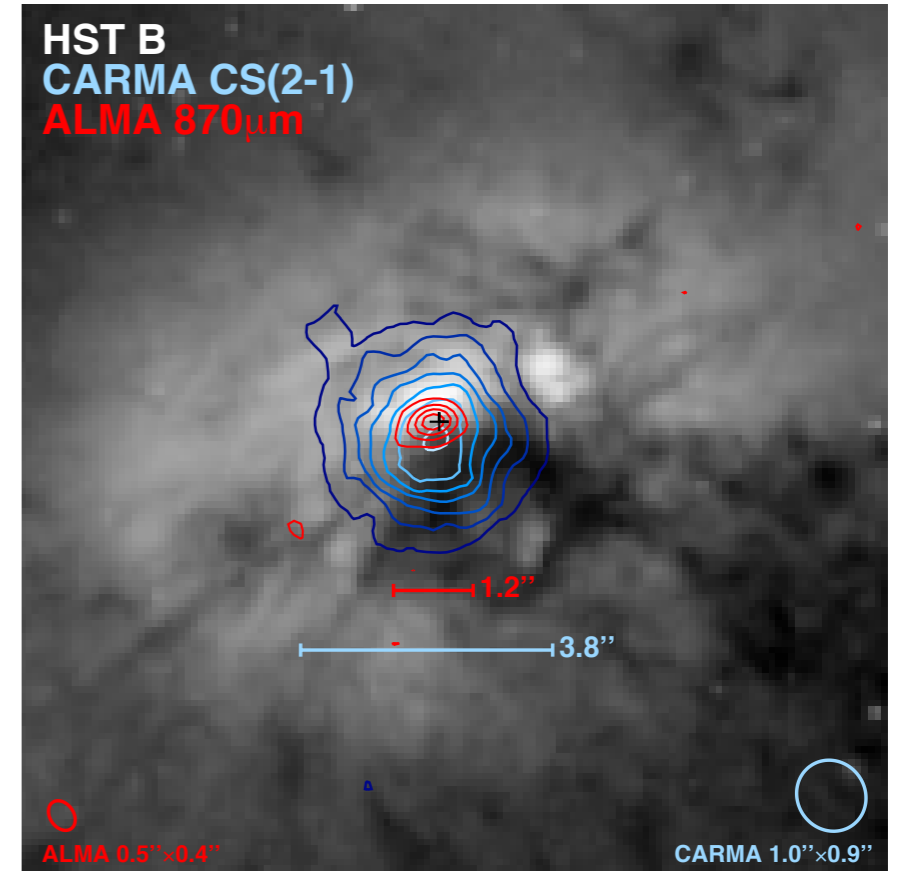
Obscuring Column: $4 \times 10^{25} \text{ cm}^{-2}$

Intrinsic 2-10 keV Luminosity: $8 \times 10^{40} \text{ erg s}^{-1}$

Localizing Star Formation (and its Suppression)

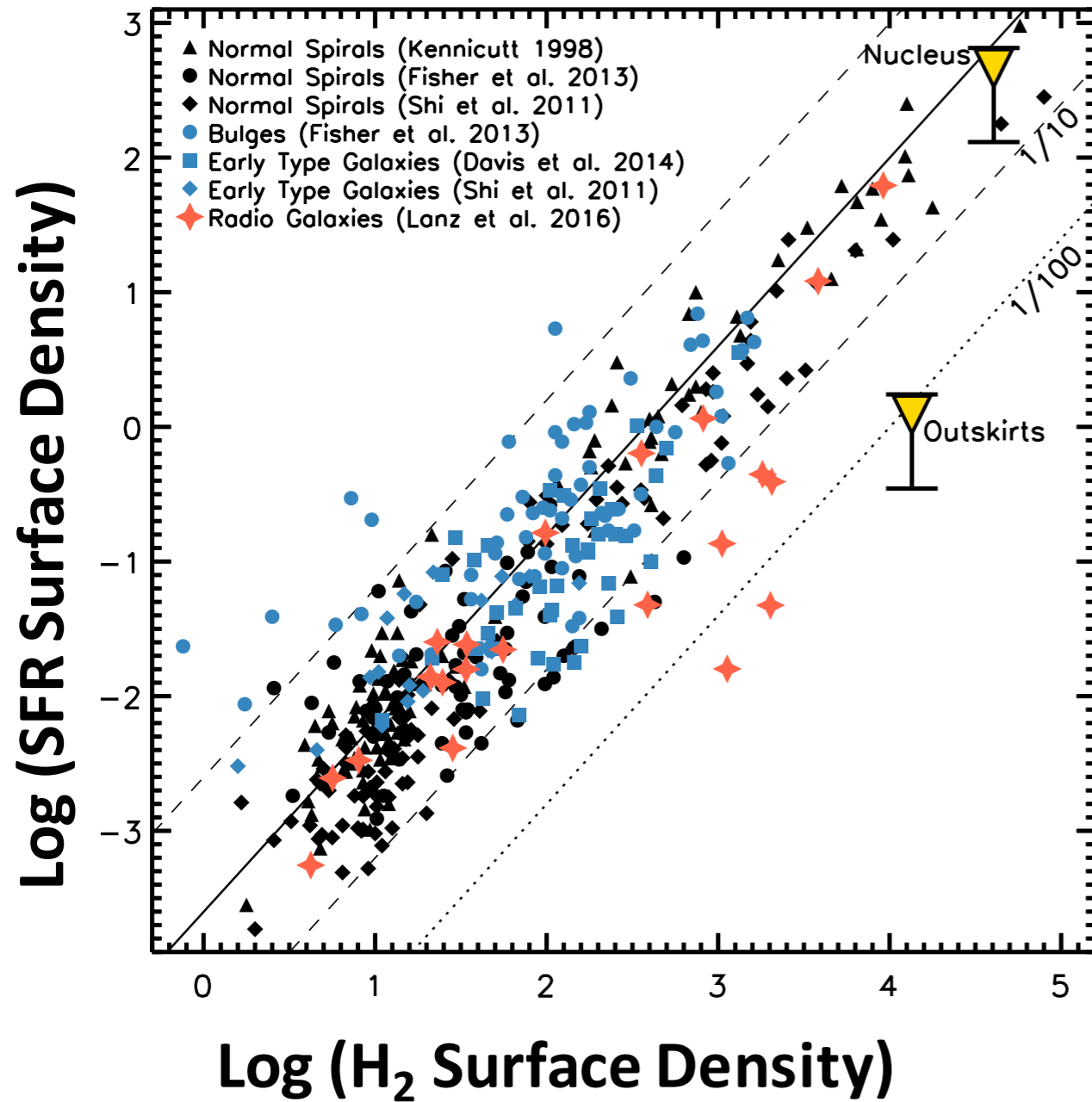


Lanz et al. (in prep.)

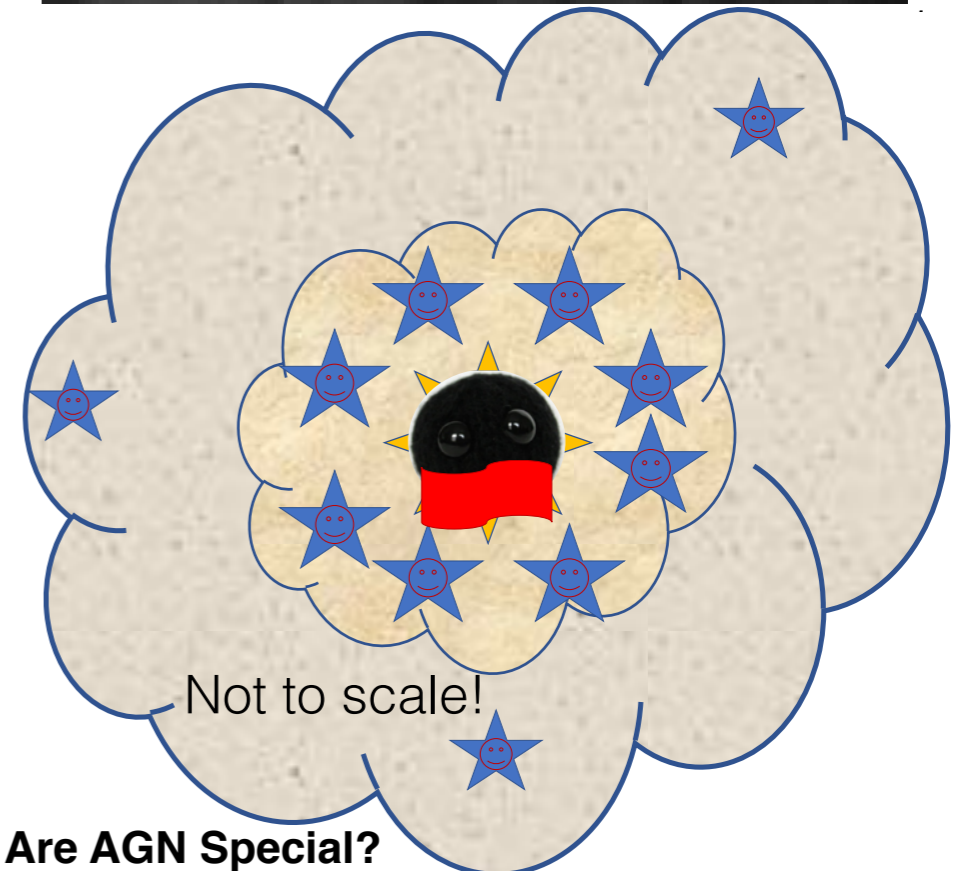
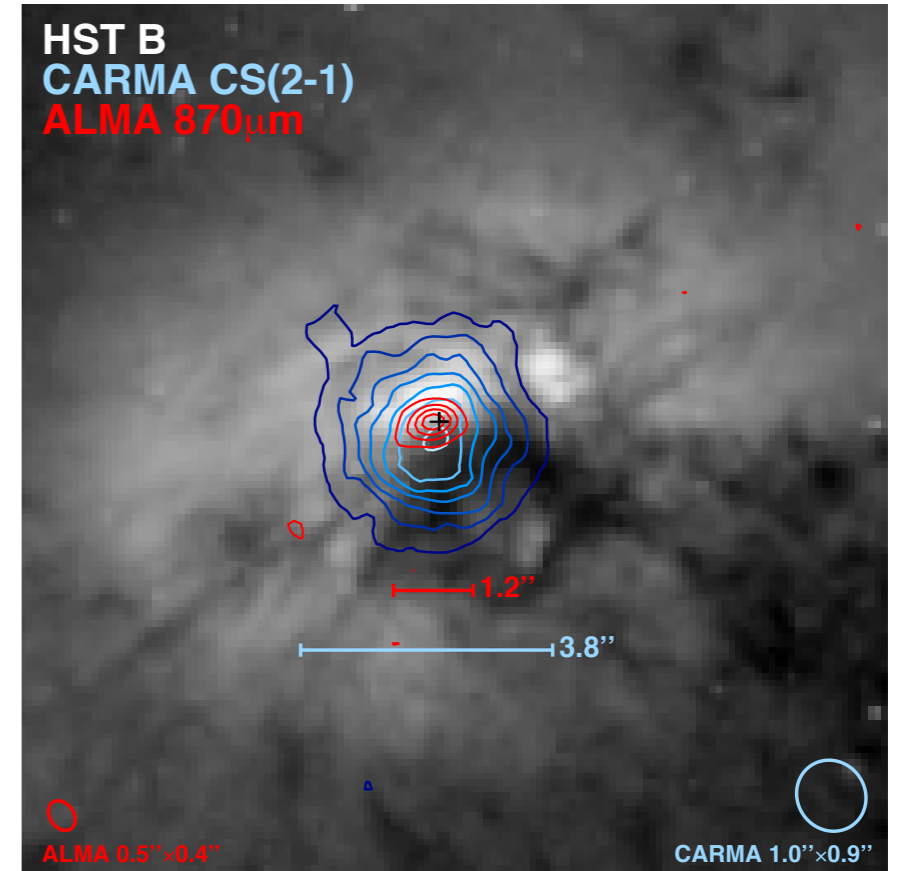


Not to scale!

Localizing Star Formation (and its Suppression)



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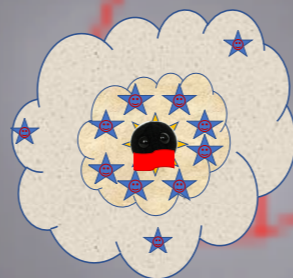
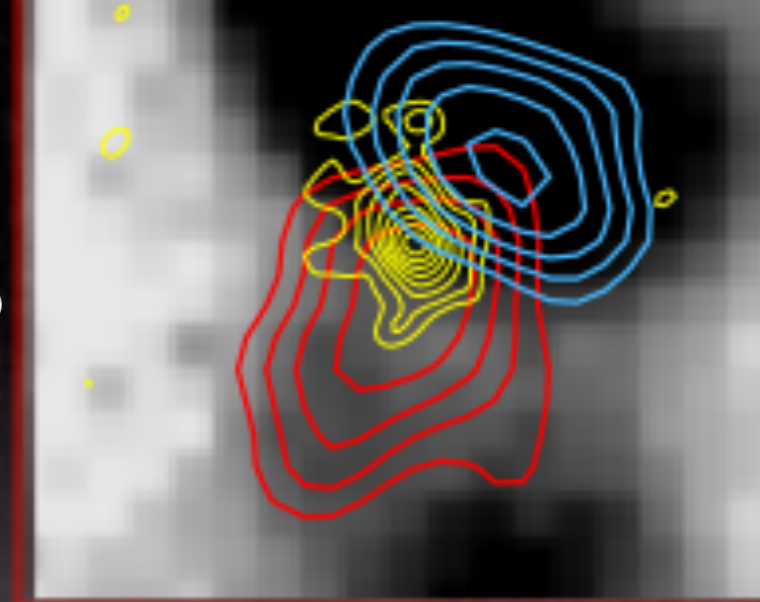


Summary

Are there AGN in Post-Starbursts?

Yes!

NGC1266's complex nuclear region includes a heavily buried, low-luminosity, outflow-driving AGN.



NGC1266-like post-starbursts have a high X-ray detection fraction, suggesting either a high fraction of AGN or similarly complex nuclei.