

On the connection of major mergers and AGNs

A closer look at high-accretion rate AGNs at $z \sim 2$

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How to trigger and feed a black hole?

- Fuel → Gas
- Transport → Torques

→ Major mergers **most feasible** option (?)

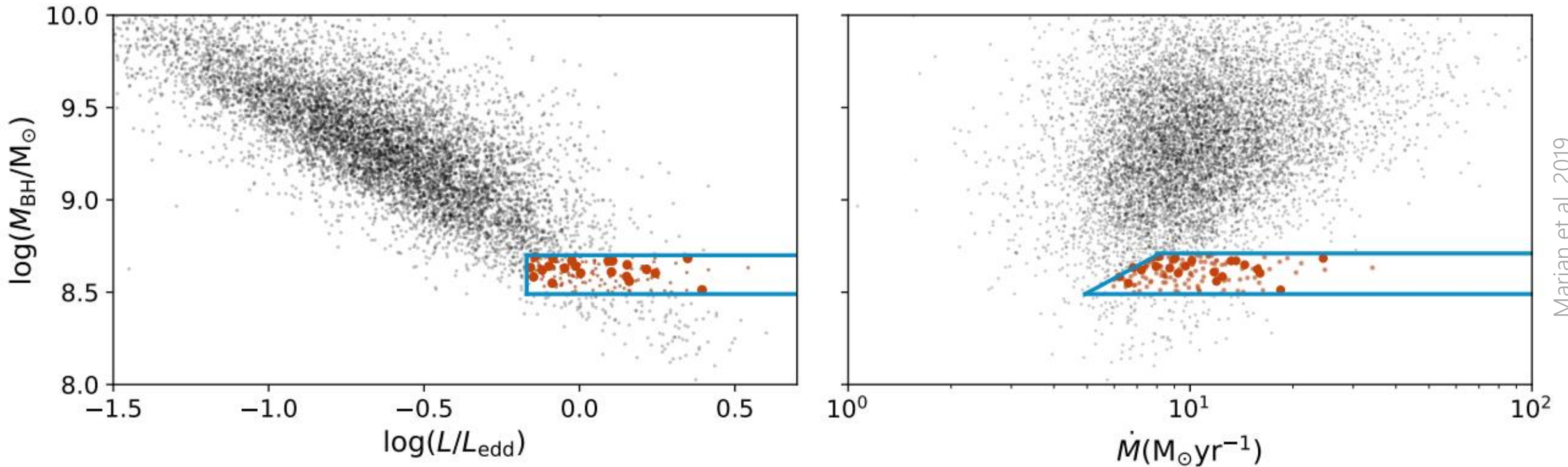
Recent studies

show **NO** enhancement in merger incidents for

- the majority of X-ray selected and optical observed AGNs across cosmic time ($z \leq 1$) (Gabor et al. 2009; Georgakakis et al. 2009; Cisternas et al. 2011)
- AGNs at low or intermediate luminosities ($L_x \leq 10^{43} \text{erg s}^{-1}$) (Grogin et al. 2005; Allevato et al. 2011; Schawinski et al. 2011; Kocevski et al. 2012; Böhm et al. 2013; Cheung et al. 2015; Cisternas et al. 2015; Rosario et al. 2015; Goulding et al. 2017)
- AGNs with high luminosities ($L_x \geq 10^{43} \text{erg s}^{-1}$) (Karouzos et al. 2014; Villforth et al. 2014, 2017; Hewlett et al. 2017)
- Black holes with the highest masses (Mehtley et al. 2016)
- Heavily obscured AGNs (Schawinski et al. 2012)
- AGNs in early evolutionary stages (Villforth et al. 2018)

Matching control sample of inactive galaxies essential

Sample selection



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Redshift

$$1.8 \leq z \leq 2.2$$

Mass

$$8.5 \leq \log(M_{\text{BH}}/M_{\odot}) \leq 8.7$$

Eddington ratio

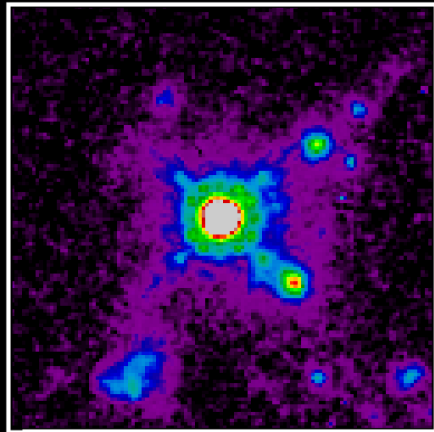
$$(L/L_{\text{edd}}) \geq 70\%$$

Sample: **21 AGN, Type I**

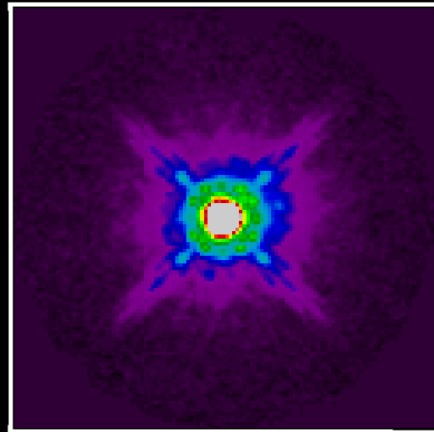
Comparison sample: **92 inactive galaxies** from CANDELS

Modeling & Point-source subtraction

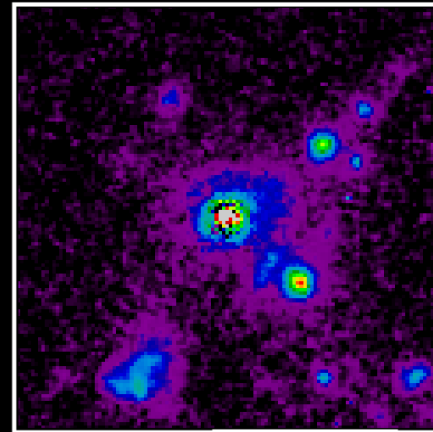
Marian et al. 2019



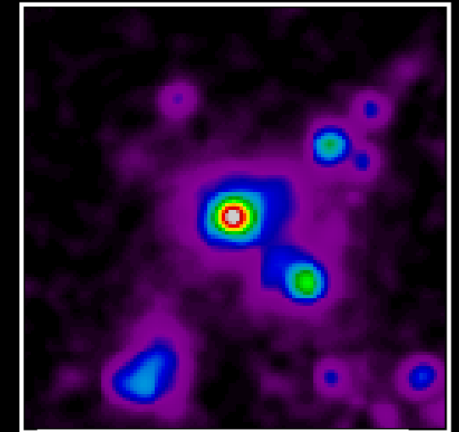
AGN + host
galaxy



Convolved
model

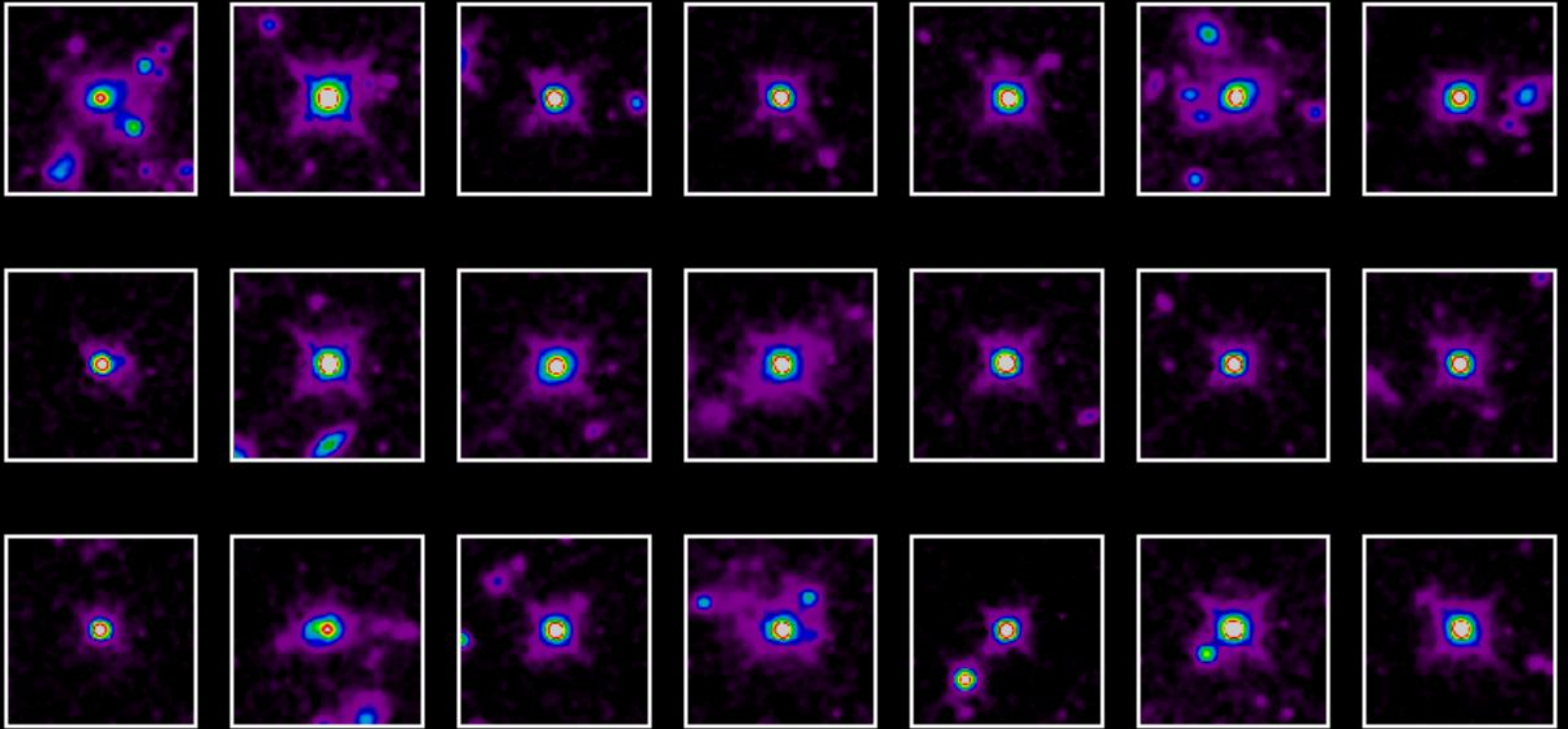


Point-source
subtracted



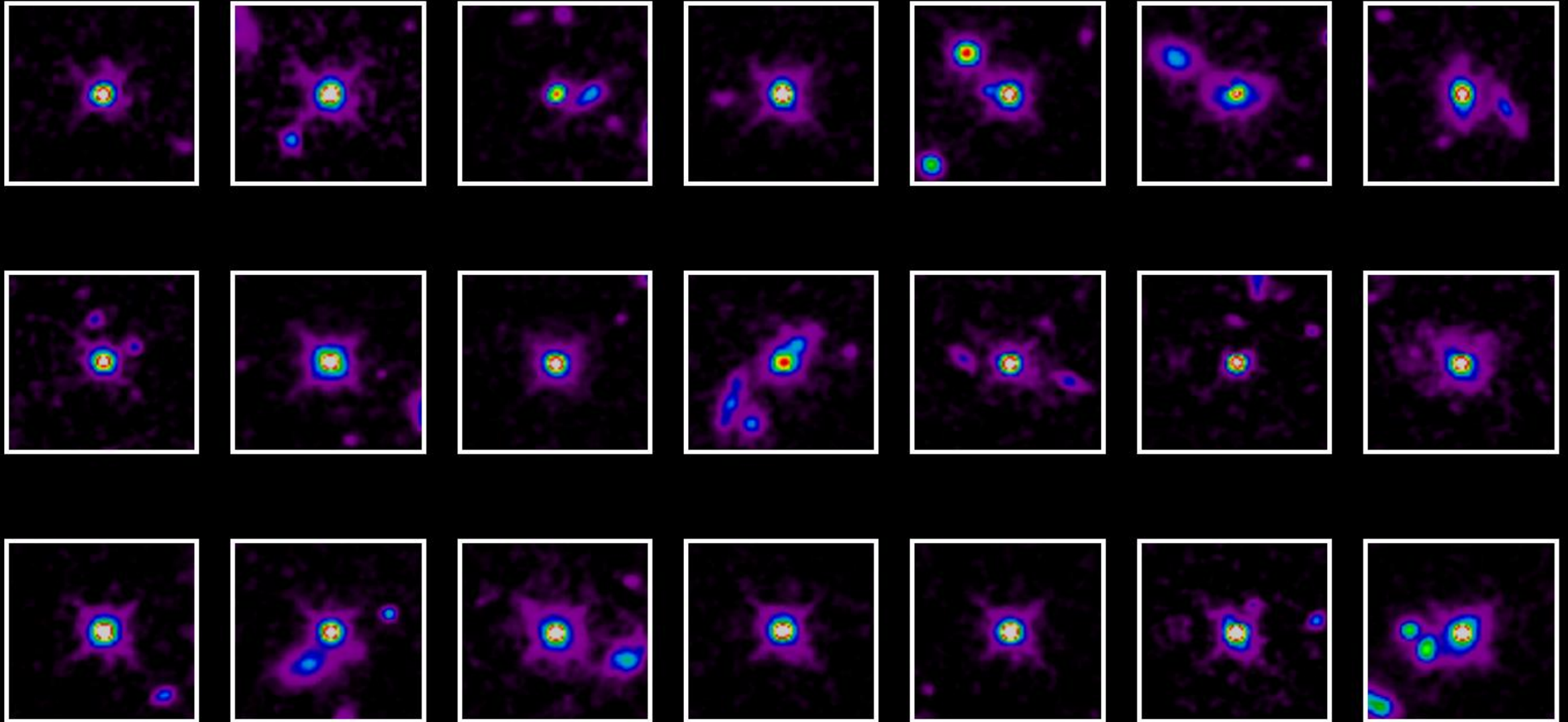
2x2 smoothed
subtracted

Modeling & Point-source subtraction



Marian et al. 2019

Modeling & Point-source subtraction



Marian et al. 2019

Analysis

Main steps:

- Coauthors rank joint sample

↳ (S. Cohen, B. Husemann, K. Jahnke, V. Jones, A. Koekemoer, V. Marian, A. Schulze, A. van der Wel, C. Villforth & R. Windhorst)

- Combine individual rankings

- Determine cut-off rank



We checked the impact of different combination methods and cut-off ranks!

- Split sample

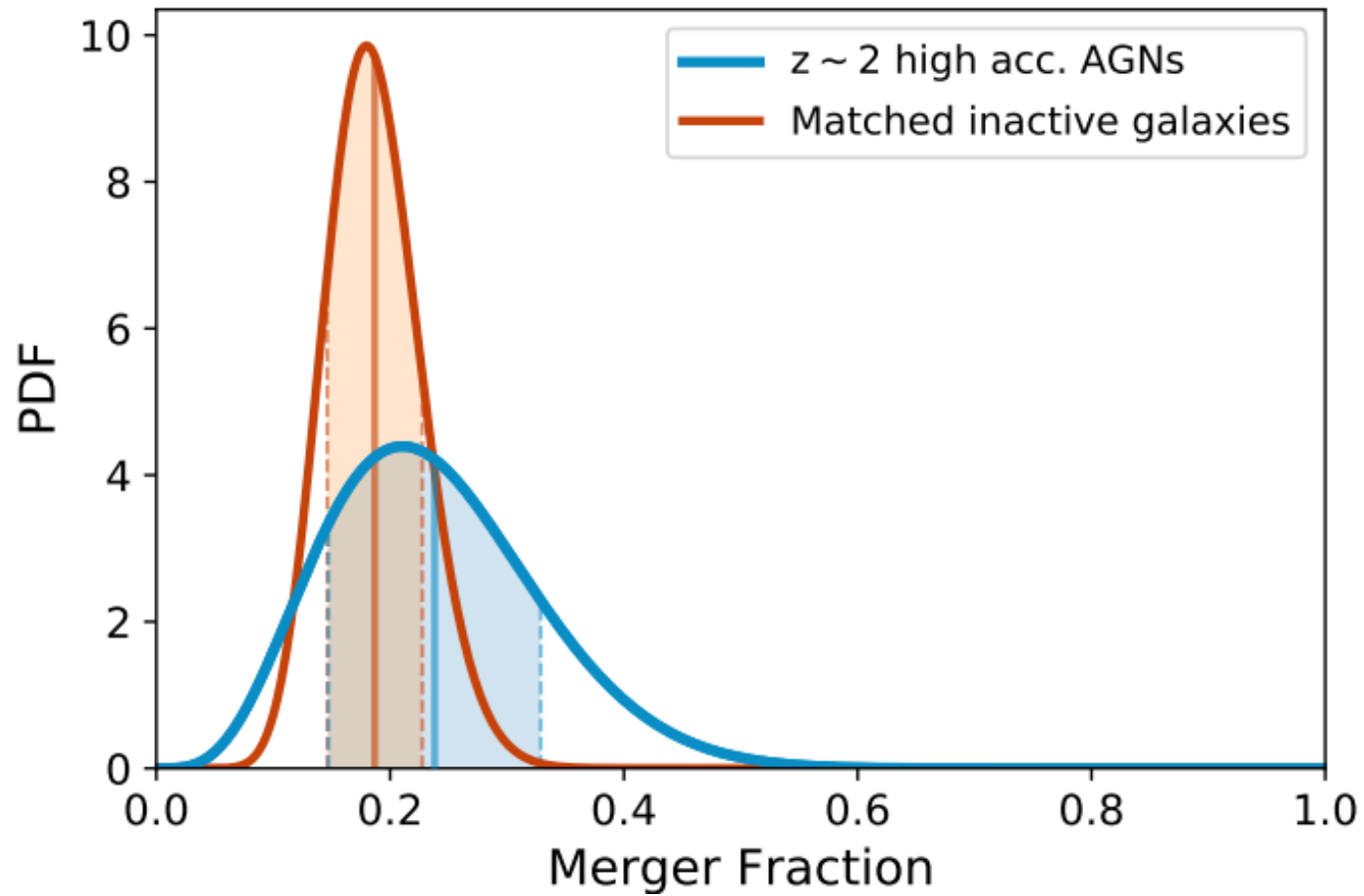
- Derive merger fractions

Merger fractions

- Showing merger features:
 - 5 AGN host galaxies
 - 17 inactive galaxies
- Showing no such features:
 - 16 AGN host galaxies
 - 74 inactive galaxies

$$f_{(m,agn)} = 0.24 \pm 0.09$$

$$f_{(m,ina)} = 0.19 \pm 0.04$$



Marian et al. 2019

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But what about...

- ...a dependence on stellar mass?

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- ~~...a dependence on stellar mass?~~
- ...a time lag between merger and AGN activity?
 - Usual lifetimes of AGNs: $10^6 - 10^8$ yr (Martini 04; Hopkins+ 05; Shen+ 07; Hopkins & Hernquist 09; Conroy & White 13; Cen & Safarzadeh 15)
 - Lifetime of merger features: $10^9 - 10^{10}$ yr (Conselice 06; Lotz+ 08; Ji+ 14; Solanes+ 18)
 - Visibility overlap of ≥ 500 Myr, even with delay of ~ 300 Myr

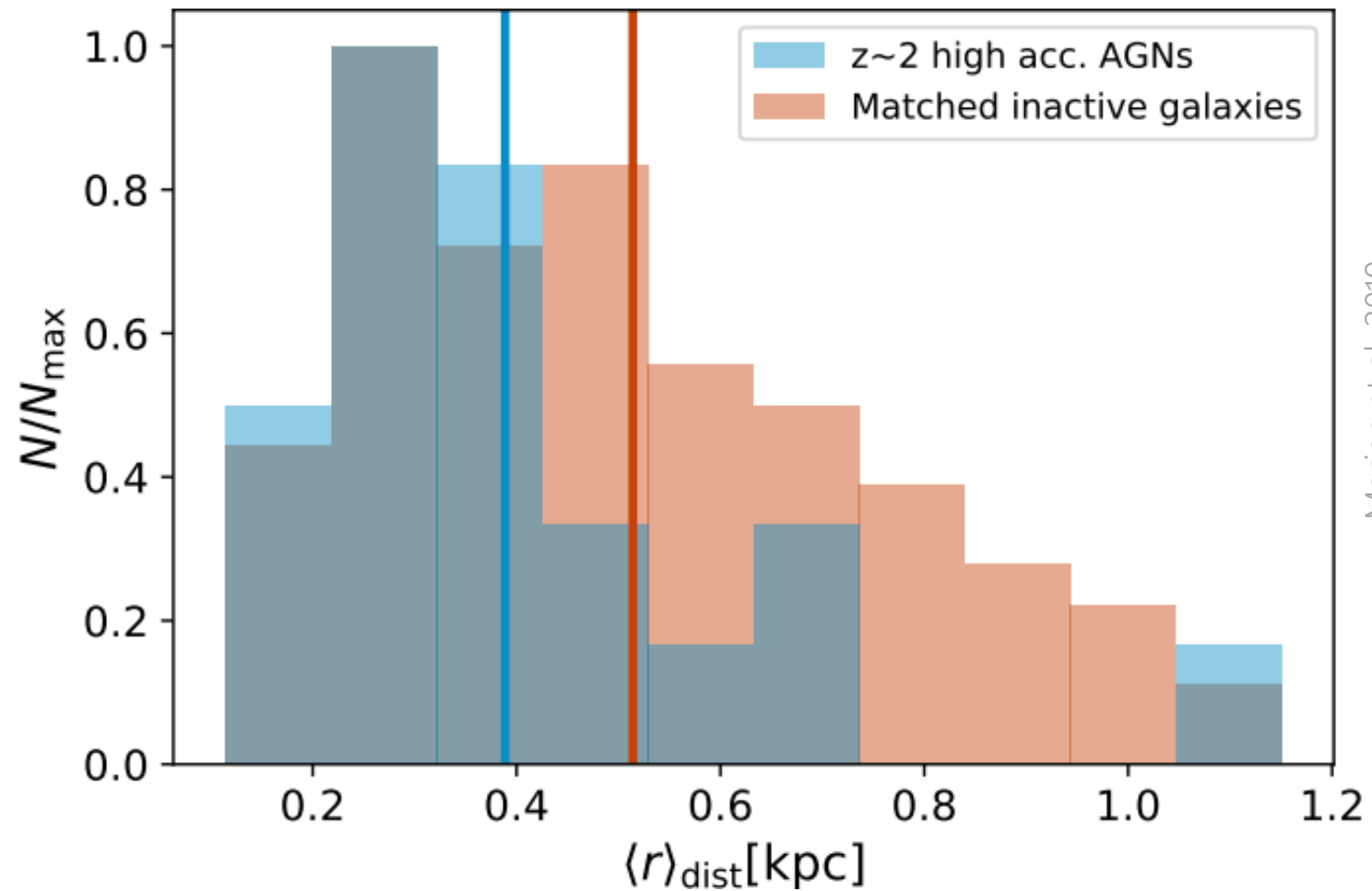
But what about...

- ~~...a dependence on stellar mass?~~
- ~~...a time lag between merger and AGN activity?~~
- ... intermittence of AGN activity?
 - AGN timescales: $\sim 10^5$ yr
or
 - $\sim 20\%$ of merging inactive galaxies host intermittent AGN

But what about...

- ~~...a dependence on stellar mass?~~
- ~~...a time lag between merger and AGN activity?~~
- ~~... intermittence of AGN activity?~~
- ... a potential offset between AGN position and host galaxy flux center

Spatial offset between AGN and host galaxy nucleus



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But what about...

- ~~...a dependence on stellar mass?~~
- ~~...a time lag between merger and AGN activity?~~
- ~~... intermittence of AGN activity?~~
- ~~... a potential offset between AGN position and host galaxy flux center~~

Take away conclusion

**Major mergers are not the dominant trigger
for (high-accretion) AGNs (at $z=2$)**

More details in

Marian V., Jahnke K., Mechtley M., Cohen S., Husemann B., Jones V.,
Koekemoer A., Schulze A., van der Wel A., Villforth C., Windhorst R.

(subm. to ApJ, arXiv:1904.00037)

Thank you