

Credit: ESO/M. Kornmesser

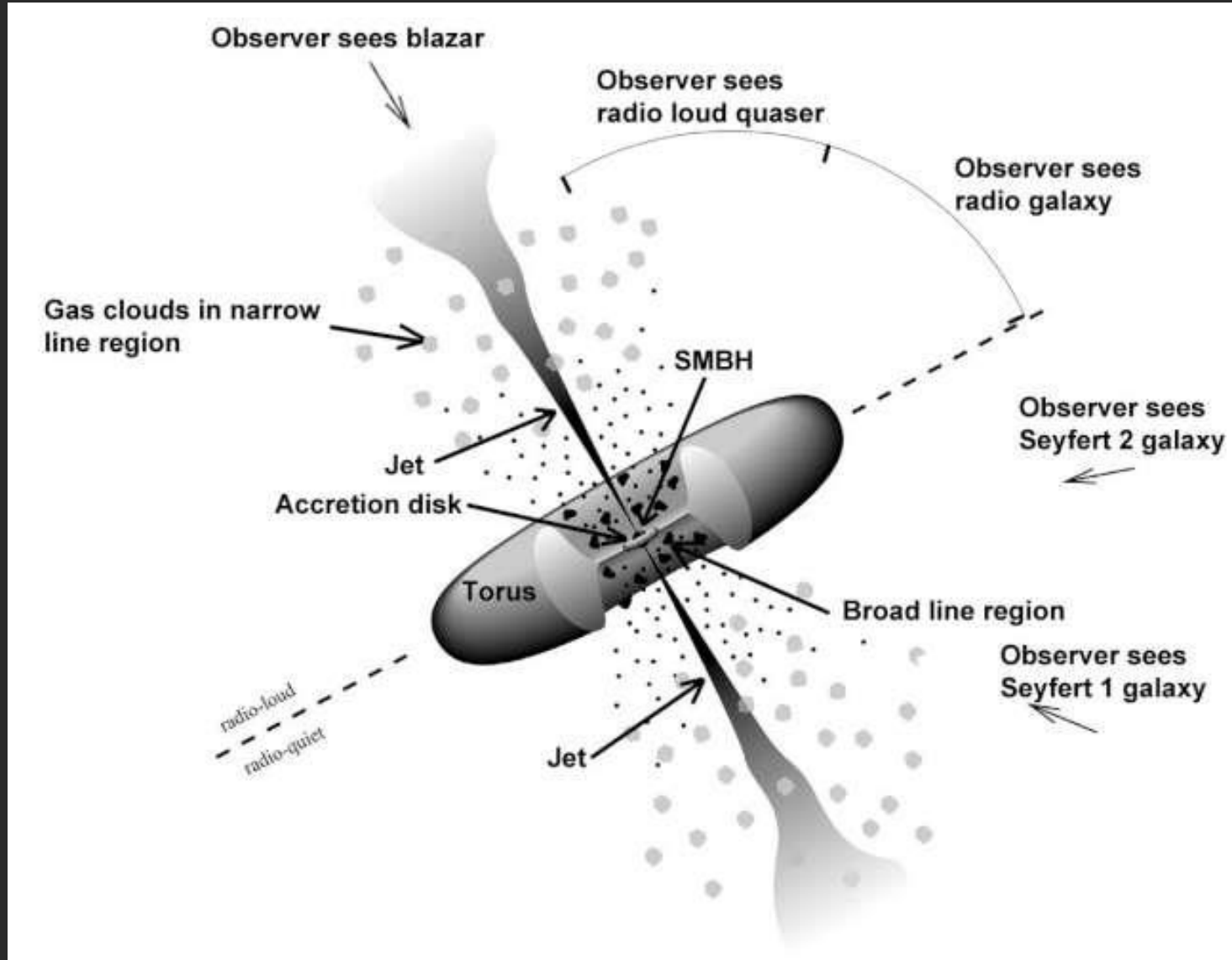


# TESTING THE CONNECTION BETWEEN MAJOR MERGERS AND THE TRIGGERING OF HIGH-ACCRETION BLACK HOLES

V. Marian,  
K. Jahnke,  
M. Mechtley

# Introduction

# FUELING A BLACK HOLE

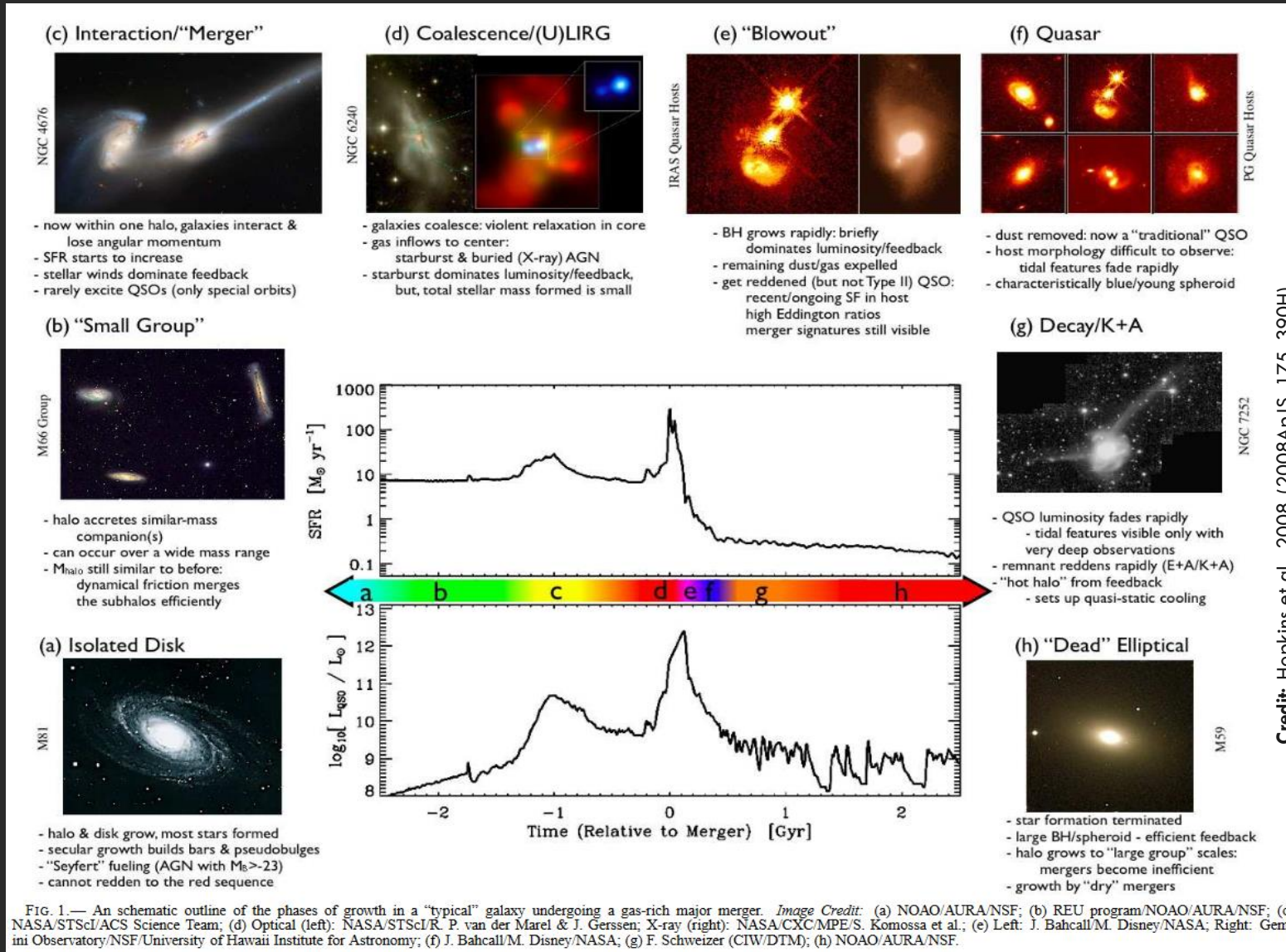


Credit: <https://fermi.gsfc.nasa.gov/science/etev/agn/>

# FUELING THE FUEL

- Gas transport from distant reservoirs (kpc) to central region
- Need to remove angular momentum

# MAJOR MERGER — AGN CONNECTION



Credit: Hopkins et al., 2008 (2008ApJS..175..390H)

# MAJOR MERGER — AGN CONNECTION



Matching control sample of inactive galaxies essential

- Examine merger fractions in parameter space:
  - Redshift
  - Mass
  - Accretion rate

# Redshift

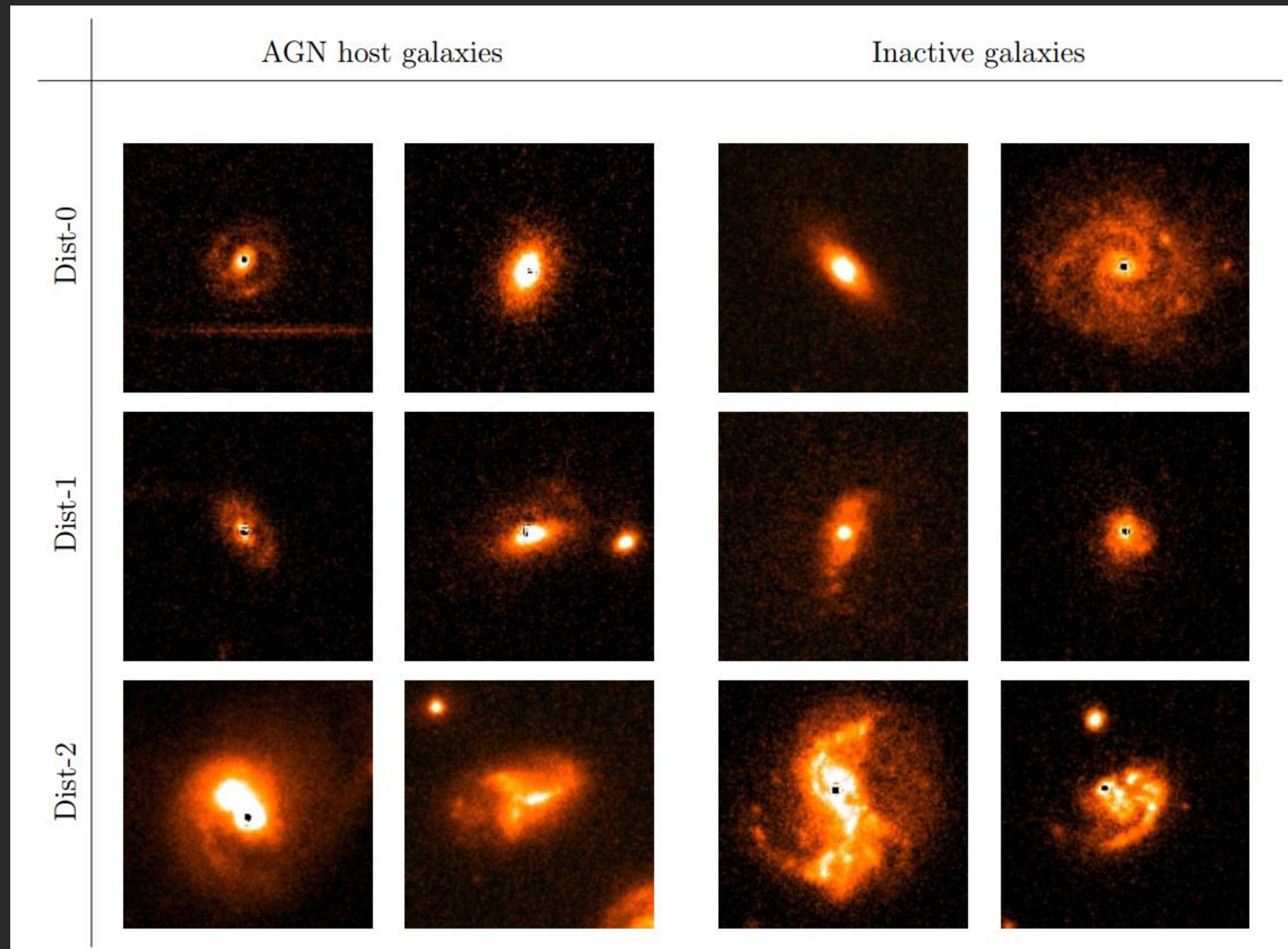
# REDSHIFT

- Cisternas+ 11:
- $z \sim 0.3 - 1$
- 140 X-ray selected, optically confirmed AGNs
- $\sim 1200$  inactive galaxies
- $M_* > 10^{11.7} M_{\odot}$



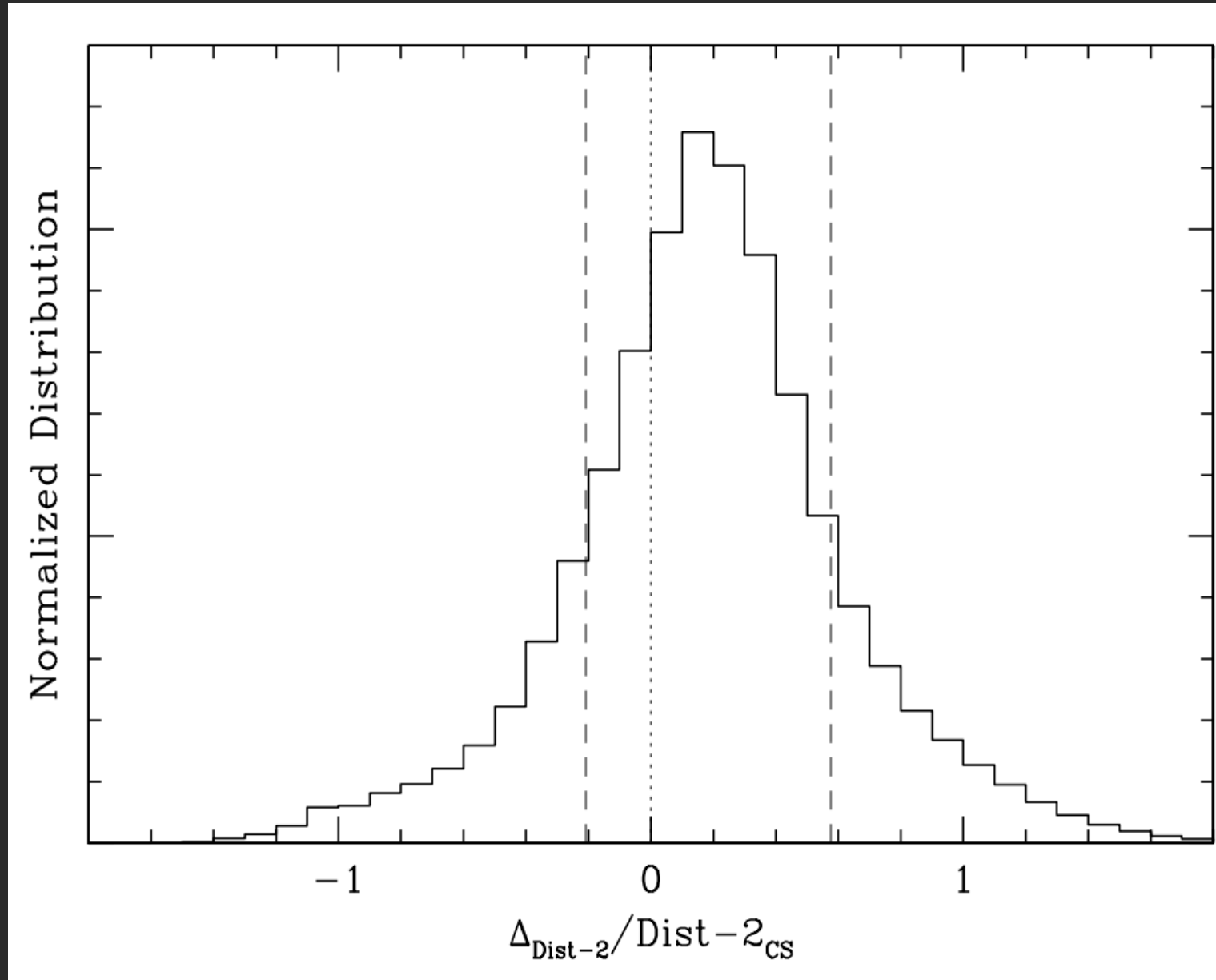
# REDSHIFT

- 2D-decomposition
- Synthetic nucleus  
for control sample
- Removing nuclear  
contribution
- Visual classification



# REDSHIFT

- Results:
- >85% of AGN host galaxies show no strong distortions
- >55% AGN hosts disk-dominated
- No significant difference in distortion fractions



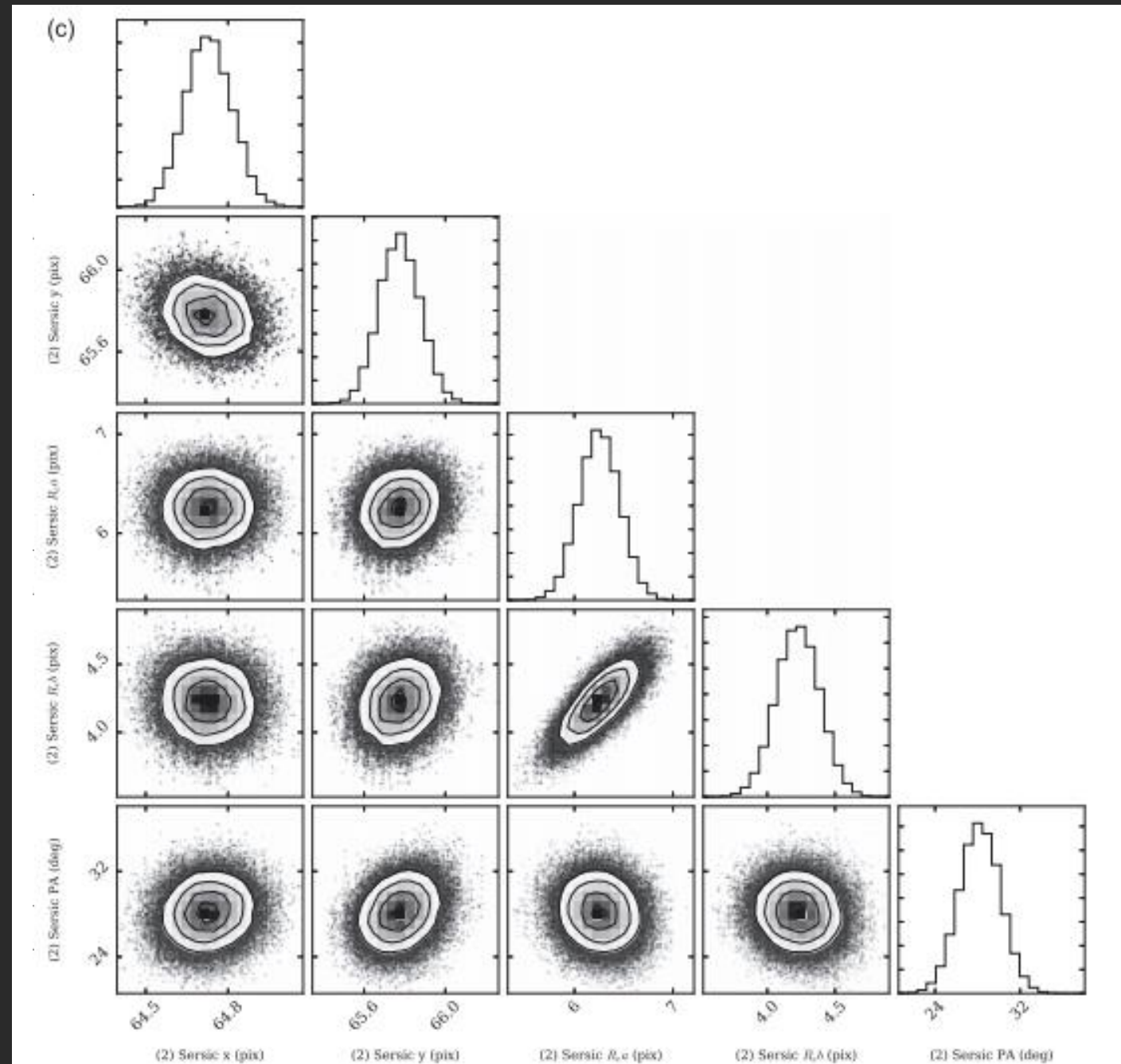
# Highest Mass BHs

# HIGH MASS

- Mechtley+ 16:
- $M_{\text{BH}} = 10^{9.3} - 10^{9.7} M_{\odot}$
- $z \sim 2$
- 19 AGNs
- 84 inactive galaxies

# HIGH MASS

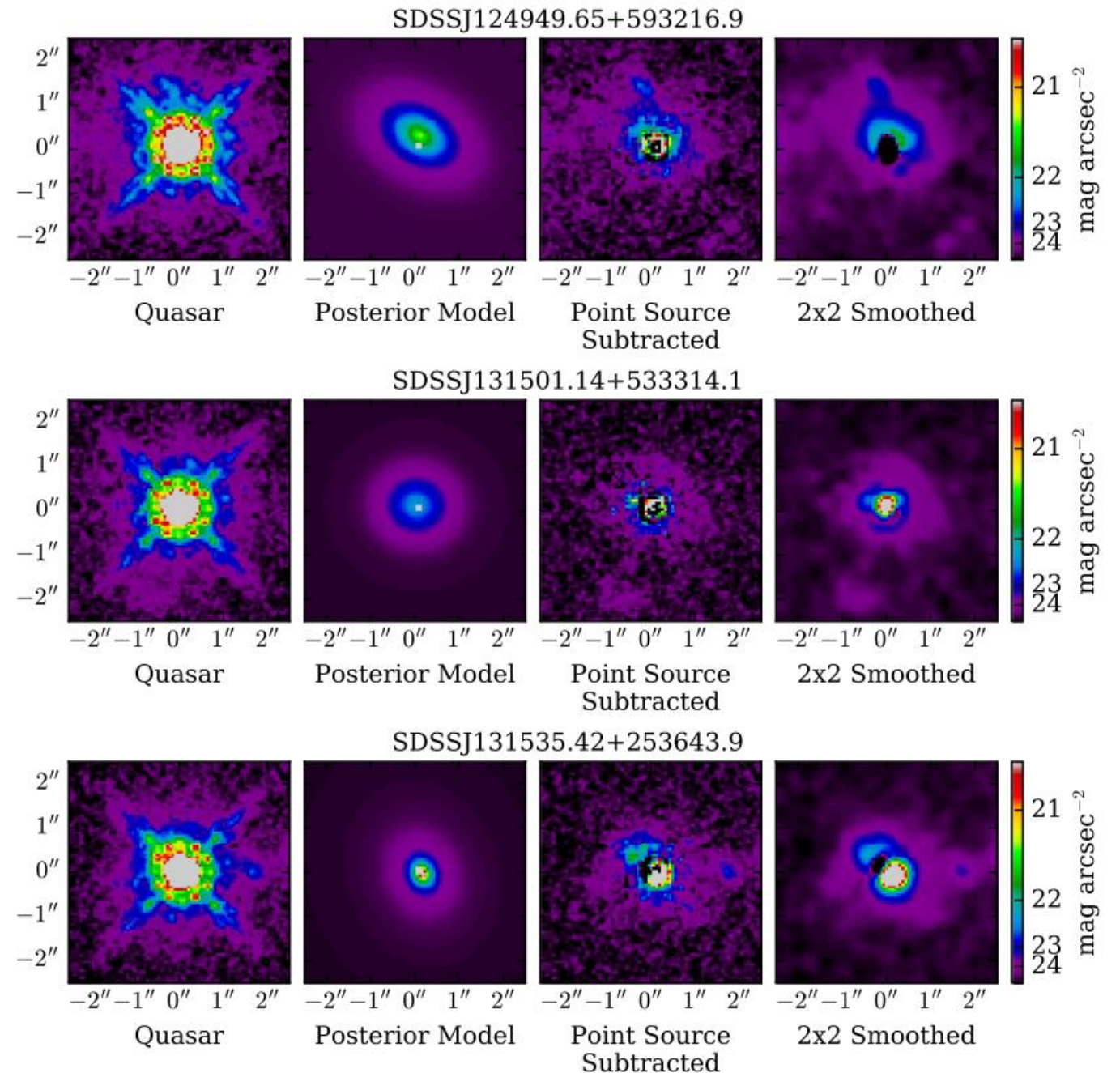
- 2D – decomposition:
- Bayesian Modeling Method
- MCMC algorithm (PSFMC)
- Synthetic nucleus for inactive galaxies
- Point source subtraction





# HIGH MASS

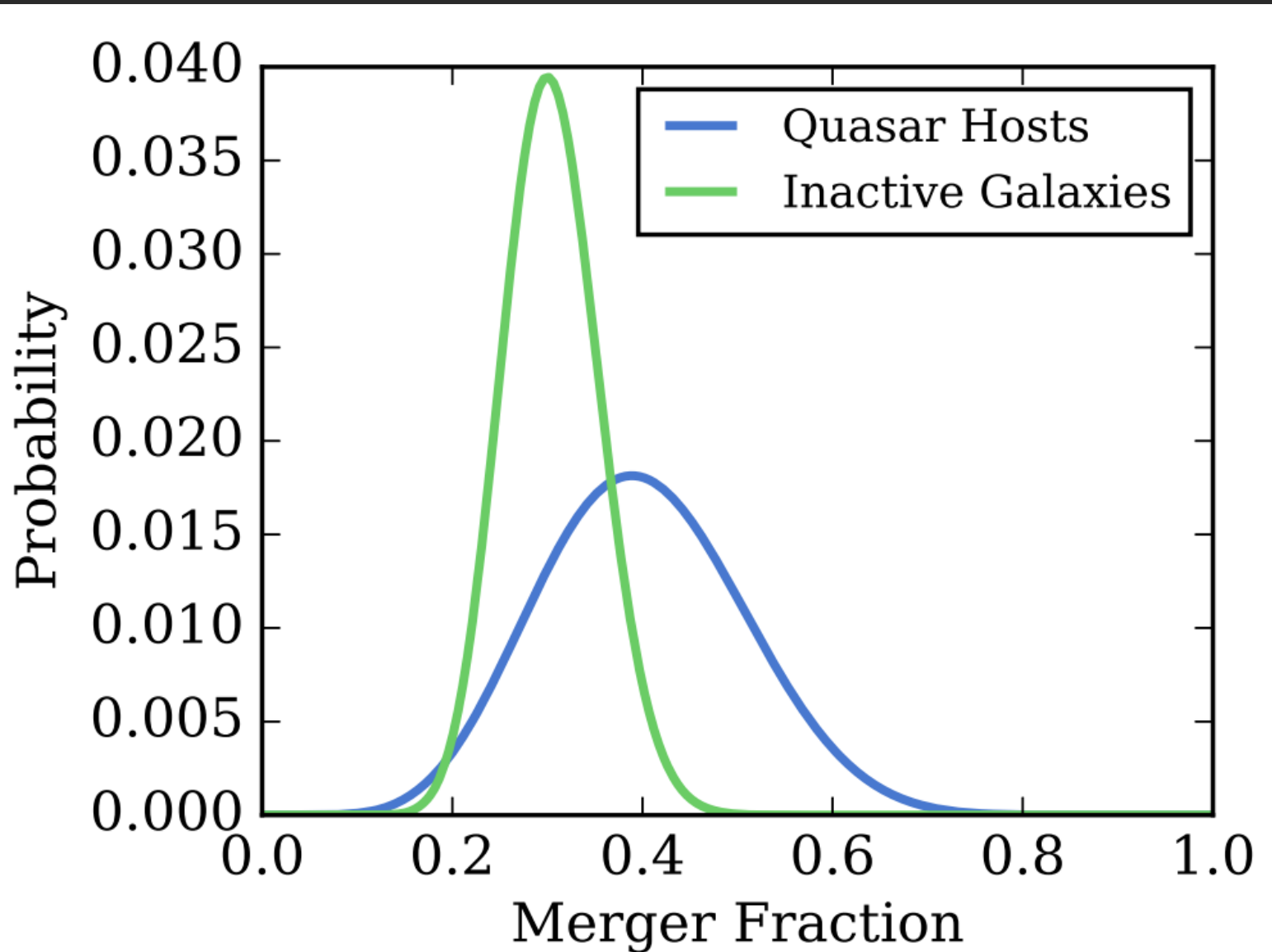
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# HIGH MASS

- Consensus ranking
- $f_{m,qso} = 0.39 \pm 0.11$
- $f_{m,gal} = 0.30 \pm 0.05$
- No significant difference in merger fractions
- Similar result for  $z = 0.2$

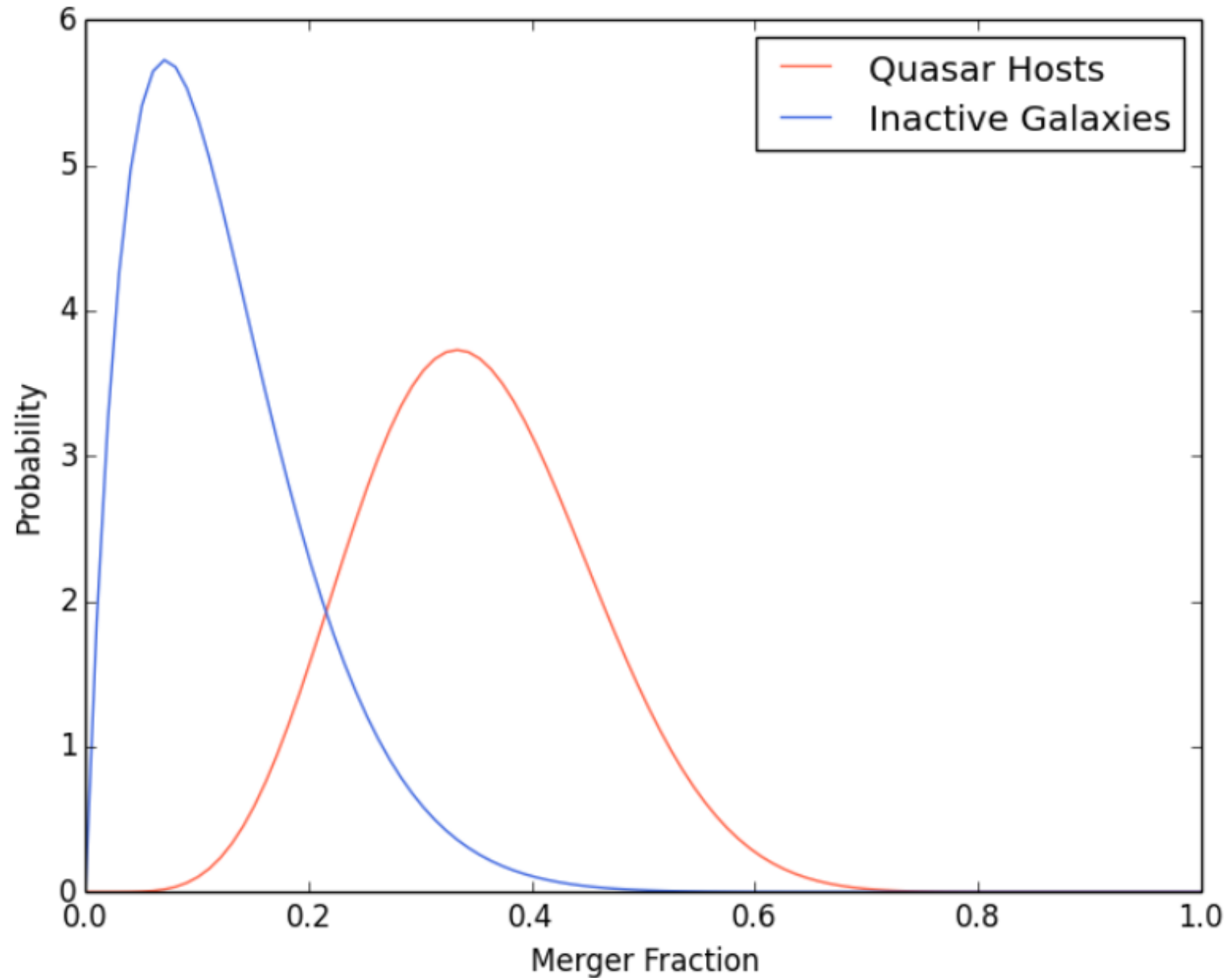
(Master Thesis: Liyualem Tilahun)



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(Master Thesis: Liyualem Tilahun)





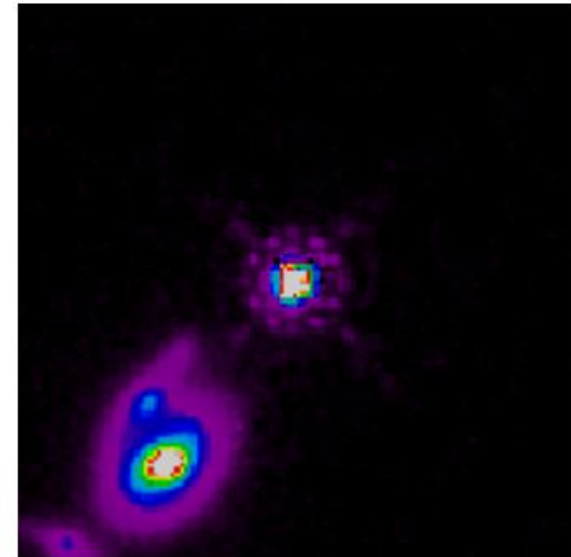
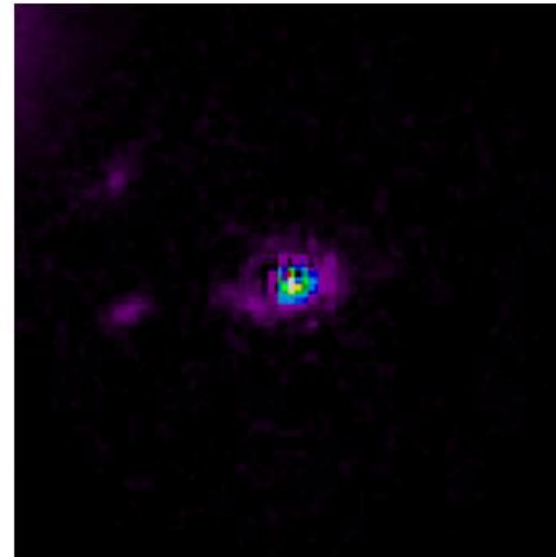
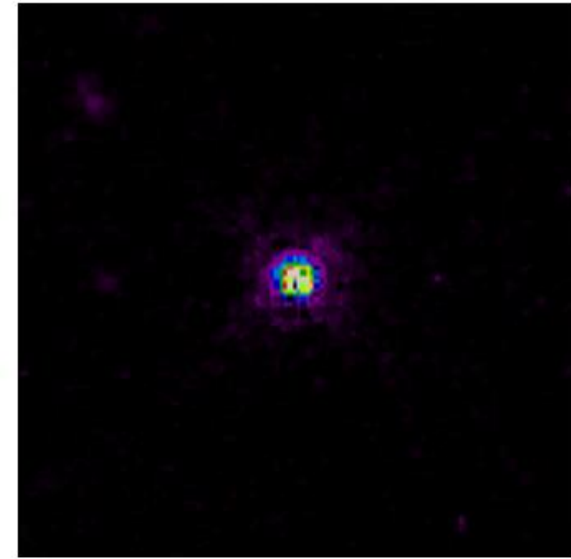
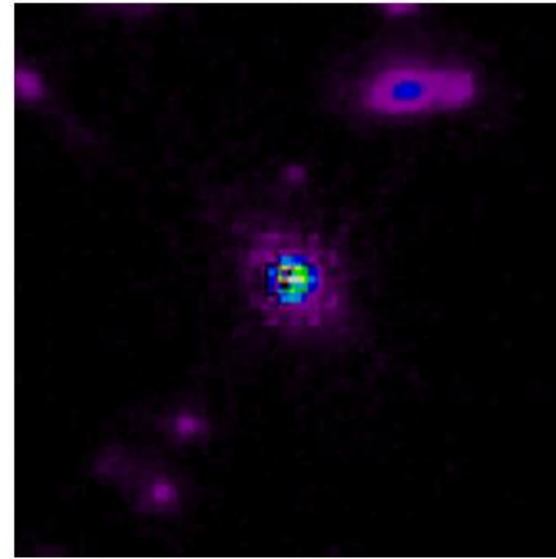
# Highest Accretion Rates

# HIGHEST ACCRETION RATES

- Examination for BHs with  $L/L_{\text{edd}} > 0.3$
- Large amount of gas needed
- → major merger dominant mechanism?

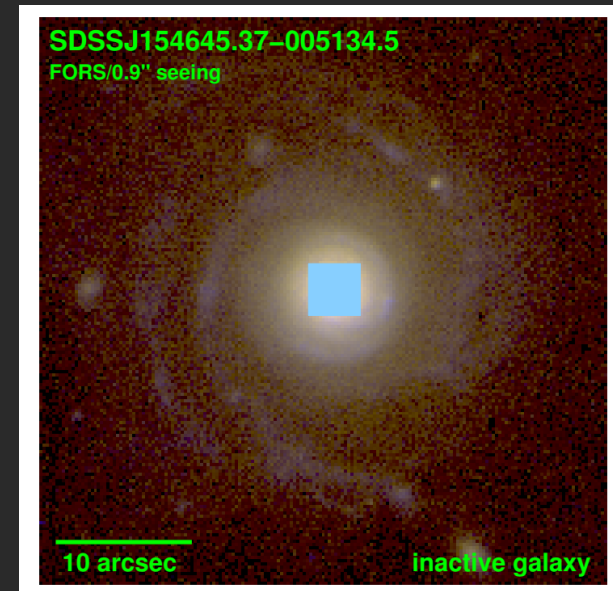
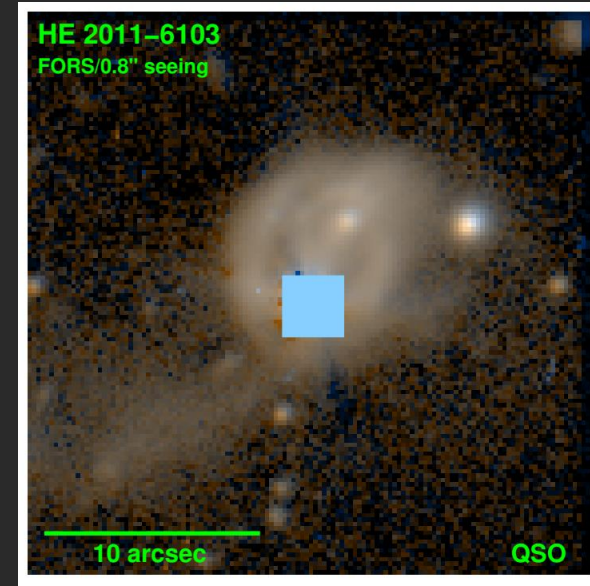
# HIGHEST ACCRETION RATES

- $z = 2$
- 21 AGNs
- 92 inactive galaxies
- Modeling complete
- Currently in ranking phase



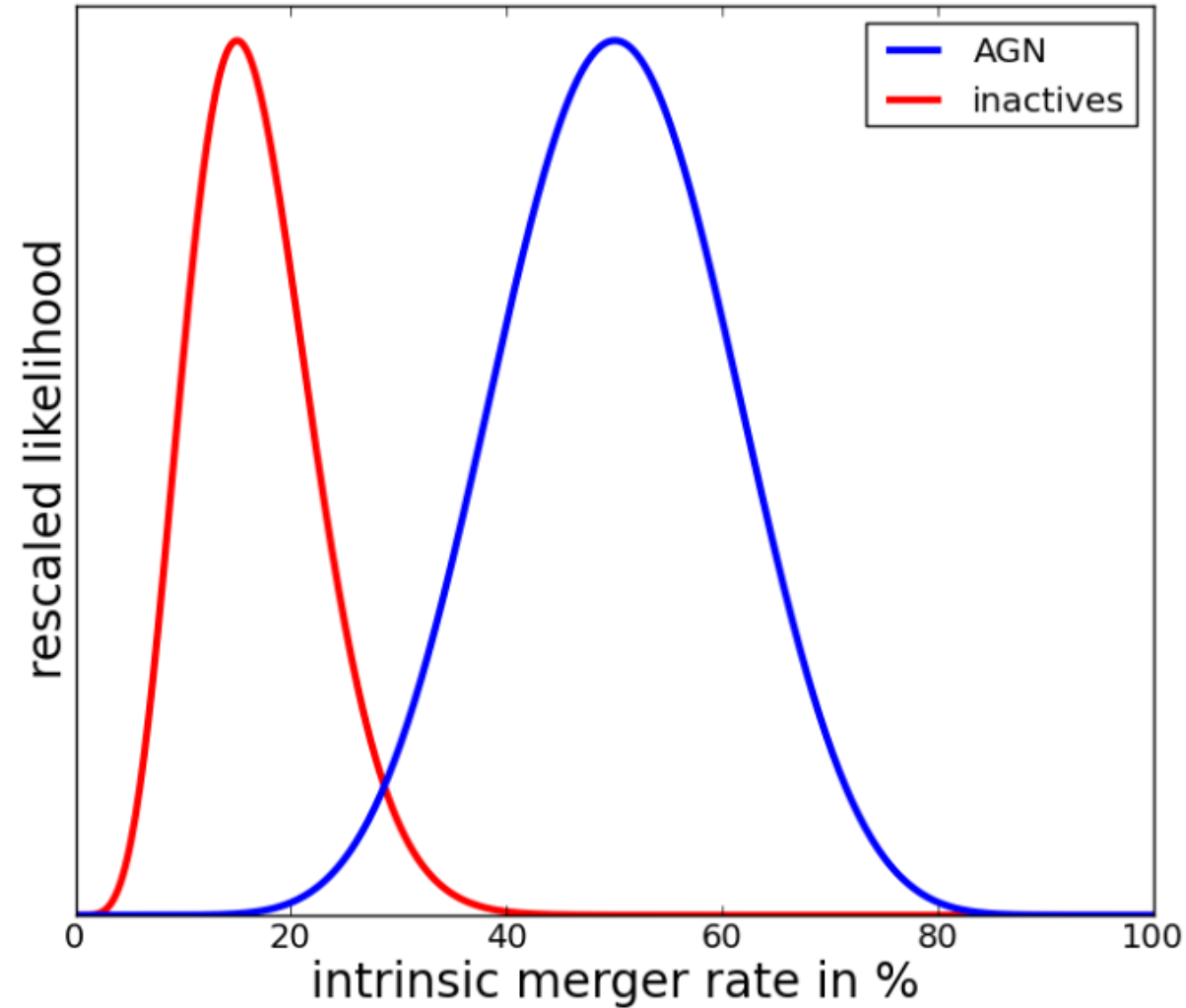
# HIGHEST ACCRETION RATES

- $z < 0.2$
- Observations nearly complete
- B-V
- 19 AGNs
- 37 comparison galaxies



# HIGHEST ACCRETION RATES

- Hypothesis:
- QSOs dominated by mergers ( $\geq 50\%$ )
- Fraction of inactive, merging galaxies  $\sim 15\%$
- Test with  $3\sigma$  significance

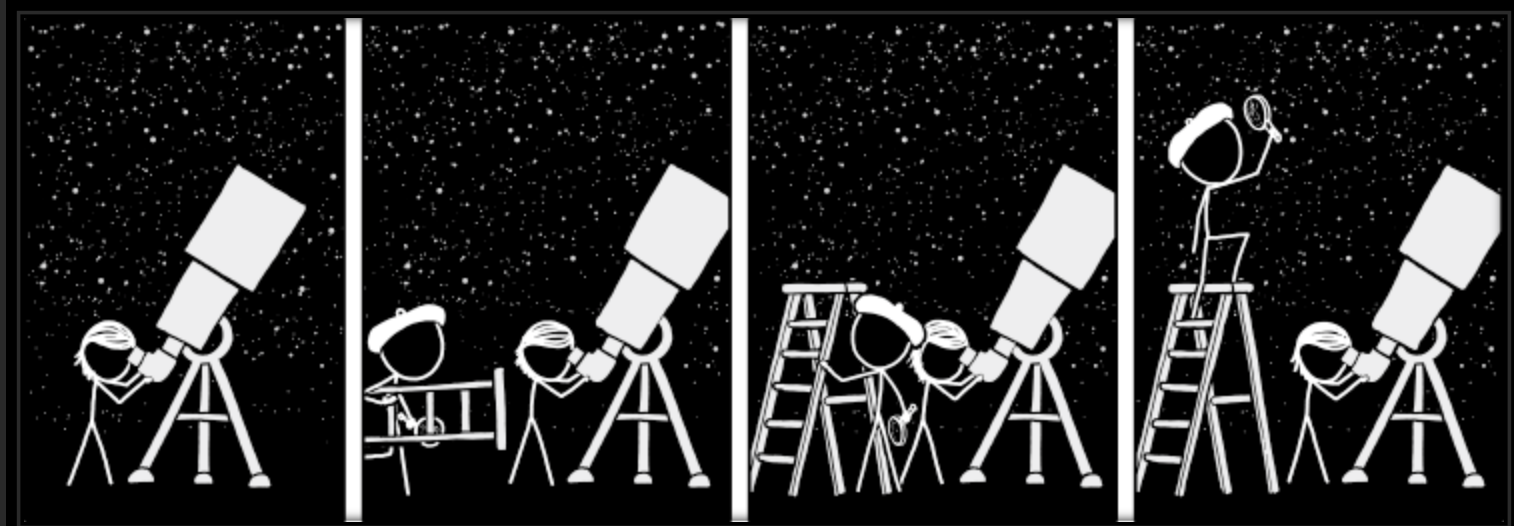


# Summary

# CONCLUSIONS

- Major mergers not dominant trigger for AGN activity for:
  - Typical AGNs at  $0.3 < z < 1.0$
  - Highest mass BHs at  $z = 2$  and  $z = 0.2$
  - Lower-luminosity AGN at  $z = 2$  (Schawinski+ 2011, Kocevski+ 2012)
  - BHs with highest accretion rates at  $z = 2$  and  $z = 0.2$ ?

# Thank you for your attention



Xkcd.com



# Time Lag

# TIME LAG

- Washing out of merger signatures
- Models:  $\sim 10^8$  yr between coalescence and peak of QSO activity
- Accretion timescales  $10^7$ - $10^8$  yr
- → merger signatures visible

# Obscuration

# OBSCURATION

- Cisternas+ 11
- Examined soft and hard X-ray emission
- No source above background level