



Testing the Merger-AGN-SFR Connection in Dynamically Close Pairs

Josephine Chishala

Supervisors: Prof. Roberto De Propris & Prof. Mirjana Povic



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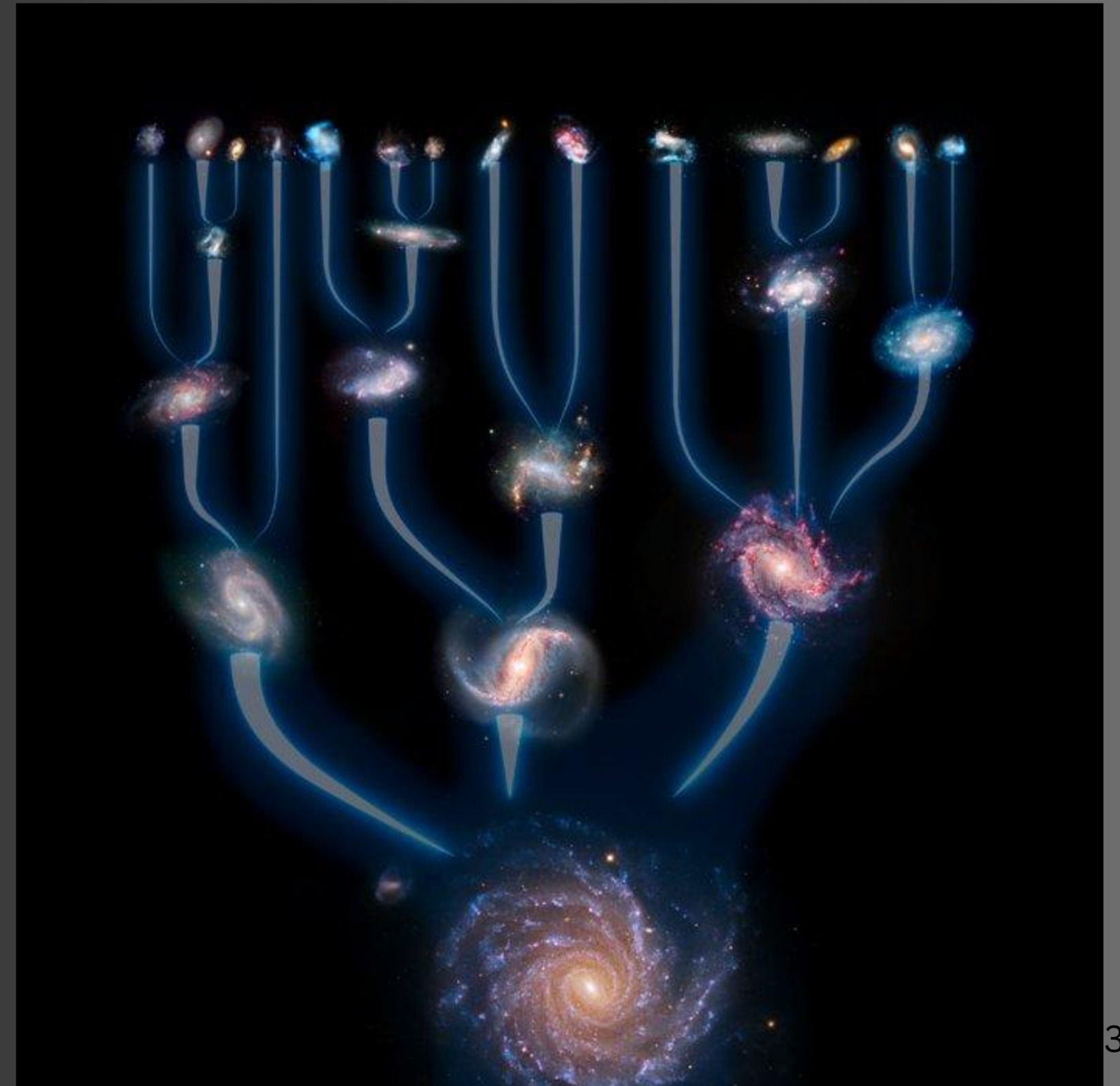


Outline

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- Data and Sample
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- Results
- Conclusion

Introduction...

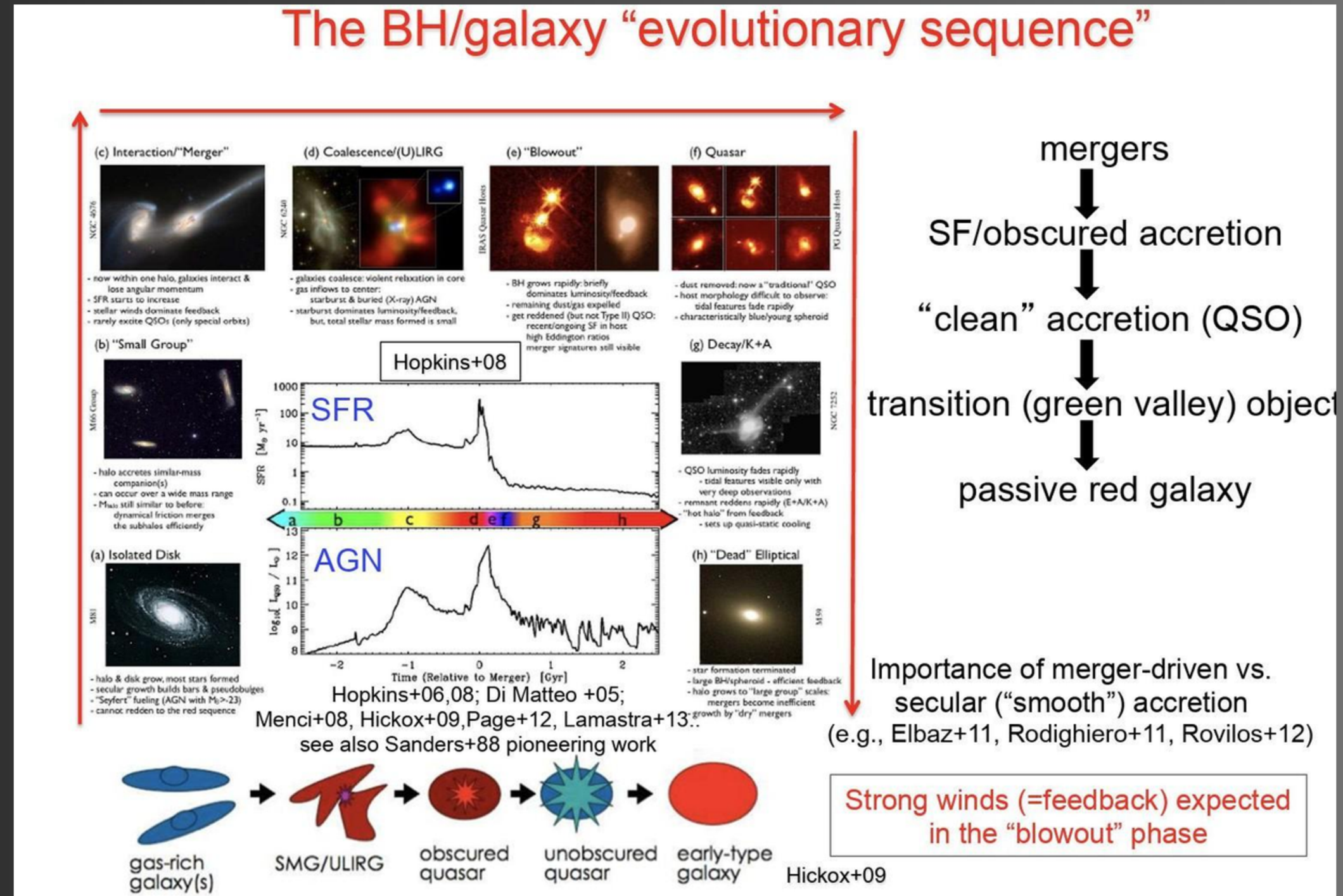
- Standard Λ CDM hierarchical model
- Small clumps merge to form large structures
- Mergers are important in the study of galaxy evolution



Credit:ESO/L.Calçada

Introduction...

- Evolutionary sequence of a galaxy
- Effects of mergers
 - Increased SFR
 - Increased AGN activity
 - Later quenching
- Is this observationally true?



Credit: Hopkins+ 2008

Overview

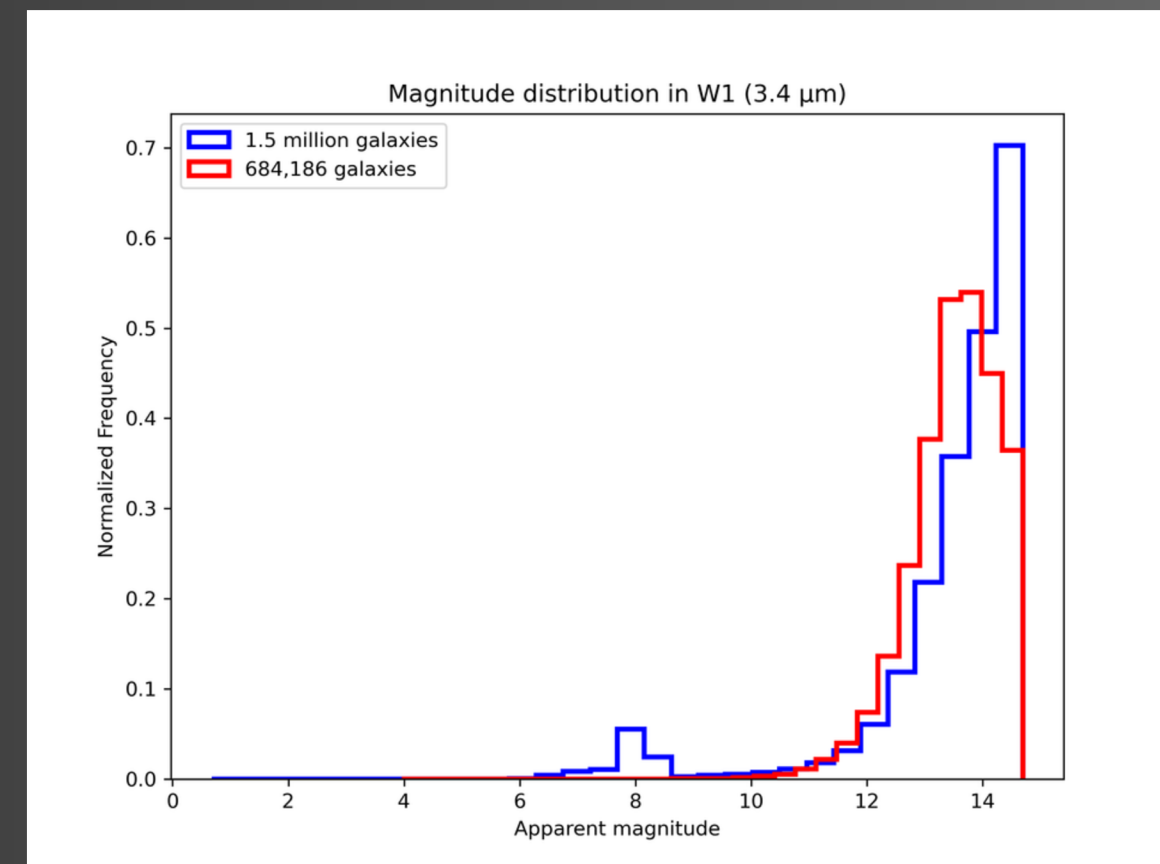
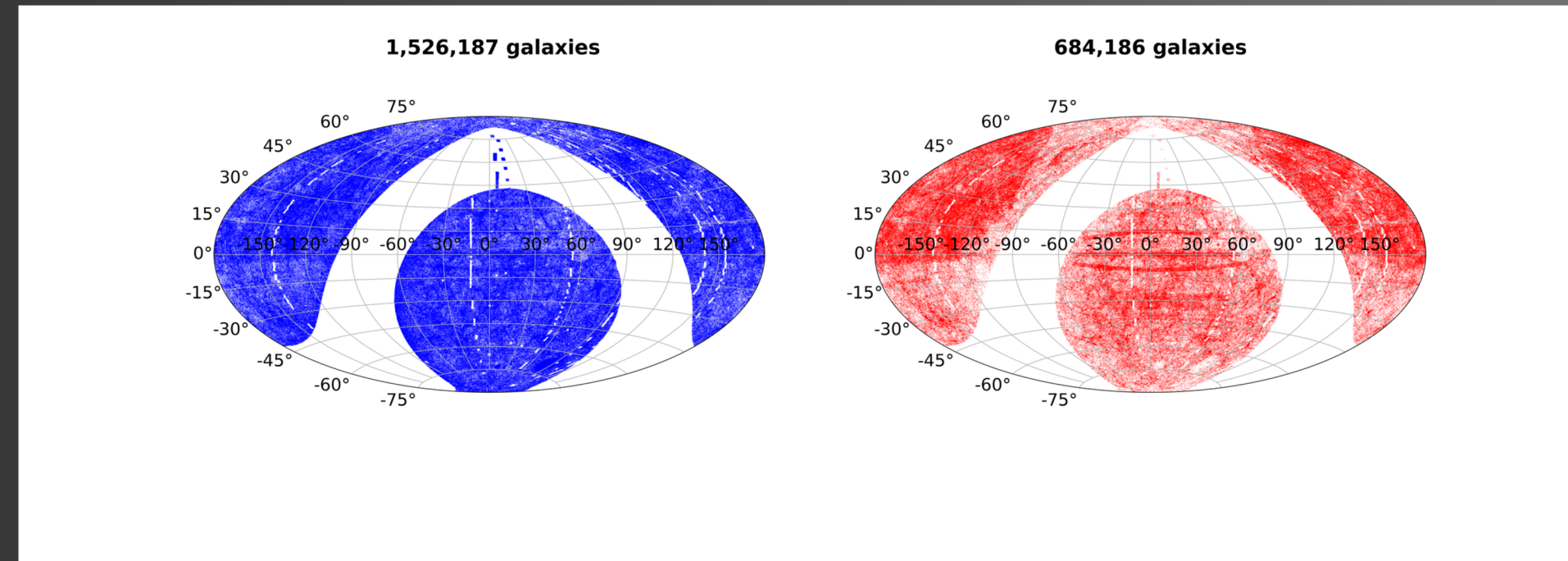
AIM: To test whether AGN activity and star formation increase with decrease in distance and velocity separation of the pairs.

Specific objectives

- Select galaxy pairs at various distance and velocity separations
- Define interacting (merging) and non-interacting pairs
- Measure AGN activity through X-ray and radio luminosities, and W1 -W2 colors
- Measure SFR through NUV-r colors
- Check if AGN activity and SFR increase as pair separation reduces

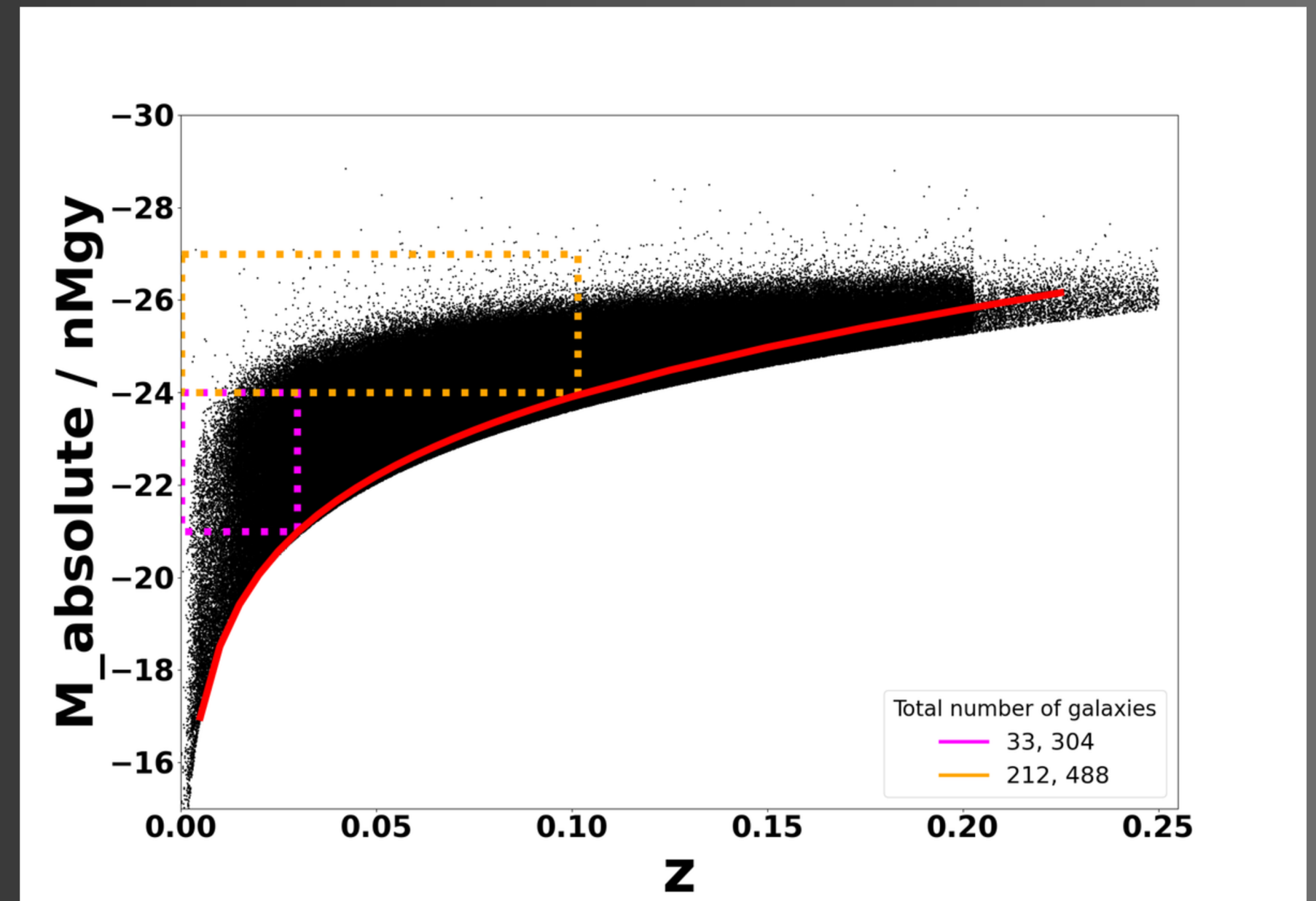
Data and sample

- unWISE data (in W1 at 3.4 μm)
- 1.5 million galaxies
- 684,186 galaxies at $z < 0.2$ using NED-LVS and SDSS
- Bias on faint sources
- Additional survey used:
 - eROSITA (X-ray data)
 - NVSS (radio data)
 - SDSS (Optical)
 - Gaia, PanSTARRS, SkyMapper



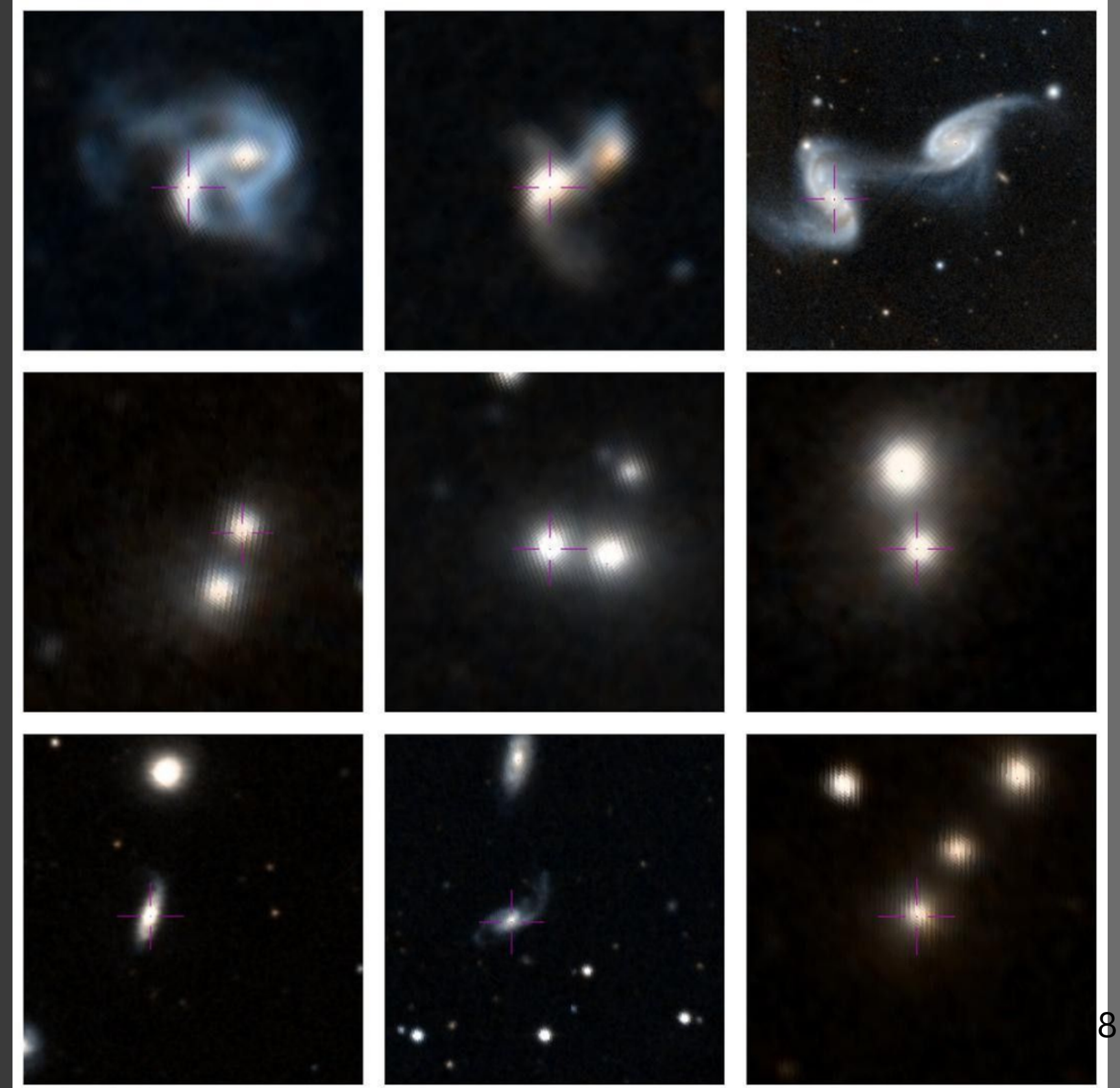
Methodology

- 2 volume-limited boxes (3 mag)
- Pair separation
 - r_p : 0-20, 20-50, 50-100, 100-250, 250-500, 500-1000 kpc
 - dv : 0-500, and 500-1000 km/s
- Closest pairs definition:
 - $r_p < 20$ kpc & $dv < 500$ km/s (Depropris+, 2007)



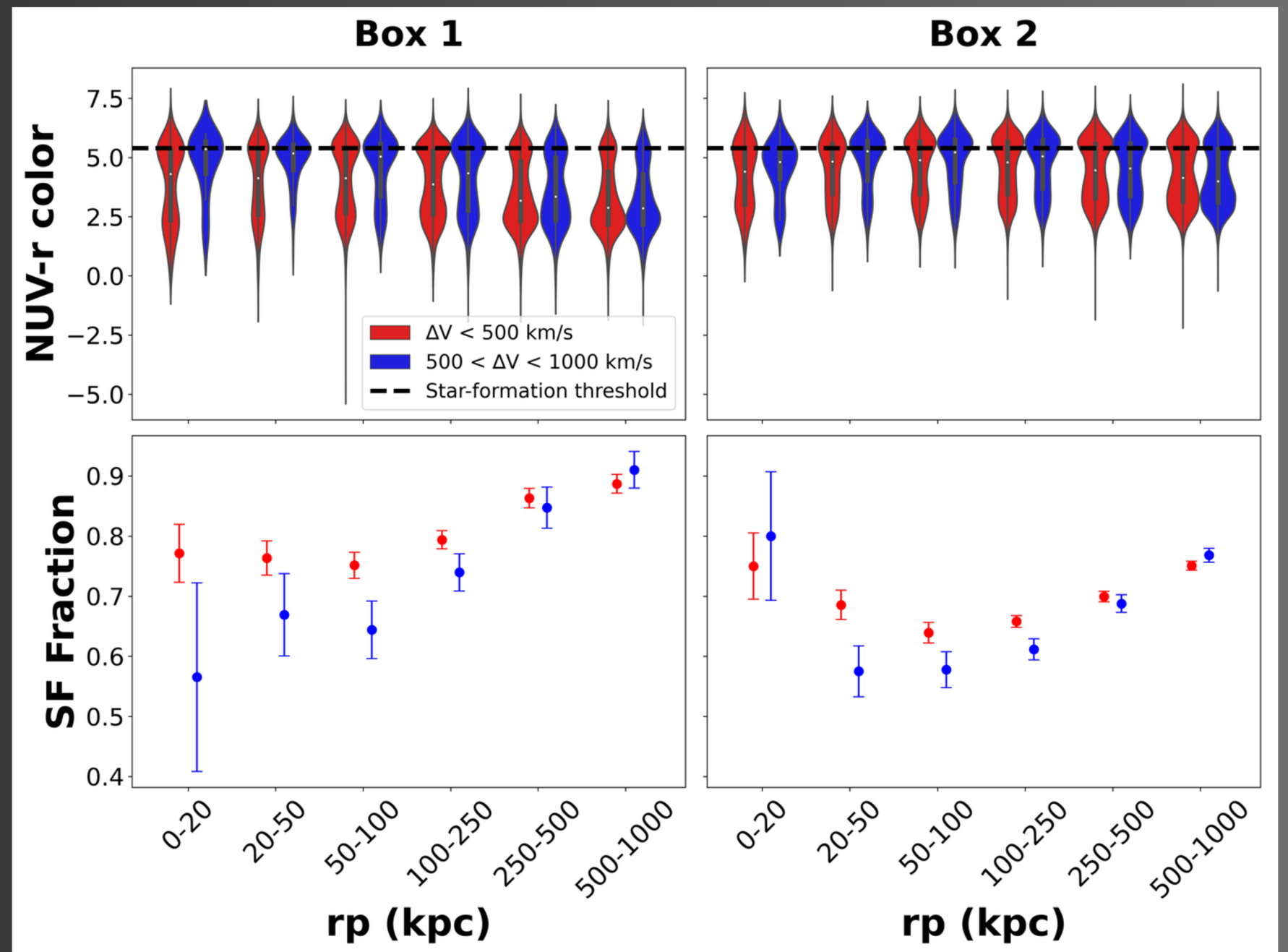
Visual classification

- Merger classes:
 - strongly interacting (top row)
 - weakly interacting (middle row)
 - not interacting (bottom row)



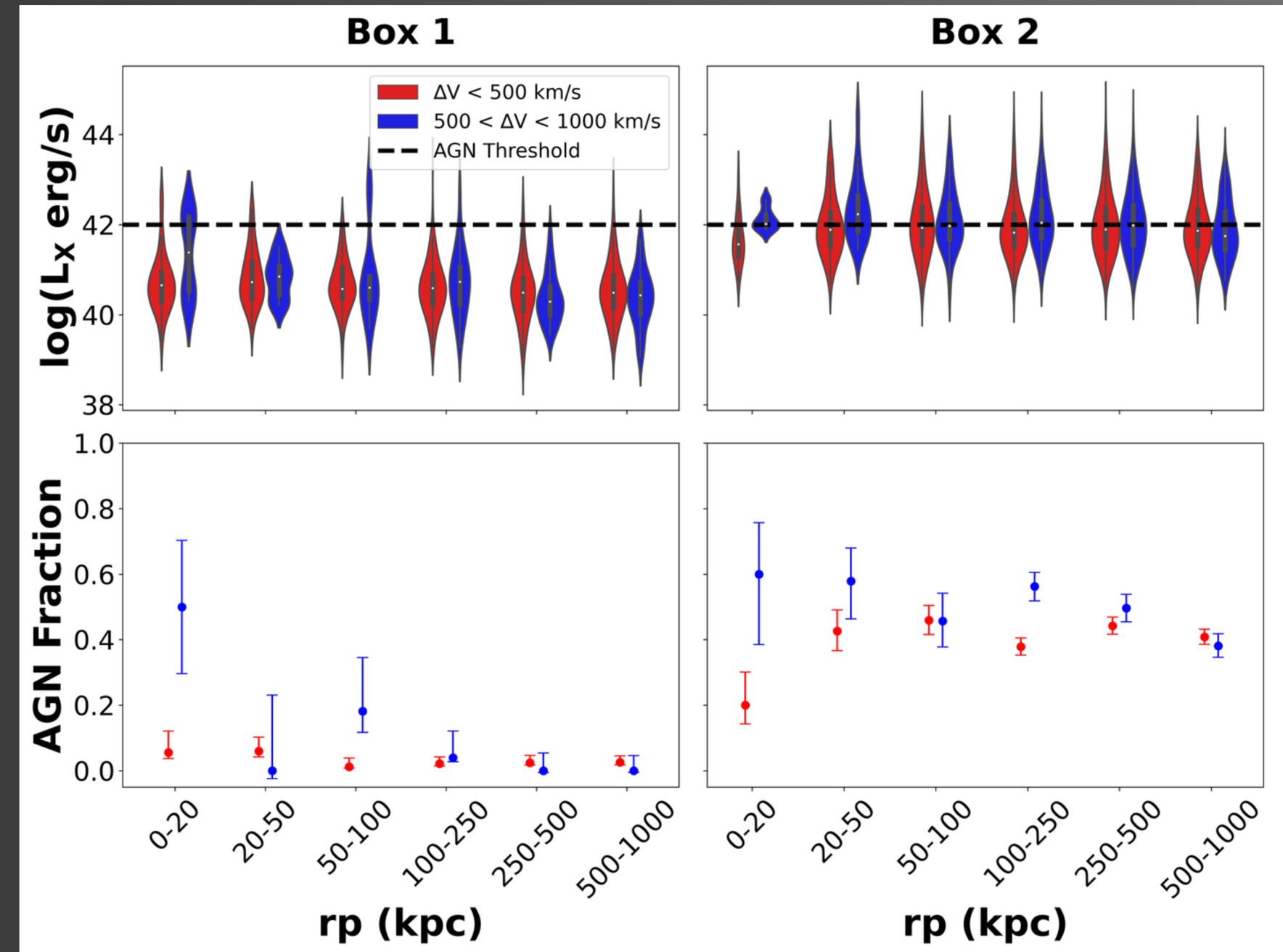
Results

- Star formation rate:
 - NUV-r color < 5.4 (e.g., Salim, 2015)
- SFR decreases with decreasing distance and velocity separation
- No significant effect of pair separation on SFR



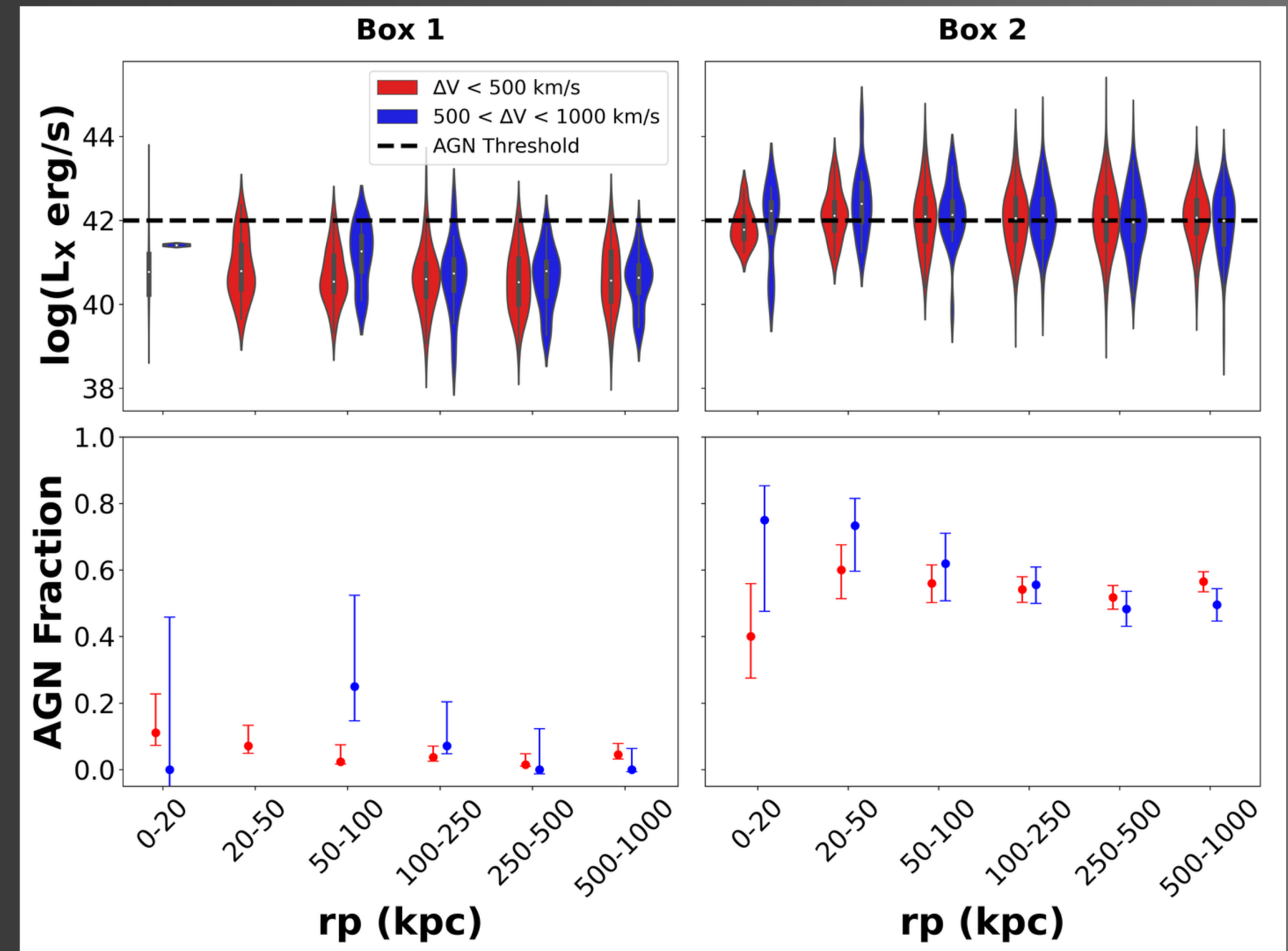
Results...

- Soft band (0.2-2.3 keV) X-ray AGN luminosity (L_x):
 - $L_x > 10^{42}$ erg/s (e.g., Liu et al., 2022)
- No significant increase in luminosity as pair separation decrease
- AGN fraction increases as magnitude (mass) increases



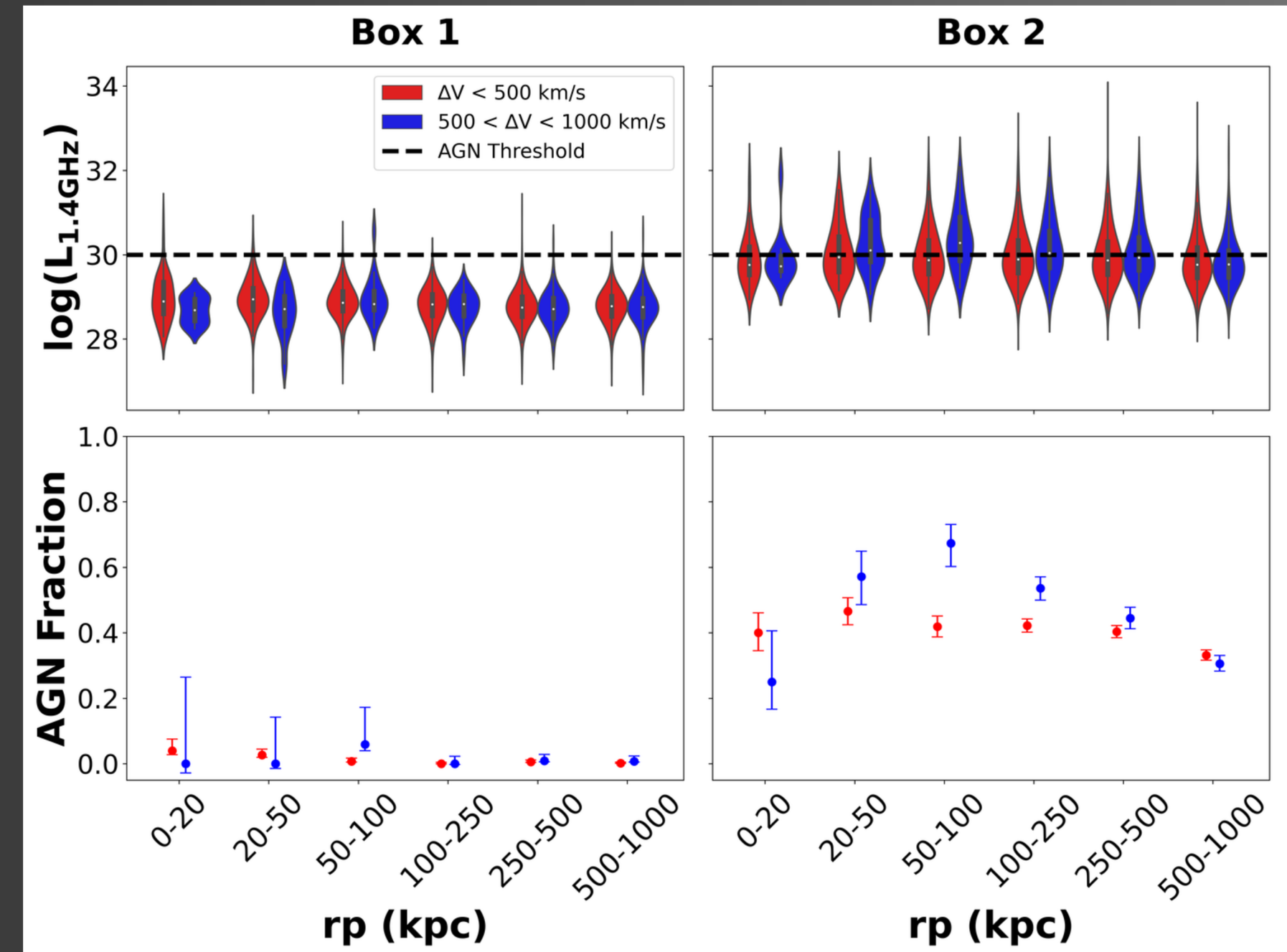
Results...

- Hard band (2-5 keV) X-ray AGN luminosity (L_x):
 - $L_x > 10^{42}$ erg/s (e.g., Liu et al., 2022)
- No significant increase in luminosity as pair separation decrease
- AGN fraction increases as magnitude (mass) increases



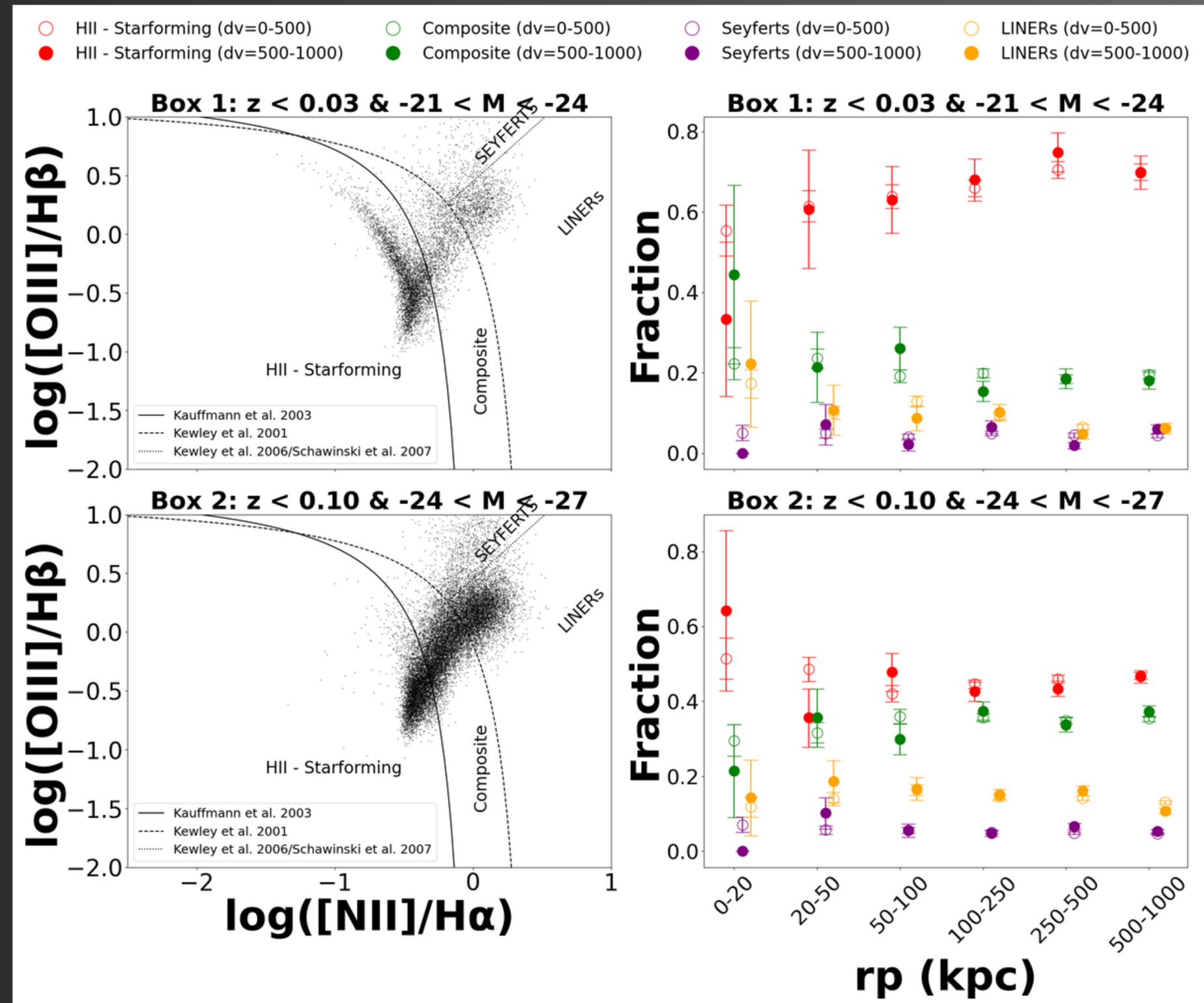
Results...

- Radio luminosity at 1.4 GHz (L_{radio}):
 - $L_{\text{radio}} > 10^{30}$ erg/s/Hz (e.g., Best et al., 2005)
- No significant increase in luminosity as pair separation decrease
- AGN fraction increases as magnitude and redshift increase
- Similar results obtained with infrared classification



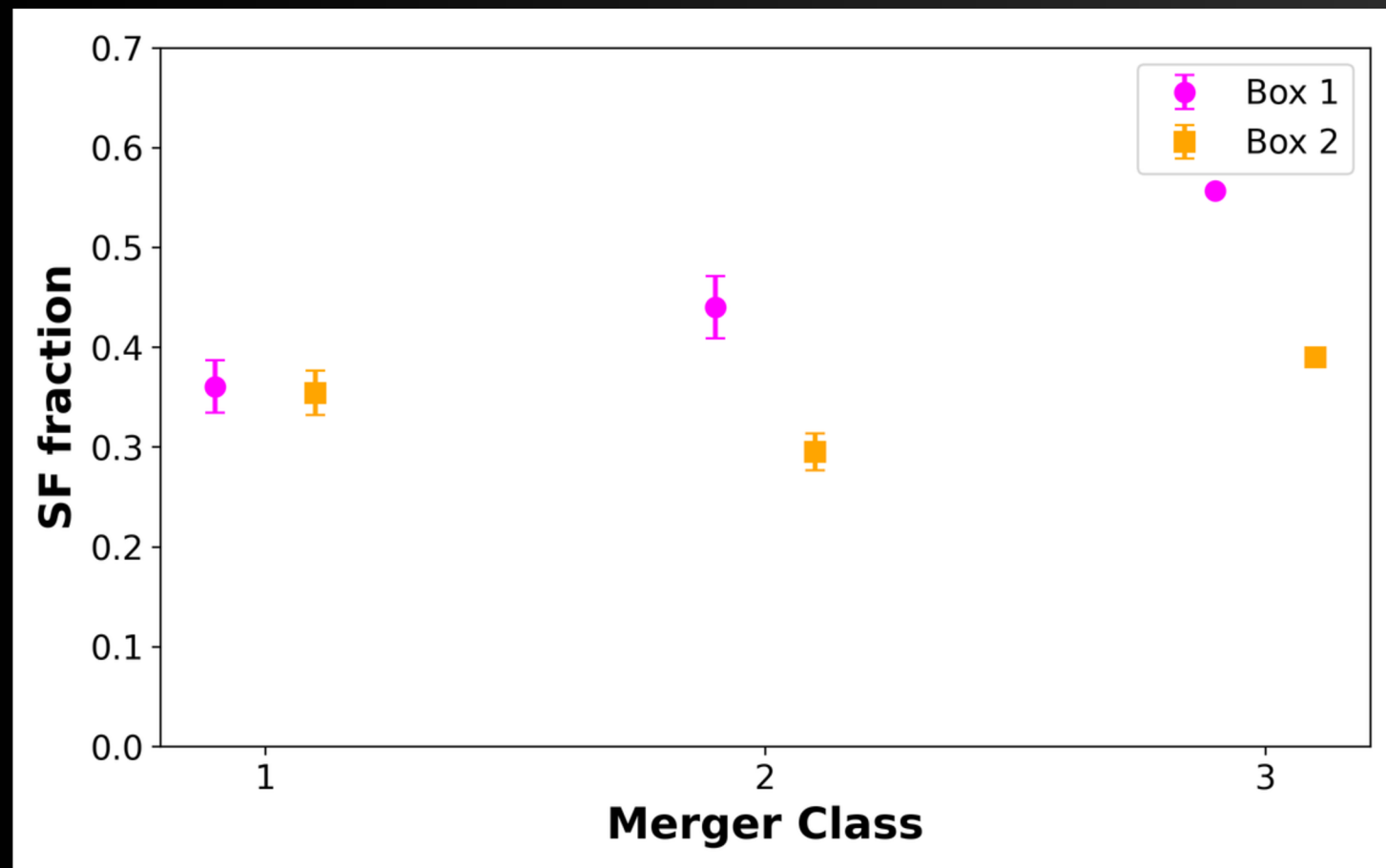
Results...

- Optical classification
- BPT diagram
- Classes
 - Star forming
 - Composite
 - Seyfert II
 - LINERS



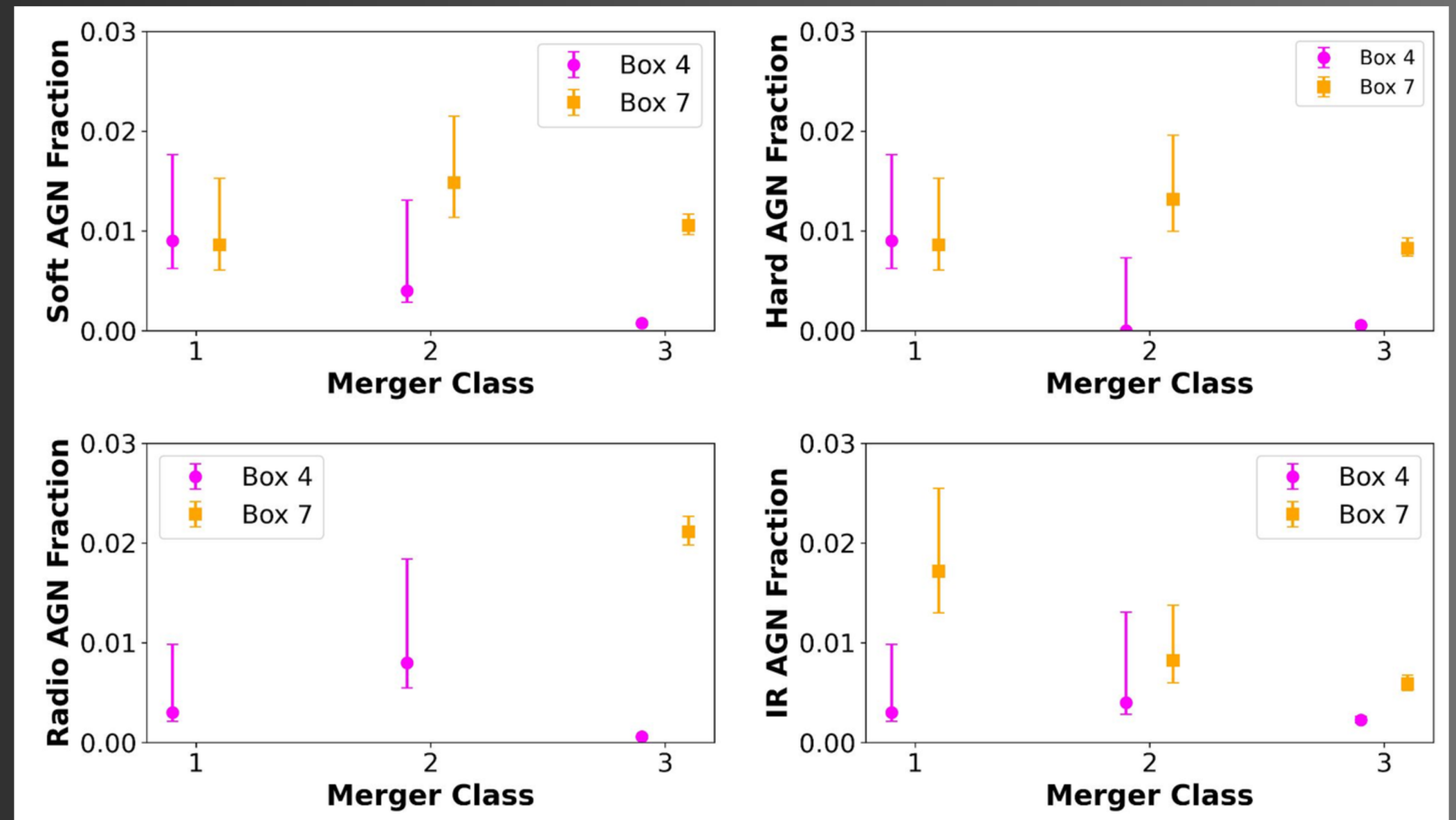
Visual classification

- No significant increase in star formation in interacting pairs



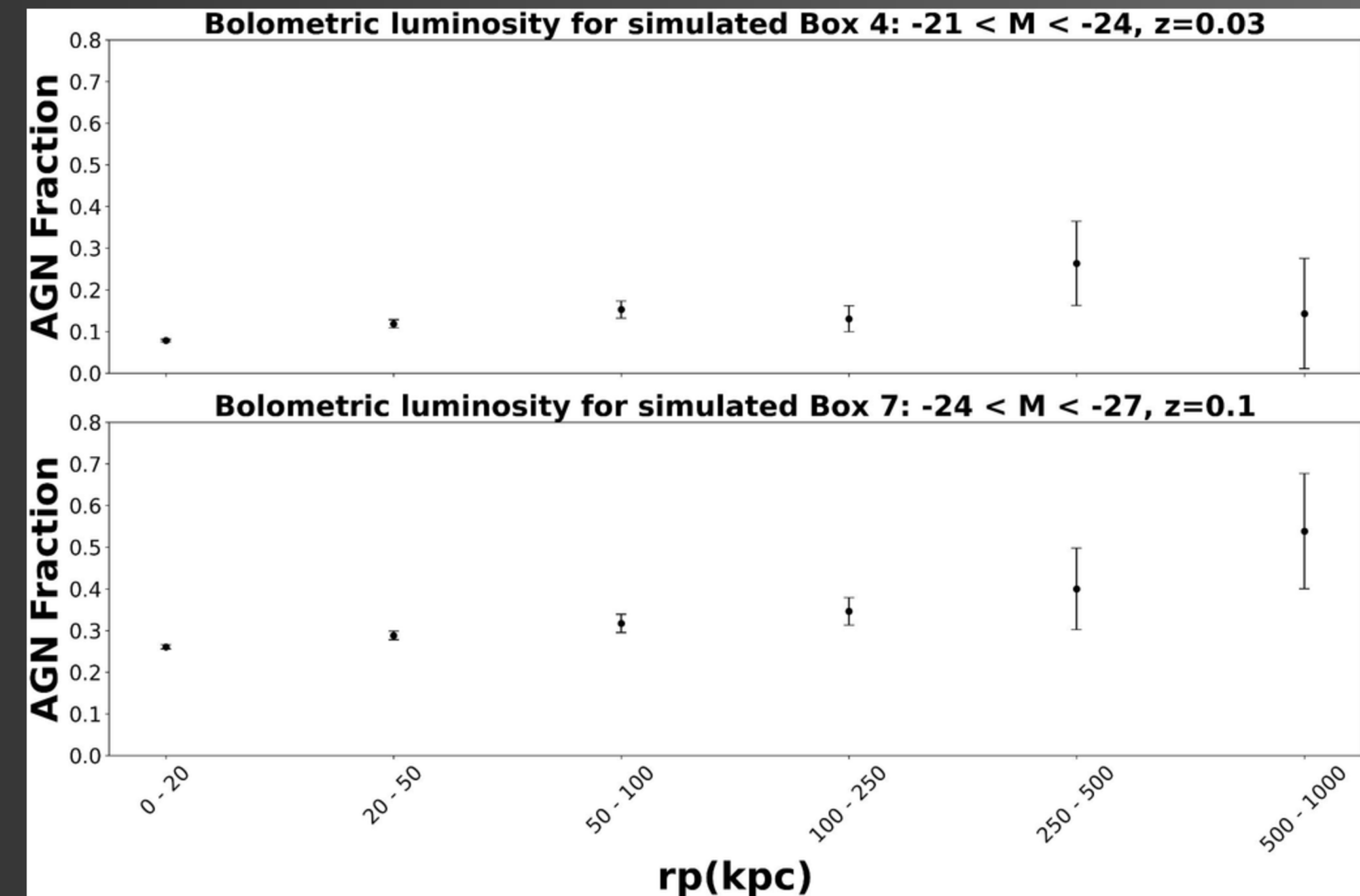
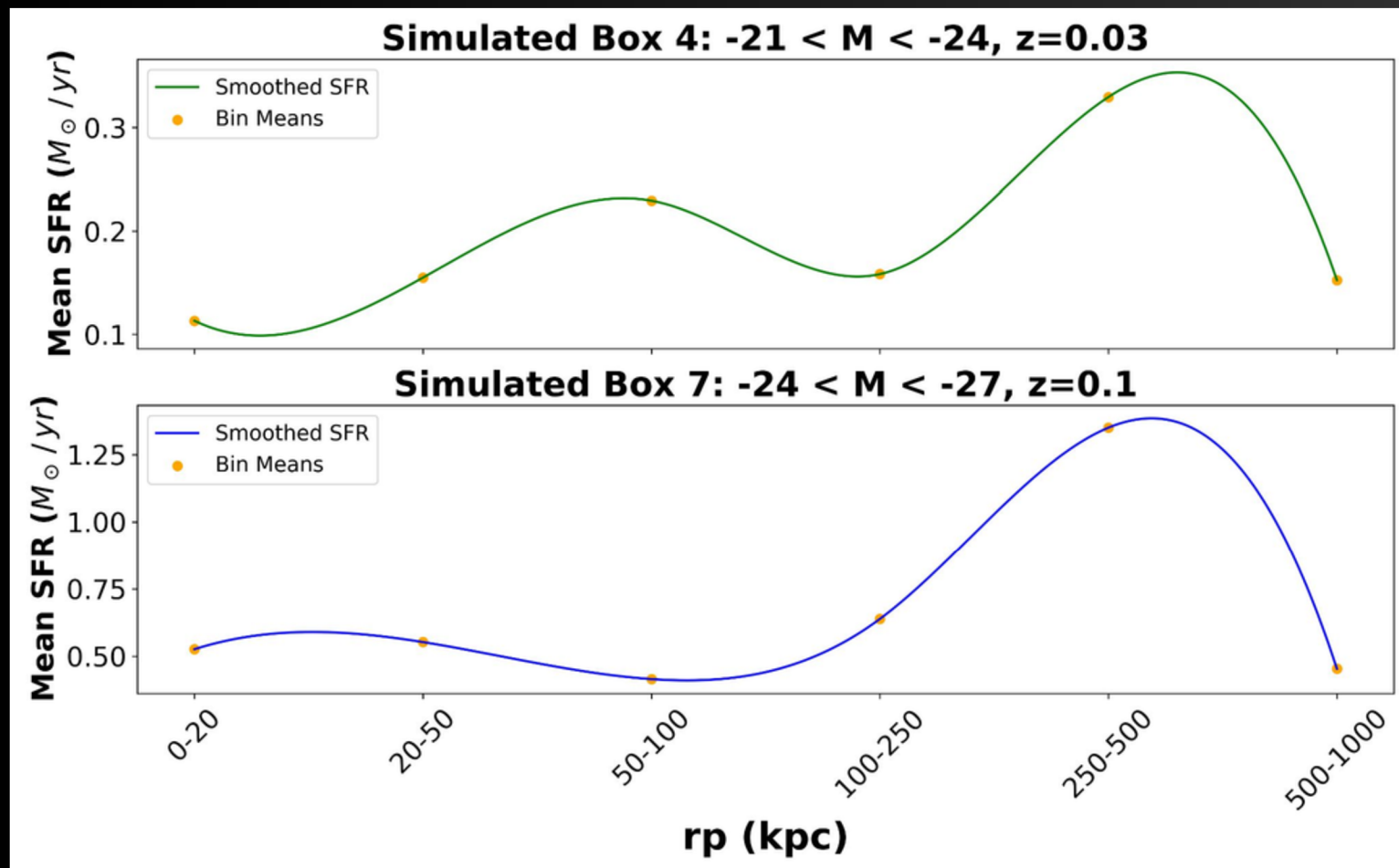
- 1: Strongly interacting
- 2: Weakly interacting
- 3: Not interacting

- No significant increase in AGN fraction in interacting pairs



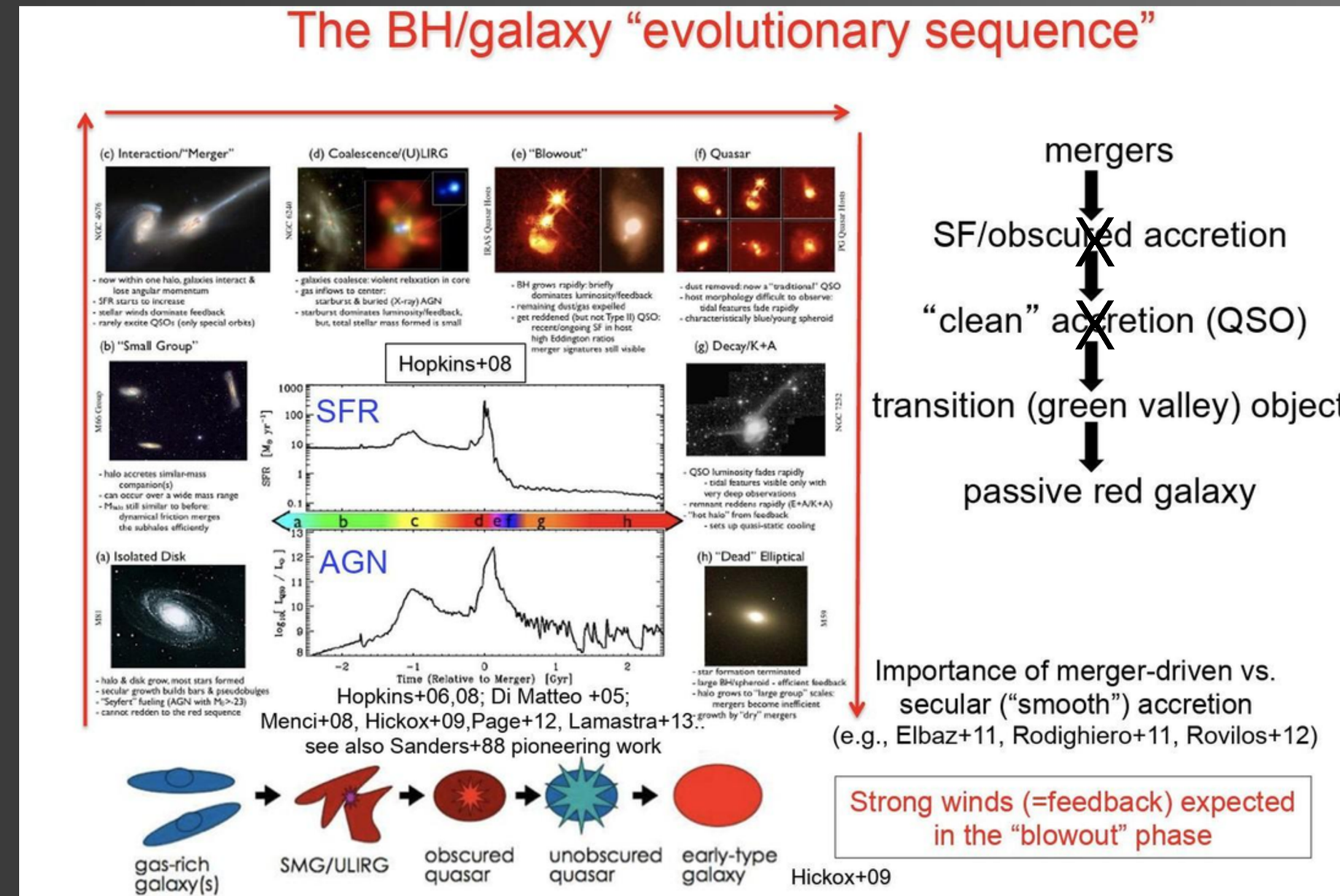
Comparison with TNG300 Simulation

- No increase in star-forming and AGN fraction in close pairs
- Consistent with observational results



Conclusion

- Galaxy close pair interactions at low redshift do not:
 - Increase star formation
 - Trigger AGN activity
- Fraction of AGN increase with increase in stellar mass



Credit: Hopkins+ 2008

Thank you !!!

