

Low Mass Galaxy Interactions Trigger Black Hole Activity

Marko Mićić (University of Oklahoma)

Dodge Family Postdoctoral Fellow



ApJL, 968, L21, 2024
Nature, 630, 795, 2024



October 8, 2024
Yerevan, Armenia

Introduction

- Discoveries of SMBHs in the young Universe

- 1) $8 \times 10^8 M_{\text{sol}}$ at $z=7.5$ (Banados+2018)

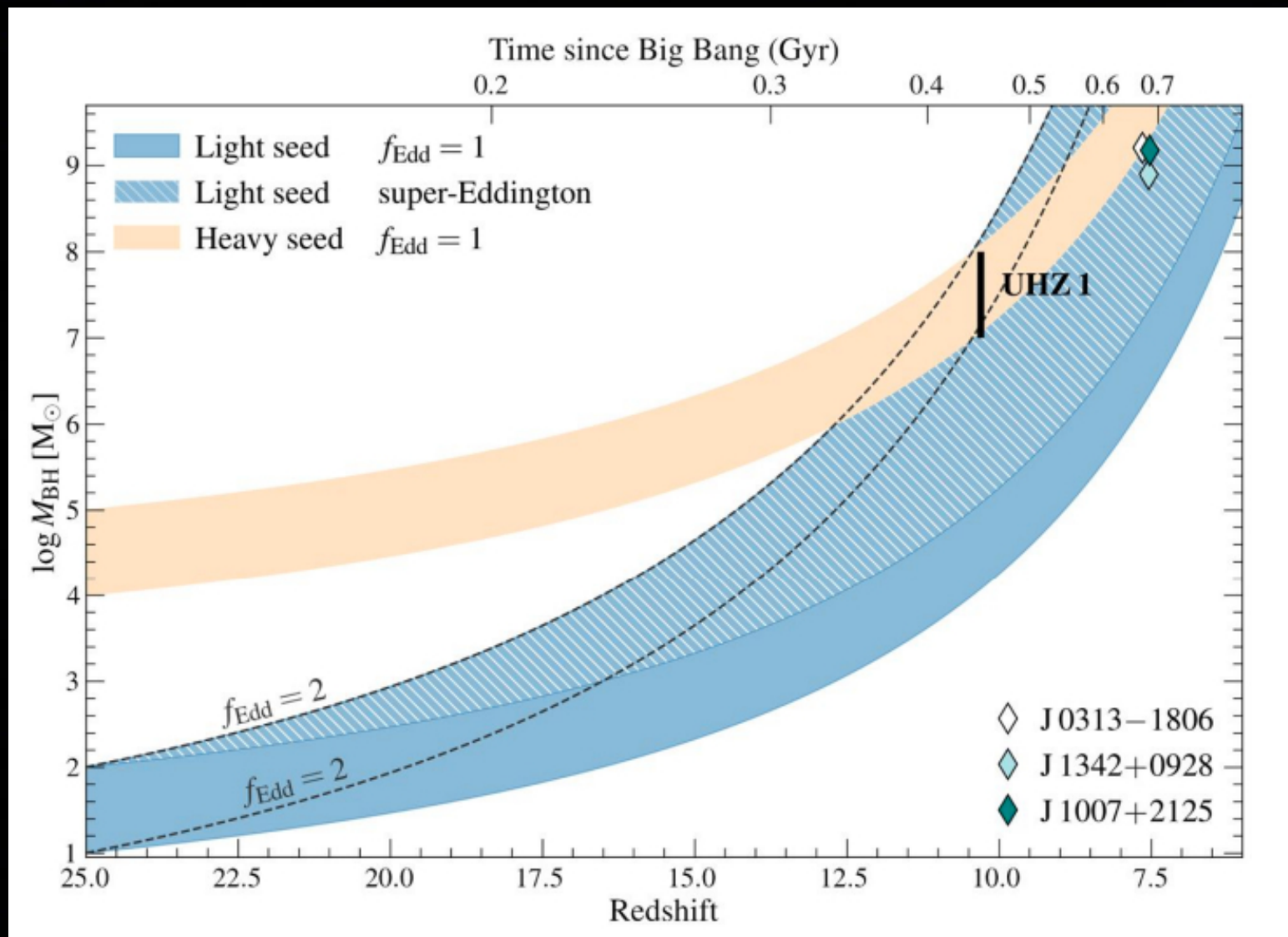
- 2) $1 \times 10^9 M_{\text{sol}}$ at $z=7.5$ (Yang+2020)

- 3) $2 \times 10^9 M_{\text{sol}}$ at $z=7.6$ (Wang+2021)

- 4) $10^7 - 10^8 M_{\text{sol}}$ at $z=10.3$ (Bogdan+2024)

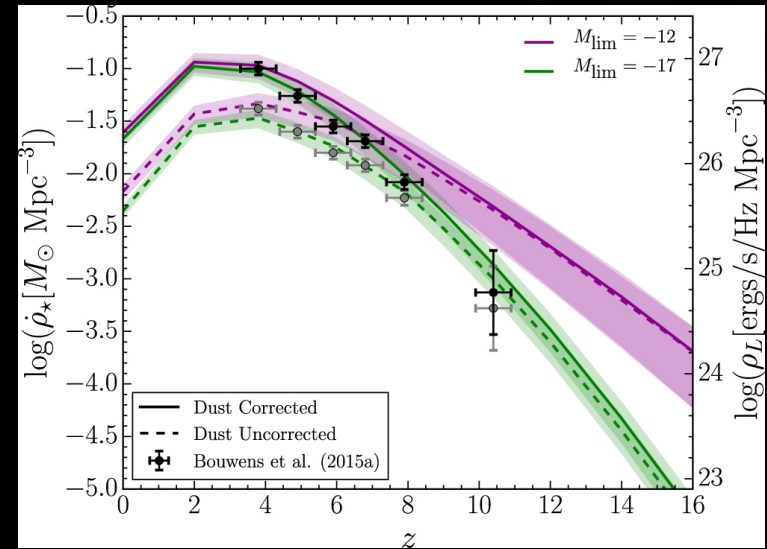
...and many more

SMBH Formation Scenarios



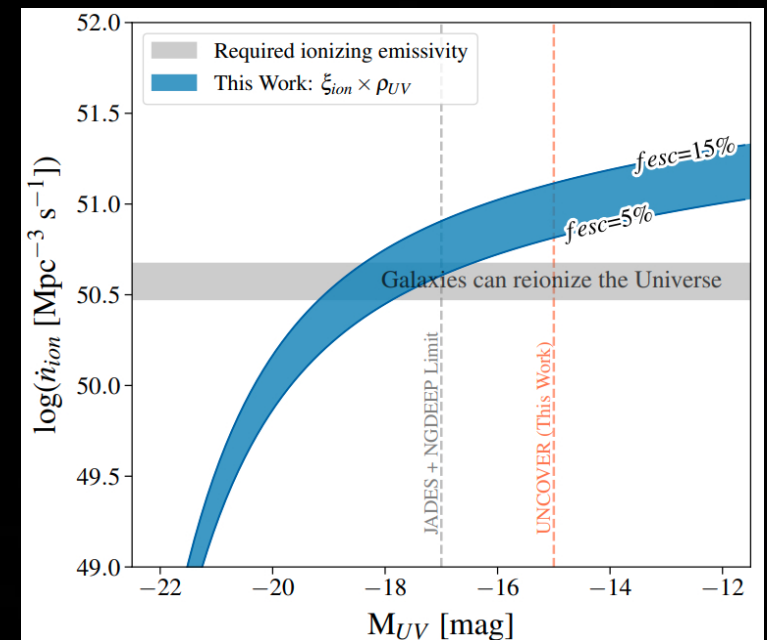
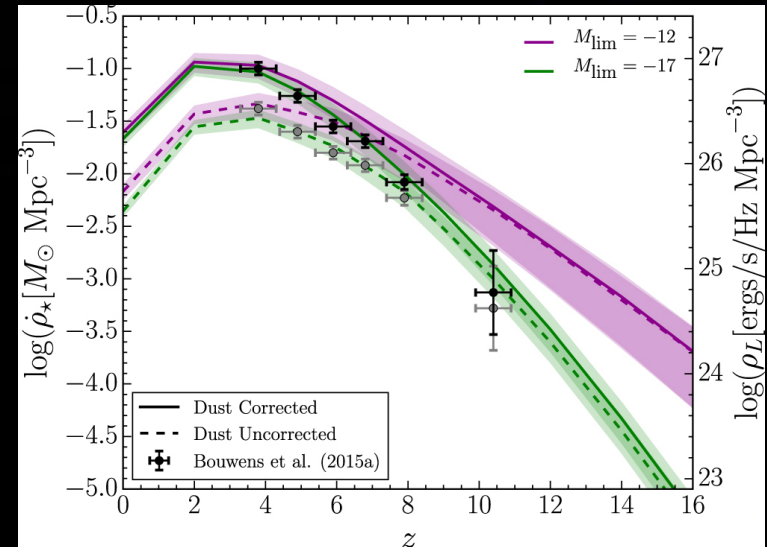
Galaxy Demographics in the Early Universe

- From UV LF, unseen faint dwarfs dominate galaxy population beyond $z=7$ (Mason+2015)



Galaxy Demographics in the Early Universe

- From UV LF, unseen faint dwarfs dominate galaxy population beyond $z=7$ (Mason+2015)
- JWST data suggests that faint galaxies reionized the Universe (Atek+2024)



Galaxy Interactions as AGN Triggers

- Theory, simulations, observations

Galaxy Interactions as AGN Triggers

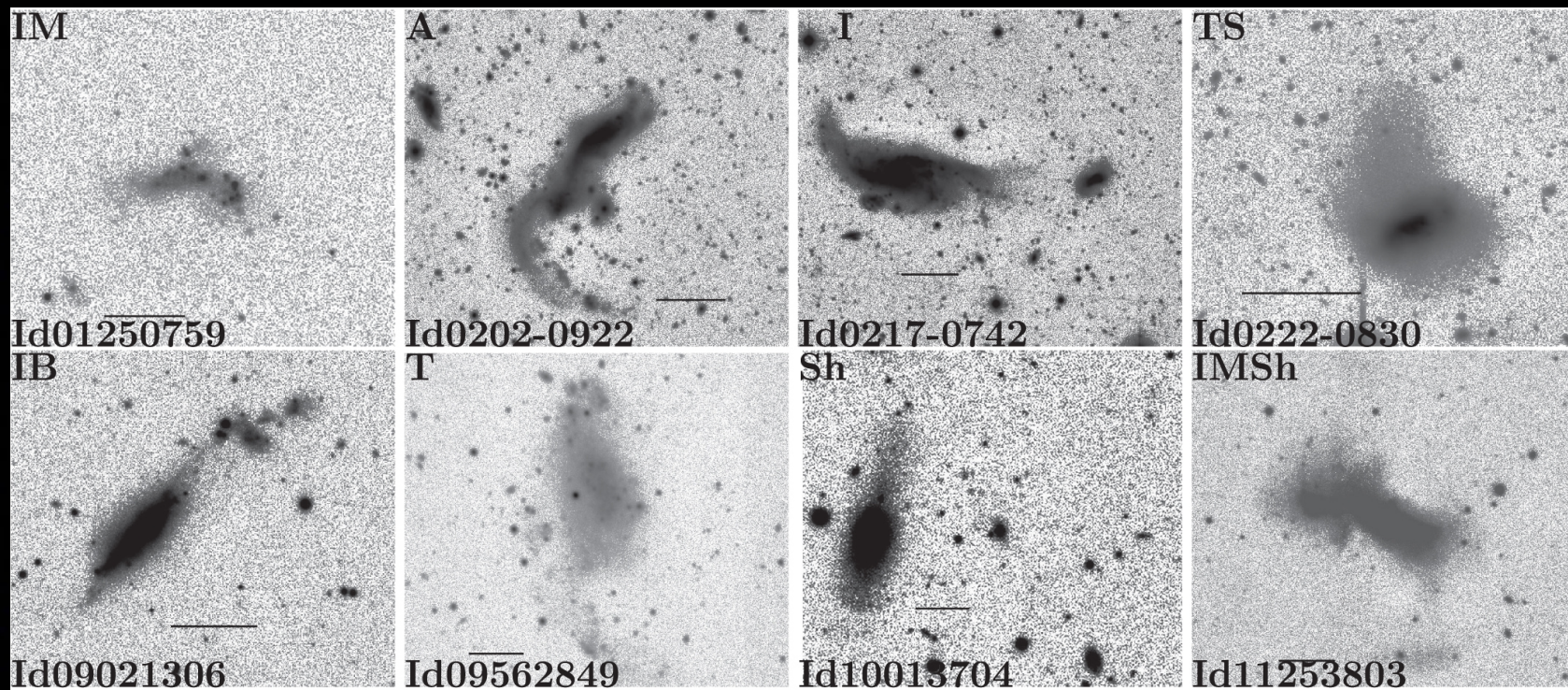
- Theory, simulations, observations
- Some claim no relationship (Alonso+2007, Li+2008, Silva+2019)

Galaxy Interactions as AGN Triggers

- Theory, simulations, observations
- Some claim no relationship (Alonso+2007, Li+2008, Silva+2019)
- Some claim strong relationship (Gao+2020, Li+2023, Comerford+2024)
- Various stages of interactions
- Various mass scales

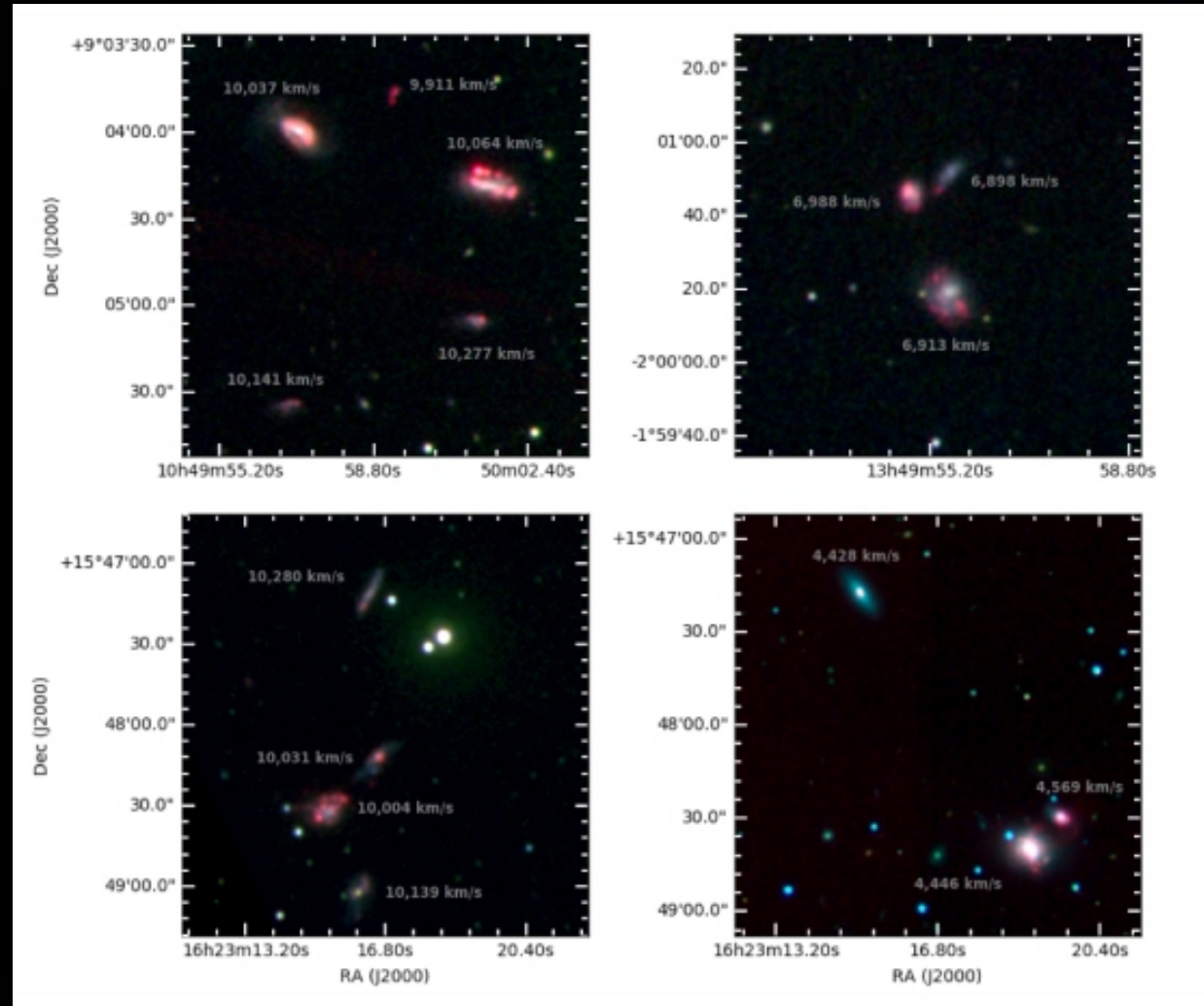
Dwarf-dwarf Galaxy Pairs

- The Tiny Titans (Stierwalt+2015)
- Sample of dwarf-dwarf pairs from SDSS (Paudel+2018)



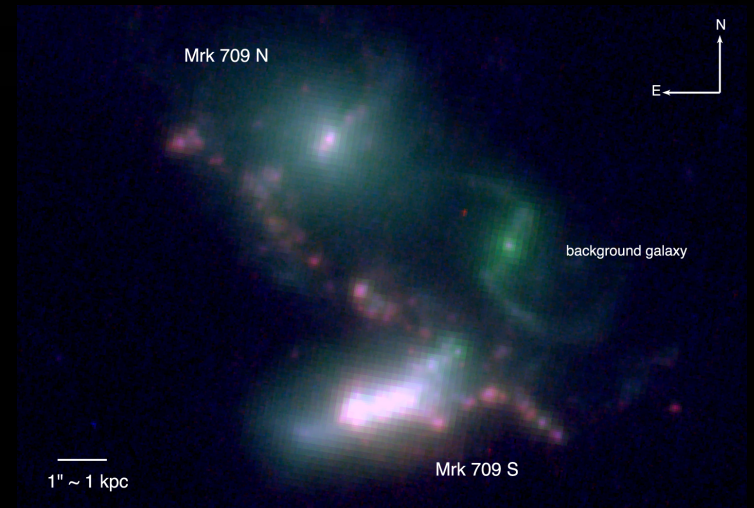
Dwarf Galaxy Groups

- Small sample of dwarf galaxy groups (Stierwalt+2017)



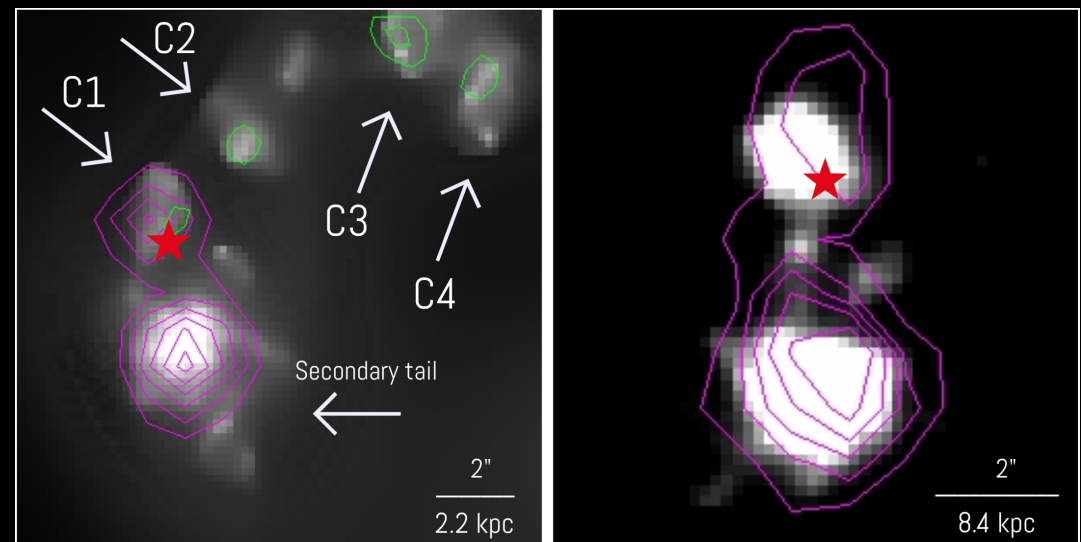
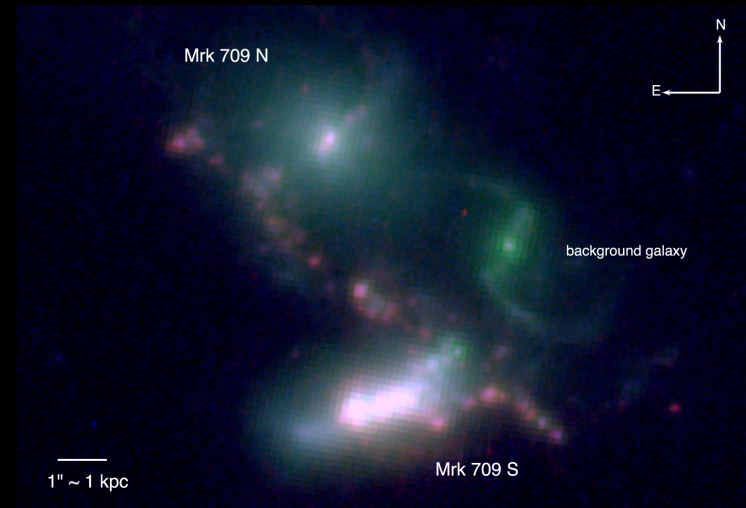
AGN in Dwarf-dwarf Interactions

- Only one confirmed AGN, Mrk709 (Reines+2014, Kimbro+2021)



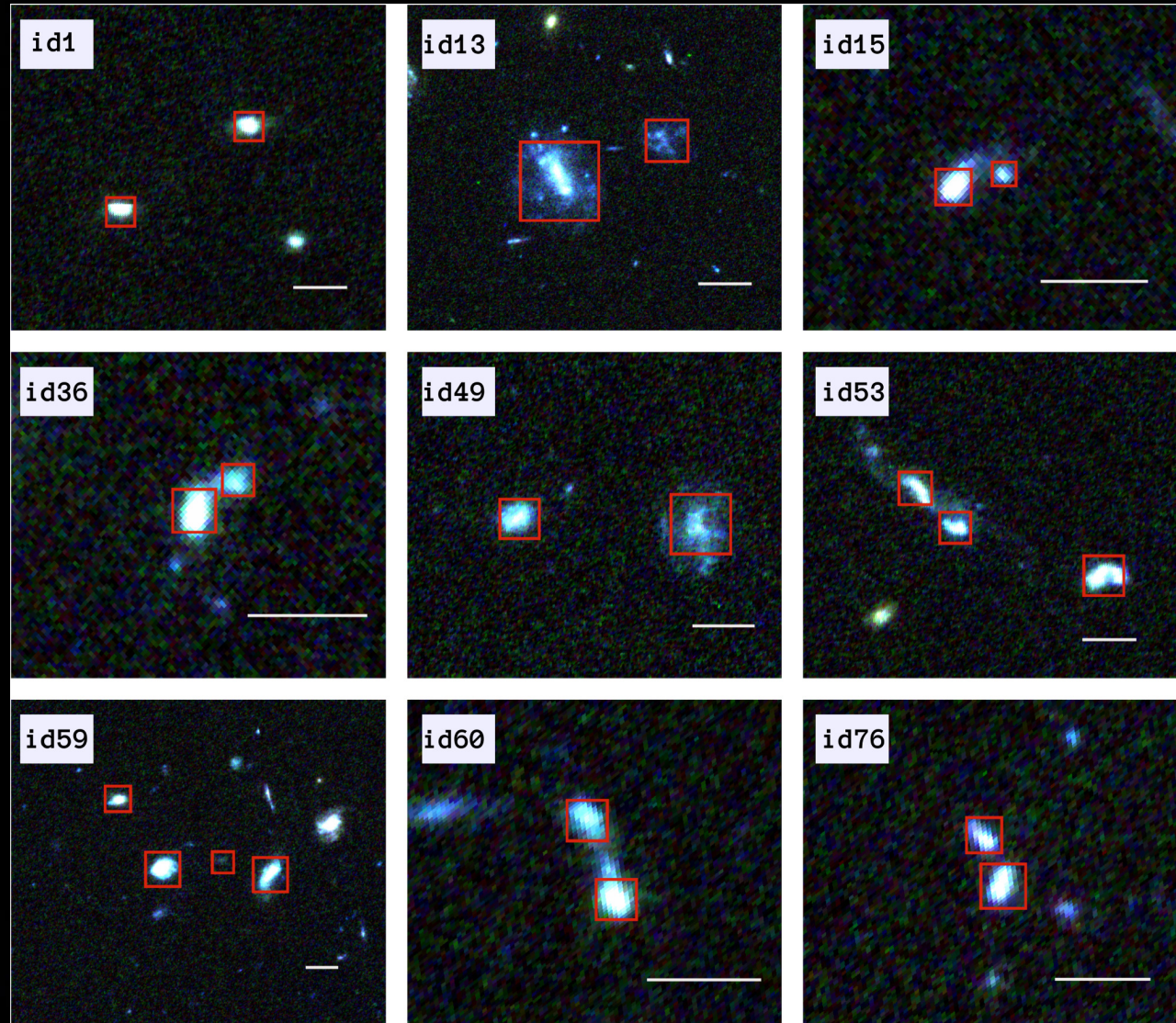
AGN in Dwarf-dwarf Interactions

- Only one confirmed AGN, Mrk709 (Reines+2014, Kimbro+2021)
- Two more candidates for dual AGN (Mićić+2023)



A New Sample of Dwarf Systems

- CANDELS fields
- 3D-HST survey
- 82 dwarf pairs
- 11 dwarf groups



X-ray Detected AGN

- GOODS-S, $t_{\text{exp}}=7\text{Msec}$

X-ray Detected AGN

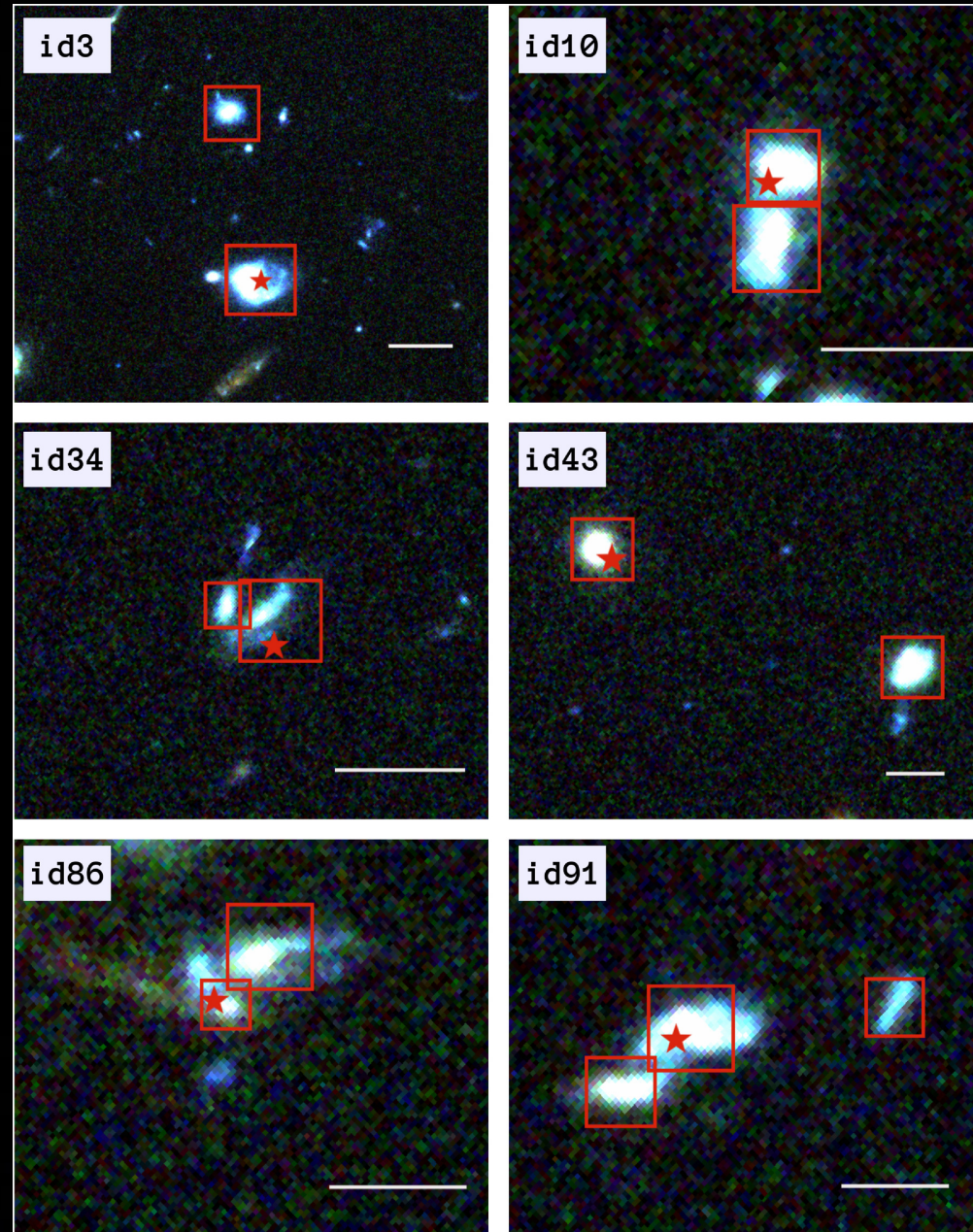
- GOODS-S, $t_{\text{exp}}=7\text{Msec}$
- Importance of LLAGN

X-ray Detected AGN

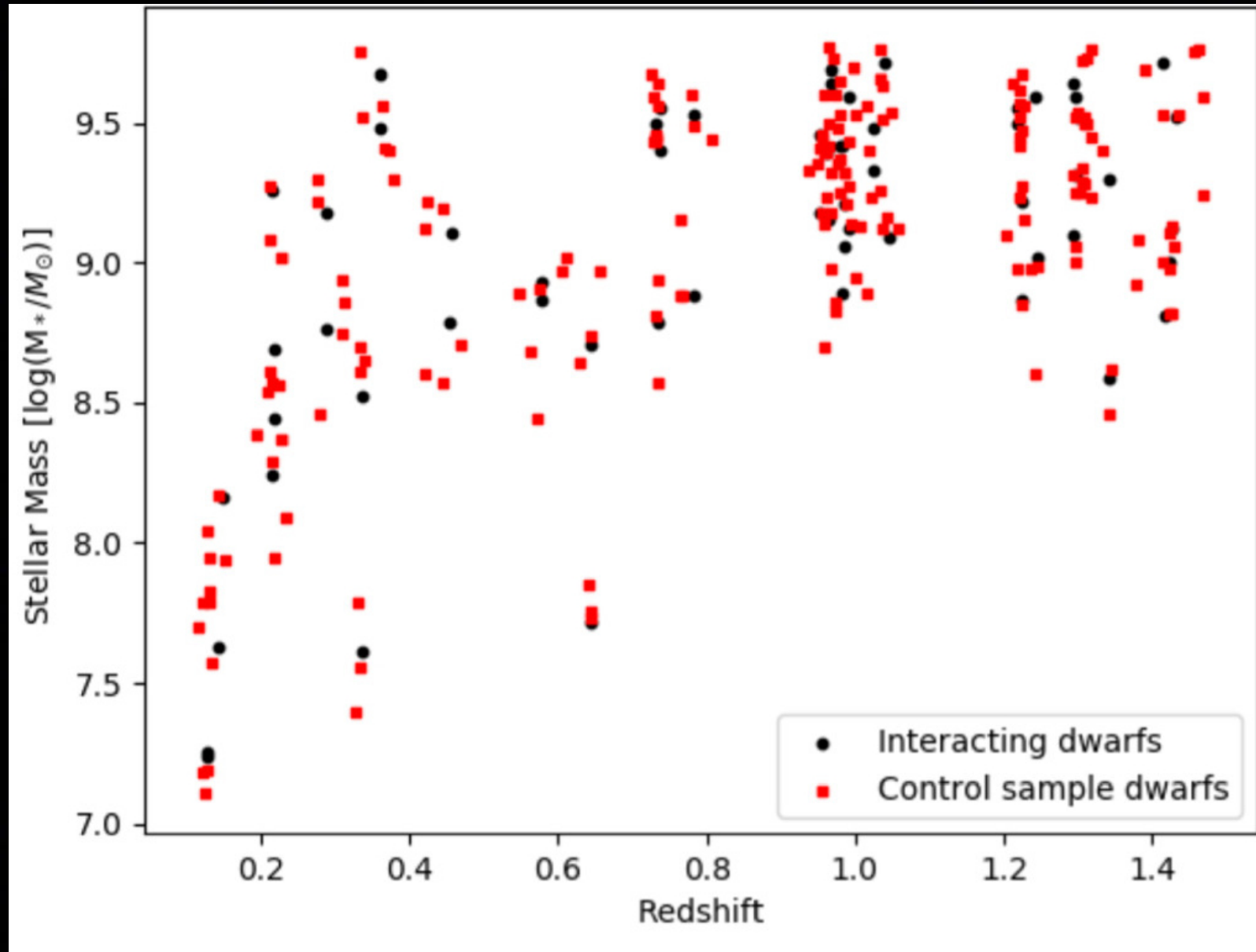
- GOODS-S, $t_{\text{exp}}=7\text{Msec}$
- Importance of LLAGN
- Corrected for non-AGN contributions

X-ray Detected AGN

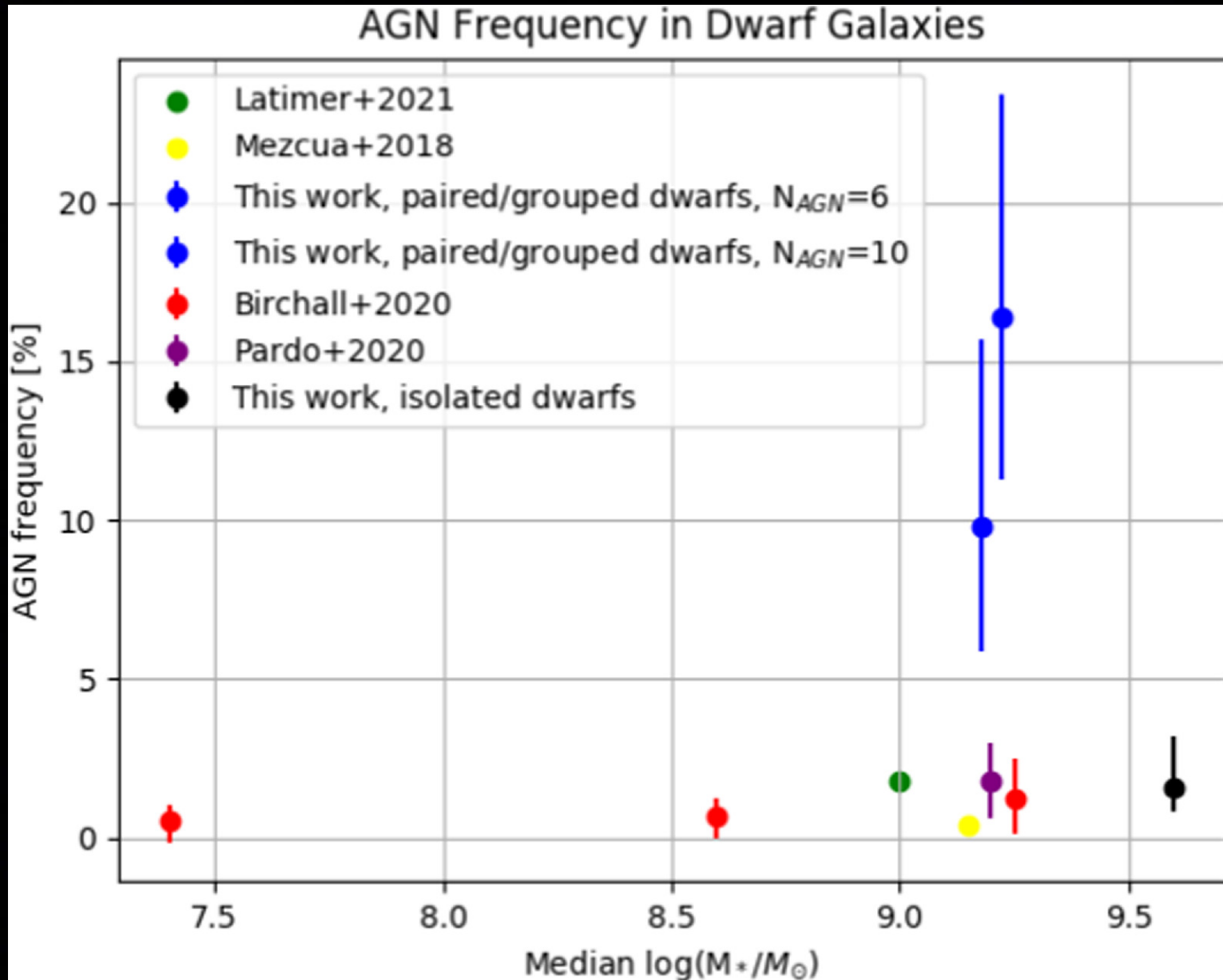
- GOODS-S, $t_{\text{exp}}=7\text{Msec}$
- Importance of LLAGN
- Corrected for non-AGN contributions
- 6-10 new AGN
- 10-15% frequency



Control Sample

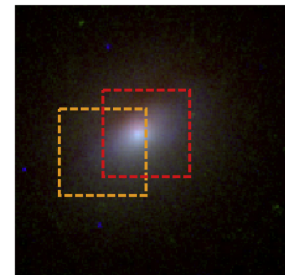
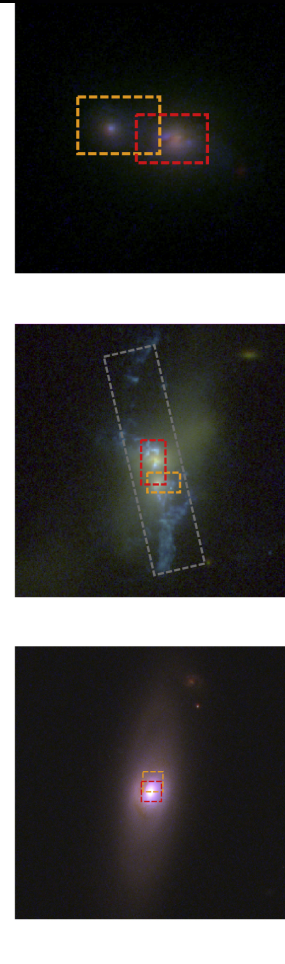
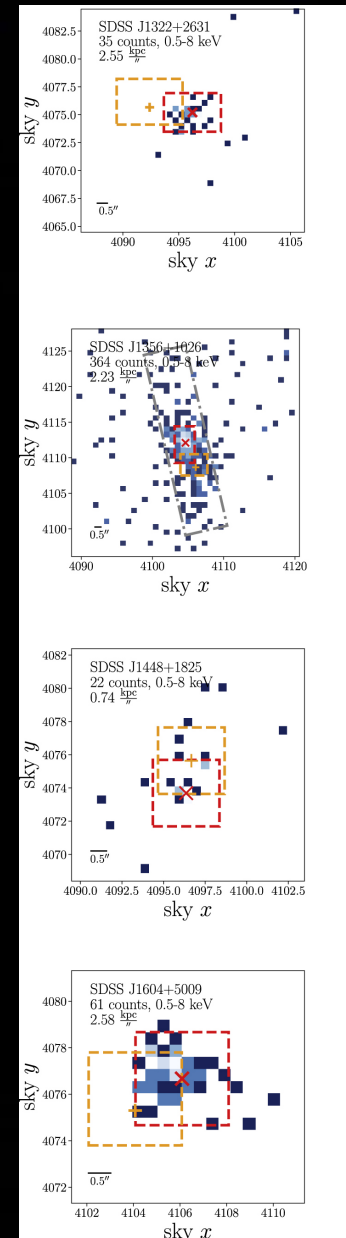


AGN in Interacting vs. Isolated Dwarfs



Current Work

- Bayesian Analysis of AGNs in X-rays-BAYMAX (Foord+2020)
- Stacking analysis
- Minor mergers and rapid black hole growth



Foord+(2020)

THANK YOU!

Demographics of Dwarf Systems

