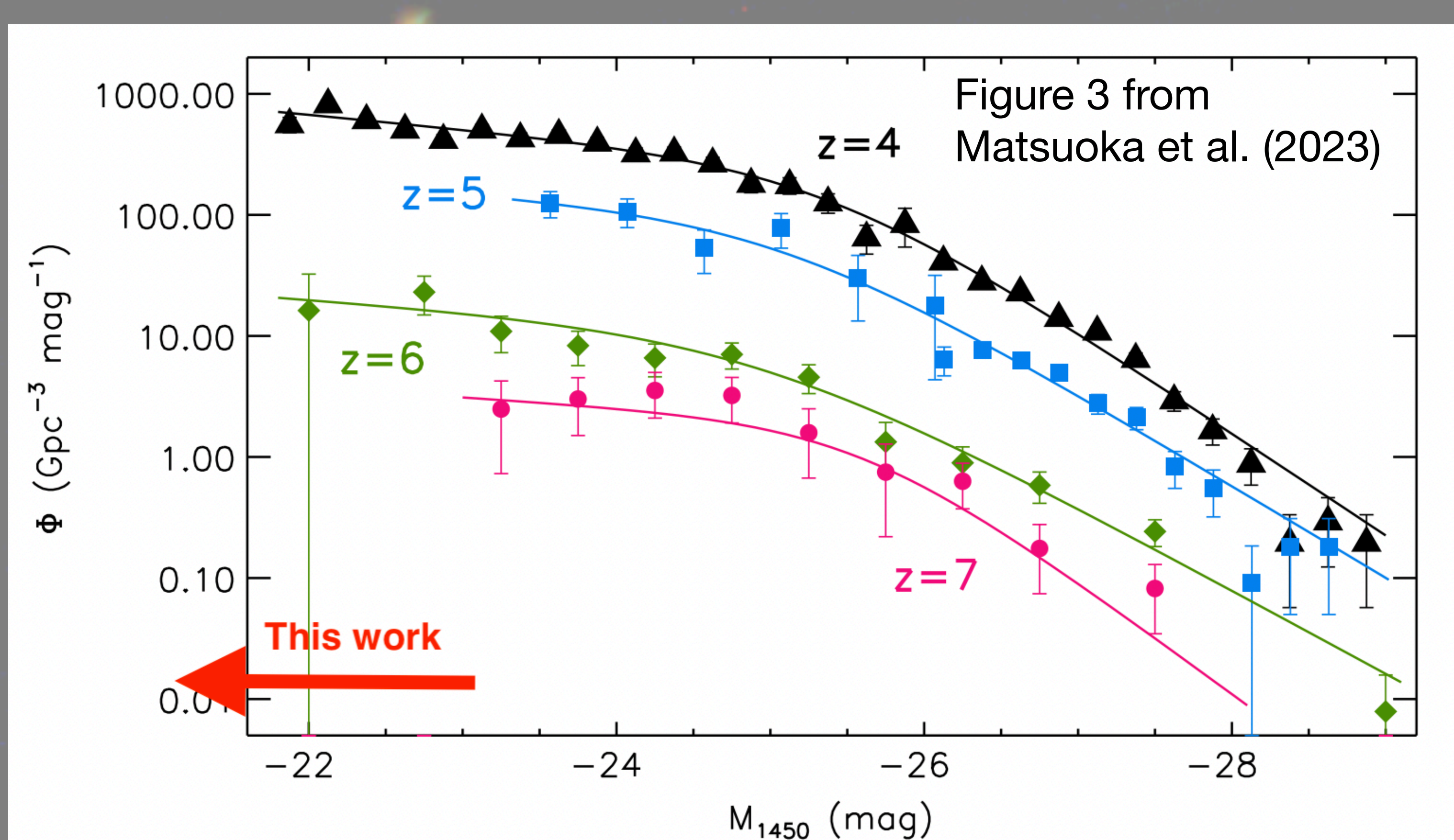
HST+JWST: NIR Variability-Selected Faint AGN at High Redshift

Wei Leong Tee: wltee@arizona.edu
Xiaohui Fan, Feige Wang, ASPIRE Collaboration
University of Arizona

Background

- Supermassive black hole (SMBH) growth at high redshift remain mystery since the discovery of high redshift quasars and AGNs [1].
- Faint, low-luminosity AGNs are important ingredients in understanding SMBH growth and BH-host galaxy co-evolution [2,3].
- High redshift faint AGN are incomplete:
  - Outshine by host galaxies.
  - Popular identification through broad emission lines only work for relatively luminous AGNs.
  - Discovery through JWST Slitless Spectroscopy only works for limited redshift and emission lines.



Sample Selection

- Utilizing archival HST and JWST in deep fields, e.g. Extended Groth Strip (EGS).
- JWST: The Cosmic Evolution Early Release Science Survey (CEERS)
- HST: The Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey (CANDELS)

Methods

- Extract photometry from PSF-matched images.
- SED fitting to obtain redshift and galaxy properties.
- Derive JWST "expected" magnitude.
- Calculate variability significance as flux difference over error in 0.35" diameter aperture.
- Differencing imaging analysis by PyZOGY to confirm the detection [4].

Motivation

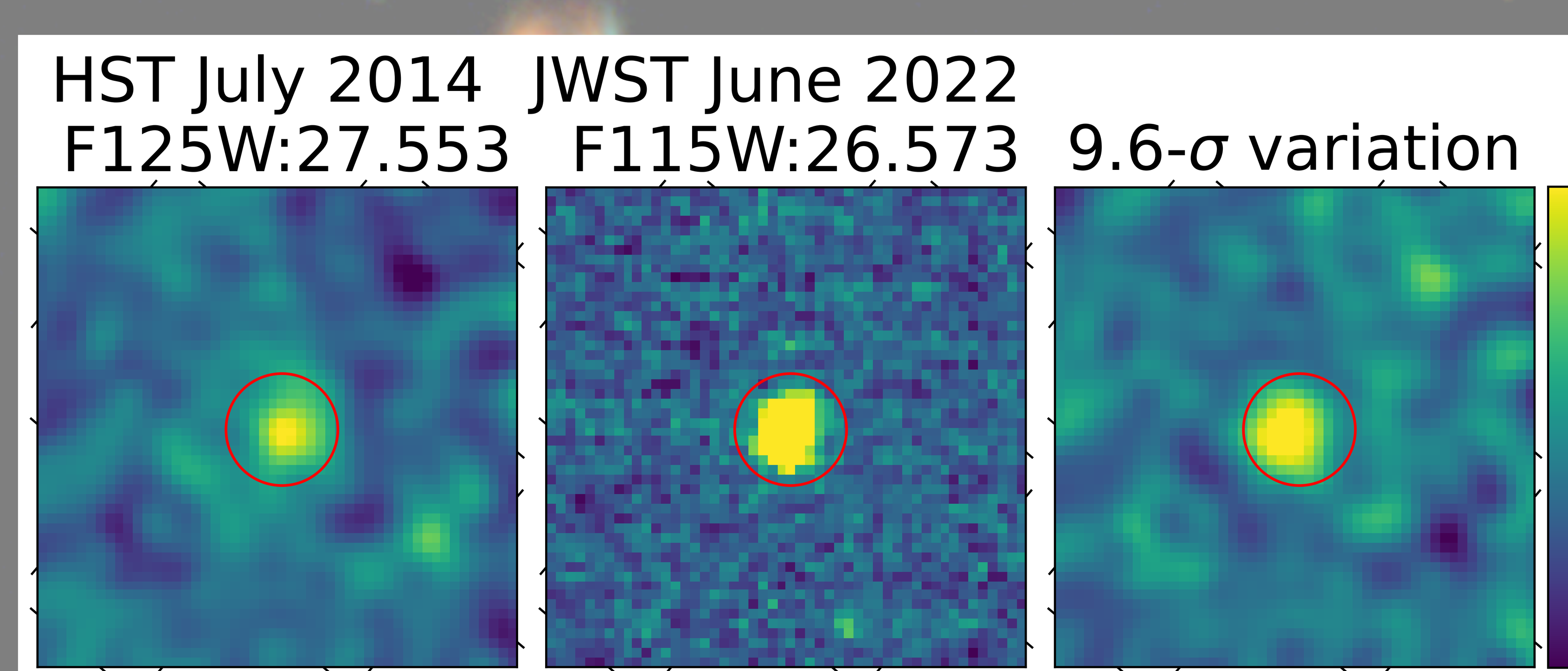
- Variability selection complete the AGN census, directly constraint SMBH accretion physics [4,5,6].
- Anticorrelation of rest UV/optical luminosity with varying amplitude [7].
- Deep fields have deep HST observation coverage, JWST new deeper IR observation expand window for time-lag studies, and improve the discovery of faint, high redshift AGN.
- Extrapolation of AGN NIR variability study [8] predicts Δm ~ 0.25-0.4 at 5<z<7.

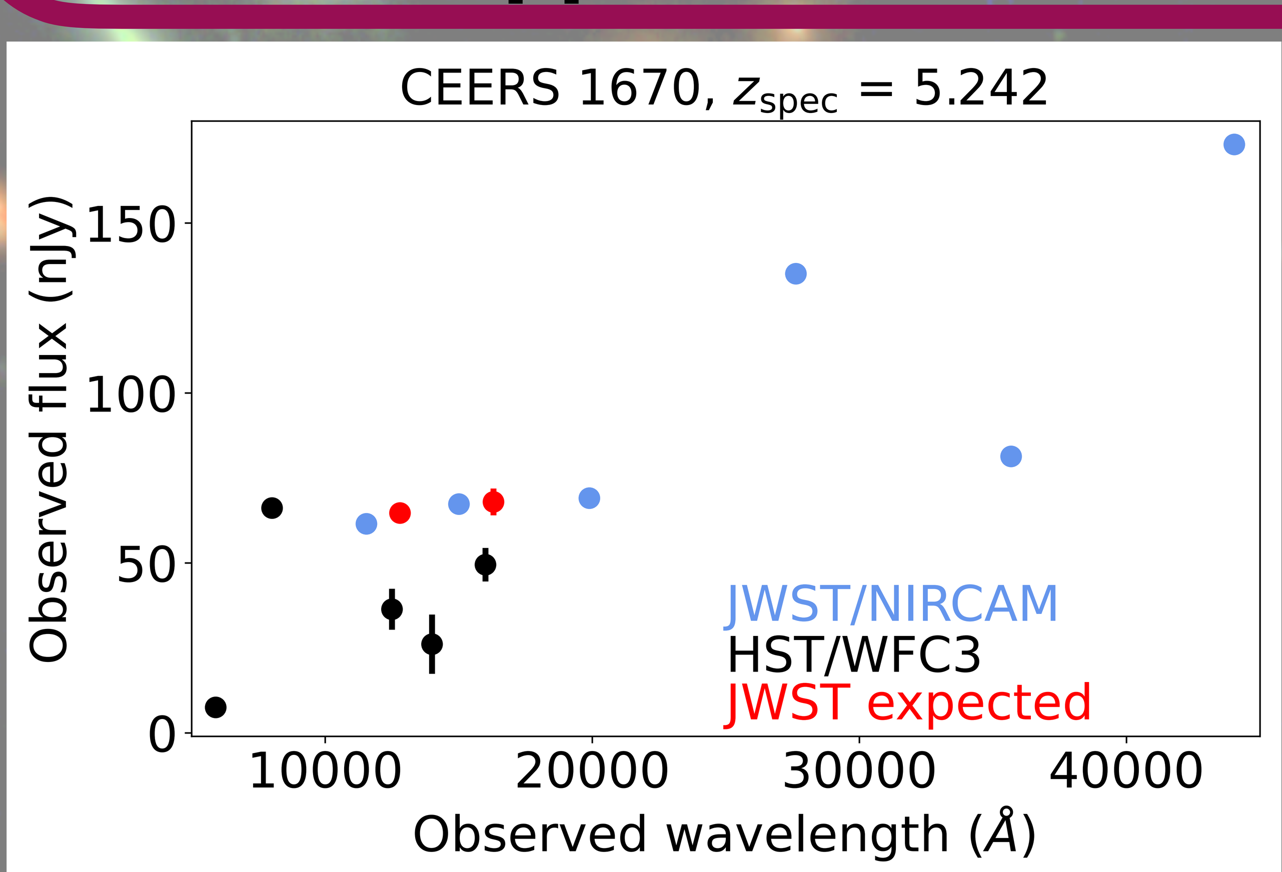
Scientific goals

- Discover ~ 200 faint (M_{UV} < -19) AGNs at 5<z<7.
- Faint-end AGN luminosity function and reionization ionizing photon budget.
- Constraining AGN accretion physics with structure function.
- An unbiased view of the co-evolution between SMBHs and their host galaxies.

Preliminary Results

- We detect more than 30 z>5 variable candidates, currently investigating their nature and properties.
- We recover CEERS-1670, one of the low-luminosity broad line Hα found with JWST WFSS [9].
- Our candidates comprise of AGNs, supernovae and various nearby transients, e.g. brown dwarfs.
- Star tune for the future result!





References

1. Inayoshi K., Visbal E., Haiman Z., 2020, ARA&A, 58, 27
2. Matsuoka Y. et al., 2023, preprint (arXiv:2305.11225)
3. Harikane Y. et al., 2023, preprint (arXiv:2303.11946)
4. Palanque-Delabrouille, N., Yeche, C., Myers, A. D., et al. 2011, A&A, 530, A122
5. Stern D. et al., 2012, ApJ, 753, 30
6. LaMassa, S. M., Urry, C. M., Cappelluti, N., et al. 2013, MNRAS, 436, 3581
7. Simm T., Salvato M., Saglia R., Ponti G., Lanzuisi G., Trakhtenbrot B., Nandra K., Bender R., 2016, A&A, 585, A129
8. Sánchez P. et al., 2017, ApJ, 849, 110
9. Kocevski D. D. et al., 2023, preprint (arXiv:2302.00012)