

# The Cosmos in its Infancy

**JADES** Galaxy Candidates from the first 600  
Million Years after The Big Bang

<https://arxiv.org/ASDF>

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<https://jades-survey.github.io/>

with Ben Johnson, Brant Robertson, Sandro Tacchella, Jakob Helton, Fengwu Sun, Daniel Eisenstein, Charlotte Simmonds, Michael Topping, Lily Whitler, Christopher Willmer, Marcia Rieke, Wren Suess, Raphael Hviding, Alex Cameron, and the JADES Collaboration

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# Introduction

Big Bang

Stars and Galaxies Form

Reionization

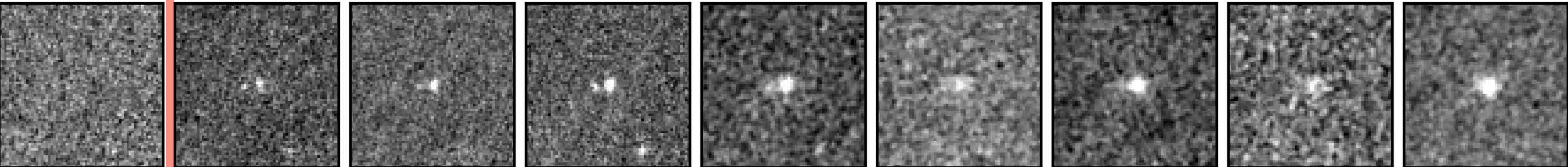


- **The first six hundred million years after the Big Bang** featured the formation of the first stars and galaxies which fundamentally changed the universe.
- Galaxies in this era have been difficult to observe with existing telescopes as galaxies at these distances are faint, and their light has been redshifted out to infrared wavelengths.
- With the launch of JWST, we have entered the most exciting era of extragalactic science.
- The JADES survey, the most comprehensive JWST extragalactic survey thus far, combines 770 hours of NIRCам, NIRSpec and MIRI observations to explore the first stars and galaxies.
- Early results from JADES included the discovery and confirmation of the most distant galaxy observed thus far, JADES-GS-z13-0.



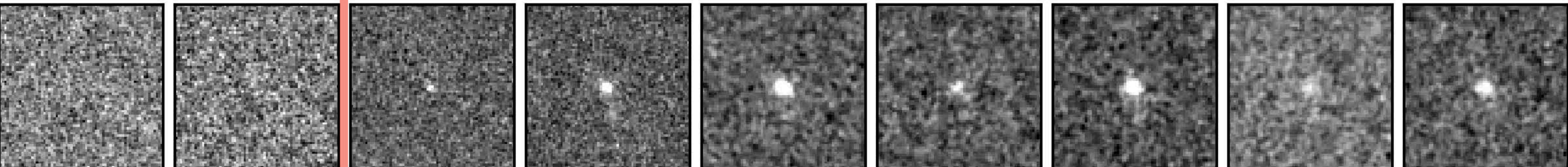
# High-redshift galaxies are found in imaging by looking for the distinctive Lyman drop in redder and redder bands.

$z = 9$



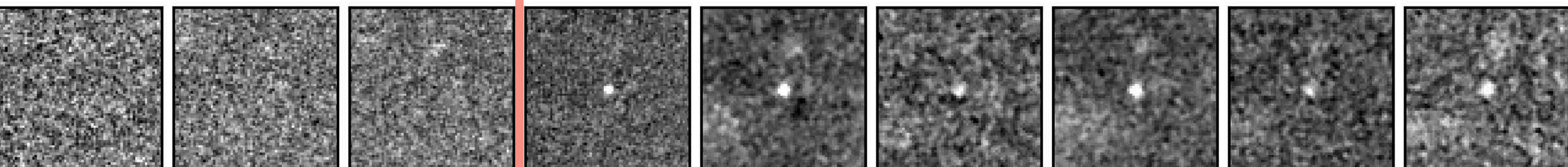
F090W F115W F150W F200W F277W F335M F356W F410M F444W

$z = 12$



F090W F115W F150W F200W F277W F335M F356W F410M F444W

$z = 14$



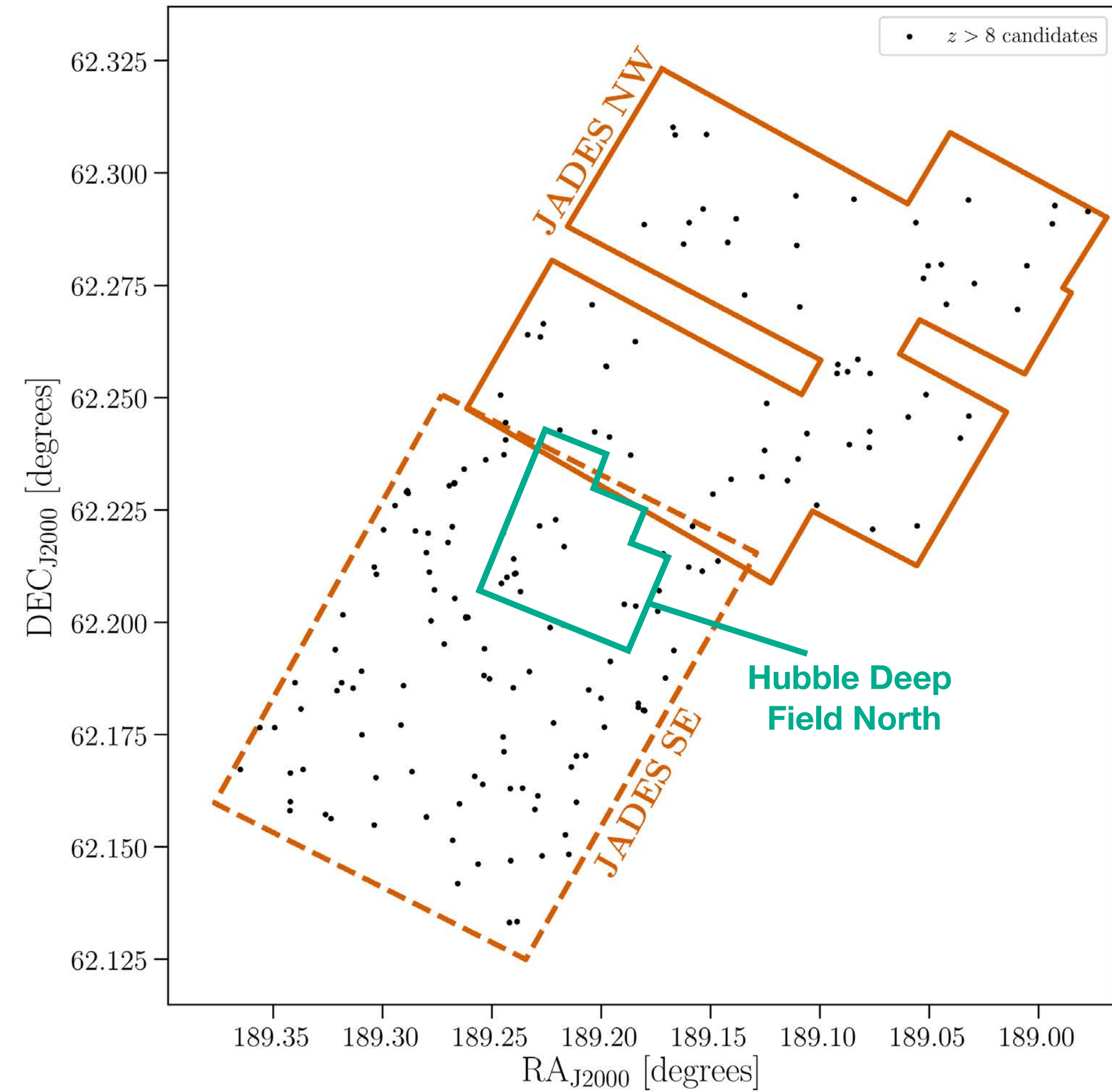
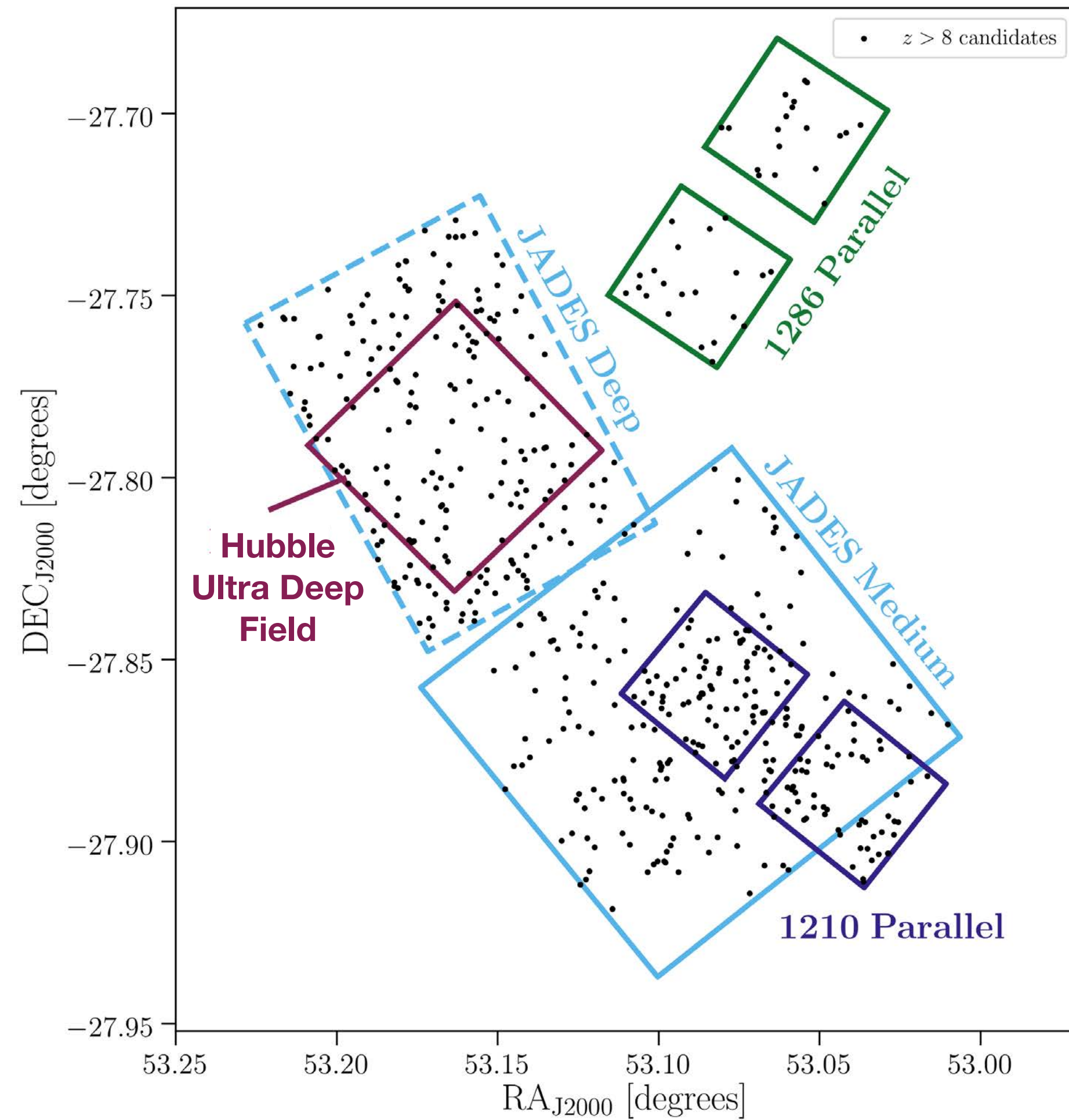
F090W F115W F150W F200W F277W F335M F356W F410M F444W

longer wavelength

JWST NIRCcam filters

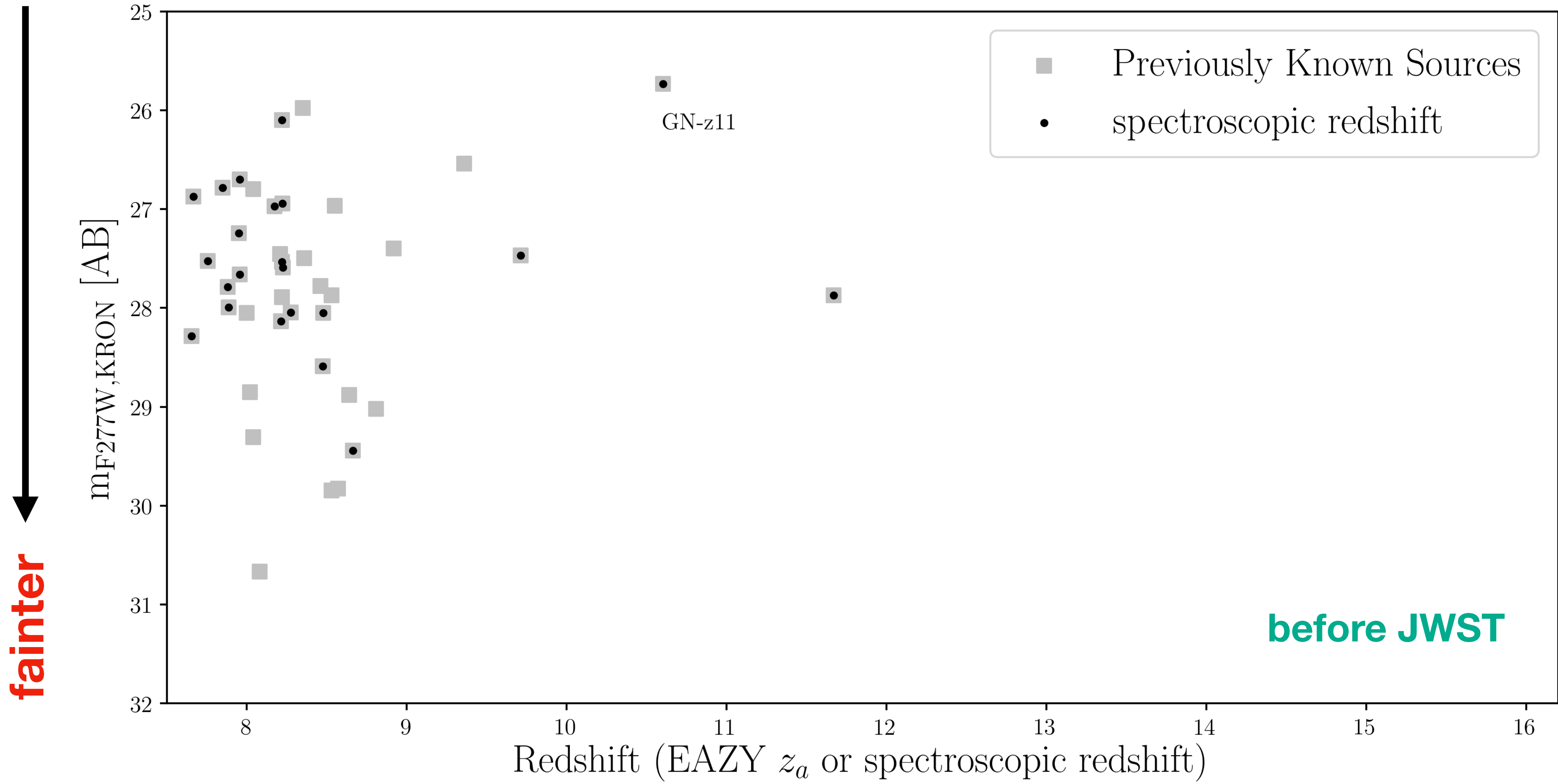


**We have found 717 galaxies that are likely at redshift  $z > 8$ , from the first 600 million years after the Big Bang, across JADES.**

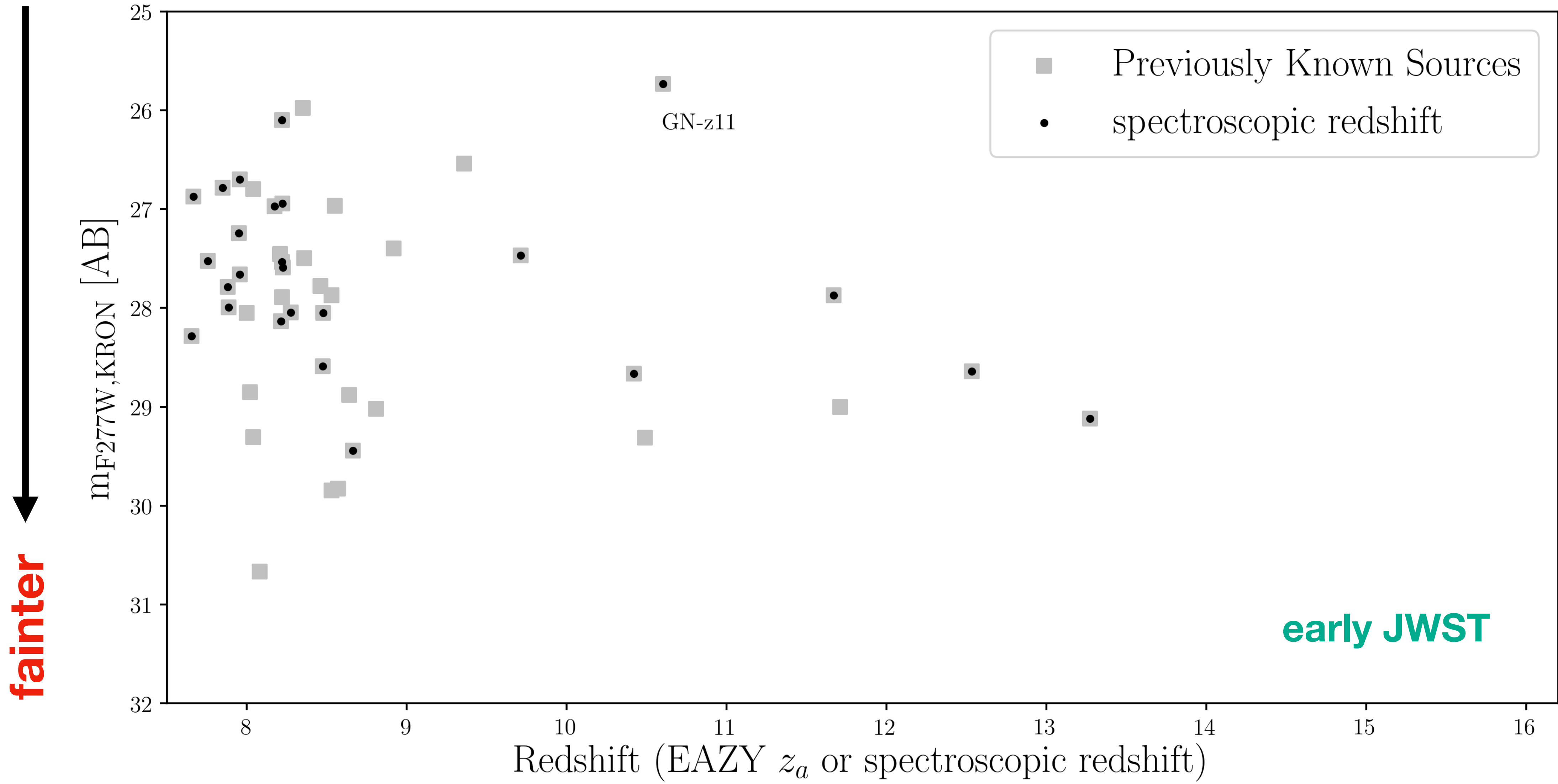


**JADES has returned to the famous Hubble Deep Field and Ultra Deep Field, but now wider and deeper.**

**Over 93% of the sources presented have never been identified before. HST only identified two sources at  $z > 10$  in these regions before JWST.**

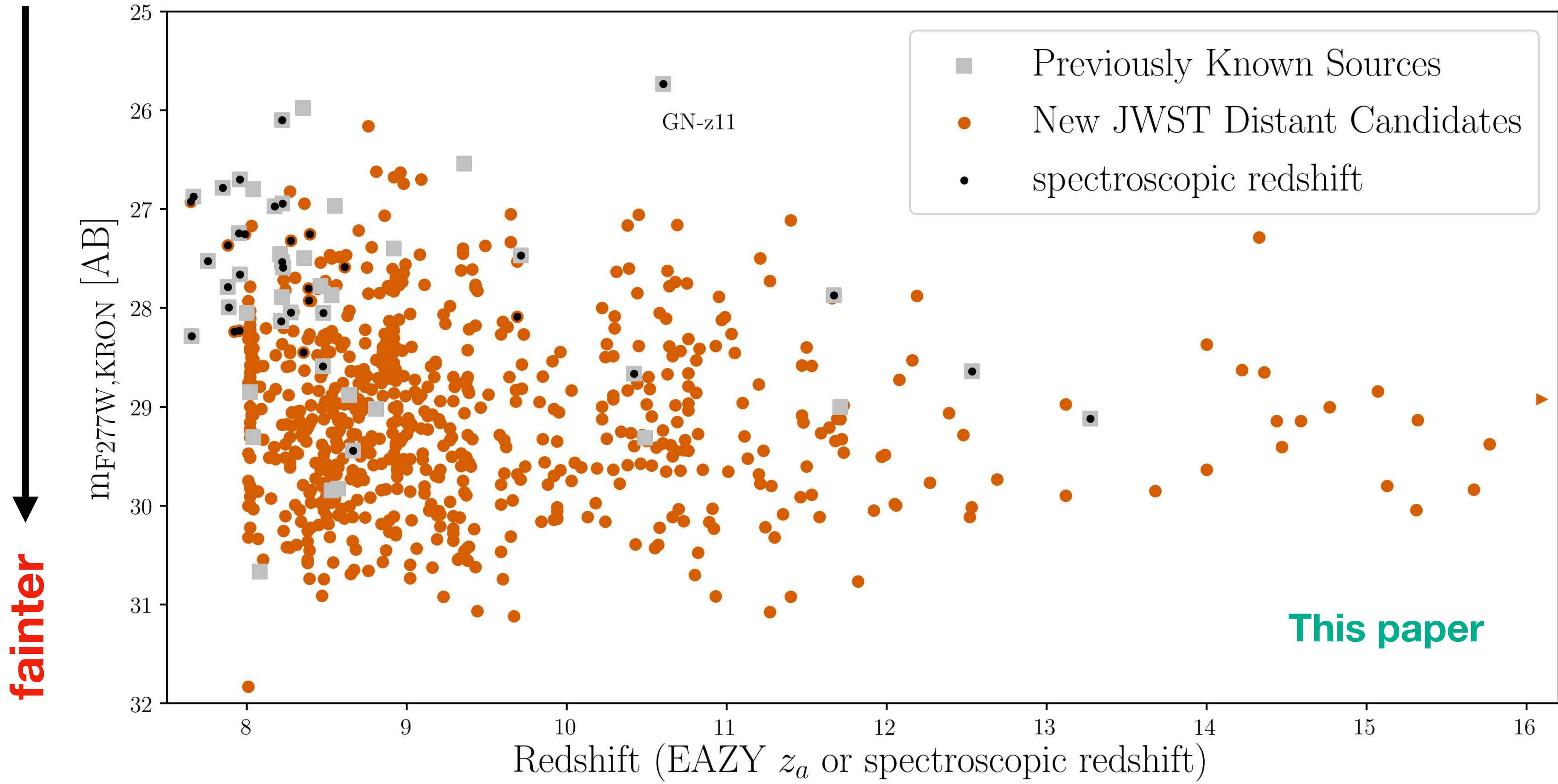


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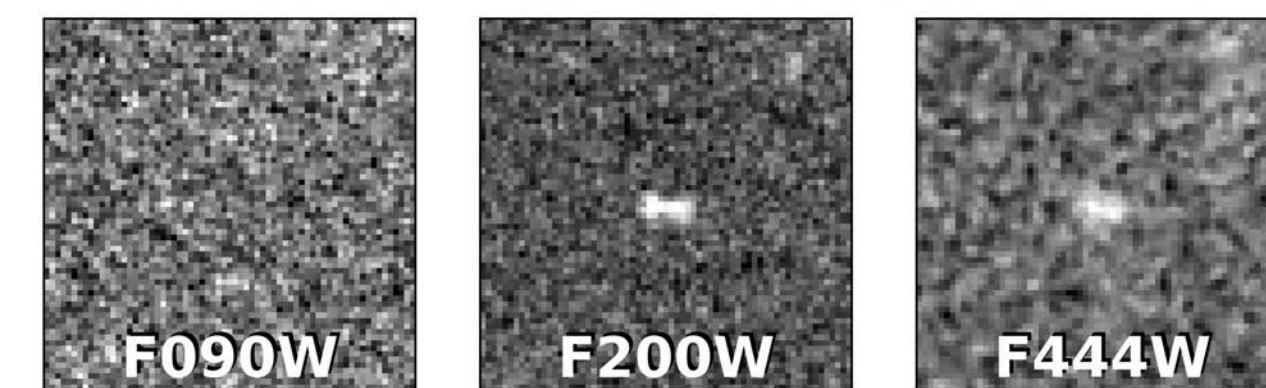
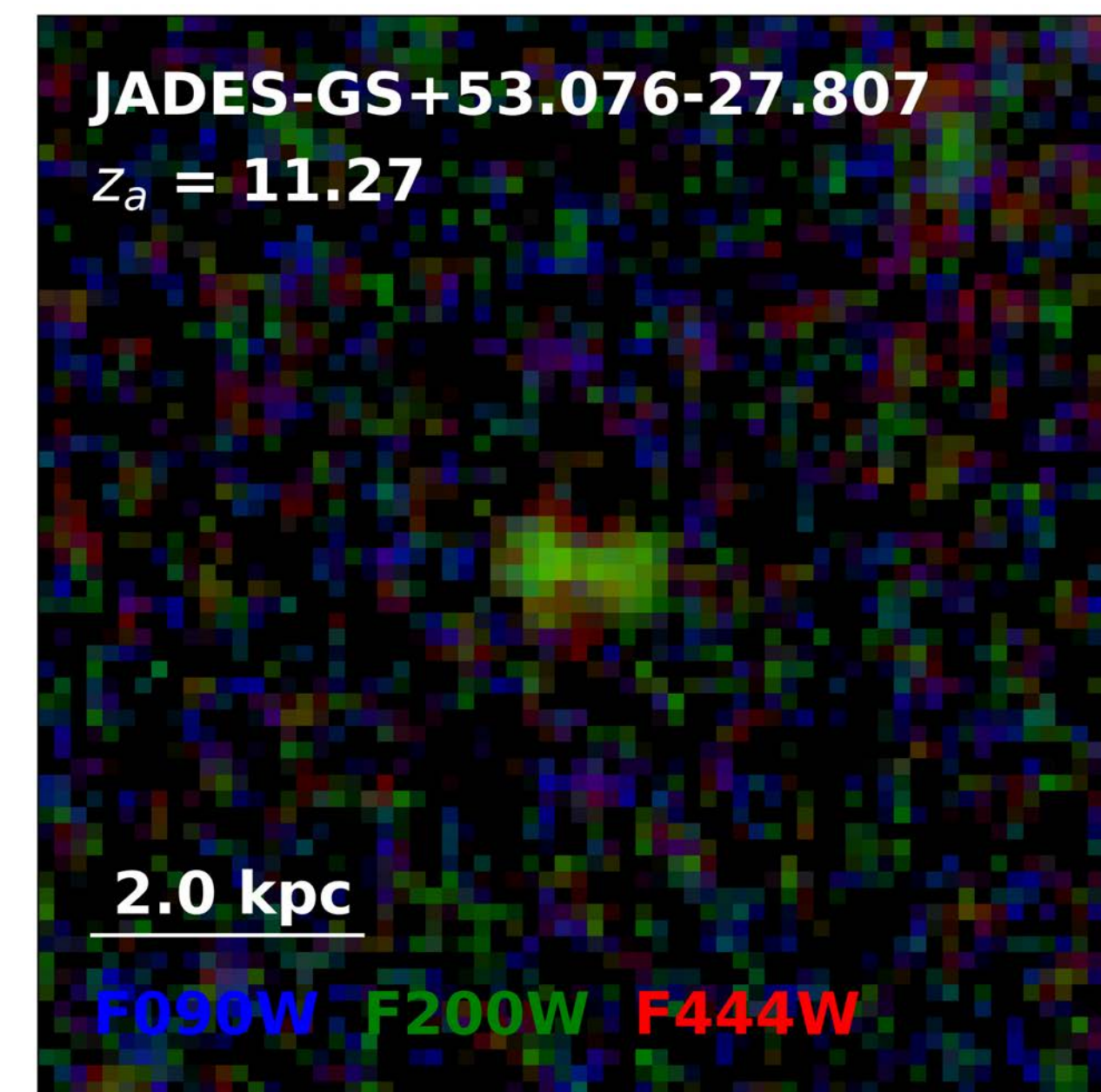
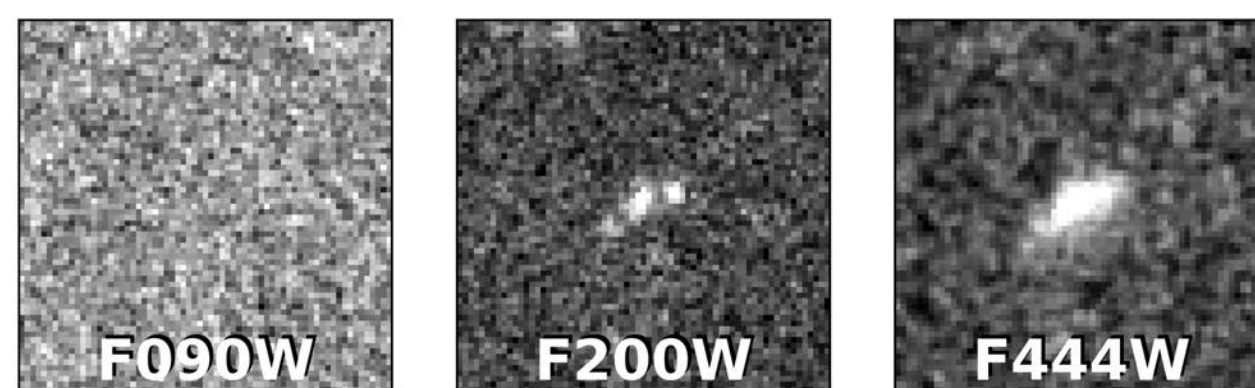
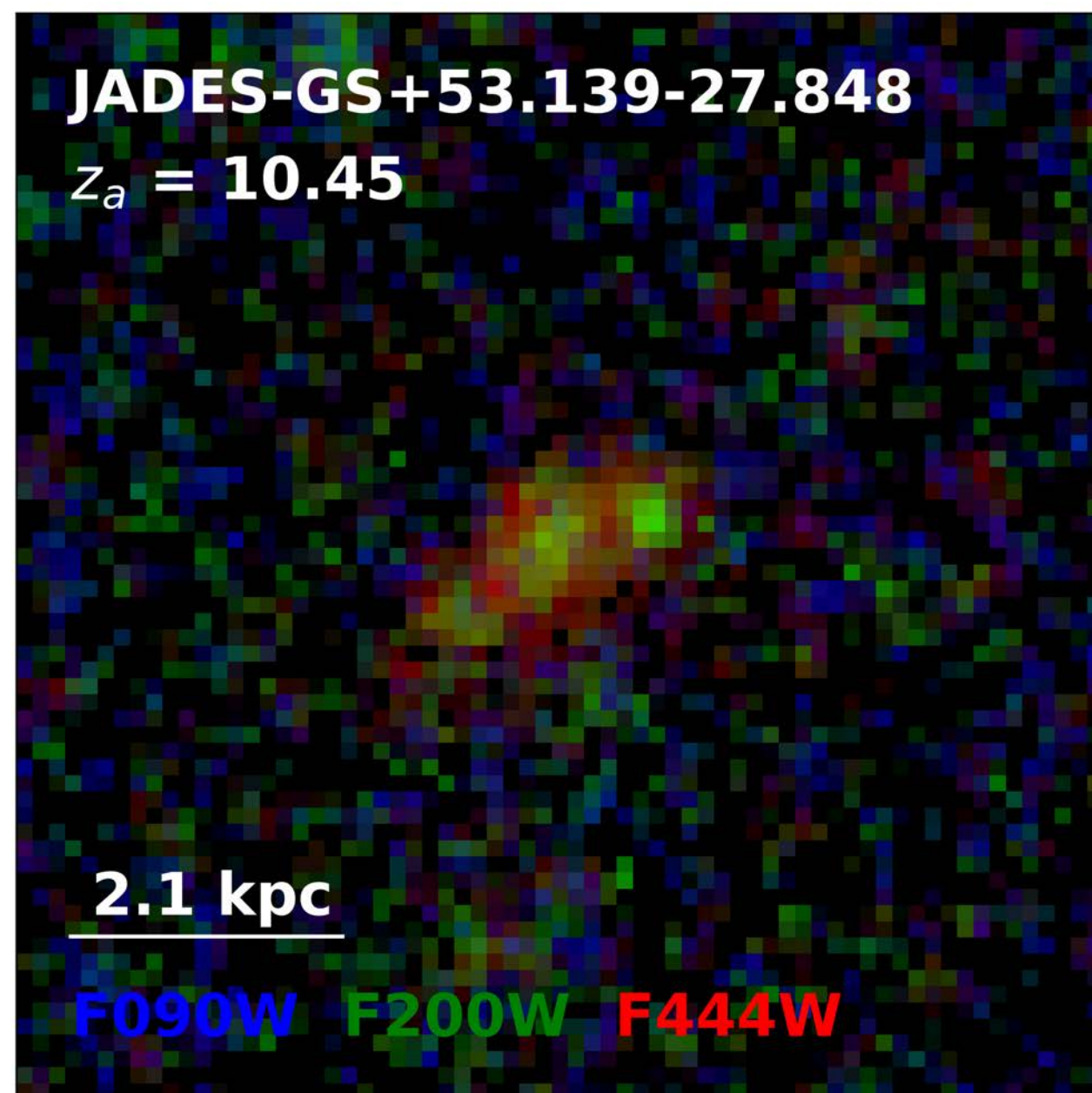
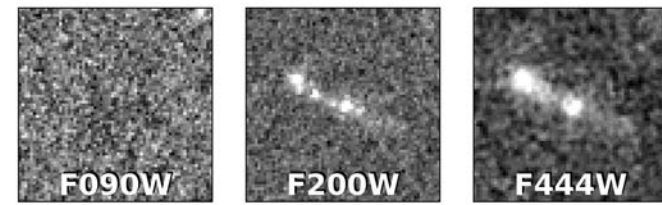
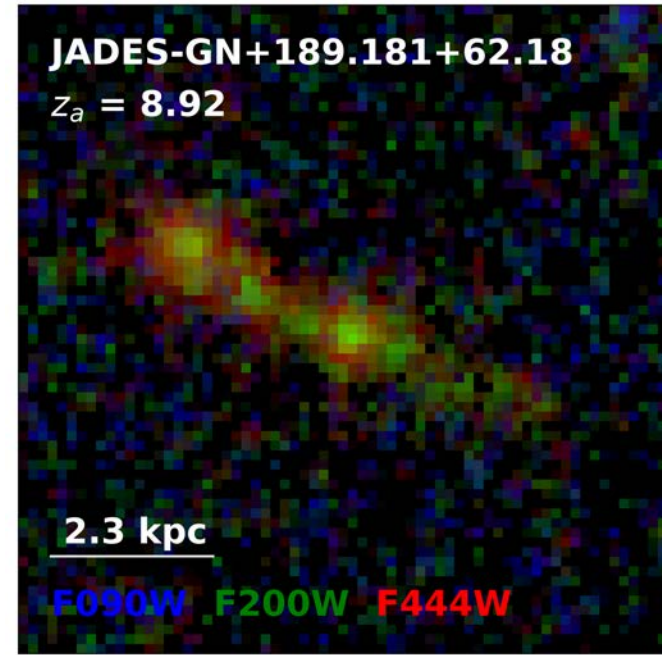
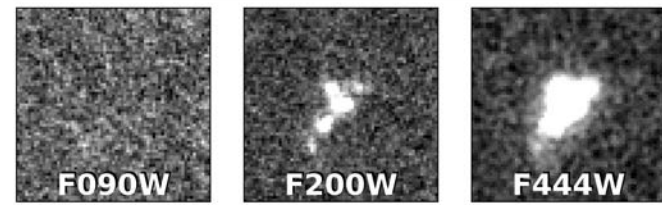
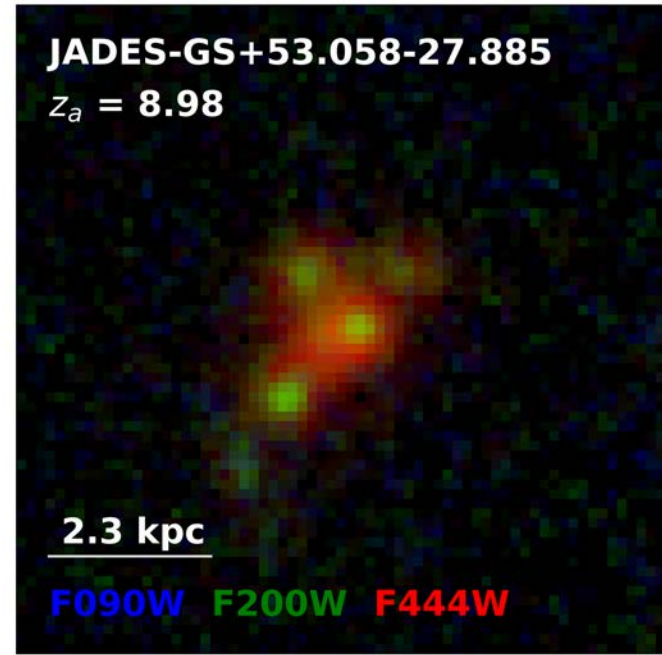
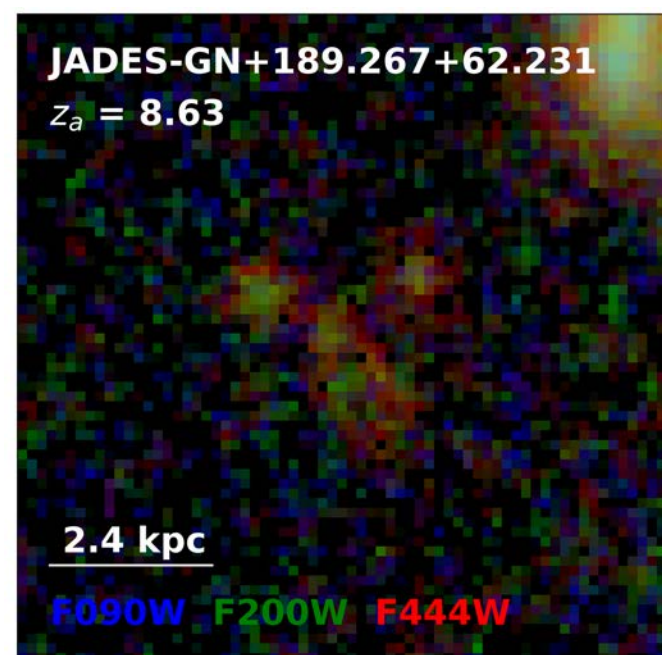
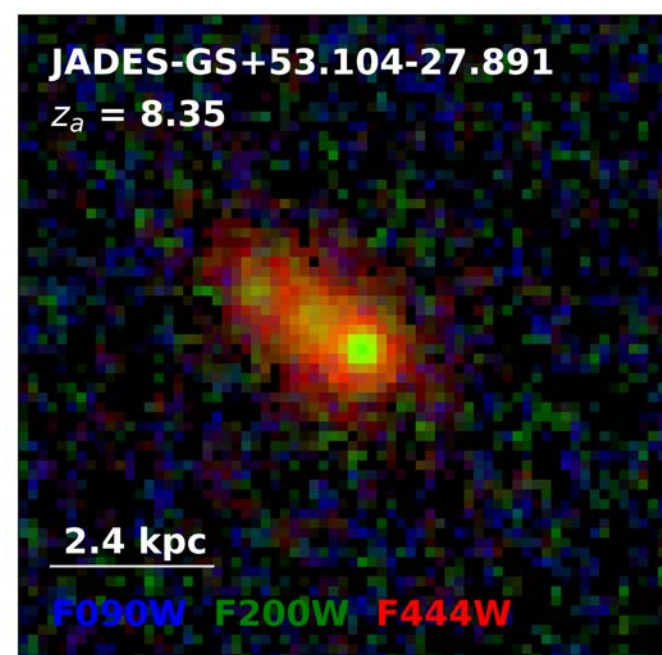
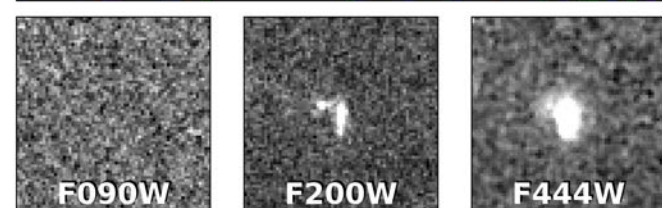
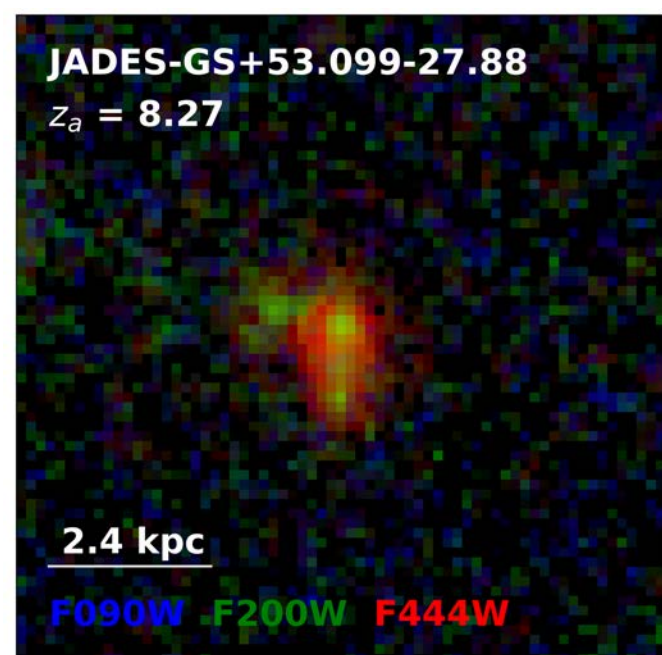
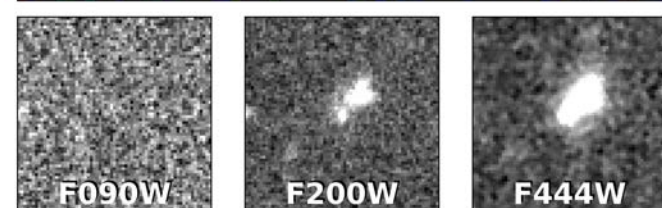
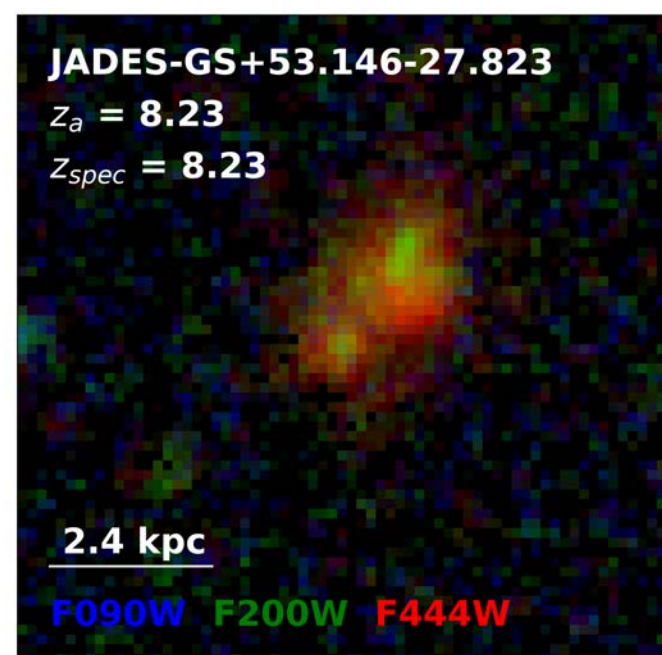
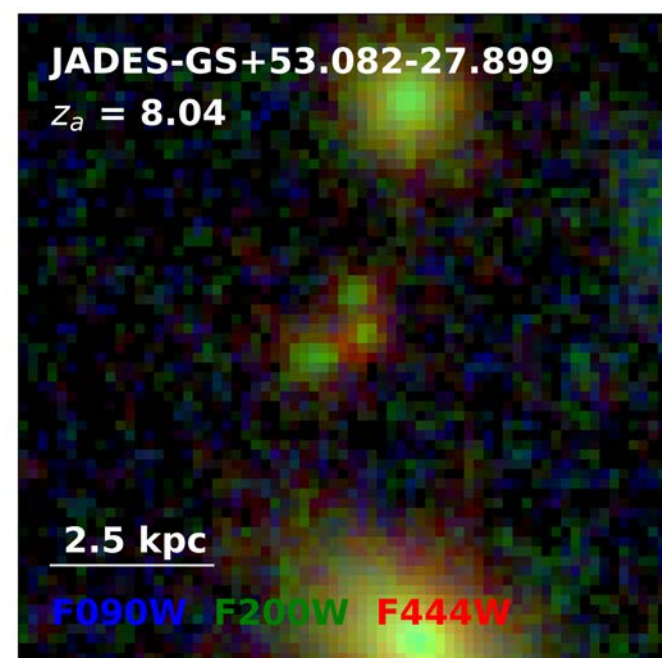
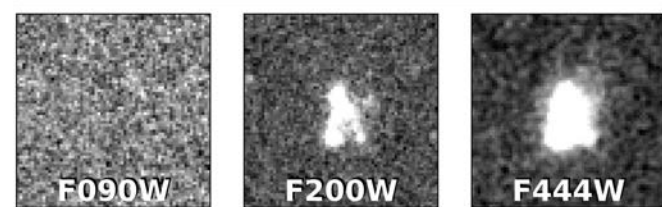
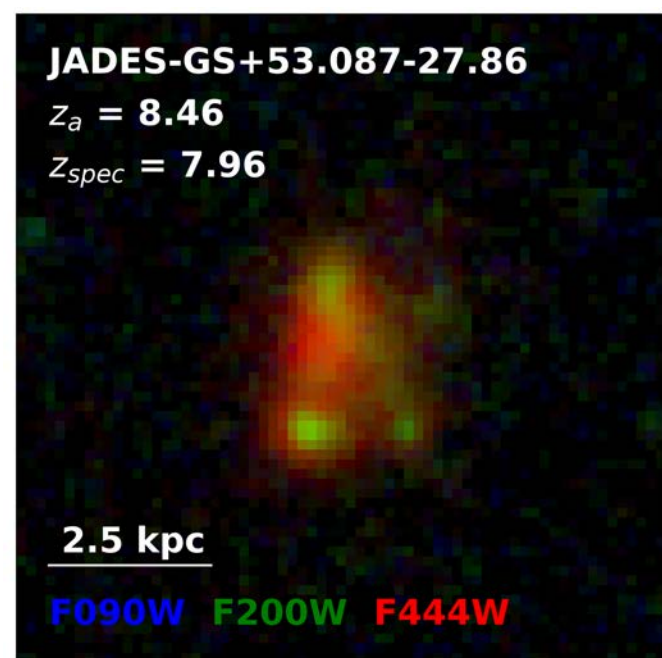
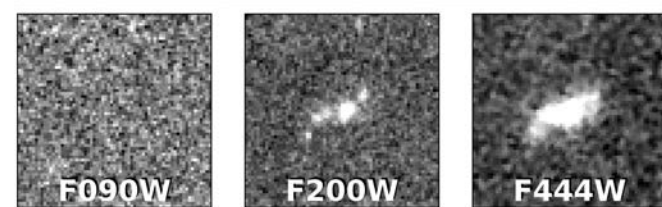
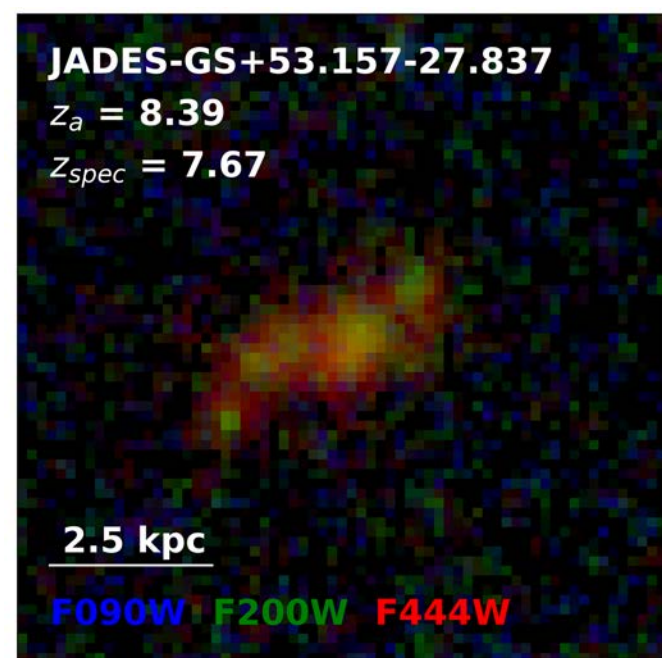
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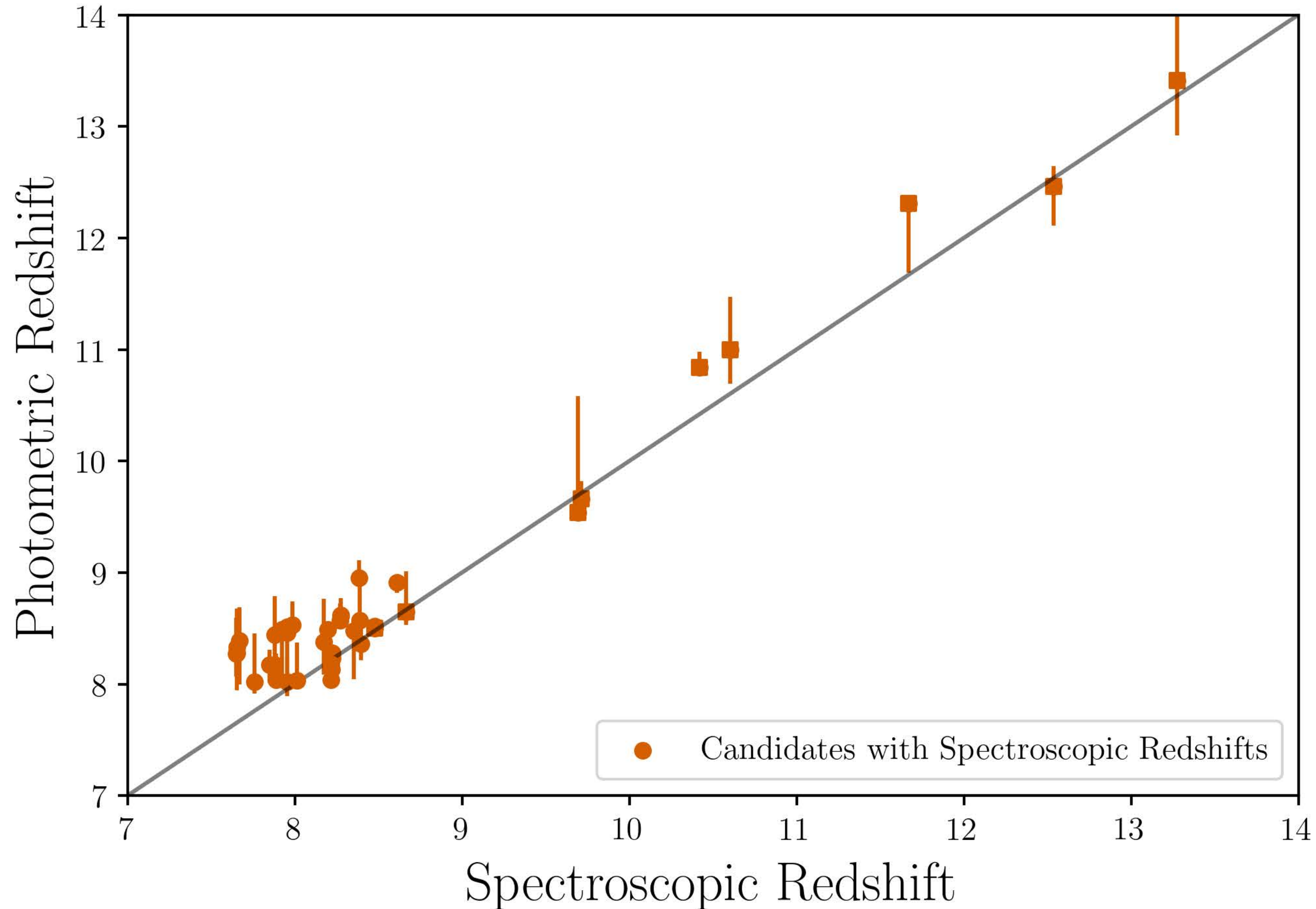
Many of our galaxies and candidates have complex shapes with multiple clusters of star formation, showing us the early growth of galaxies.

These two candidates are from 400 - 450 Million years after the Big Bang





**Forty-two sources are spectroscopically confirmed in our sample, and we find excellent agreement with our predicted photometric redshifts.**





# Conclusions

- **Across the 125 square arcminutes of the current JADES footprint, we find 717 galaxies that are likely to have redshift  $z > 8$  from the first six hundred million years after the Big Bang.**
- **Over 93% of the sources are newly discovered** because of JWST NIRCam's unique ability to observe these faint, distant galaxies.
- **Many of the galaxies have complex structure that extends across many tens of thousands of light years,** demonstrating the ways in which galaxies were building in the early Universe.
- **For those 42 sources that have been spectroscopically confirmed thus far, we find excellent validation of our methods of identifying high-redshift galaxies.**

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