

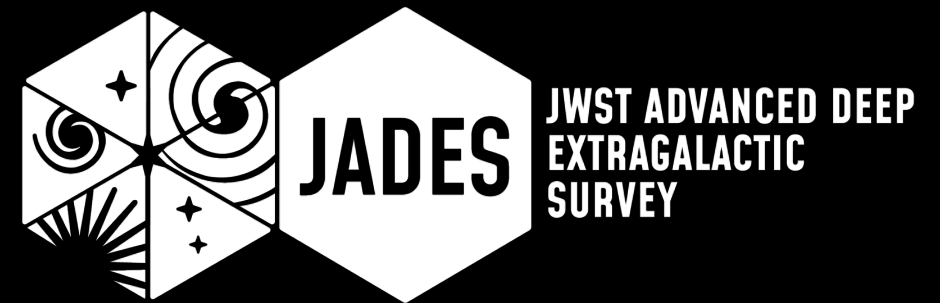
Uncovering the Properties of Dwarf Galaxies in the Early Universe with JWST

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The University of Texas at Austin

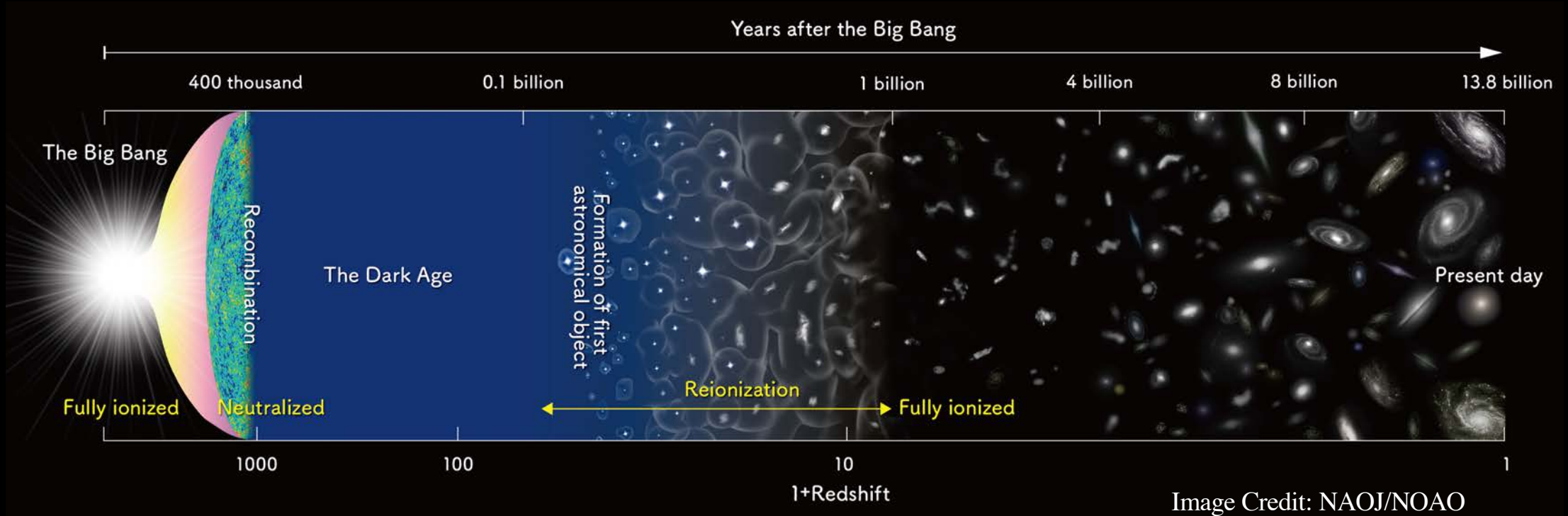
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<https://jades-survey.github.io/>

The Epoch of Reionization

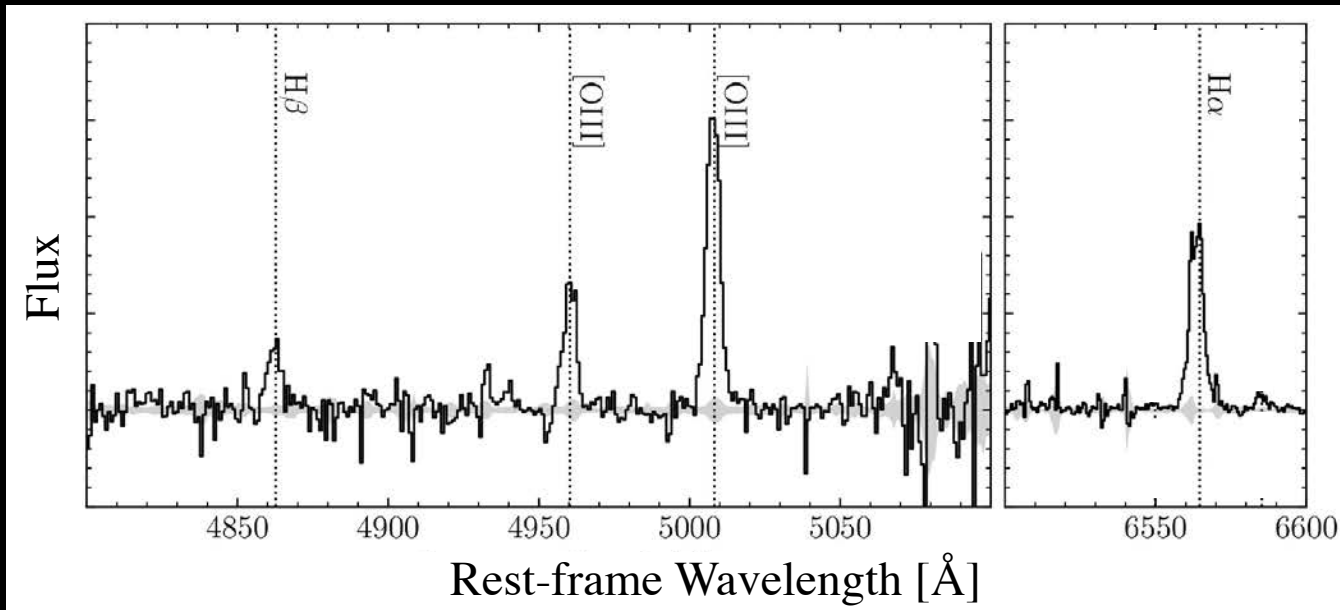


The formation of the first galaxies resulted in cosmic reionization, a process which completely altered the hydrogen atoms filling the early Universe.

Studying Very Early Galaxies with Emission Lines

Galaxy emission lines are valuable probes of ionizing light and very recent star formation.

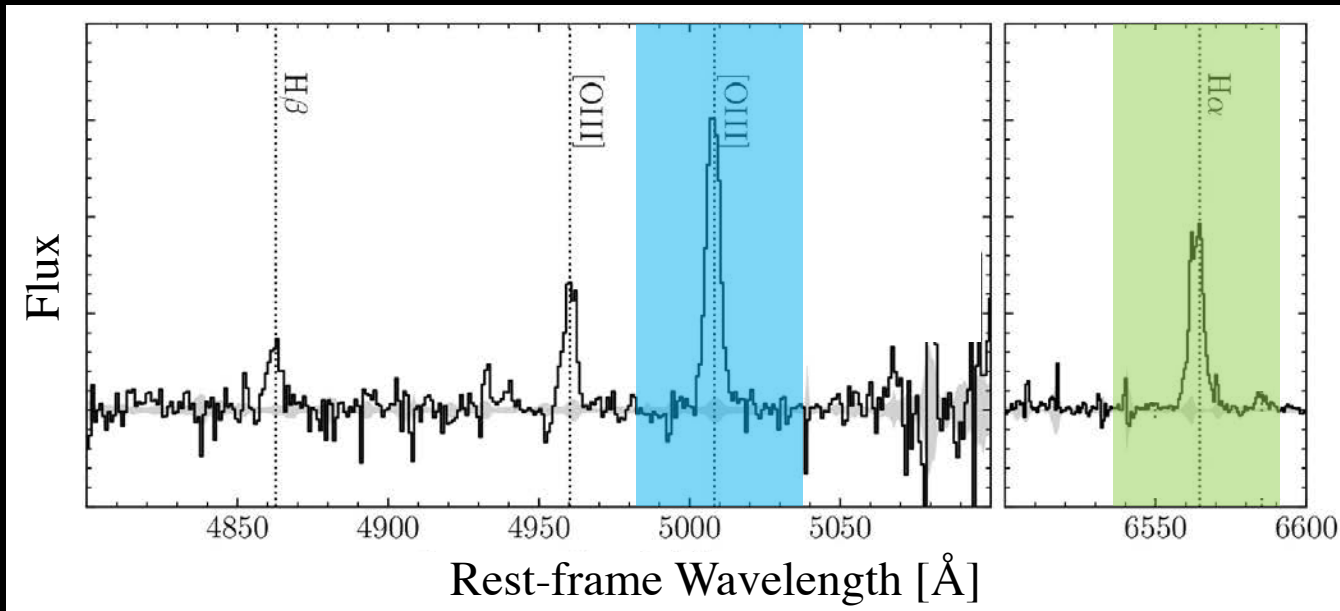
- Ultraviolet light produced by young, massive stars is reprocessed by gas within the galaxy.
- Results in emission lines at discrete wavelengths, some of which lie in the rest-frame optical.



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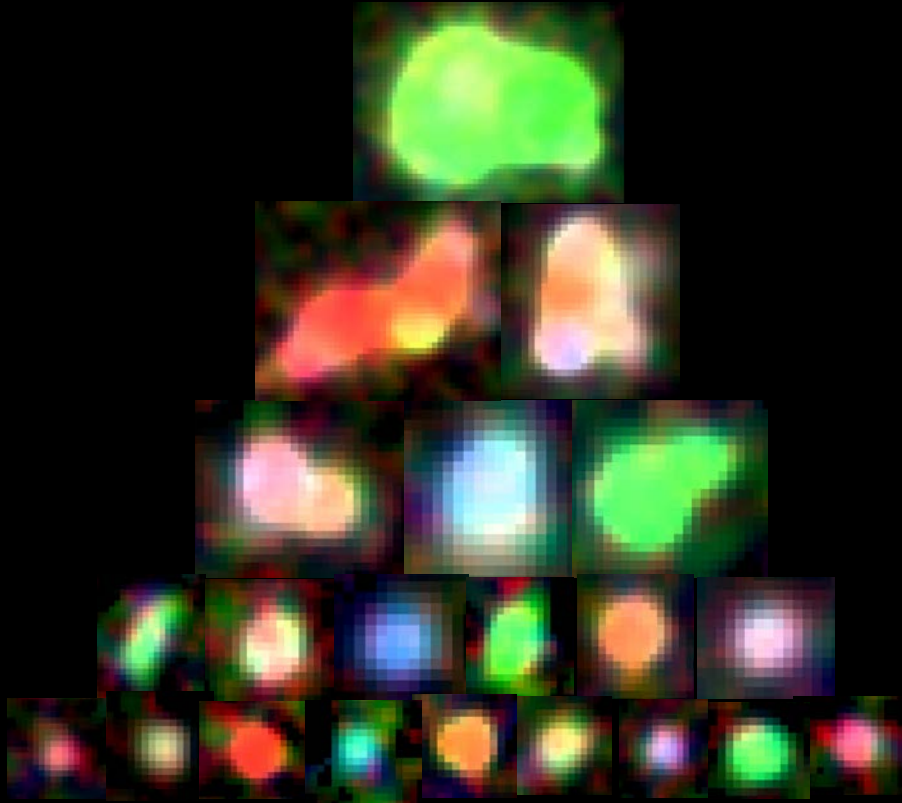
Tang et al. 2019, MNRAS, 489, 2572



Nearby star-forming region
Seeing ionized **Oxygen** and **Hydrogen**

A First Detailed, Statistical Study of Early Galaxies

Brightest, very rare



Fainter, far more numerous

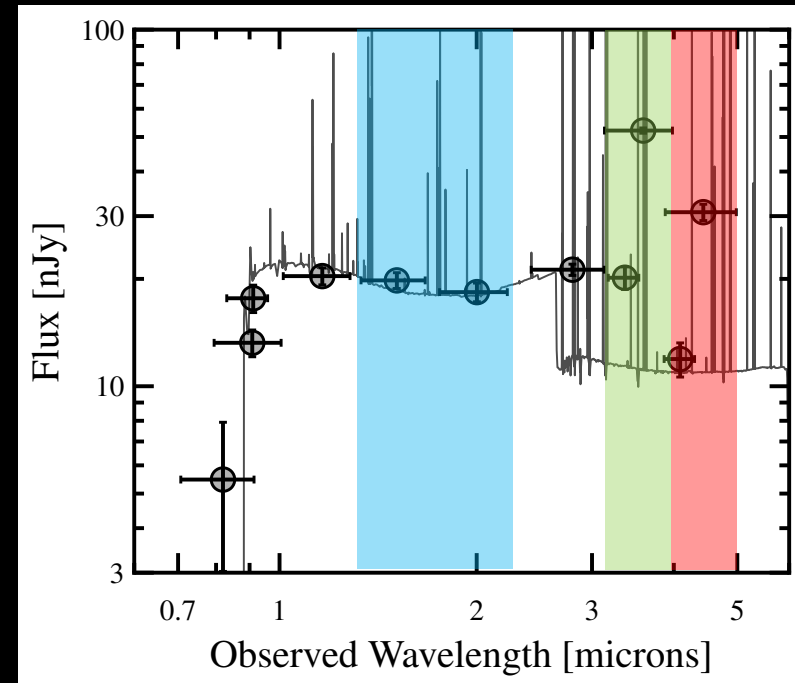
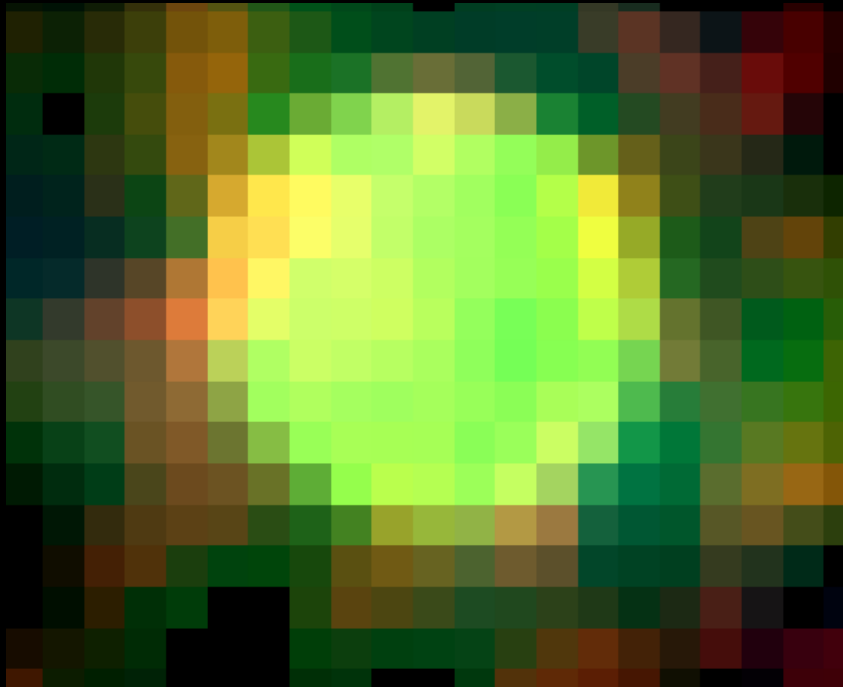
With JADES, we are now building a far more wholistic picture of very early galaxies.

- Constraining emission lines in galaxies $\sim 50x$ fainter than possible before JWST.
- Now past the “tip of the iceberg” and into the more general dwarf galaxy population.

An Early Universe Teeming With Intense Star Formation

An astonishingly large fraction of very early galaxies show extremely strong emission lines.

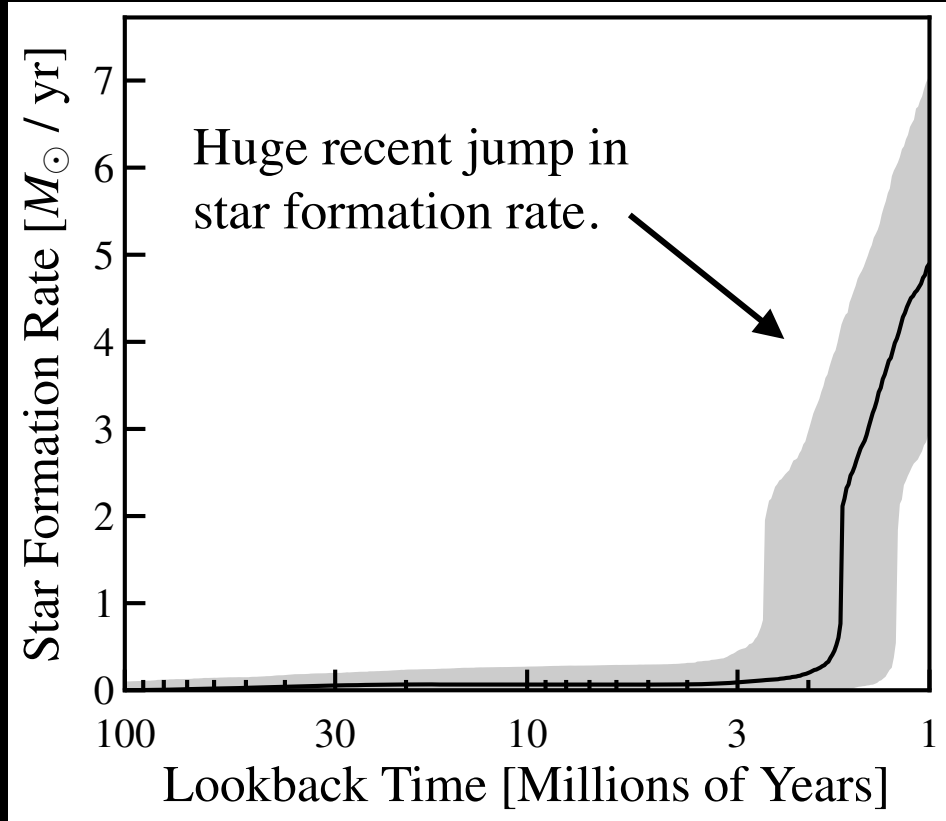
- About 10-20% of galaxies at $z \sim 6-9$ ($\approx 550-900$ million years after the Big Bang).
- Such extreme line emission seen from only a very tiny fraction ($\ll 1\%$) of local galaxies.



Insights on How Galaxies First Assembled

Implies that very early galaxies frequently undergo bursts of star formation.

➤ The earliest stars in galaxies are commonly formed in these bursts.



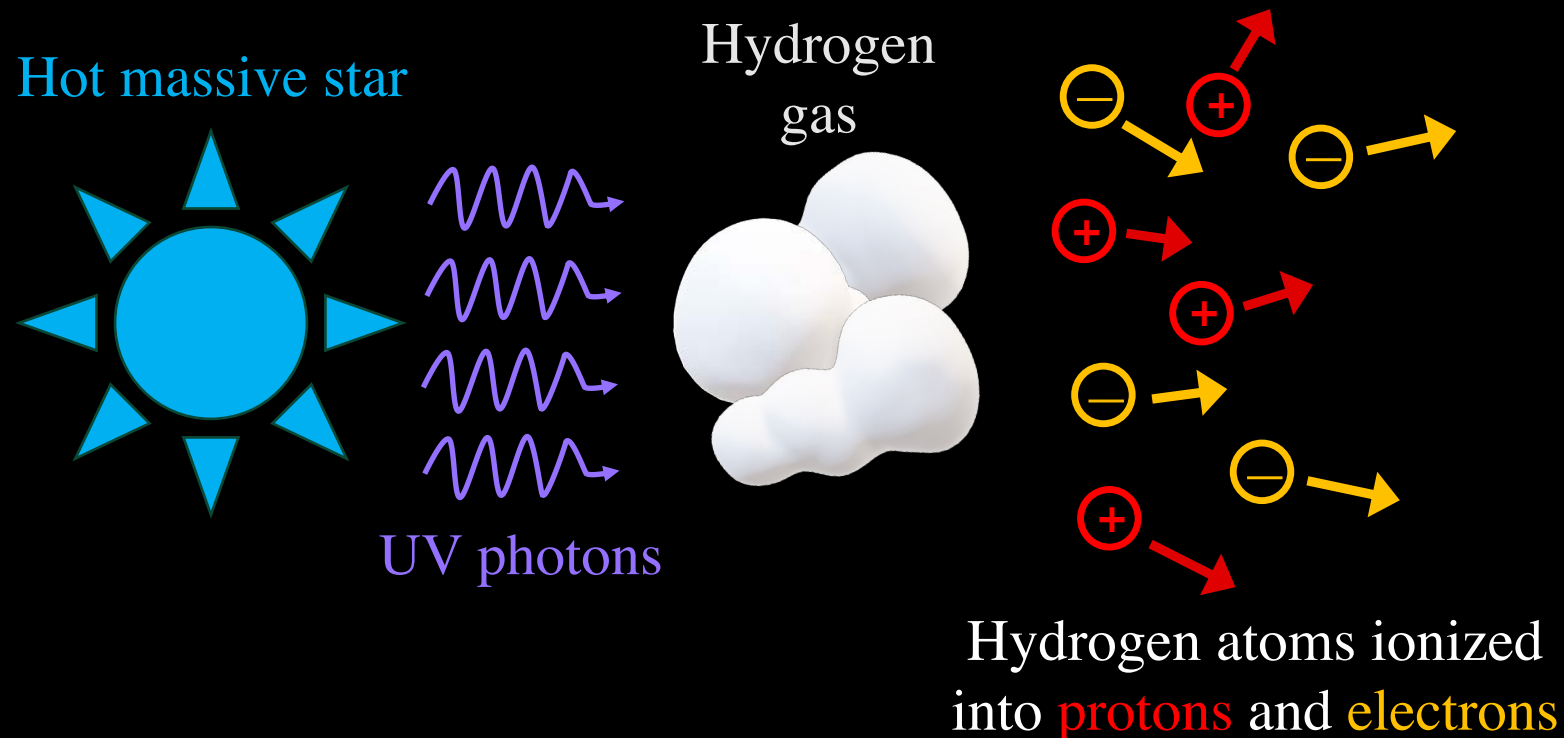
Nearby starburst region R136

Credit: NASA, ESA

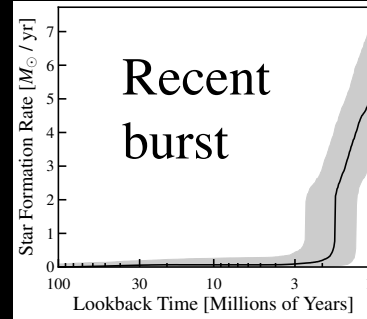
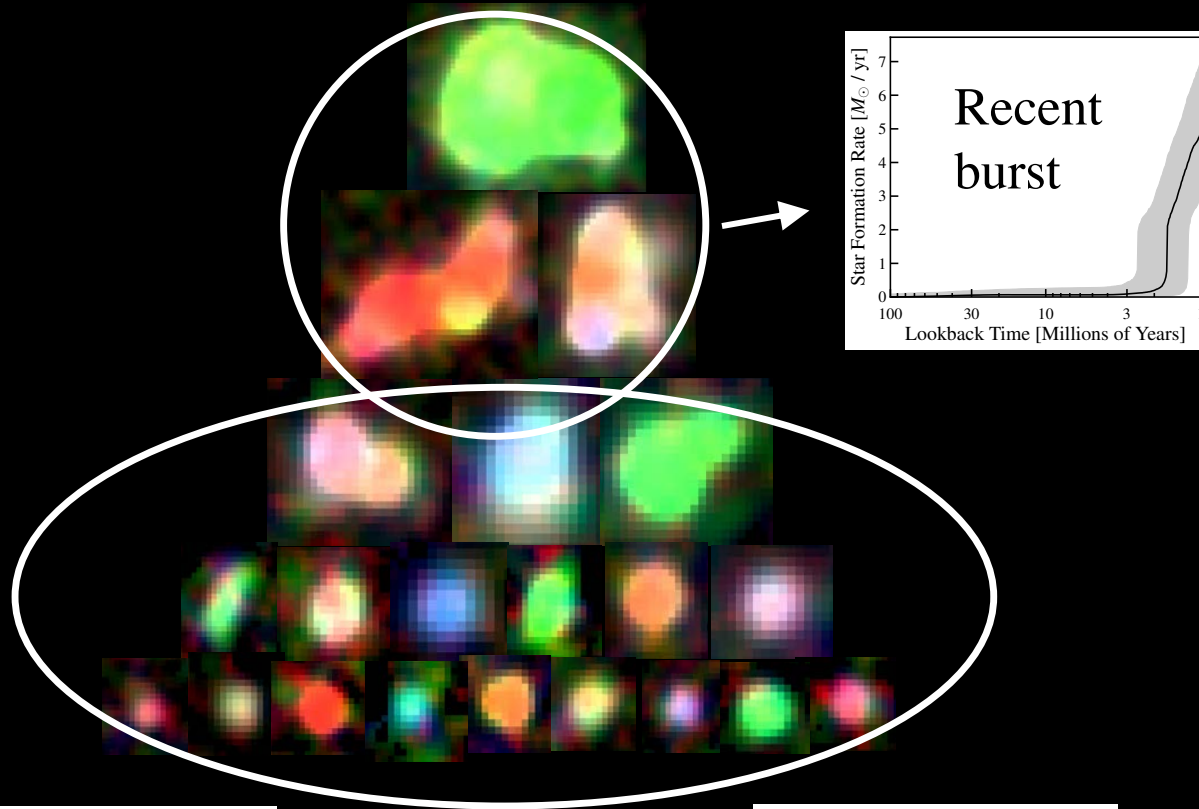
Understanding the Impact on Reionization

Galaxies in a starburst phase are very efficient at producing the ultraviolet light needed to drive cosmic reionization.

- Emergent light is almost entirely due to hot, massive stars.

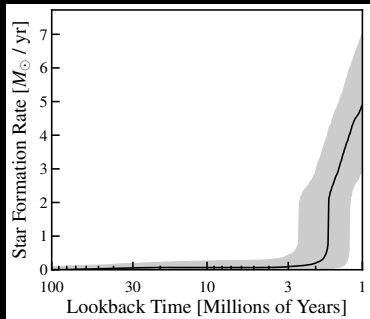


The Different Nature of Bright and Faint Early Galaxies

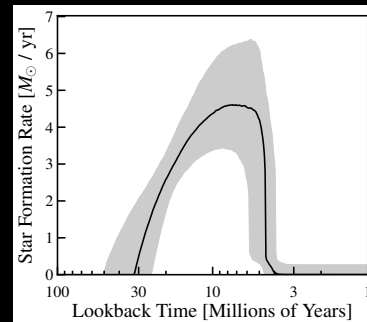


The brightest galaxies are more frequently undergoing a starburst phase relative to the fainter galaxies.

- Crucial clues into the nature of bright galaxies being found at even earlier cosmic times.



Faint galaxies are a more even mix of recent bursts and currently inactive.



Summary

- Astonishingly high rate of extreme line emission among $z\sim 6-9$ galaxies.
- Very early galaxies assembled in bursts of star formation.
- The hot, massive stars formed during these bursts drove cosmic reionization.
- Earliest bright galaxies are likely undergoing bursts of star formation.

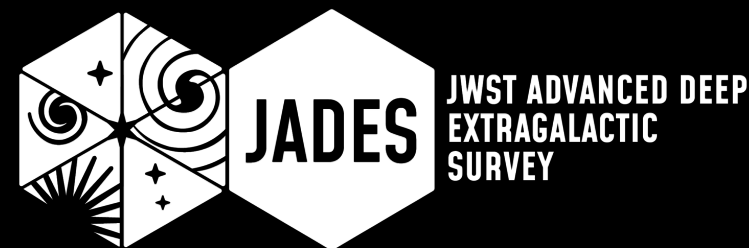
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