

REIONIZATION: STAR-FORMING GALAXIES AT REDSHIFT $z \sim 6$?

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Finding distant galaxies using the Advanced Camera for Surveys (ACS) on the Hubble Space Telescope (HST)

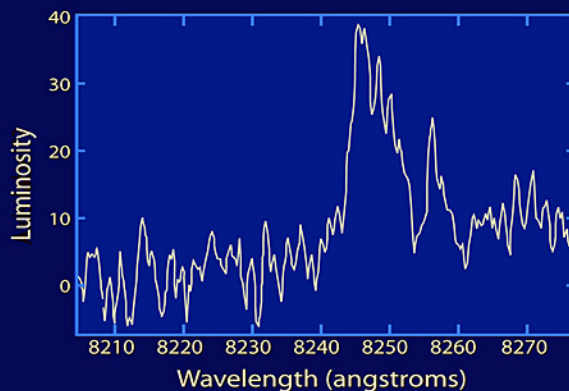
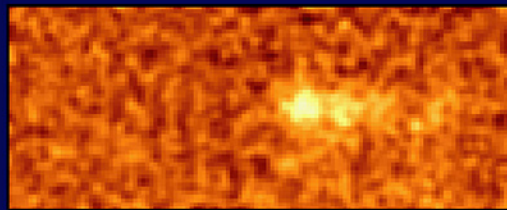
- Distant galaxies are very red
- We showed that ACS/HST could find them (Stanway, Bunker, and McMahon, 2003, using GOODS)
- We build on our technique with UDF: Going fainter



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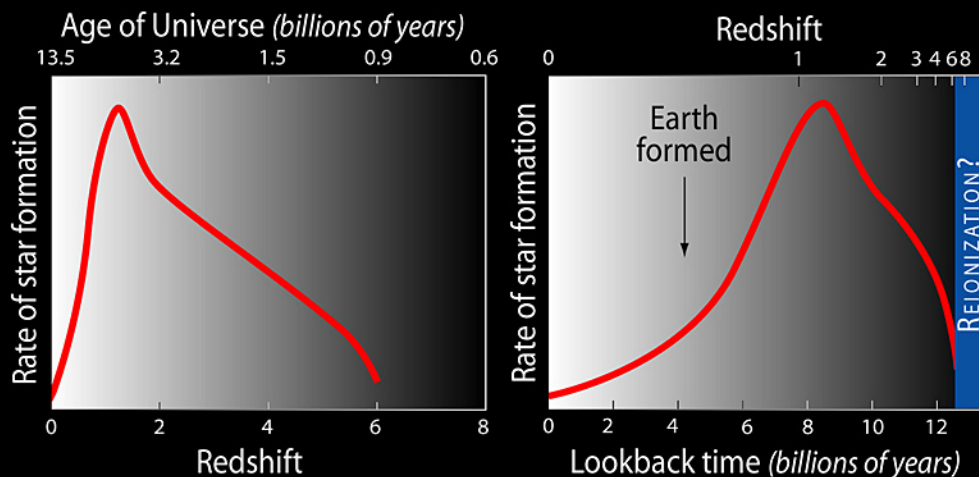
Spectroscopy with Keck

- We were the first to prove these ACS-selected galaxies really are distant (90% of the way back to the Big Bang).
- We used the Keck telescope to find redshift (distance) line emission (star formation) $z \approx 5.8$ galaxy (Bunker et al., 2003).



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Star-formation history of the Universe



- UDF enables us to identify even fainter galaxies at these times.
- We were the first to analyze and publish 50 high-redshift galaxies in the UDF.
- UDF confirms our previous work: Much **less** star formation than in the more recent past.

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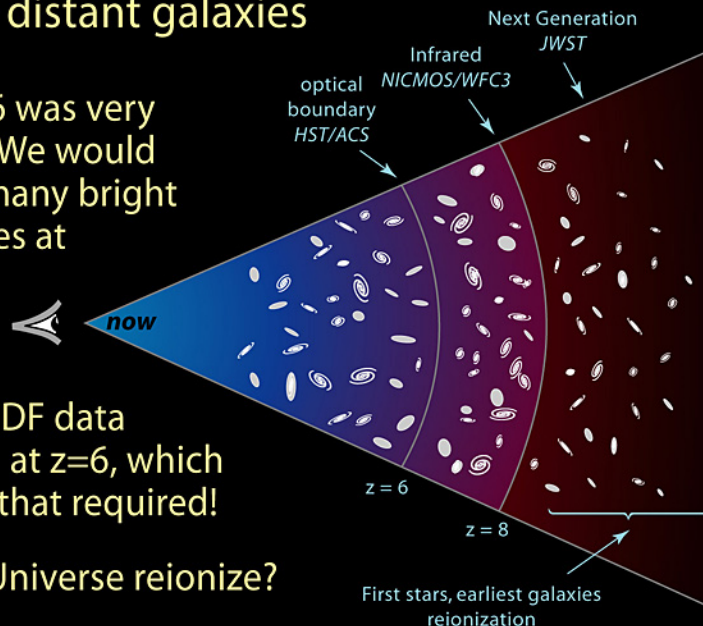
Probing the dark ages

Reionization and distant galaxies

- The Universe at $z \sim 6$ was very different from $z \sim 3$: We would predict 6 times as many bright star-forming galaxies at $z \sim 6$ as we see!

- Reionization: The UDF data have star formation at $z=6$, which is 3 times less than that required!

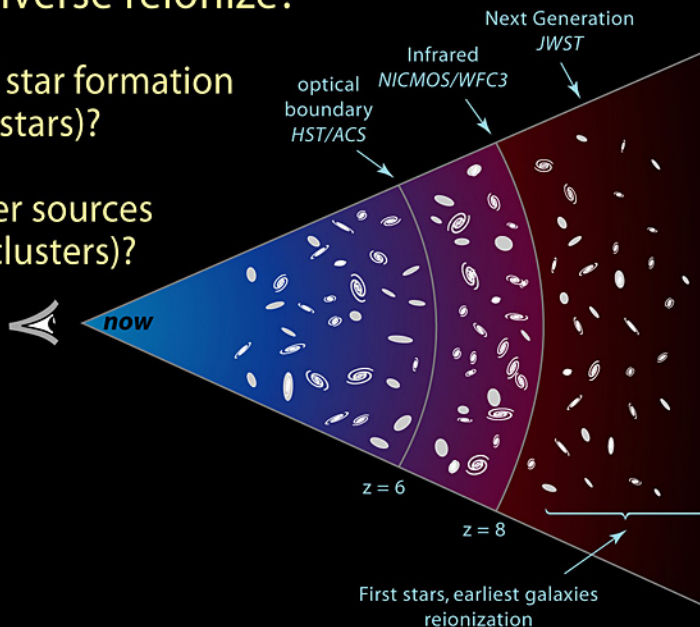
So: How does the Universe reionize?



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How does the Universe reionize?

- Different physics of star formation early on (masses of stars)?
- Undiscovered fainter sources (forming globular clusters)?
- Star formation at even earlier times?



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