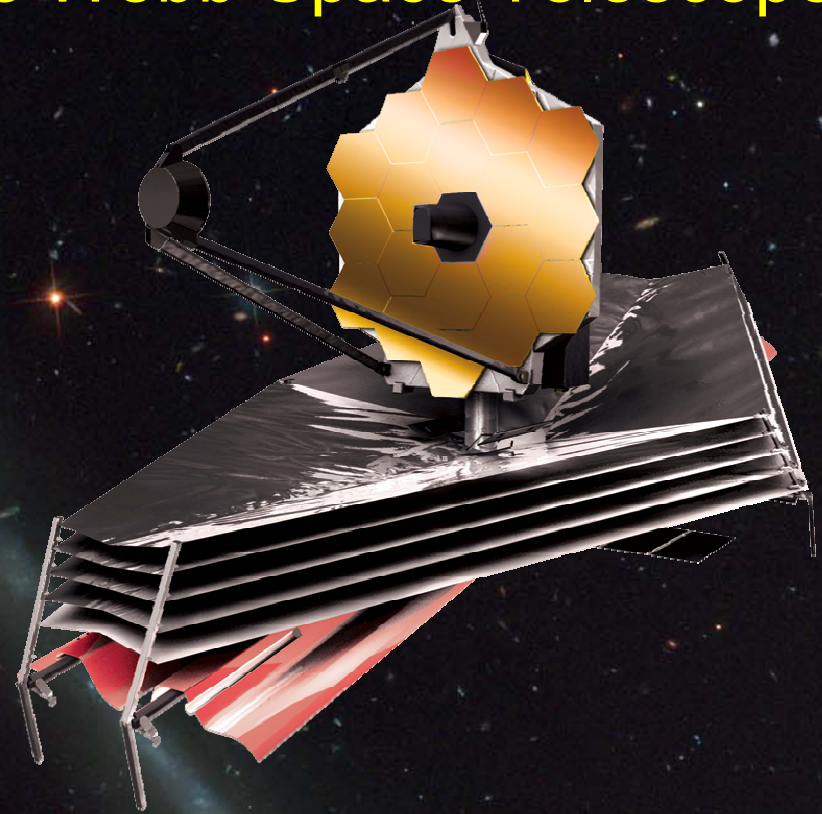
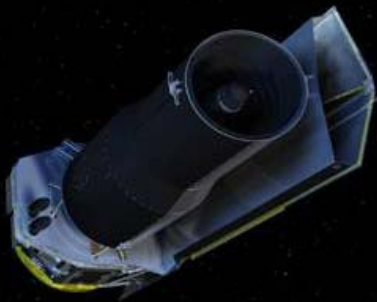
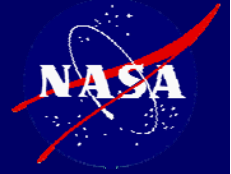


A Spitzer warm mission Ultra-Wide Survey as a target finder for the James Webb Space Telescope

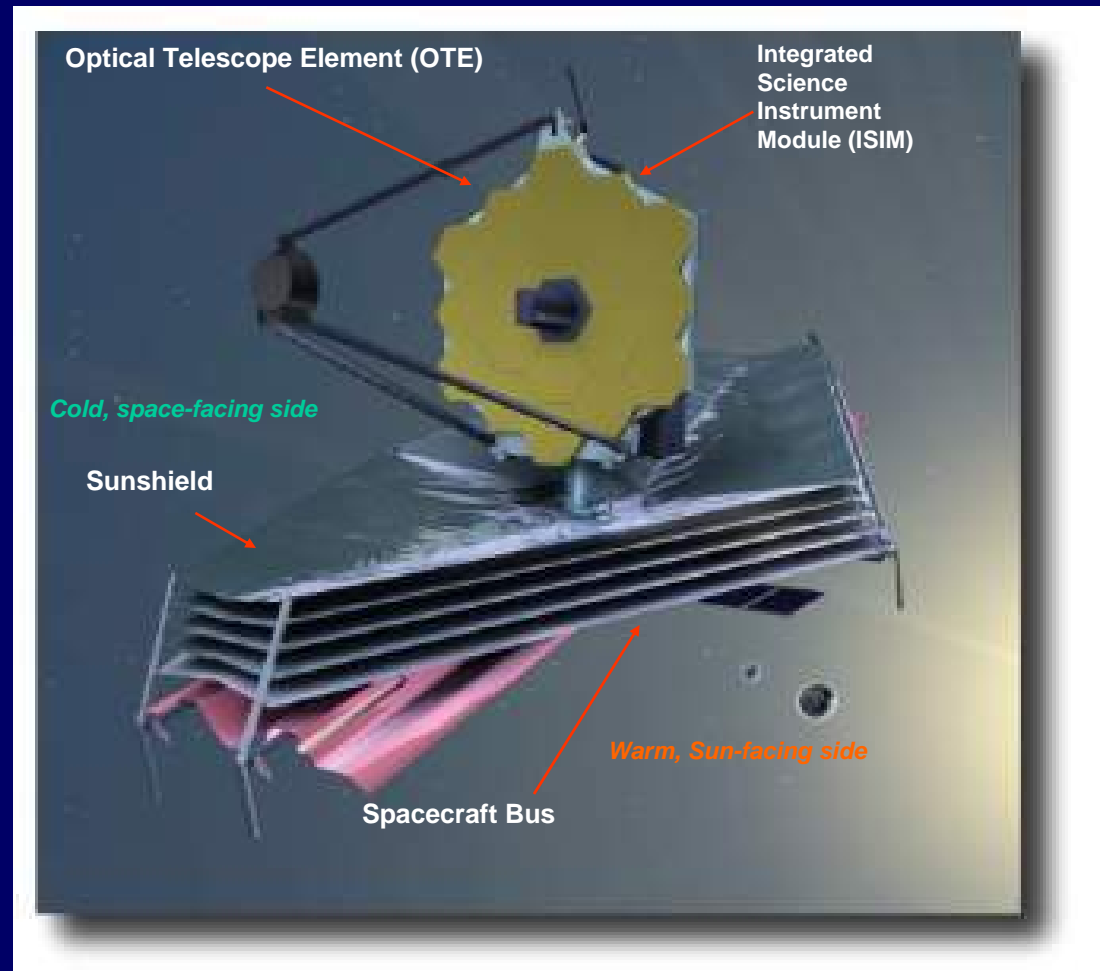


Jonathan P. Gardner, (GSFC), Xiaohui Fan (AZ),
Gillian Wilson (SSC), Massimo Stiavelli (STScI)

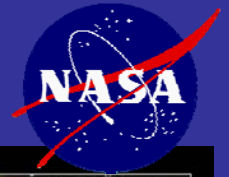
James Webb Space Telescope



- 6.6m Telescope
- Launch in 2013 to L2 on Ariane 5.
- Successor to Hubble & Spitzer.
- Imaging and spectroscopy over 0.6 to 28.5 microns
 - NIRCam (U AZ)
 - NIRSpec (ESA)
 - MIRI (JPL+ESA)
 - TFI (CSA)
- All technology at TRL-6
- Lead: Goddard Space Flight Center
- Prime: Northrop Grumman Space Technology
- Operations: STScI
- Senior Scientist: Nobel Laureate John Mather

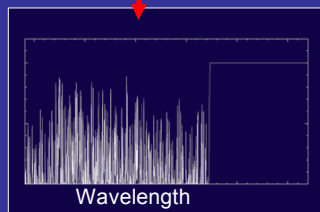
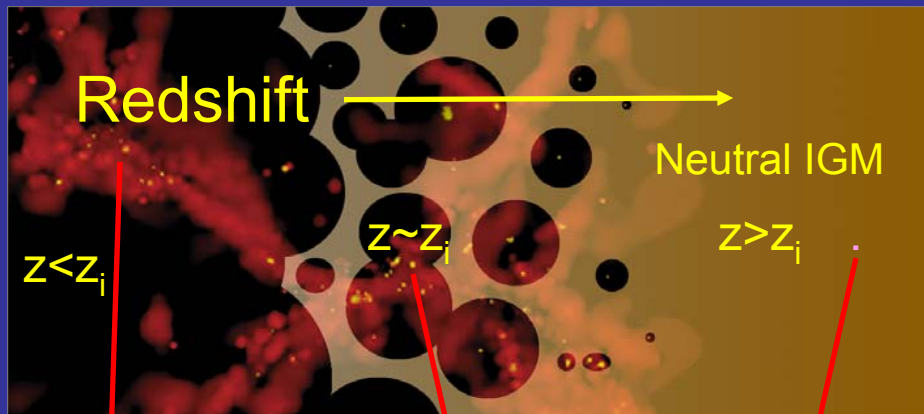


see: [Space Science Reviews, 2006, 123/4, 485](#)
or [astro-ph/0606175](#)

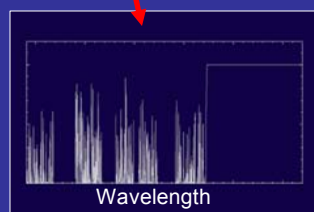


End of the dark ages: first light and reionization

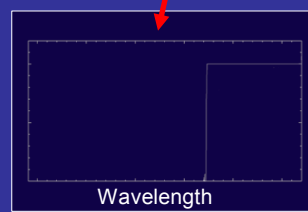
- What are the first galaxies?
- When did reionization occur?
 - Once or twice?
- What sources caused reionization?



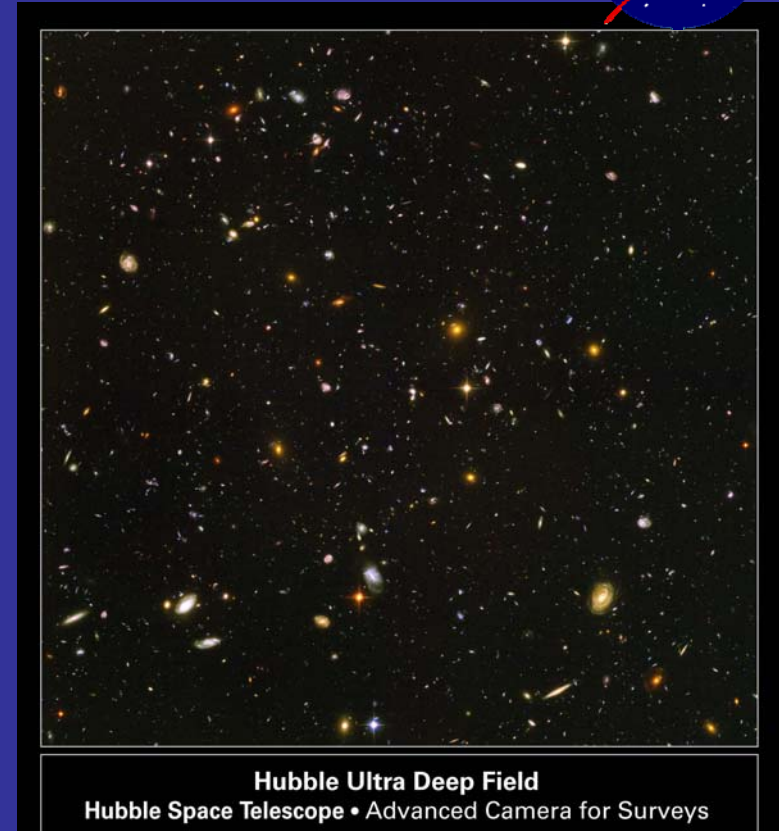
Lyman Forest Absorption



Patchy Absorption

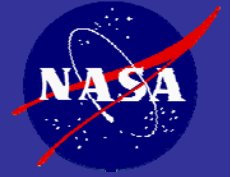


Black Gunn-Peterson trough



Hubble Ultra Deep Field
Hubble Space Telescope • Advanced Camera for Surveys

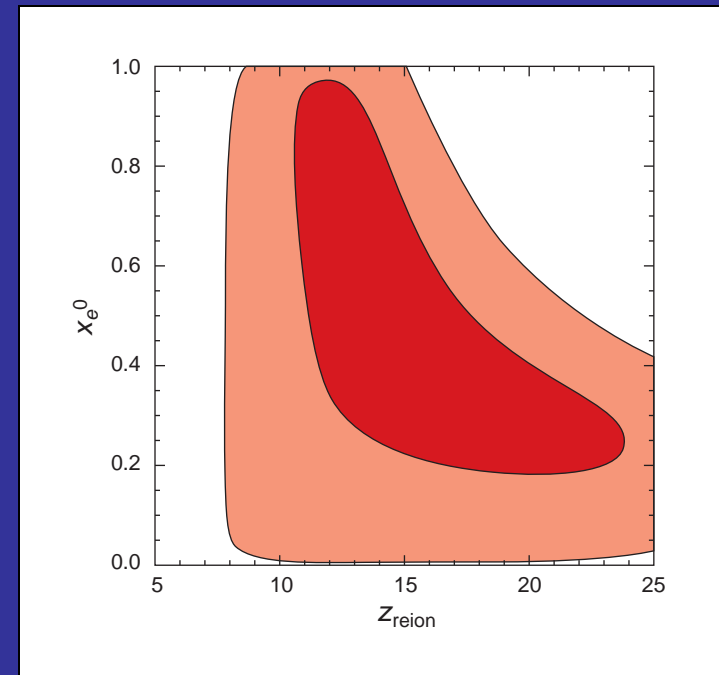
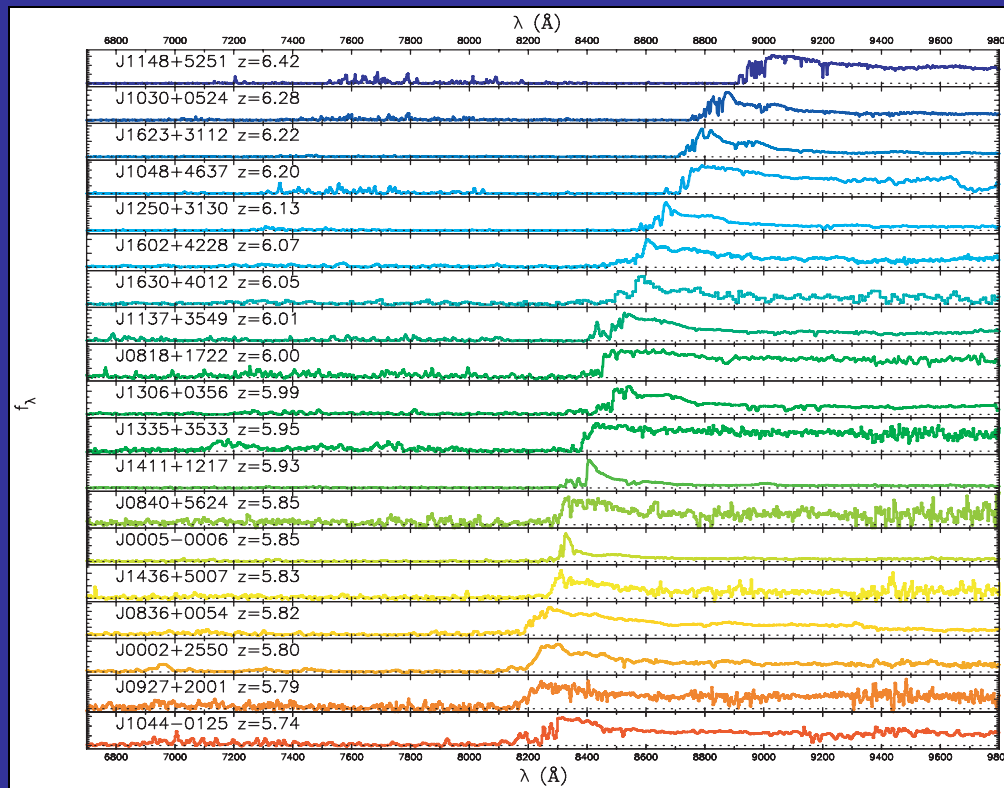
- Ultra-Deep NIR survey (1.8 nJy), spectroscopic & Mid-IR confirmation.
- QSO spectra: Ly- α forest
- Galaxy spectra: Balmer lines (2×10^{-19} ergs/cm²/sec)



Reionization

- End of reionization is seen at $z \sim 6$ in SDSS quasars.

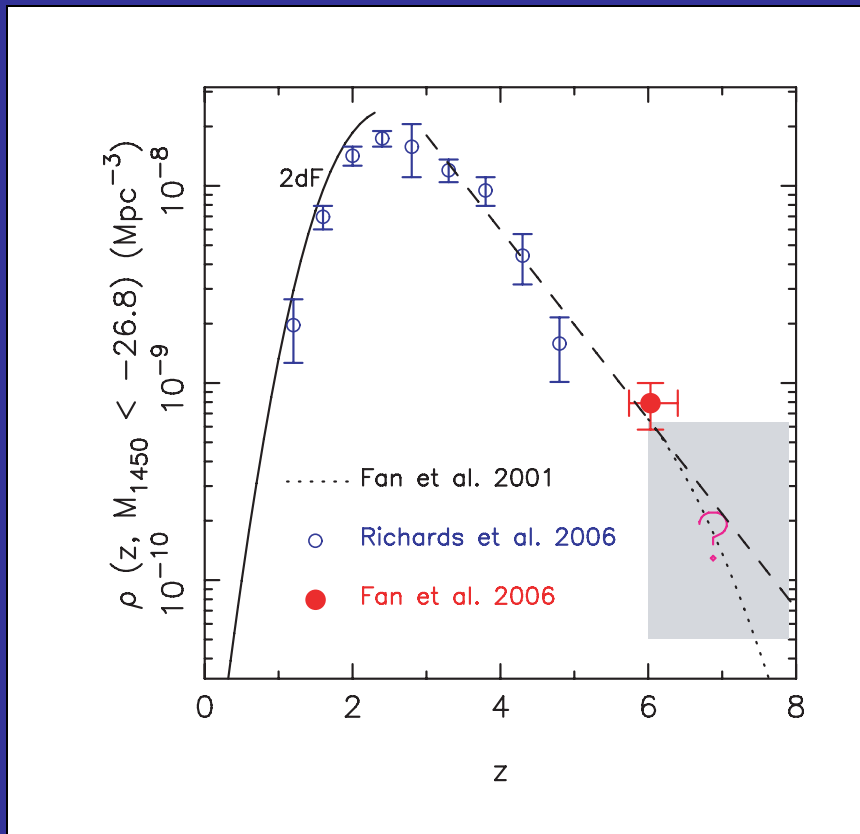
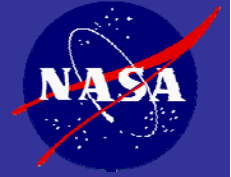
Spectra of high- z quasars showing Gunn-Peterson trough (Fan et al. 2007)



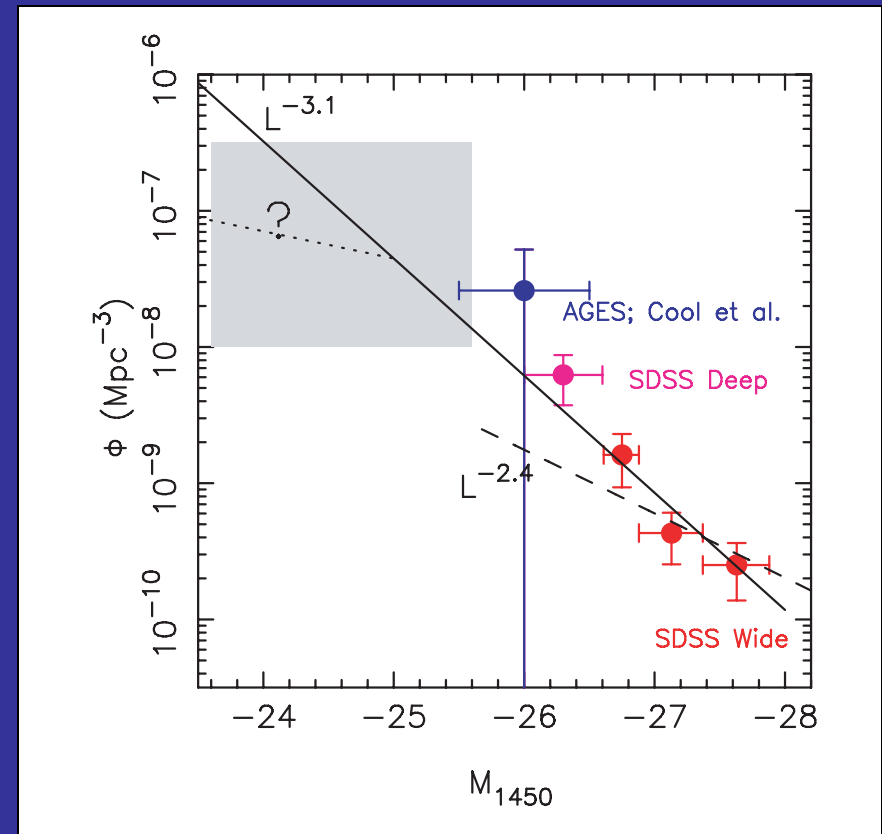
Universe is partially ionized with fraction x_e^0 at redshift z_{reion} , and fully reionized at $z=7$. (Spergel et al. 2007)

- WMAP polarization shows reionization started earlier.
- Complex history?

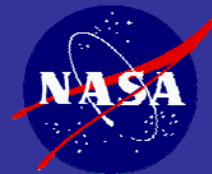
High Redshift Quasars



Evolution of quasar number density.



LF of quasars at $z \sim 6$. A break is expected at low luminosities, but not yet observed.



How well would a Spitzer survey do?

- Compare two surveys:
 - 3 μJy , 500 sq. degrees
 - 10x exposure over 50 sq. degrees

Area, depth	$z > 6$	$z > 8$	$z > 10$
500 sq. deg., 3 μJy	130	22	0.8
50 sq. deg., 1 μJy	120	20	0.7

- Quasars in the shallow survey would typically be brighter, better for spectroscopic studies of reionization with JWST.
- Identification is non-trivial, need deep optical and/or NIR.