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

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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?

- Ultra-Deep NIR survey (1.8 nJy), spectroscopic & Mid-IR confirmation.
- QSO spectra: Ly-α forest
- Galaxy spectra: Balmer lines (2x10^{-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 $z_{\text{reion}}$, 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 $\mu$Jy, 500 sq. degrees
  - 10x exposure over 50 sq. degrees

<table>
<thead>
<tr>
<th>Area, depth</th>
<th>$z &gt; 6$</th>
<th>$z &gt; 8$</th>
<th>$z &gt; 10$</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 sq. deg., 3 $\mu$Jy</td>
<td>130</td>
<td>22</td>
<td>0.8</td>
</tr>
<tr>
<td>50 sq. deg., 1 $\mu$Jy</td>
<td>120</td>
<td>20</td>
<td>0.7</td>
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- 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.