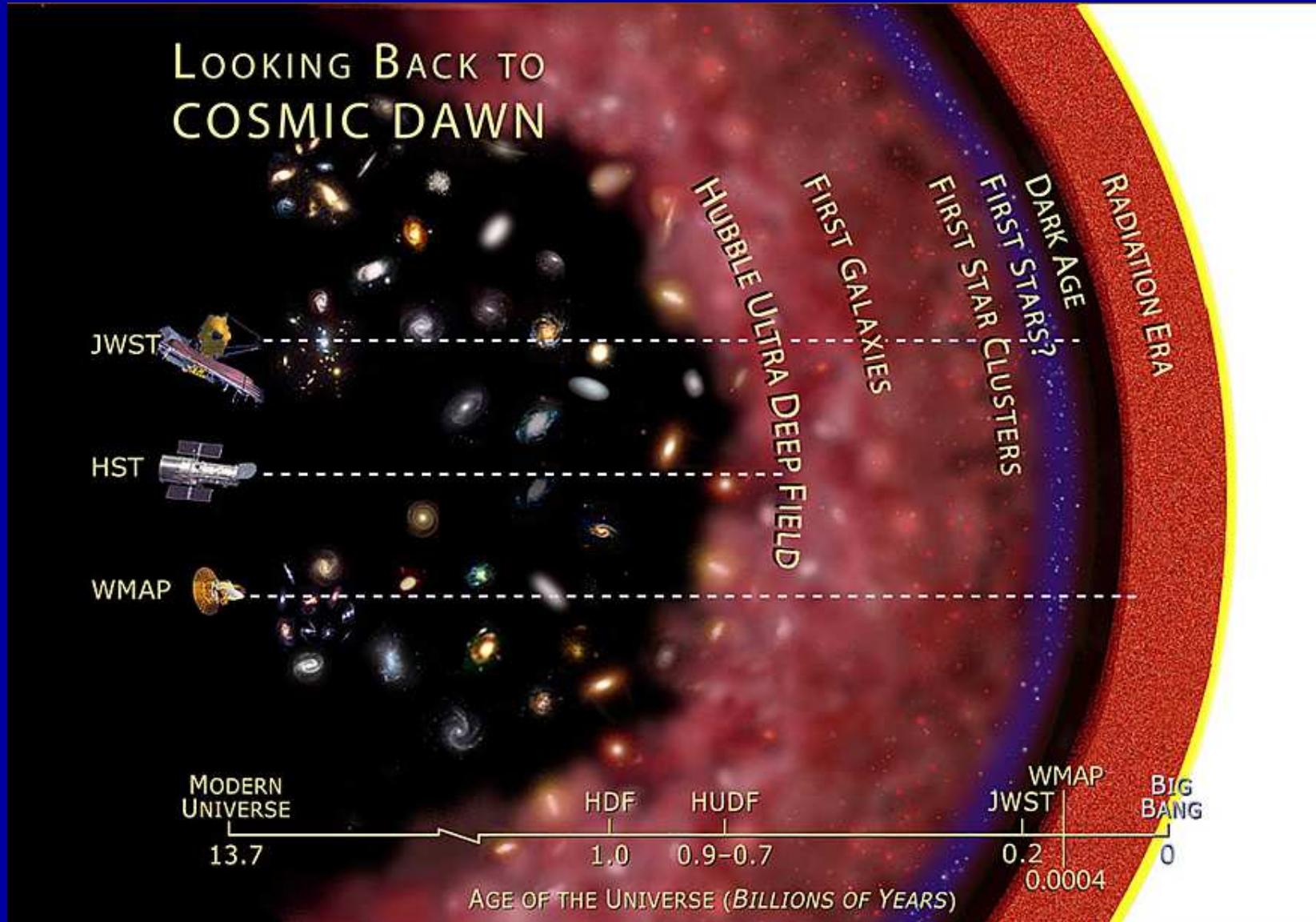


HST, JWST and WMAP observing the History of the Universe



HST (+WFC3): Hubble sequence & galaxy evolution from $z \approx 0$ to $z \approx 7-8$.

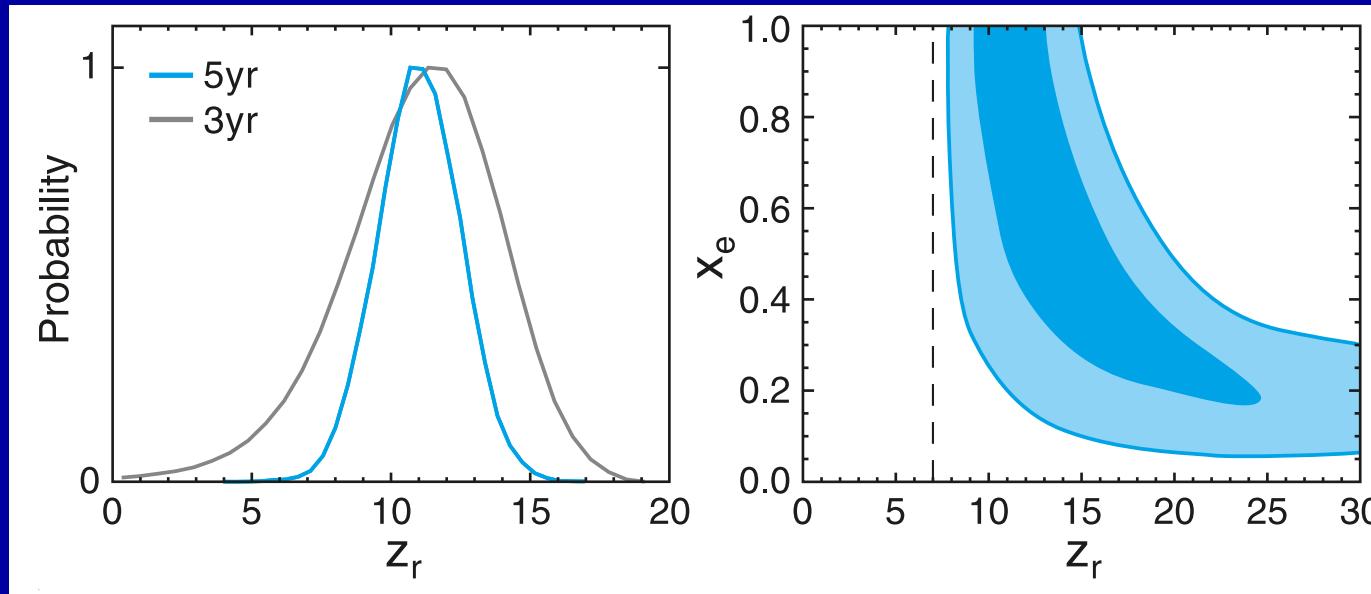
JWST: First Light, Reionization, & (dwarf) Galaxy Assembly at $z \approx 8-25$.

WMAP: H-Recombination at $z = 1091 \pm 1$. Imprints of all foregrounds.

Implications of the March 2008 5-year WMAP results on JWST science:

HST/WFC3 $z \lesssim 7\text{--}8 \leftarrow$

\longrightarrow JWST $z \simeq 8\text{--}25$



The year-5 WMAP data provided much better foreground removal (Dunkley ea. 2008 astro-ph/0803.0586; Komatsu ea. astro-ph/0803.0547). This implies that First Light & Reionization occurred between these extremes:

- (1) Universal & instantaneous at $z \simeq 10.8 \pm 1.4$, or, more likely:
- (2) Inhomogeneous & drawn out: starting at $z \sim 20\text{--}25$, peaking at $z \simeq 11$, ending at $z \simeq 7$. In both cases, the implications for HST and JWST are:
- HST has covered $z \lesssim 6$ and HST/WFC3 will cover $z \lesssim 7\text{--}8$.
- For First Light & Reionization, JWST must sample $z \simeq 8$ to $z \simeq 15\text{--}25$.
 \Rightarrow JWST must cover $\lambda = 0.6\text{--}28 \mu\text{m}$, with its diffraction limit at $2.0 \mu\text{m}$.