

A tale of three histories: distinguishing reionization scenarios in the JWST era

Christopher Cain

School of Earth & Space Exploration
Arizona State University

First Billion Years Conference, KITP @ UCSB

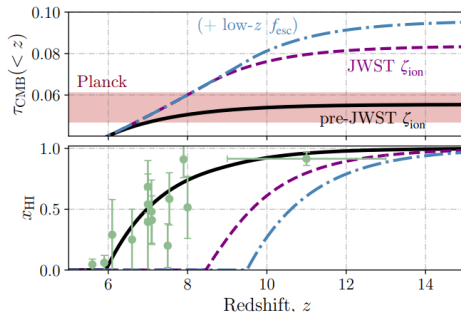
Some collaborators:

Rogier Windhorst (ASU), Rolf Jansen (ASU), Garrett Lopez (UCR), Anson D'Aloisio (UCR), Julian Muñoz (UTA)

Can galaxies drive cosmic reionization?

- Recent work (Munoz+24) suggest galaxy ionizing output could have been enough to complete reionization as early as $z \sim 8 - 9$
- Based on JWST UVLF and measurements of ξ_{ion} (Simmonds+24), and f_{esc} inferred from UV slopes (Chisholm+22)

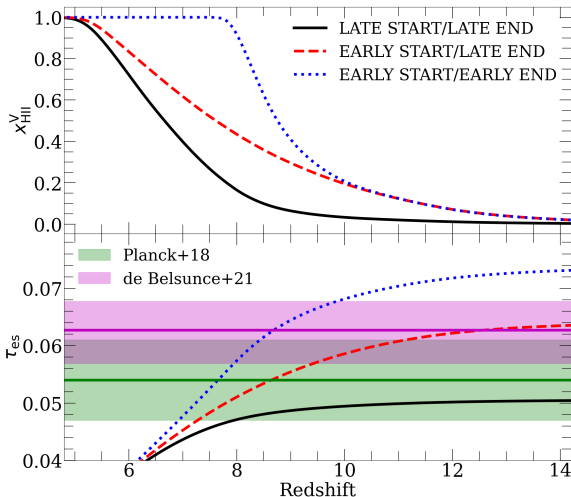
Seems like yes!



When did Reionization Start & End?

Three possibilities...

- Early start ($z \sim 13$)
early end ($z \sim 8$)
- Late start ($z \sim 9$),
late end ($z \sim 5$)
- Early start ($z \sim 13$)
late end ($z \sim 5$)
- Investigated using
Radiative transfer
simulations with
FlexRT

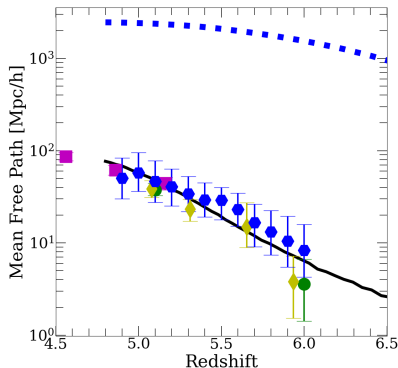
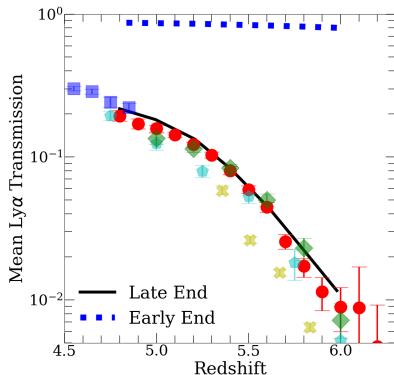


A late end is required by high- z QSOs

1 Mean transmission of $\text{Ly}\alpha$ at $z \leq 6$

early end =
too many photons!

2 Mean free path to ionizing photons



Do observations prefer a late or early start?

Category	Probe	Late Start	Early Start
CMB	τ_{es} Patchy kSZ	No Pref. Preferred	No Pref. Not preferred
High- z Galaxies	UVLF/ $\xi_{\text{ion}}/f_{\text{esc}}$ LAEs at $z > 8$ $x_{\text{HI}}(z > 6.5)$	Preferred Preferred No Pref.	Not preferred Not preferred No Pref.
$z < 6.5$ QSOs	$\langle F_{\text{Ly}\alpha} \rangle$ $P(< \tau_{\text{eff}}^{50})$ Mean Free Path Thermal History $x_{\text{HI}}(z < 6.5)$	No Pref. Not preferred Preferred Not preferred Not preferred	No Pref. Preferred Not preferred Preferred Preferred
Final Score	All Data	Preferred	Not preferred