WFIRST

WIDE-FIELD INFRARED SURVEY TELESCOPE

ASTROPHYSICS • DARK ENERGY • EXOPLANETS

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Extragalactic Science over Twelve Billion Years of Cosmic History

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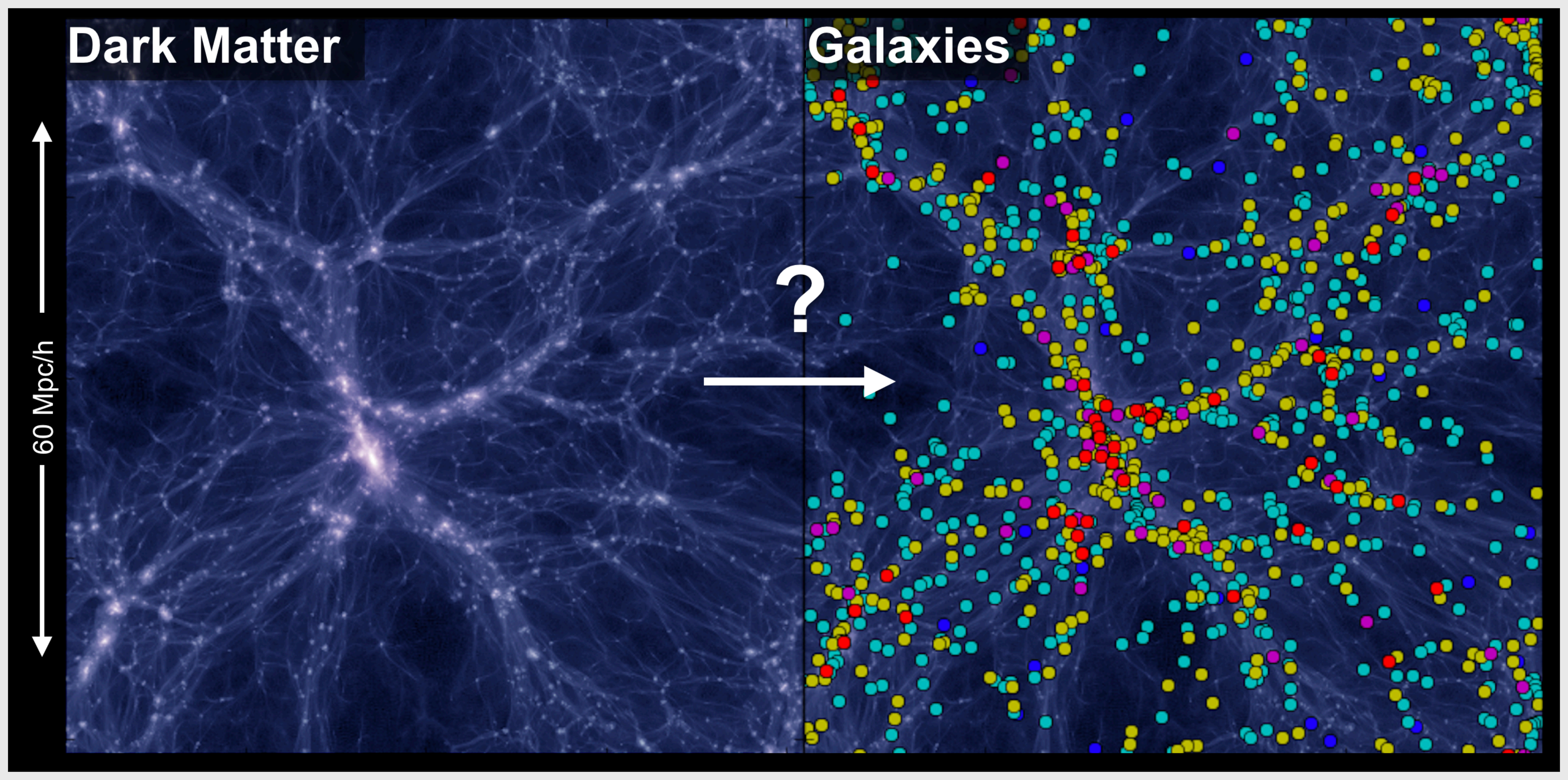
WFIRST will transform extragalactic science

WFIRST's High Latitude Survey (HLS) will obtain infrared multiband imaging and slitless spectroscopy covering thousands of square degrees. The WFIRST Guest Observer (GO) program will offer the opportunity for additional deep and ultradeep IR surveys covering areas >100x larger than those achieved by the Hubble Space Telescope. Together, these wide and deep WFIRST surveys will revolutionize our understanding of galaxy formation and evolution by providing the first complete picture of star formation and stellar mass build-up in galaxies over twelve billion years of cosmic history. Archival Guest Investigator (GI) research will enable wide community access to these rich data sets.

Our WFIRST Extragalactic Potential Observations (WFIRST-EXPO) Science Investigation Team has identified a host of possible GO and GI research programs where WFIRST can transform our views of the connections between the star formation, environment, morphology, stellar mass, and dark matter halo properties of galaxies, and can singularly probe the connection between early galaxies and the process of cosmic reionization. We present these WFIRST capabilities, and discuss how the science from WFIRST relates to other major forthcoming space- and ground-based facilities.

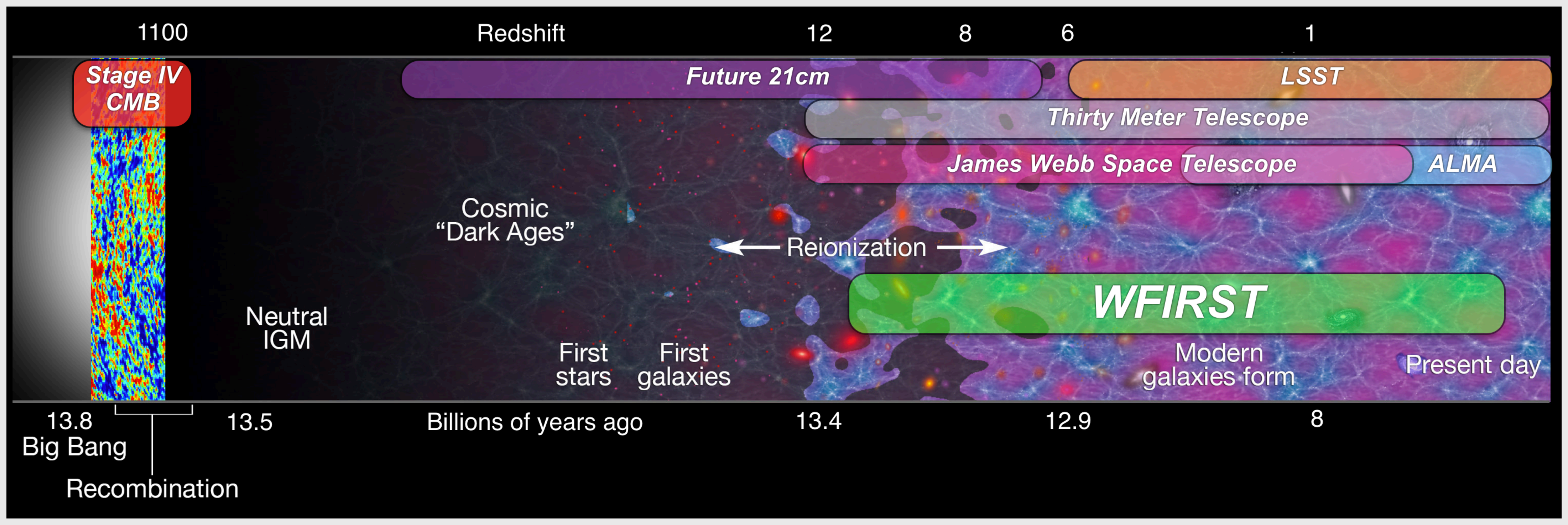
WFIRST provides cosmic context



Above: Dark matter structures (left; 1024^3 particles, 60 Mpc/h box) serve as the backbone of the galaxy population (right; color coded by stellar age from a semi-analytical model). Via rest-frame optical imaging and spectroscopic redshifts, WFIRST will enable us to understand the mapping of dark matter to galaxies.

WFIRST will provide high resolution rest-frame optical imaging of hundreds of millions of galaxies, and grism spectroscopy for tens of millions of sources. By simultaneously enabling weak lensing estimates of dark matter halo masses and three-dimensional clustering information, WFIRST will allow the mapping between dark matter halo mass, galaxy stellar mass, and star formation rate to be determined for enormous populations. WFIRST will provide a complete picture of how galaxy formation is influenced by environment by measuring high-quality morphologies and spectral line properties over the full dynamic range of cosmic large scale structure, from voids and filaments to rare overdensities with unusual formation and mass accretion histories.

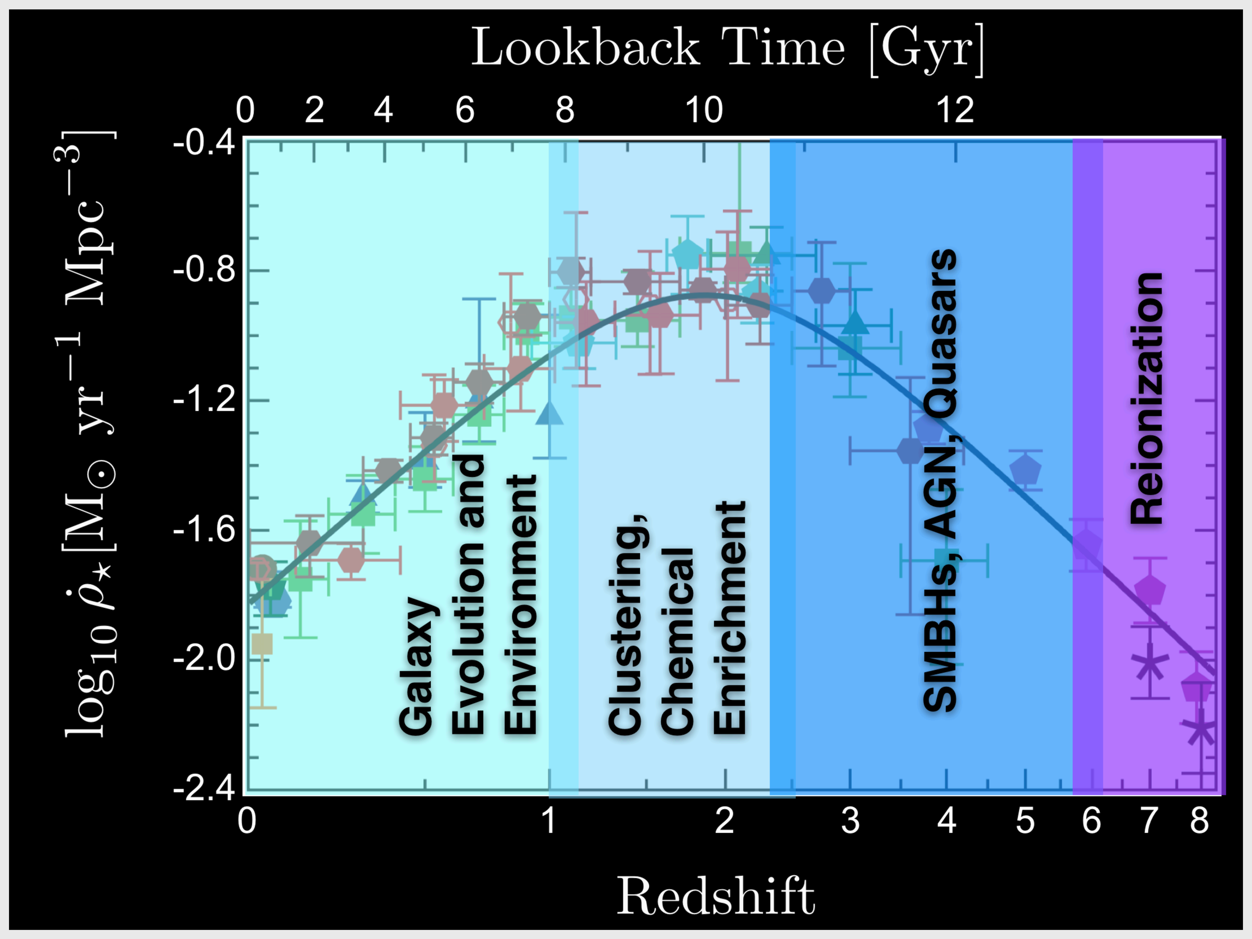
Astronomical facilities in the next decade

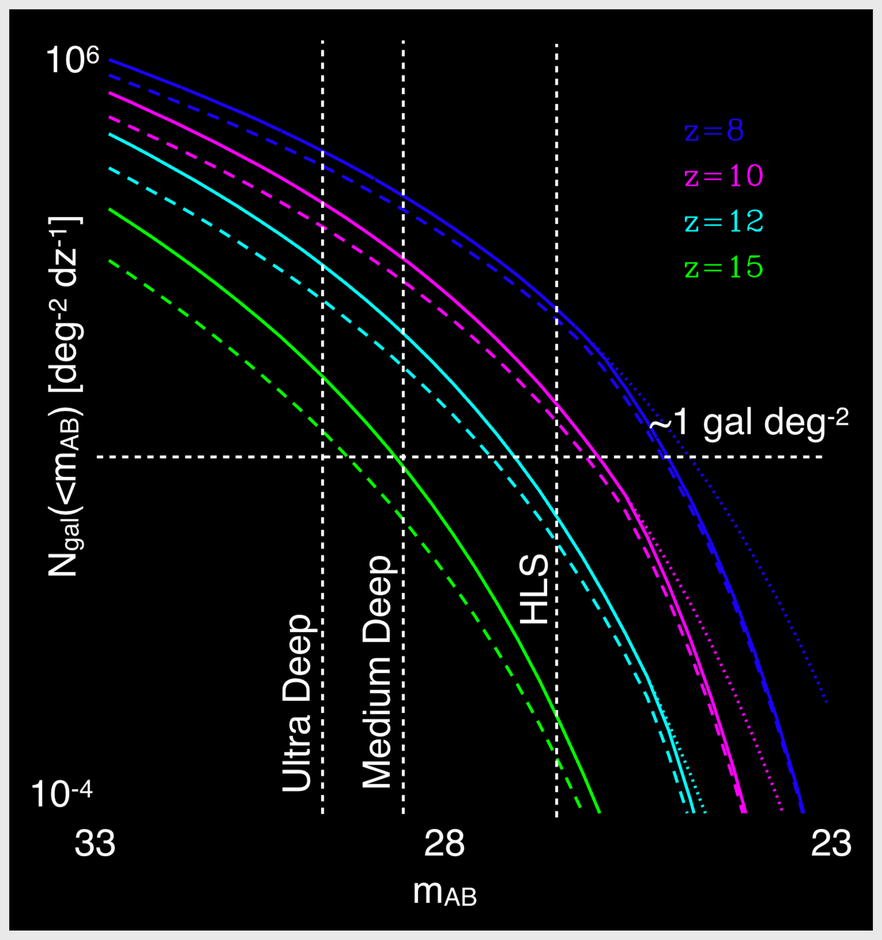


Above: Major astronomical facilities operational during or under development for the next decade, along with the important cosmic epochs they will explore. WFIRST will provide deep synergies with these new facilities.

The coming decade will provide wide-area optical imaging with LSST, high-resolution spectrophotometry with the Thirty Meter Telescope and other new giant segmented mirror telescopes, deep infrared space imaging and spectroscopy over small areas with the James Webb Space Telescope, sub-mm imaging and molecular line spectroscopy with ALMA, redshifted 21cm probes of the reionization era IGM, and new constraints on cosmology and reionization from Stage IV CMB experiments. WFIRST infrared space imaging over thousands of square degrees complements the science programs of all these contemporary facilities, and will help unify observational efforts to understand galaxy formation during the late 2020s.

WFIRST science themes spanning 12 Gyrs





Left: Cosmic star formation history from Madau & Dickinson 2014 (ARAA, 52, 412; points + line), along with major WFIRST science themes indicated at each cosmic epoch. With wide-area spectroscopic capabilities, WFIRST expands the science themes explored with HST to include environment and redshift clustering.

Right: Expected WFIRST high-redshift galaxy samples from notional High Latitude Survey (1600 deg^2), Medium Deep (25 deg^2) and Ultra Deep (1 deg^2) programs (Furlanetto et al. 2017). Solid, dashed and dotted lines indicate different prescriptions for regulation of star formation by feedback.

Do you have great ideas for WFIRST GO/GI science? Or questions about GO/GI science that might be relevant for WFIRST mission planners? Let us know! Contact WFIRST-EXPO PI Brant Robertson at brant@ucsc.edu.

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