

Key Science Themes for Future JWST and HST Observations

Thematic Areas (Check all that apply):

- (Theme A) Key science themes that should be prioritized for future JWST and HST observations
- (Theme B) Advice on optimal timing for substantive follow-up observations and mechanisms for enabling exoplanet science with HST and/or JWST
- (Theme C) The appropriate scale of resources likely required to support exoplanet science with HST and/or JWST
- (Theme D) A specific concept for a large-scale (~500 hours) Director's Discretionary exoplanet program to start implementation by JWST Cycle 3.

Summary: This white paper highlights key science themes that should be prioritized for future James Webb Space Telescope (JWST) and Hubble Space Telescope (HST) observations. The recommended science objectives include characterizing exoplanet atmospheres, probing exoplanet habitability, investigating exoplanet formation and dynamics, exploring exoplanet diversity, and studying transient and time-domain exoplanet phenomena. These objectives are urgent, feasible, and timely, and cannot be fully accomplished within the normal General Observer (GO) cycle.

Anticipated Science Objectives:

1. **Characterizing Exoplanet Atmospheres:** The objective is to obtain high-resolution spectroscopic observations using JWST's instruments to analyze exoplanet atmospheres across a range of planet types.
2. **Probing Exoplanet Habitability:** The objective is to study exoplanets in the habitable zone of their host stars, characterizing their atmospheric compositions and searching for signs of habitability.
3. **Investigating Exoplanet Formation and Dynamics:** The objective is to study protoplanetary disks, young planetary systems, and mature systems to understand the processes of exoplanet formation and the dynamical evolution of planetary systems.
4. **Exploring Exoplanet Diversity:** The objective is to conduct surveys to study exoplanet demographics, including occurrence rates of different planet types and the distribution of orbital architectures and multi-planet systems.
5. **Studying Transient and Time-Domain Exoplanet Phenomena:** The objective is to monitor exoplanet systems to capture transient and time-domain phenomena, studying exoplanet atmospheres, weather patterns, and orbital dynamics.

Urgency: The urgency lies in advancing our understanding of exoplanets and their characteristics. Exoplanet research is a rapidly evolving field, and the scientific community must seize the opportunity to make crucial observations with the upcoming capabilities of JWST and HST.

Risk/Feasibility: The proposed science objectives are feasible, leveraging the capabilities of JWST and HST, including their advanced instruments for imaging and spectroscopy. The risk associated with these objectives is low, as they align with established observational techniques and the expertise of the scientific community.

Timeliness: Timely action is essential to capitalize on the availability of JWST and HST and their unique capabilities. These observatories represent significant advancements in technology and offer unprecedented opportunities to address key questions in exoplanet science.

Cannot be accomplished in the normal GO cycle: The comprehensive investigation of these science objectives requires dedicated observing time and re-

sources beyond the scope of individual GO proposals. A coordinated effort and extended observation time are necessary to achieve the scientific goals outlined in this white paper.