

NASA Exoplanet Exploration Program Science Update

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2023 edition of the Exoplanet Program Science Gap List

<https://exoplanets.nasa.gov/exep/science-overview/>

- Description of 16 research areas where additional work would benefit current & future NASA exoplanet missions. Tactical goals, flowing from Decadal strategic goals.
- Connects mission needs to work in theory, laboratory measurements, simulations, and supporting observations.
- Its major utility is as a guide for XRP proposers, review panels, and NASA HQ selection officials. Not used proscriptively.
- Updated throughout with 2022 inputs from the community; 2 new gaps spunoff from prior ones
- No ExEP science gap list update in 2024. In June there will be a call for inputs on the 2025 edition.

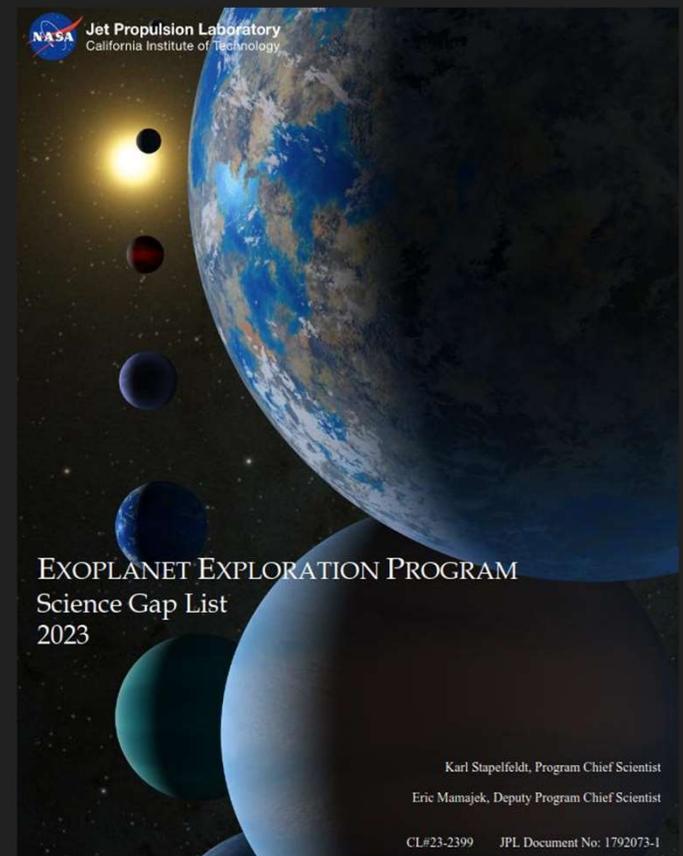


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Each gap is described by:

- Title
- Summary
- Capability Needed
- Capability Today
- Mitigations in Progress

Mitigations NOT in Progress are what you should be proposing !

Context for each gap is detailed in the ExEP Science Plan Appendix document, currently under revision

The "other" science gap list :

Decadal Survey Precursor Science

- NASA Astrophysics is offering a second proposal opportunity this spring to support the definition of the HWO, Far-IR, and X-ray Great Observatories recommended by Astro2020. NOIs are due on March 29, proposals April 26
- This opportunity is specific to investigations whose results can affect architecture trades for these three large missions; *not preparatory science*
- For the previous 2023 proposal opportunity, 18 precursor science gaps were formulated from community inputs, with 8 derived from existing ExEP science gaps. <https://exoplanets.nasa.gov/exep/astro2020-precursor-sciws2-roses-call/>
- The comment period on the previous version recently closed. Based on inputs from ExEP, COR, and PhysCOS, NASA HQ expects to issue a new gap list in late January to guide spring 2024 precursor science proposers

Exoplanet-related ROSES 2022 Precursor Science Selections

Principal Investigator	Proposal Title
Bryson, Stephen <i>NASA Ames</i>	Obtaining Better Constraints on Eta-Earth by Reprocessing Kepler Data to Generate a More Complete and Reliable Exoplanet Catalog
Courtney Dressing <i>University of California, Berkeley</i>	A Pathway to Planet Properties
Steve Ertel <i>University of Arizona</i>	Securing revolutionary exozodi research with VLTI/NOTT
Joshua Krissansen-Totton <i>University of Washington</i>	Determining the Habitable Worlds Observatory capabilities needed to corroborate oxygen biosignatures
Meredith MacGregor <i>University of Colorado</i>	Unraveling the Disk - Sensitivity, spectral and spatial resolution requirements for accurate determinations of disk masses Far-IR
Dmitry Savransky <i>Cornell University</i>	Open Source Tools for Mapping Exoplanet Science Goals to Architecture Properties of the IR/O/UV Great Observatory
Margaret Turnbull <i>SETI Institute</i>	Quantifying Spectroscopic Performance Requirements for Detecting Biosignatures with a Habitable Worlds Observatory
David Wilson <i>University of Colorado</i>	Stellar X-ray and Ultraviolet characterization of the Habitable Worlds Observatory habitable planet target sample X-ray

Provisional ExEP target star list for *Habitable Worlds Observatory* precursor science: The most accessible nearby habitable zones

<https://exoplanets.nasa.gov/exep/science-overview/>

Selection criteria:

1. HZ Earth analog bright enough for spectroscopy with 6m telescope in <2 months integration time
2. Detection contrast consistent with Program technology goals
3. Inner Working Angle sufficient to achieve the Astro2020 goal of characterizing ~25 HZ rocky planets

Parameter	Tier A	Tier B	Tier C
IWA constraint	83 mas	72 mas	65 mas
Exoplanet brightness limit (Rc)	30.5 mag	31.0 mag	31.0 mag
Exoplanet-star Brightness ratio limit	4e-11	4e-11	2.5e-11
Disk criterion	No known dust disks of any kind	No disk, or KB disks OK if $L_{\text{disk}}/L^* \leq 10^{-4}$	All disks OK, even if $L_{\text{disk}}/L^* \geq 10^{-4}$ or detected HZ warm dust disk
Treatment of binaries	Single or binary companion > 10" sep	Single or binary companion > 5" sep	Single or binary companion > 3" sep
Number of Stars	47	51	66

Sample	F	G	K	M
Tier A	14	15	17	1
Tier B	15	23	11	2
Tier C	37	17	12	0
Total (A+B+C)	66	55	40	3

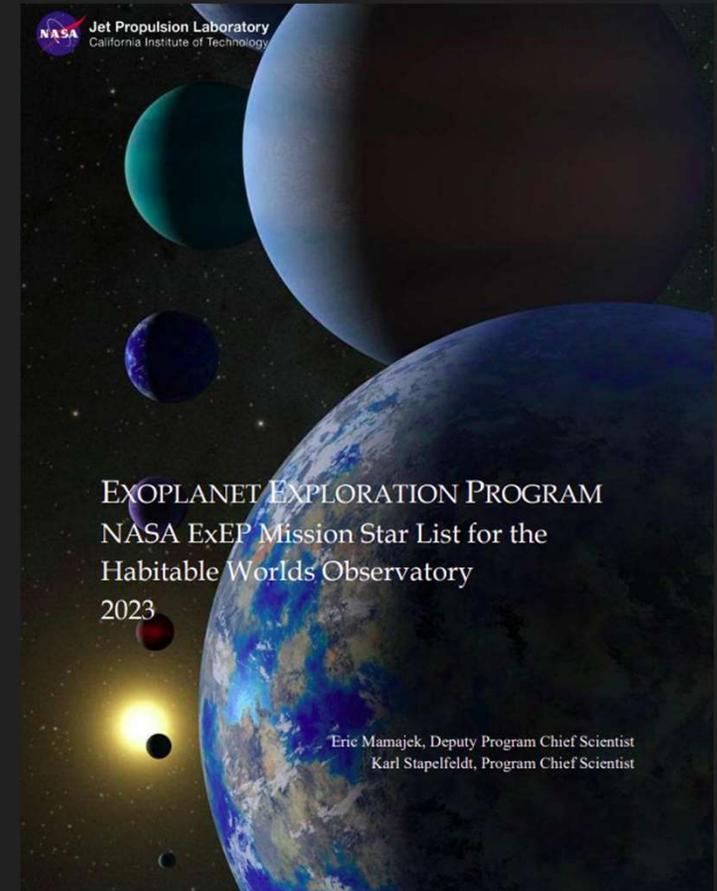
Approx. magnitude & distance limits:

F*s: $V < 6.0$, $d < 23.3$ pc

G*s: $V < 6.4$, $d < 20.5$ pc

K*s: $V < 7.0$, $d < 12.8$ pc

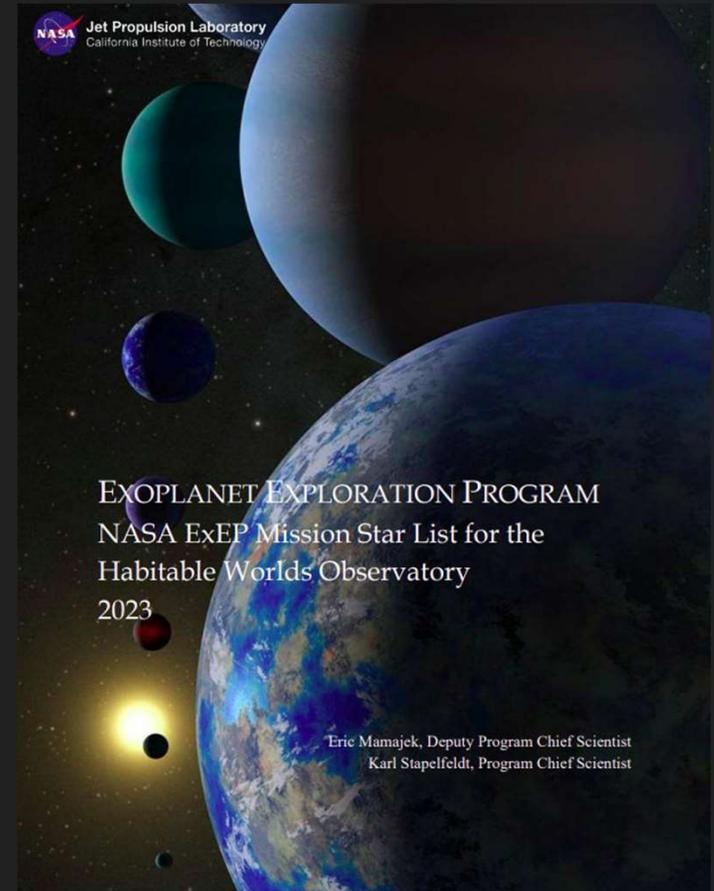
M*s: $V < 7.5$, $d < 4.0$ pc



Provisional ExEP target star list for HWO precursor science: Progress since the February 2023 release

<https://exoplanets.nasa.gov/exep/science-overview/>

- For the UV subgroup of the ExEP Coronagraph Technology Roadmap Team, we studied the accessibility of the targets in the near-UV ozone band. For ~40 of the stars, a HZ Earth analog would appear to be too faint to measure with HWO – most of the K and M stars
- Will issue an updated list by early March 2024, to support the late April deadline for the 2nd round of Decadal Survey Precursor Science Proposals
- Queryable table of ExEP HWO target star list is available through NASA Exoplanet Archive <https://exoplanetarchive.ipac.caltech.edu/>
- Accepting community comments on the 2023 target list through January 19; please email us with your suggestions
 - Most useful would be your inputs on the selection criteria
 - We won't act on requests to add somebody's favorite star(s)
- Refereed paper on the target list this spring



You can now find the provisional HWO precursor stars in Eyes on Exoplanets!



- Eyes on Exoplanets is a visualization tool of known exoplanetary systems
- By selecting "Earth" as the viewing point, any geographical point as your location, and the "Future Target Stars" you can get to know the individual target systems the HWO is likely to explore. They are the circles w/o diffraction spikes in the animated starfield above left.
- Alternatively, by selecting "Browse Destinations", and then "Stars", you can see depictions of the likely HWO targets, and text descriptions of their properties and presence in popular culture

Exoplanet Science Metrics for the Habitable Worlds Observatory

- Many aspects of exoplanet science could affect the HWO architecture selection, beyond Astro2020's goal of spectrally characterizing ~25 temperate rocky exoplanets – the only exoplanet science metric established so far for HWO
- To gather ideas on other possible metrics, the ExEP Science Office convened a working group which was active in spring and summer 2023, including a splinter session at AAS 242 (Albuquerque)
- Participating community members developed detailed write-ups on the suggested metrics at right. *Thanks much for their efforts!*
- We will ask the HWO/START Exoplanet Imaging Yields Subgroup to continue development of multiple exoplanet science metrics, these and others yet to be discussed

Champion	Metric idea
Eliza Kempton (U. of Maryland)	Comparative atmospheres of rocky exoplanets
Nancy Kiang (GSFC/GISS, ExEP visitor)	Detecting photosynthetic pigments
Jake Lustig-Yeager (APL)	Detecting exoplanet rotational variability
Avi Mandell (GSFC)	Water band search
Michael Meyer (U. of Michigan)	Hypothesis testing with system architecture subsamples
Ty Robinson (U. of Arizona)	Detecting surface oceans from glint

Exoplanet Sessions at AAS 243

Exoplanets @ AAS 243

January 6-11, 2024 – New Orleans

All these AAS events are at Ernest N. Morial Convention Center ("CC"), except ExoPAG 29 (Jan 6-7) which is at New Orleans Hilton Riverside, 2 Poydras Street.

All times = Central Standard Time (CST) = UTC - 6h

DATE	TIME	MEETING TITLE	LOCATION	SESSION TYPE
Saturday January 6, 2024				
Saturday January 6	9:00am- 5:00pm	ExoPAG 29 (Day 1 presentations) Agenda	<i>Hilton Riverside - Quarterdeck Ballroom</i>	NASA Program Analysis Group Meeting
Saturday January 6	9:00am- 5:00pm	NASA'S TESS Interactive Data Workshop	CC 219	Workshop
Sunday January 7, 2024				
Sunday January 7	9:00am- 12:30pm	ExoPAG 29 (Day 2 presentations + business meeting) Agenda	<i>Hilton Riverside - Quarterdeck Ballroom</i>	NASA Program Analysis Group Meeting
Sunday January 7	3:00pm- 5:00pm	Joint Program Analysis Group (PAG) Session including presentation & discussion with NASA Astrophysics Director Mark Clampin Agenda	CC 244/245	NASA Program Analysis Group Meeting
Monday January 8, 2024				
Monday January 8	9:00am- 6:30pm	NASA ExEP table at NASA booth, including live coronagraph instrument demo	CC Hall B-1/B-2	Exhibit
Monday January 8	9:00am- 10:00am	105 - Exoplanets & Brown Dwarfs 106 - Extrasolar Planets: Formation of Planets & Protoplanetary Disks 109 - SETI & Technosignatures	CC Hall B-1/B-2	iPosters

Flyer produced by Eric Mamajek to help guide your path through the New Orleans AAS

Mailing list subscribers already received the PDF version; we have hardcopies available here today

By our count there are 71 sessions relevant to exoplanet science !

Monday and Wednesday afternoons there are 5 exoplanet sessions running in parallel ! That's a lot of divided attention.

Is it time for a new AAS Division of Exoplanetary Sciences ???