

Transits in the Roman galactic EXoplanet Survey (TRExS). Updated Yields and Science Opportunities

Robby Wilson

UMD/NASA GSFC

**Shifting Landscapes in Astrophysics:
New Frontiers to Explore with Roman**

July 13, 2026



TRExS: Transits in the Roman galactic EXoplanet Survey

- **Data Products**
- **End of Season Data Releases**
 1. Catalog of Transiting Planet Candidates from Searching Light Curves for all 100 Million Stars

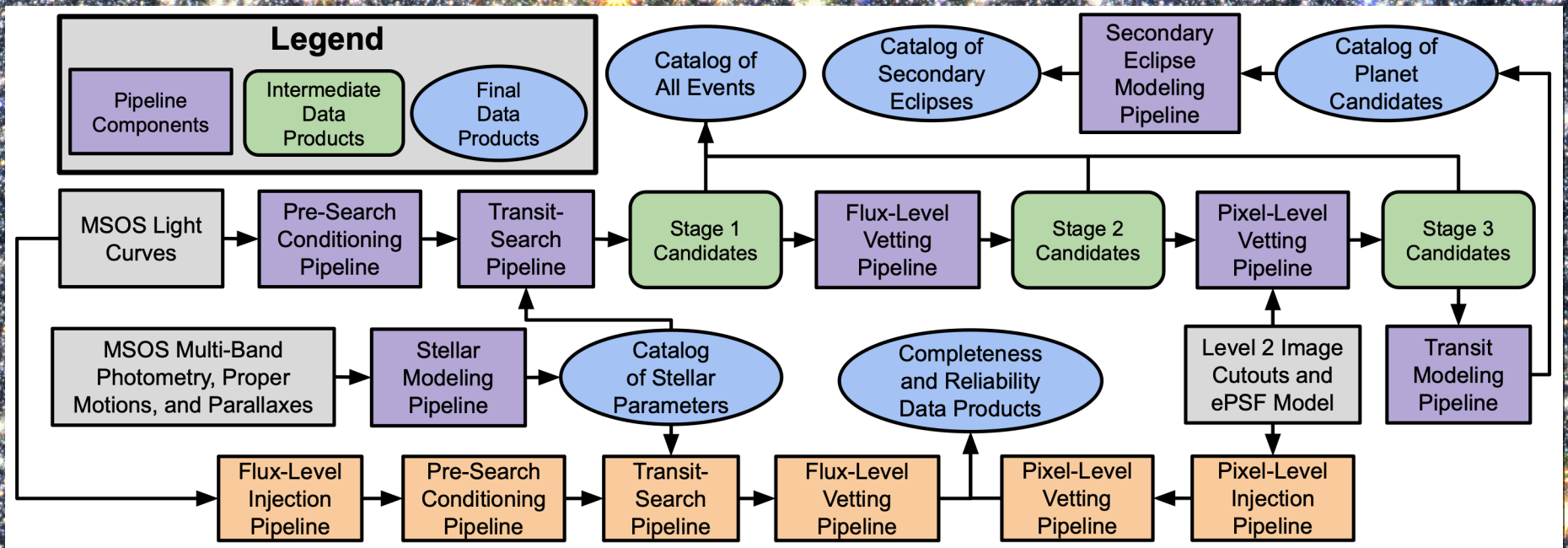
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 3. Supplementary Catalog of Transiting Planet Candidates with Eclipse Measurements/Detections

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- **End of Season 3 Data Release:**
 - **Comprehensive Completeness/Reliability Products**
 - Catalog of all Events (e.g., False Positives, False Alarms, etc.)

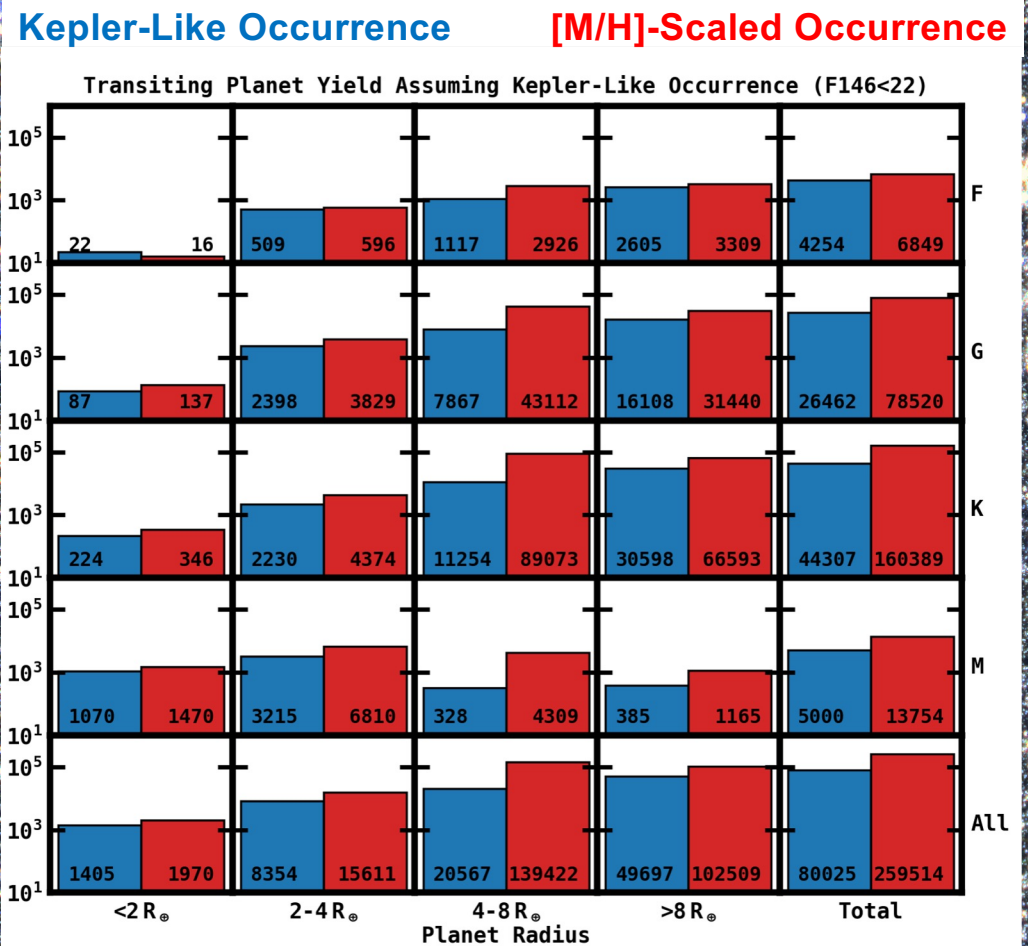
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Transiting Planets in Roman

1. Demographics of (Ultra-) Hot Jupiter Atmospheres
2. Demographics for *Rare** Planetary Systems
3. Demographics across all major Galactic populations

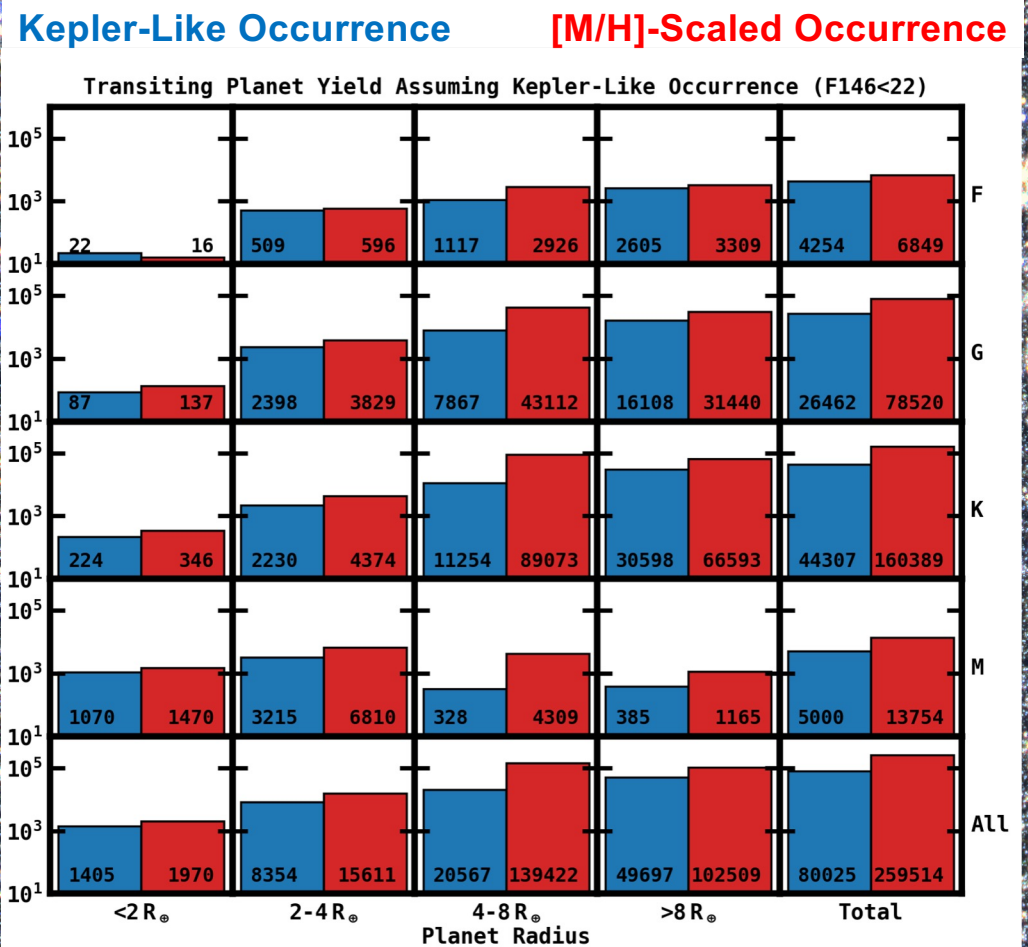
*Rare**: occurrence has yet to be measured well due to sample size



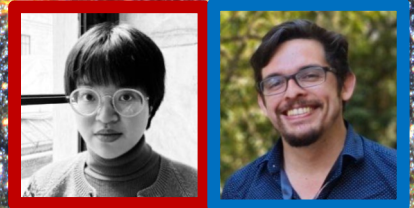
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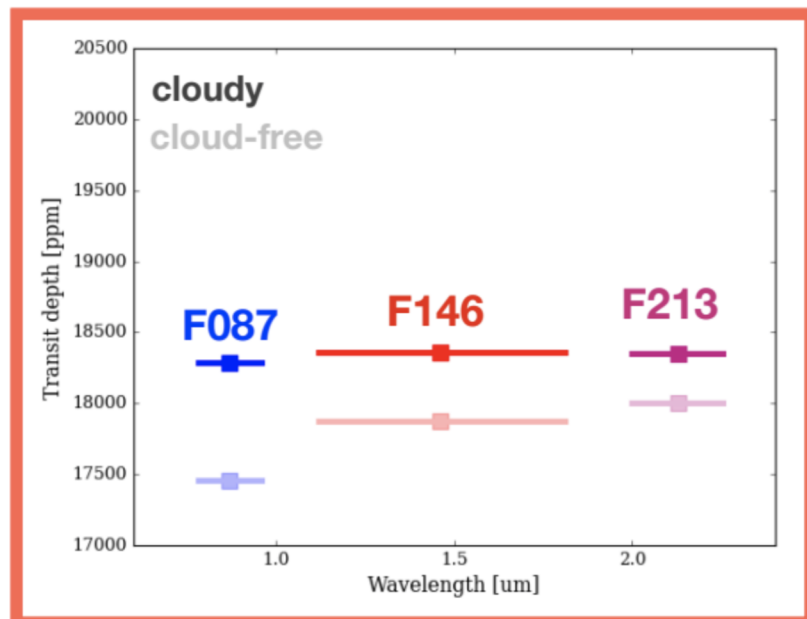


Exoplanet Atmospheres with Roman

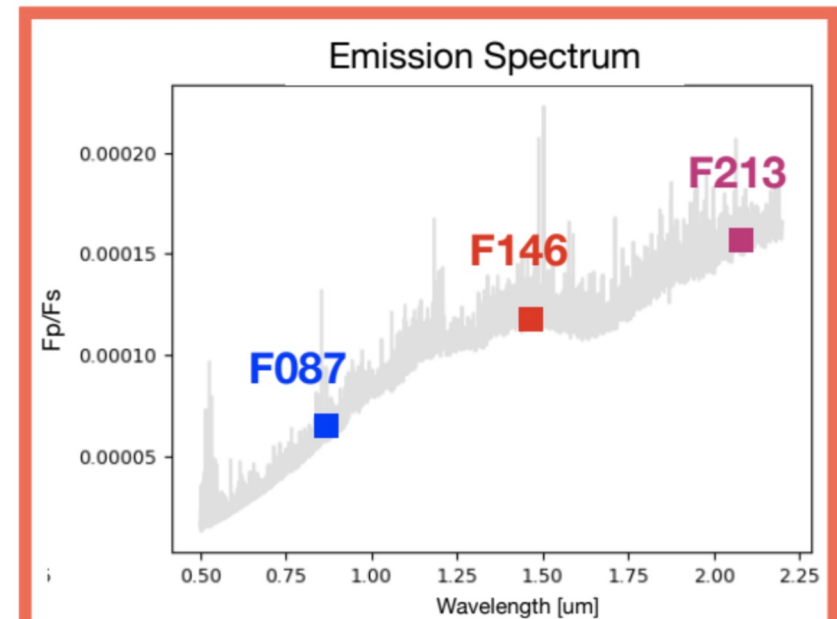


Yiwei Chai (JHU)

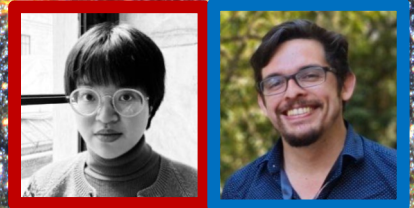
Case 1: Broadband Transit Spectrophotometry



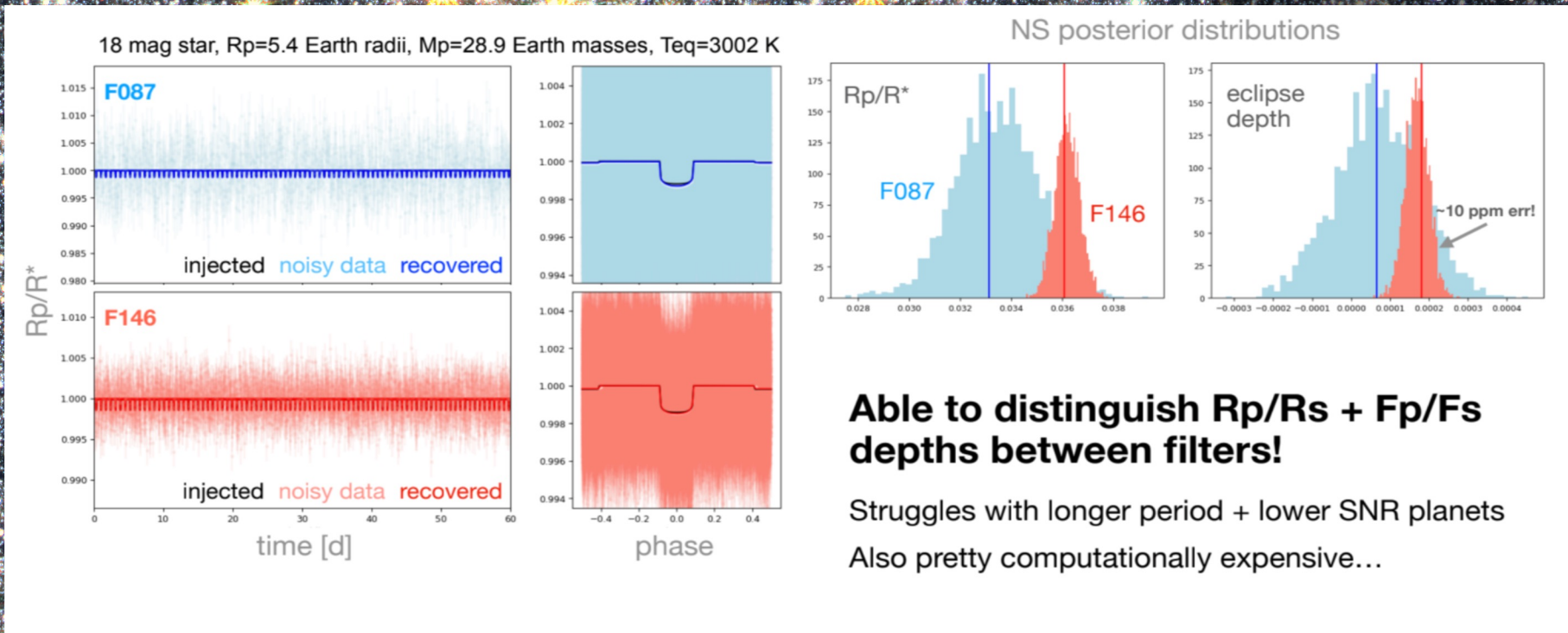
Case 2: Broadband Secondary Eclipses



Exoplanet Atmospheres with Roman



Yiwei Chai (JHU)



Exoplanet Atmospheres with Roman



Yiwei Chai (JHU)

Case 1 - Chromatic Transits (>500 total)

Clear, C/O=0.55, logZ=0.0

F087-F146 F146-F213

3 hour	121	4
6 hour	73	1
12 hour	38	1

Cloudy, C/O=0.55, logZ=0.0

F087-F146 F146-F213

3 hour	90	0
6 hour	49	0
12 hour	23	0

Able to detect more chromatic transits for clear atmospheres

Case 2 - Secondary Eclipses (>900 total)

clear/cloudy, C/O=0.55, logZ=0.0
thermal only

F146 F087 F213

3 hour	166	0	5
6 hour	173	0	1
12 hour	175	0	1

clear/cloudy, C/O=0.2, logZ=0.0
thermal only

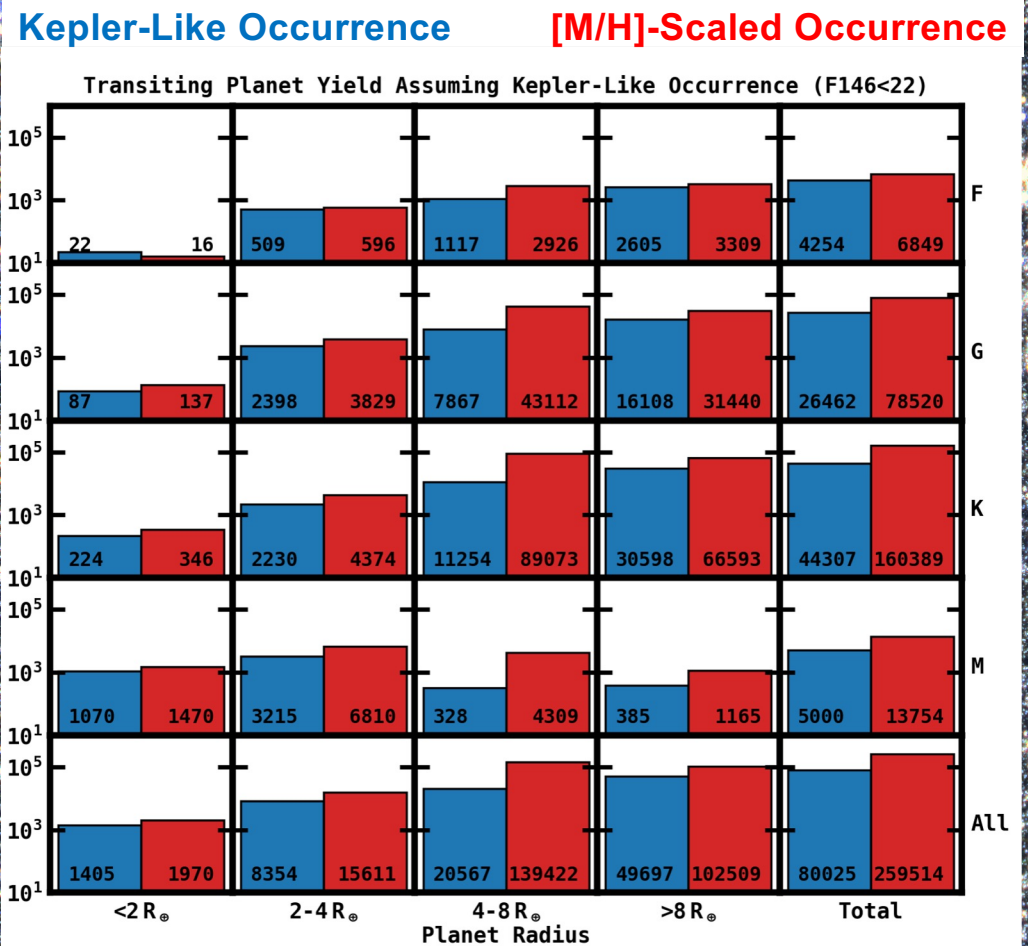
F146 F087 F213

3 hour	169	0	3
6 hour	177	0	0
12 hour	180	0	0

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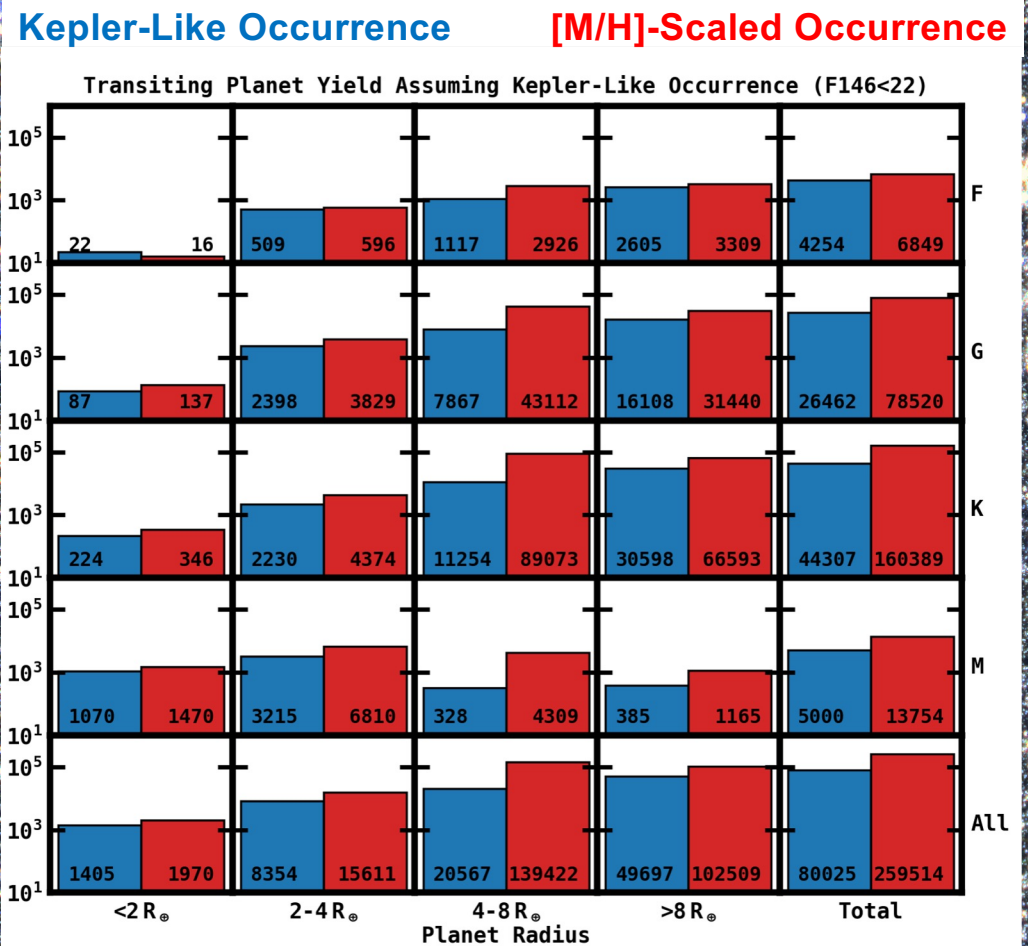
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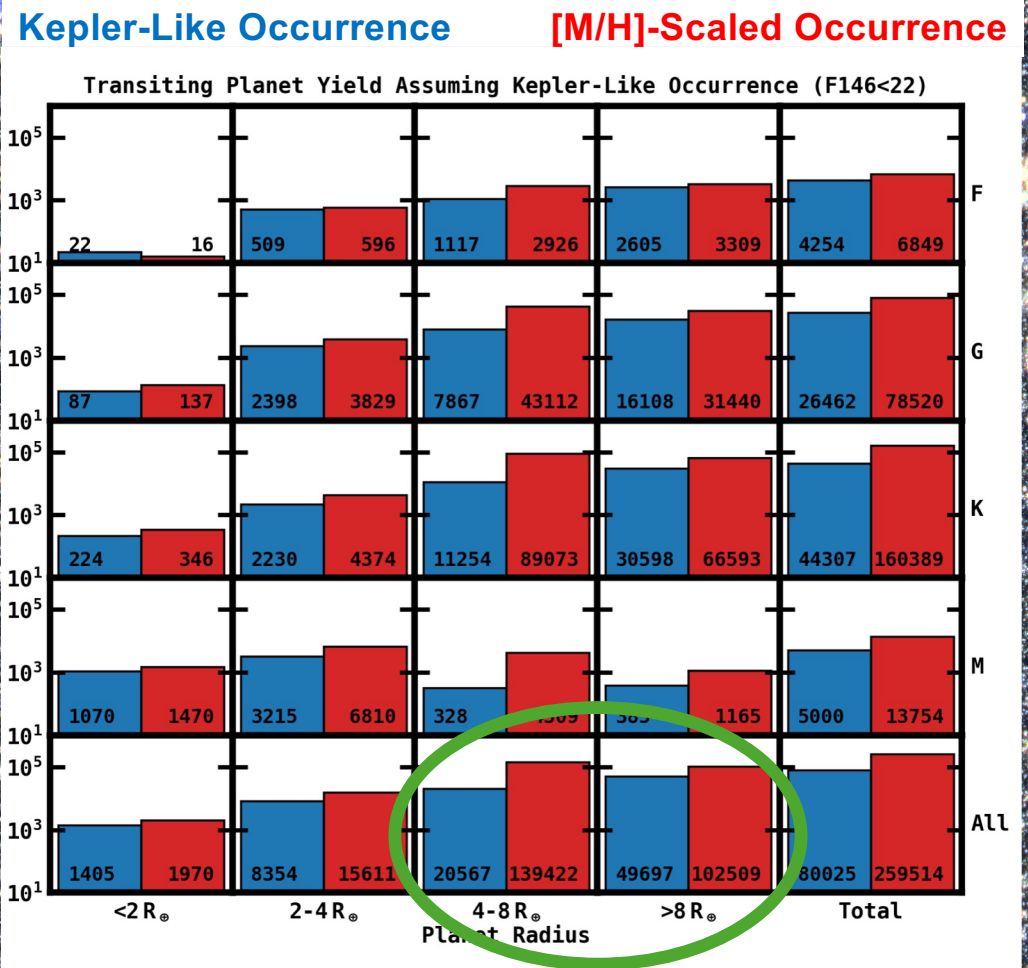
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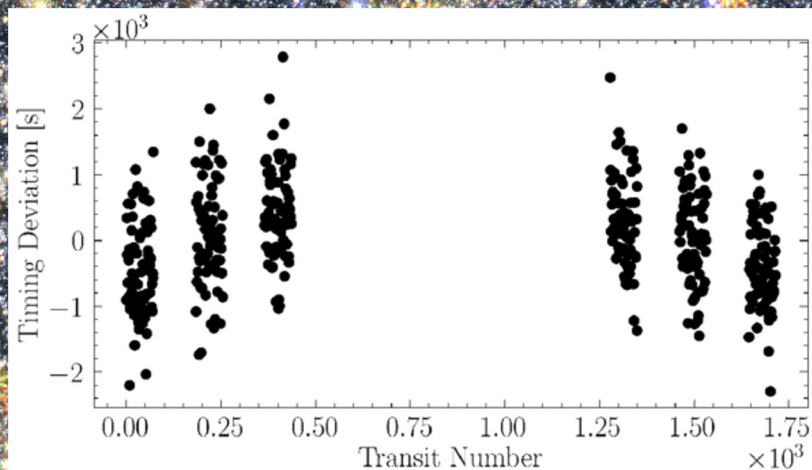


Detecting Orbital Decay with Roman

Kylee Carden (JHU)



Predicting up to ~1-10 planets with detectable orbital decay in the GBTDS



A Short History of (Orbital) Decay: Roman's Prospects for Detecting Dying Planets

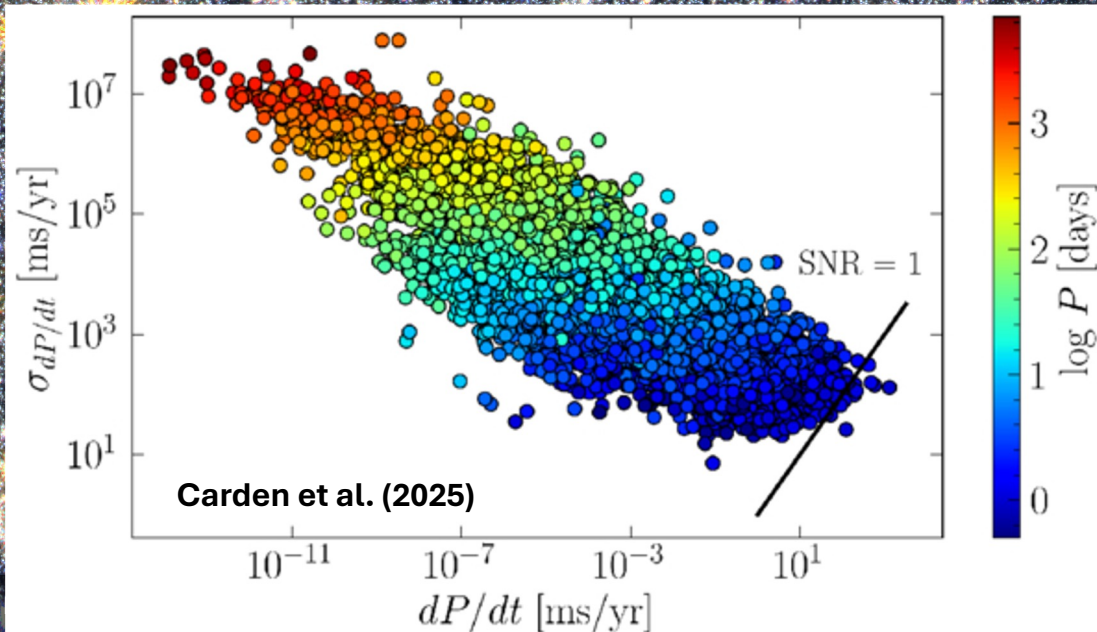
Kylee Carden¹, B. Scott Gaudi¹, and Robert F. Wilson^{2,3}

¹Department of Astronomy, The Ohio State University, 140 West 18th Avenue, Columbus, OH 43210, USA; carden.33@osu.edu

²Department of Astronomy, University of Maryland, College Park, MD, USA

³NASA Goddard Space Flight Center, 8800 Greenbelt Road, Greenbelt, MD, USA

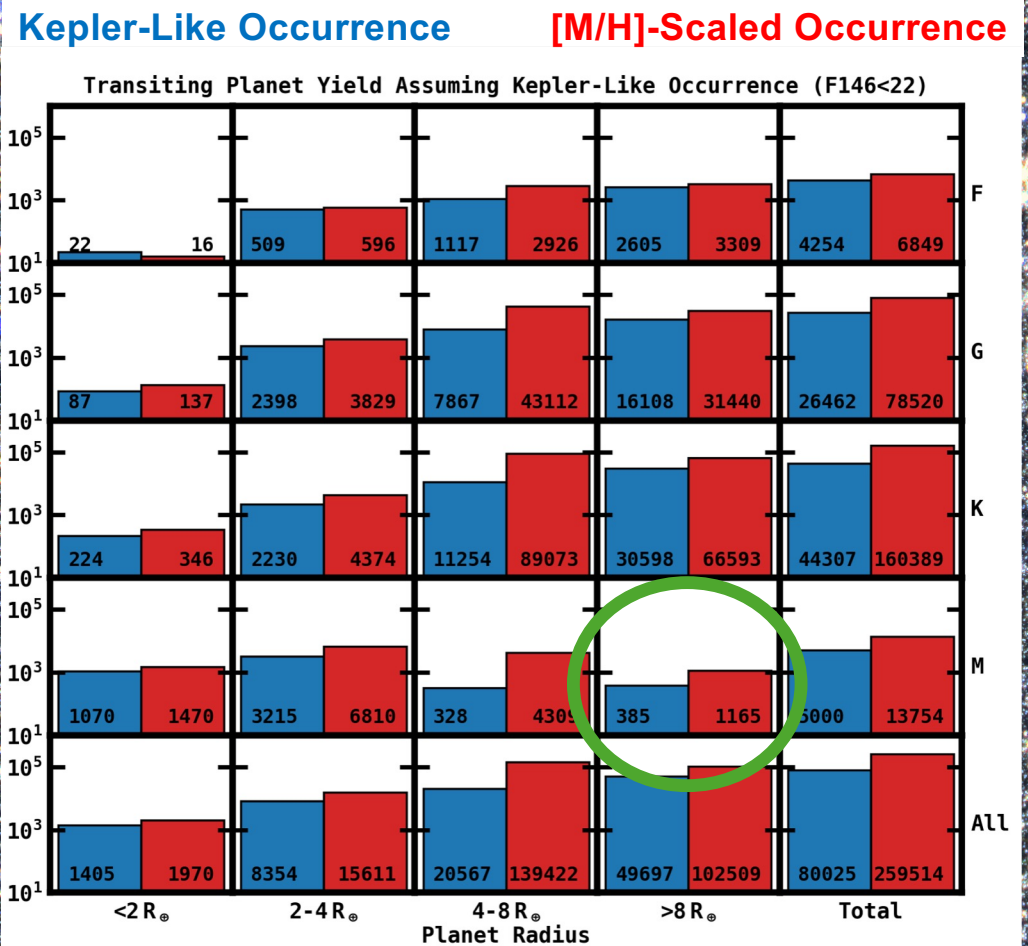
Received 2025 April 21; revised 2025 June 4; accepted 2025 June 9; published 2025 July 16



Transiting Planets in Roman

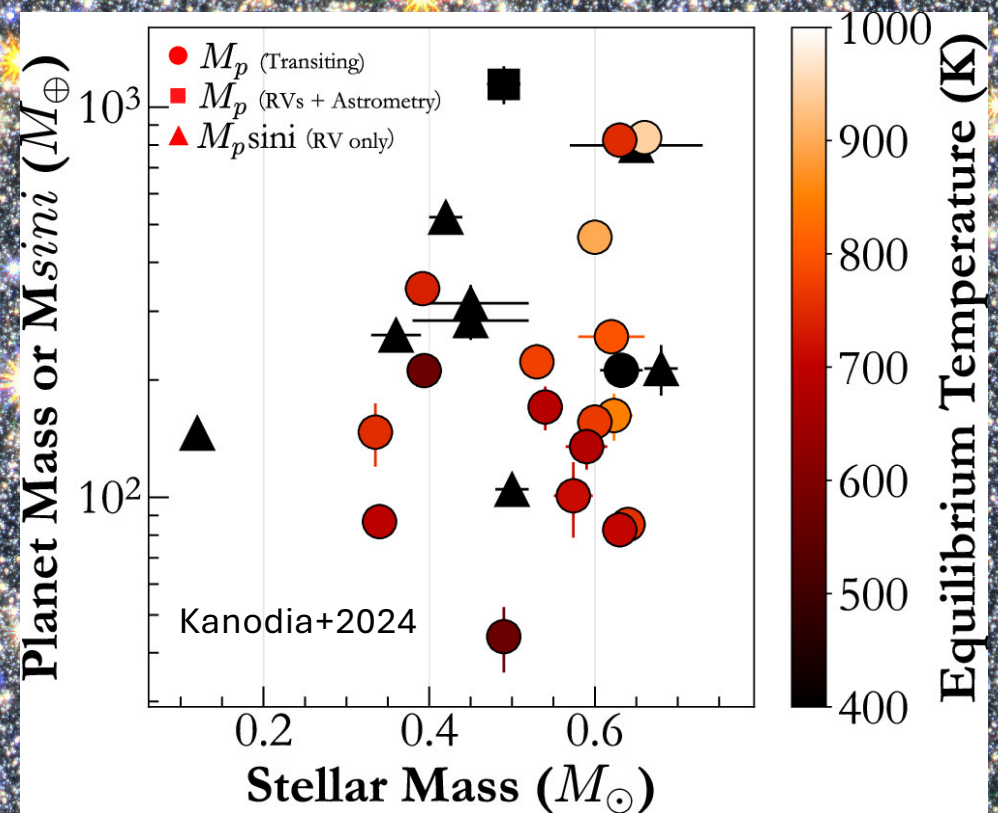
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Giant Planets Orbiting M Dwarfs

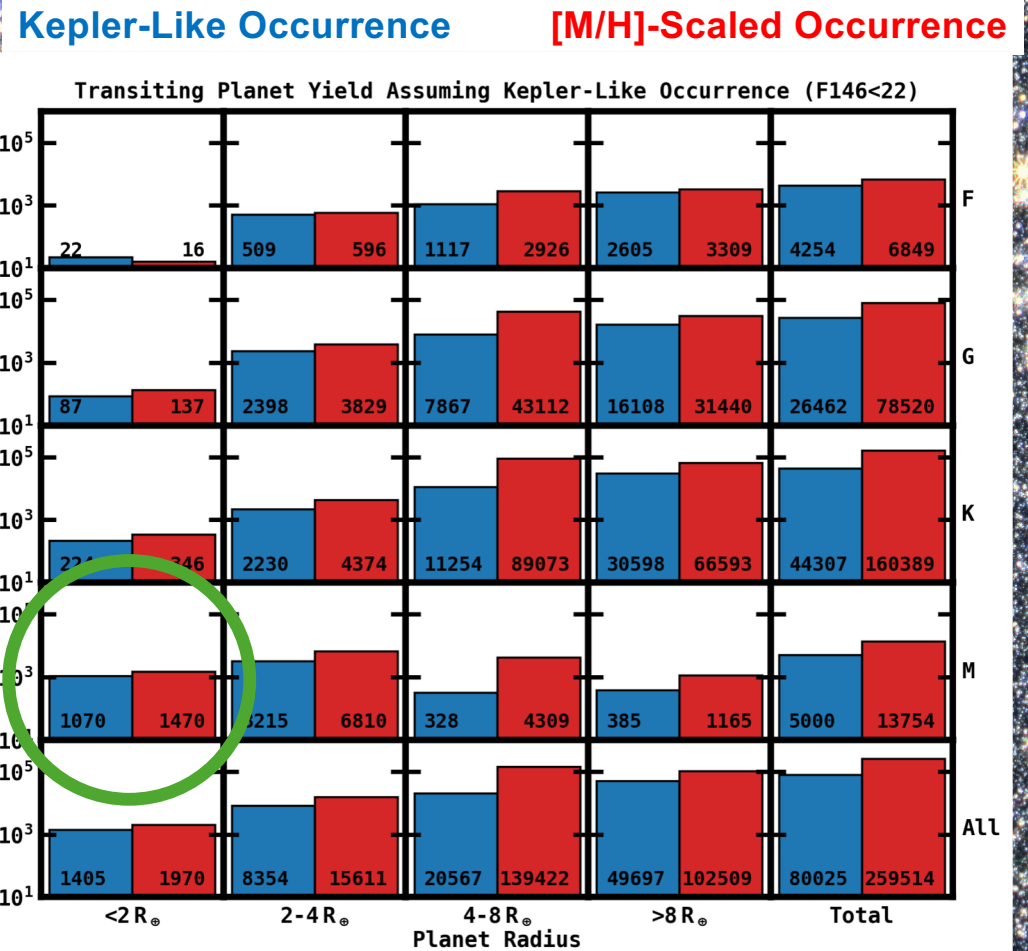
- ~30 Confirmed Giant Exoplanets around M-type Stars
- GBTDS: Should find ~300-1000 Candidates
- Reliable Detections:
 - High SNR: Color Information?
 - No Secondary Eclipses



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Roman's Rocky Temperate Transiting Planet Yields

See also:
Tamburo et
al. (2023)

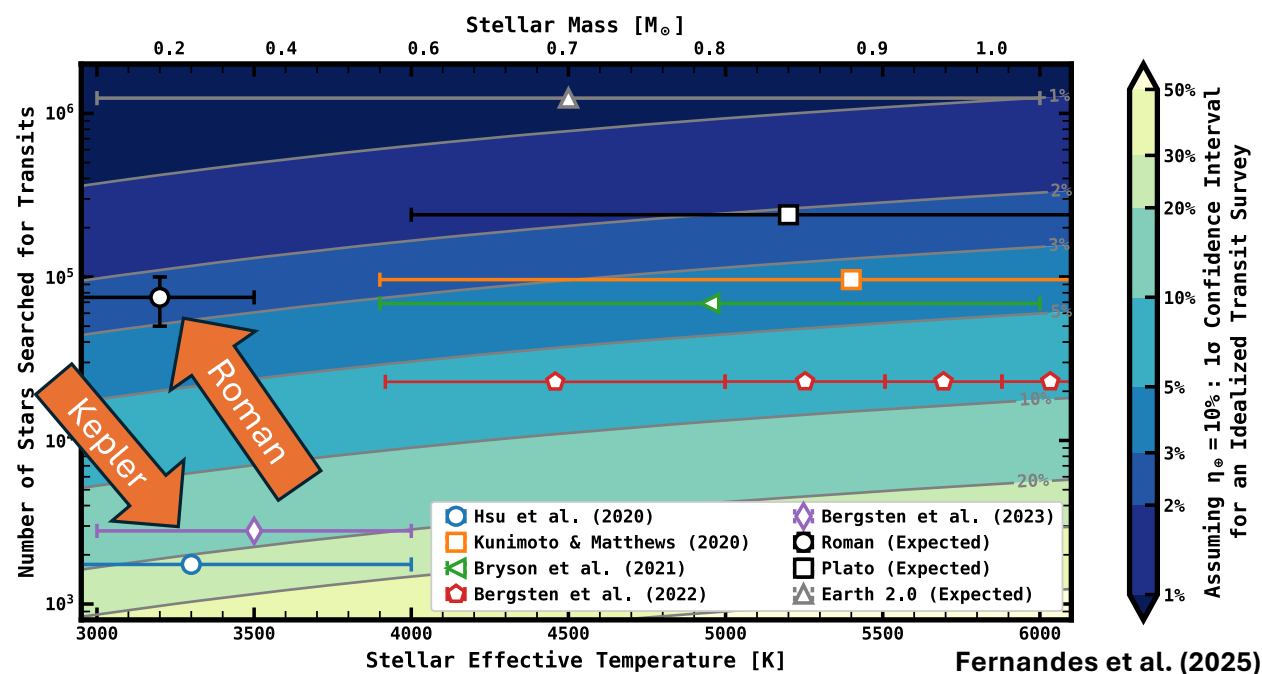
Earth-like: $R_p = 0.5-1.5 R_\oplus$

Conservative HZ Yield: 20-30

Optimistic HZ Yield: 40 - 60

Hosts will be late M dwarfs

- $0.1-0.3 M_\odot$
- Periods from ~9-40 days
- $F146 = 18-21 \text{ mag}_{AB}$
- Distance: ~0.5-1.3 kpc



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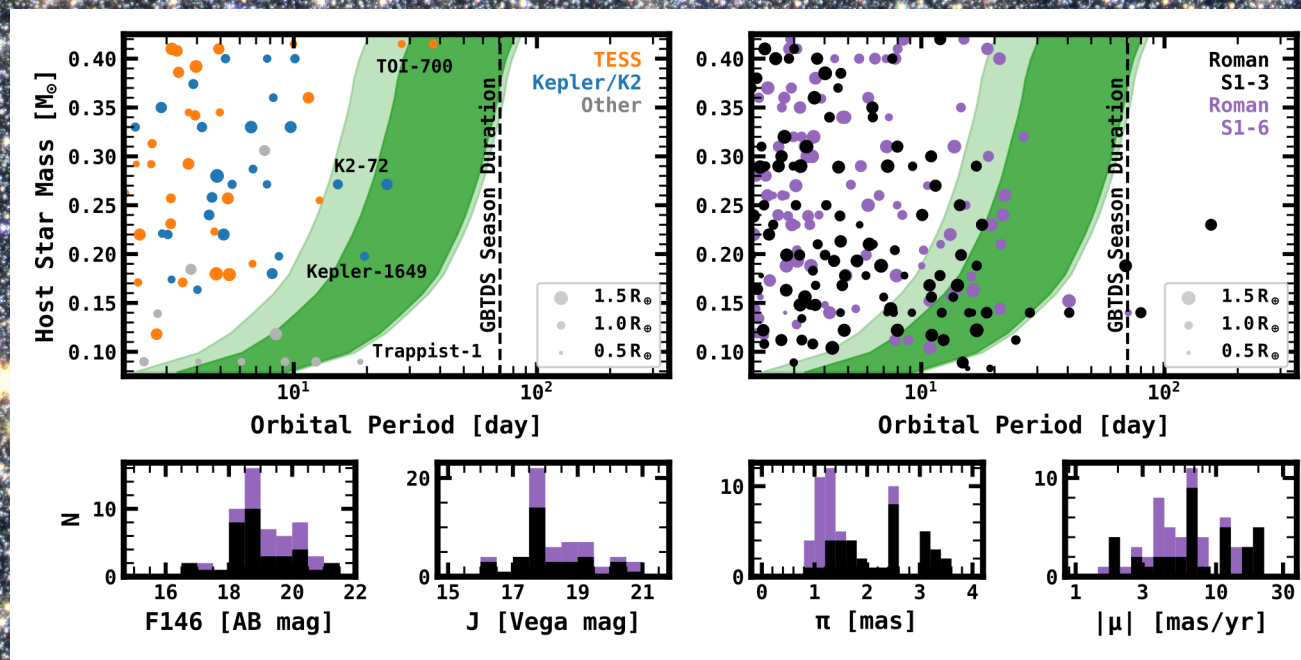
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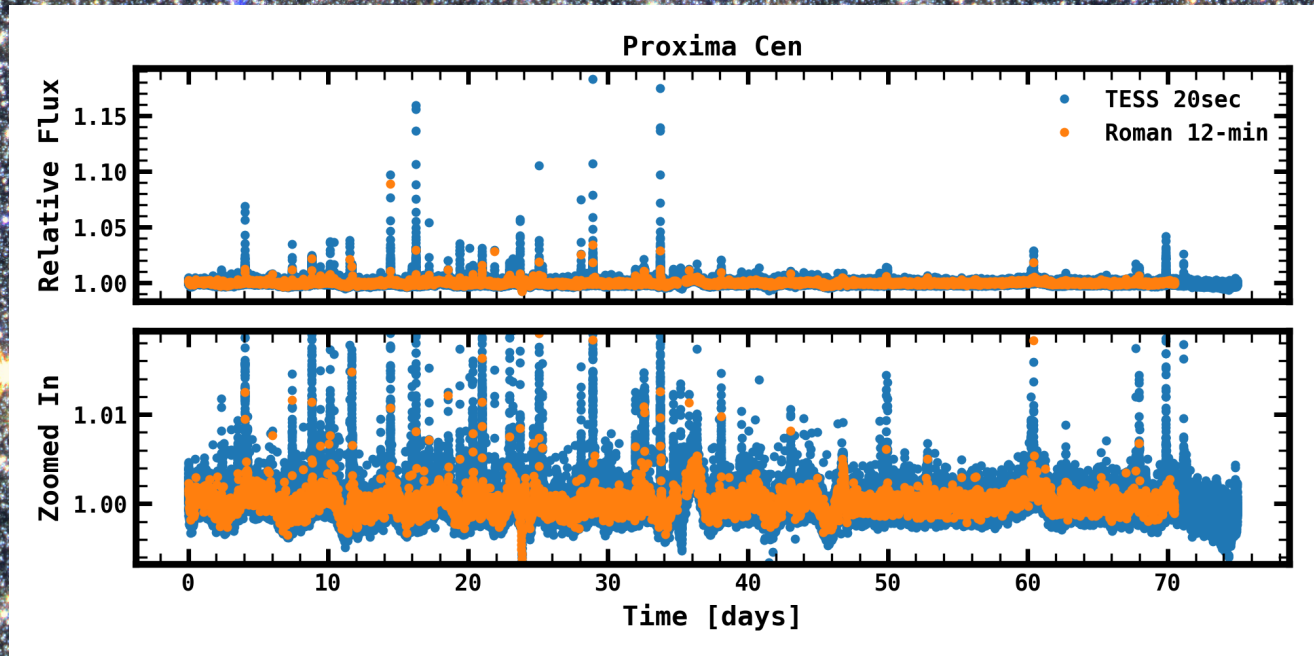
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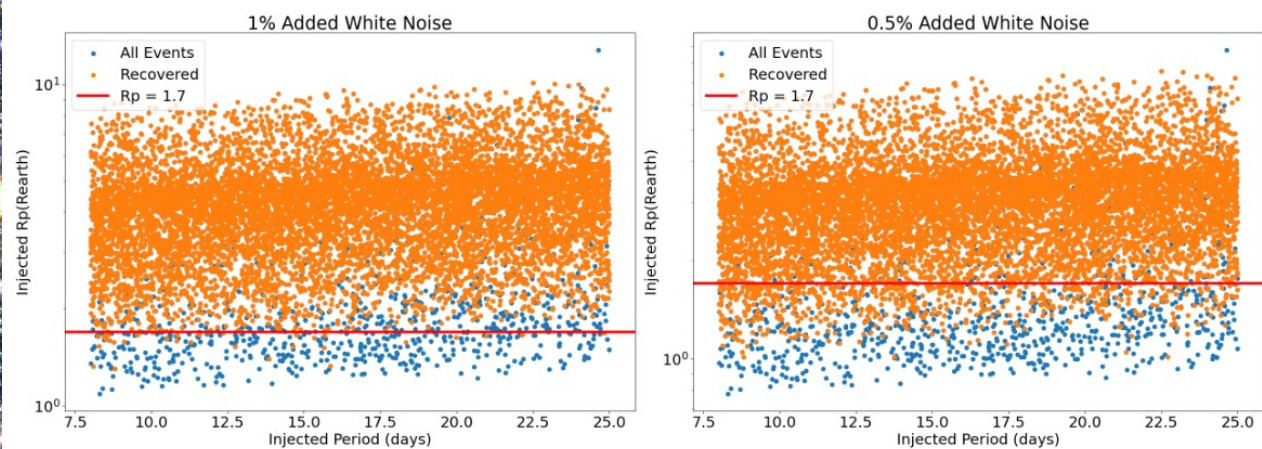
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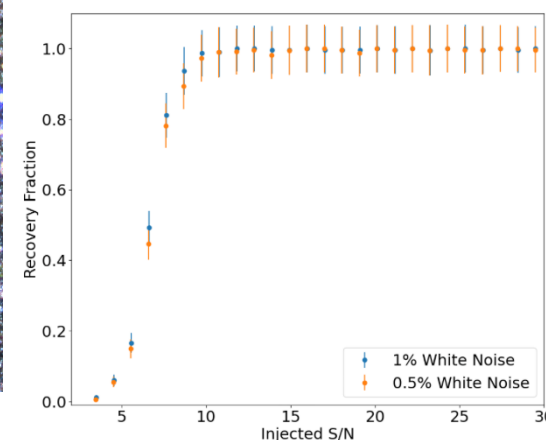
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Proxima Cen: $R_s = 0.1542$



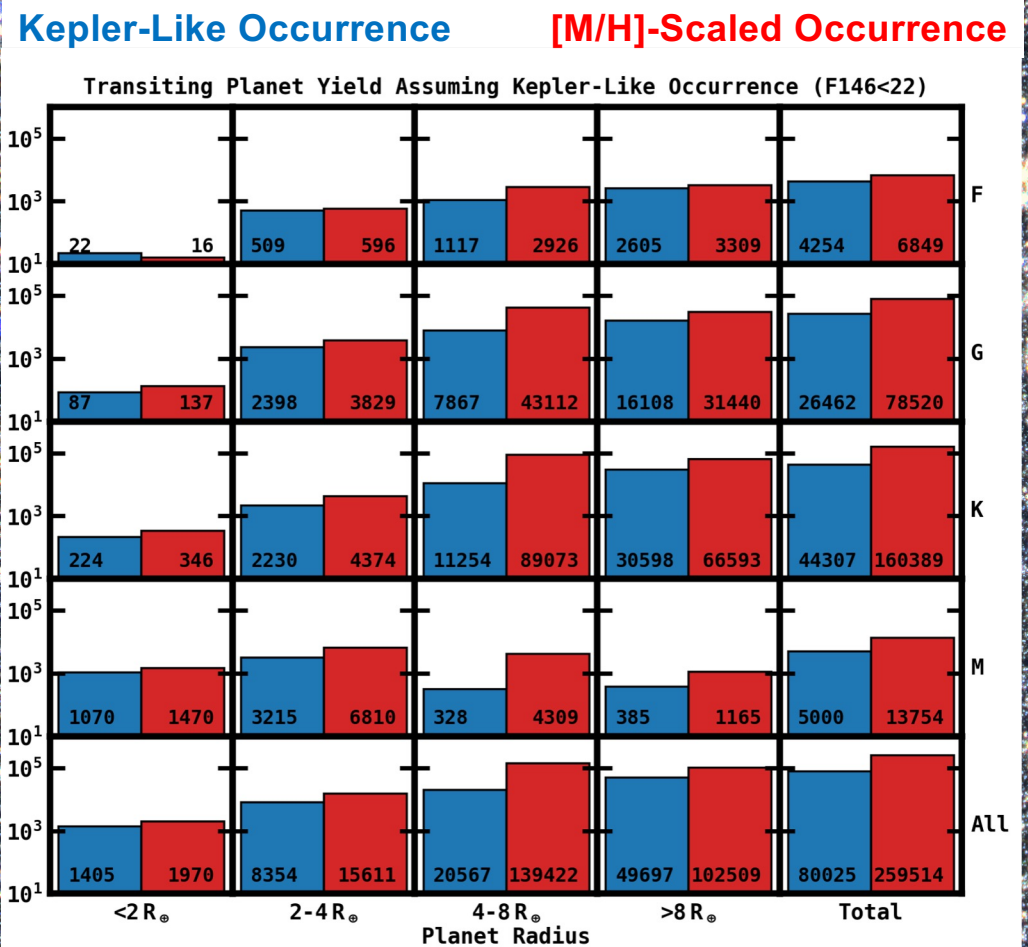
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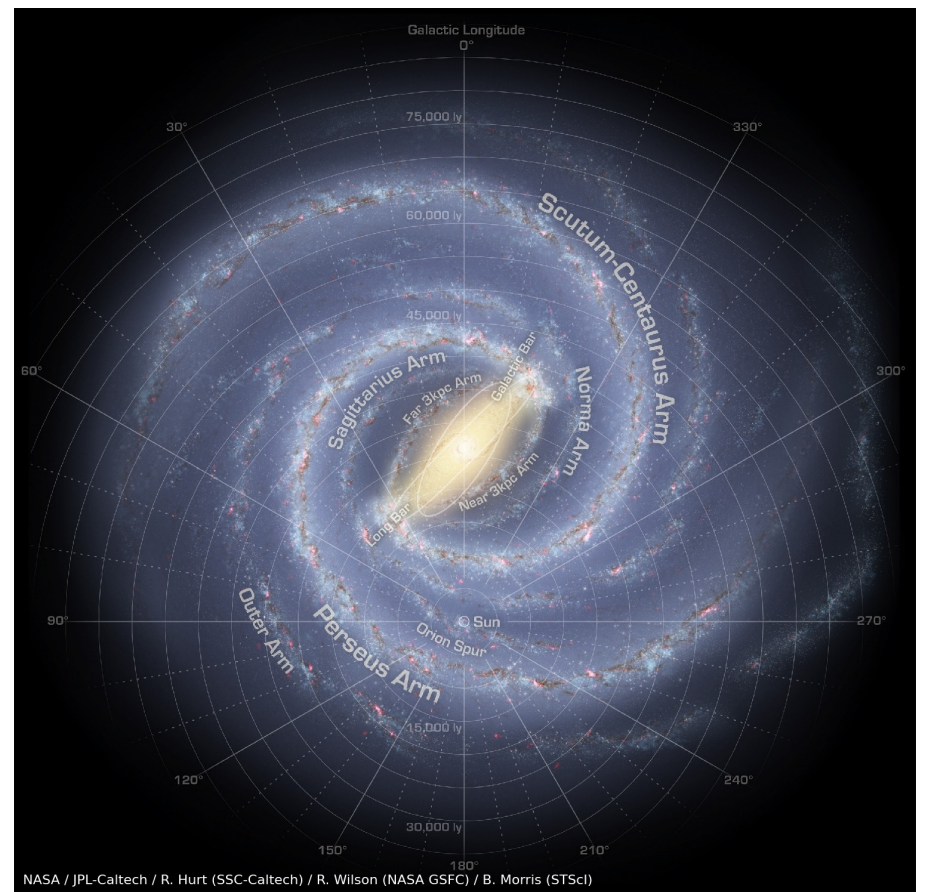
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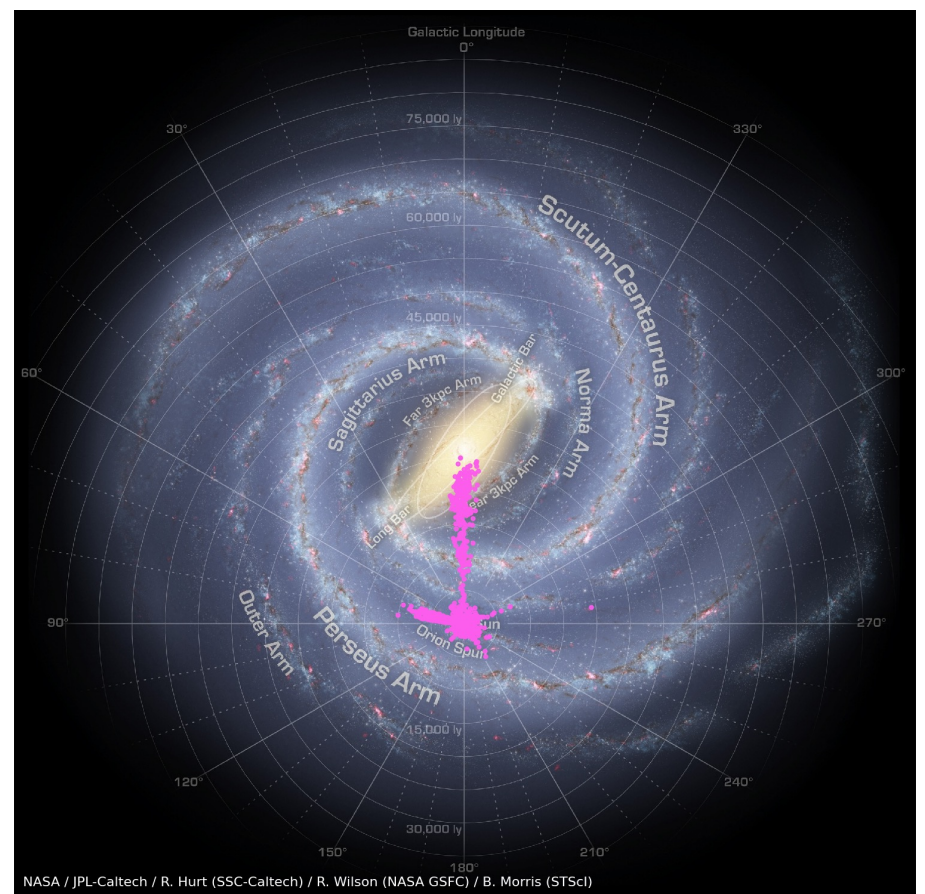
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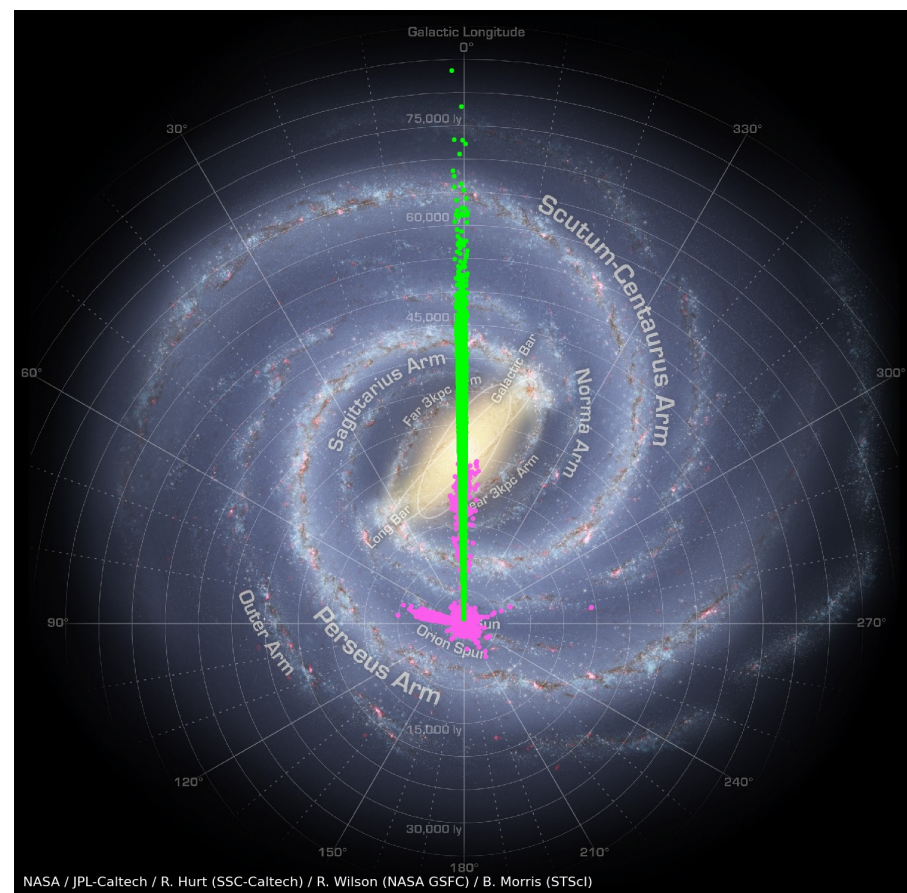


Demographics across all major Galactic populations



NASA / JPL-Caltech / R. Hurt (SSC-Caltech) / R. Wilson (NASA GSFC) / B. Morris (STScI)

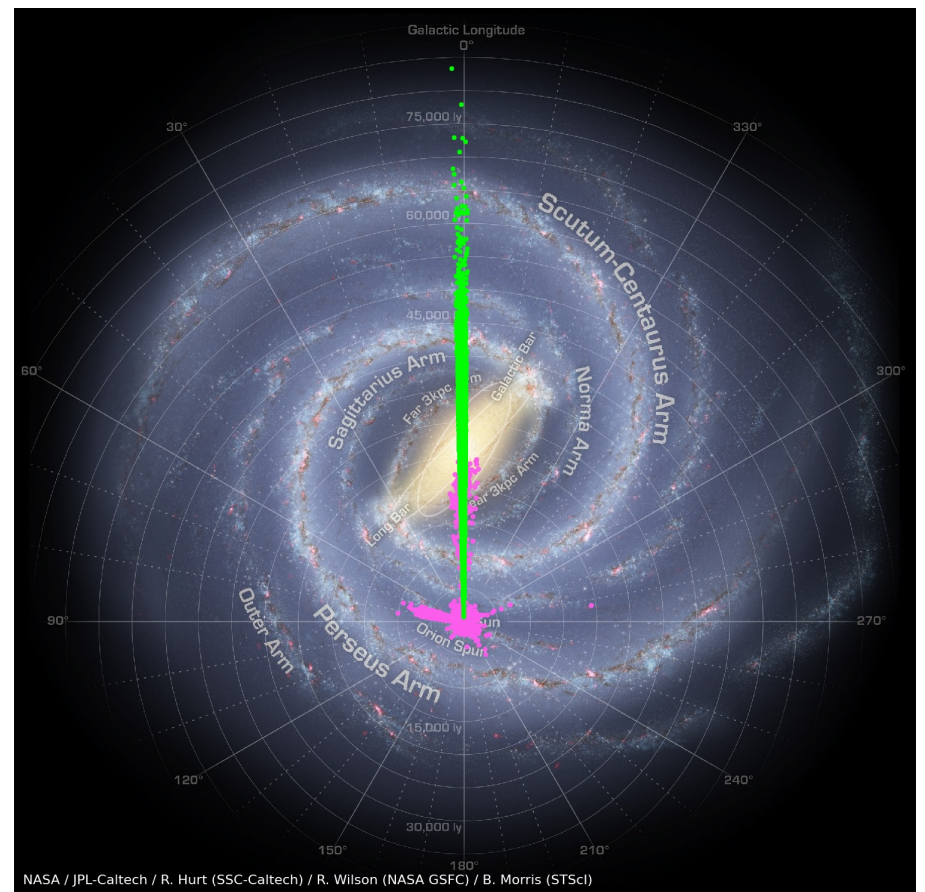
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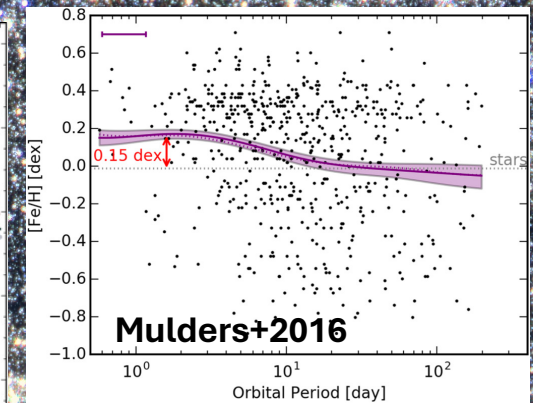
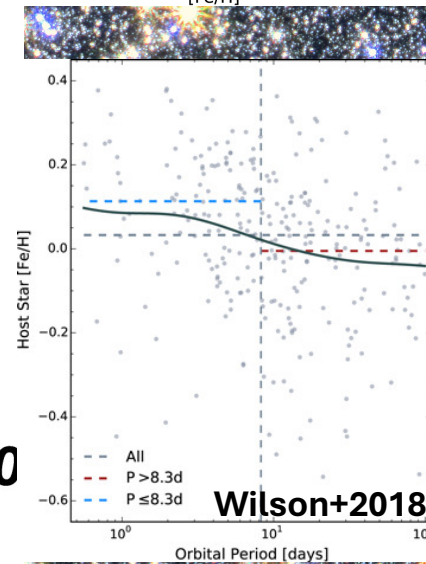
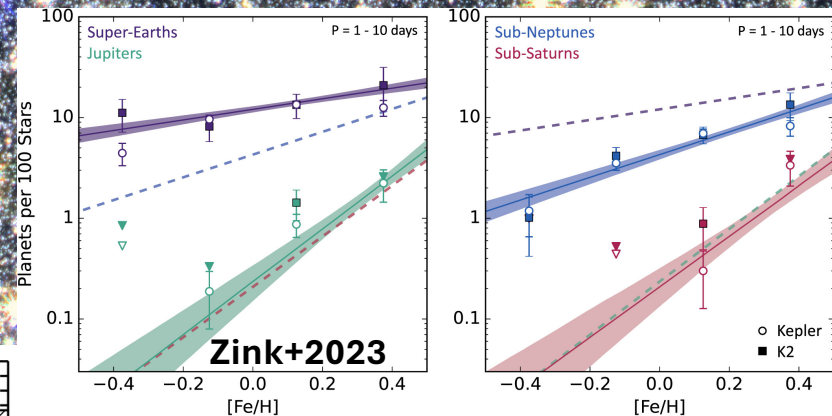
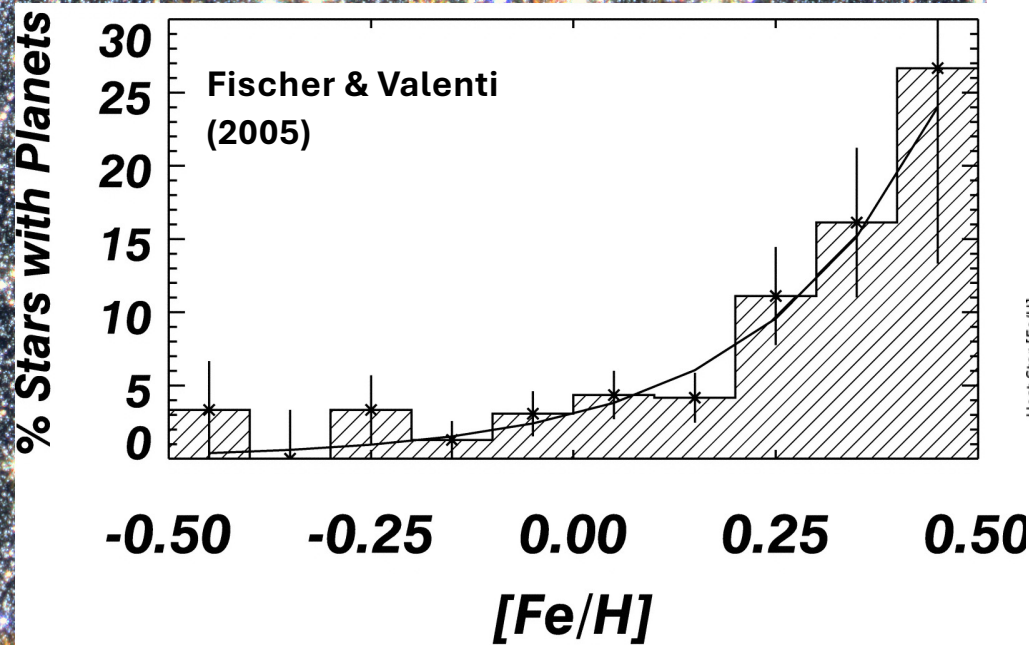
Planets found in every Major Galactic Population:

- Bulge/Bar: ~69%
- Thin: ~13%
- Thick Disk/Thick Bulge: ~18%



NASA / JPL-Caltech / R. Hurt (SSC-Caltech) / R. Wilson (NASA GSFC) / B. Morris (STScI)

Demographics across all major Galactic populations



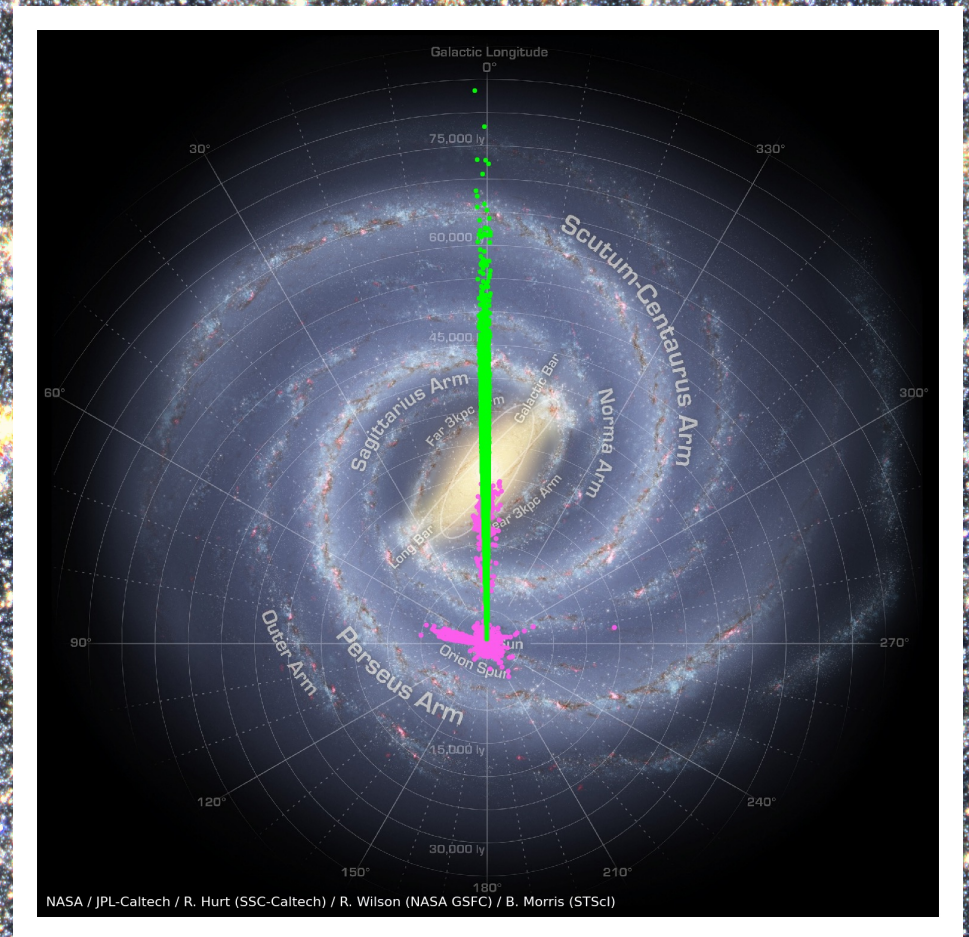
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With Metallicity Effects:

- Bulge/Bar: ~80%
- Thin: ~17%
- Thick Disk/Thick Bulge: ~3%



Demographics across all major Galactic populations

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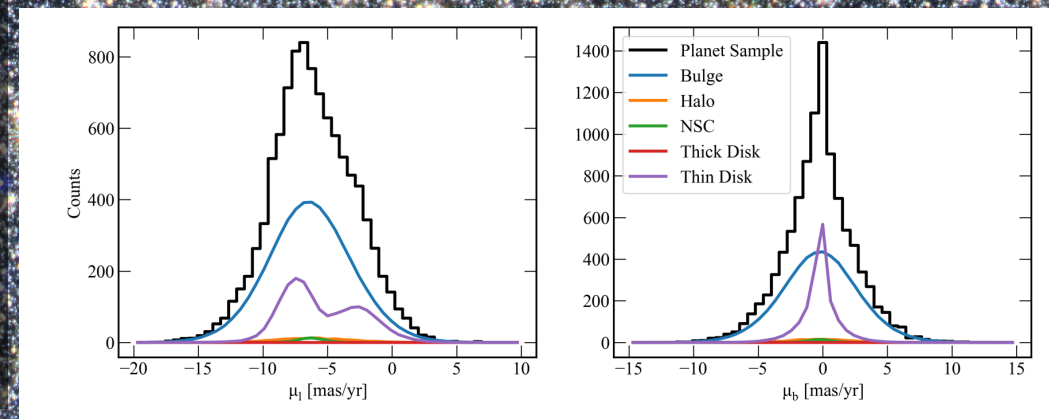
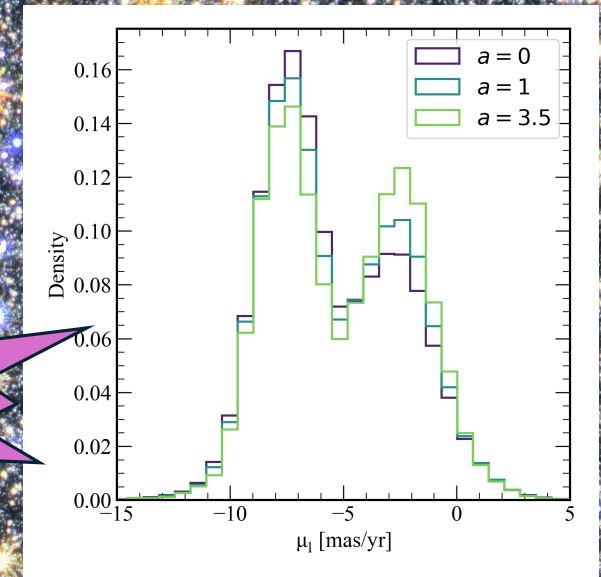
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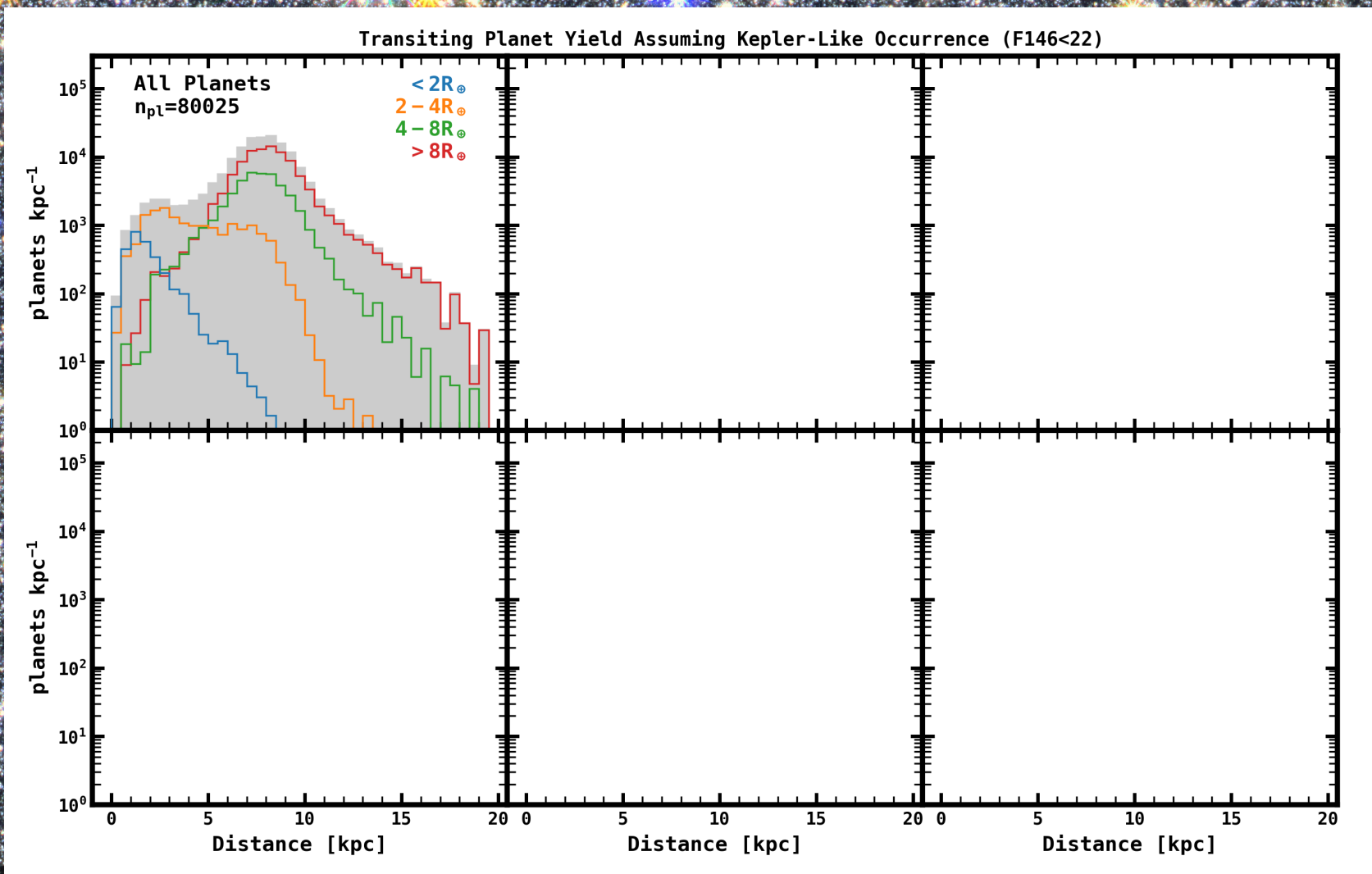
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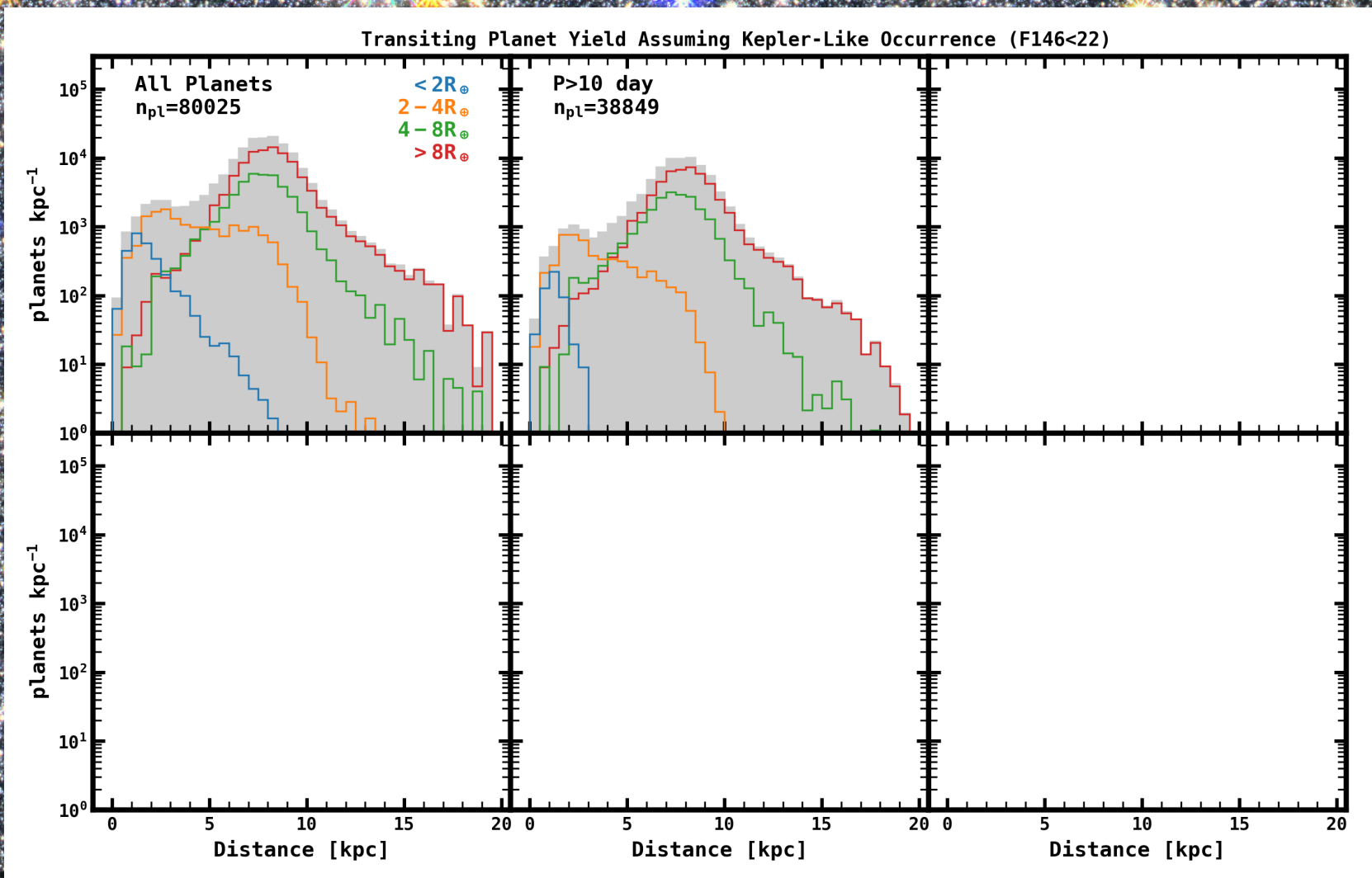
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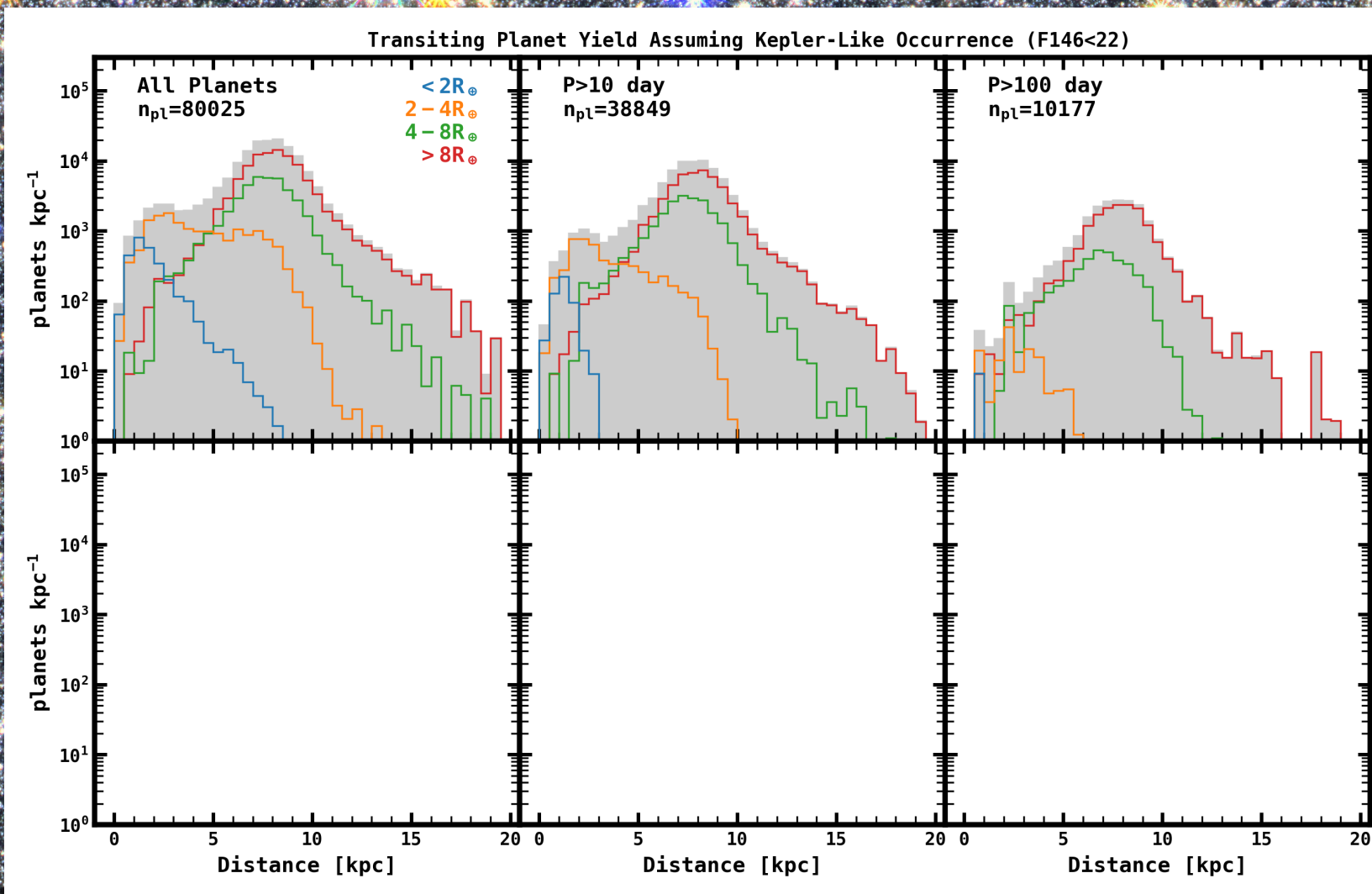


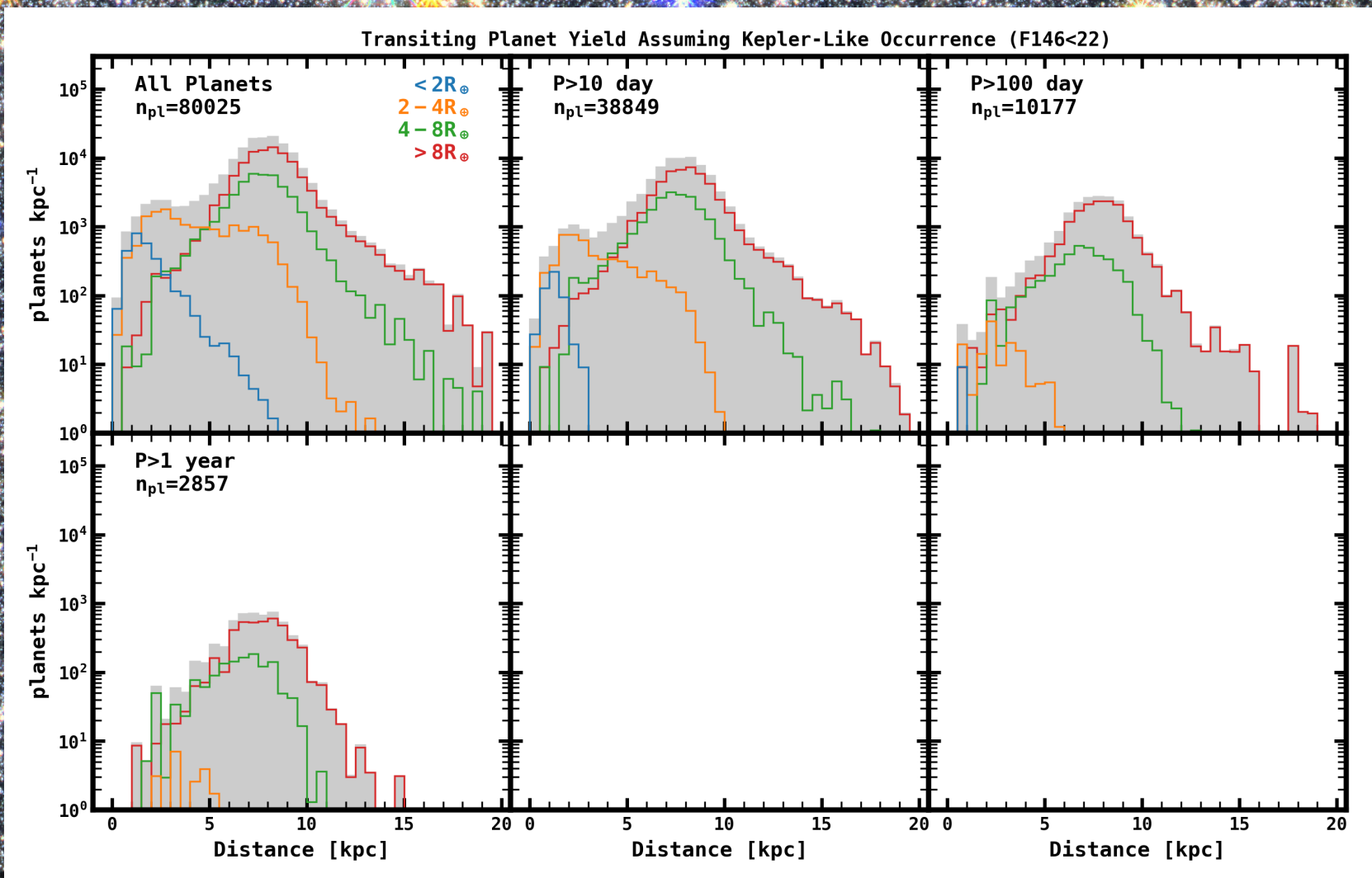
See Matt's
Poster!

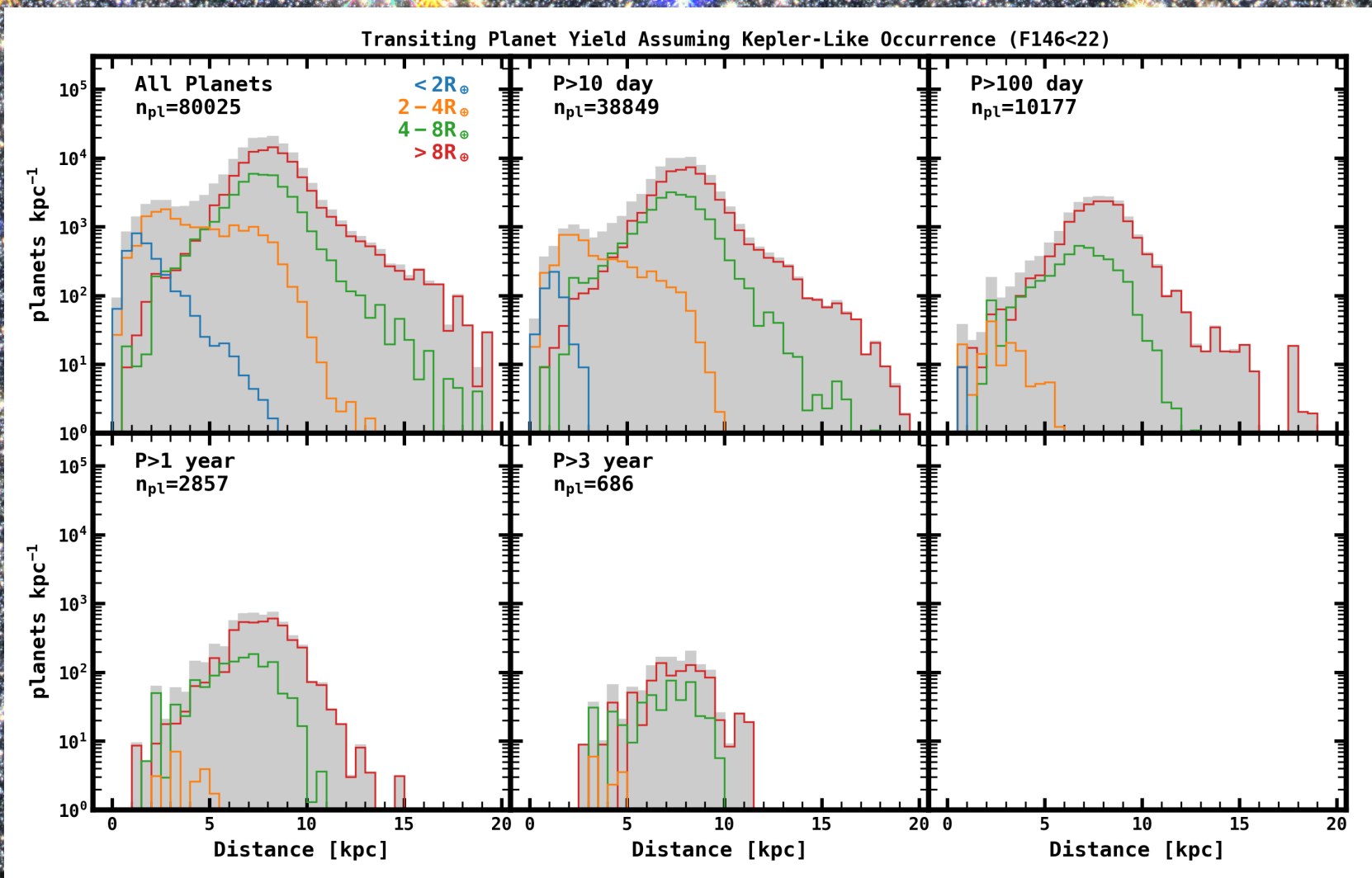


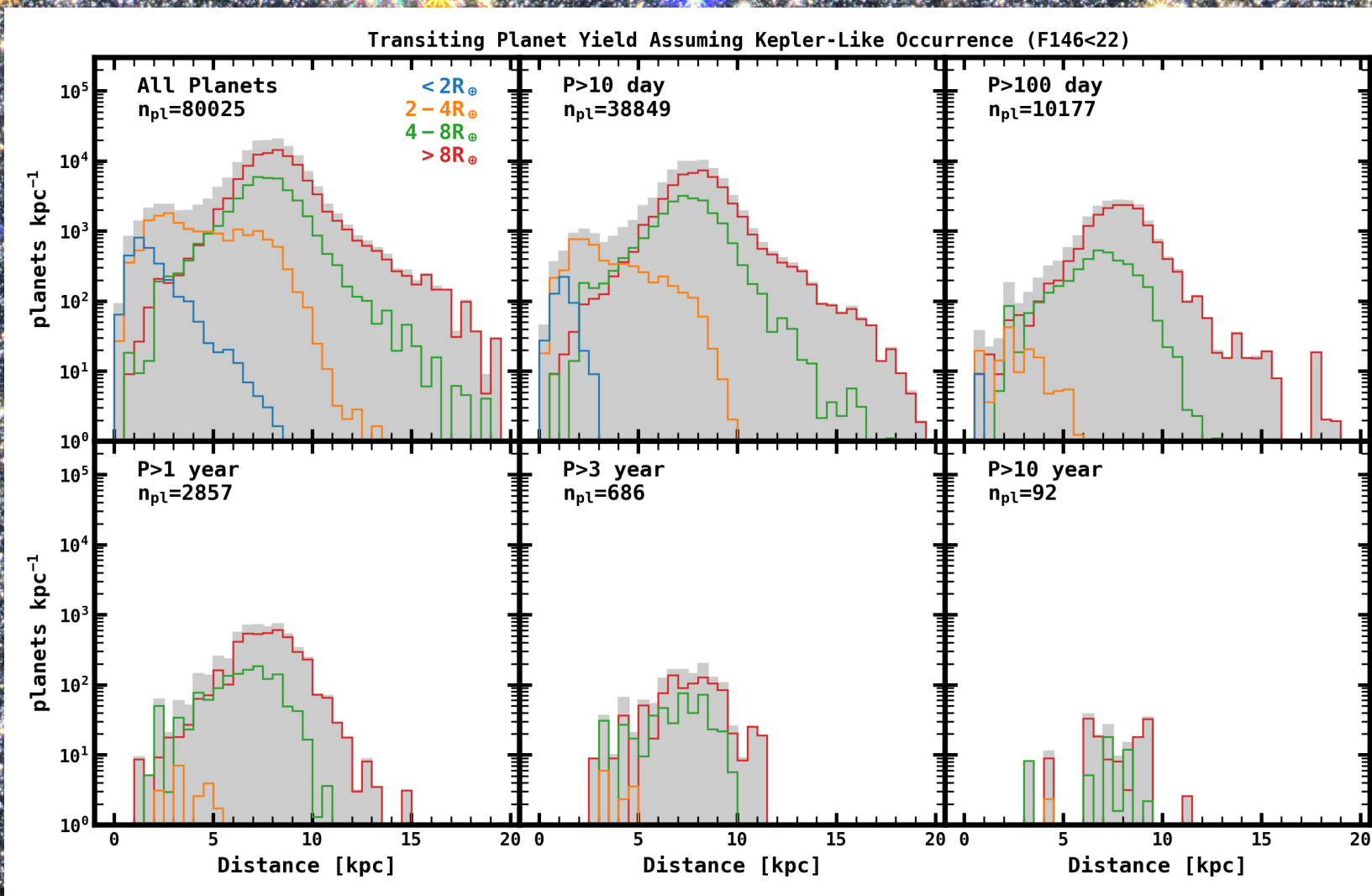




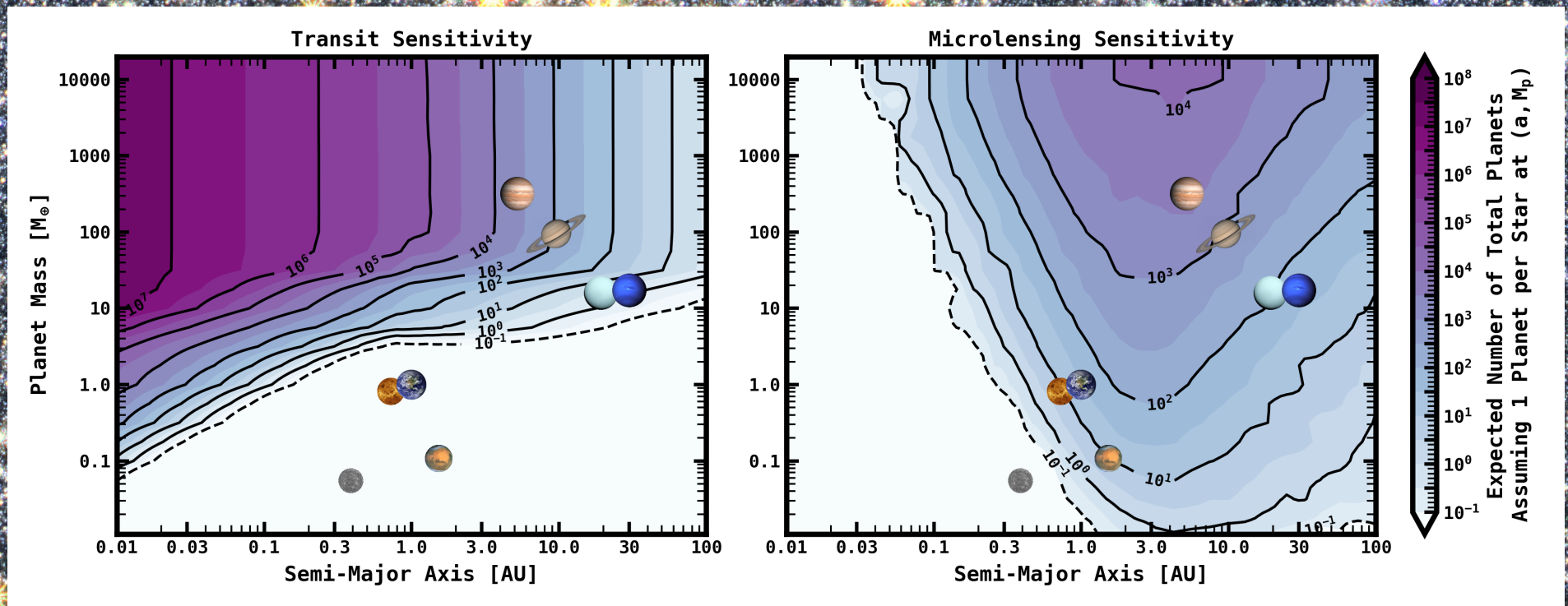








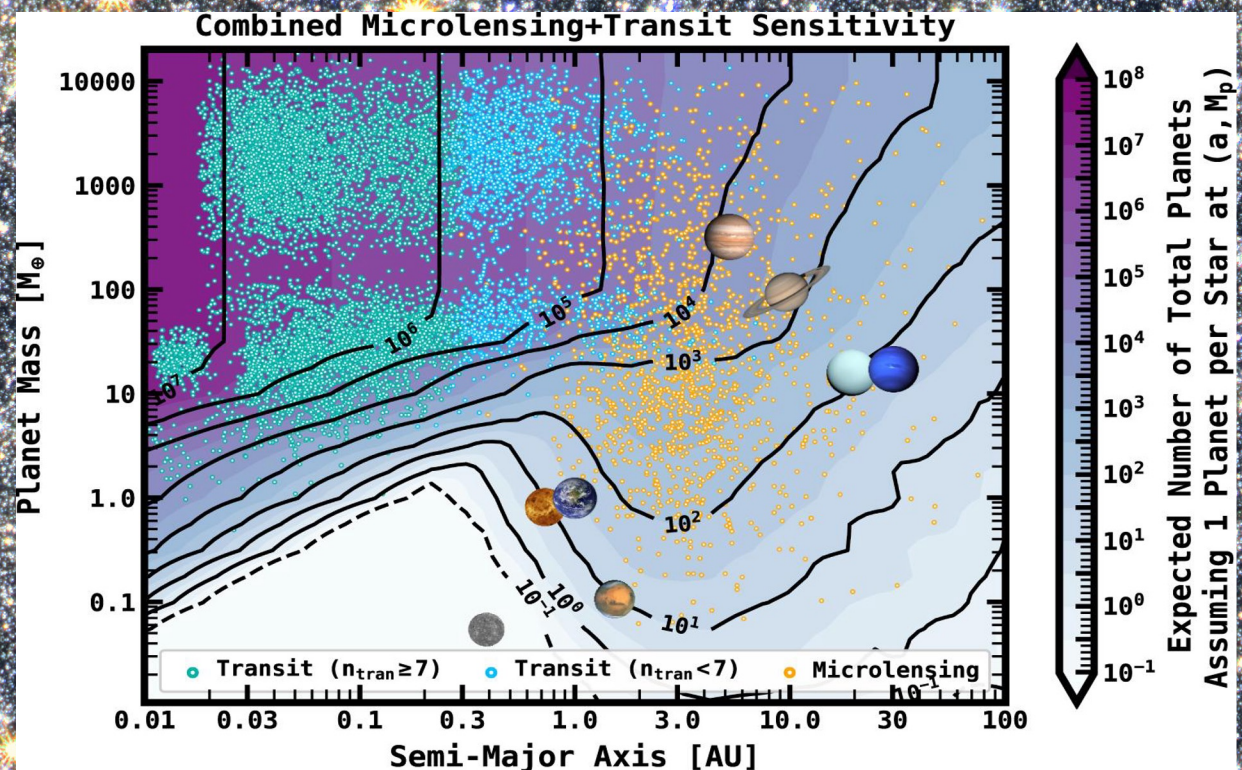
Roman Transits and Microlensing



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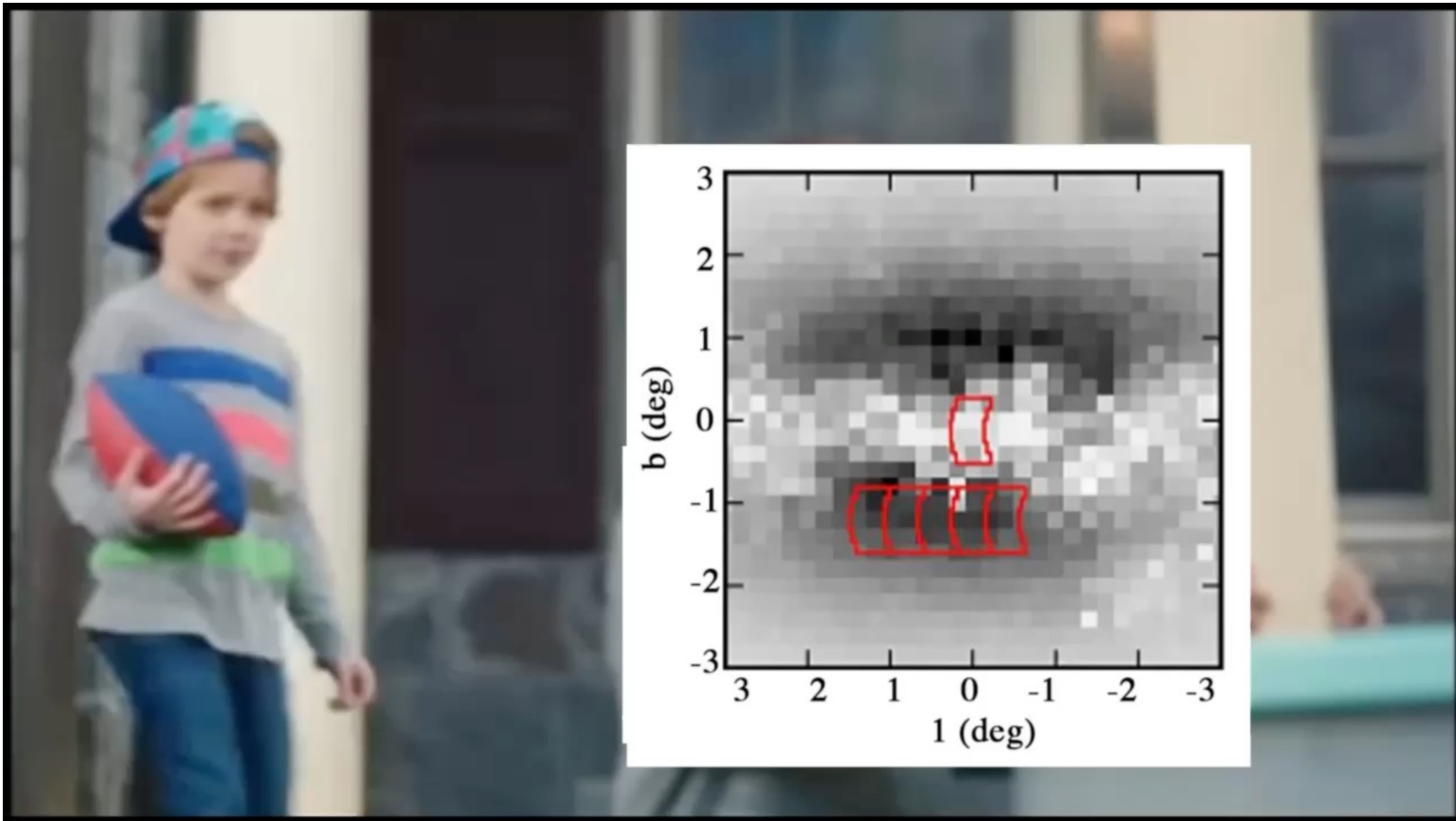
Joint Demographics!

- Sensitivity to different features
 - Mass vs. Radius
 - Mutual inclinations & multiplicity
 - Coverage from 0-infinity AU for gas-giants
- Same Stellar Population at long periods



Summary and Things to Look Forward to

- **TRExS will Produce a Catalog with (hopefully) everything you need for Demographics and your Science**
- **Roman Transiting Exoplanets have a lot of new science to offer**
 - Demographics of Hot Jupiter Atmospheres: ~1000 eclipses
 - Demographics across Galactic Populations
 - Joint Demographics with Microlensing
 - And yes, even habitable zone planets!
- **By this time next year, Roman will be finished collecting data for season 1 of the GBTDS.**



Depth of Transiting Planets Host Stars



July 10, 2024

Challenging Theory with Roman

Depth of Transiting Planets Host Stars



M0 V: ~5 kpc

K0 V: ~10-12 kpc

G0V : ~15 kpc

Red Giants:>> Gala

BACKUP SLIDES

July 13, 2026

Shifting Landscapes in Astrophysics

42

BIG DATA

The Nancy Grace Roman Space Telescope will transmit an unprecedented amount of data from its orbit a million miles away from Earth. Scientists expect it to average almost 1.4 terabytes each day, and after just five years of observations, it should total 20,000 terabytes on MAST, the Mikulski Archive for Space Telescopes. The Hubble Space Telescope sends less than three gigabytes a day, while in the same time even the James Webb Space Telescope will send less than 60 gigabytes.

Hubble

2.7

Webb

58

Roman

1,375

Gigabytes per day sent to Earth



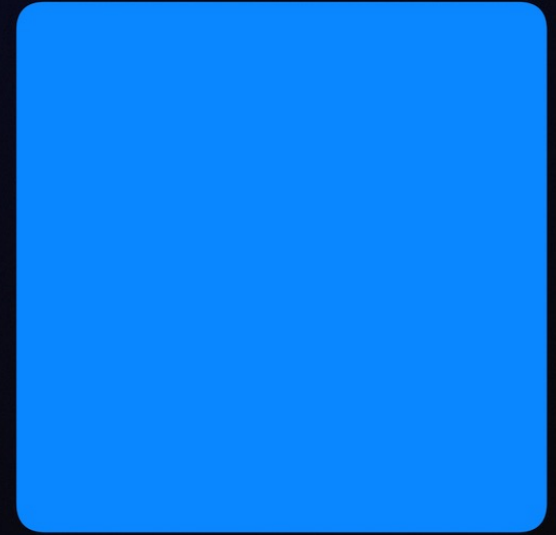
172 terabytes

Hubble's data archive
1990-2020



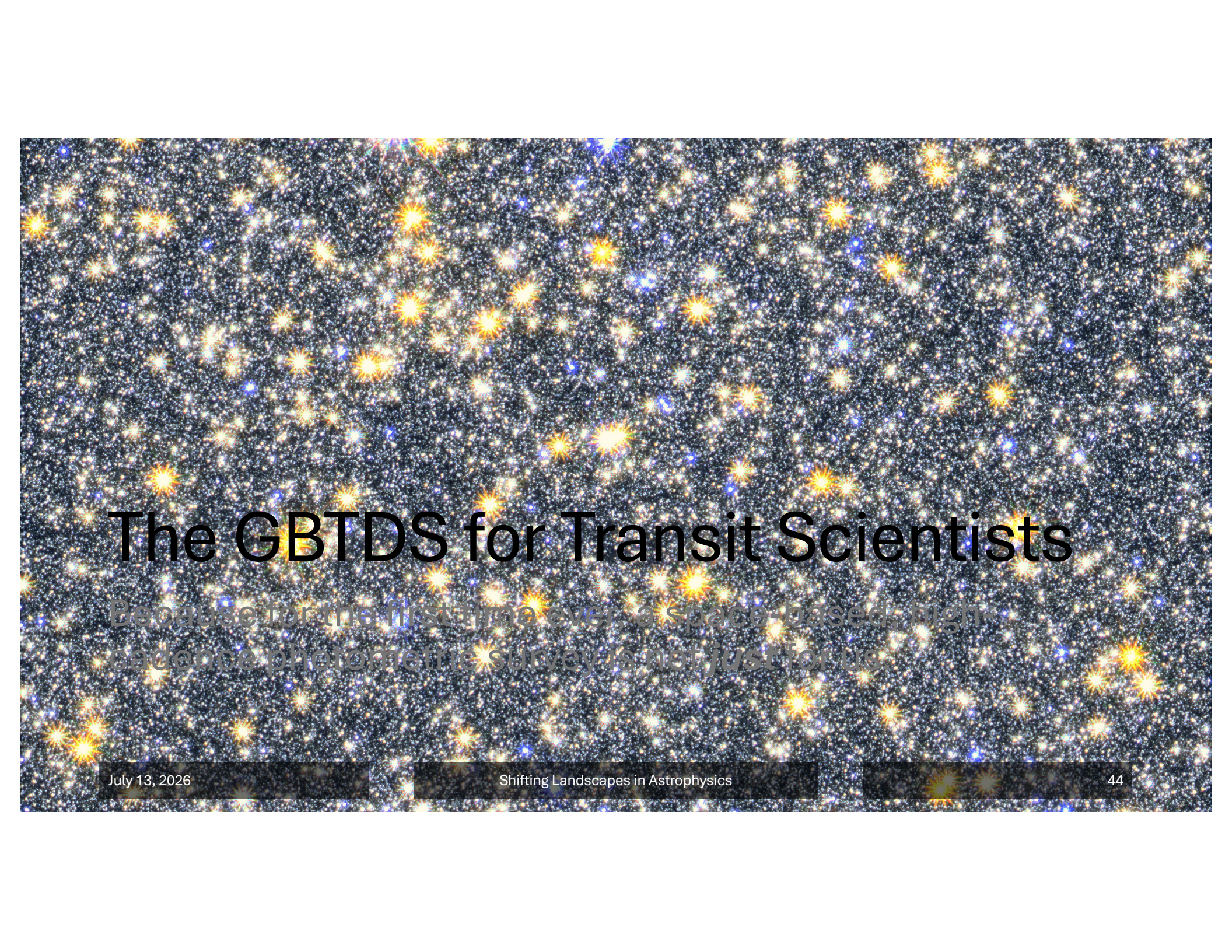
1,000 terabytes

Webb's data archive
after five-year primary
mission (projected)



20,000 terabytes (20 petabytes)

Roman's data archive
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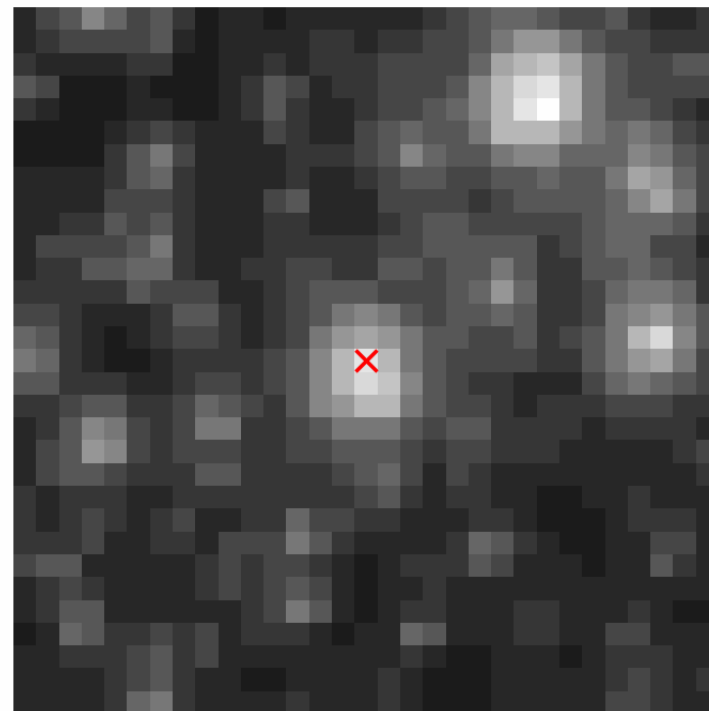


The GBTDS for Transit Scientists

Because for the first time ever, a space-based, high-cadence photometric survey is not *just* for us.

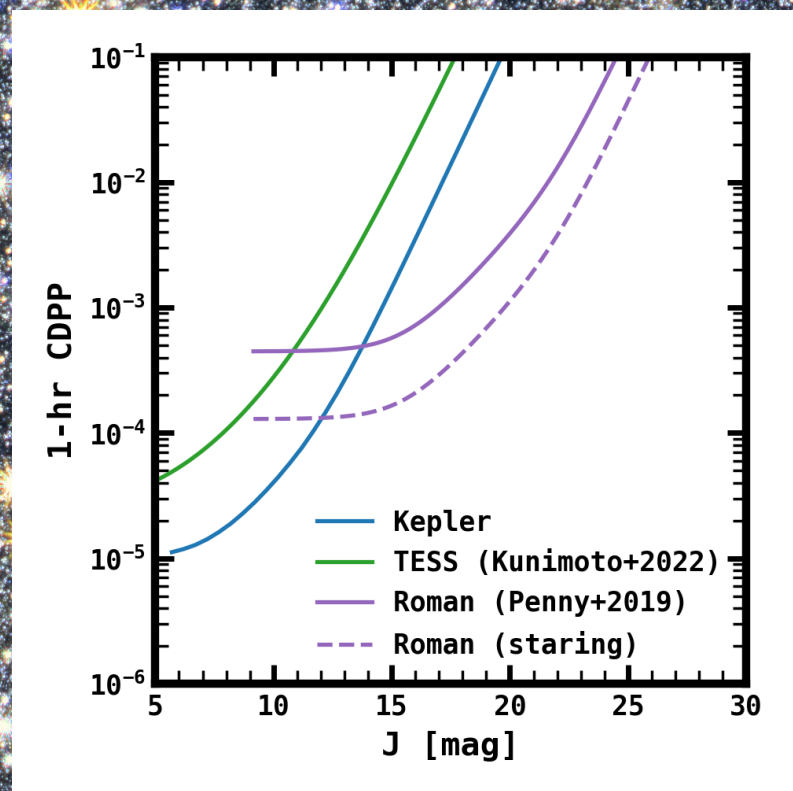
Quirks of the GBTDS for Transit Scientists: **Roman will not be Staring.**

- **Images will be Dithered**
 - Likely sensitive to systematics such as inter-/intra-pixel sensitivity variations



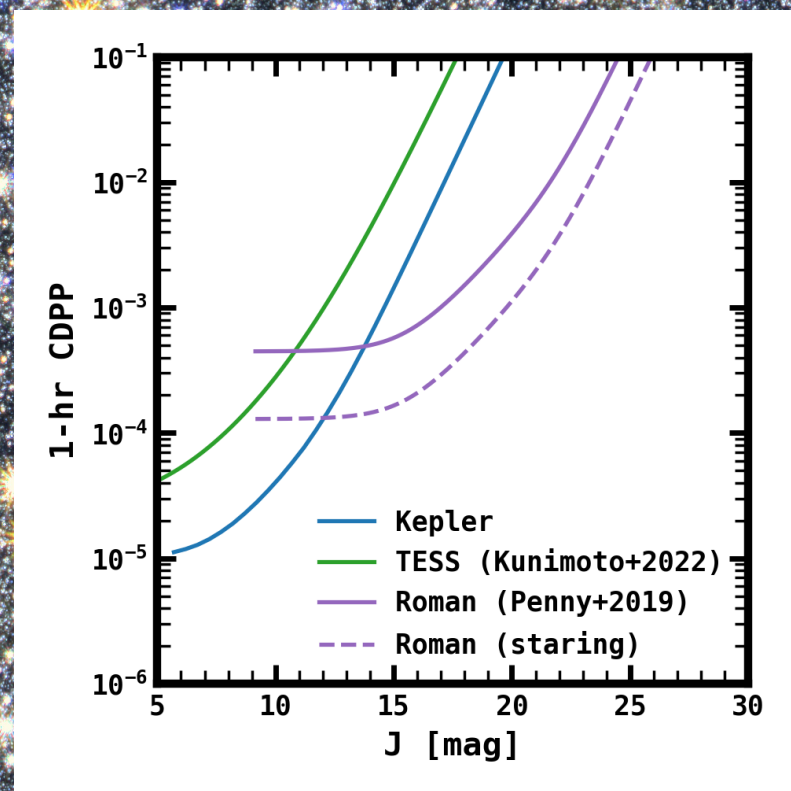
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- **Increased Overhead:**
 - Each Star has ~91% Overhead
 - Noise Equivalent to a ~0.8-m Aperture with no Overhead



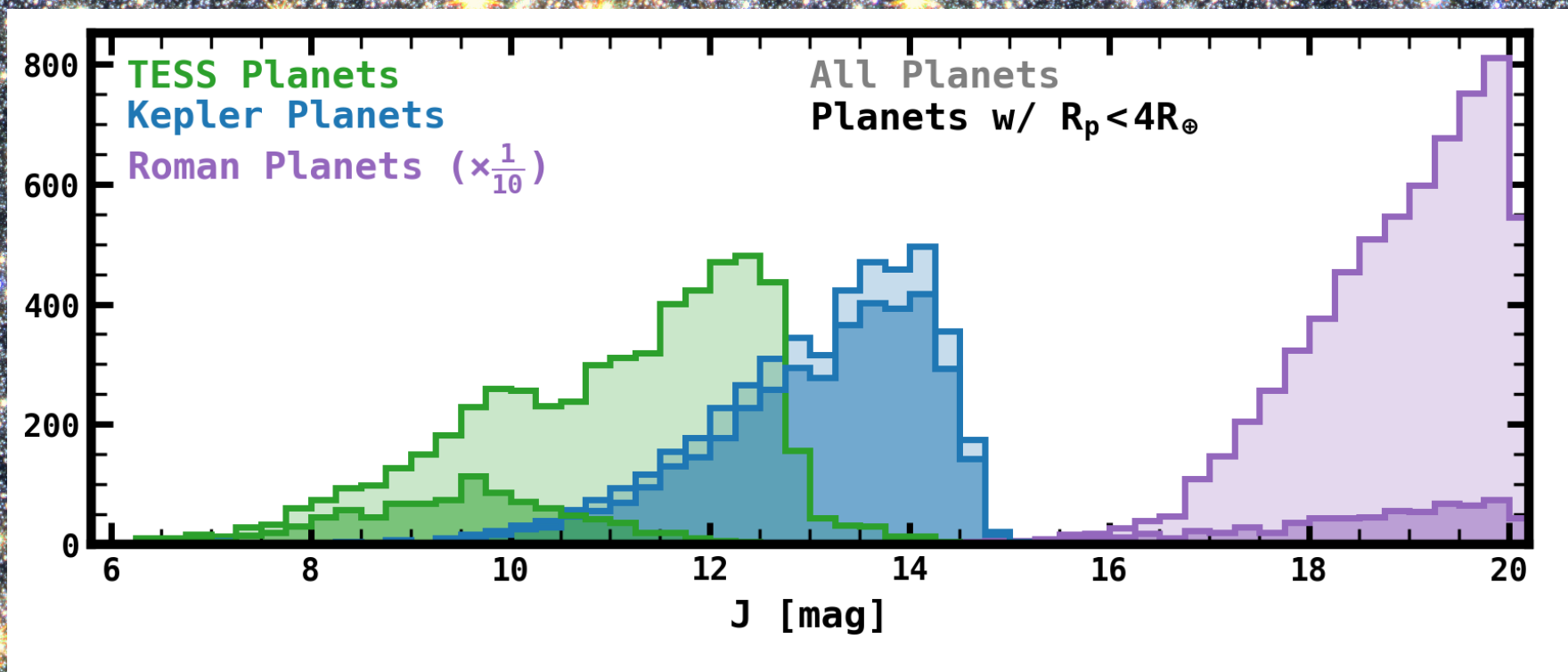
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- **Transits are Undersampled**
 - Likely some implications for TTVs



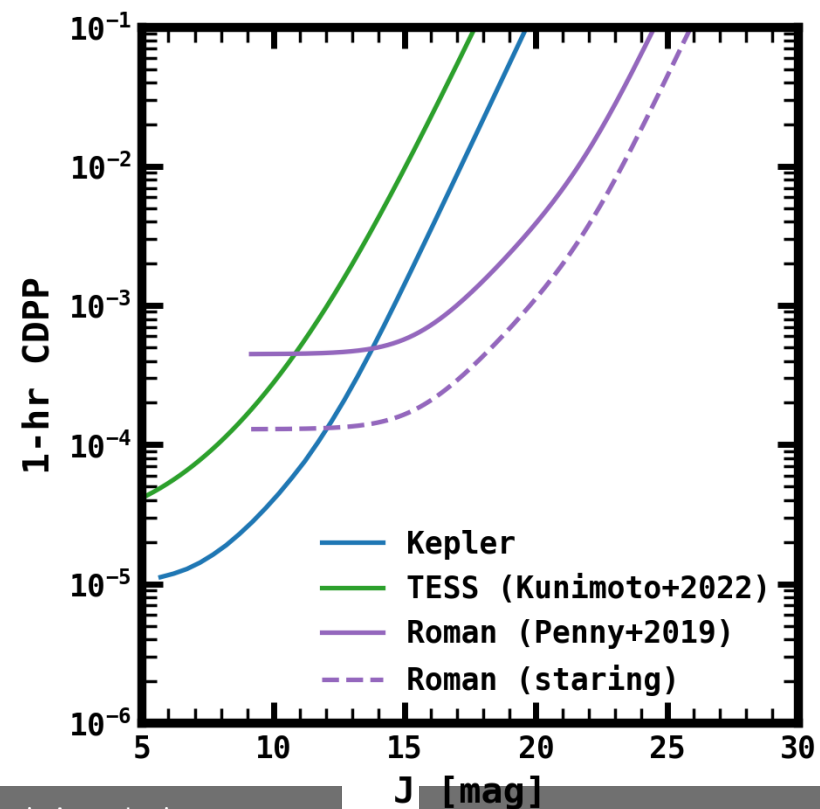
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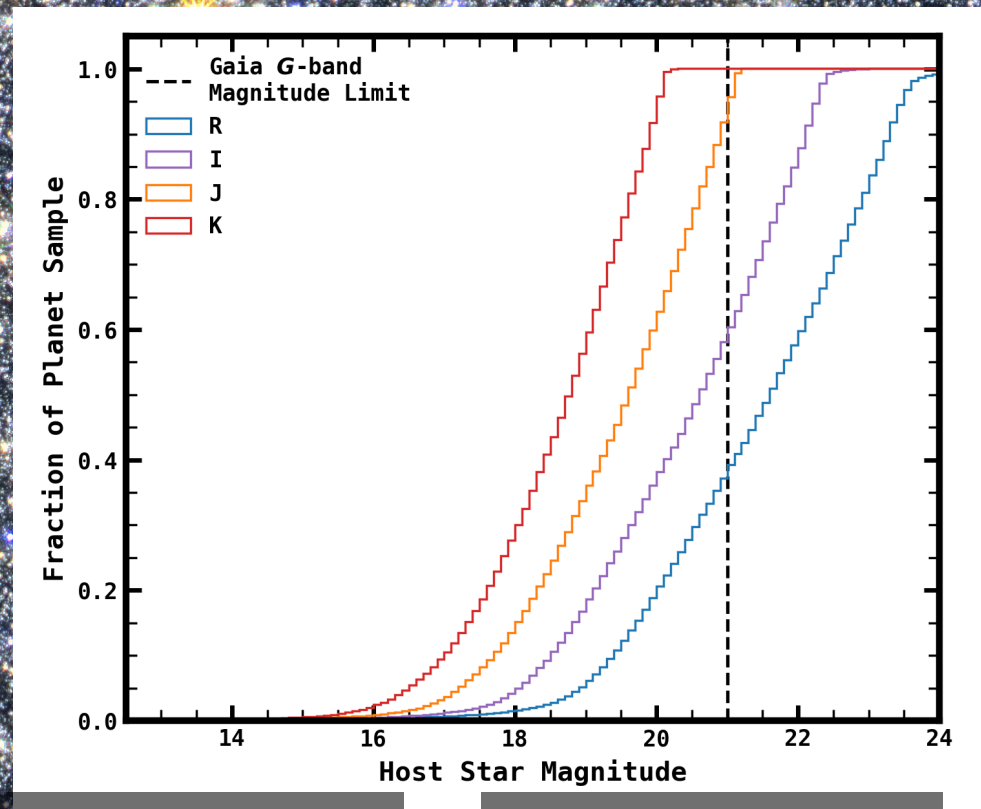
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 - But not as hard as Kepler!
- RV Follow-up is **REALLY** Hard



Challenges of the GBTDS for Transit Scientists: **Roman Stars will be Faint.**

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- RV Follow-up is **REALLY** Hard
- **Roman is Deeper than Gaia**
 - No a priori input catalog**
 - Reliable stellar parameters will take a while

***see Sean's talk next*

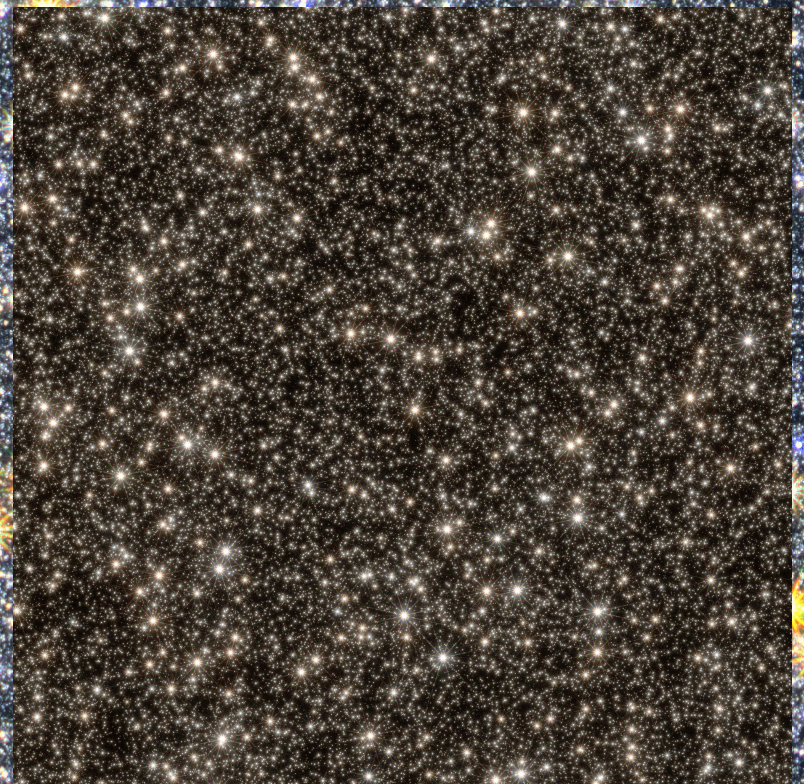


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Image Credit: Troxel/Duke



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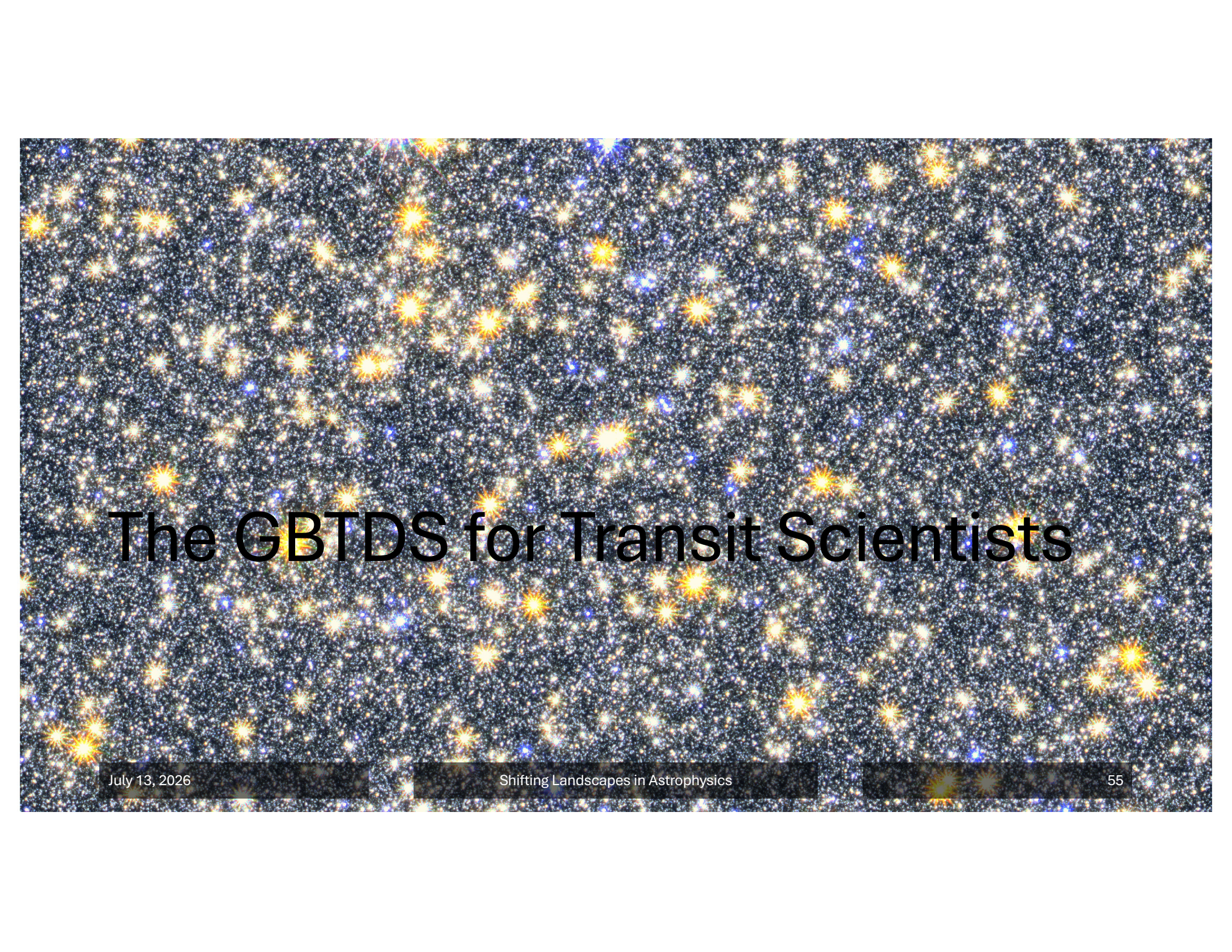
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Image Credit: Troxel/Duke

Stellar Parameters in the GBTDS

- Will rely on

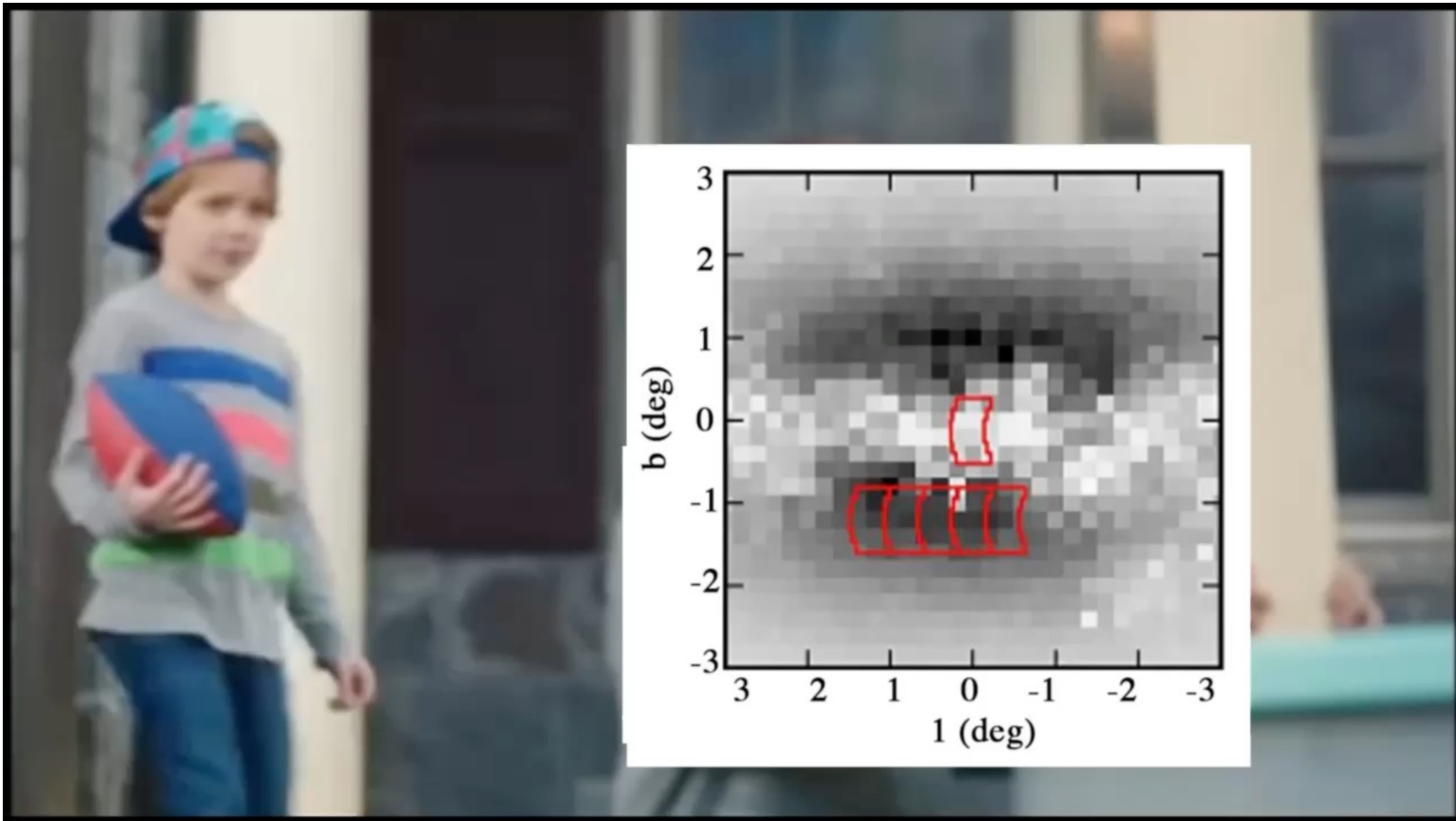


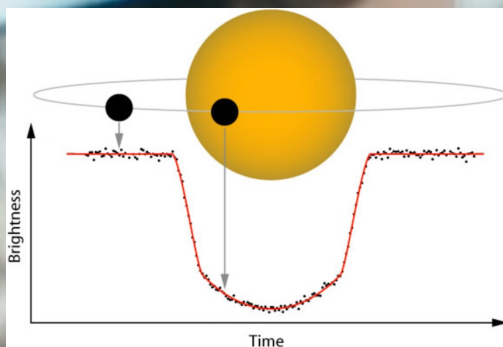
The GBTDS for Transit Scientists

July 13, 2026

Shifting Landscapes in Astrophysics

55





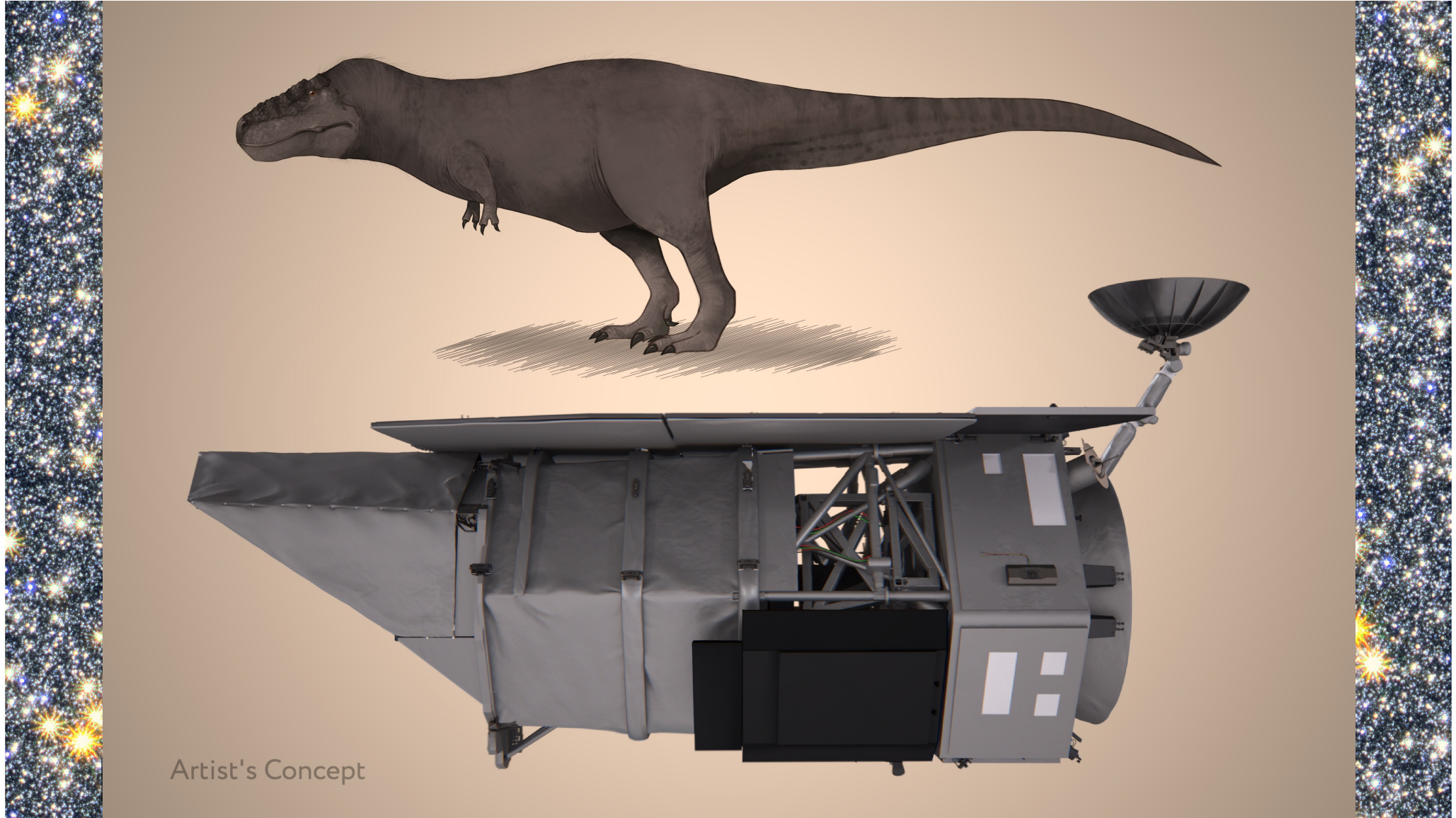
EVERYTHING IS FOR YOU!
AND THIS ONE THING IS FOR HIM!



July 13, 2026

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58



Artist's Concept