

A large, cratered planet or moon is shown in the foreground, partially obscured by the text. The background is a dark space filled with stars, with a prominent bright red star on the left side.

# Dead Planets, What They Could Mean, and What We Should Do Next

**Stephen Kane**

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# TrExoLiSTS: Transiting Exoplanets List of Space Telescope Spectroscopy

Welcome to TrExoLiSTS! This table contains spectroscopic time series observations of transiting exoplanets made and/or planned with all instruments on the JWST. Please use the arrows and filter boxes below to sort or filter the table. The search bar on the right can be employed to look for targets that may have already been observed by a previous program.

Table download: [CSV](#) and [TXT](#)  
 Documentation: [ISR](#), [RNAAS](#) and [arXiv](#)

**Last update: Thu Feb 22 00:00:03 2024**

For questions, or to report issues, please contact Nikolay Nikolov at: [nnikolov@stsci.edu](mailto:nnikolov@stsci.edu)

Links to: [TrExoLiSTS: HST](#) and [DIExoLiSTS: JWST](#)

10 entries per page

Search:

filter by Program filter by PI name filter by Observation filter by Visit filter by Target name filter by Right Ascension filter by Declination filter by Event filter by Phase Start

Program	PI name	Observation	Visit	Target name	Right Ascension	Declination	Event	Phase Start
<a href="#">COM 1033</a>	Kendrew	5	1	<a href="#">L168-9</a>	23:20:06.8620	-60:03:56.63	Transit	0.91616
<a href="#">COM 1118</a>	Proffitt	5	1	<a href="#">HAT-P-14</a>	17:20:27.8813	+38:14:31.81	Transit	0.96454
<a href="#">COM 1442</a>	Schlawin	1	1	<a href="#">HAT-P-14</a>	17:20:27.8813	+38:14:31.81	Transit	0.96454
<a href="#">COM 1442</a>	Schlawin	2	1	<a href="#">WASP-18</a>	01:37:25.0709	-45:40:40.06	Transit	0.82767
<a href="#">COM 1541</a>	Espinoza	1	1	<a href="#">HAT-P-14</a>	17:20:27.8812	+38:14:31.81	Transit	0.96454
<a href="#">COM 1541</a>	Espinoza	2	1	<a href="#">WASP-18</a>	01:37:25.0708	-45:40:40.06	Transit	0.82763
<a href="#">COM 1541</a>	Espinoza	3	1	<a href="#">K2-34</a>	08:30:18.8936	+22:14:09.31	Transit	0.94121
<a href="#">COM 1541</a>	Espinoza	4	1	<a href="#">WASP-164</a>	22:59:29.6611	-60:26:52.15	Transit	0.91672
<a href="#">COM 2734</a>	Pontoppidan	1	1	<a href="#">HAT-P-18</a>	17:05:23.1302	+33:00:44.37	Transit	0.97125
<a href="#">COM 2734</a>	Pontoppidan	2	1	<a href="#">WASP-96</a>	00:04:11.1377	-47:21:38.32	Transit	0.95499

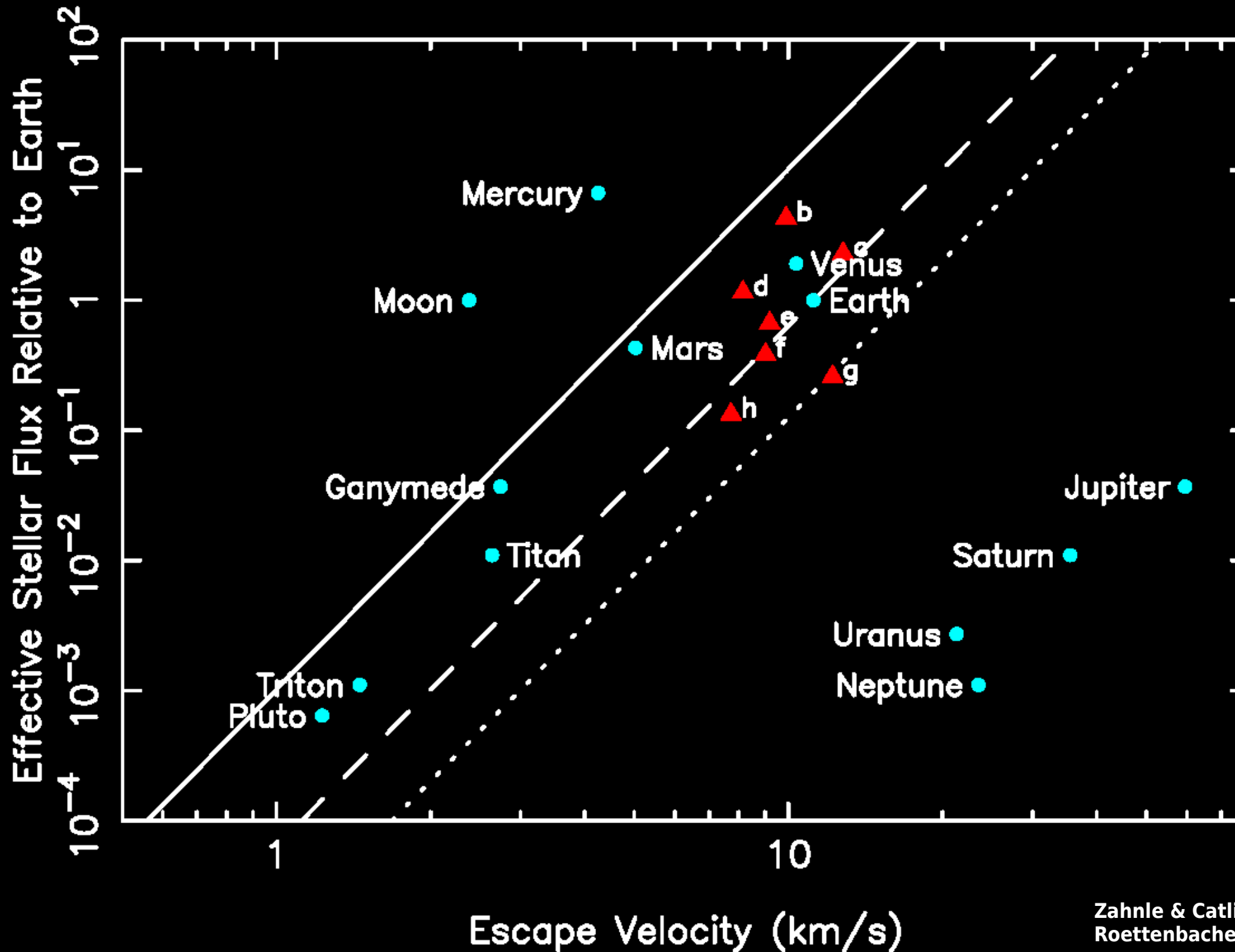
Program PI name Observation Visit Target name Right Ascension Declination Event Phase Start

Showing 1 to 10 of 366 entries

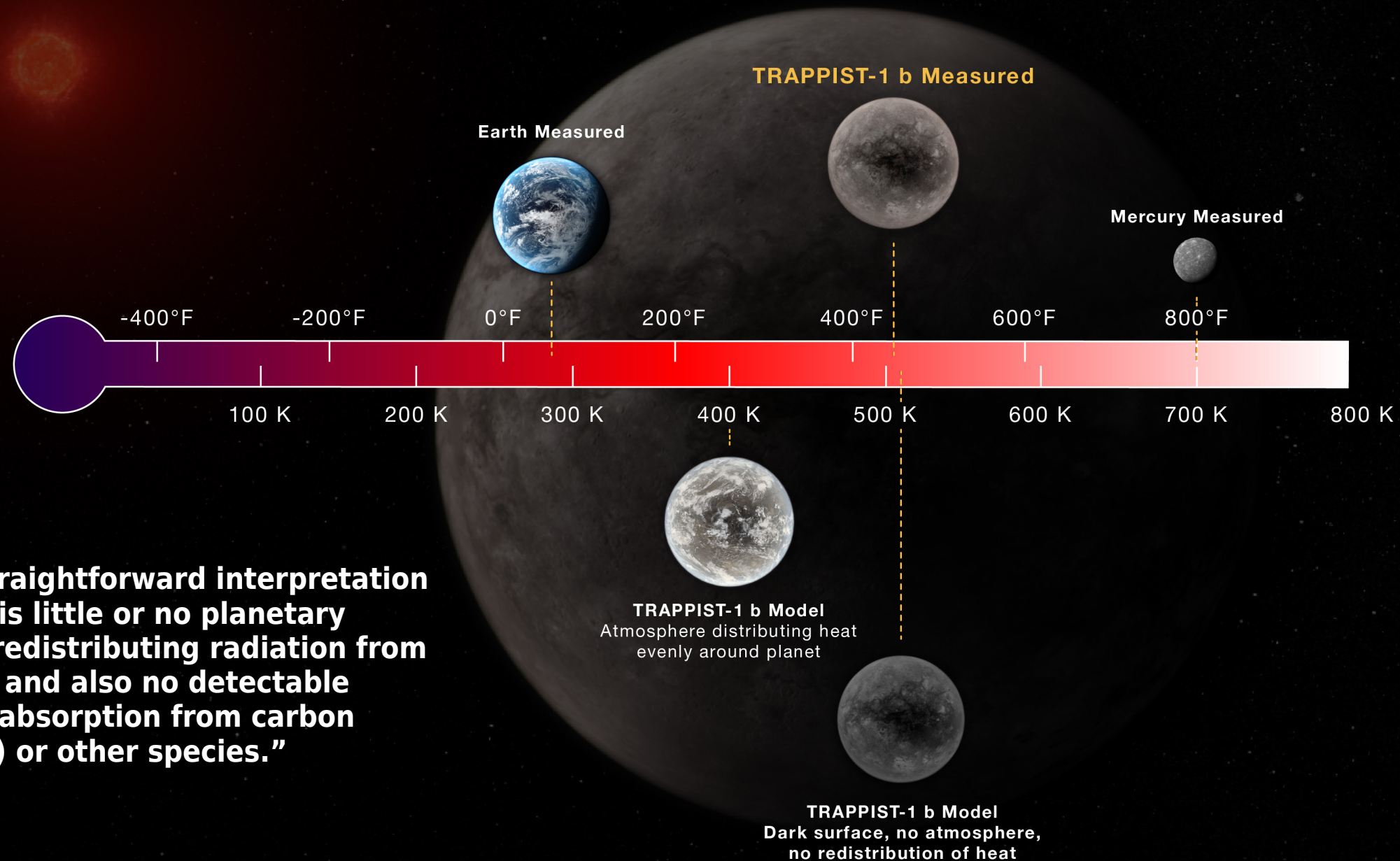
« < 1 2 3 4 5 ... 37 > »

<https://www.stsci.edu/~nnikolov/TrExoLiSTS/JWST/trexolists.html>

# The Cosmic Shoreline



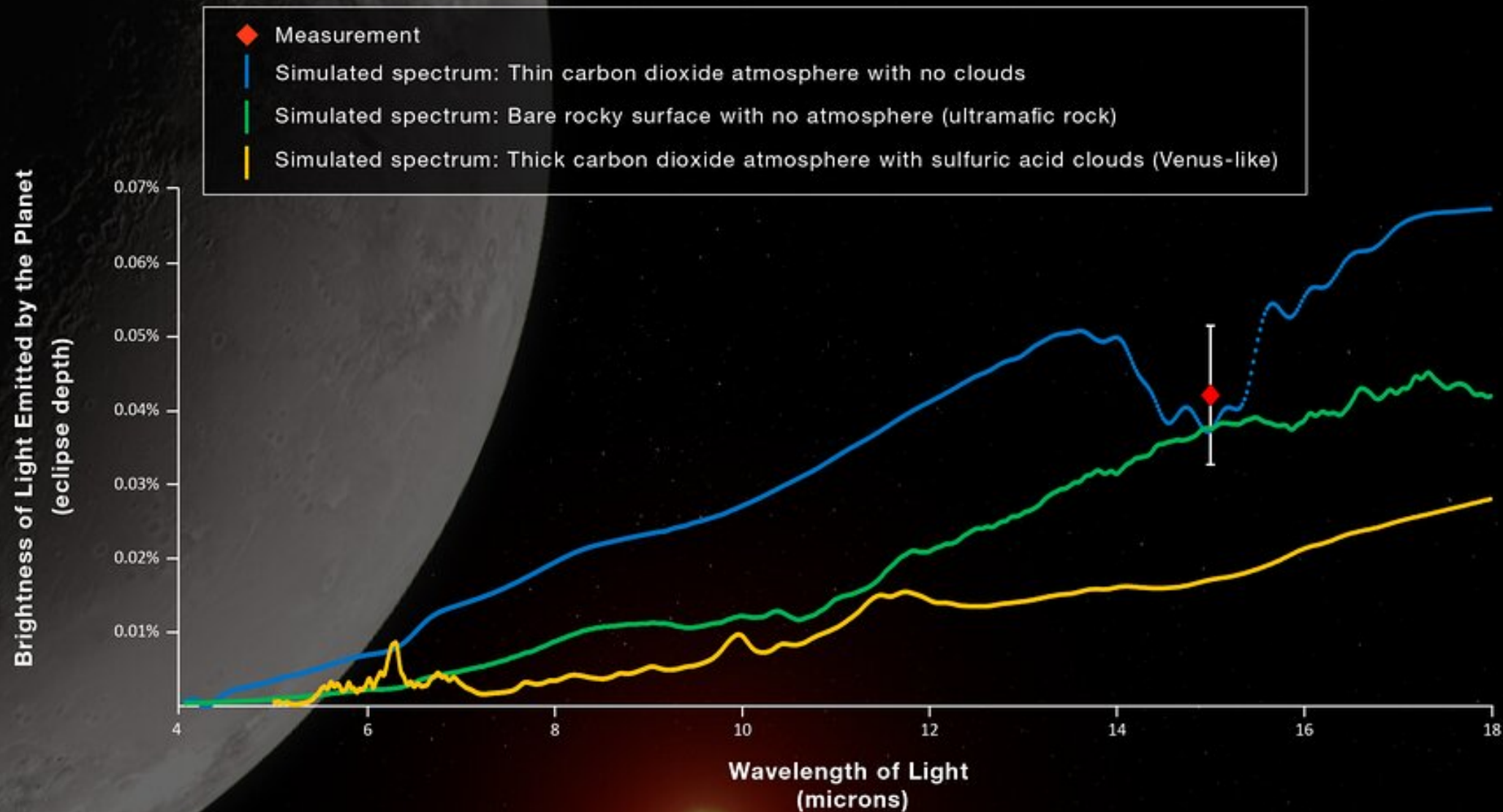
# DAYSIDE TEMPERATURE COMPARISON



**“The most straightforward interpretation is that there is little or no planetary atmosphere redistributing radiation from the host star and also no detectable atmospheric absorption from carbon dioxide (CO<sub>2</sub>) or other species.”**

# ROCKY EXOPLANET TRAPPIST-1 c EMISSION SPECTRA

MIRI | Time-Series Photometry (F1500W)



# No atmosphere, or consistent with no atmosphere ...

- **GJ 1132 b: (Rp = 1.192 RE, Fp = 19.2 FE, Host = M4.5 V)**  
<https://ui.adsabs.harvard.edu/abs/2025AJ....170..205B/abstract>
- **GJ 1252 b: (Rp = 1.193 RE, Fp = 232 FE, Host = M3 V)**  
<https://ui.adsabs.harvard.edu/abs/2022ApJ...937L..17C/abstract>
- **GJ 3929 b: (Rp = 1.09 RE, Fp = 17.3 FE, Host = M3.5 V)**  
<https://ui.adsabs.harvard.edu/abs/2025arXiv250812516X/abstract>
- **LHS 1140 c: (Rp = 1.27 RE, Fp = 5.3 FE, Host = M4.5V)**  
<https://ui.adsabs.harvard.edu/abs/2025arXiv251011397R/abstract>  
<https://ui.adsabs.harvard.edu/abs/2025A%26A...701A..25F/abstract>
- **LHS 3844 b: (Rp = 1.30 RE, Fp = 70.1 FE, Host = M5 V)**  
<https://ui.adsabs.harvard.edu/abs/2019Natur.573...87K/abstract>  
<https://ui.adsabs.harvard.edu/abs/2020PSJ.....1...36K/abstract>
- **LTT 1445 A b: (Rp = 1.34 RE, Fp = 5.7 FE, Host = M3 V)**  
<https://ui.adsabs.harvard.edu/abs/2025AJ....169..311W/abstract>
- **LTT 3780 b: (Rp = 1.325 RE, Fp = 111 FE, Host = M4 V)**  
<https://ui.adsabs.harvard.edu/abs/2025AJ....170..240A/abstract>
- **TOI-1468 b: (Rp = 1.401 RE, Fp = 36.4 FE, Host = M3 V)**  
<https://ui.adsabs.harvard.edu/abs/2025A%26A...698A..68M/abstract>
- **TRAPPIST-1 b: (Rp = 1.116 RE, Fp = 4.153 FE, Host = M8 V)**  
<https://ui.adsabs.harvard.edu/abs/2023Natur.618...39G/abstract>
- **TRAPPIST-1 c: (Rp = 1.097 RE, Fp = 2.214 FE, Host = M8 V)**  
<https://ui.adsabs.harvard.edu/abs/2023Natur.620..746Z/abstract>
- **TRAPPIST-1 d: (Rp = 0.788 RE, Fp = 1.115 FE, Host = M8 V)**  
<https://ui.adsabs.harvard.edu/abs/2025ApJ...989..181P/abstract>
- **TRAPPIST-1 e: (Rp = 0.920 RE, Fp = 0.646 FE, Host = M8 V)**  
<https://ui.adsabs.harvard.edu/abs/2025ApJ...990L..52E/abstract>  
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SEPTEMBER 9, 2025 | 7 MIN READ

## Hints of Atmosphere on Earth-Sized Exoplanet Raise Hopes for Life

A monumental sign of an atmosphere on TRAPPIST-1e could be the precursor to finally finding a living world around another star

BY JONATHAN O'CALLAGHAN | EDITED BY LEE BILLINGS



Edwin Kite

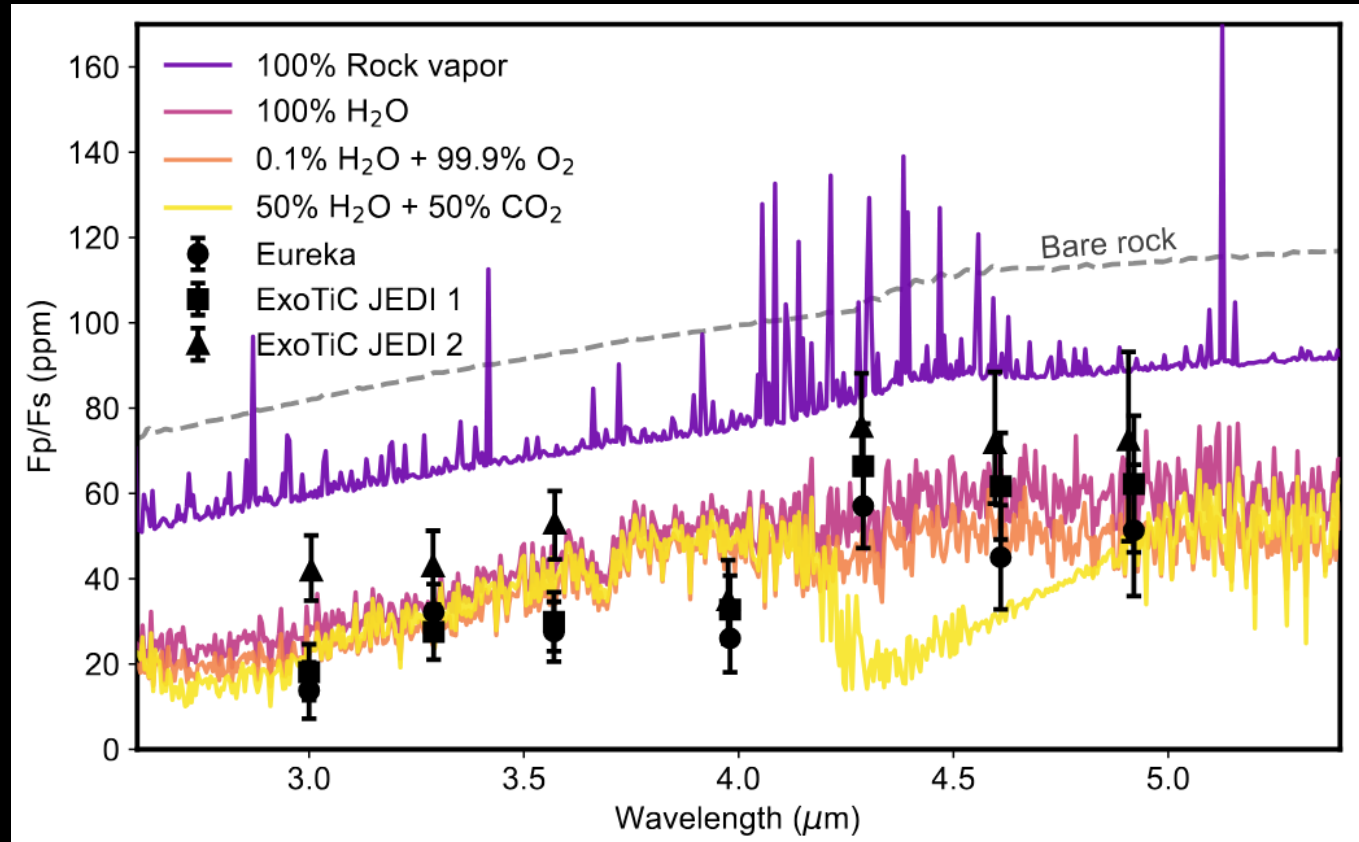
@edwinkite.bsky.social

That's not what the papers say. Glidden et al. write, "Both a bare rock and an N<sub>2</sub>-rich atmosphere provide adequate fits to the data." That's not "hints of an atmosphere," any more than flipping a coin and covering it with my hand is "hints of heads."

September 10, 2025 at 4:55 AM

# Atmosphere detected!

- **TOI-561 b: ( $R_p = 1.397$  RE,  $F_p = 4709$  FE, Host = G9V)**  
<https://ui.adsabs.harvard.edu/abs/2025arXiv250917231T/abstract>

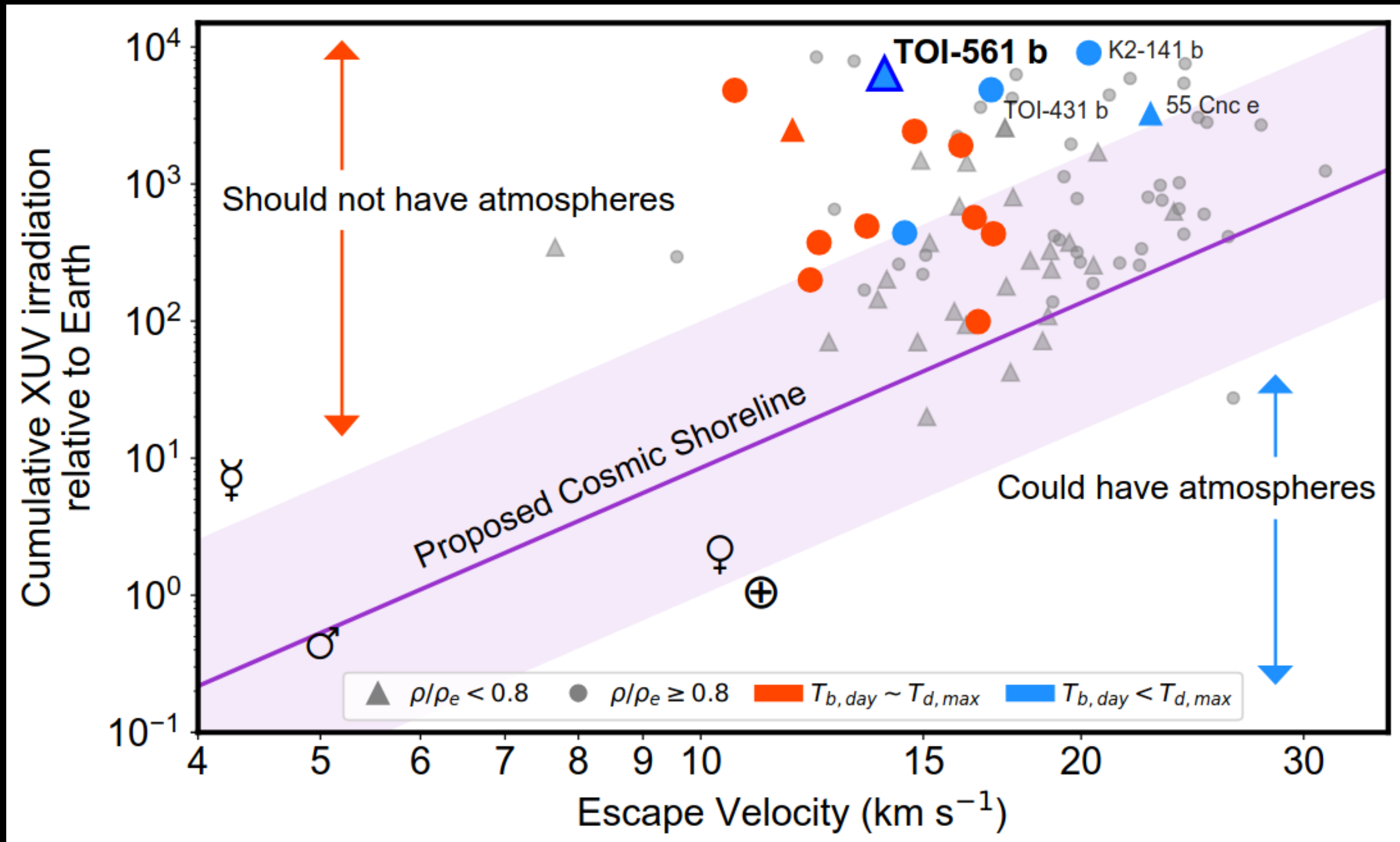


# Potential water worlds

- **LHS 1140 b: ( $R_p = 1.73$  RE,  $F_p = 0.43$  FE, Host = M4.5 V)**  
<https://ui.adsabs.harvard.edu/abs/2021AJ....161...44E/abstract>  
<https://ui.adsabs.harvard.edu/abs/2024ApJ...960L...3C/abstract>  
<https://ui.adsabs.harvard.edu/abs/2024ApJ...968L..22D/abstract>  
<https://ui.adsabs.harvard.edu/abs/2024ApJ...970L...2C/abstract>
- **K2-18 b: ( $R_p = 2.37$  RE,  $F_p = 1.0$  FE, Host = M2.5 V)**



# The Cosmic Shoreline (again)



# Where should we direct our efforts next?

## Reminder: Transmission Spectroscopy Metric

$$\text{TSM} = (\text{Scale factor}) \times \frac{R_p^3 T_{\text{eq}}}{M_p R_*^2} \times 10^{-m_J/5}.$$

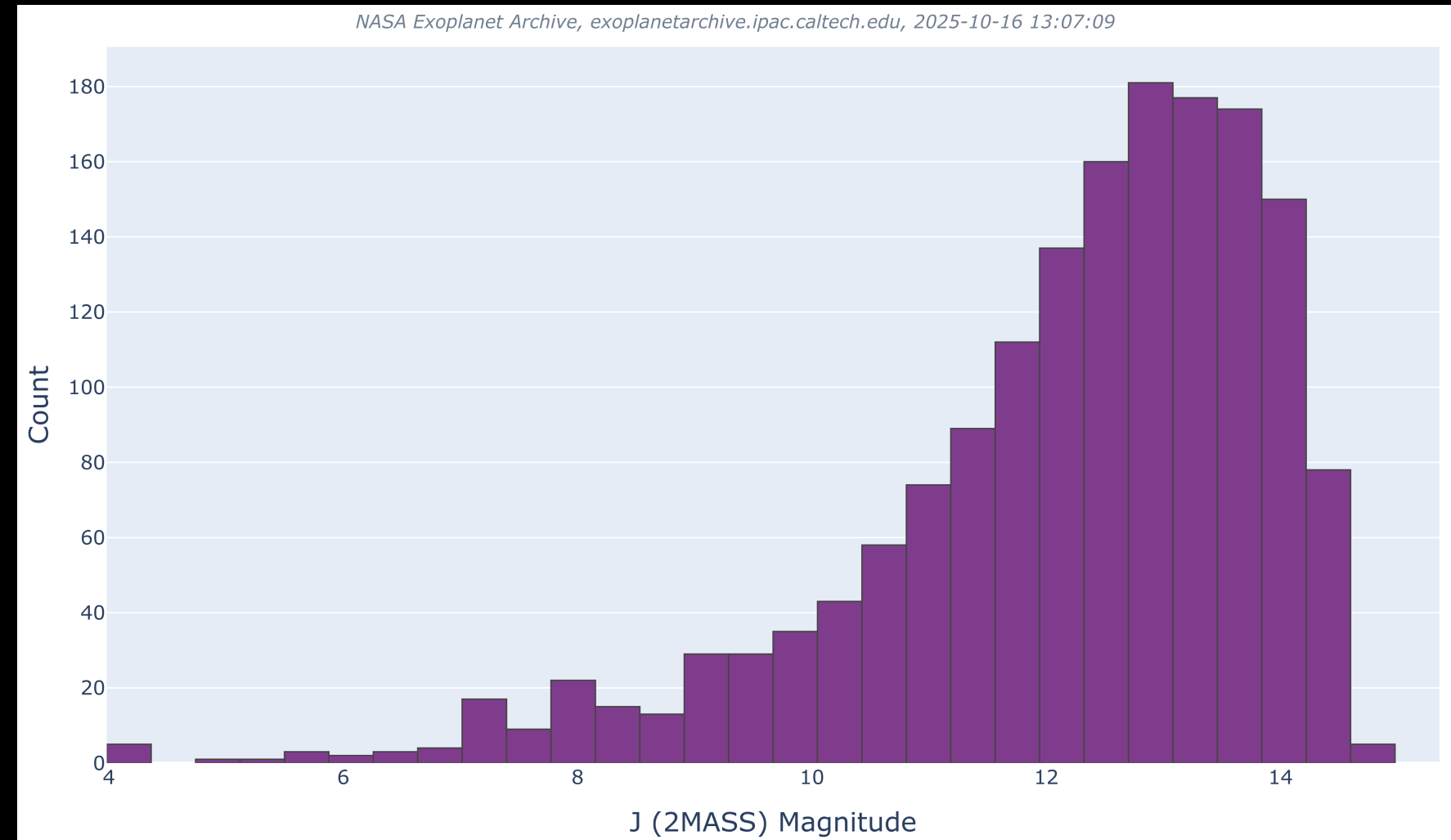
**R<sub>p</sub>** = planet radius

**M<sub>p</sub>** = planet mass

**T<sub>eq</sub>** = planet equilibrium temperature

**R<sub>\*</sub>** = stellar radius

**m<sub>J</sub>** = J band magnitude



## Some random thoughts ...

- 1. Are we running out of JWST targets? The transit method is biased toward faint stars to overcome transit geometric probability. “To first order, the transit method detects nothing.”**
- 2. Should we dive deeper on the TRAPPIST-1 system? TRAPPIST-1e remains unresolved, as do the farther planets, but are dramatically more observationally expensive.**
- 3. Are we starting to see an answer to a fundamental planetary science question: Can terrestrial planets around M dwarfs sustain secondary atmospheres over Gyr time scales?**
- 4. Should the community continue to burn the remaining precious JWST time on M dwarfs? Should we pivot to focus on sub-Neptunes?**
- 5. This work re-emphasizes the importance of the axis of time in the context of planetary evolution. This is especially true for M dwarfs, which tend to be old. E.g., TRAPPIST-1 age is  $7.6 \pm 2.2$  Gyr.**
- 6. More work is needed on characterizing M dwarfs, particular age determinations and the UV/XUV flux environment for planets around M dwarfs during the first Gyr.**
- 7. Further complementary work is needed regarding atmospheric photochemistry, atmospheric loss, and degassing lifetimes for M dwarf planets.**
- 8. In addition to host star spectral type, atmospheric retention may also be sensitive to disk longevity, migration, and final orbital architecture with respect to volatile delivery.**
- 9. Important to note that, in many cases, the word “consistent” is doing a lot of heavy lifting!**

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