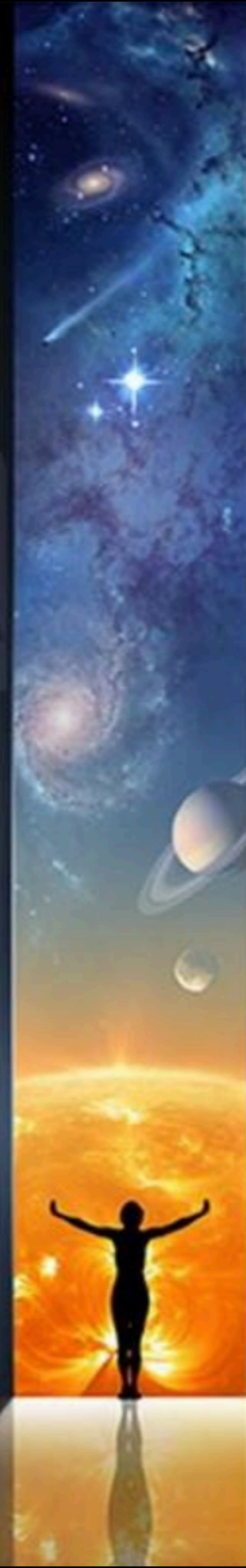


NASA



Life at NASA

Knicole Colón
NASA Goddard Space Flight Center
Exoplanet Explorers, 30 April 2021

My path to NASA

What I do at NASA

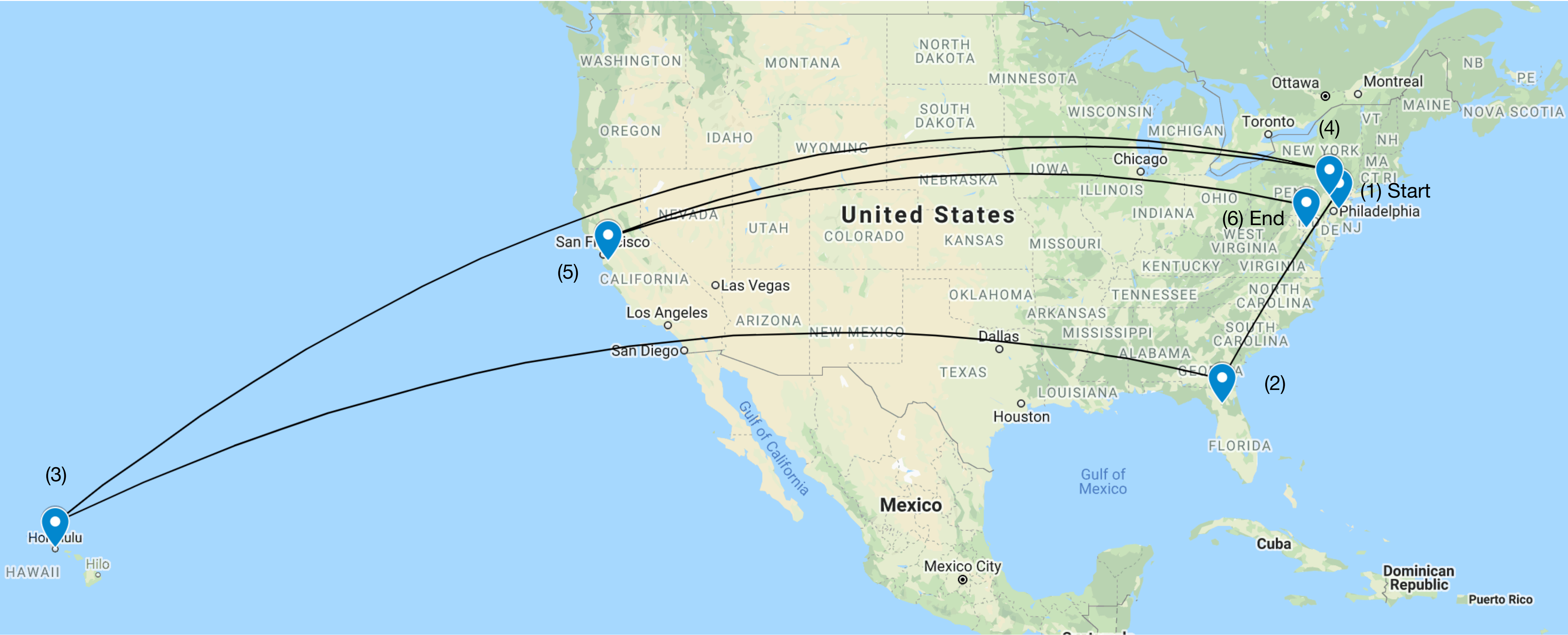
Opportunities at NASA

> My path to NASA

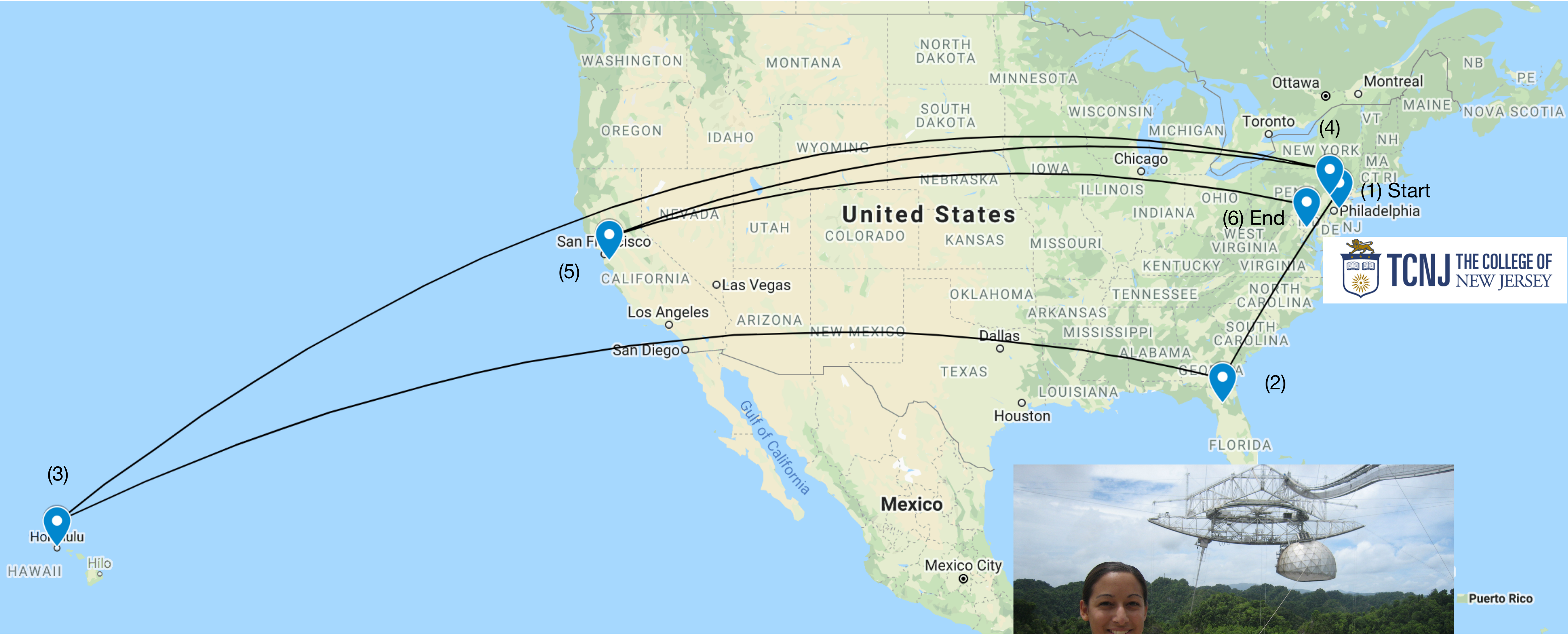
What I do at NASA

Opportunities at NASA

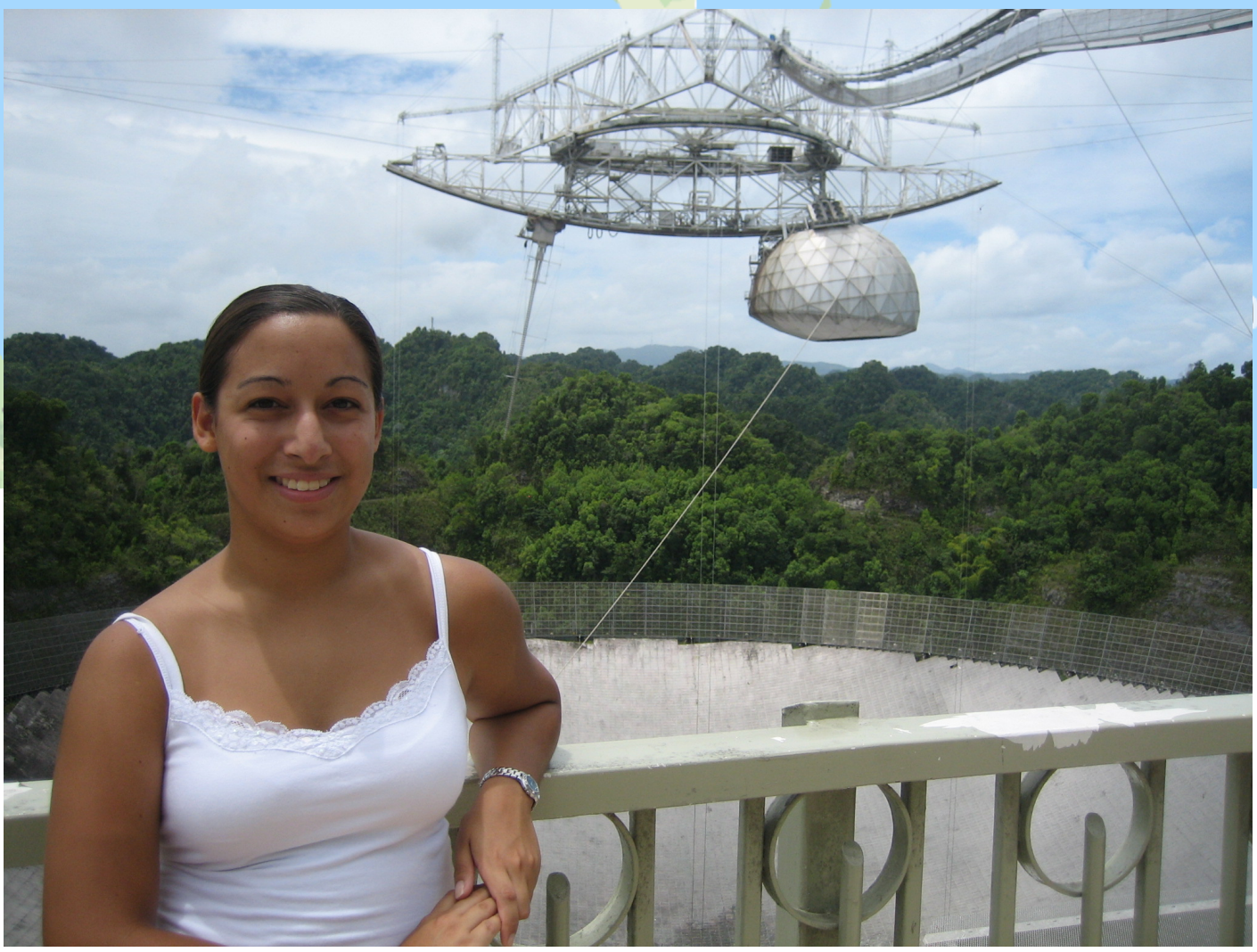
My Path to NASA



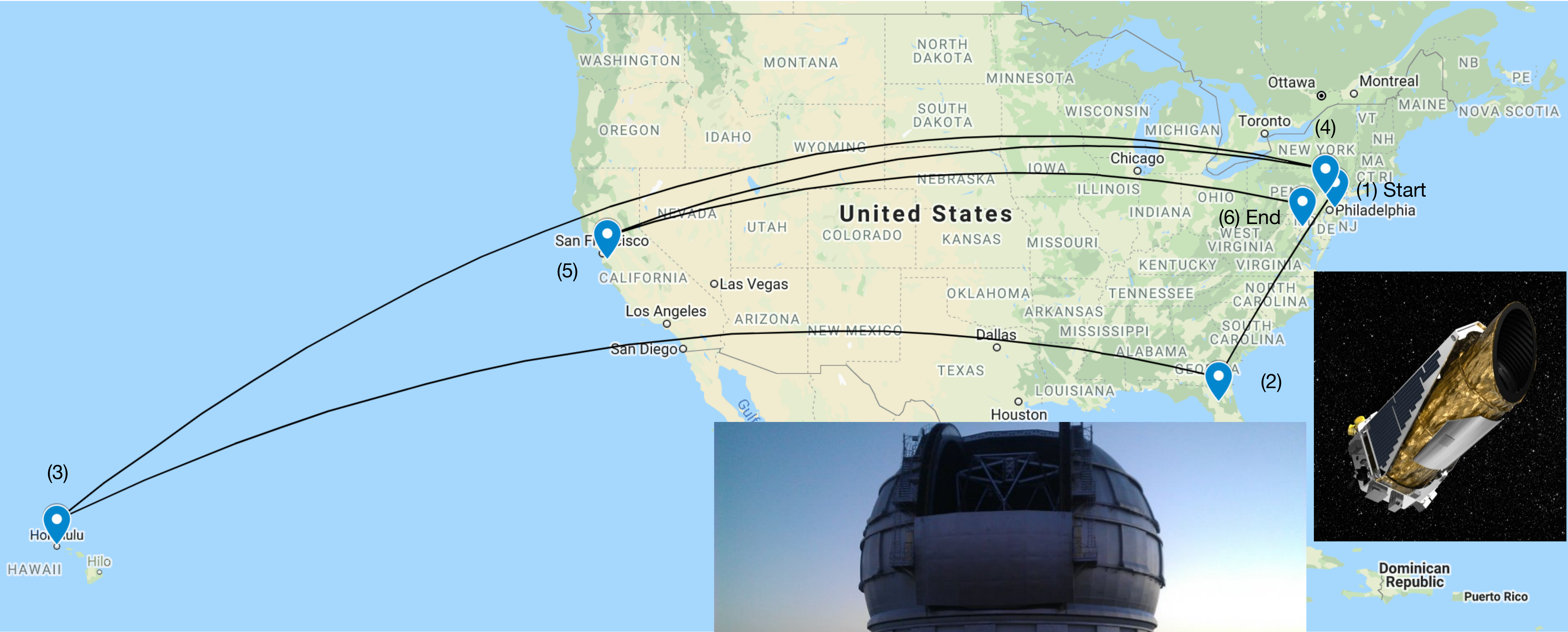
My Path to NASA



(1) The College of New Jersey



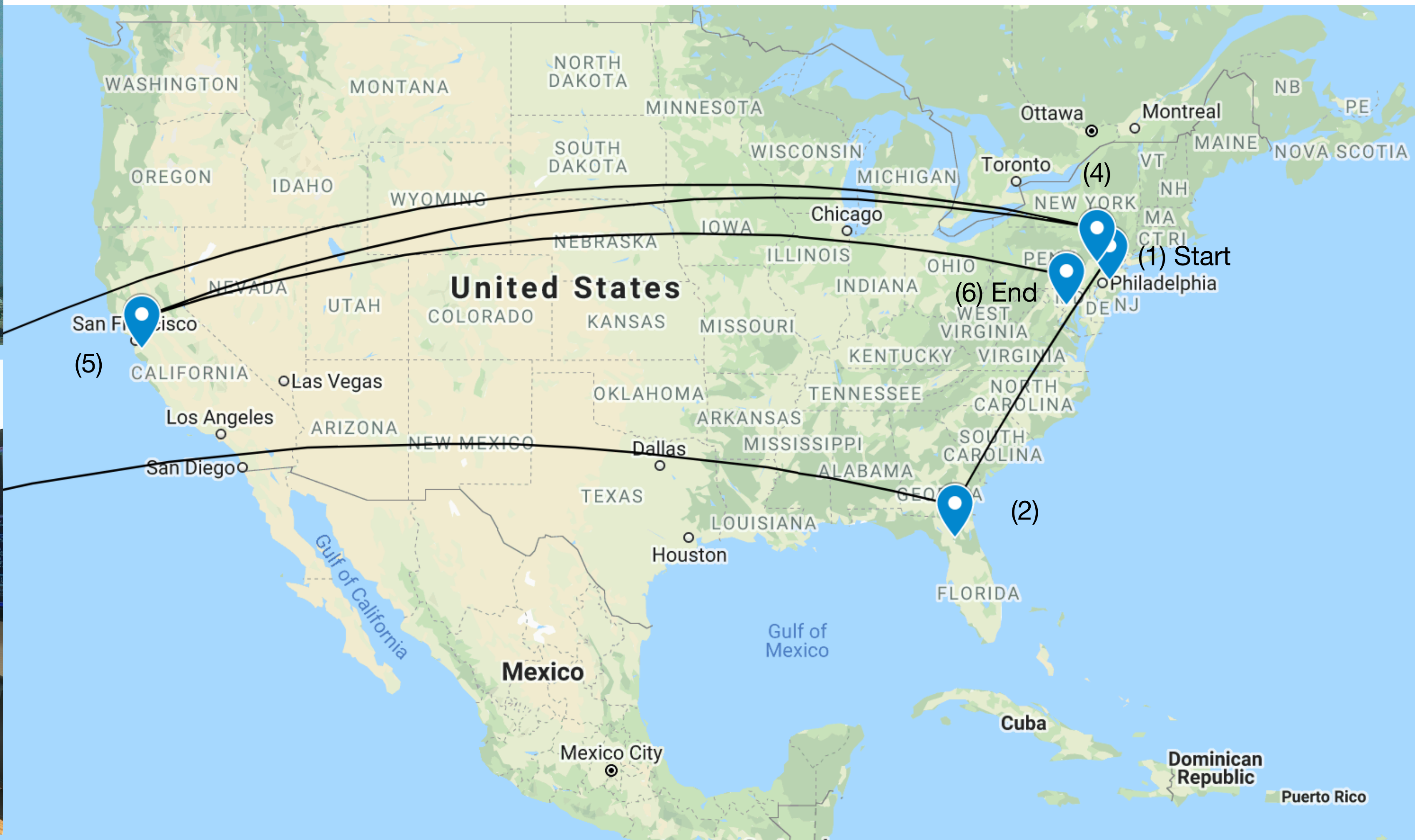
My Path to NASA



(1) The College of New Jersey

(2) University of Florida

My Path to NASA



- (1) The College of New Jersey
- (2) University of Florida
- (3) University of Hawaii at Manoa

My Path to NASA

What Is **KELT**? Kilodegree **E**xtrremely **L**ittle **T**elescope

[LEARN MORE.](#)

26 PLANETS
DISCOVERED

KELT-9B: HOTTEST PLANET EVER DISCOVERED

20 PEOPLE
INVOLVED

- (1) The College of New Jersey
- (2) University of Florida
- (3) University of Hawaii at Manoa

- (4) Lehigh University

My Path to NASA



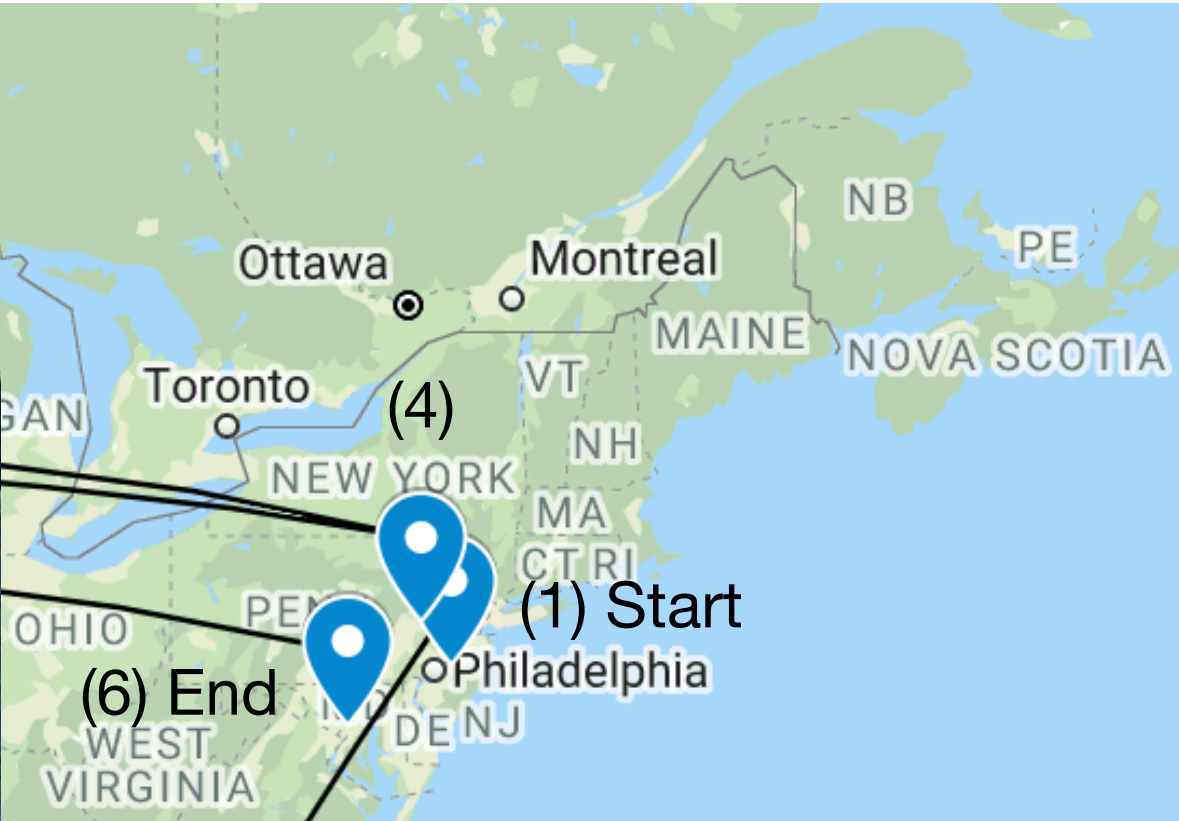
What Is **KELT?**
Kilodegree Extremely Little Telescope

LEARN MORE.

26 PLANETS DISCOVERED

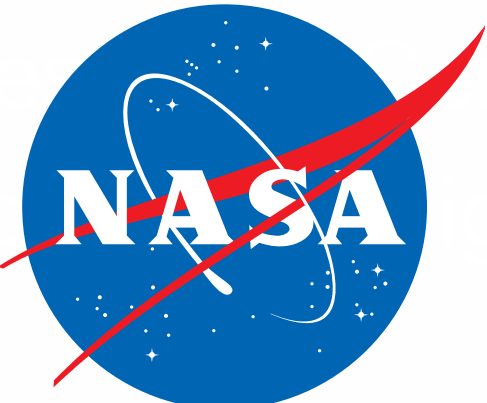
20 PEOPLE INVOLVED

KELT-9B: HOTTEST PLANET EVER DISCOVERED

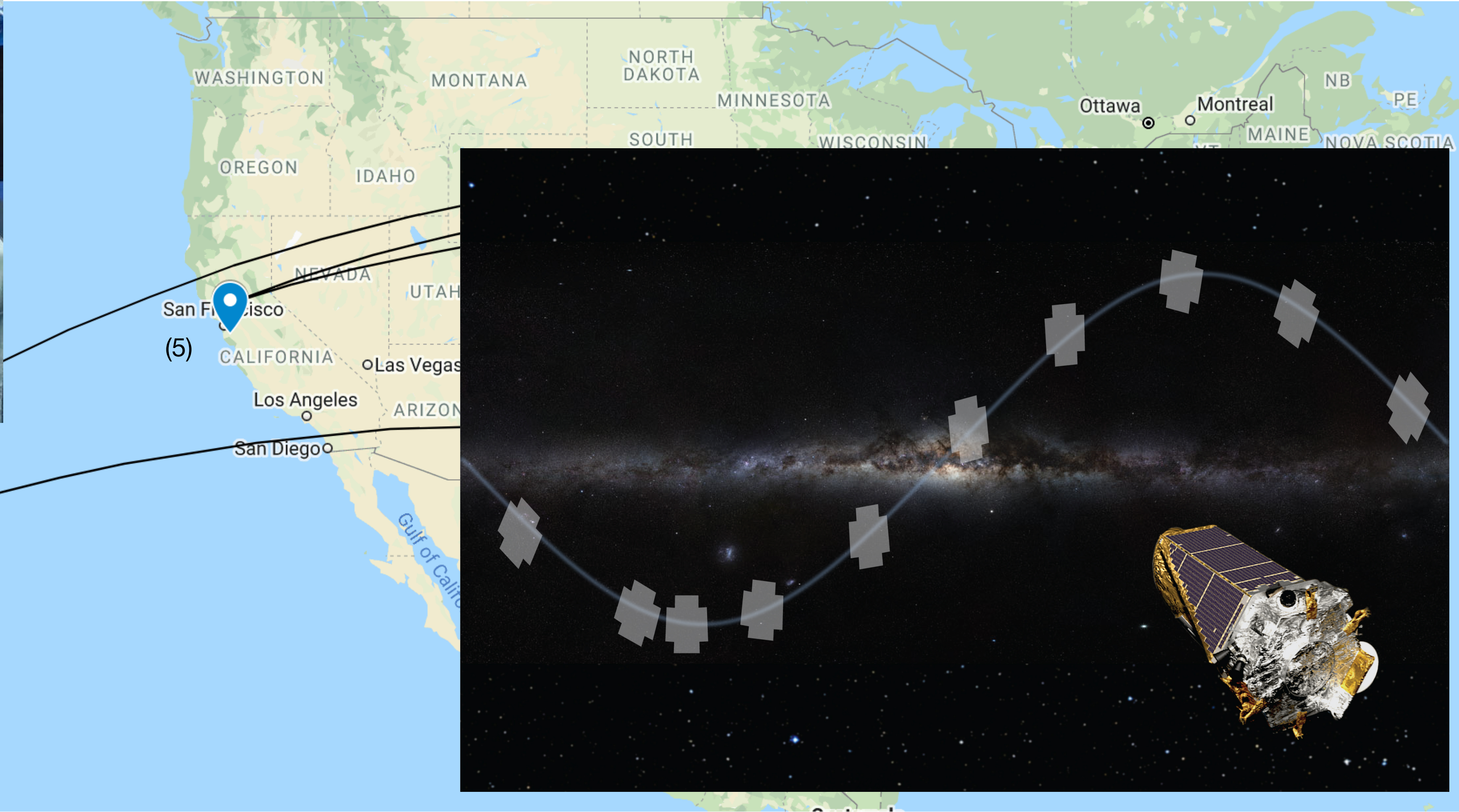


- (1) The College of New Jersey
- (2) University of Florida
- (3) University of Hawaii at Manoa

(4) Lehigh University



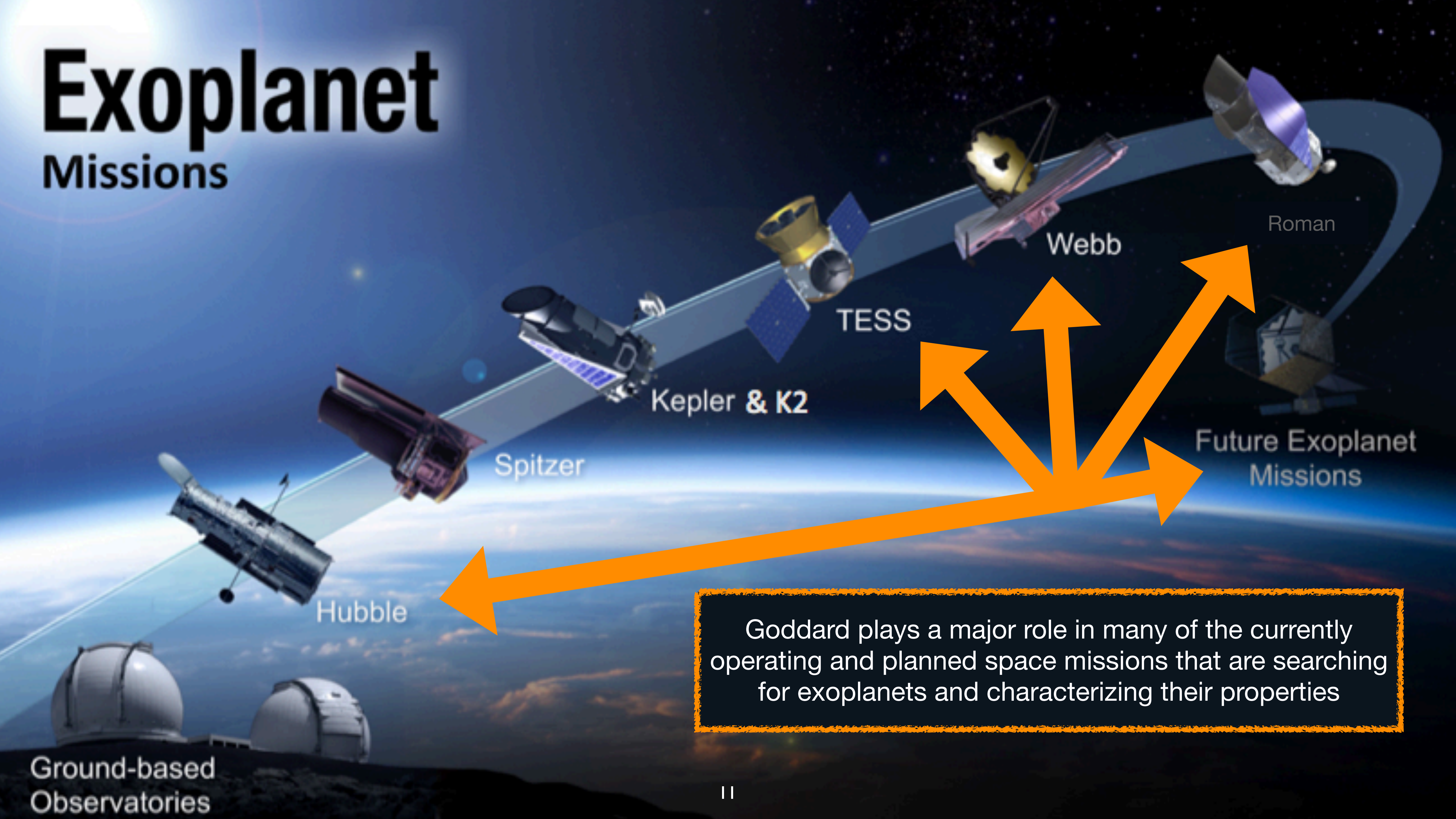
My Path to NASA



- (1) The College of New Jersey
- (2) University of Florida
- (3) University of Hawaii at Manoa

- (4) Lehigh University
- (5) NASA Ames Research Center

Exoplanet Missions



Ground-based Observatories

Hubble

Spitzer

Kepler & K2

TESS

Webb

Roman

Future Exoplanet Missions

Goddard plays a major role in many of the currently operating and planned space missions that are searching for exoplanets and characterizing their properties

My Path to NASA



- (1) The College of New Jersey
- (2) University of Florida
- (3) University of Hawaii at Manoa

- (4) Lehigh University
- (5) NASA Ames Research Center
- (6) NASA Goddard Space Flight Center

My path to NASA

> What I do at NASA

Opportunities at NASA

My Roles at NASA Goddard

- Civil Servant
- Research Astrophysicist
- TESS Guest Investigator Program Office Deputy Director
- JWST Deputy Project Scientist for Exoplanet Science
- Pandora Project Scientist

(*also formerly the HST Deputy Operations Project Scientist)

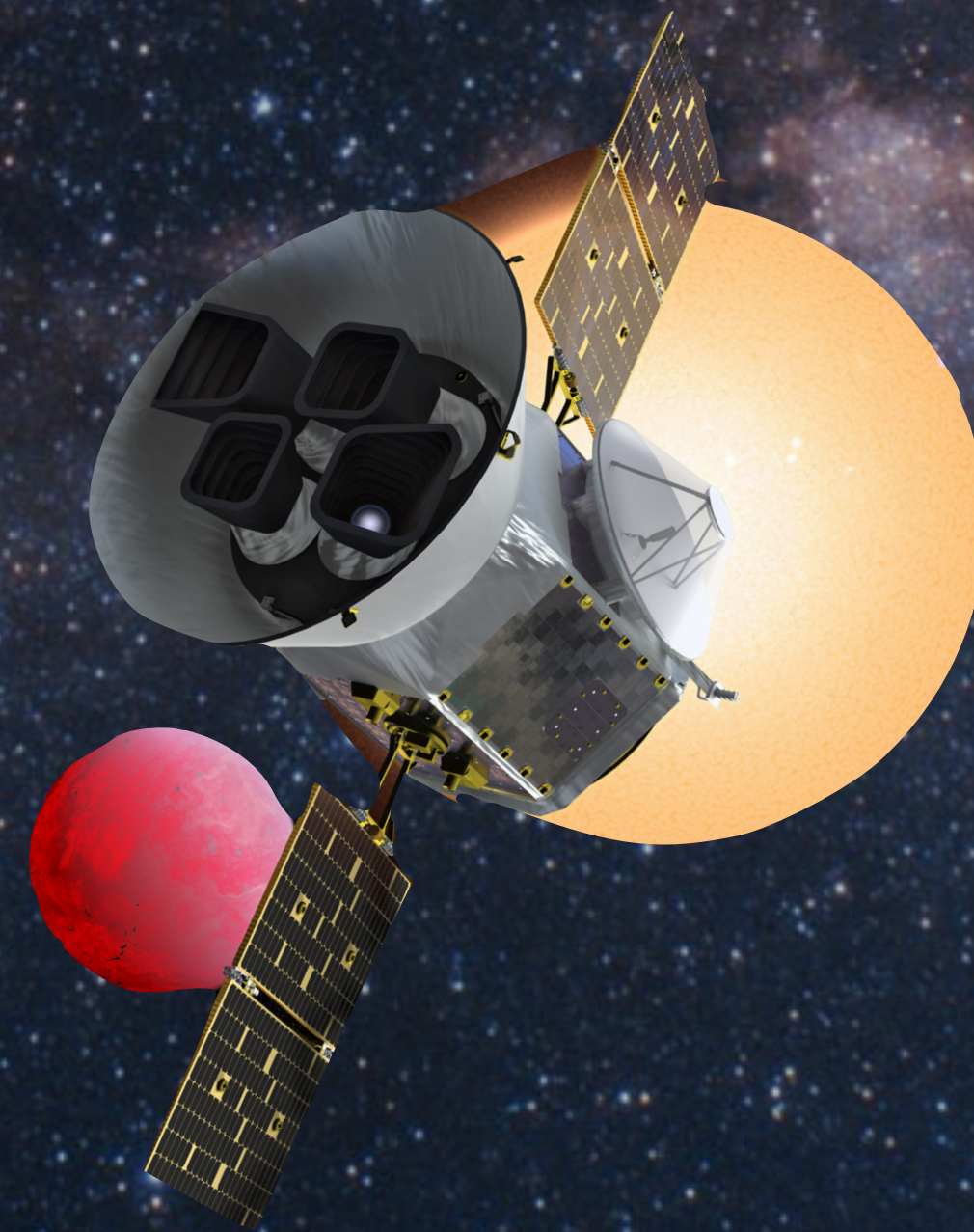
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- **JWST Deputy Project Scientist for Exoplanet Science**
- **Pandora Project Scientist**

(*also formerly the HST Deputy Operations Project Scientist)

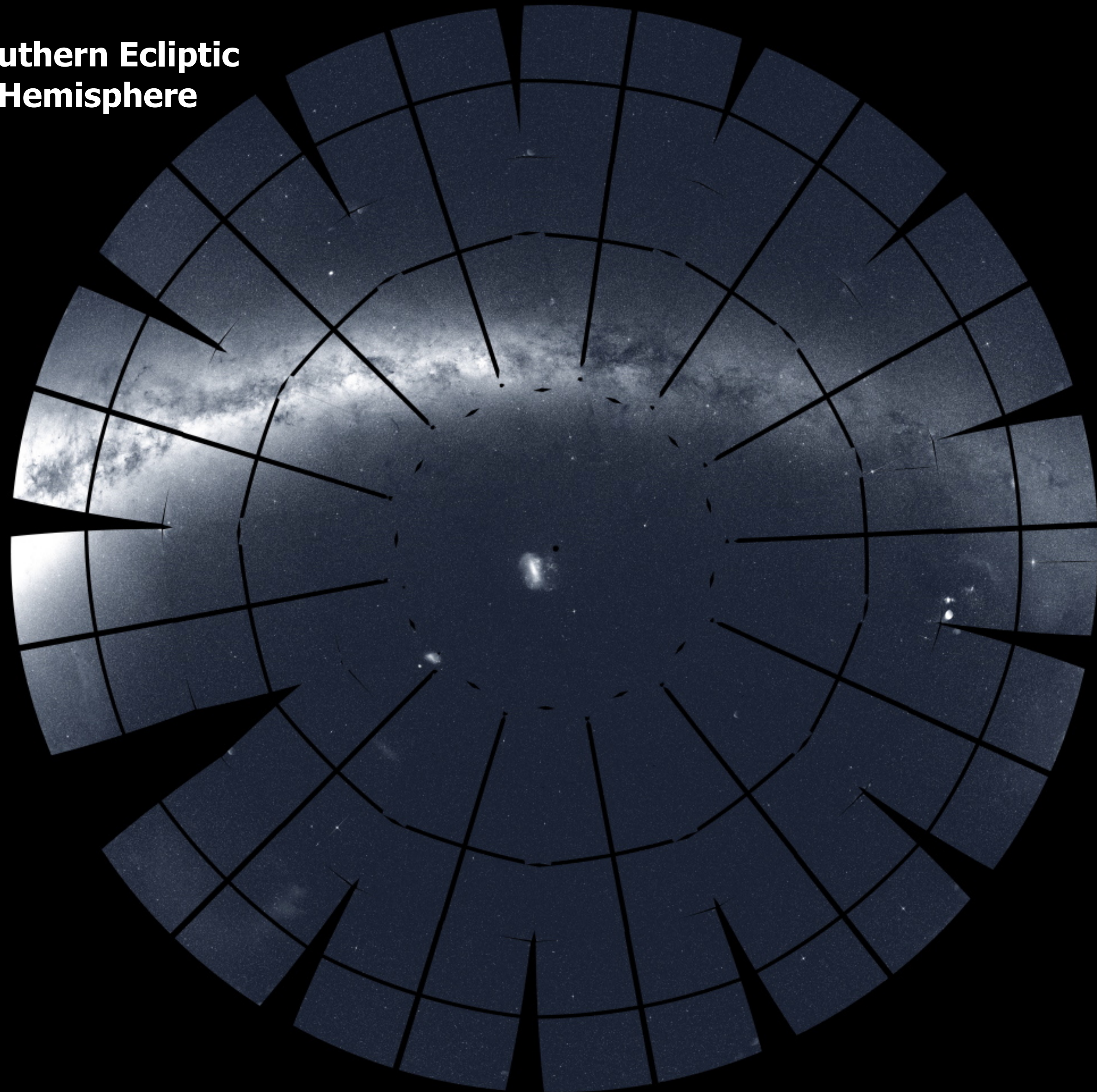
TESS Mission (2018+)

A search for small planets around nearby stars that are "easy" to study

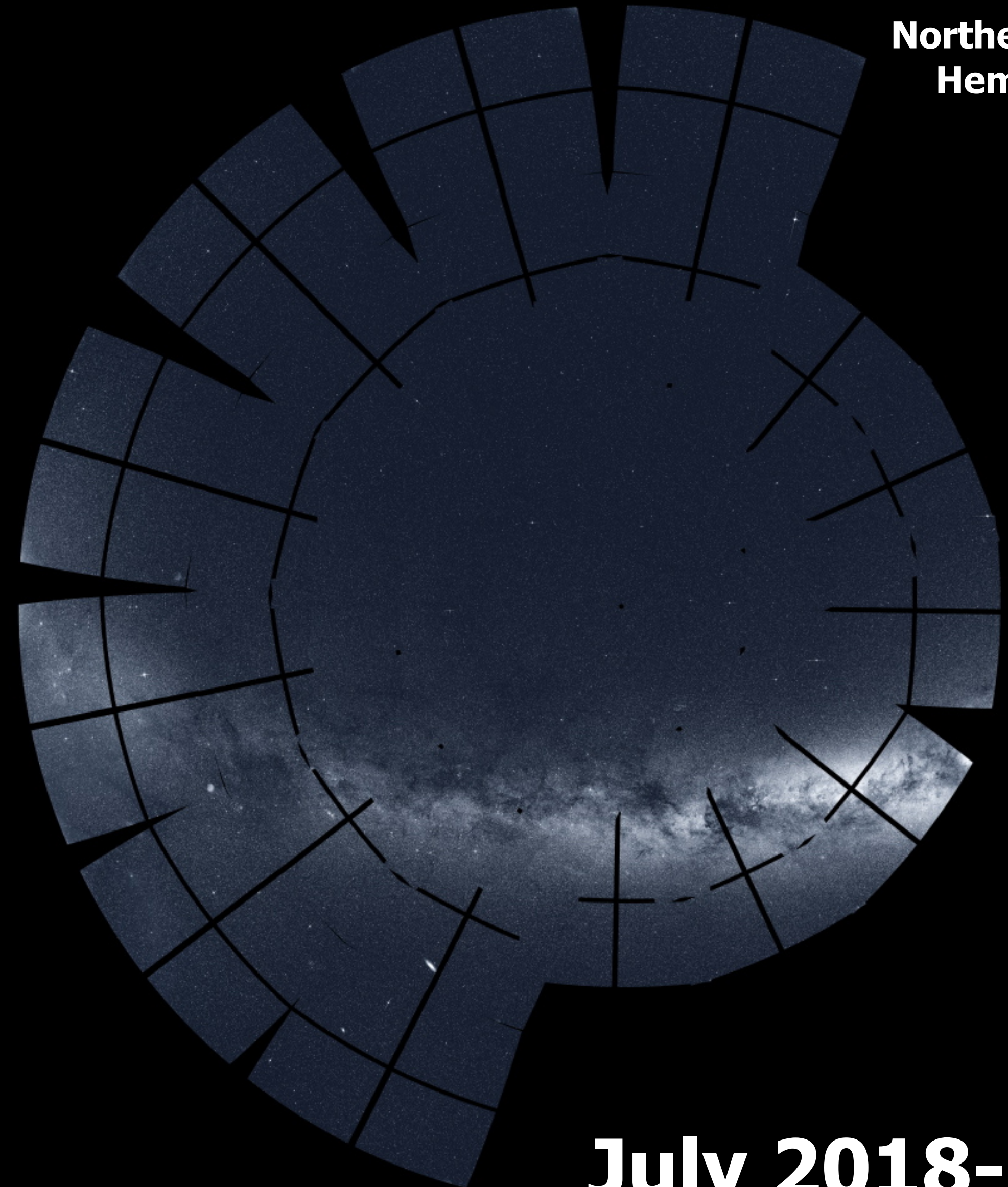


TESS Prime Mission Sky Coverage

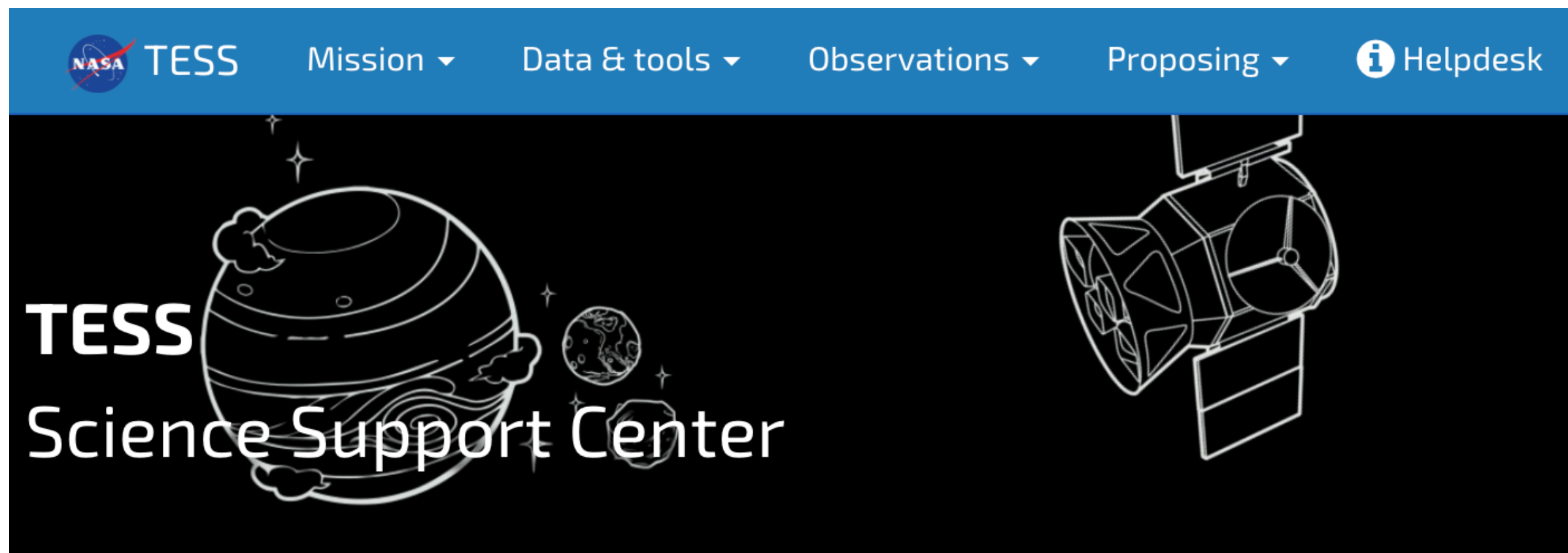
Southern Ecliptic Hemisphere



Northern Ecliptic Hemisphere



July 2018-2020



tess.gsfc.nasa.gov

Q Key Information

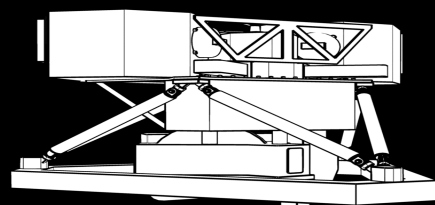
- The TESS extended mission
- 📖 Telescope information
- ☁ How to access the data
- ✔ Web TESS target tool
- 📅 Observing dates
- 📄 Proposing science
- ☑ Citizen Science
- 💬 Volunteer to serve on a review
- 📊 Do you have news-worthy TESS result?
- ▶ Outreach resources
- 📄 Publications



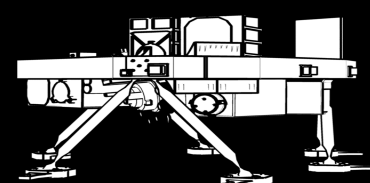
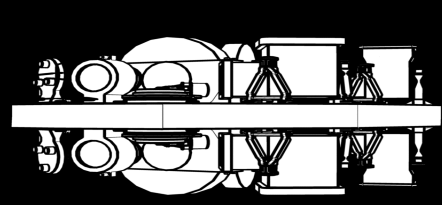
James Webb Space Telescope

An infrared optimized
6.5-meter diameter
telescope slated to
launch in 2021

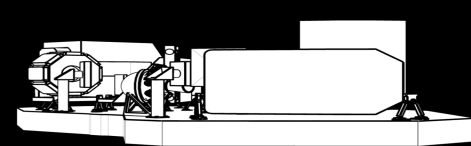
MIRI (ESA, JPL)



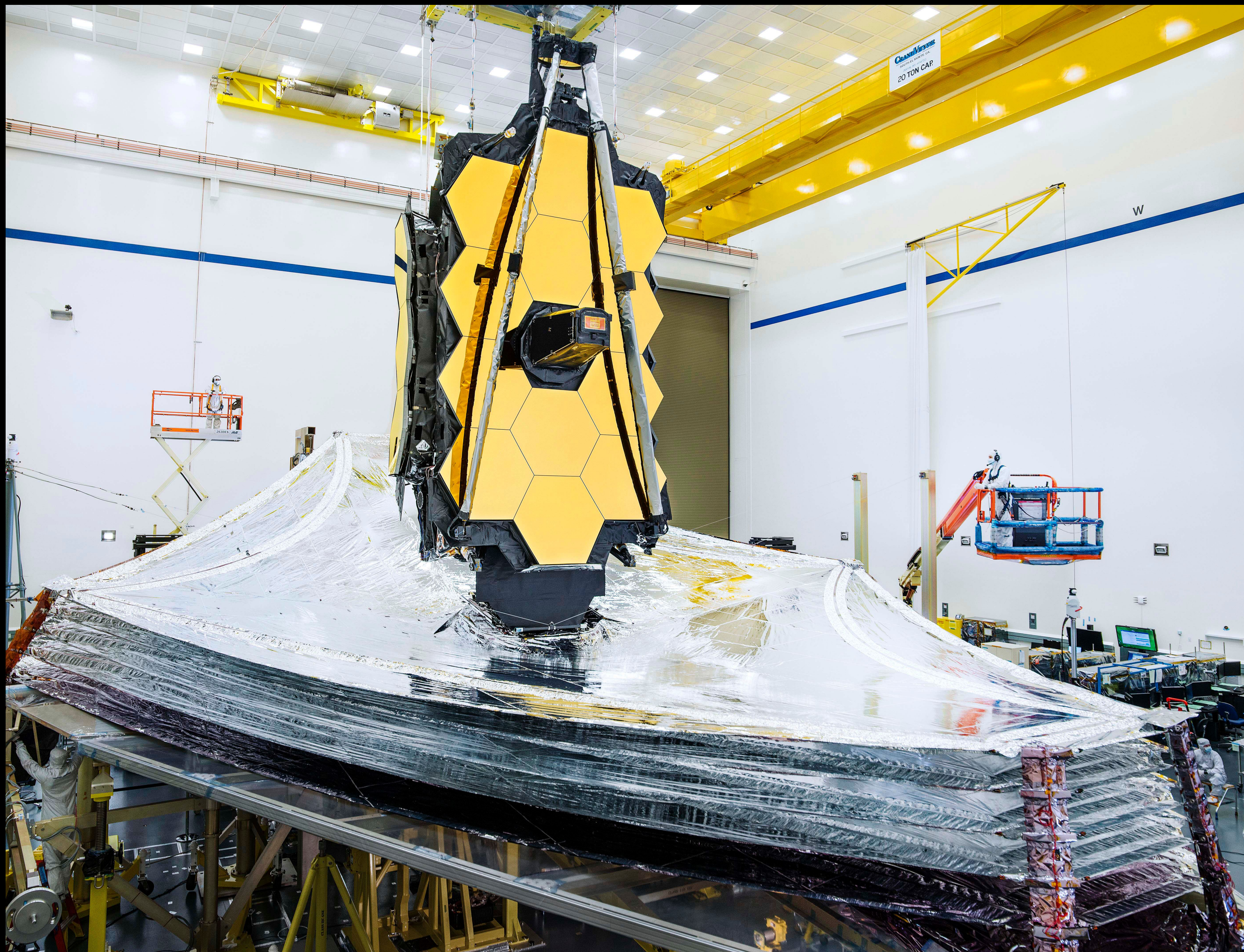
NIRcam (University of Arizona)



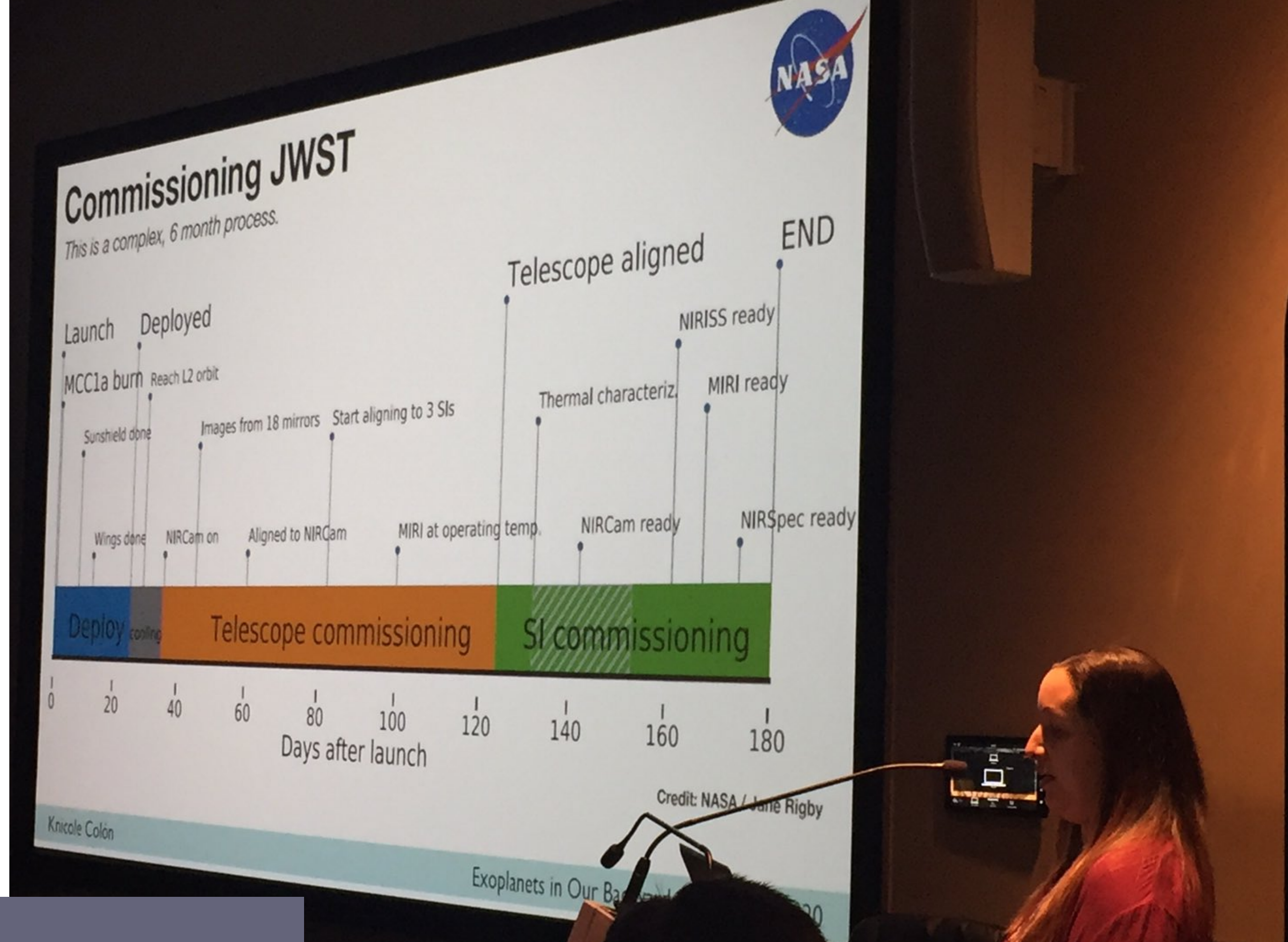
FGS/NIRISS (CSA)



NIRSpec (ESA, with components from GSFC)



JWST sunshield deployment (Oct. 2019). Credit: NASA / Chris Gunn



James Webb Space Telescope User Documentation

Home | Quick Links | Search

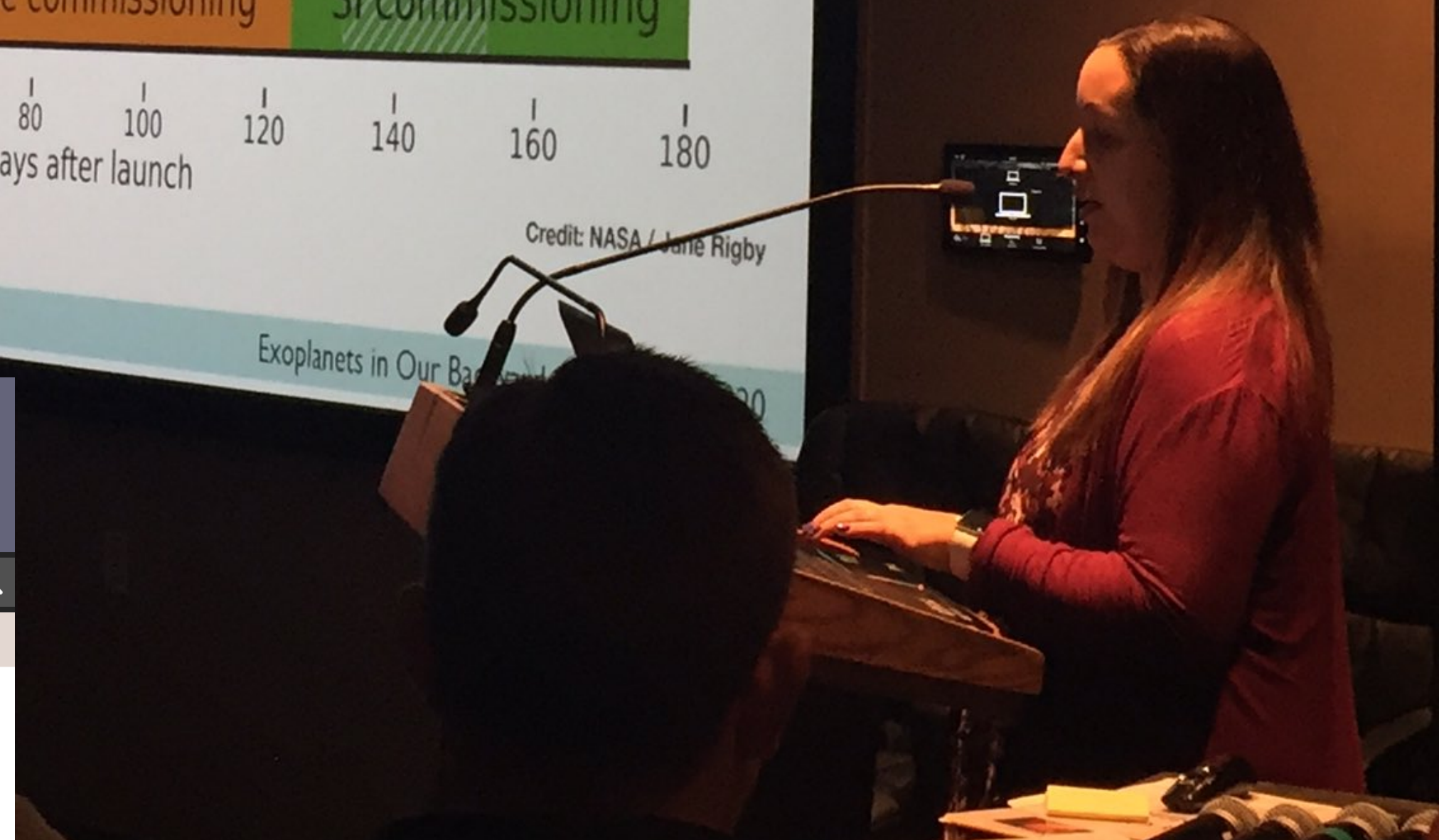
Home / Methods and Roadmaps / JWST Time-Series Observations

JWST Time-Series Observations

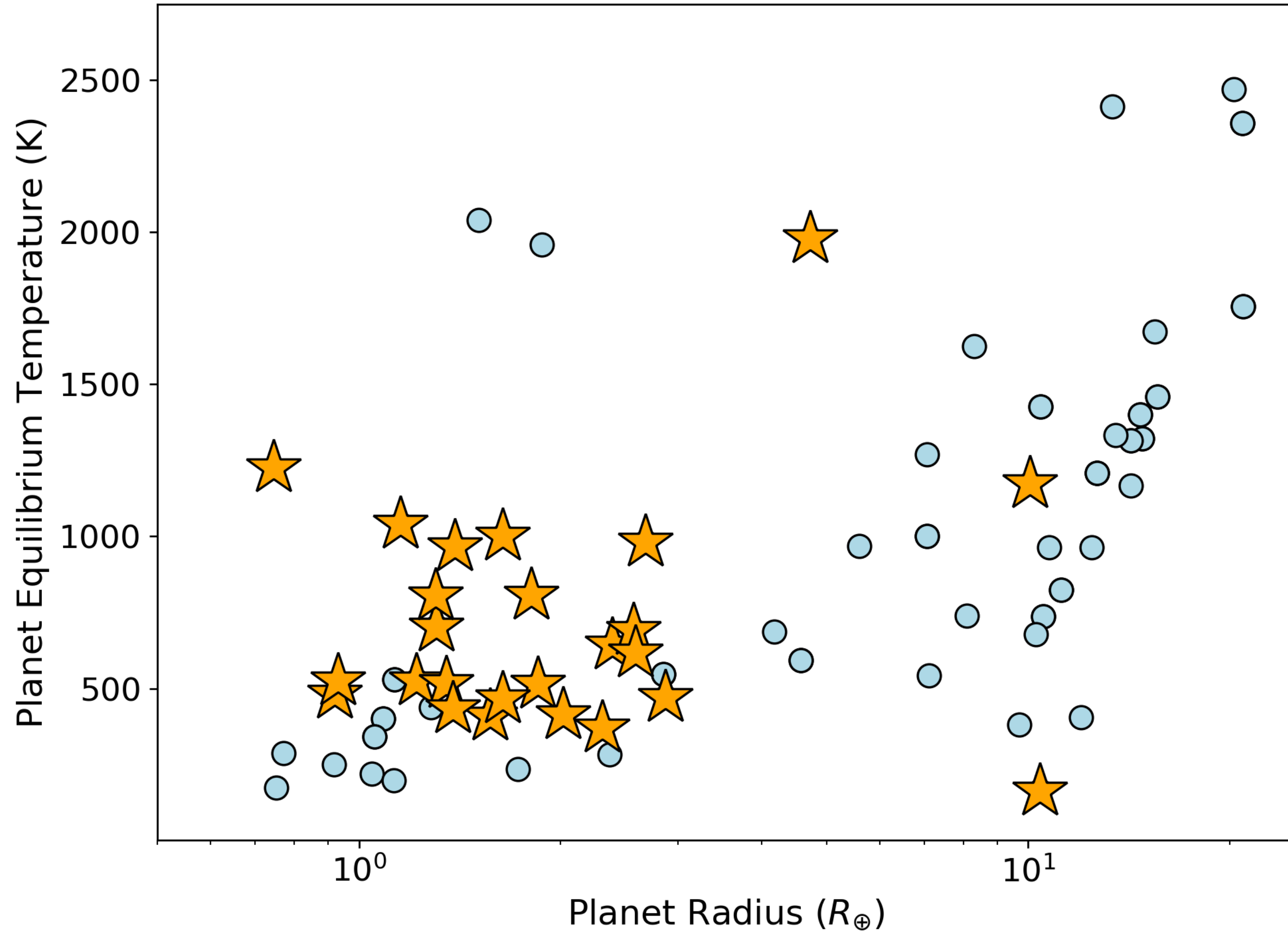
JWST time-series observations provide a way to monitor time variable phenomena, with observations optimized for detecting faint variations in flux over short or long timescales.

On this page

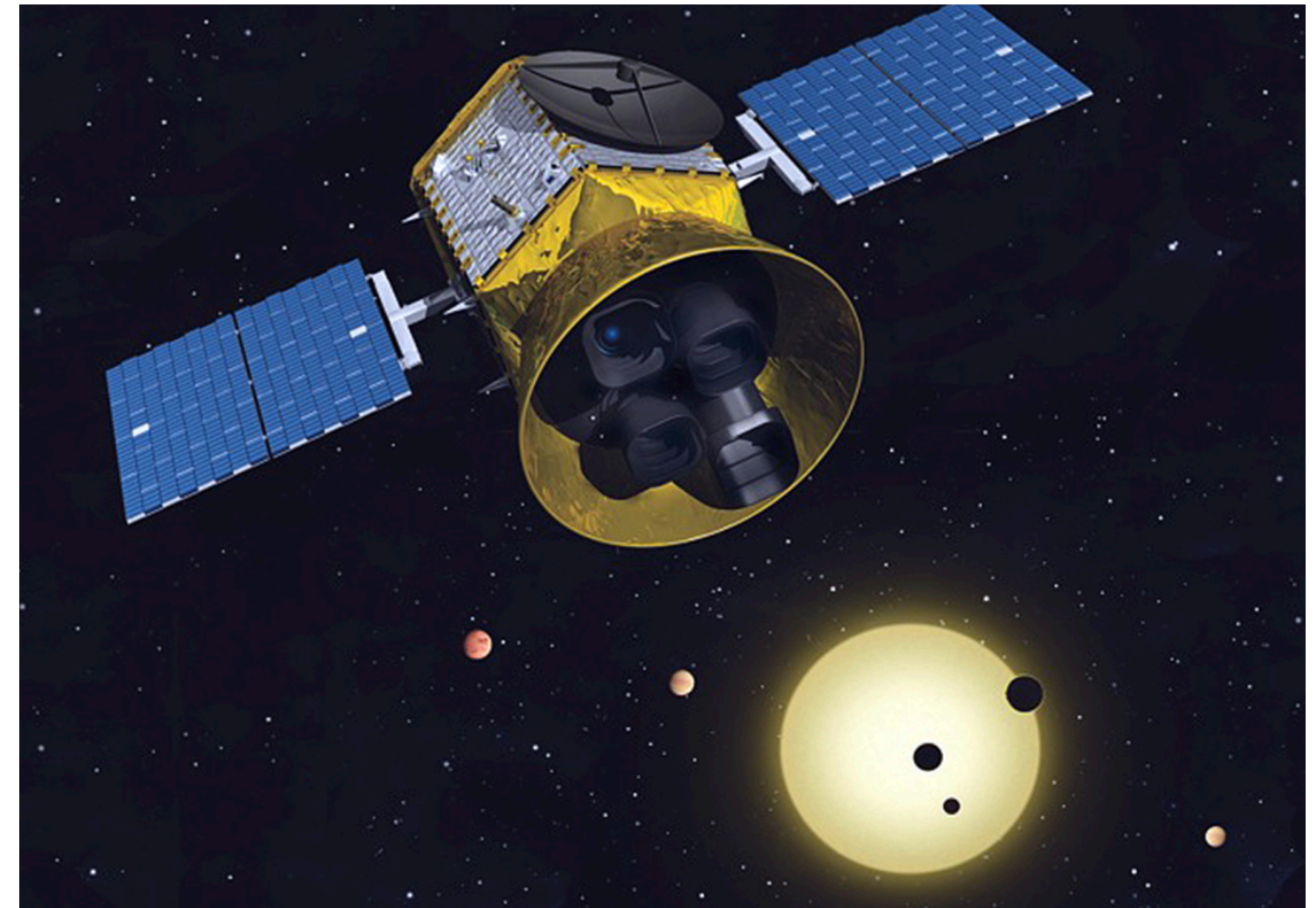
- Time-series observation with JWST
- Instrument modes for TSOs
- TSOs roadmaps
- TSOs example science programs



JWST Cycle 1 Transiting Exoplanet Targets

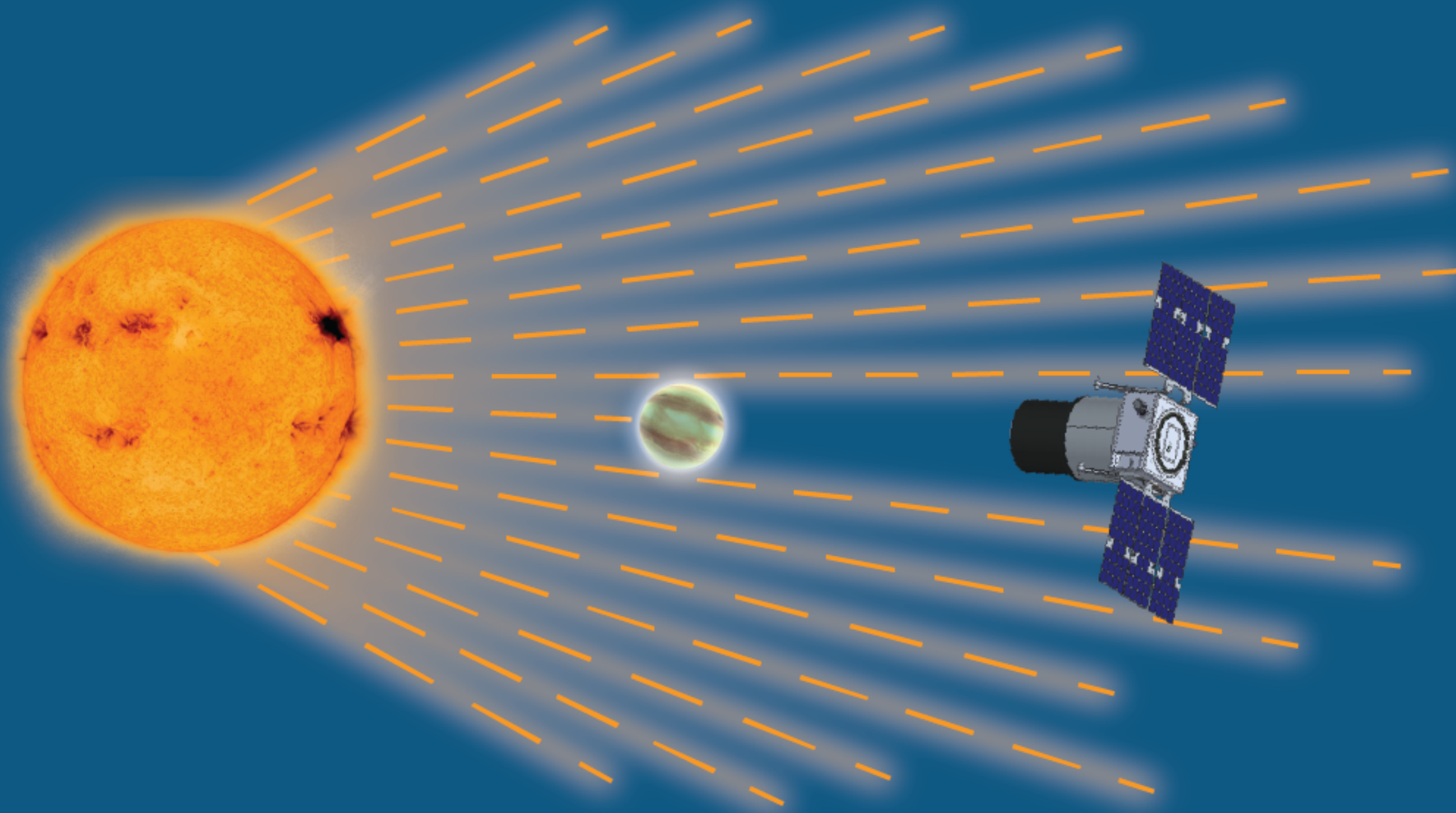


- ★ TESS-discovered exoplanets
- Other exoplanets



Pandora

*Multiwavelength Characterization of
Exoplanets and their Host Stars*



PI Elisa Quintana
NASA Goddard Space Flight Center



**NASA Selects 4 Concepts
for Small Missions to Study
Universe's Secrets**

Deputy PI Jessie Dotson
NASA Ames Research Center

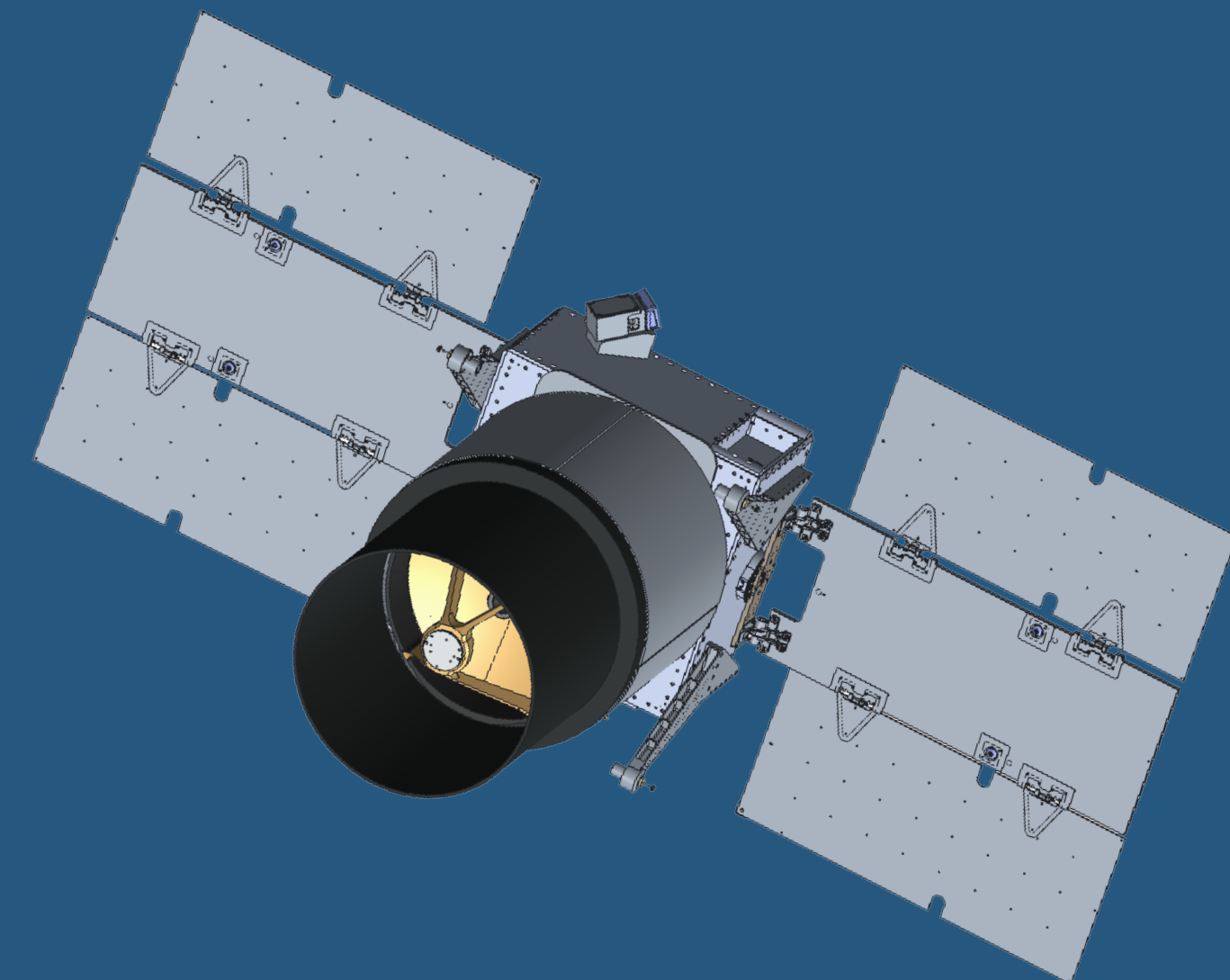
Pandora is a SmallSat designed to observe transiting exoplanets and their host stars with long time-baseline, simultaneous visible photometry and infrared spectroscopy to:

Science Objectives

1. determine the spot and faculae covering fractions of exoplanet host stars and the impact of these active regions on exoplanet transmission spectra
2. identify exoplanets with hydrogen- or water-dominated atmospheres, and determine which types of planets are covered by clouds and hazes

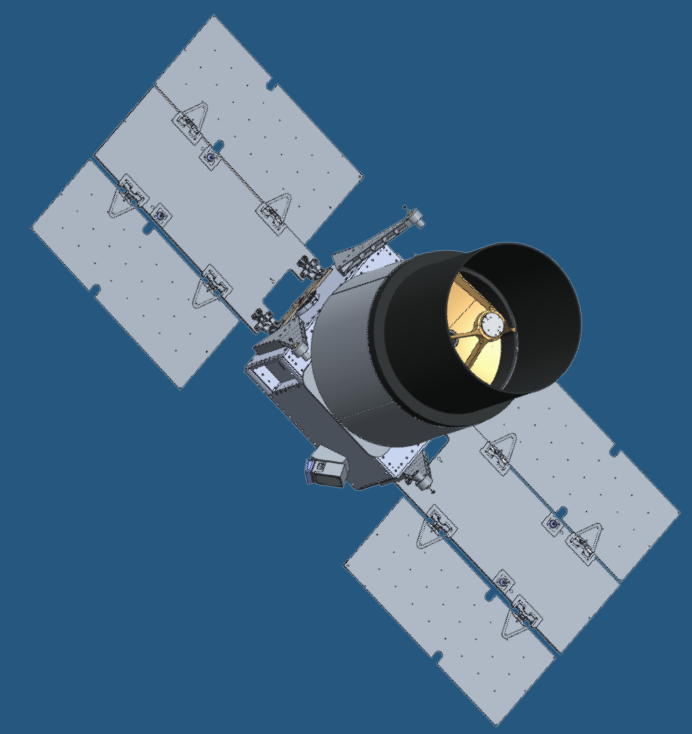
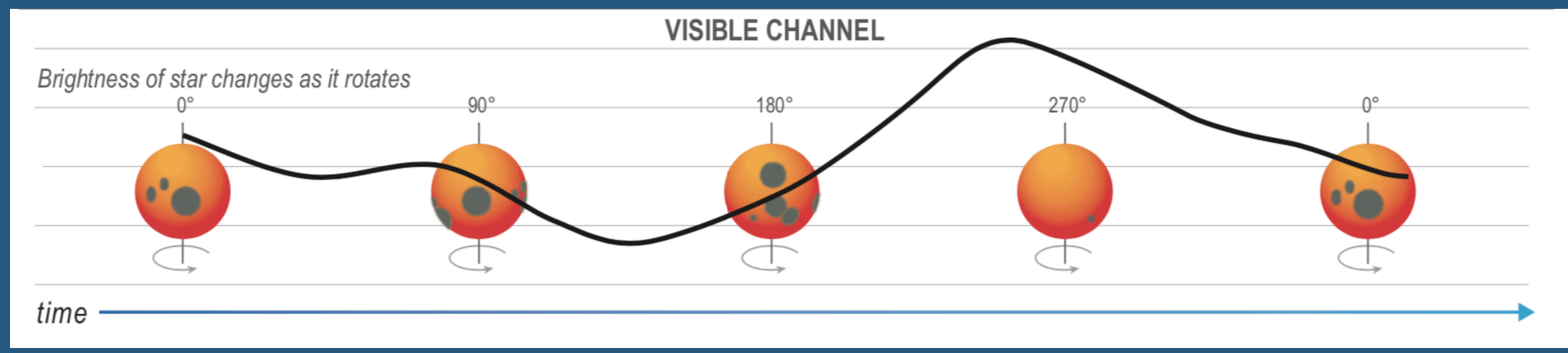
Mission Overview

Launch Date	mid 2020s
Mission Duration	12 months
Payload	Telescope (0.45m)
Channels	Visible photometry IR spectroscopy
Orbit	LEO Sun-Synchronous
Targets	20 stars (K and M dwarfs) with 20 planets (Earth to Jupiter size)

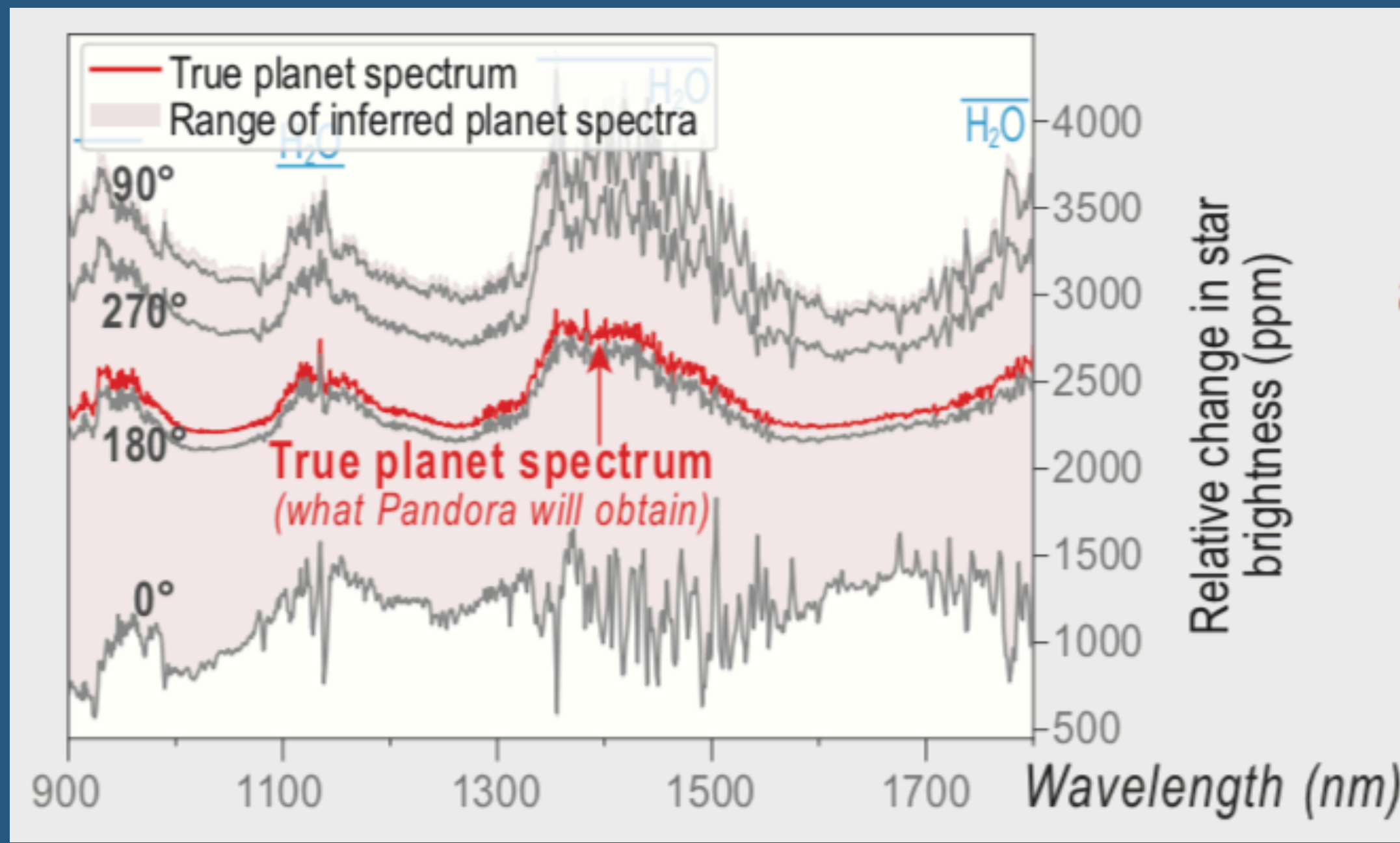


Pandora's Observing Strategy

Visible photometry captures stellar brightness over time



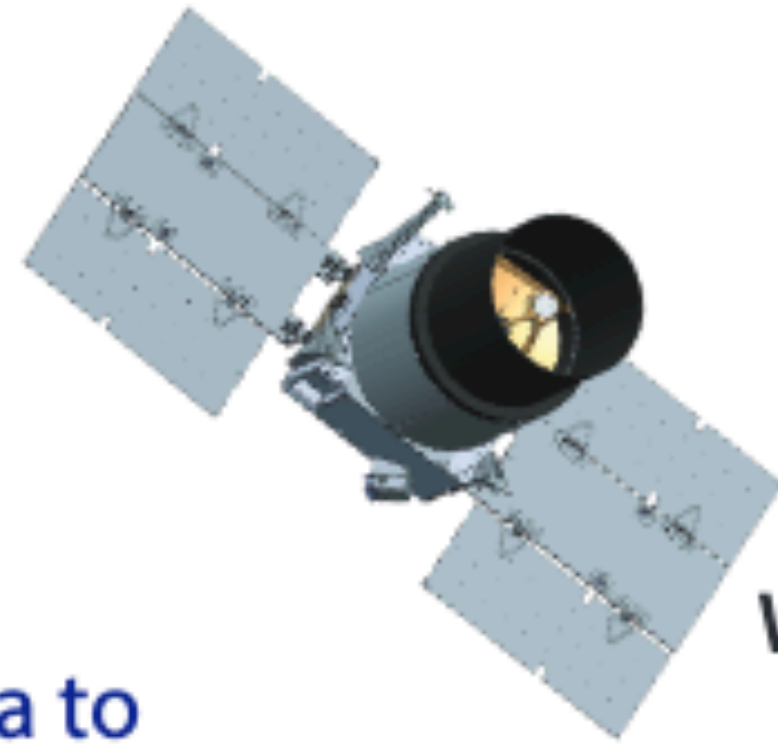
Simultaneous IR spectroscopy captures variations in spectra over time



Together, the visible photometry + spectroscopy provides constraints on star spot coverage, which is needed to disentangle the star and planet spectra, **providing robust measurements of the planet's true atmospheric makeup**



Pandora Mission At-A-Glance

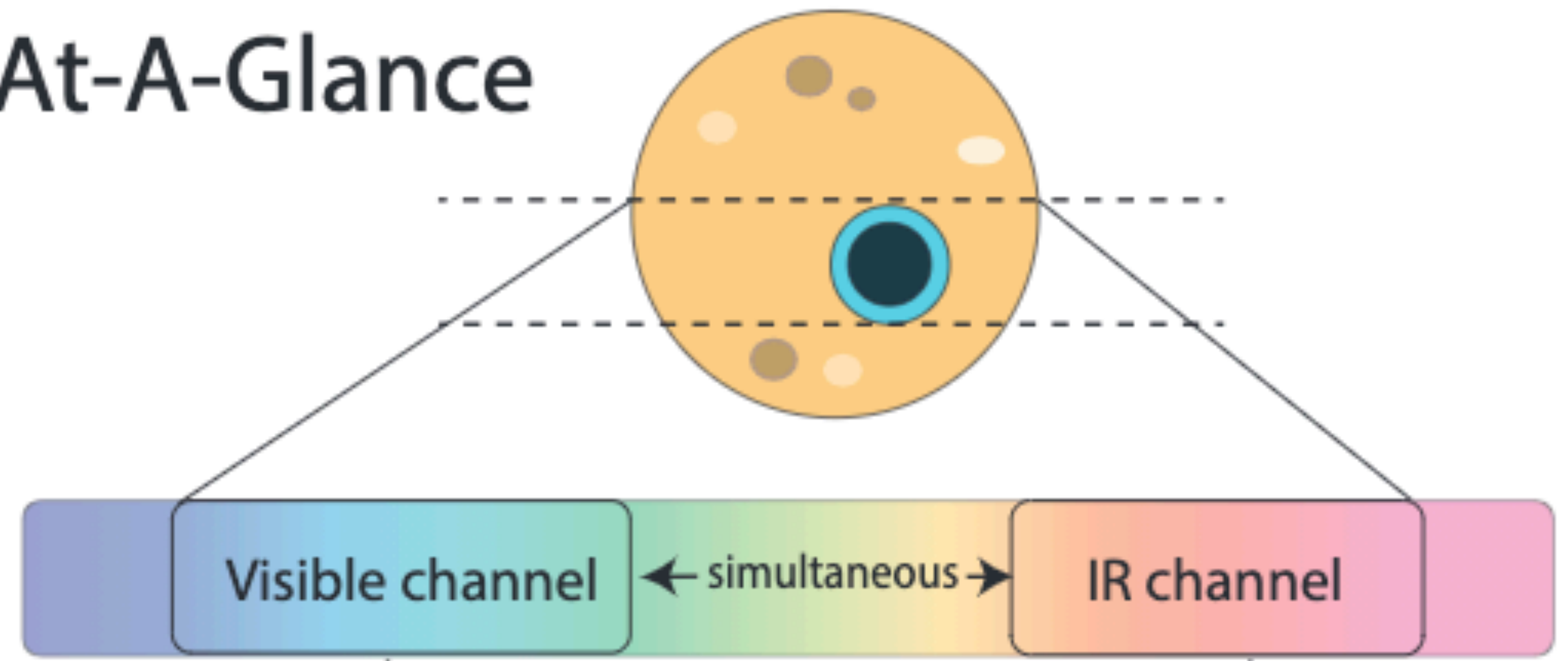


Pandora provides unique, continuous dual-band data to determine stellar photosphere properties and disentangle star and planetary signals in transmission spectroscopy.

Mission Overview

Launch Date	Mid-2020s
Payload	Telescope (0.45m)
Channels	Visible photometry IR spectroscopy
Orbit	Sun-sync LEO
Science Operations	1+ years

Wavelength



What do we measure?

Time-varying star brightness (in visible band where stellar variability has high contrast)

Time varying spectrum (in IR band where water is strong molecular absorber)

What do measurements provide?

Star spot and faculae brightness contrasts (from visible) and covering fractions (from Vis+IR) as a function of time & stellar rotation

What do we learn?

Stellar atmosphere contribution to planetary spectrum + deeper understanding of stellar heterogeneity

Star-corrected planet spectrum revealing composition of intrinsic planetary atmospheres (water, hydrogen, clouds)

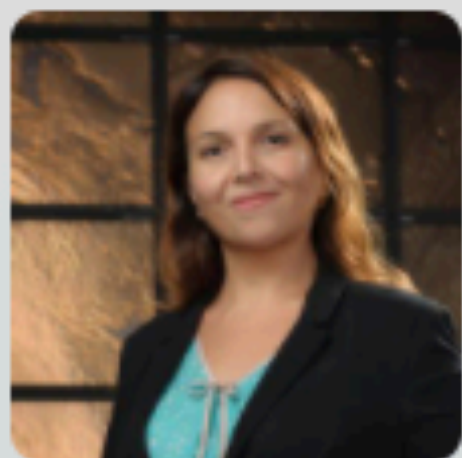
Why are the data unique?

Pandora will produce the first long-duration dataset with simultaneous visible photometry and IR spectroscopy of exoplanets and their host stars.

Why Now?

Pandora will inform JWST exoplanet transmission spectroscopy analyses, and operate concurrently with JWST.

The Pandora Team



Elisa Quintana
Principal Investigator
NASA GSFC



Jessie Dotson
Deputy Principal Investigator
NASA Ames



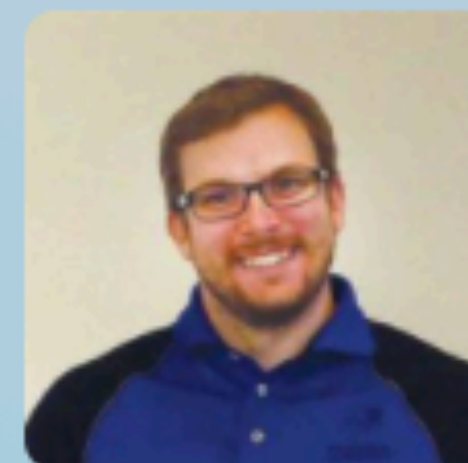
Knicole Colón
Project Scientist
NASA GSFC



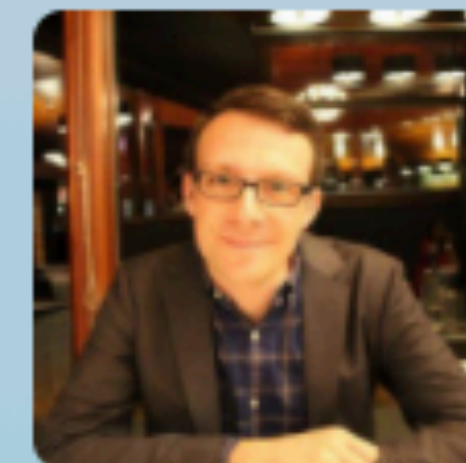
Pete Supsinskas
Project Manager
LLNL



Nikole Lewis
Science Team
Cornell University



James Mason
Mission Operations Lead
LASP/CU



Brett Morris
Science Team
University of Bern



Greg Mosby
Detector Scientist
NASA GSFC



Dániel Apai
Science Team
University of Arizona



Thomas Barclay
Instrument Scientist
NASA GSFC



Jessie Christiansen
Archive Scientist
IPAC/Caltech



Emily Gilbert
Science Team
University of Chicago



Susan Mullally
Science Team
STScI



Elisabeth Newton
Science Team
Dartmouth College



Joshua Pepper
Science Team
Lehigh University



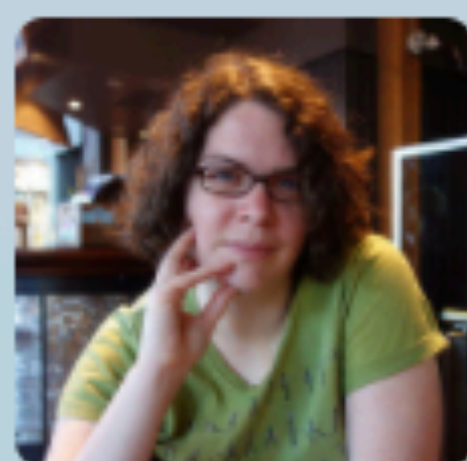
Benjamin Rackham
Science Team
MIT



Tom Greene
Science Team
NASA Ames



Christina Hedges
Data Processing Lead
NASA Ames



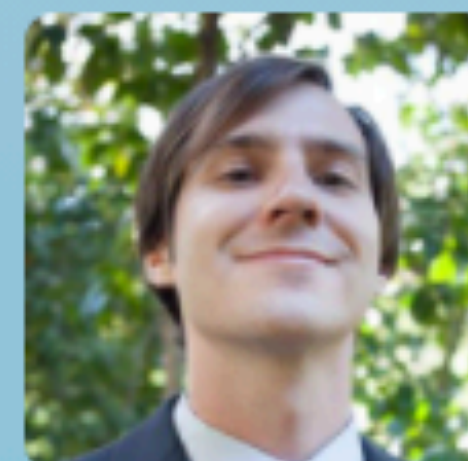
Kelsey Hoffman
Science Team
SETI Institute



Veselin Kostov
Science Team
SETI Institute



Jason Rowe
Science Team
Bishops University



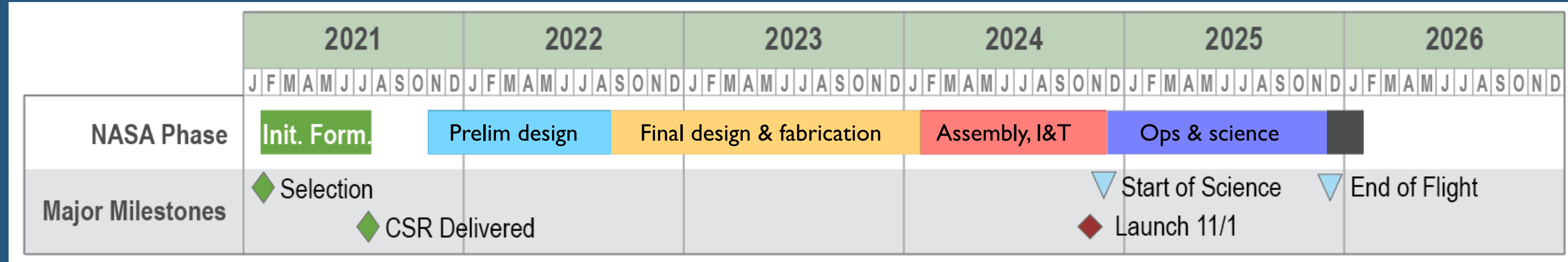
Joshua Schlieder
Science Team
NASA GSFC



Allison Youngblood
Science Team
LASP/CU

+ lots more
from LLNL

Pandora SmallSat Timeline



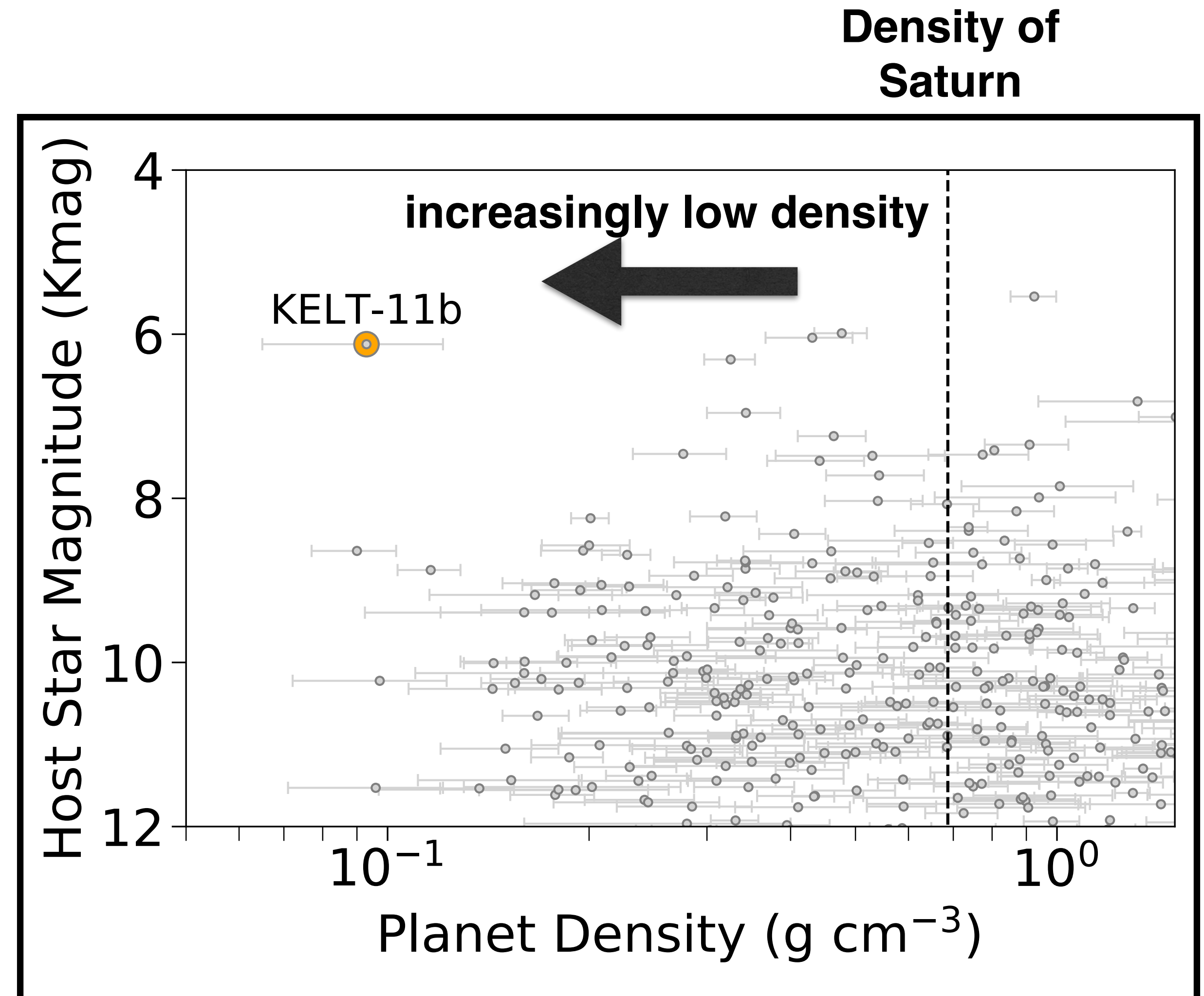
Current Status: Preparing the Concept Study Report

- Six month timeline
- Engineering trade studies on detectors, thermal design, etc
- Developing notional “year in the life” observing plan
- Simulating observations of benchmark targets to demonstrate science capability

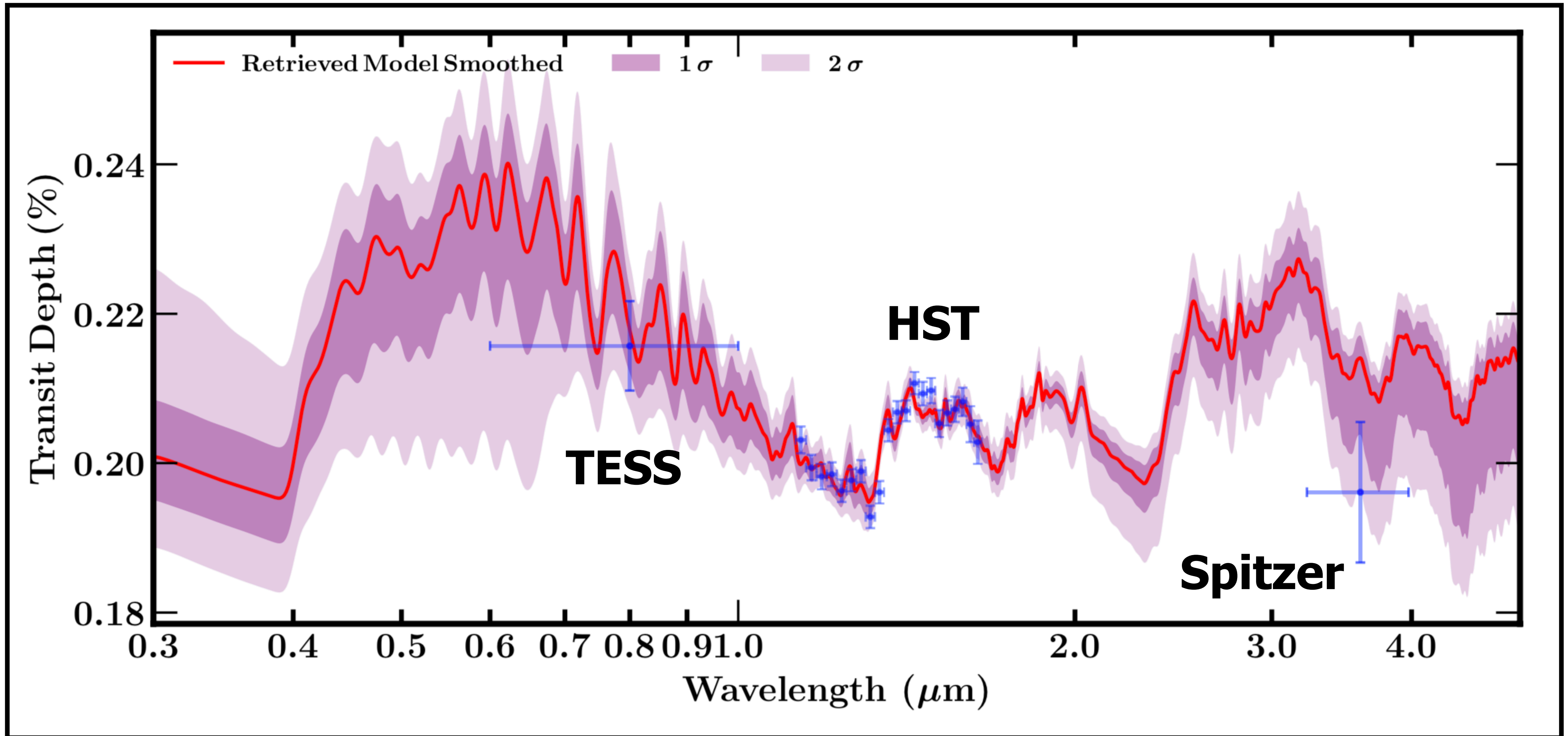
Science!

An Introduction to KELT-11b

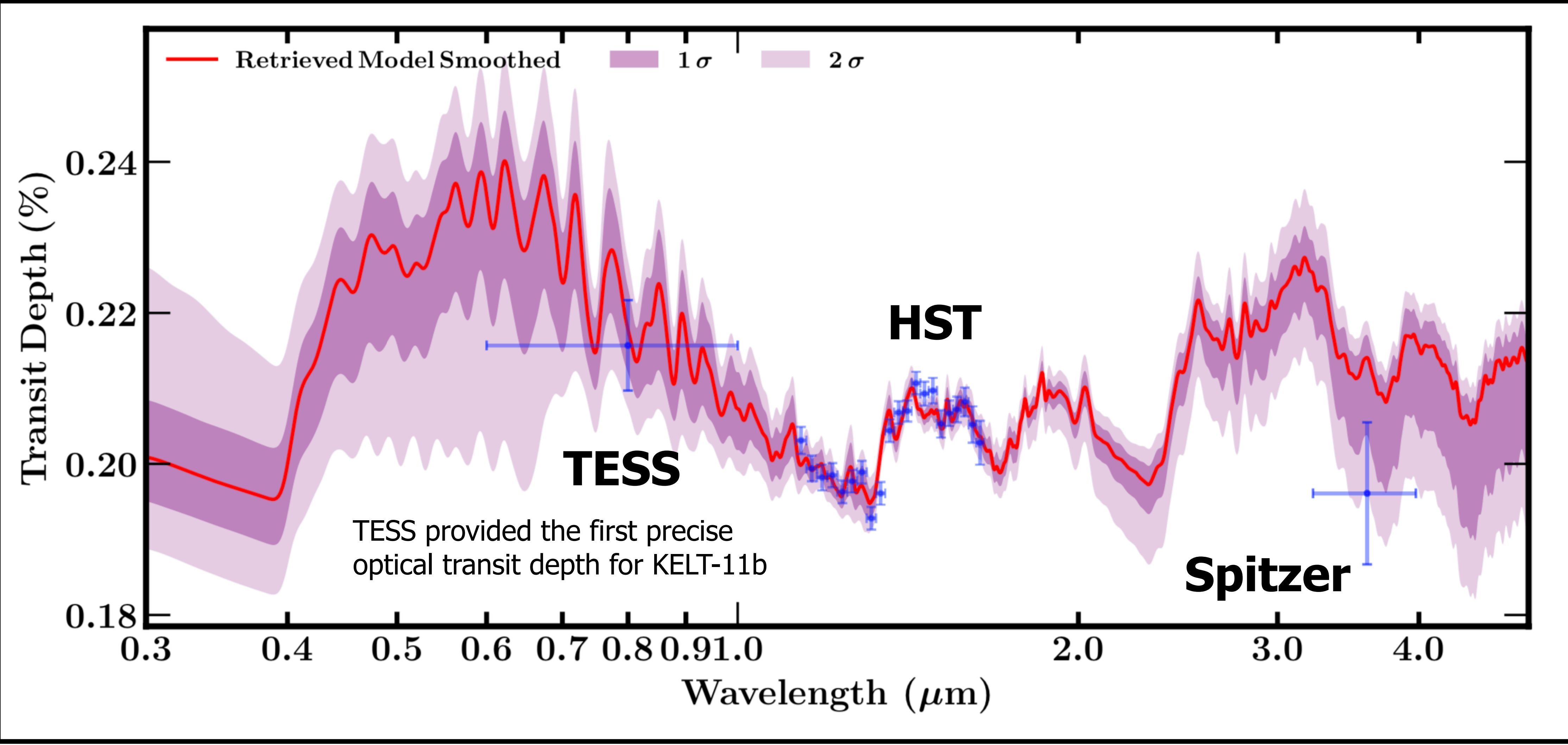
- Part of a growing population of “sub-Saturns” and has one of the lowest densities of any known exoplanet ($M_p = 0.17 M_J$ and $R_p = 1.3 R_J$)
- Has a very bright slightly-evolved sub-giant host star, leading to a relatively shallow and long (7 hour) transit
- One of the best targets for atmospheric studies all-around



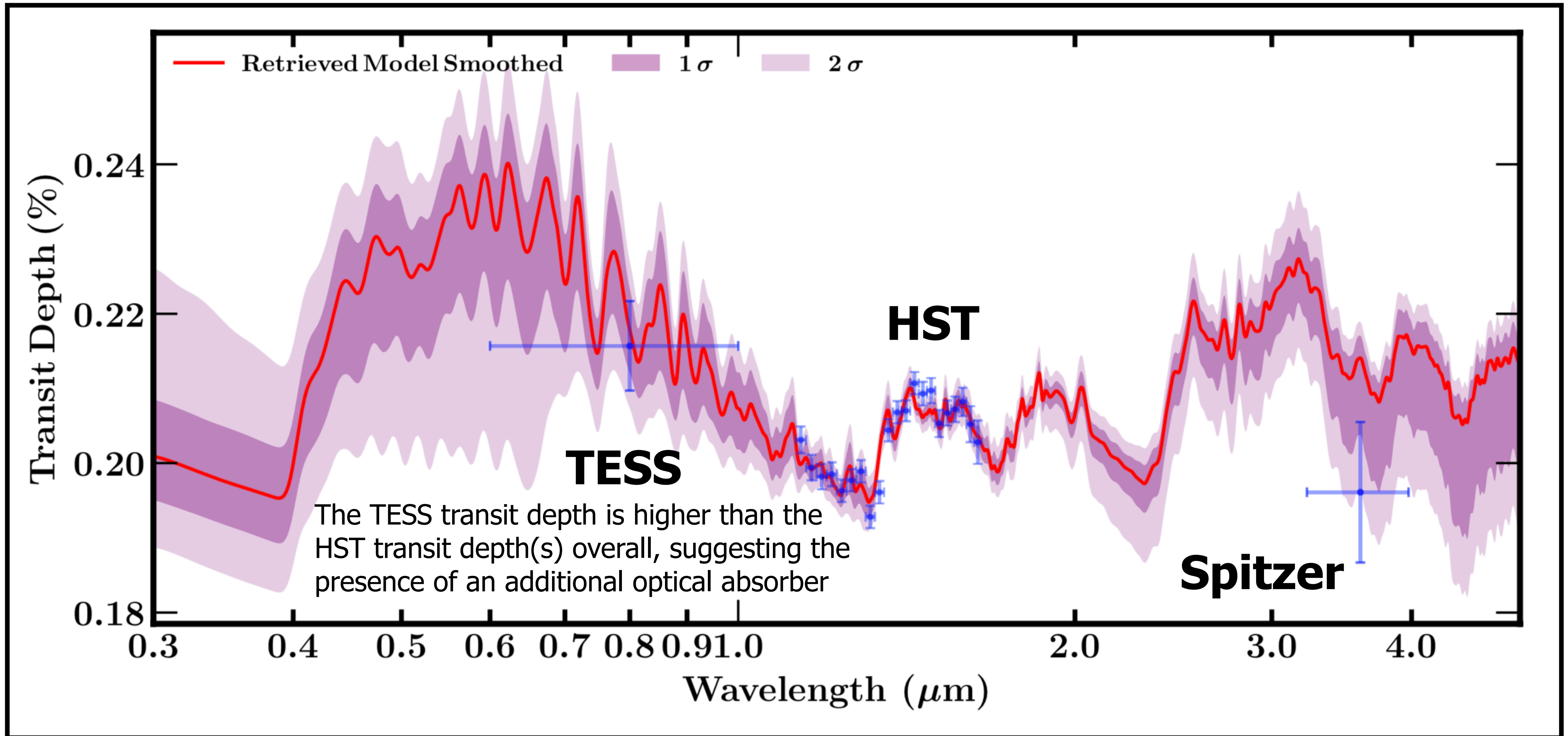
Transmission Spectroscopy of KELT-11b



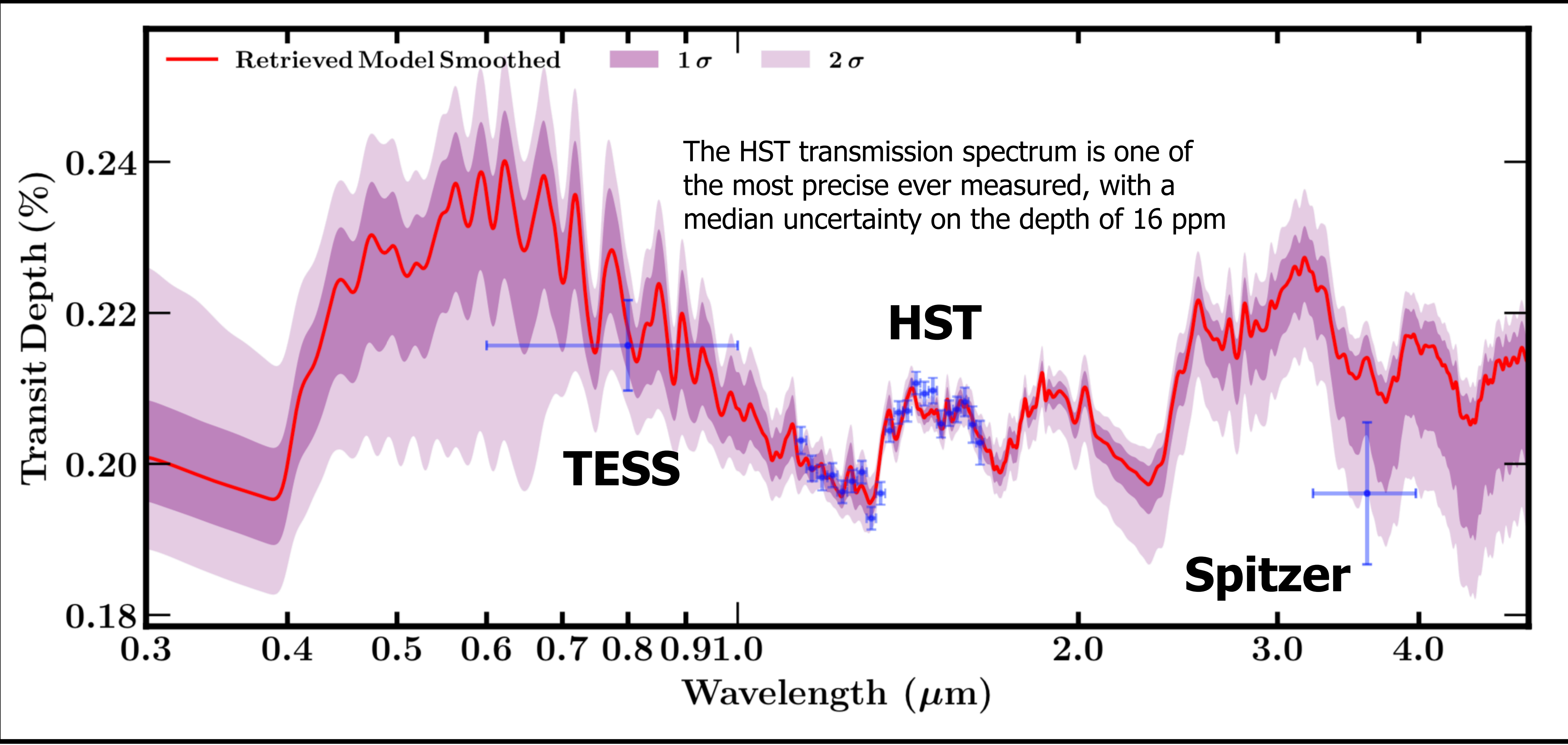
Transmission Spectroscopy of KELT-11b



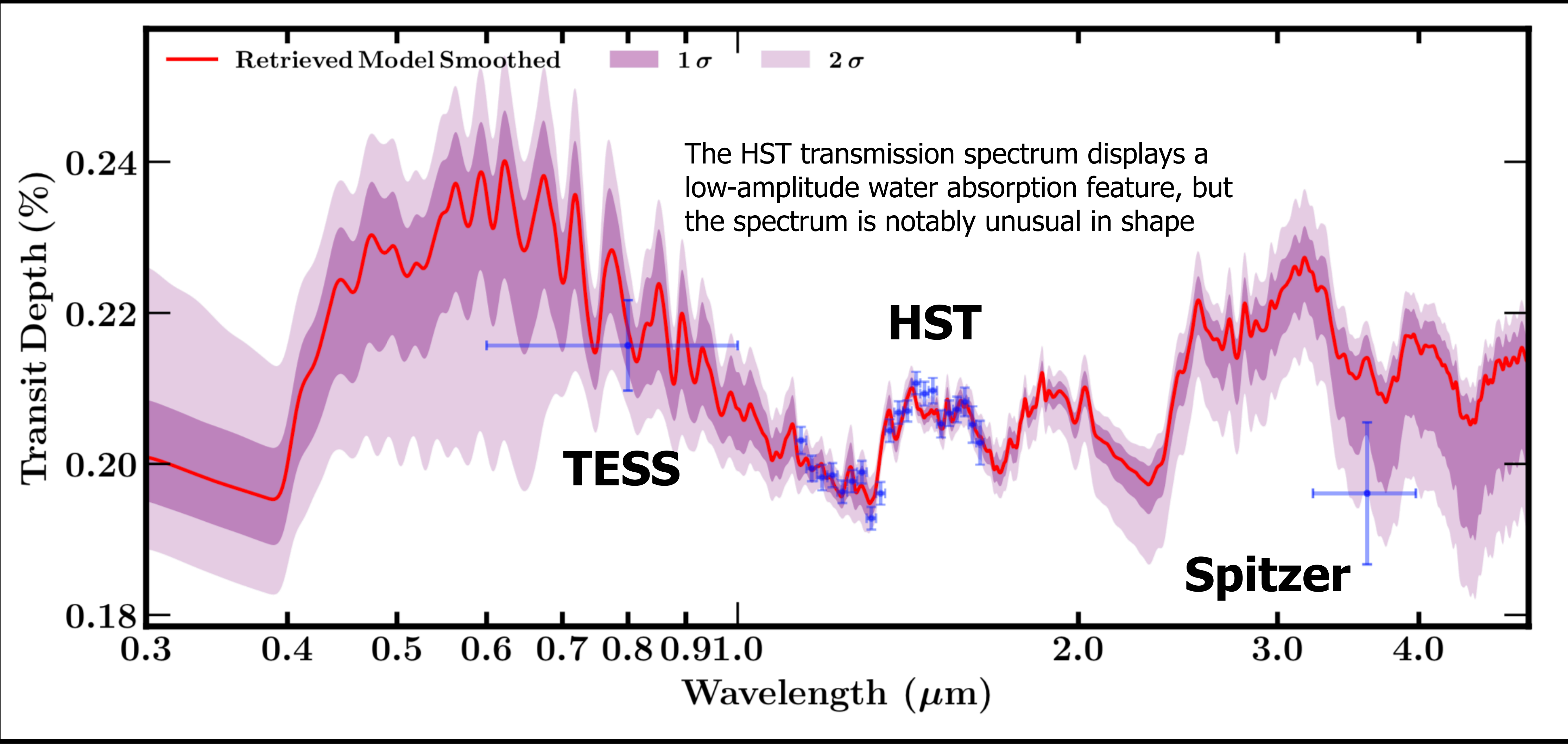
Transmission Spectroscopy of KELT-11b



Transmission Spectroscopy of KELT-11b

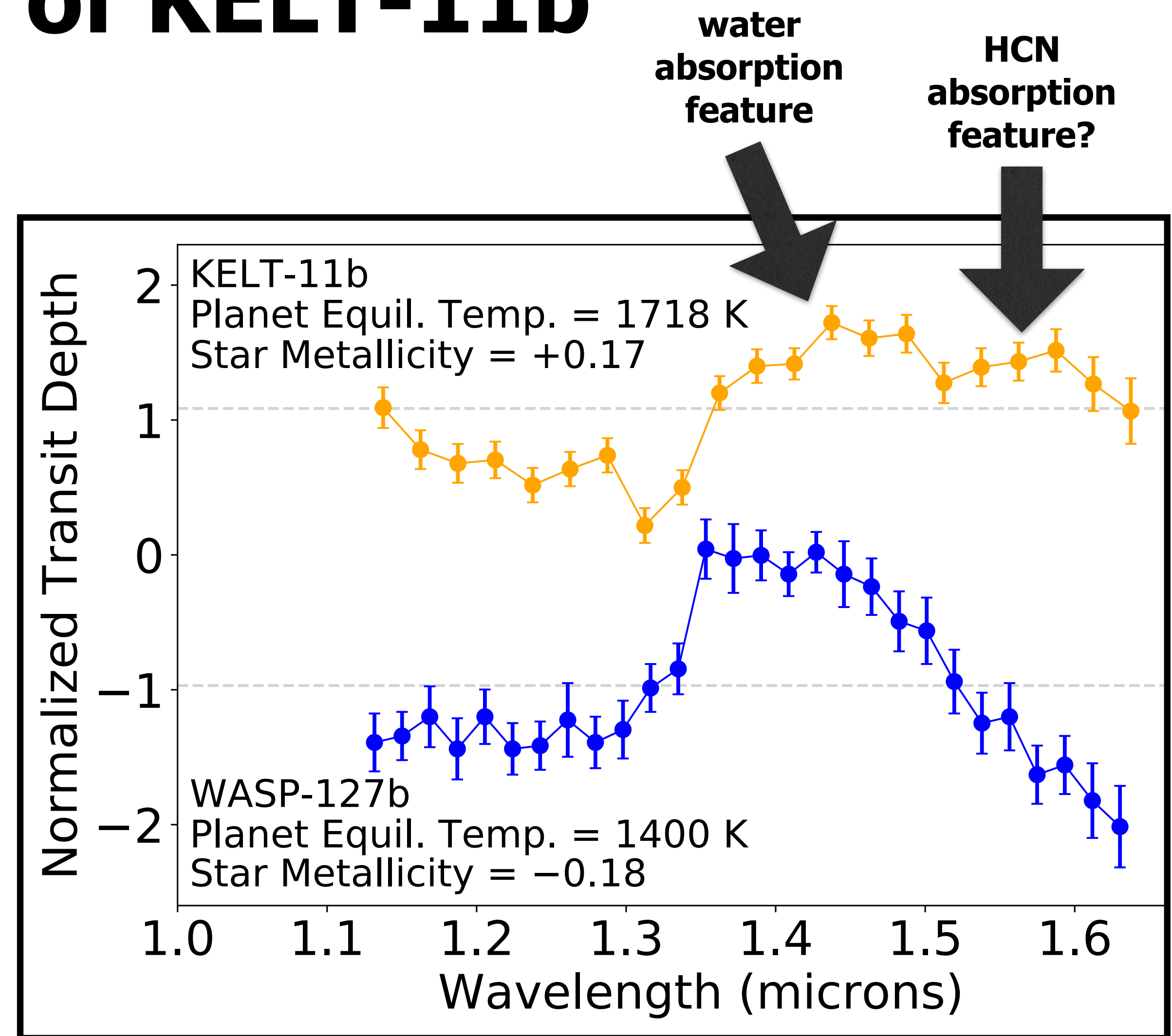


Transmission Spectroscopy of KELT-11b



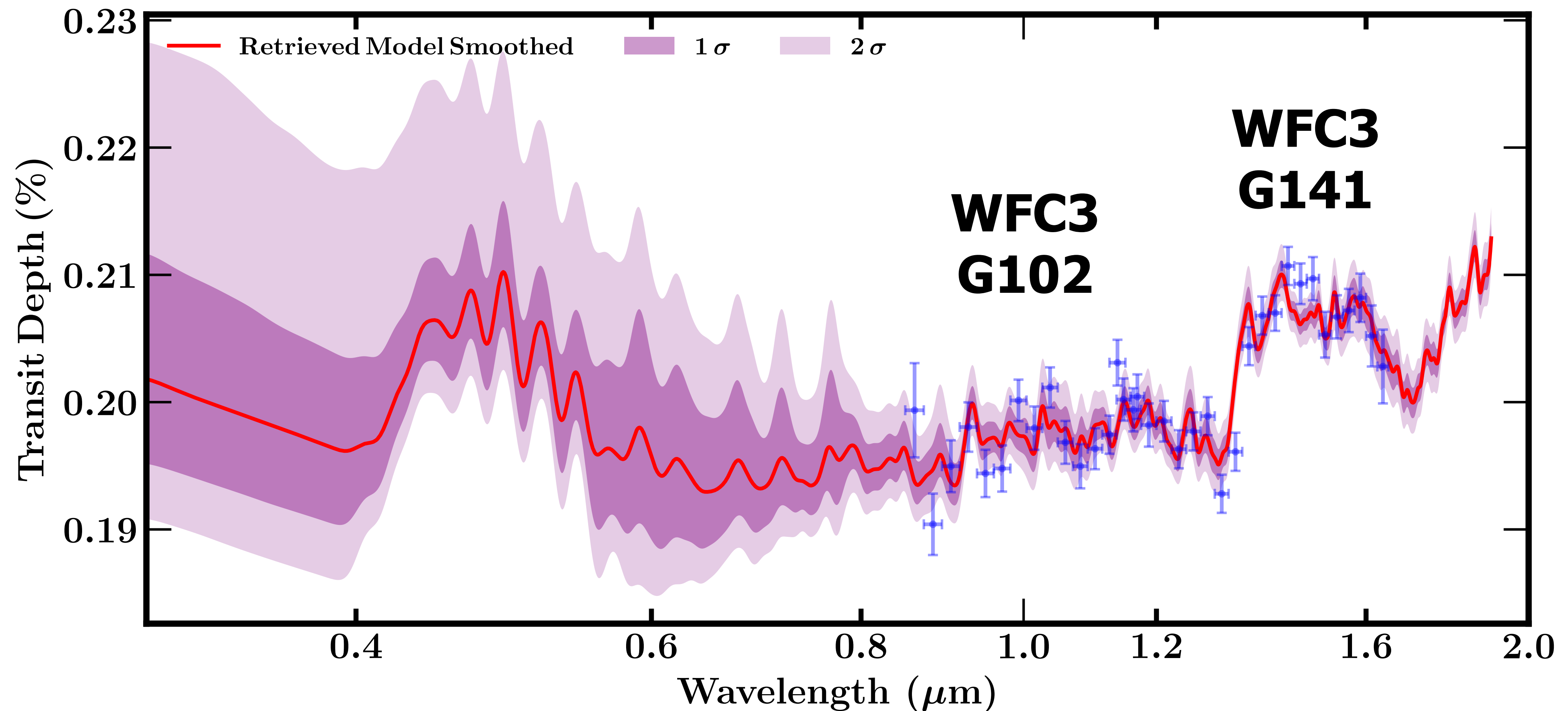
Transmission Spectroscopy of KELT-11b

- We find strong evidence for water absorption and tentative evidence for other absorbers in the atmosphere of KELT-11b based on TESS, HST, and Spitzer transit observations
- The near-infrared transmission spectrum is particularly unusual in shape, possibly suggesting absorption from HCN
- The retrieved water abundance is extremely low and generally $<0.1x$ solar composition, which is *several orders of magnitude lower than expected from planet formation models*



New results coming soon!

We recently observed another transit of KELT-11b in the HST/WFC3 G102 bandpass in December 2020, which provides further constraints on the optical slope and the presence of any optical absorbers



“My” Research Group



Knicole Colón



**John Ahlers
NPP Fellow**



**Dana Louie
NPP Fellow**



**Steven Villanueva
NPP Fellow (09/2021)**



**Ben Hord
FINESST Graduate
Student Fellow**



**Ryan Morris
Summer Intern
2019**



**Lauren Arnold
Summer Intern
2017**



**Kaylin Borders
High School Intern
2017-2018**

"Our" Research Group



Tom Barclay



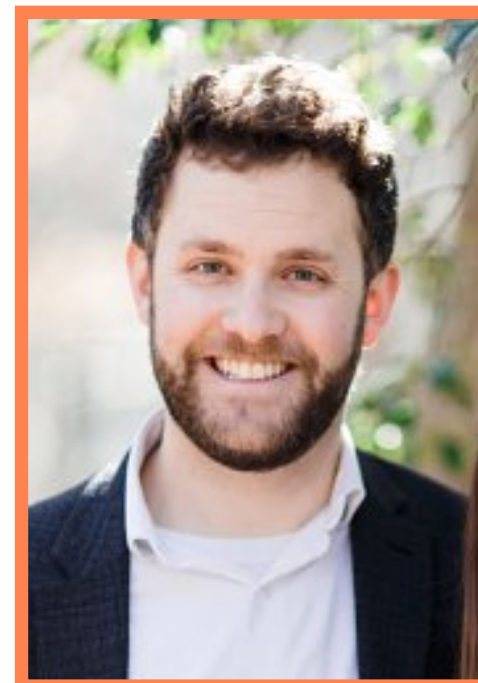
Knicole Colón



Elisa Quintana



Josh Schlieder



John Ahlers



Veselin Kostov



Ethan Kruse



Dana Louie



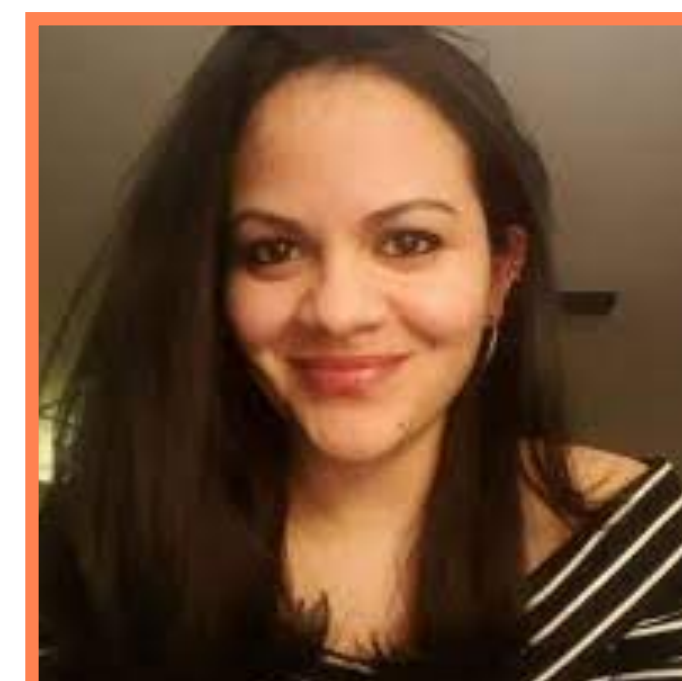
Teresa Monsue



Rishi Paudel



Michele Silverstein



Laura Vega



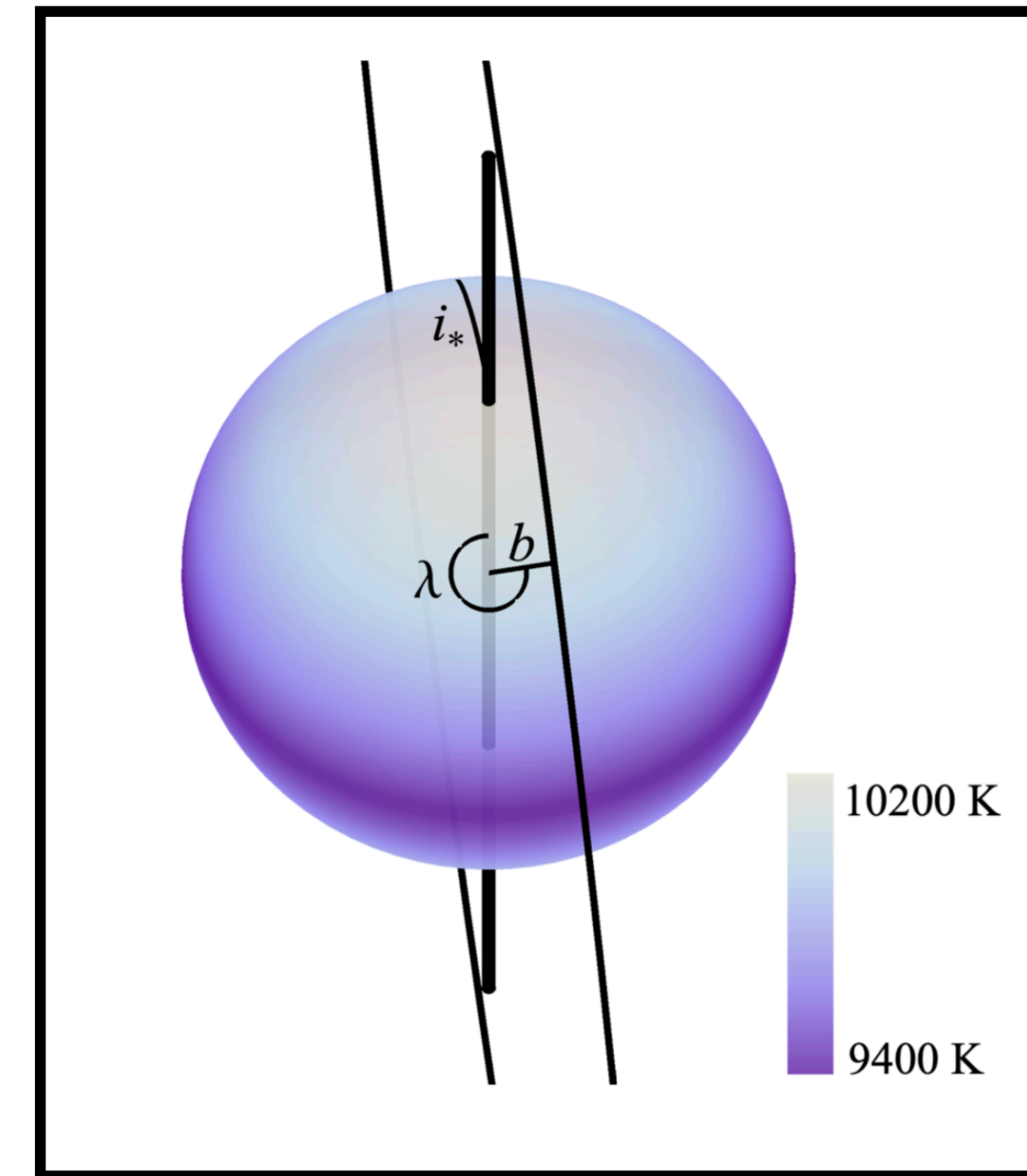
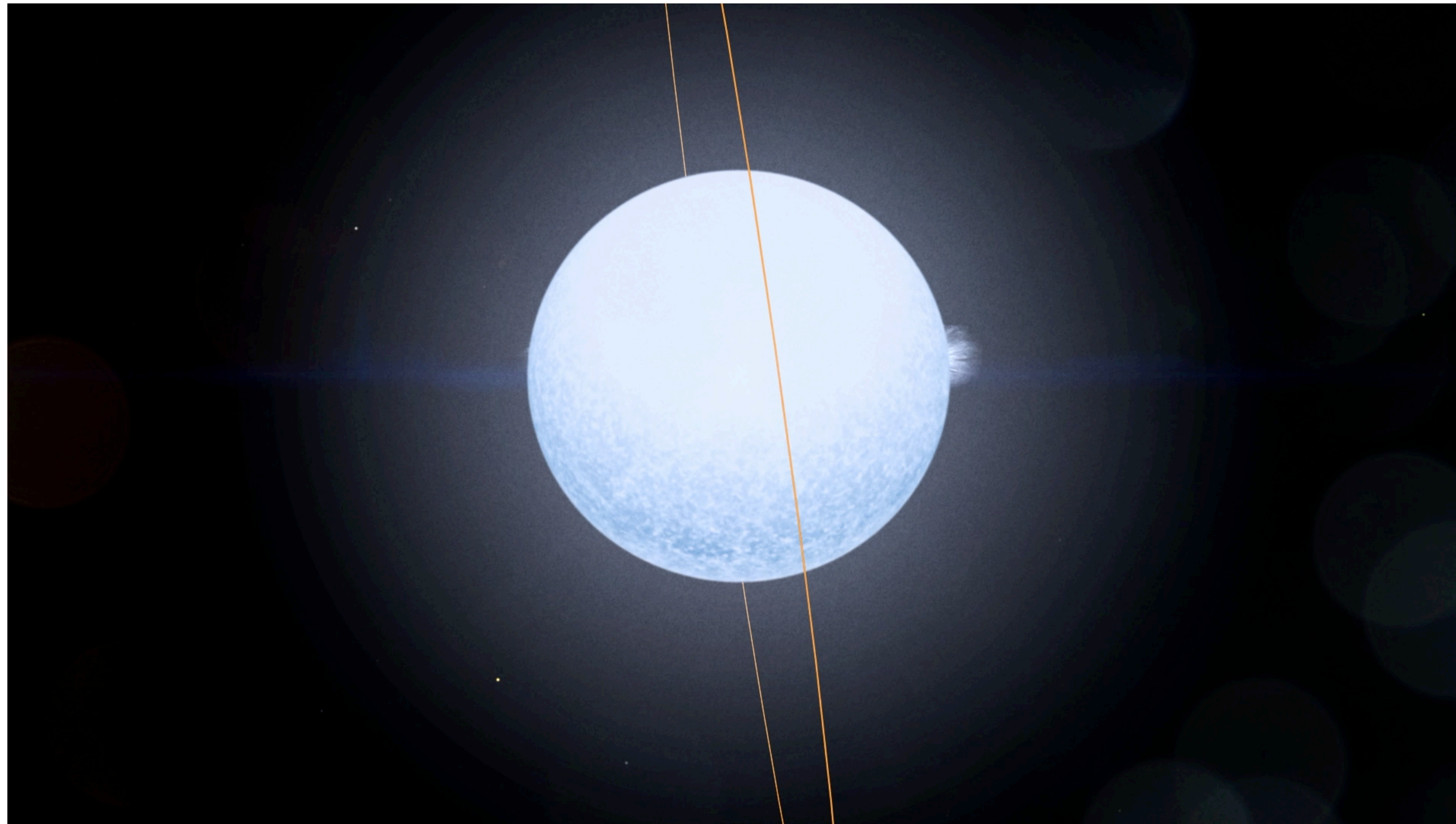
Emily Gilbert



Ben Hord

KELT-9 b's Asymmetric TESS Transit Caused by Rapid Stellar Rotation and Spin-Orbit Misalignment (John Ahlers et al. 2020)

- This is the hottest known exoplanet by far, with a dayside equilibrium temperature of ~ 4600 K
- It has a misaligned orbit around a rapidly-rotating host star, leading to extremely gravity-darkened light curves

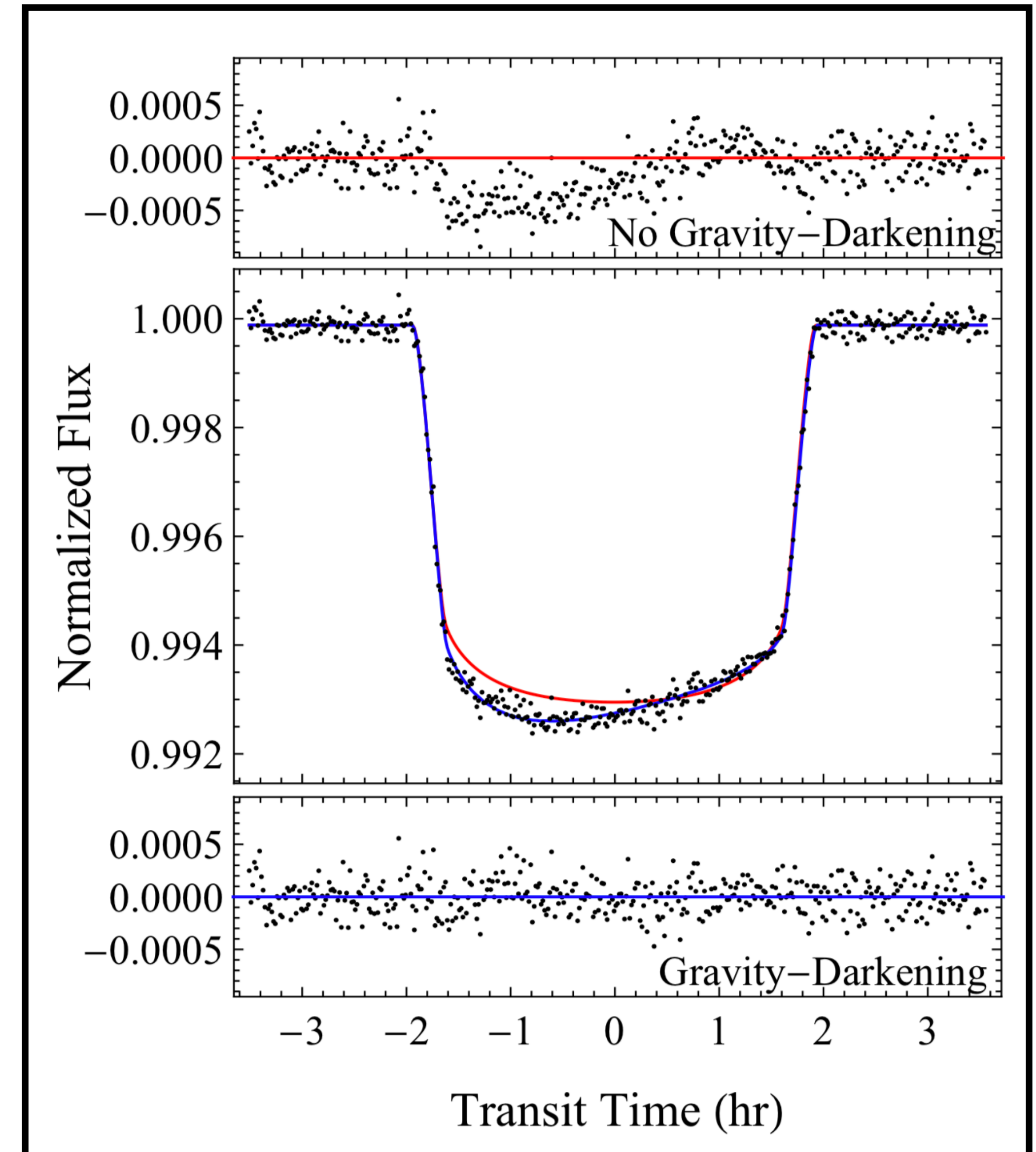


Ahlers, Johnson, Stassun, Colón, et al. 2020

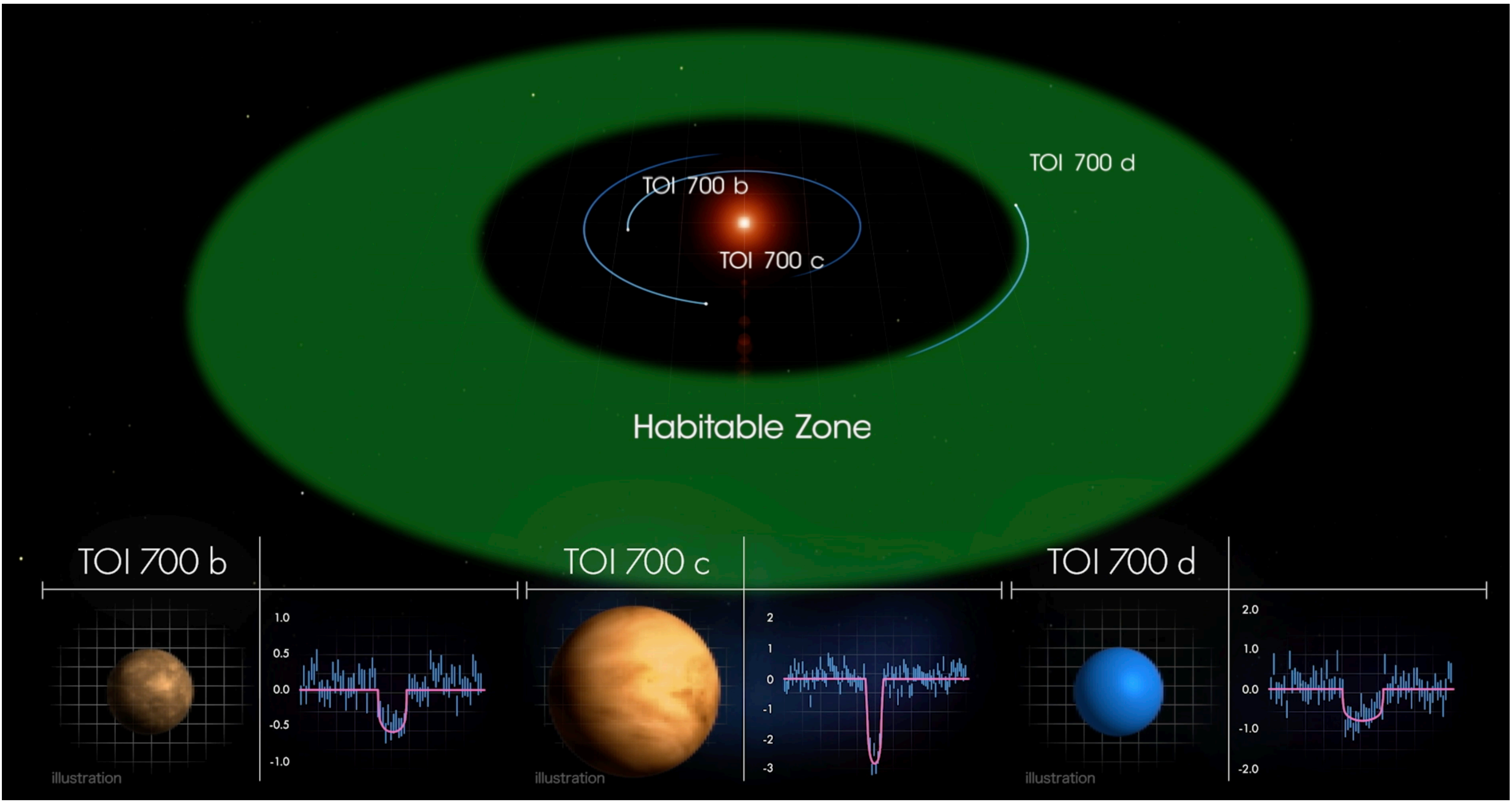
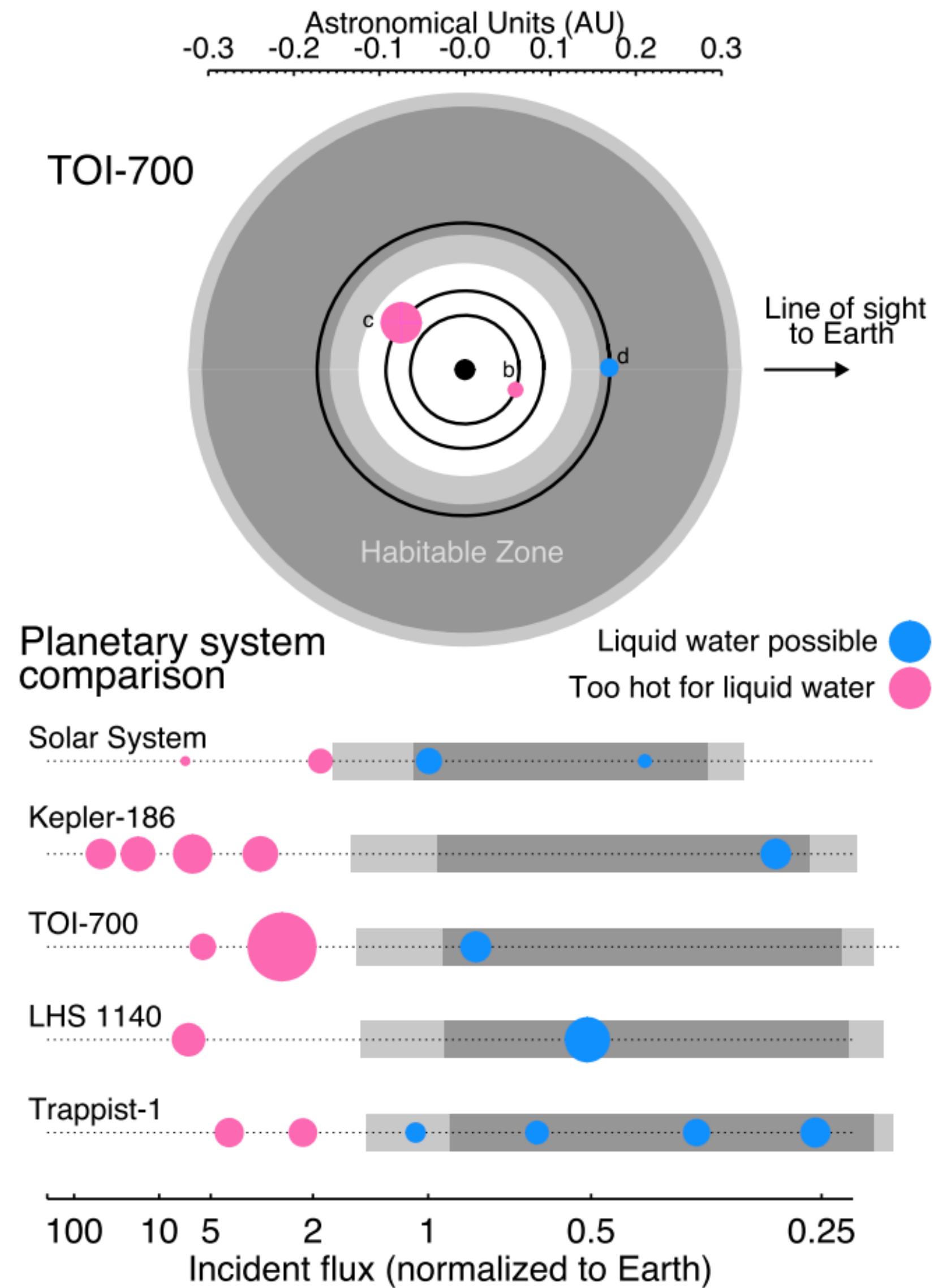
NASA's Goddard Space Flight Center/Chris Smith (USRA)

KELT-9 b's Asymmetric TESS Transit Caused by Rapid Stellar Rotation and Spin-Orbit Misalignment (John Ahlers et al. 2020)

- With TESS, we measured the planet's true spin-orbit angle to be $87 (+10/-11)$ degrees
- We also constrained the host star's equatorial radius and the variation in its local surface brightness
- KELT-9b's received flux varies by 10% in the ultraviolet and 1 – 2% in the visible throughout its orbit, which particularly affects measurements of the orbital phase variations (Wong et al., 2020)



The First Habitable-zone Earth-sized Planet from TESS. I. Validation of the TOI-700 System (Emily Gilbert et al. 2020)



- ▶ **My path to NASA**
- ▶ **What I do at NASA**
- ▶ **Opportunities at NASA**

Opportunities at NASA

- Graduate Student Internships (<https://intern.nasa.gov/>)
- Future Investigators in NASA Earth and Space Science and Technology (FINESST) (Graduate Student Fellowship)
- NASA Fellowship Activity (Graduate Student Fellowship) - includes funding for a student to spend time on research activities at a NASA center

- Postdoctoral Research positions
 - NASA Postdoctoral Program Fellowship (<https://npp.usra.edu/>)
 - AAS Job Register

- Research or Support Scientist positions
 - AAS Job Register
 - Civil Servant Positions (<https://www.usajobs.gov/>)

The Astrophysics Science Division (ASD) at NASA's Goddard Space Flight Center is hiring soon!

This announcement is to alert the community of upcoming employment opportunities for US citizens, which will be advertised in USAJobs at a later time (anticipated for summer 2021). We are seeking expressions of interest at this time, in the form of a statement of interest and CV/resume. We will make sure all those expressing interest will be informed when the formal job announcements are advertised.

GSFC's Astrophysics Science Division (ASD) is one of the world's largest astrophysics institutions, with approximately 300 Ph.D. scientists. While focusing on scientific areas accessible through NASA's space astrophysics mission, work at ASD is broad in multiple dimensions, from the range of wavelengths (radio to gamma-rays) to gravitational waves and particles, and from theory to data analysis and technology development. More information can be found at <https://science.gsfc.nasa.gov/astrophysics/>.

The 2020 Astrophysics Decadal Survey will release its much-awaited report in Spring 2021. The report's recommendations will chart the future of Astrophysics for the next 10 years, guiding the science priorities and their implementation at NASA. The Astrophysics Division looks forward to this next step in building a vibrant program of new missions, technology development, theoretical modeling, and data analysis aimed at realizing the Decadal recommendations. The ASD expects to have several new civil servant positions at a junior and senior level, with a focus on Decadal science priorities. The positions will be advertised in Summer 2021 and will be at both the permanent and term (5-6 years) appointments.

We solicit expressions of interest from individuals who would like to join us at GSFC in the exciting times ahead. Are you a PhD, or soon to be PhD, astrophysicist with a passion for discovery? Do you like being challenged with novel and challenging problems? Do you value teamwork, innovation, and thinking outside the box in an inclusive environment of collaboration? We want to hear from you. Send us your resume or CV, and a letter stating your research interests, to Dr. Rita Sambruna, ASD Deputy Director, at the following email address: rita.m.sambruna@nasa.gov, with the Subject: Hiring in ASD. Submissions received by May 1 will receive full consideration; later submissions will be considered for additional positions as they become available. We will let all applicants know of the opening of the hiring ad on USAJobs, which will require a more detailed submission.

Diversity and Inclusion are two core values of ASD. We value a diverse workforce, not only because diversity and inclusion lead to mission success, but – more fundamentally – because it is the right thing to do. If you are an Underrepresented Minority, we especially want to hear from you.

US citizenship is required for civil servant positions at the time of response. If you are anticipating U.S. citizenship prior to the deadline, please do respond. We note that we will have other job opportunities through our partner universities for non-U.S. citizens. NASA GSFC is an Equal Opportunity Employer.

Mission Leadership Opportunities

PI Launchpad Workshop Content

2021 Virtual PI Launchpad

NASA SMD, the University of Arizona, the University of Michigan, JPL, and the Heising-Simons Foundation are organizing a virtual workshop in June of 2021 for researchers and engineers who would like to submit a NASA space mission proposal in the next few years but don't know where to start. We are interested in broadening the pool of potential NASA space mission PI's. People with marginalized identities are strongly encouraged to apply. There is no cost to attend the workshop.

PI Launchpad: designed to broaden the pool of potential NASA space mission PI's

<https://science.nasa.gov/researchers/new-pi-resources>


<https://science.nasa.gov/researchers/pi-launchpad-resources>



- + NASA APRA and Pioneers are a great platform for early-career to build experience
- + You do not have to work at NASA to work on space missions!



Chesapeake Bay Area Exoplanet Meeting

Friday 14 of May 2021 11am - 4pm 

<http://chexo.org/>

All are welcome!



Thank You!