
AROUND the Earth
1000
DAYS

xuhuang@mit.edu

Credit:
The TESS Team

TESS Science Conference II

Aug 2 - 6 2021, Online

https://tsc.mit.edu/

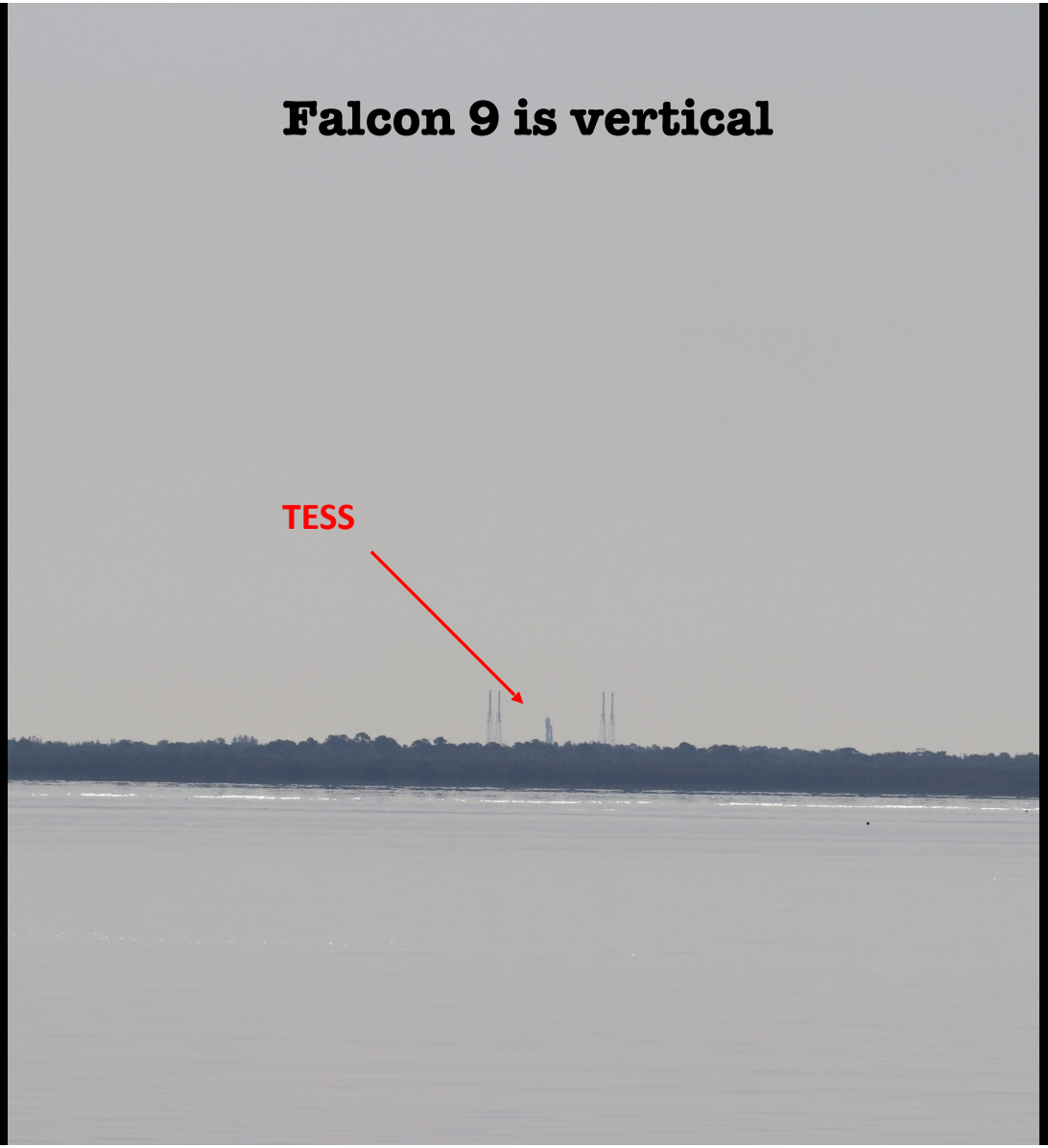
- February 4th: Open abstract submission (Talks and posters, Splinter sessions)
- March 29: Open registration.
- April 2: Splinter session abstract deadline.
- April 30: Talks and posters abstract deadline.
- June 4: Announcement of the program.
- July 1: Registration deadline
- August 2: The first day of the conference.

Apr 18th, 2018

Jun 2021

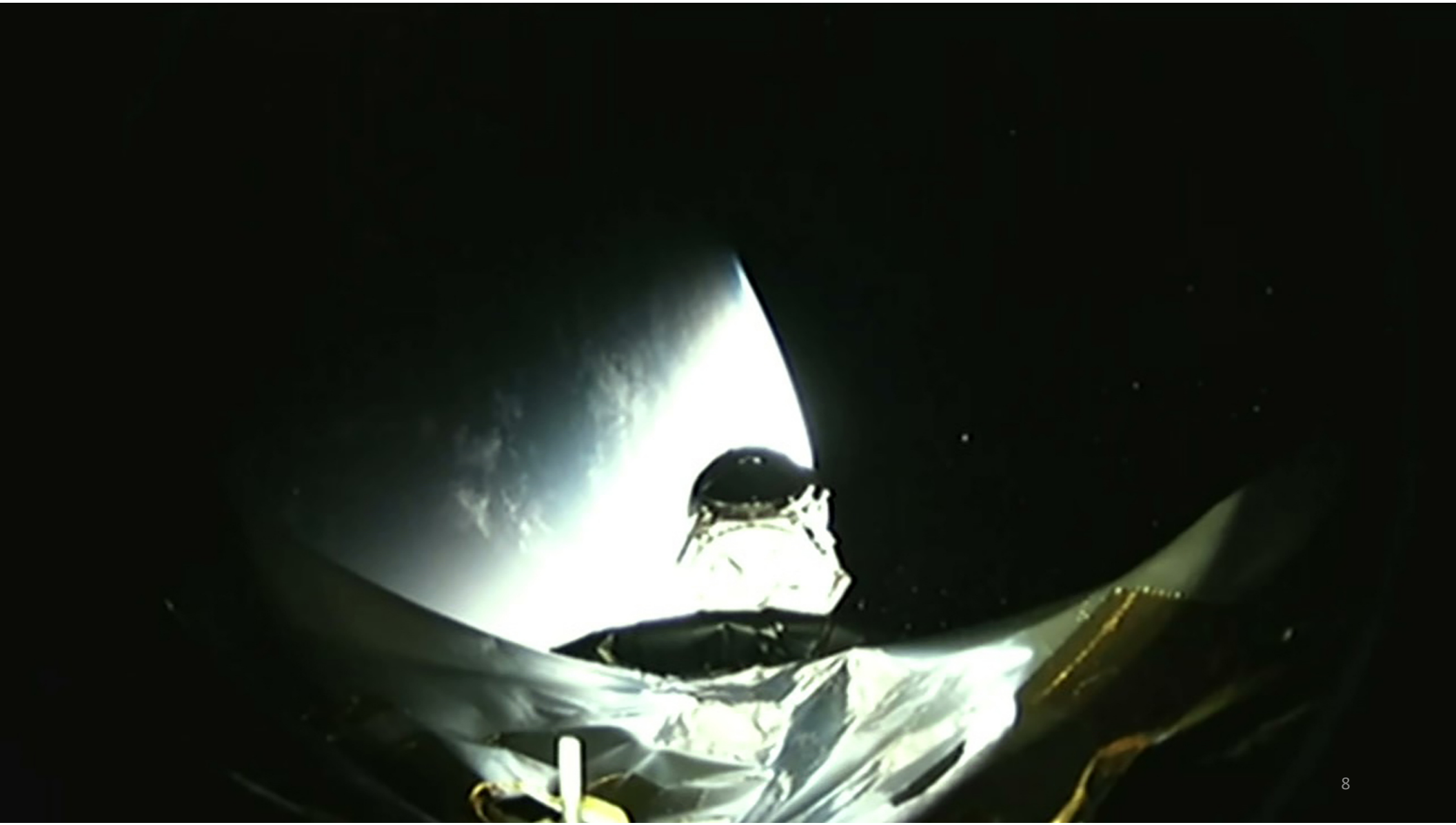
Apr 18th, 2018, 5am

Falcon 9 is vertical



Apr 18th, 2018
6pm


T- 00:00:10
UPCOMING
LIFTOFF
STARTUP
THE FALCON 9 FLIGHT COMPUTERS HAVE TAKEN CONTROL OF THE COUNTDOWN
LAUNCH: TESS



Apr 18th, 2018

July 25th, 2018

Aug 7th, 2018

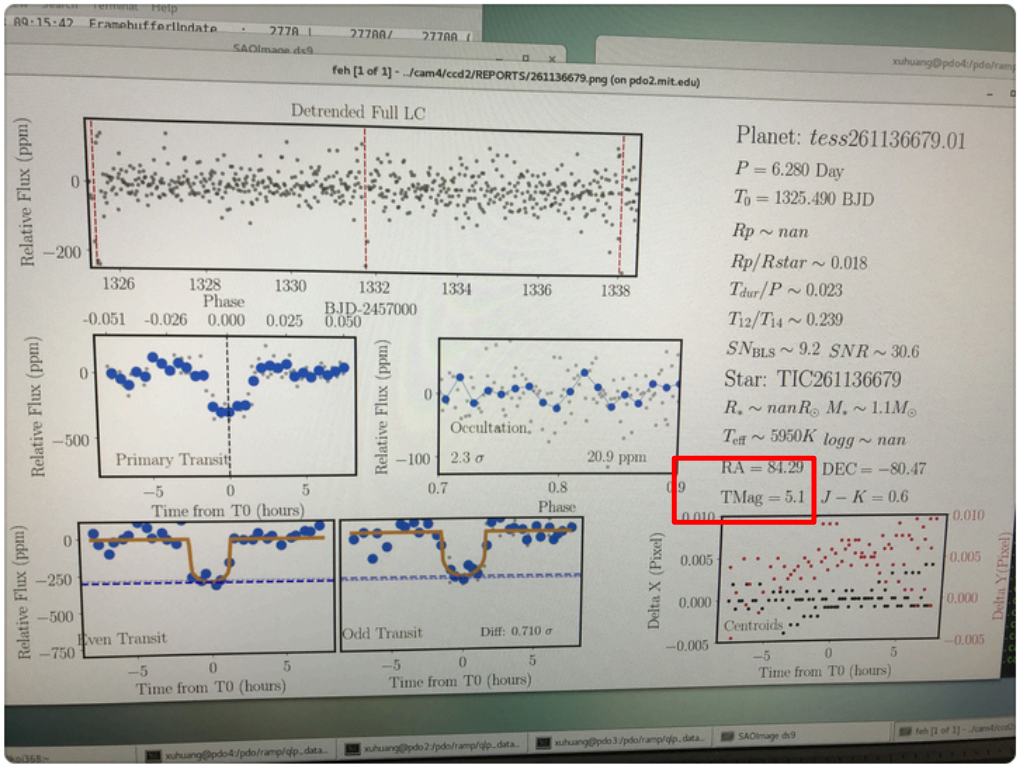
Start of science operation

First orbit data downlink

Chelsea Huang 10:25 AM

Double checked that I can share the data with you. I'll let you know where the TPF file is once I finish making it

Image from iOS



Then we see this super Earth …

Gaia says it is a high proper motion star; radius of planet based on Gaia are ~3RE

There is also a known RV planets with long period in the system

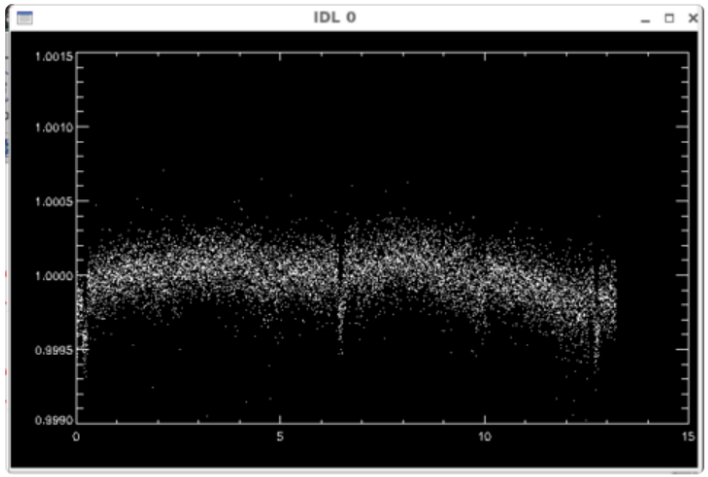
AndrewV 1:31 AM

!!

signal'

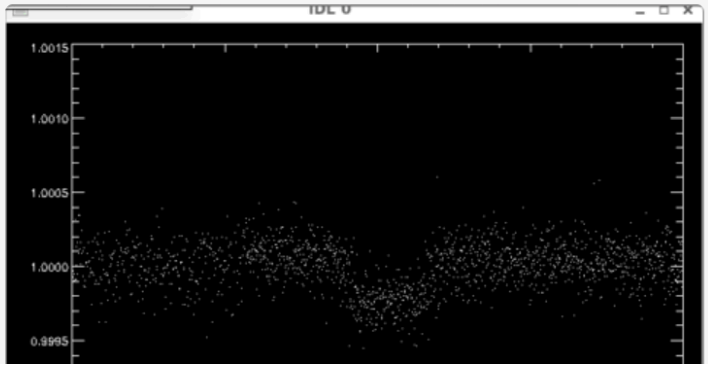
ss definitely there

Pasted image at 2018-08-12, 12:31 AM



1:35 AM Here's my phase fold:

Pasted image at 2018-08-12, 12:35 AM



Aug 12th, 2018

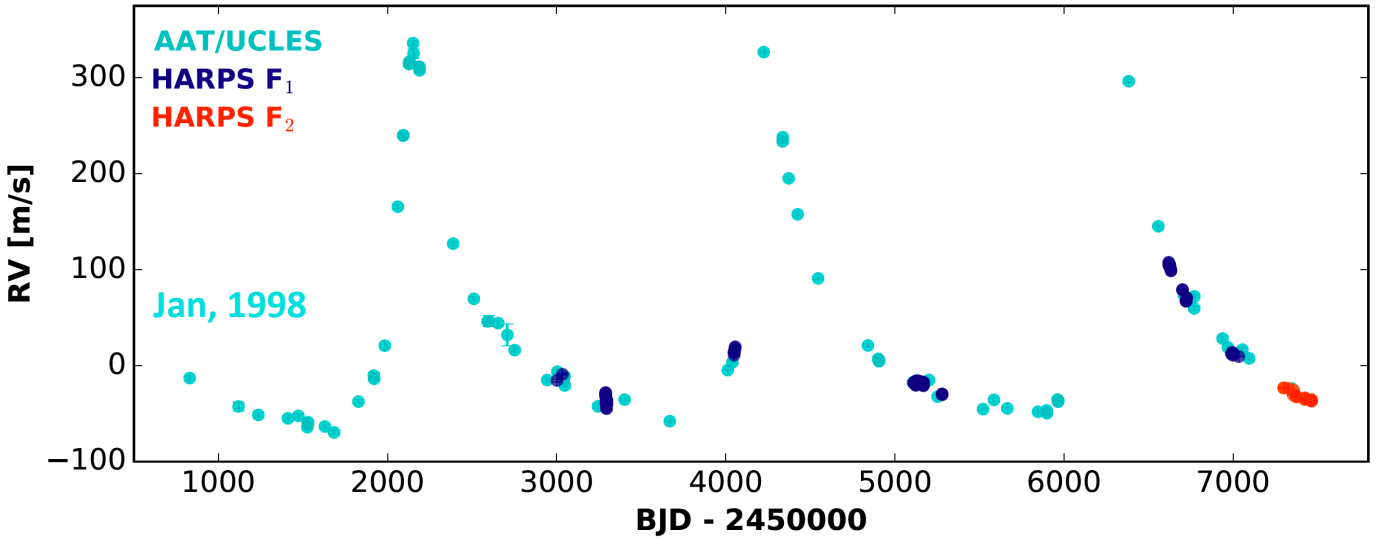
TESS at MIT @TESSatMIT · Aug 13, 2018

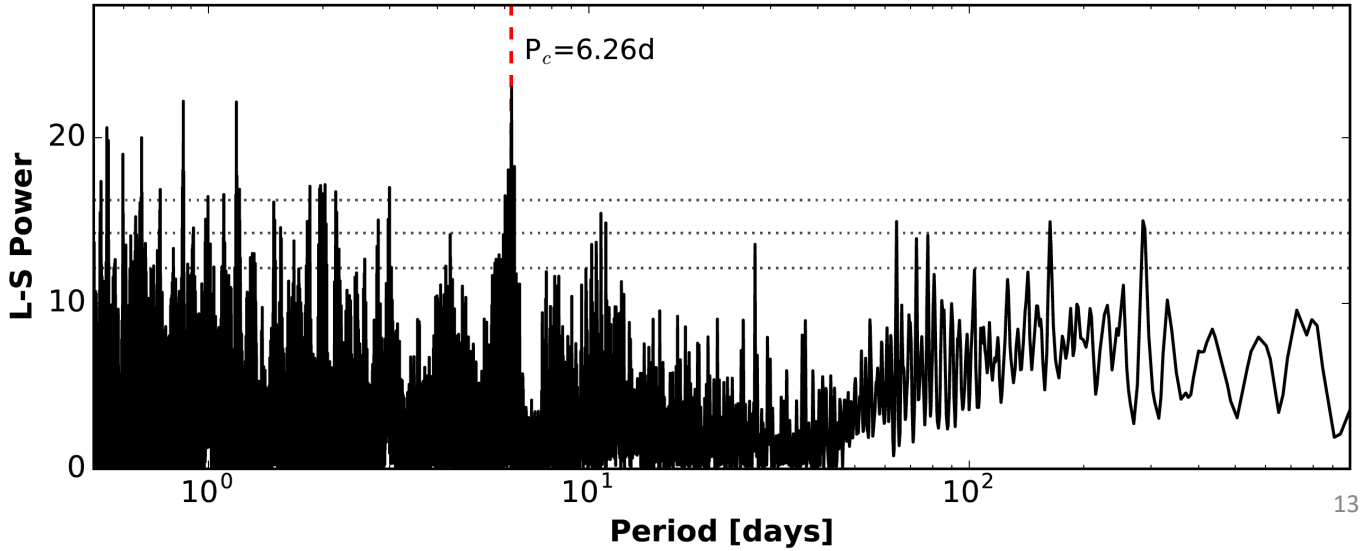
Let the vetting begin! The @NASA_TESS Science team is searching for planet candidates in over 1,000 transits produced by preliminary analysis. Sign up to follow our findings at tess.mit.edu/alerts

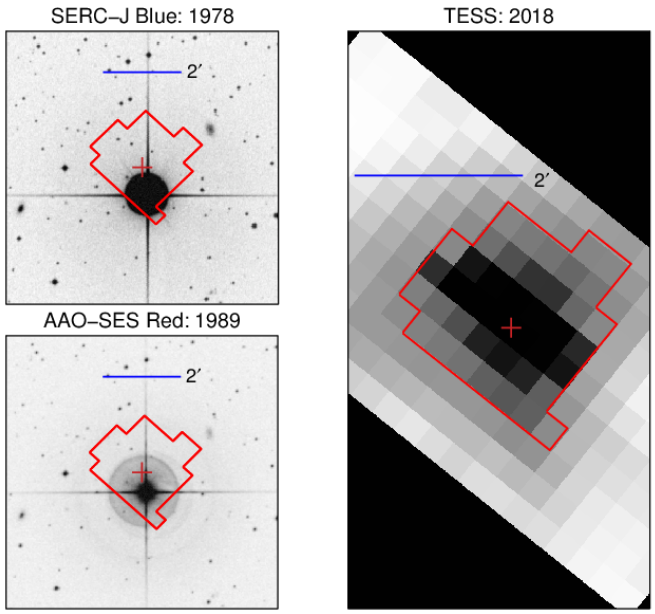
10 61 192

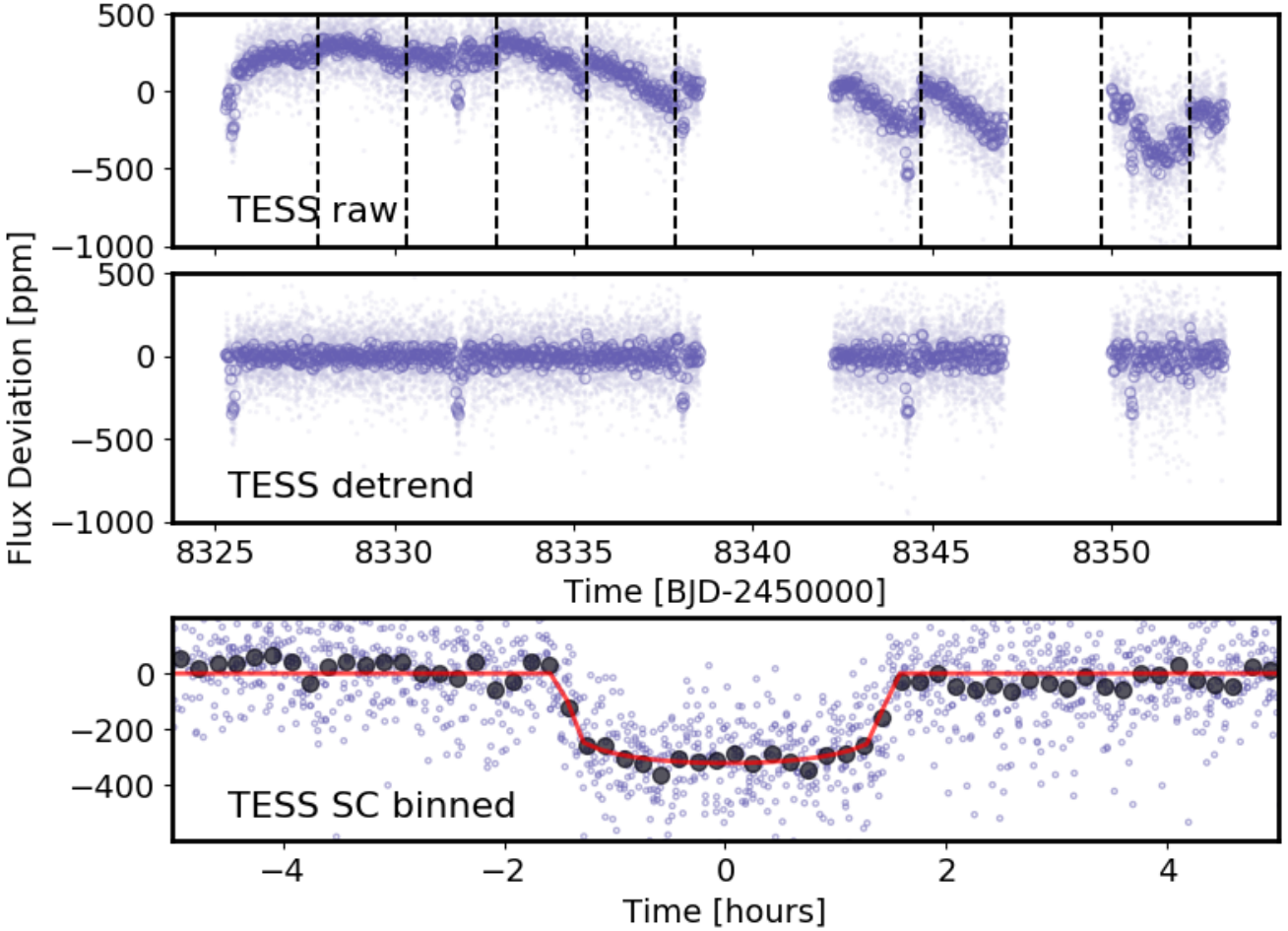
Jenn Burt

JPL



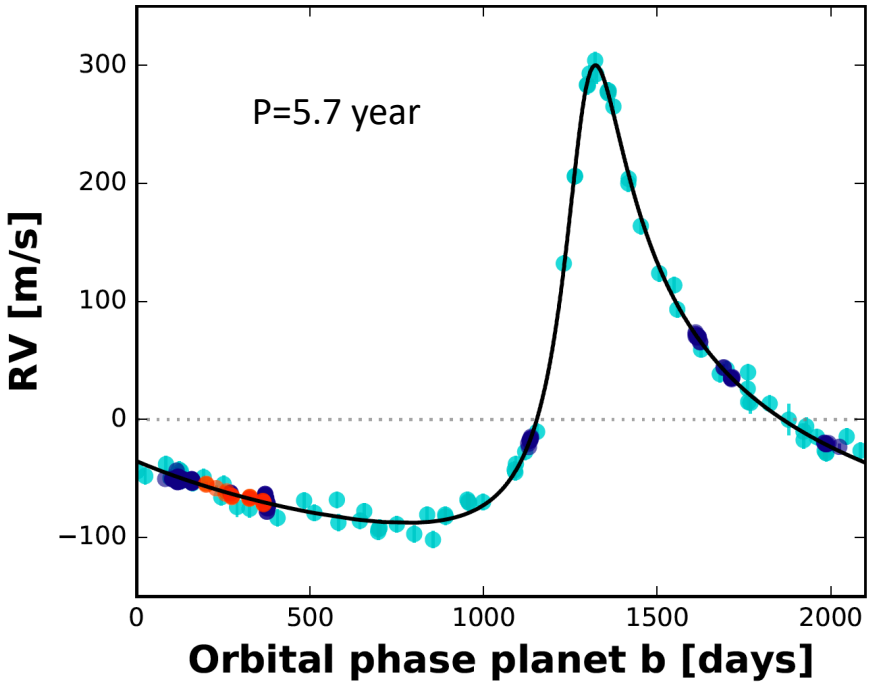


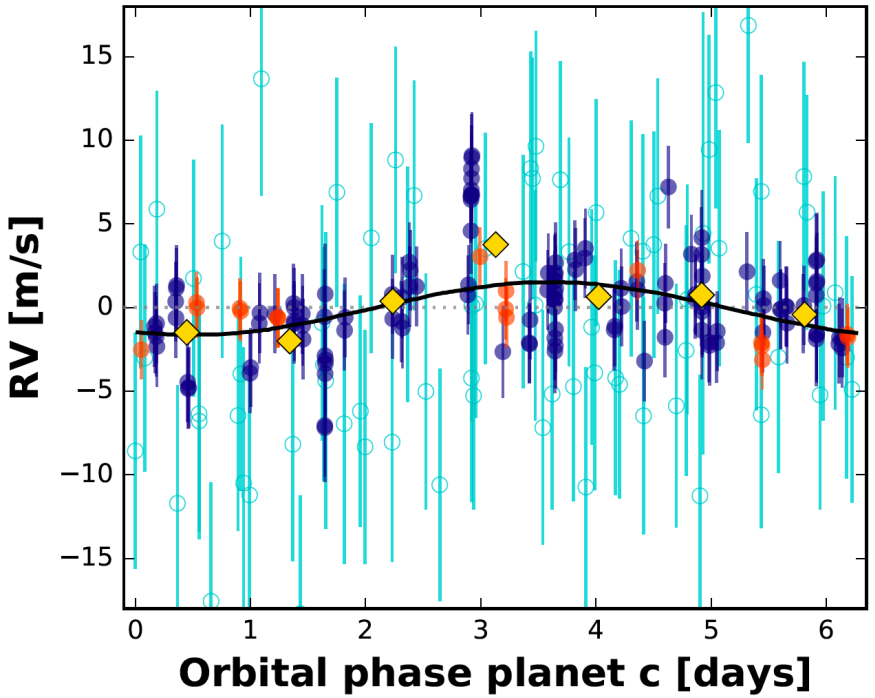




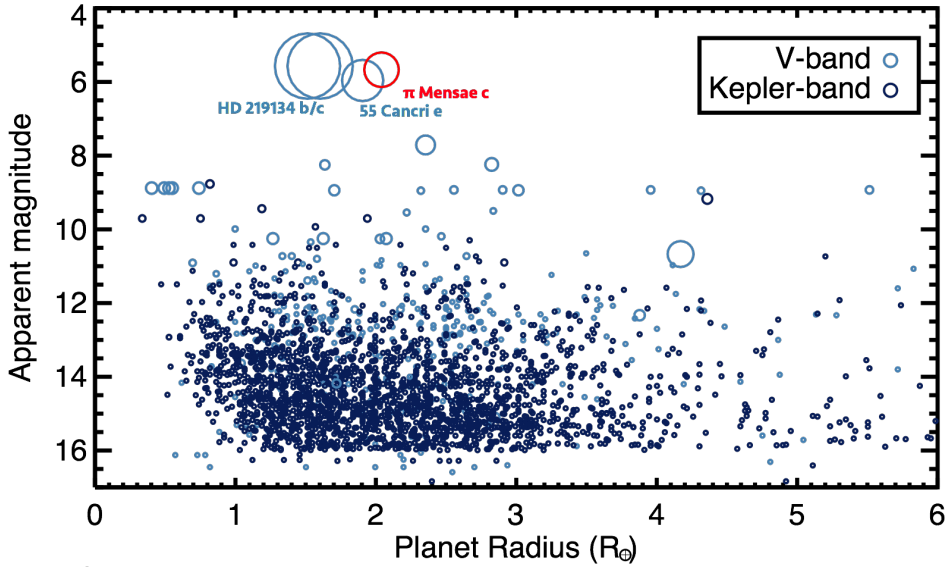
Total noise 30 ppm per 6 hour (10 ppm white noise)

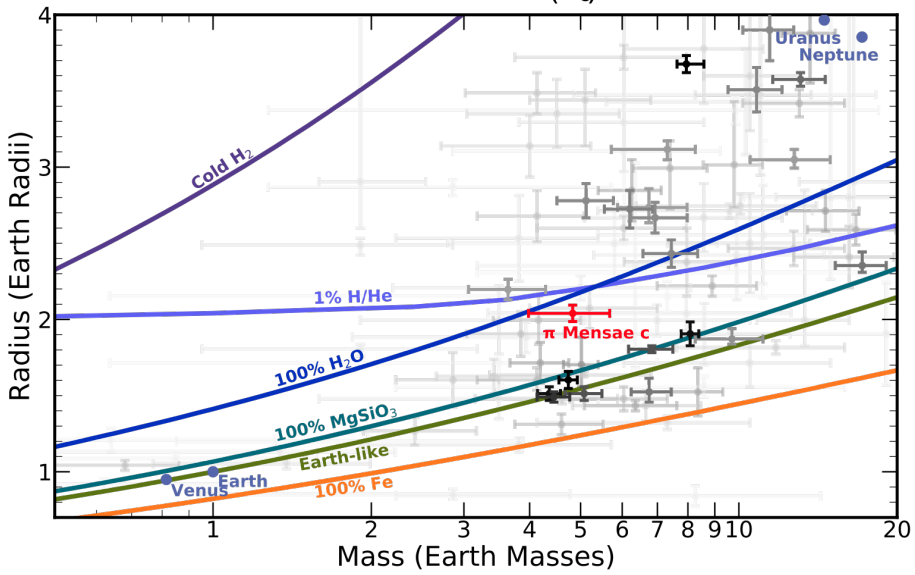
Huang et al (2018)

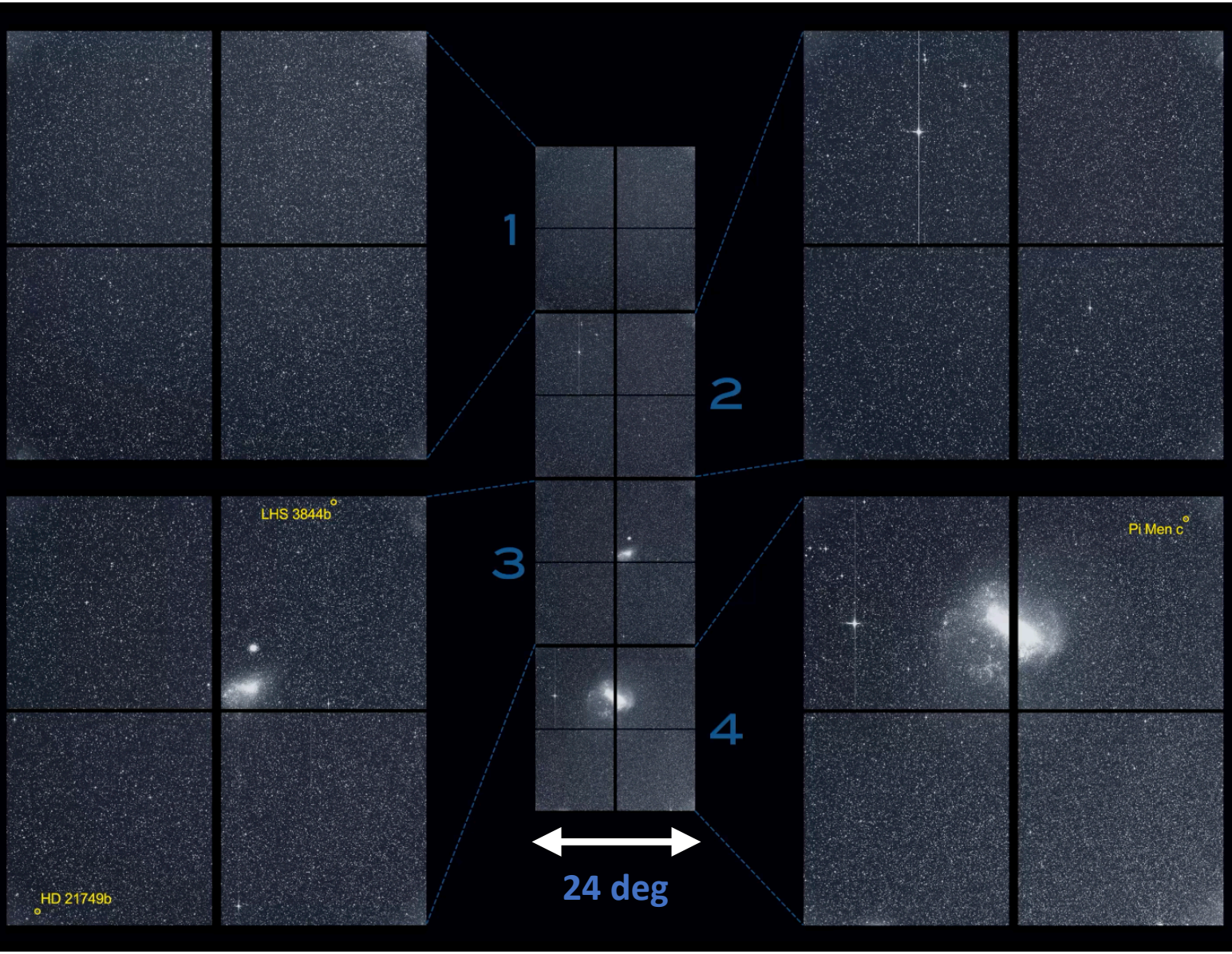




Cold Jupiters like to have super Earths! (Zhu et al 2018)

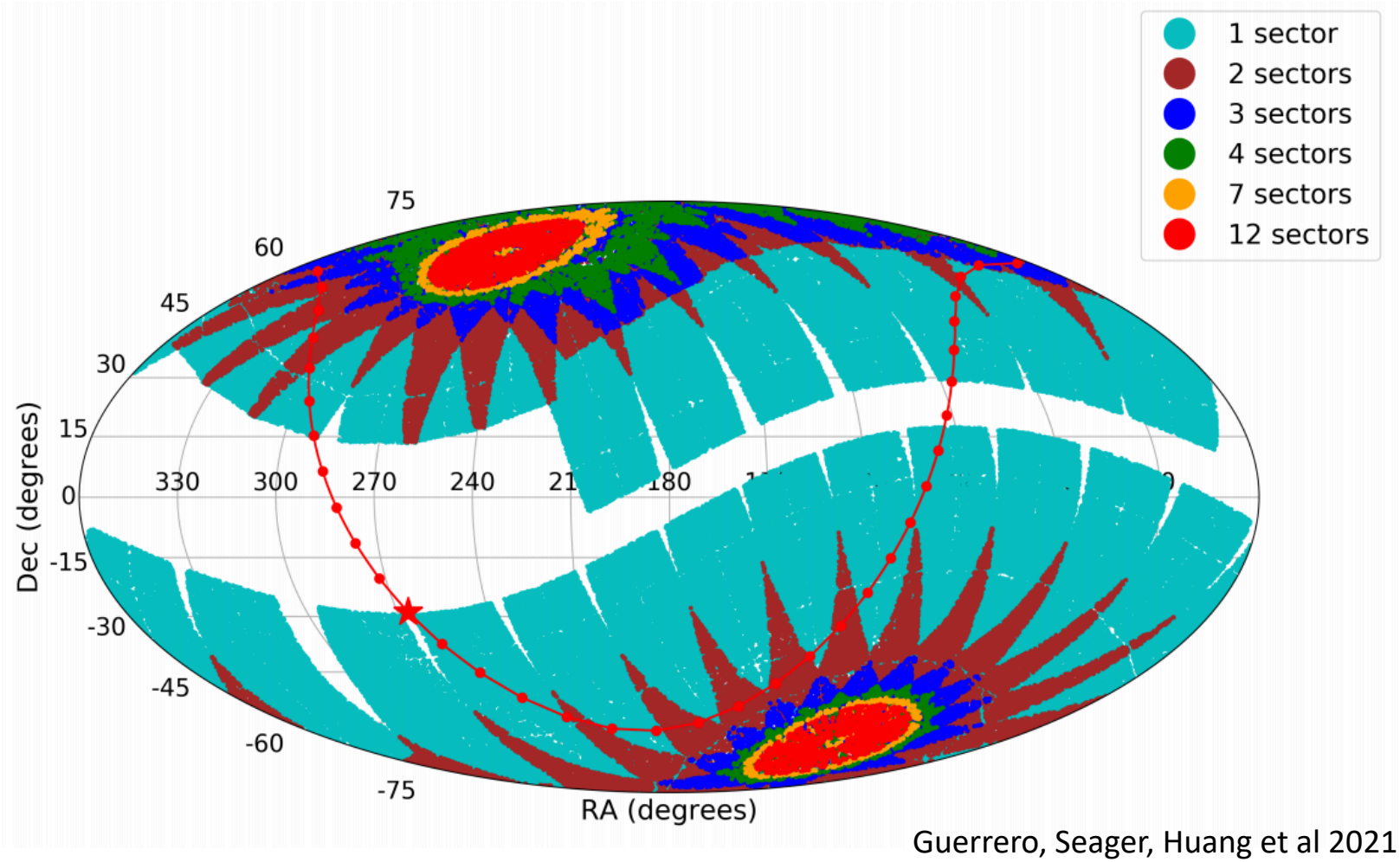

V-band
Kepler-band
HD 219134 b/c
π Mensae c
55 Cancri e
Apparent magnitude
Planet Radius (R⊕)


Uranus
Neptune
Cold H2
1% H/He
π Mensae c
100% H2O
100% MgSiO3
Earth-like
100% Fe
Venus
Earth
Radius (Earth Radii)
Mass (Earth Masses)

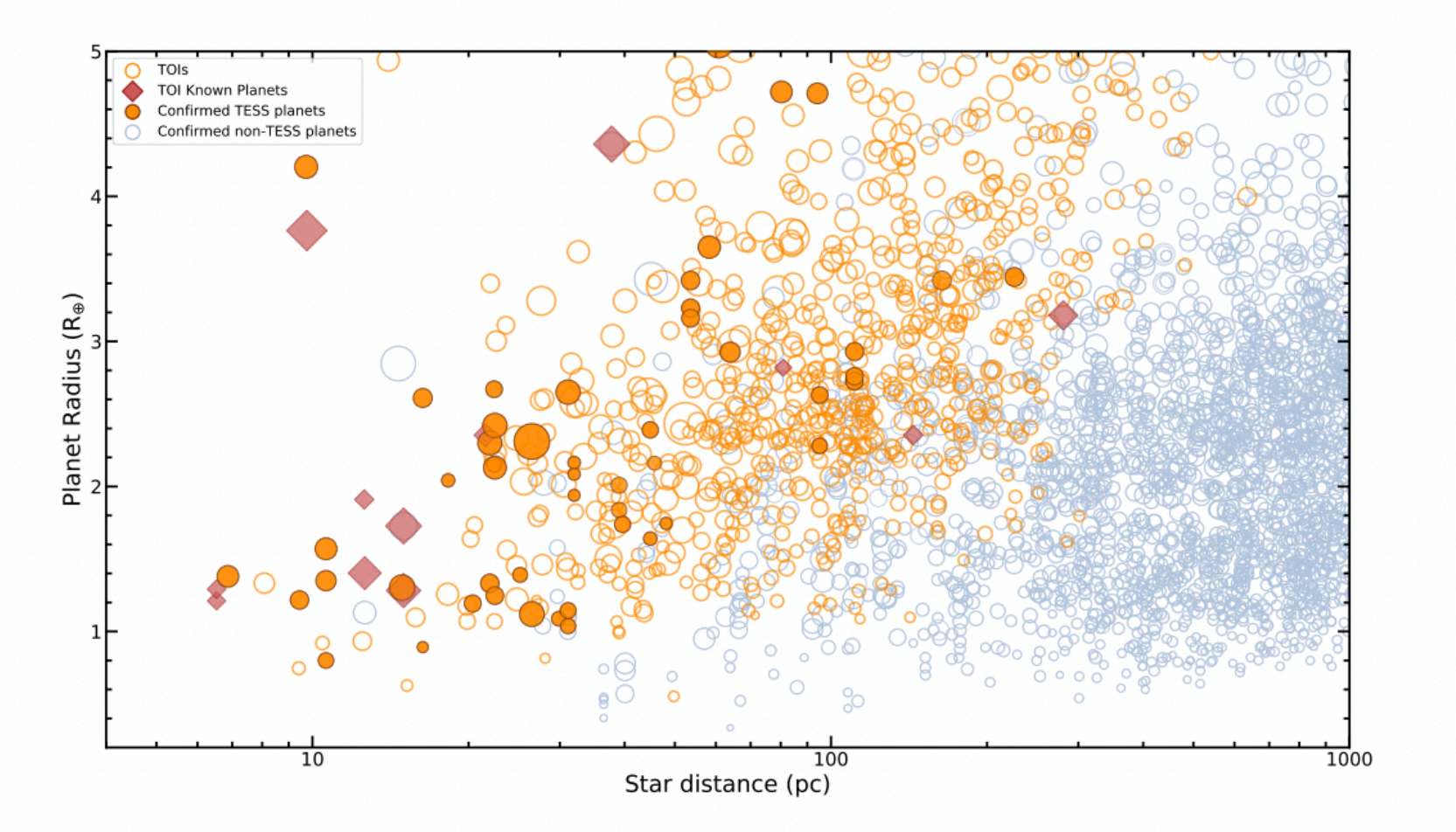

1
2
3
4
LHS 3844b
Pi Men c
HD 21749b
24 deg

Natalia Guerrero

Deputy TOI Manager

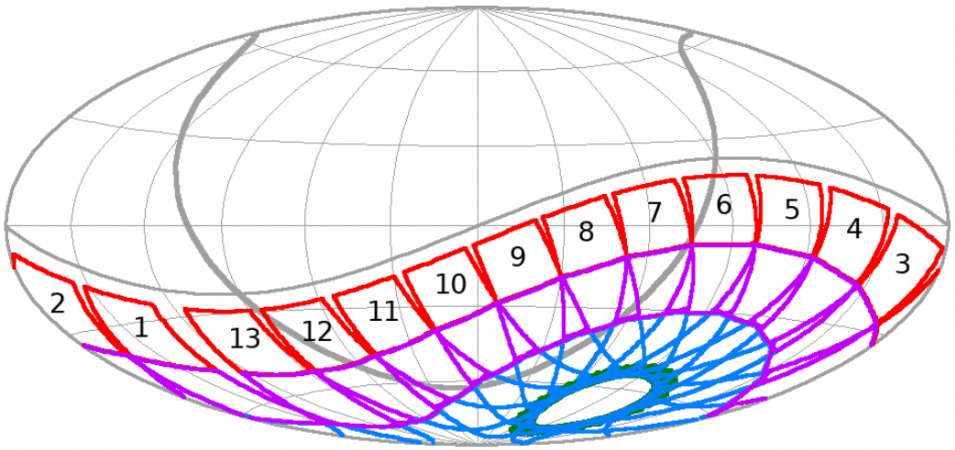


Guerrero, Seager, Huang et al 2021

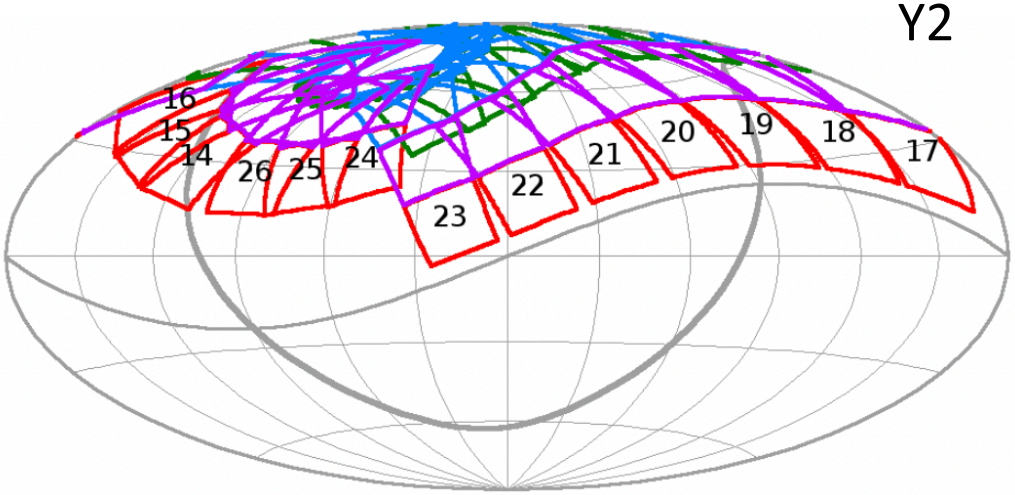


Guerrero, Seager, Huang et al 2021

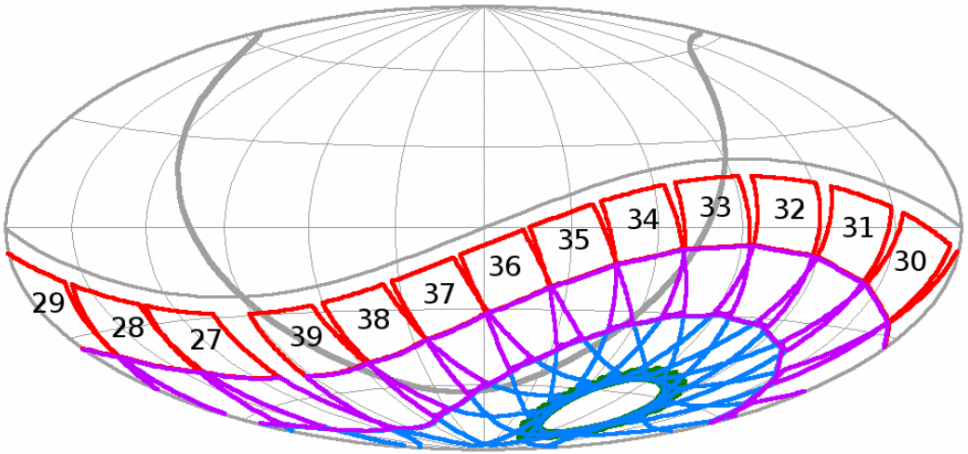
Y1


1
2
3
4
5
6
7
8
9
10
11
12
13

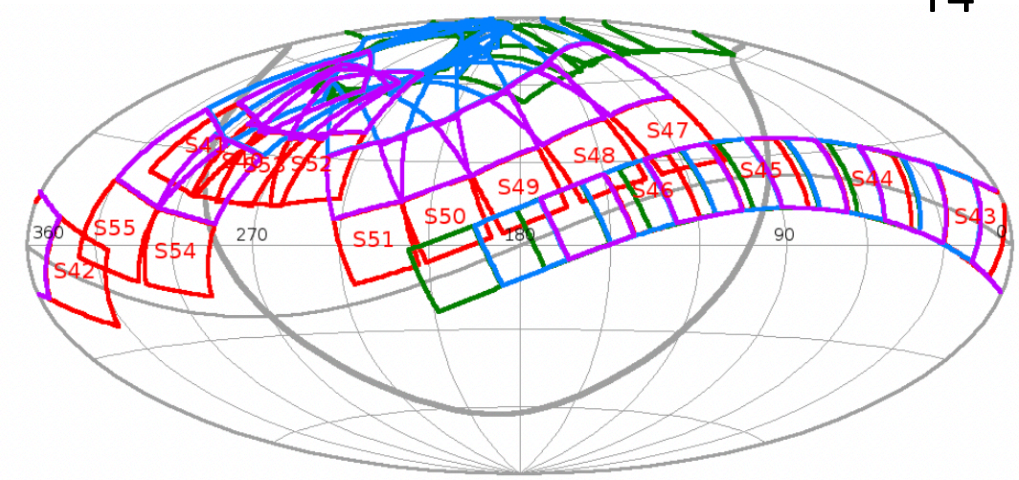
Y2


14
15
16
17
18
19
20
21
22
23
24
25
26

Y3


27
28
29
30
31
32
33
34
35
36
37
38
39

Y4


S42
S43
S44
S45
S46
S47
S48
S49
S50
S51
S52
S53
S54
S55
360
270
180
90
0

Apr 18th, 2018

July 25th, 2018

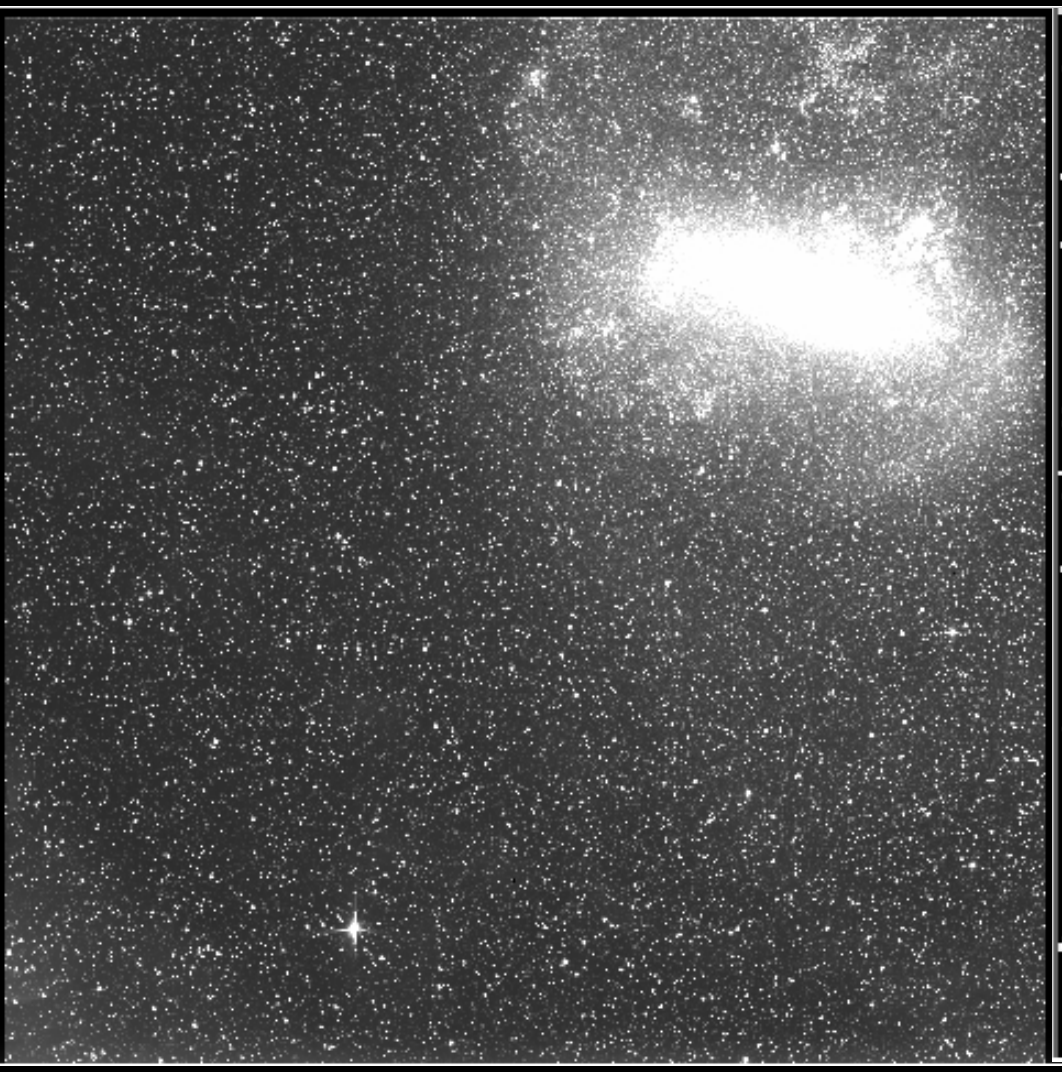
July 4th, 2020

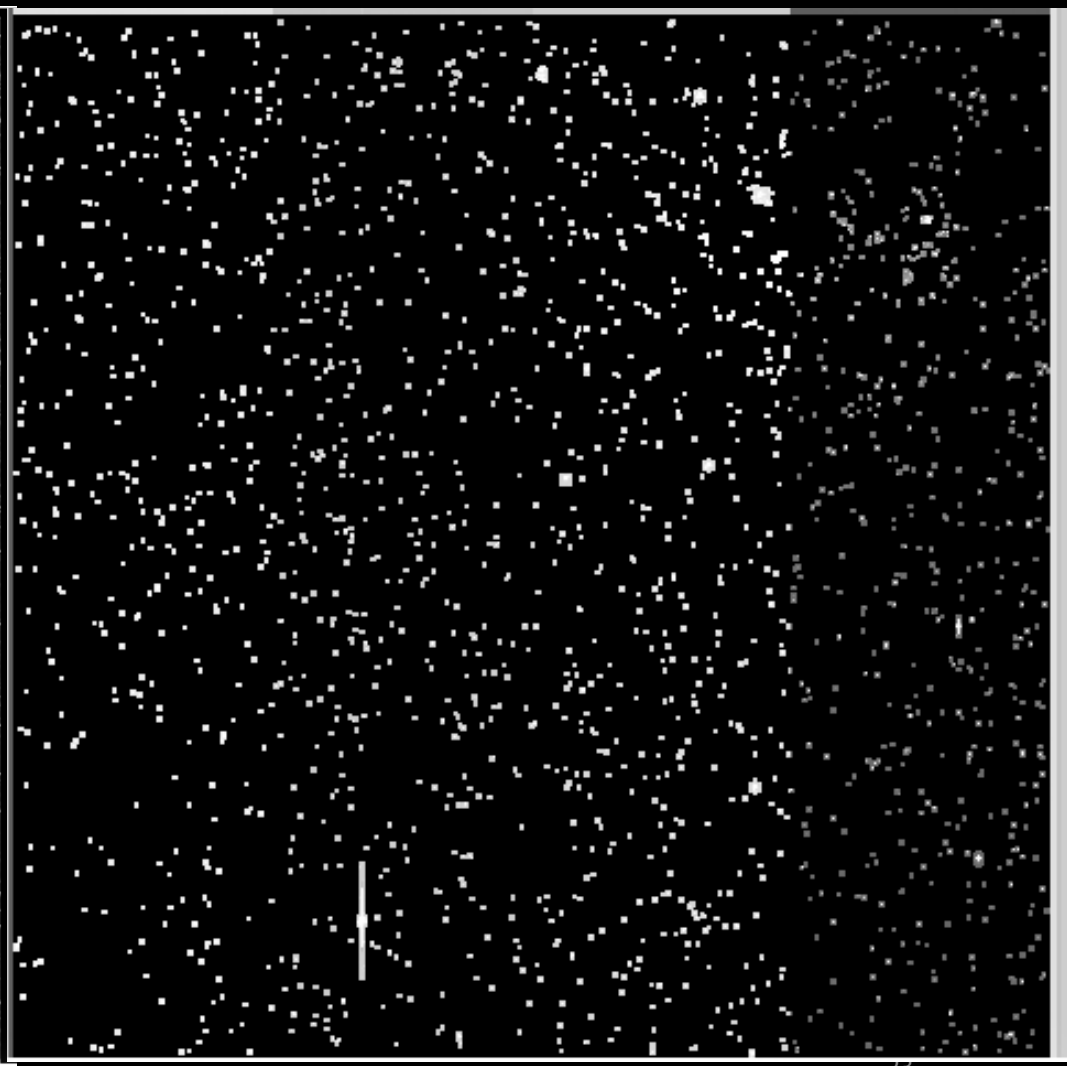
June 2021

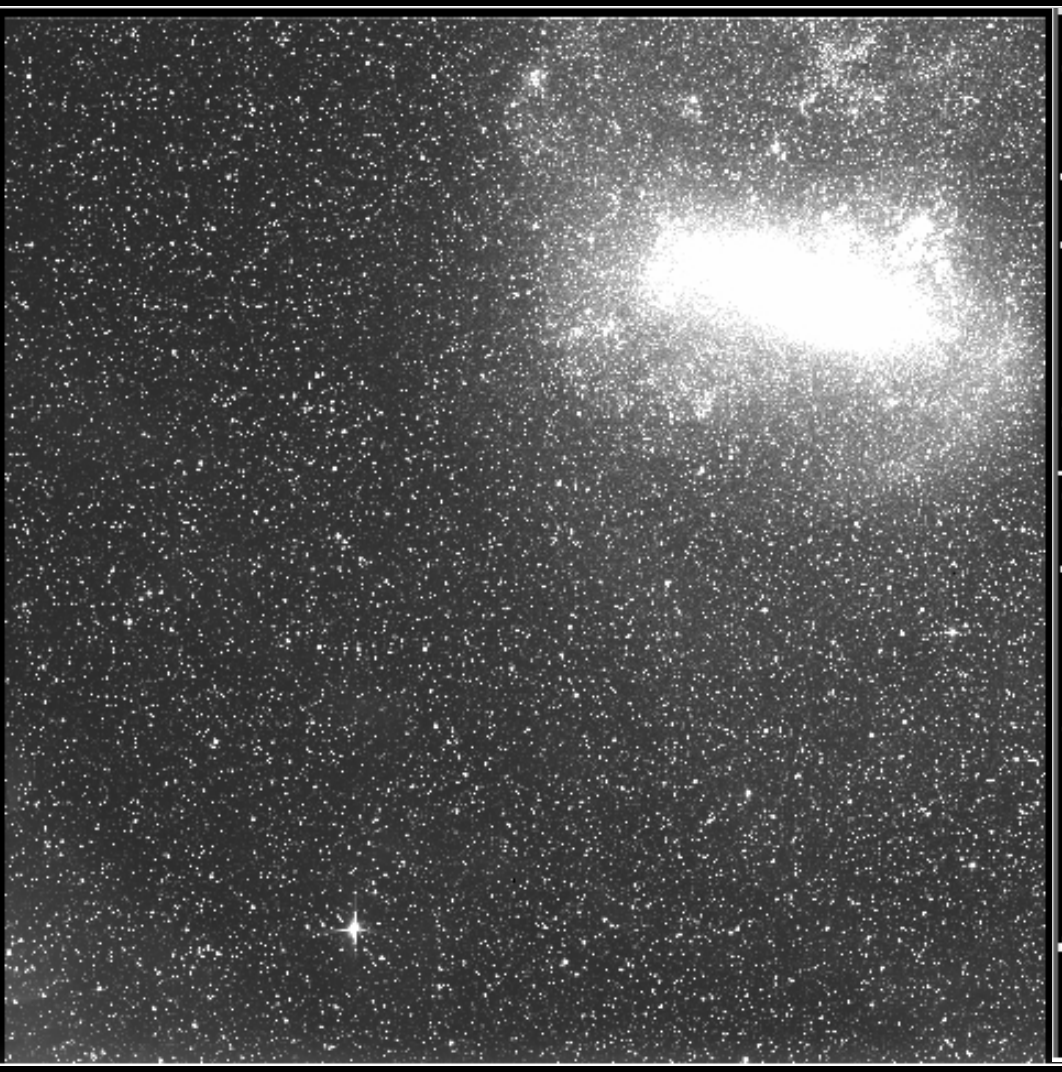
Start of science operation

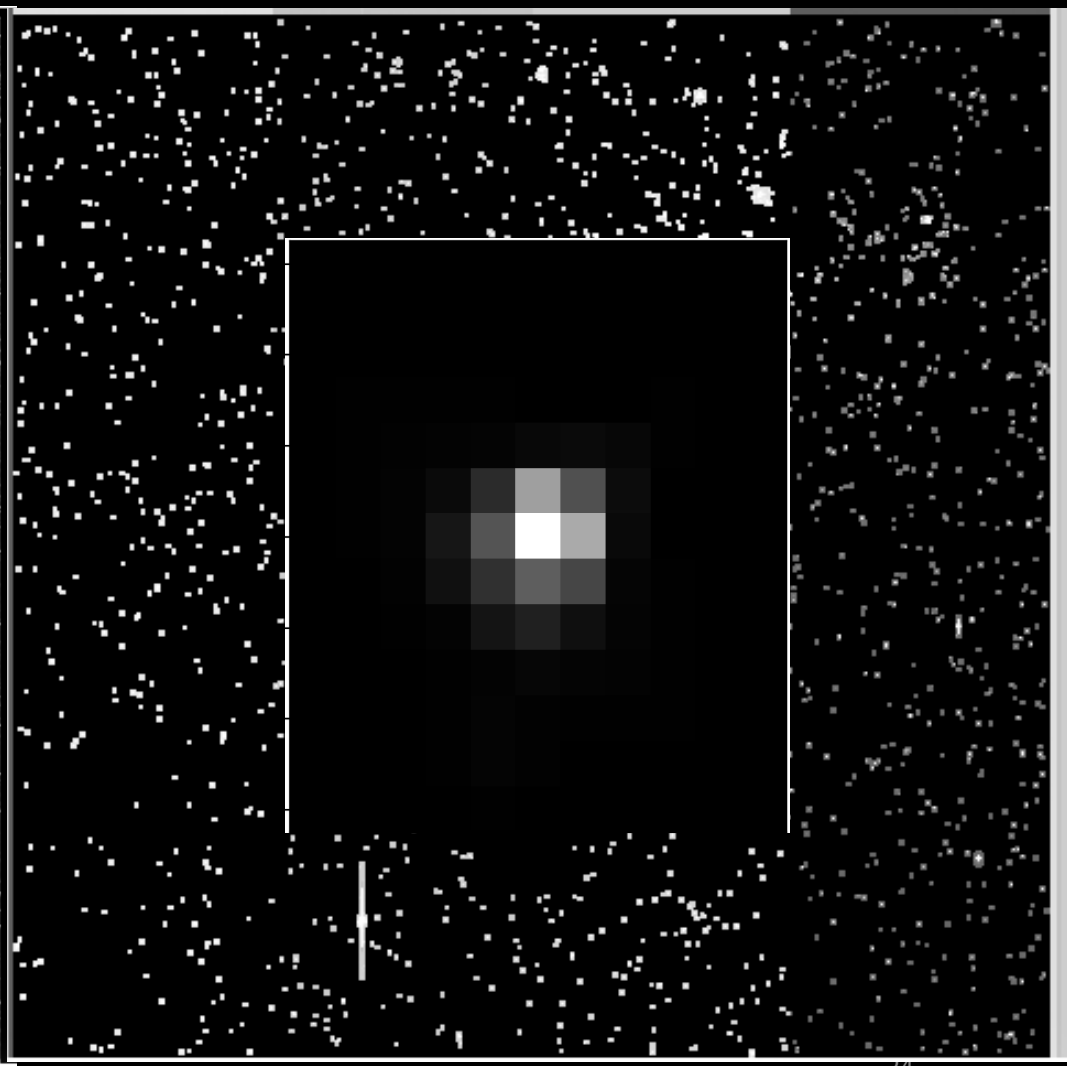
End of Primary Mission

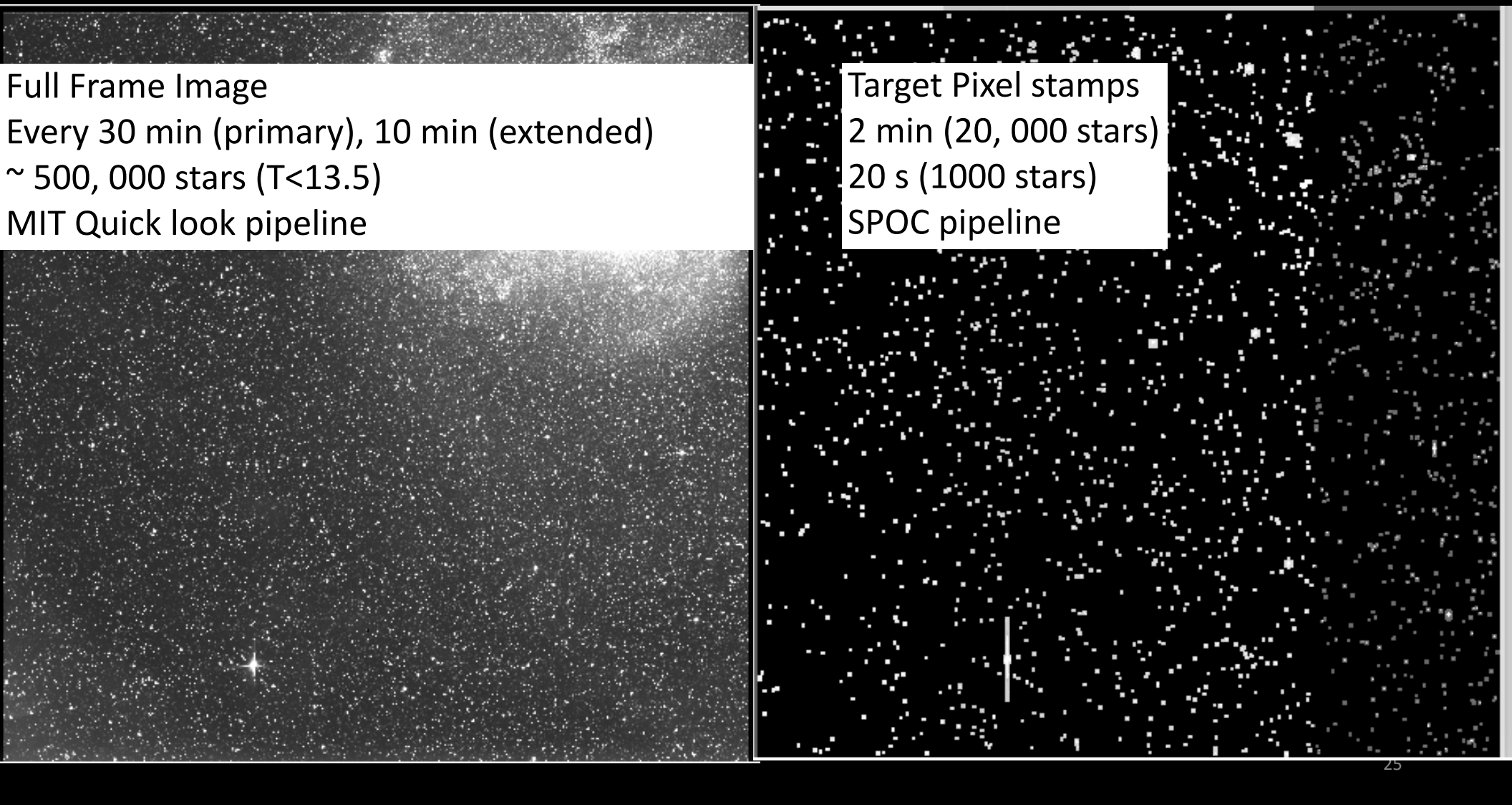
- 38 month observations
- 2686+ Candidate Alerts
- 100+ publications on arXiv










Full Frame Image
Every 30 min (primary), 10 min (extended)
~ 500, 000 stars (T<13.5)
MIT Quick look pipeline
Target Pixel stamps
2 min (20, 000 stars)
20 s (1000 stars)
SPOC pipeline

https://archive.stsci.edu/hlsp/tica

TESS Image CAlibrator Full Frame Images ("TICA")

Primary Investigator: Michael Fausnaugh

HLSP Authors: Michael Fausnaugh, Christopher Burke, George Ricker, Roland Vanderspek

Released: 2021-02-02

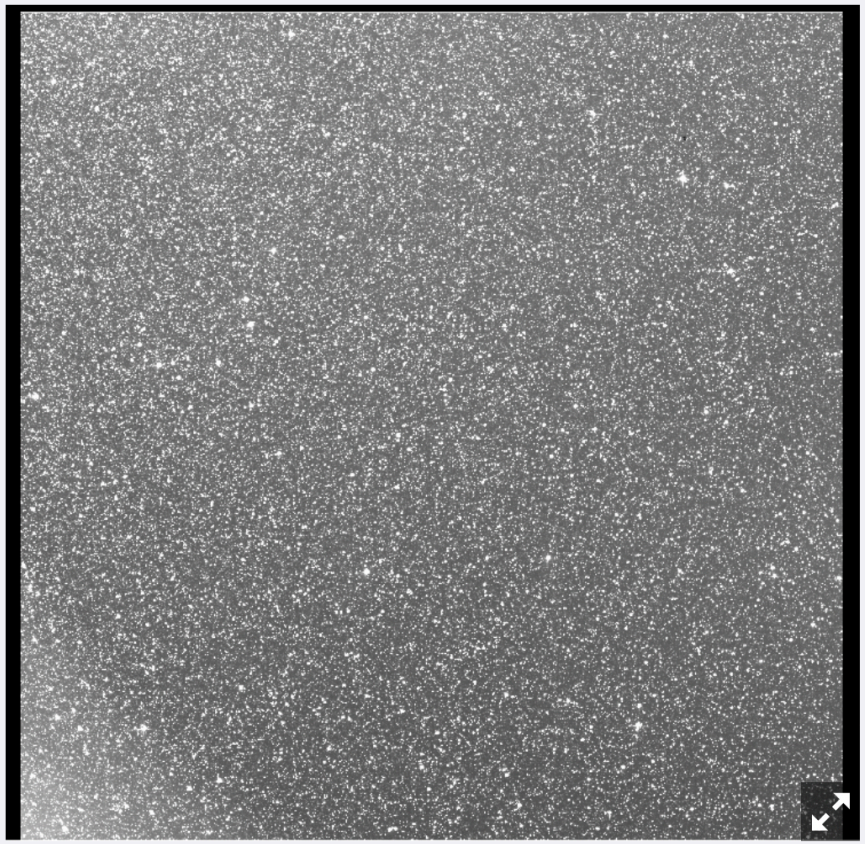
Updated: 2021-04-12

Primary Reference(s): Fausnaugh et al. 2021

DOI: 10.17909/t9-9j8c-7d30

Citations: See ADS Statistics

Read Me



Example calibrated full frame image from Sector 27, Camera 1, CCD 1.

https://archive.stsci.edu/hlsp/tess-spoc

TESS Light Curves From Full Frame Images ("TESS-SPOC")

Primary Investigator: Douglas A. Caldwell

HLSP Authors: Douglas A. Caldwell, Jon M. Jenkins, Eric B. Ting, Peter Tenenbaum, Joseph D. Twicken, Jeffrey C. Smith, Christina Hedges, Michael M. Fausnaugh, Christopher J. Burke, Bill Wohler

Released: 2020-11-12

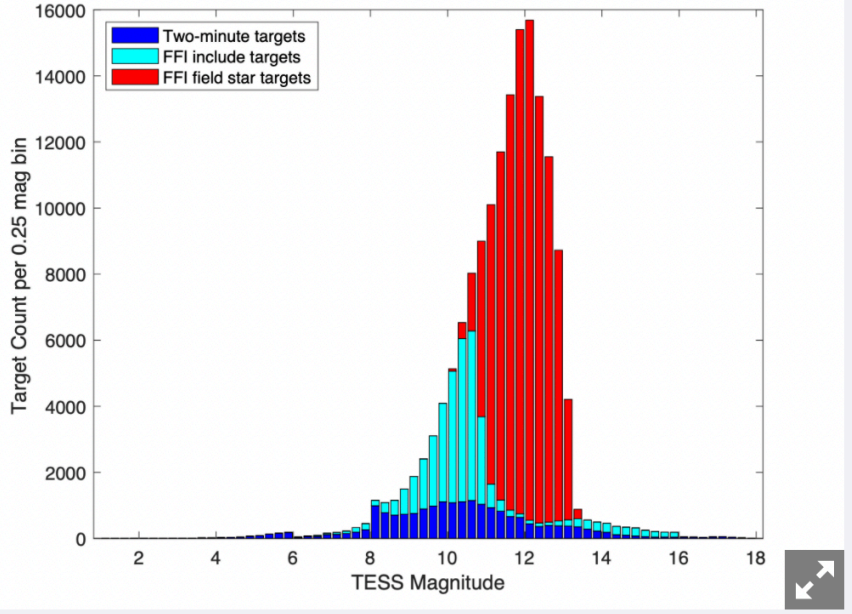
Updated: 2020-11-12

Primary Reference(s): Caldwell et al. 2020

DOI: 10.17909/t9-wpz1-8s54

Citations: See ADS Statistics

Read Me



Distribution of selected TESS-SPOC FFI targets from Sector 14 shown as a stacked histogram. The Sector 14 FFI target list includes 156,217 total targets with 20,000 targets from the two-minute cadence list (blue), 31,175 IR-bright, or nearby targets (cyan), and 105,042 FFI field star targets selected by TESS magnitude (red).

https://archive.stsci.edu/hlsp/qlp 20, 000, 000 light curves from the primary mission

TESS Lightcurves From The MIT Quick-Look Pipeline ("QLP")

Primary Investigator: Chelsea X. Huang

HLSP Authors:

Sector 1 onwards: Chelsea X. Huang, Andrew Vanderburg, András Pál, Lizhou Sha, Liang Yu, Willie Fong, Michael Fausnaugh, Avi Shporer, Natalia Guerrero, Roland Vanderspek, George Ricker

Sectors 27 onwards: Michelle Kunimoto, Willie Fong, Evan Tey, Avi Shporer, Natalia Guerrero, Michael Fausnaugh, Roland Vanderspek, George Ricker

Released: 2020-11-12

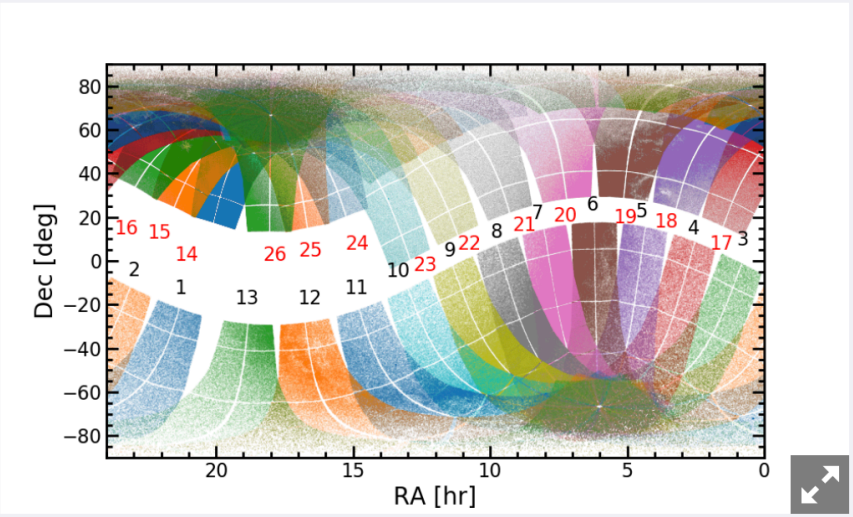
Updated: 2020-11-12

Primary Reference(s): Huang et al. 2020a, Huang et al. 2020b

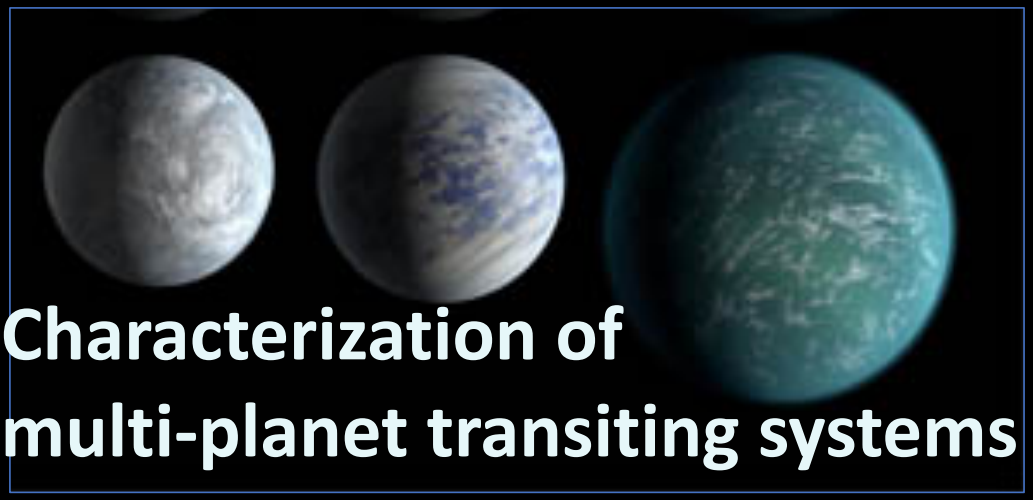
DOI: 10.17909/t9-r086-e880

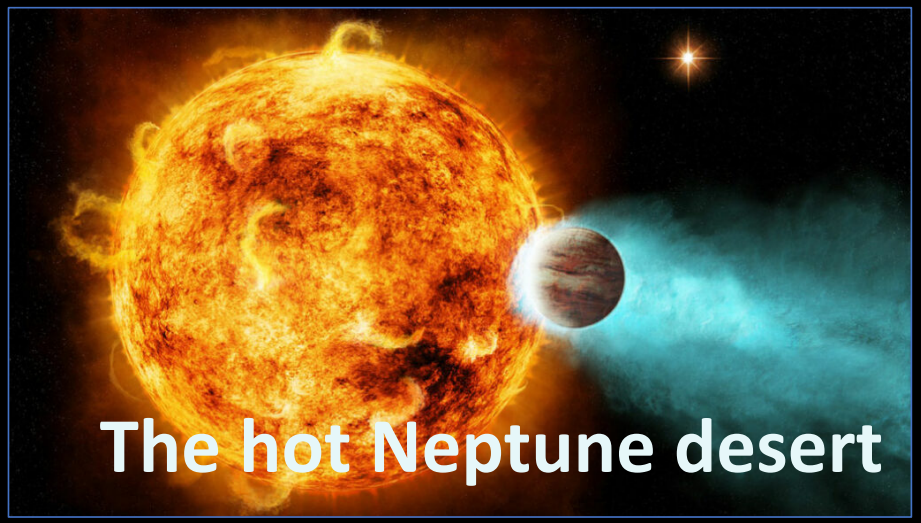
Citations: See ADS Statistics

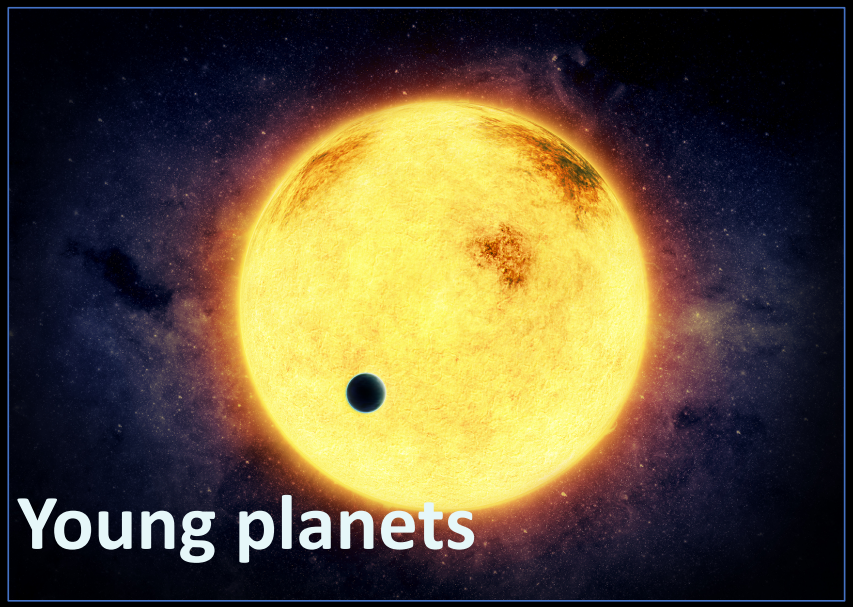
Read Me | **Data Product Description**



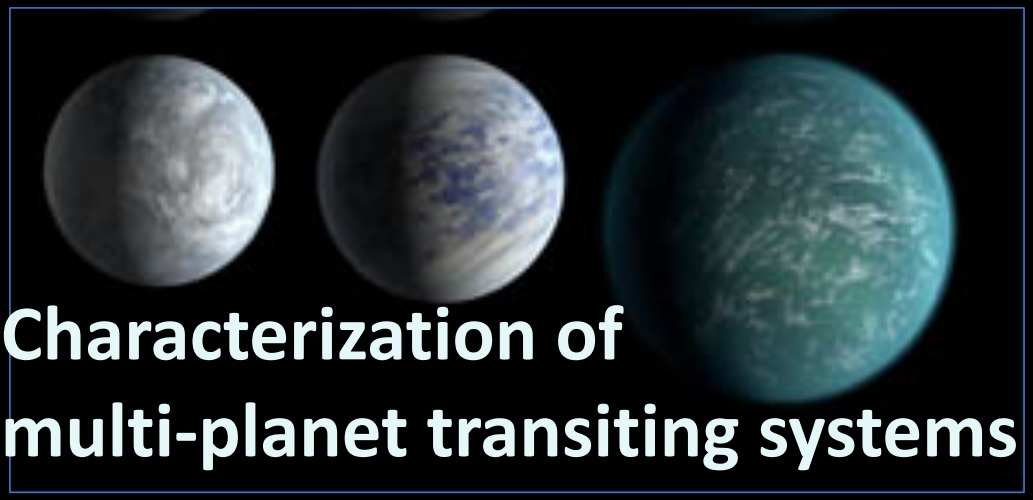
Sky coverage for TESS QLP Sectors 1-26.


Characterization of
multi-planet transiting systems


The hot Neptune desert


Young planets


Gas giants legacy



Characterization of multi-planet transiting systems

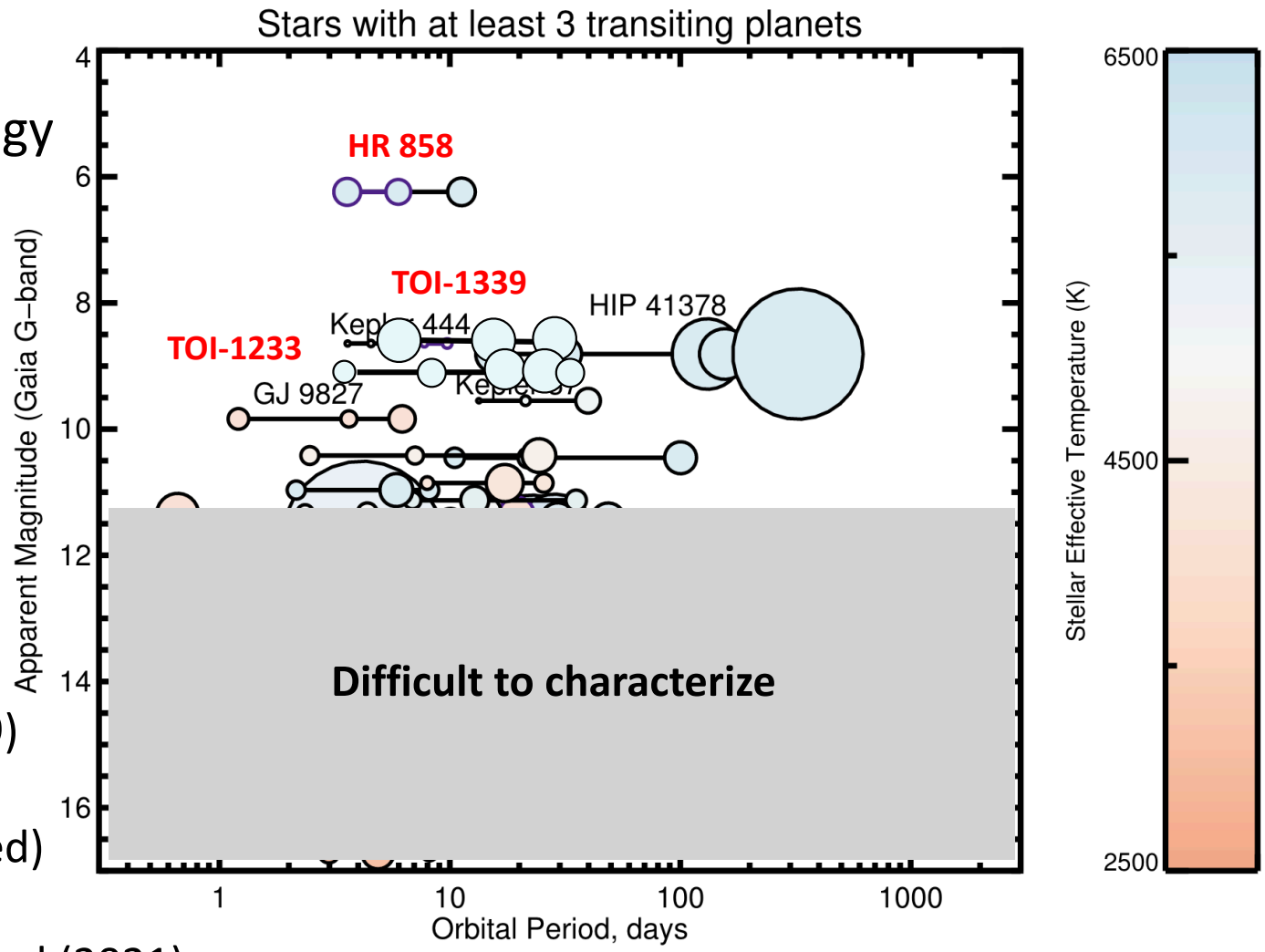
The hot Neptune desert

Young planets

Gas giants legacy

Comparative Exoplanetology

- Density
- Orbital orientation
- atmosphere

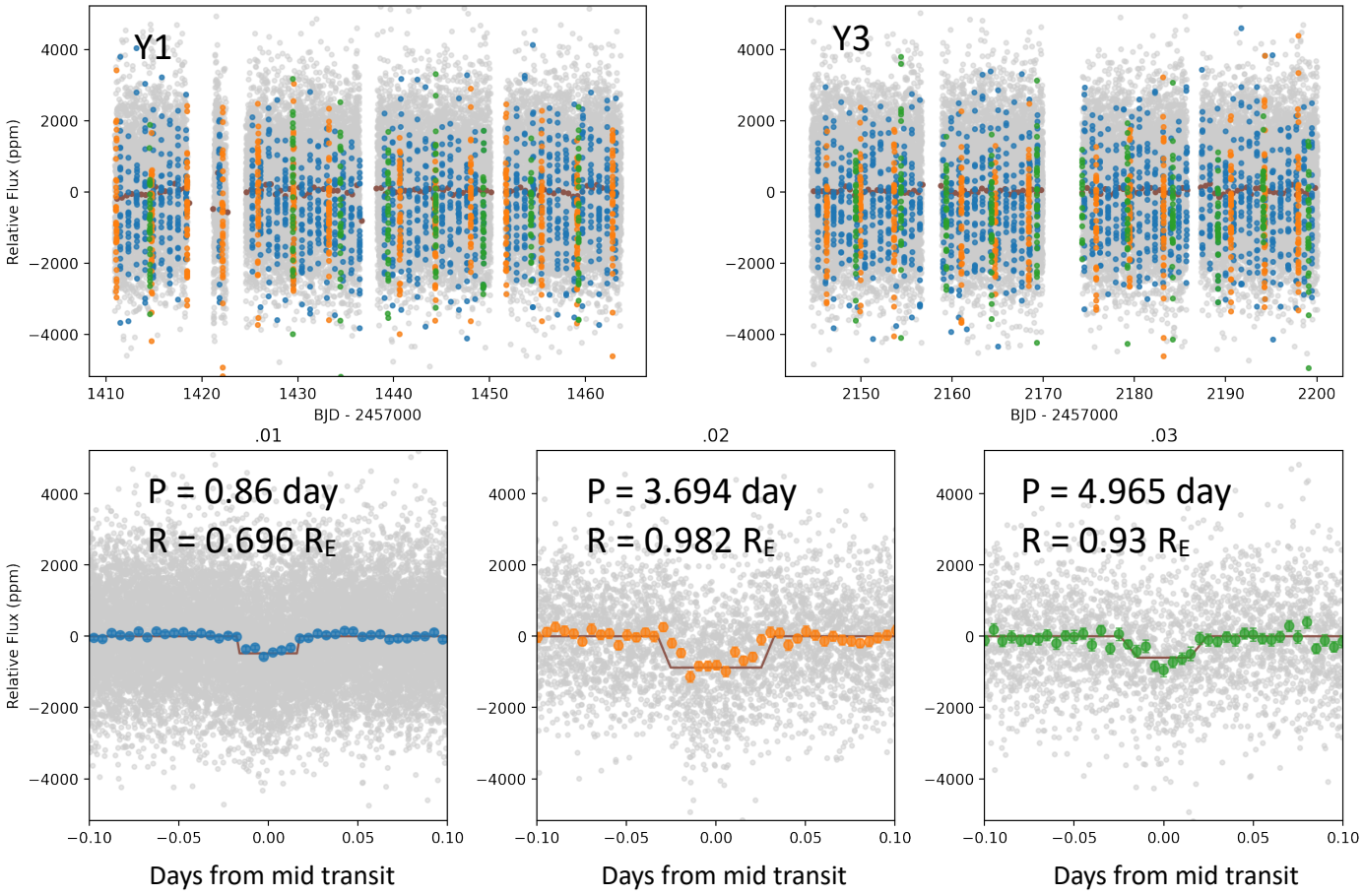


HR 858
Vanderburg , Huang et al (2019)
TOI 1339 b, c, d
Badenas-Agusti et al (submitted)
TOI 1233 b, c, d, e, f
Daylan et al (2020), Bonfanti et al (2021)

Evan Tey
MIT

Tmag = 10.43
$R_* = 0.34\ R_{sun}$
$M_* = 0.32\ M_{sun}$

First TESS Multi with all planets ≤ Earth radius



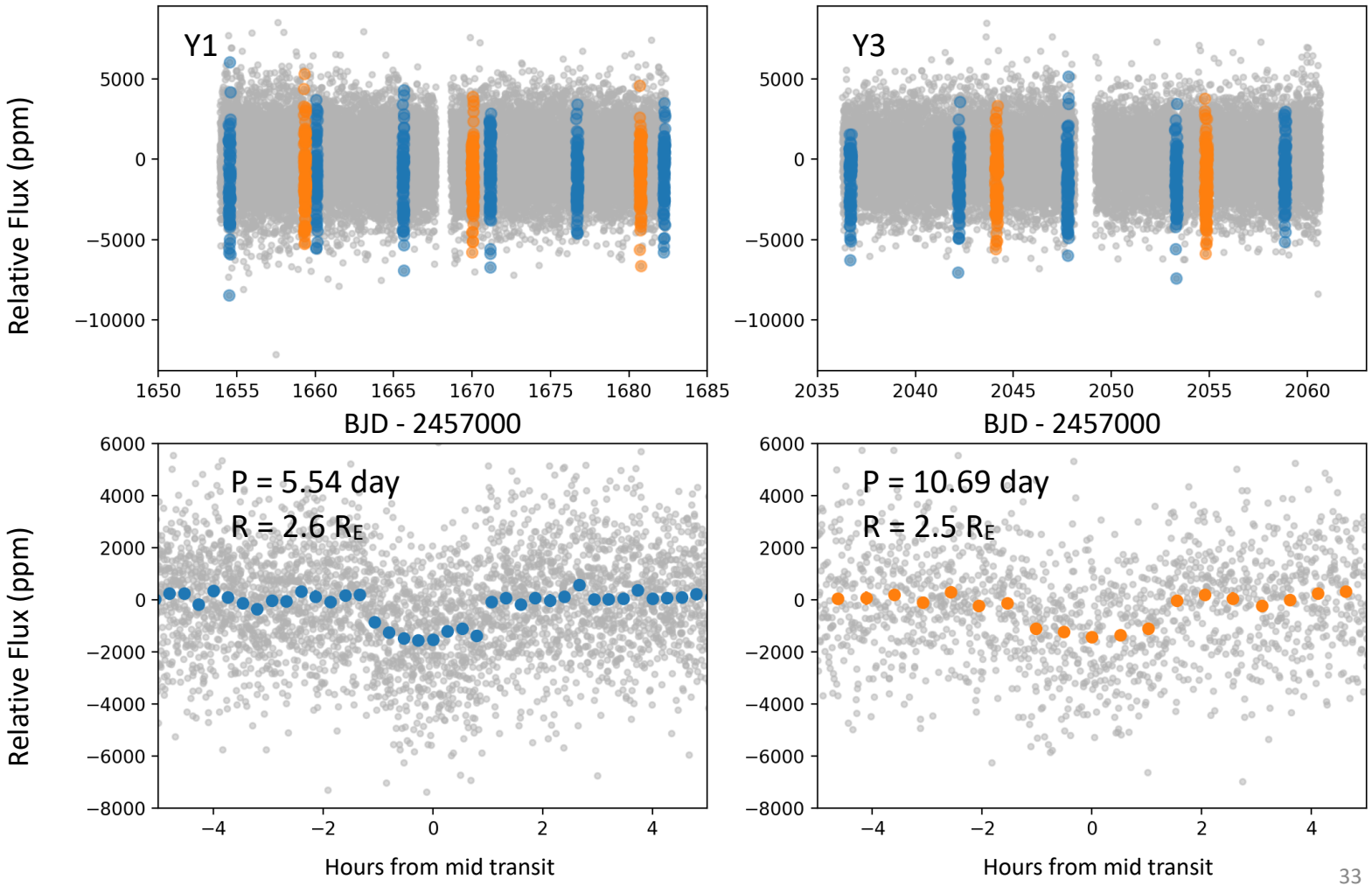
SliverStein et al, to be submitted

Tey et al, in prep

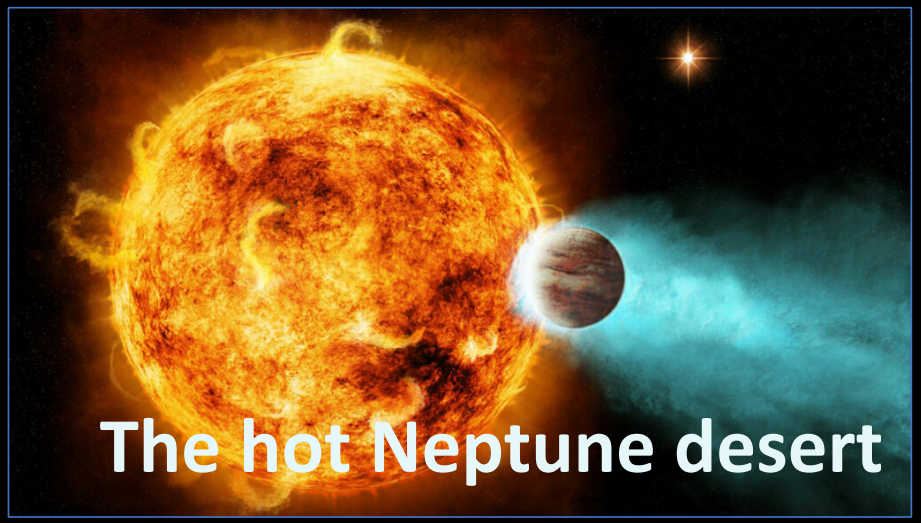
Tmag = 11.0

$R_* = 0.59\ R_{sun}$

$M_* = 0.58\ M_{sun}$



Characterization of
multi-planet transiting systems

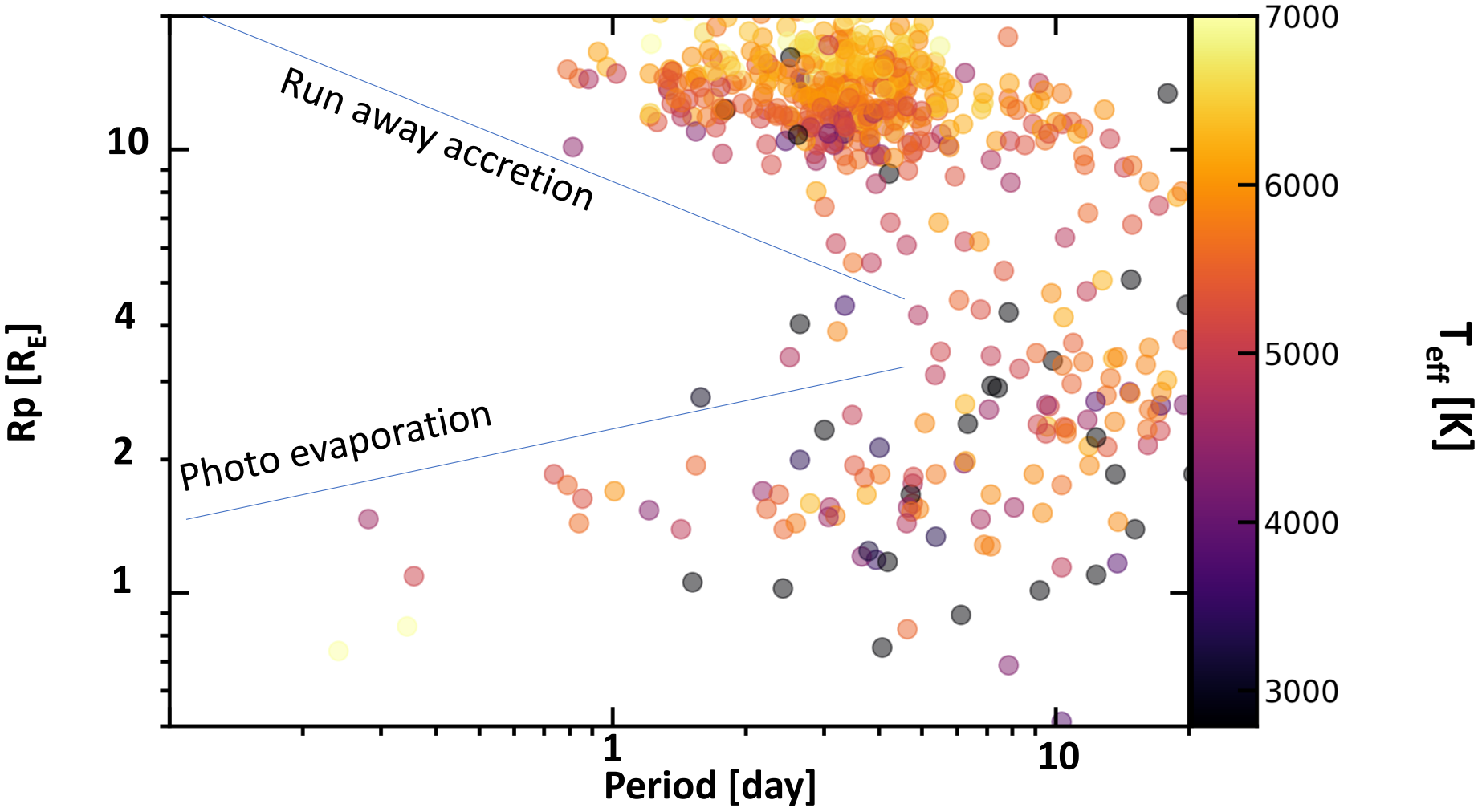


The hot Neptune desert

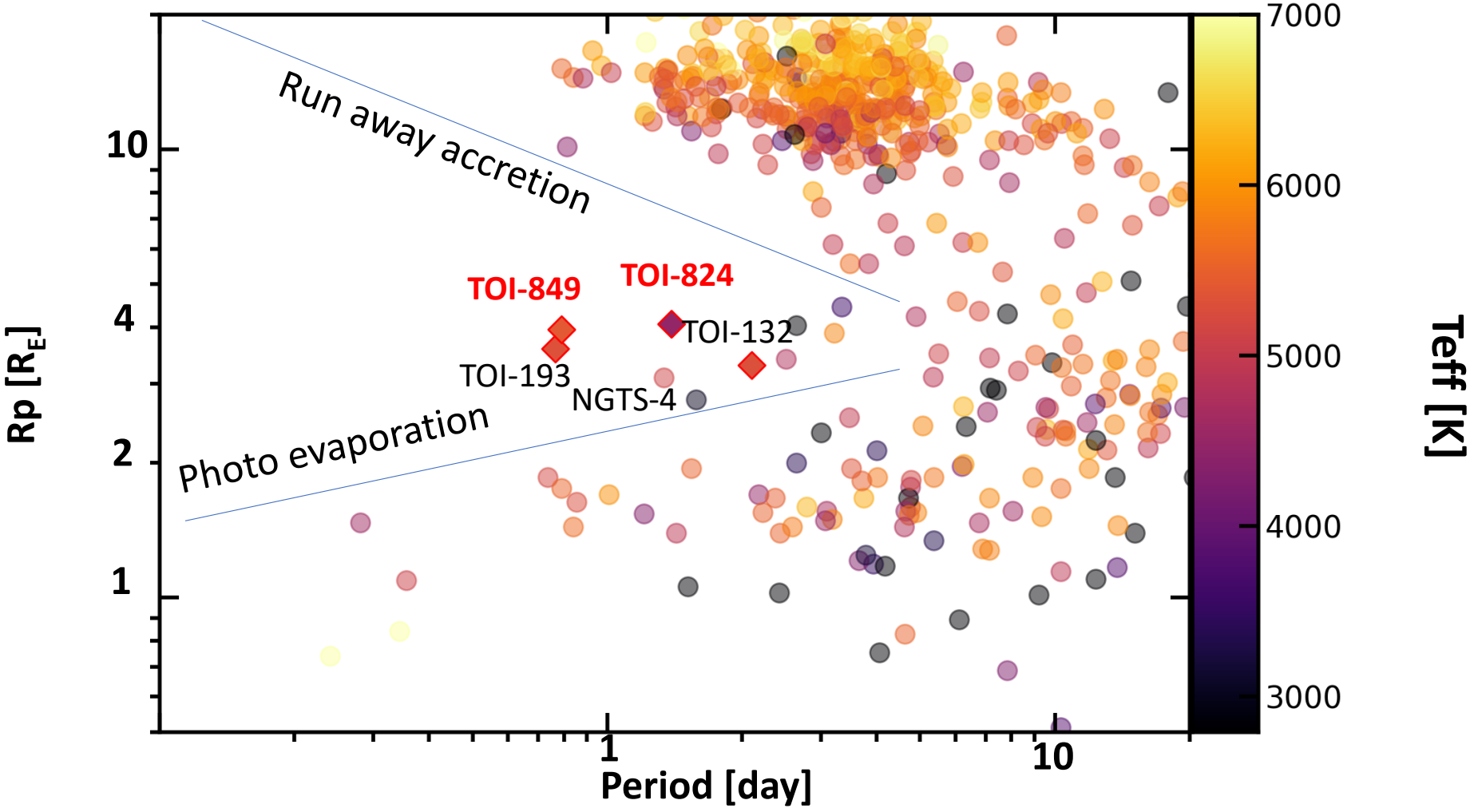
Young planets

Gas giants legacy

Explore the hot Neptune desert

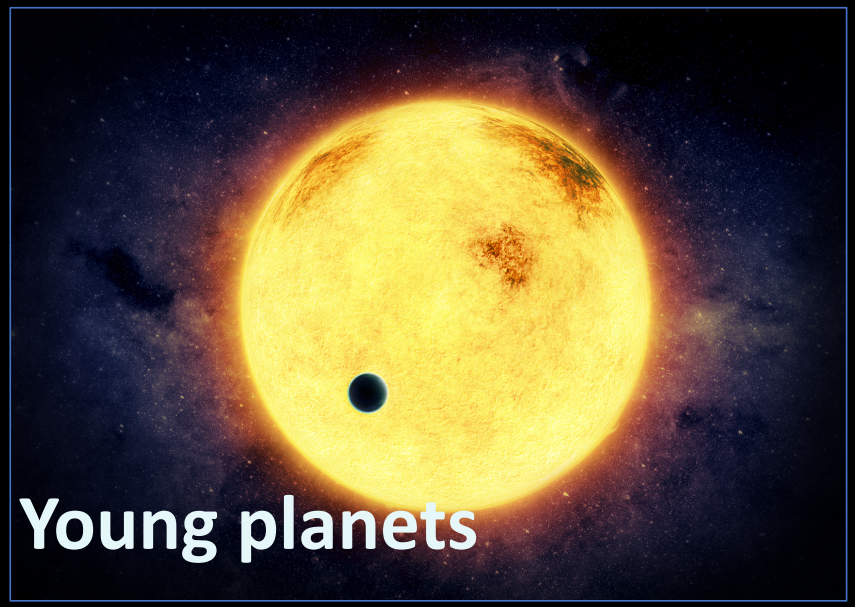


Explore the hot Neptune desert



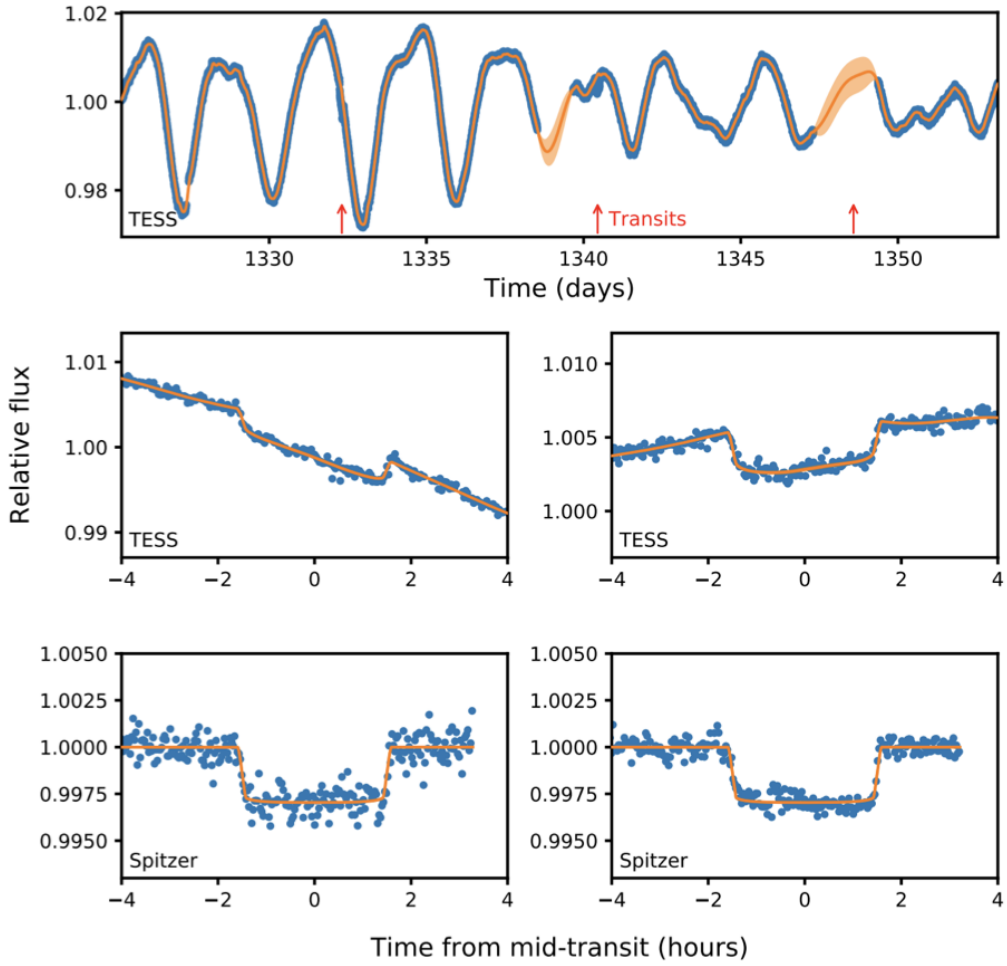
Characterization of
multi-planet transiting systems

The hot Neptune desert

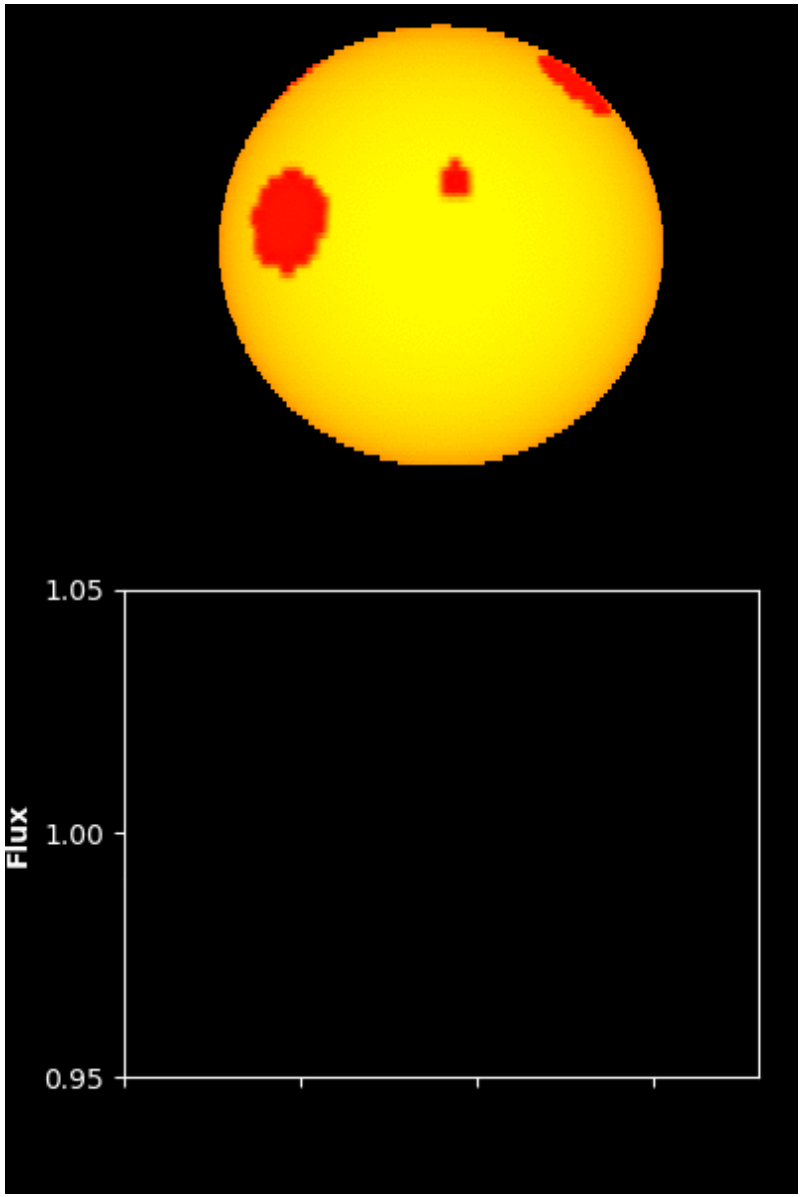


Young planets

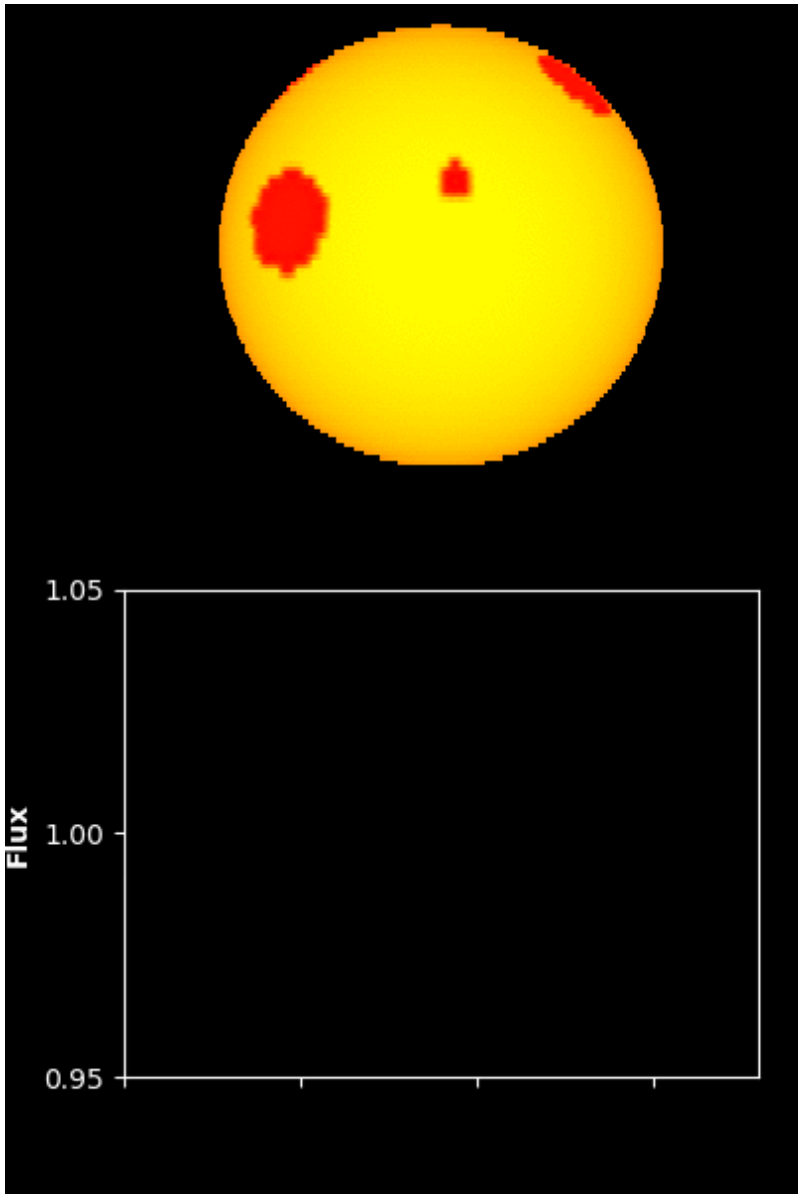
Gas giants legacy

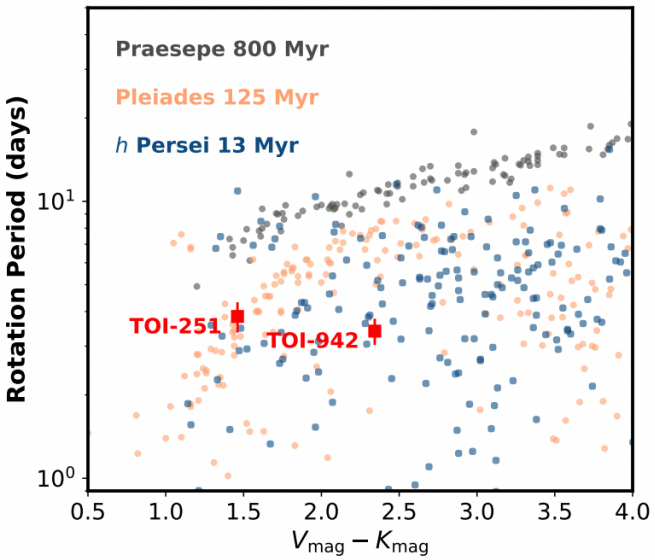


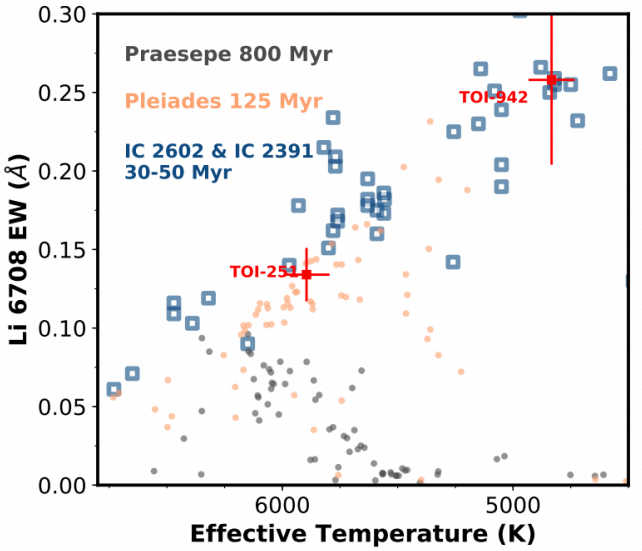
DS Tuc Ab (Newton+ 2019)



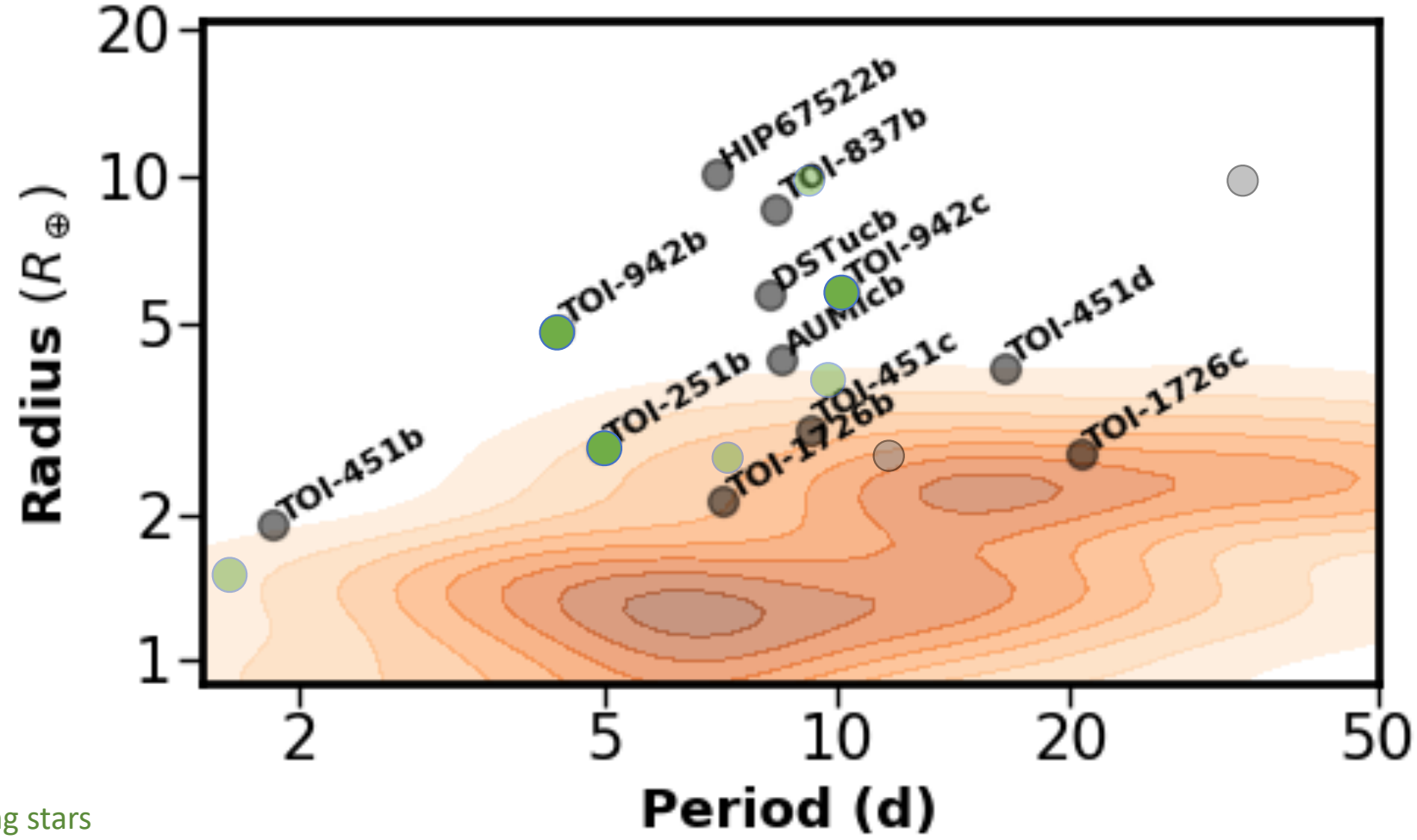
Looking for candidate young stars
in Full Frame Images







Zhou et al 2021



Field young stars

Cluster members

Mature star

Characterization of
multi-planet transiting systems

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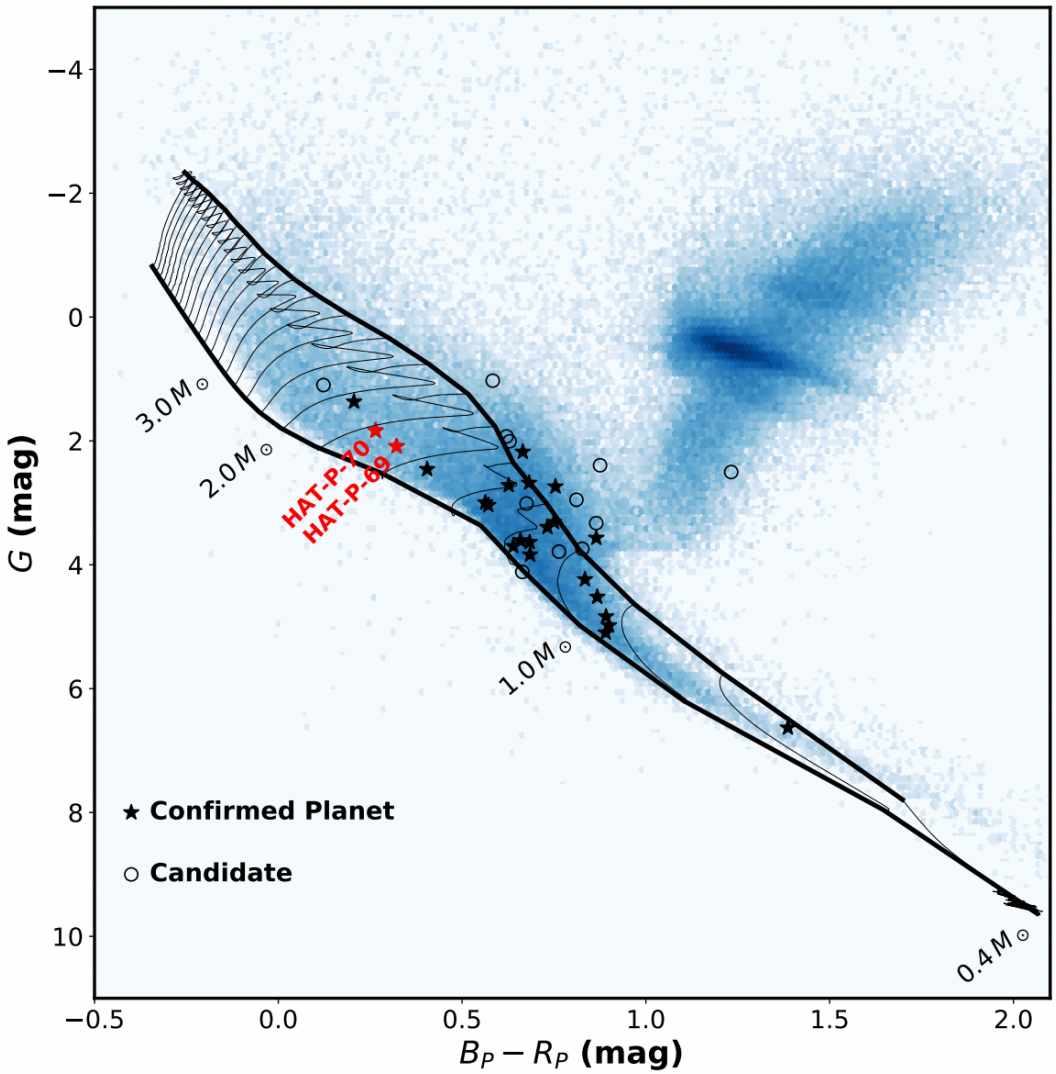
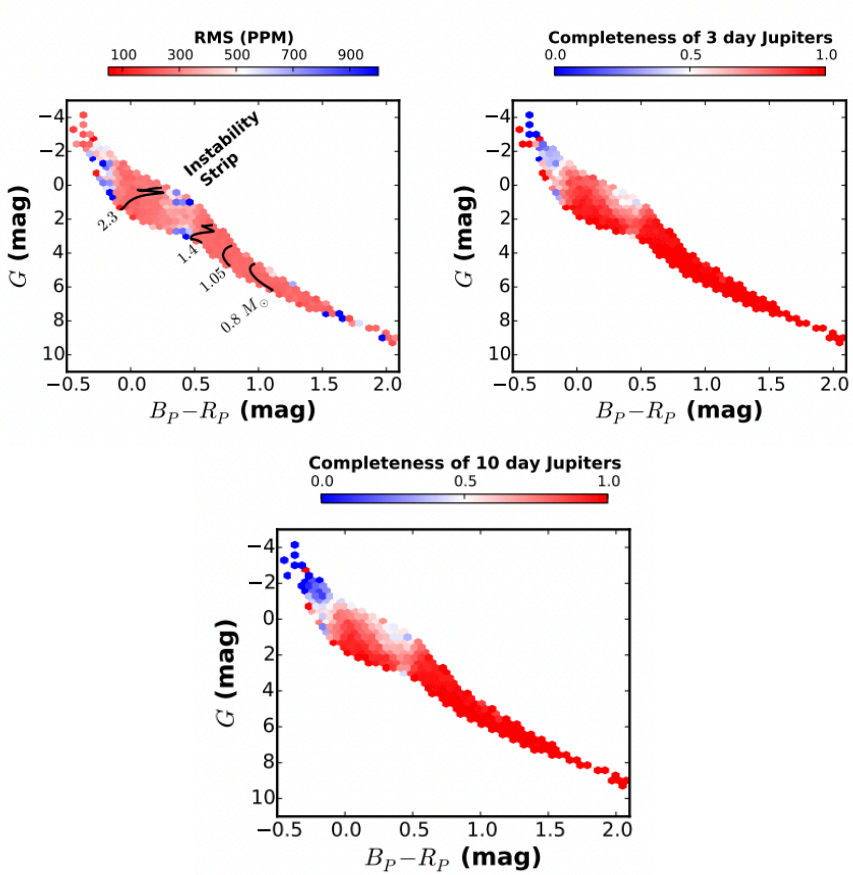
Gas giants legacy

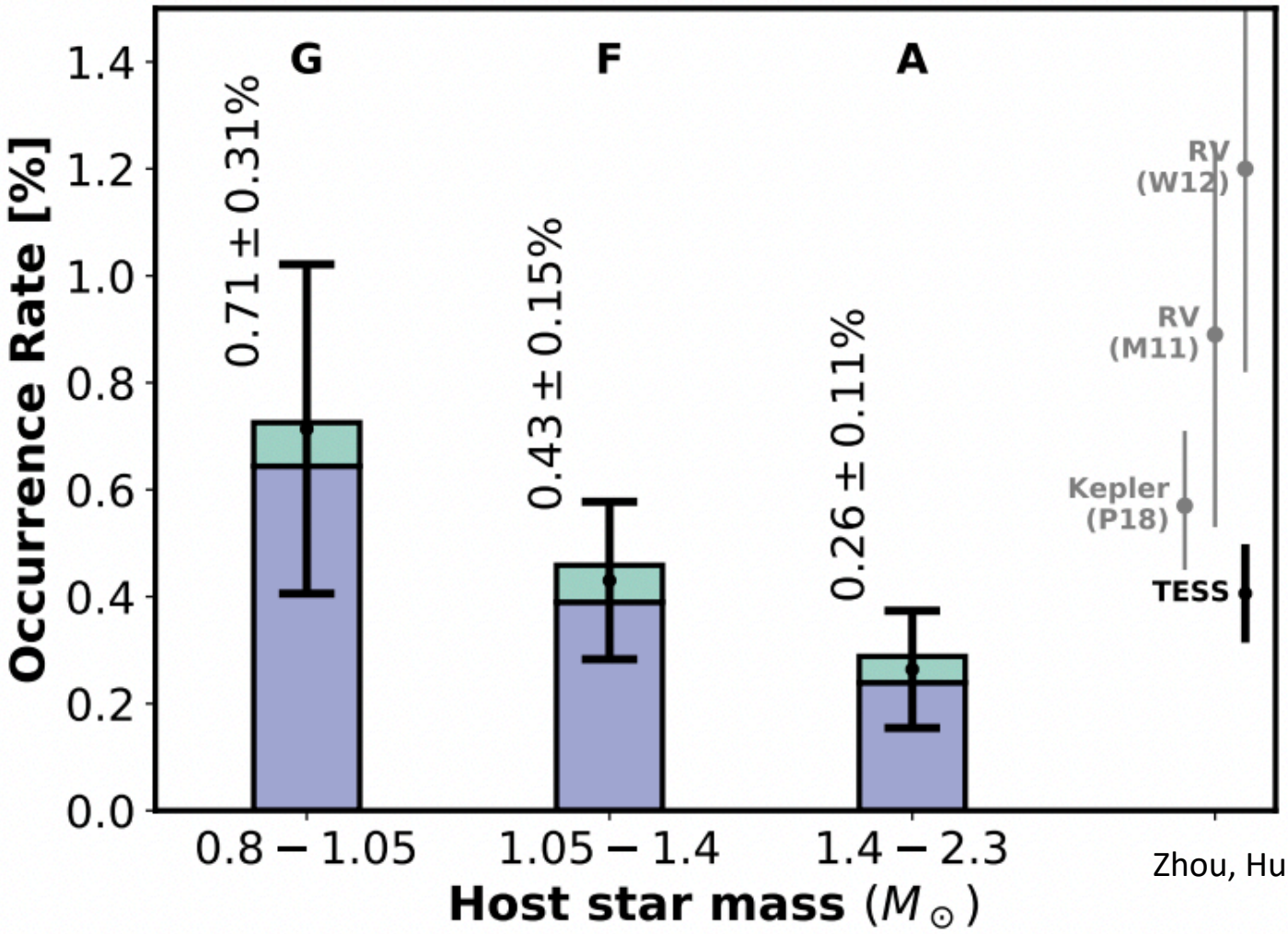
TESS is the perfect statistic mission for gas giants

- Good precision -> high completeness
- Bright stars -> easy to follow up
- Large number of stars -> detect rare population





Zhou, Huang et al (2019)

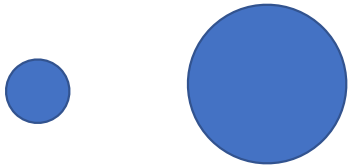


Zhou, Huang et al (2019)

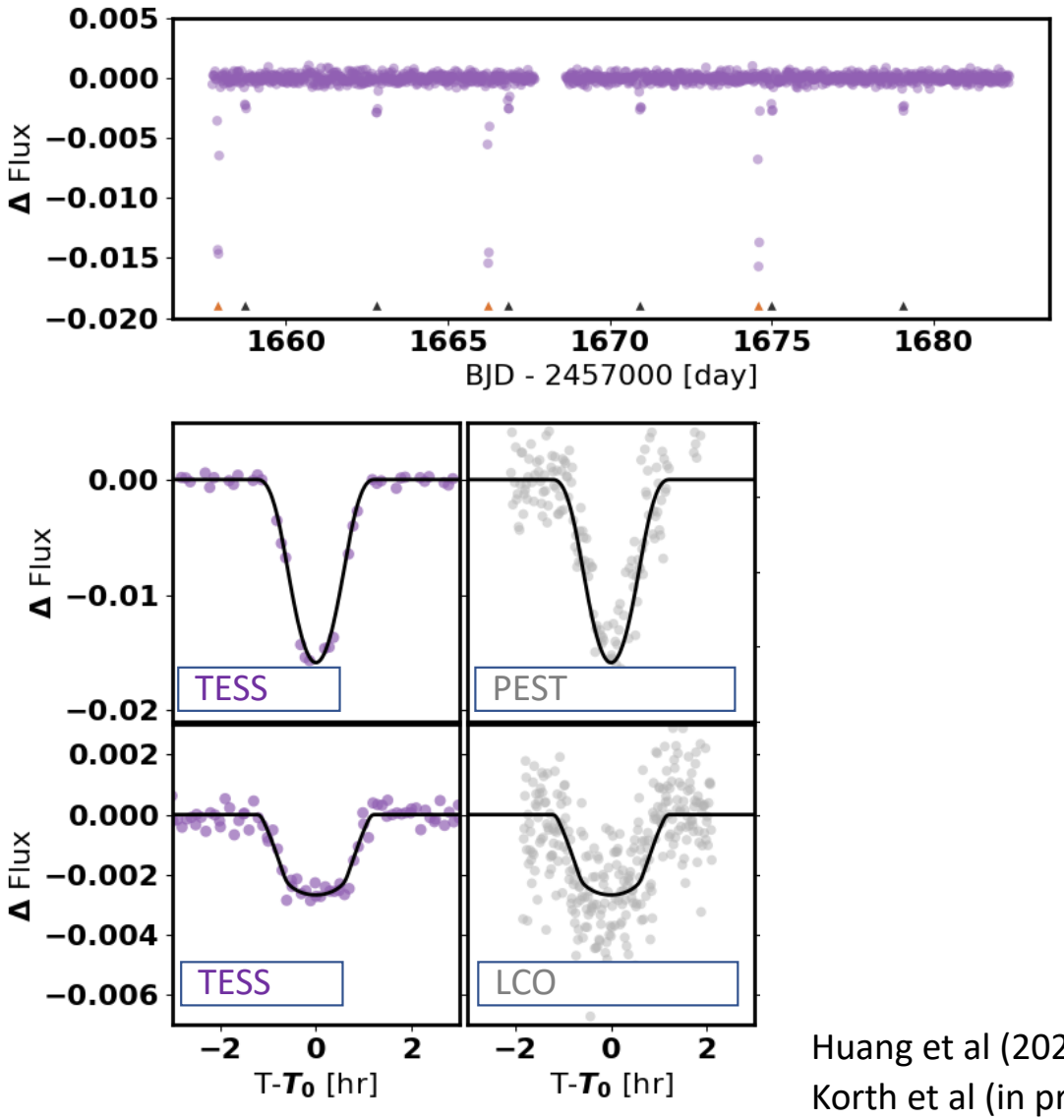
A rare planetary system discovered using TESS FFI

WASP-47 system

TOI-1130 system

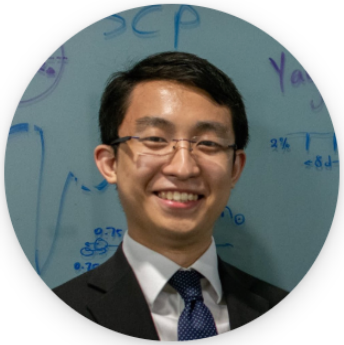


TOI-2000 system



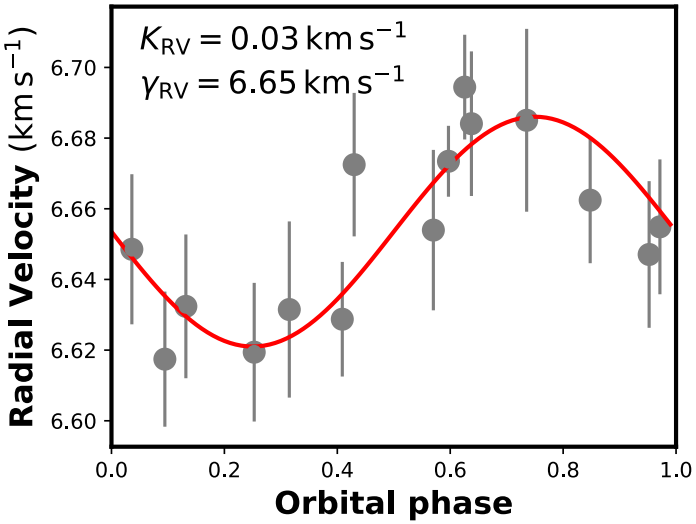
Huang et al (2020)
Korth et al (in prep)

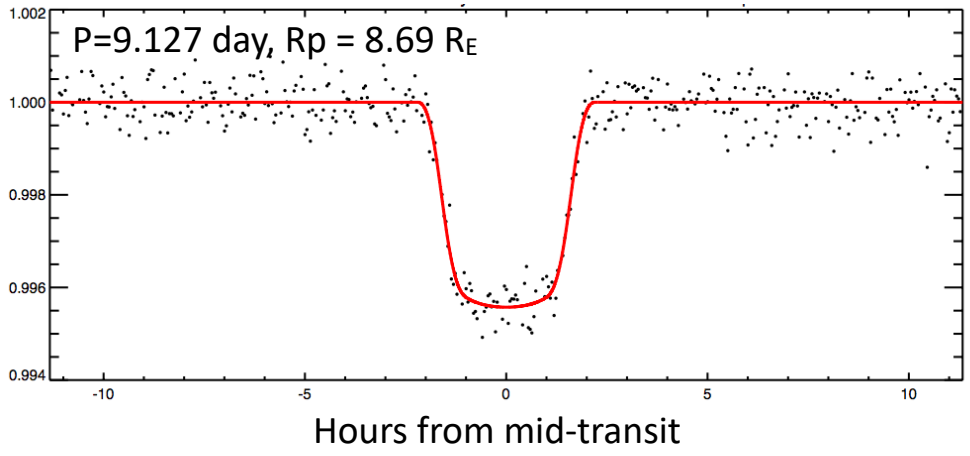
TOI-2000

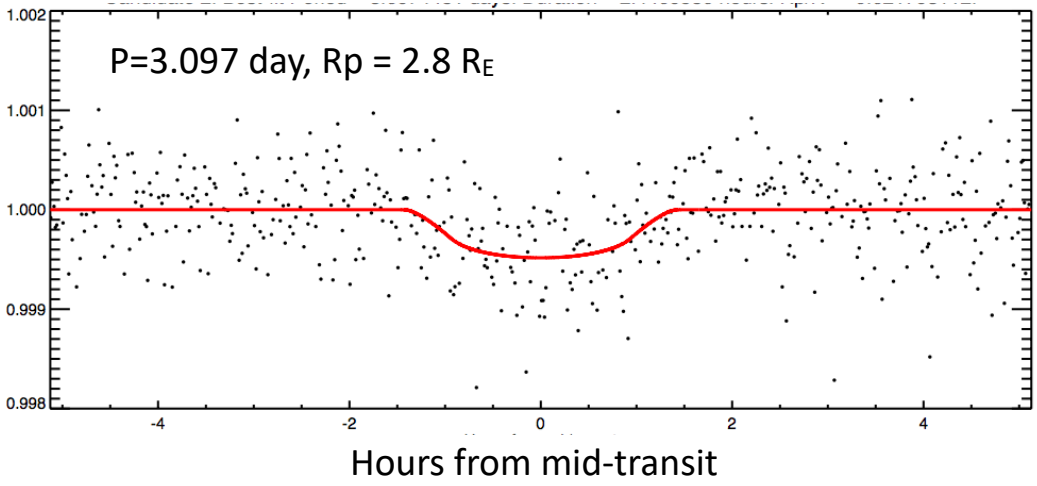


Lizhou Sha

University of Wisconsin-Maddison

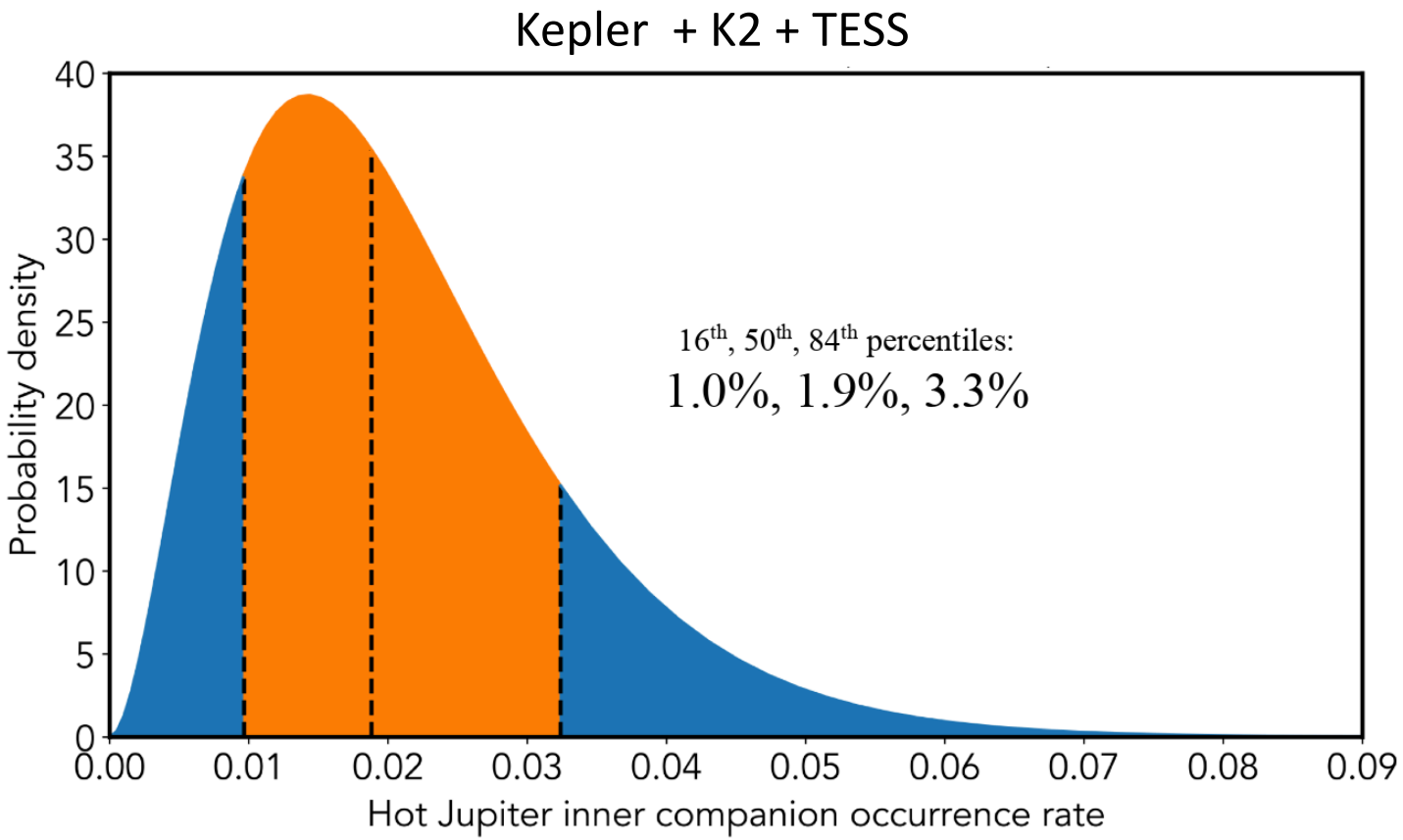




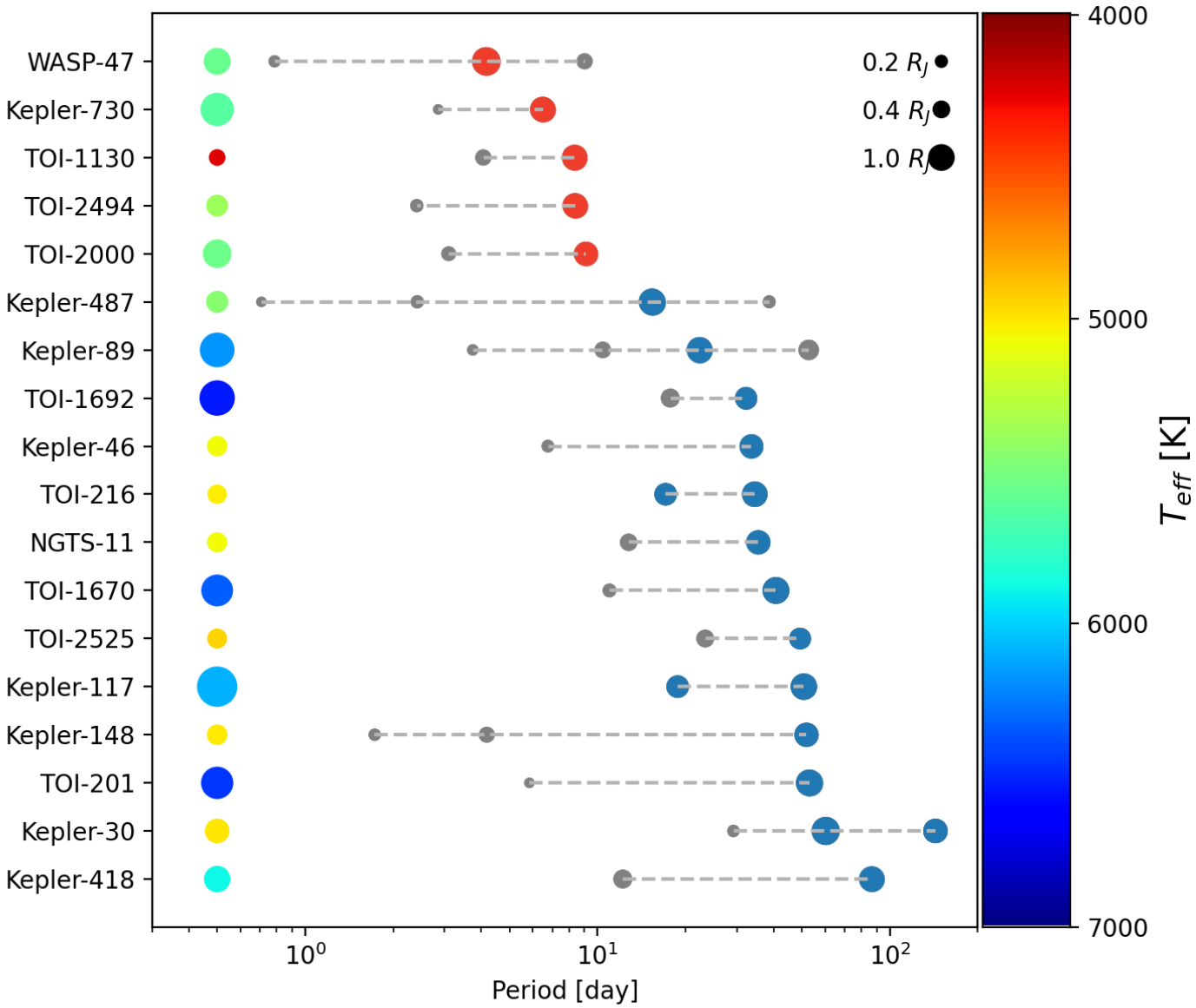


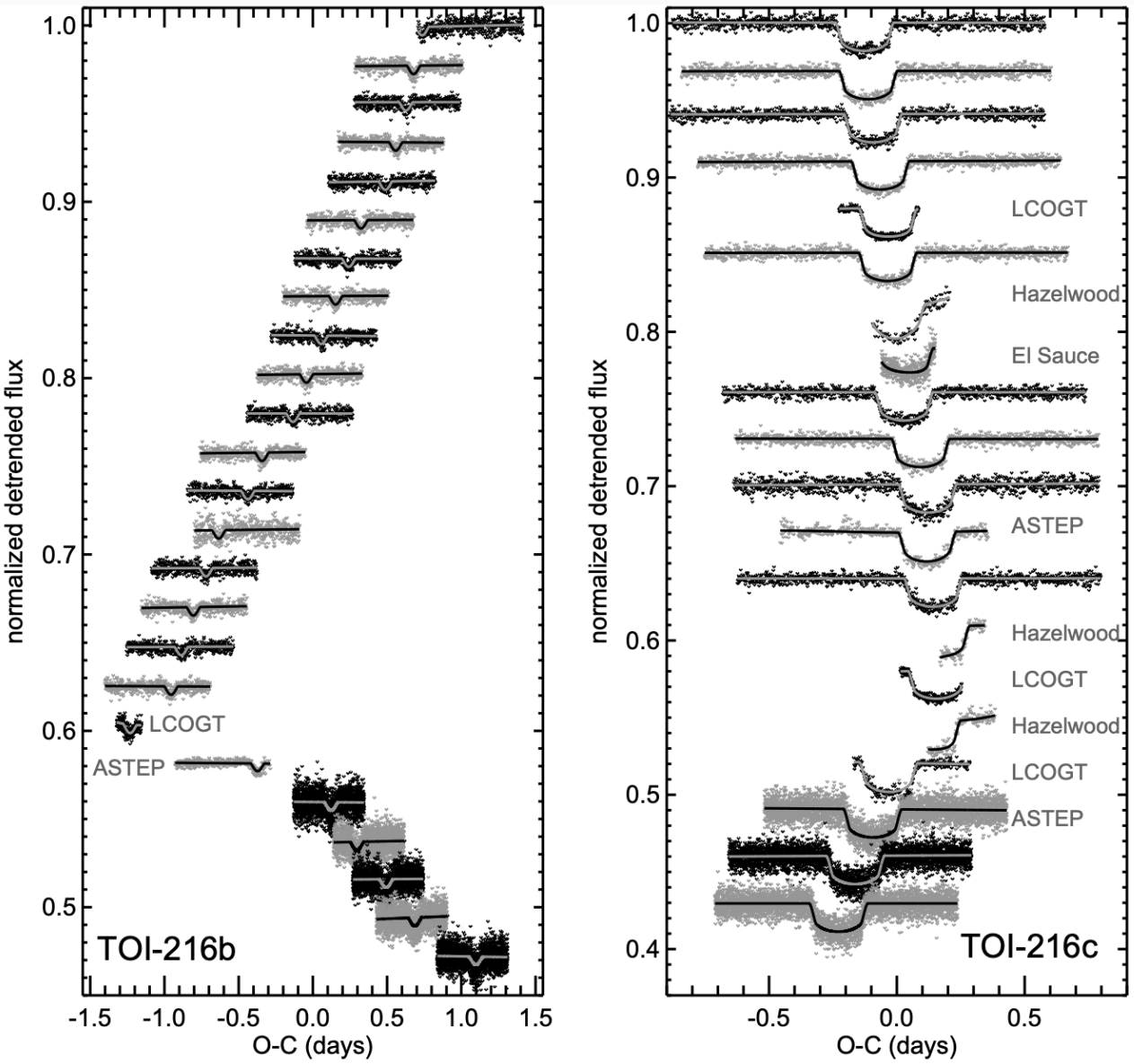
Sha et al in Prep

Refined Occurrence rate of Hot Jupiter inner transiting companions



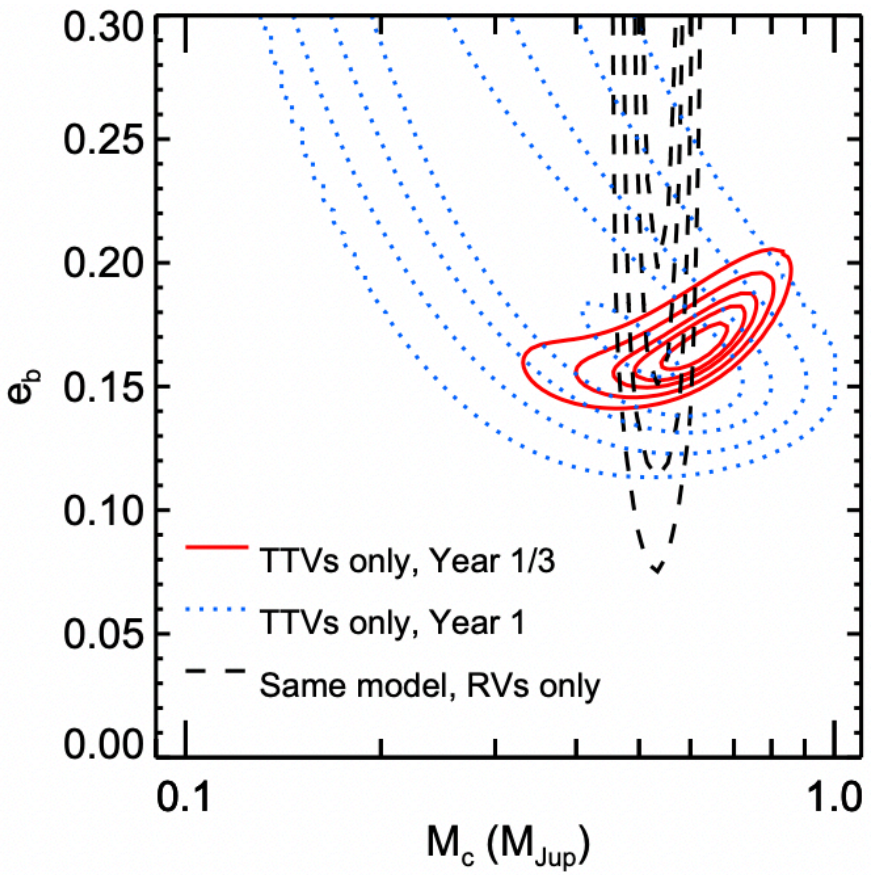
Sha et al in Prep

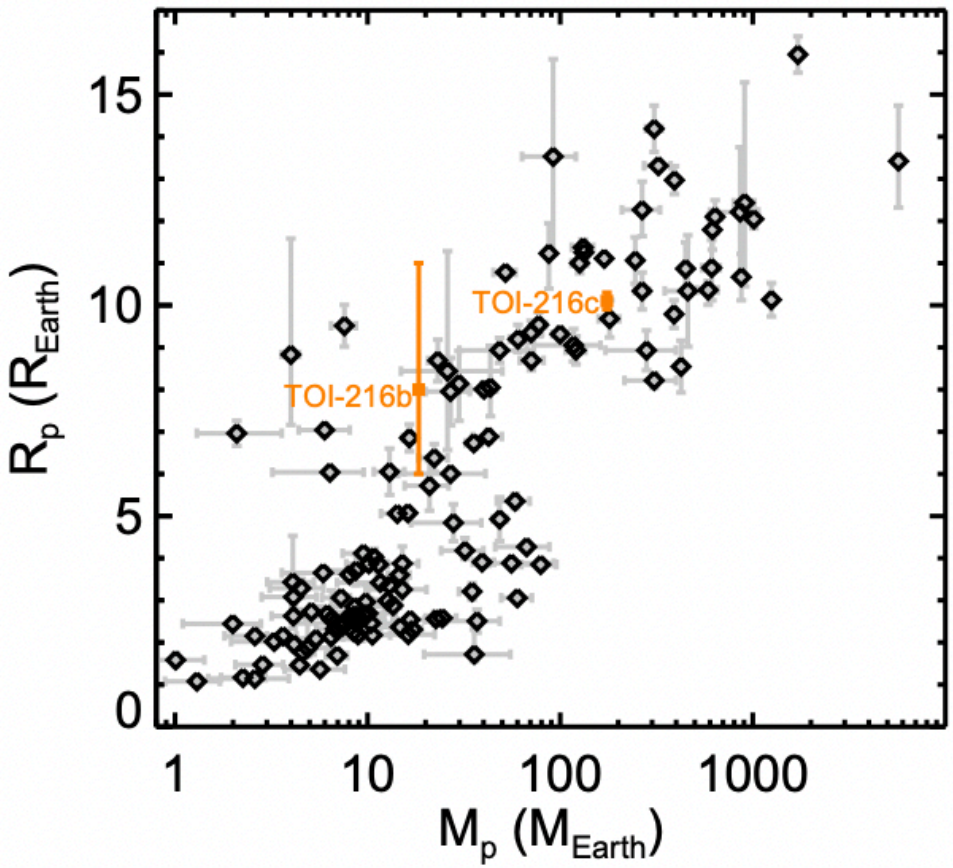

WASP-47
Kepler-730
TOI-1130
TOI-2494
TOI-2000
Kepler-487
Kepler-89
TOI-1692
Kepler-46
TOI-216
NGTS-11
TOI-1670
TOI-2525
Kepler-117
Kepler-148
TOI-201
Kepler-30
Kepler-418
0.2 R_J
0.4 R_J
1.0 R_J
10^0
10^1
10^2
Period [day]
4000
5000
6000
7000
T_{eff} [K]



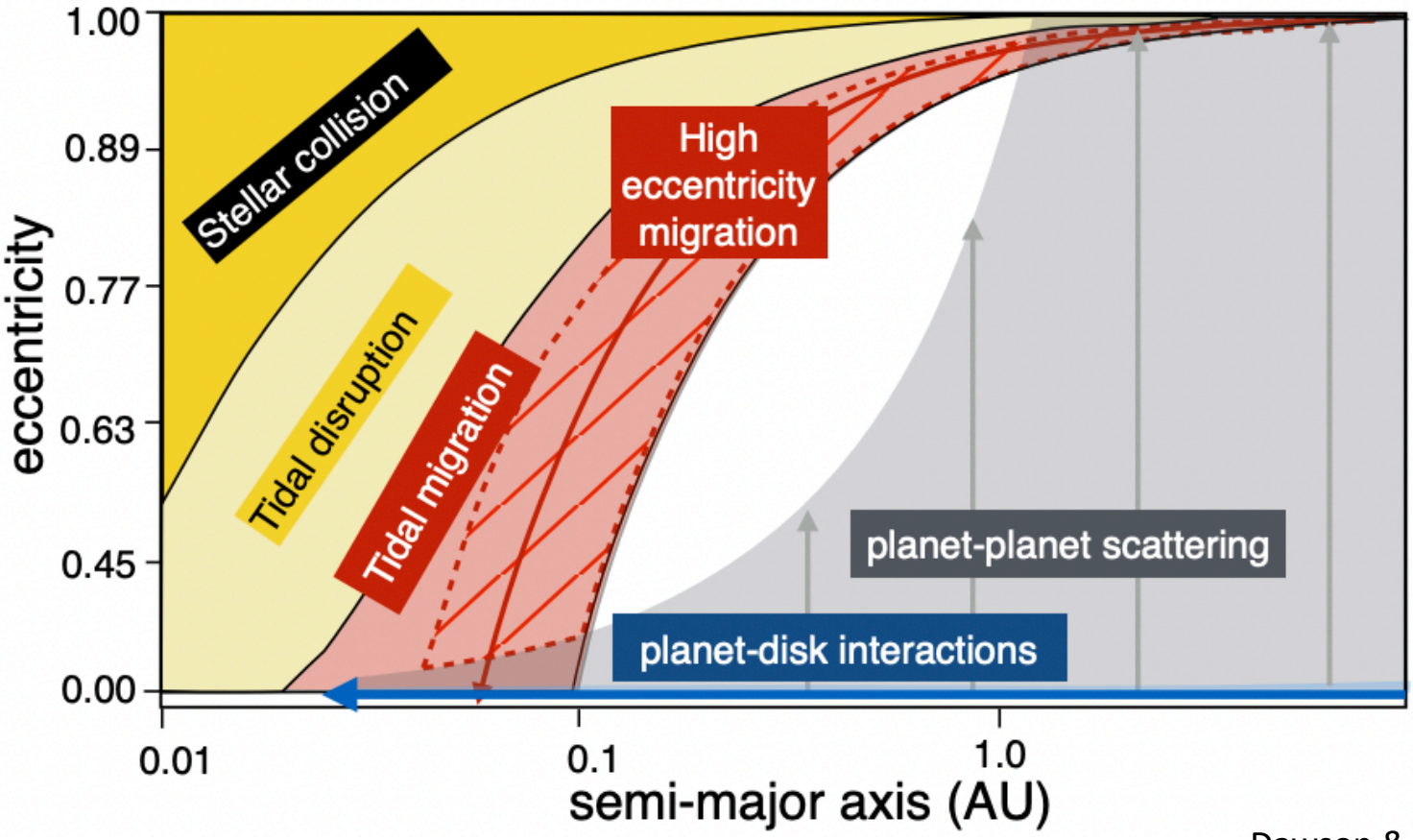
TOI-216
TESS's King of TTV

Dawson et al (2019, 2021)





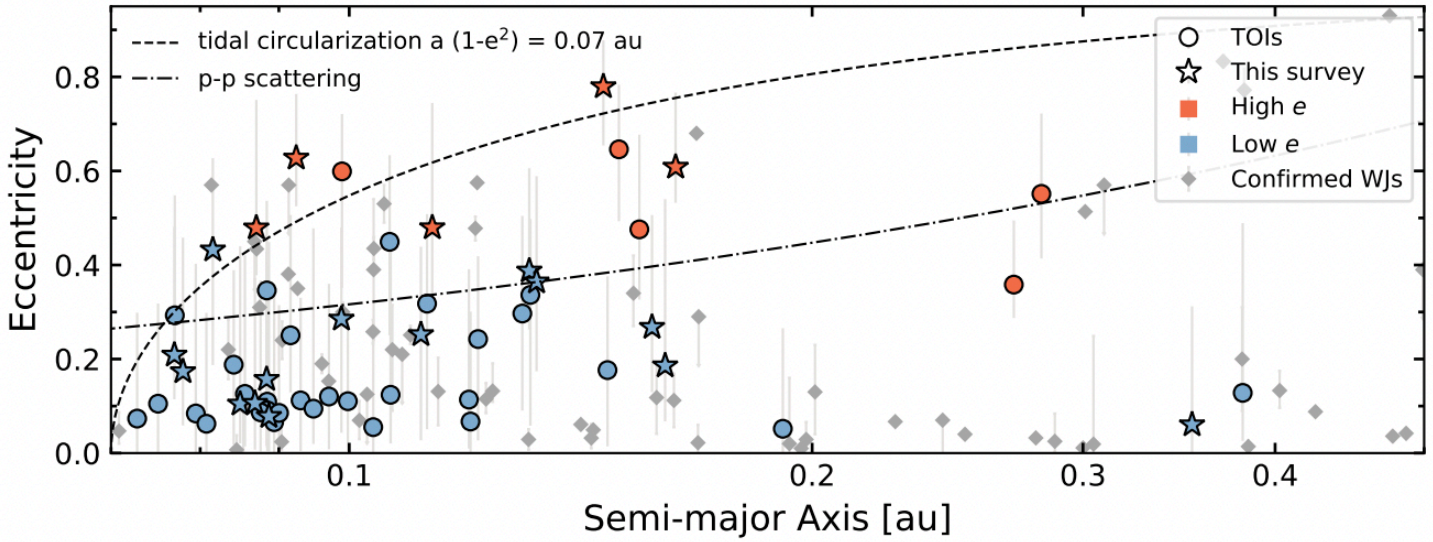
Dawson et al (2019, 2021)



Dawson & Johnson (2018)

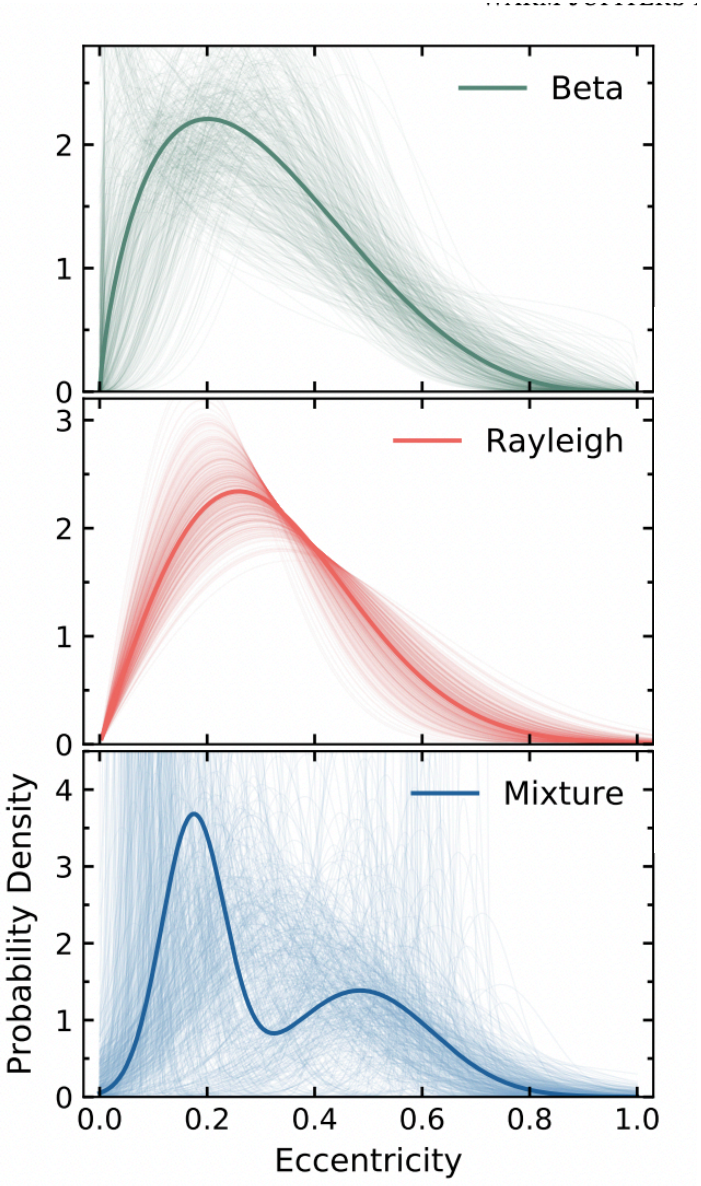
DJ Dong
PSU

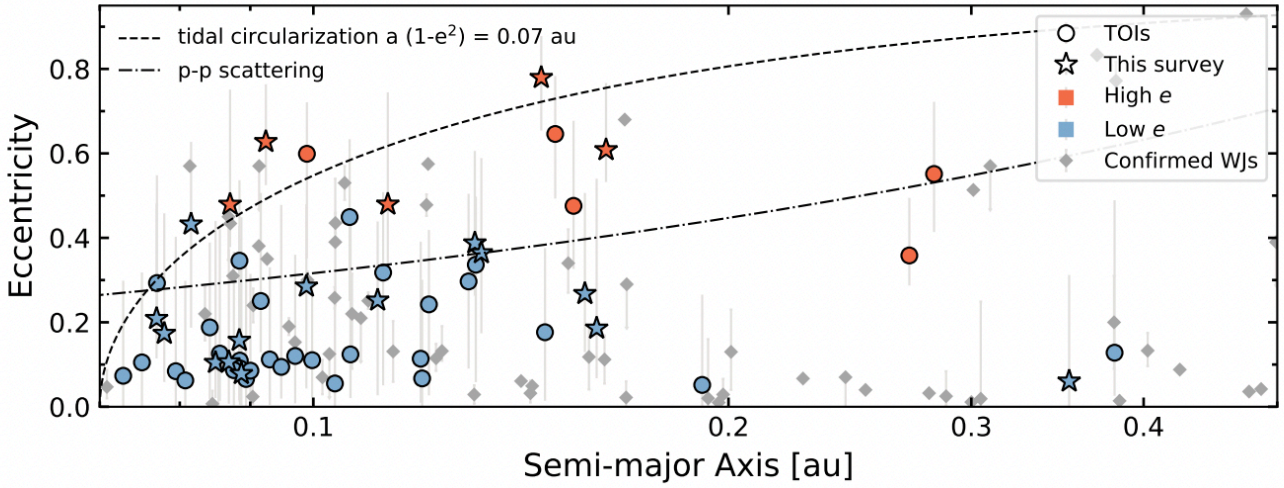
Uniform Search of Warm Giant Planets in Y1 TESS FFIs



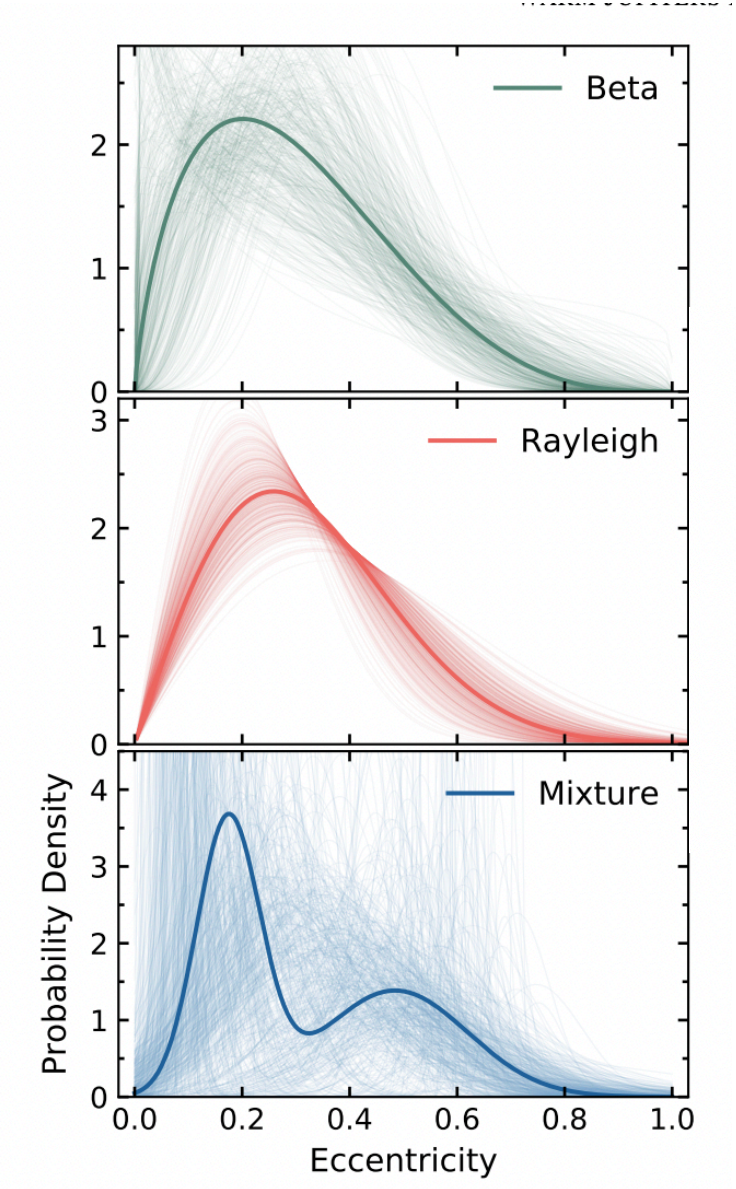
*Eccentricity of all TESS Warm Jupiters are uniformly measured with photo-eccentric effect

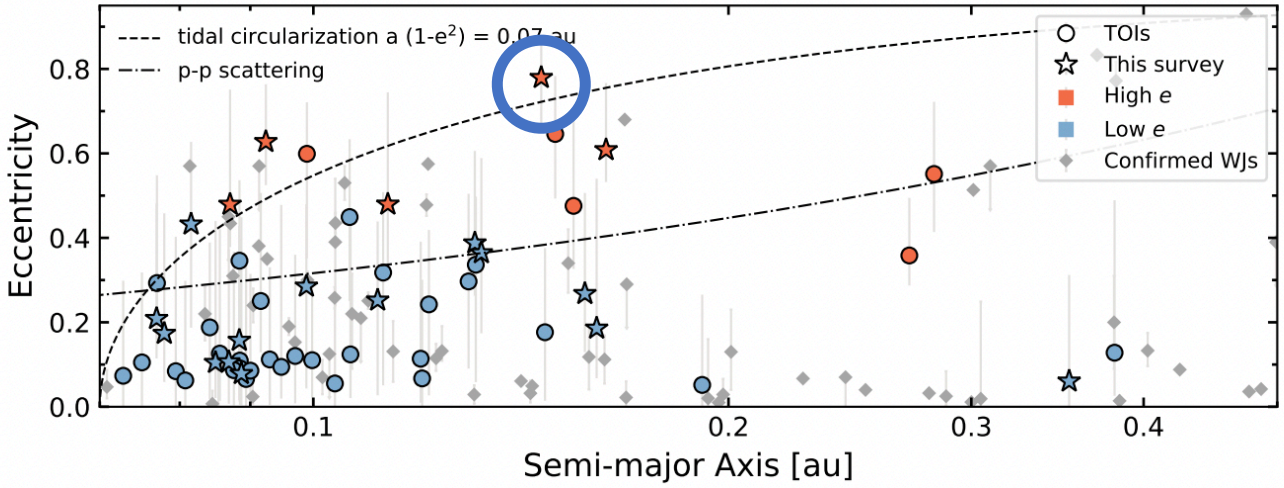
Dong et al 2021



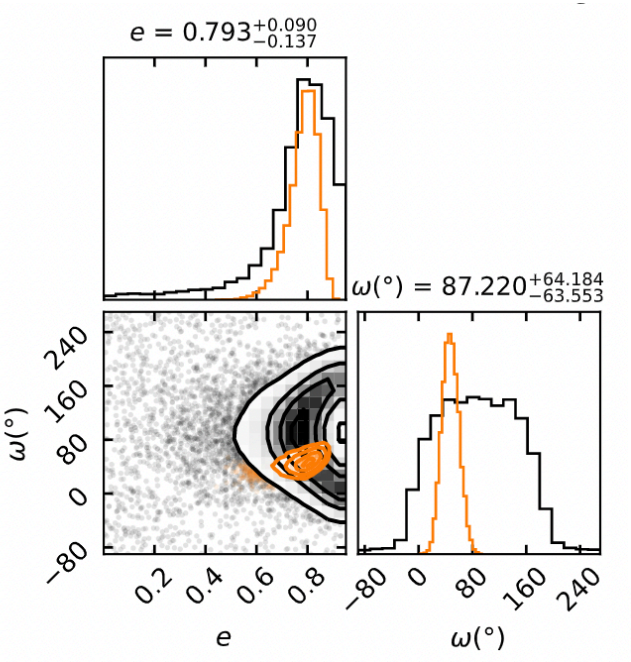


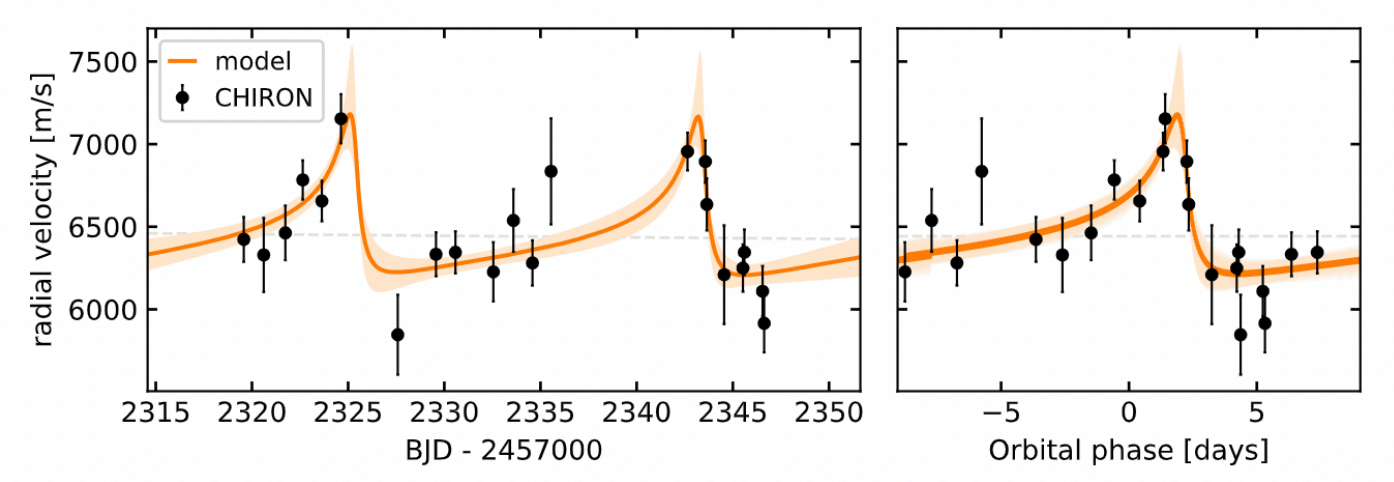
Dong et al 2021

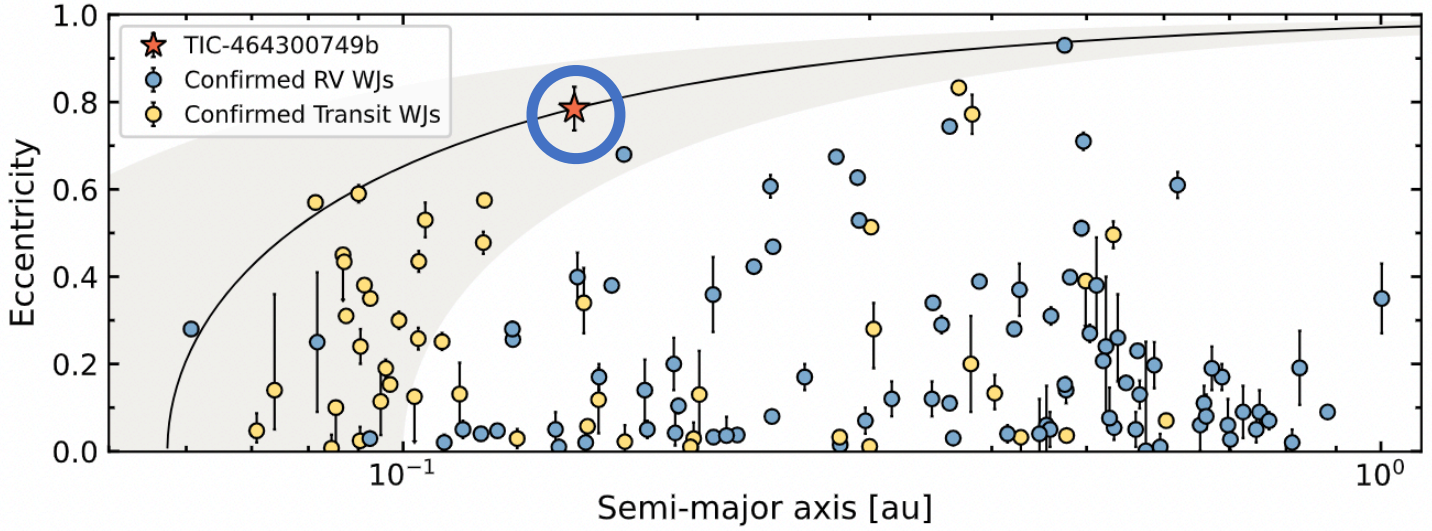




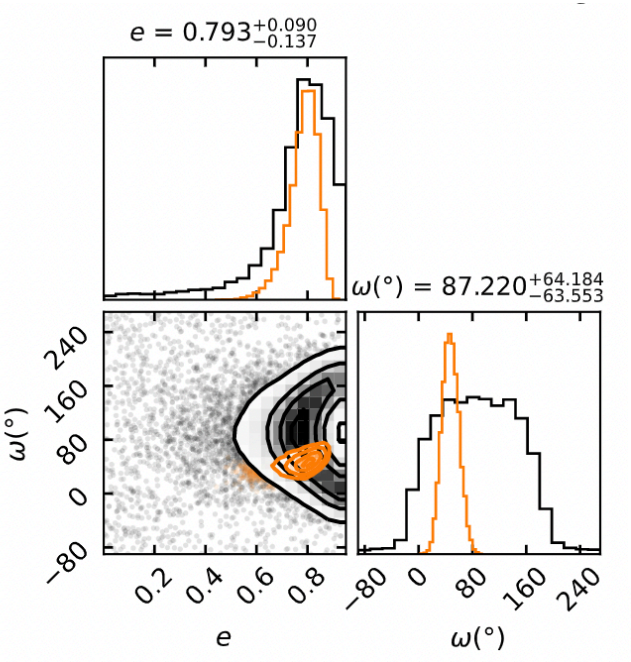
Dong et al 2021



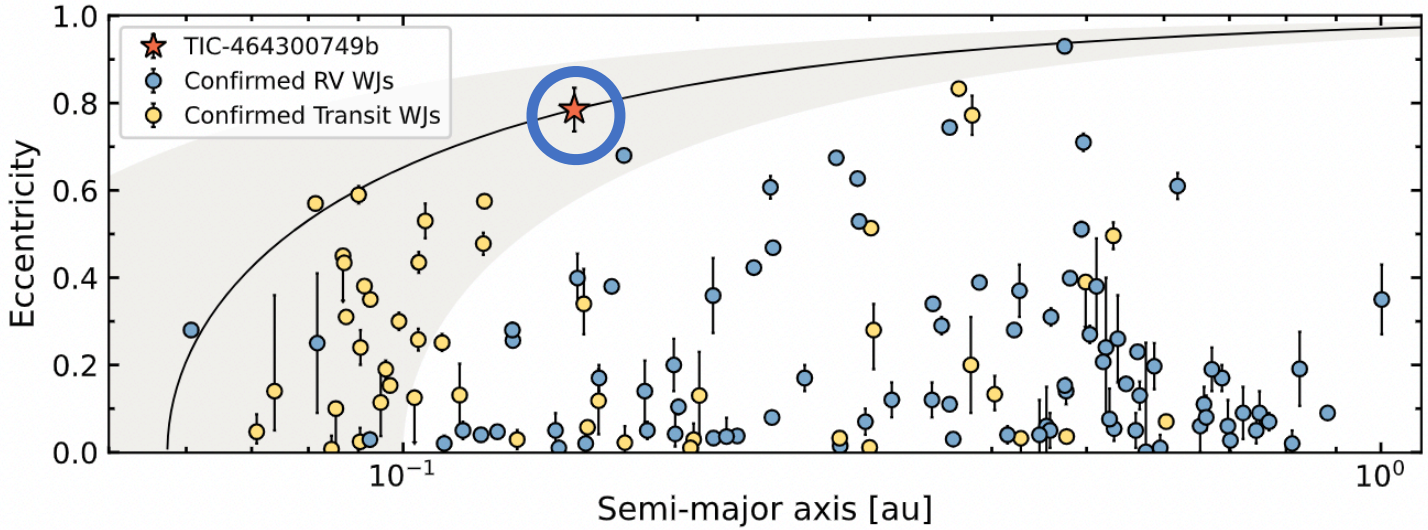




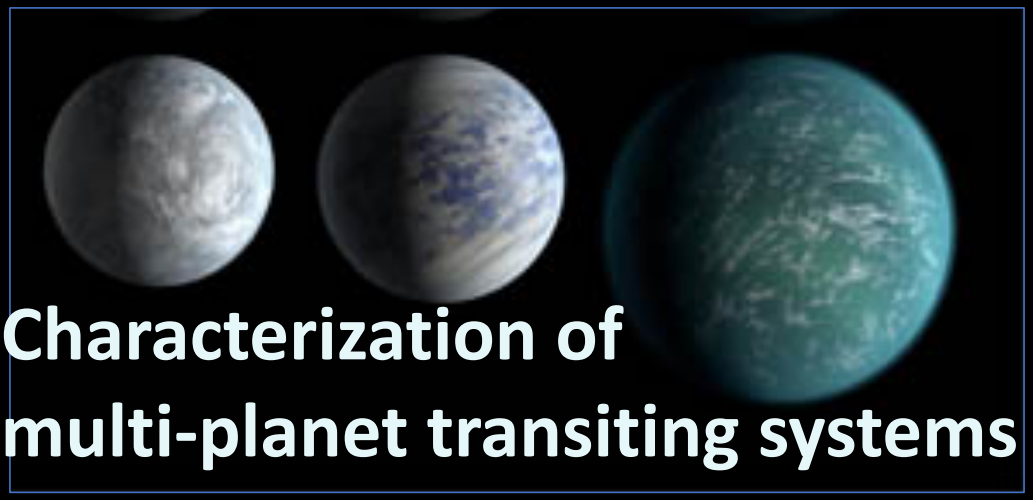
Dong et al to be submitted

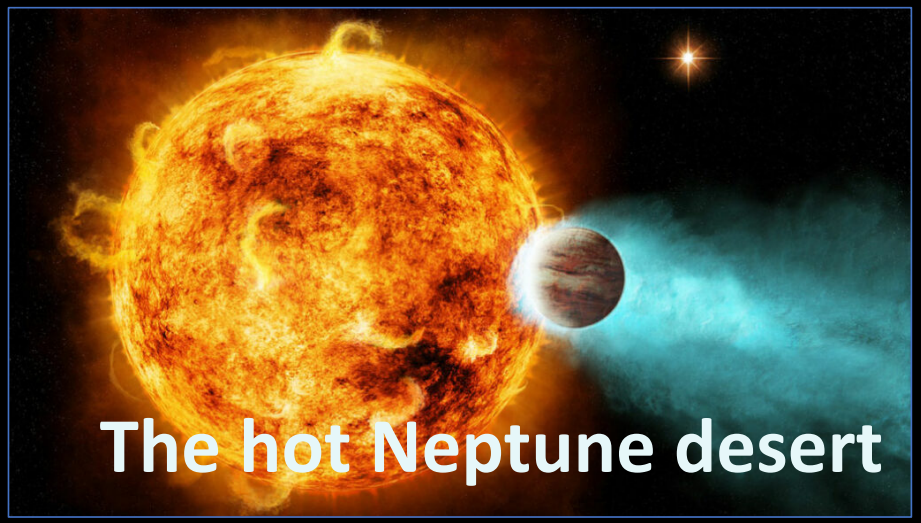


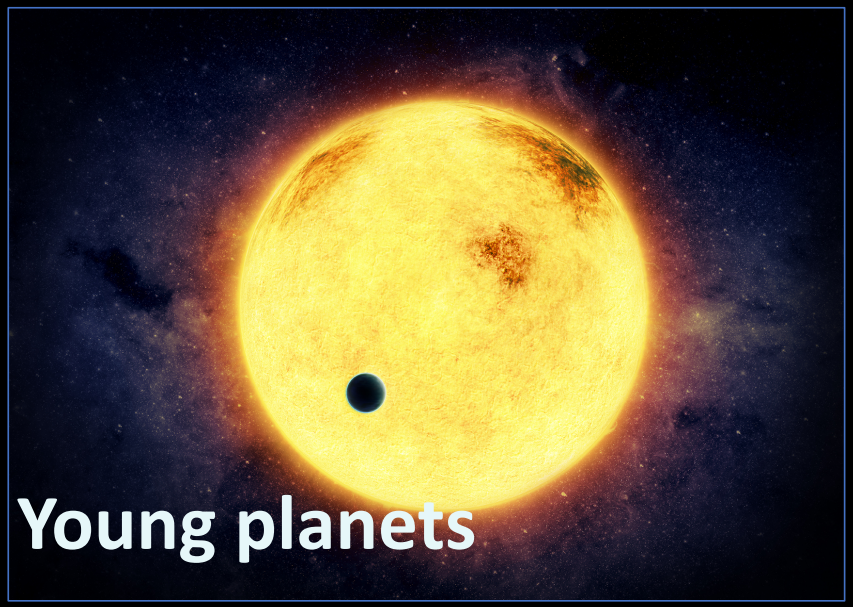
First Proto-hot Jupiter discovered by Transits



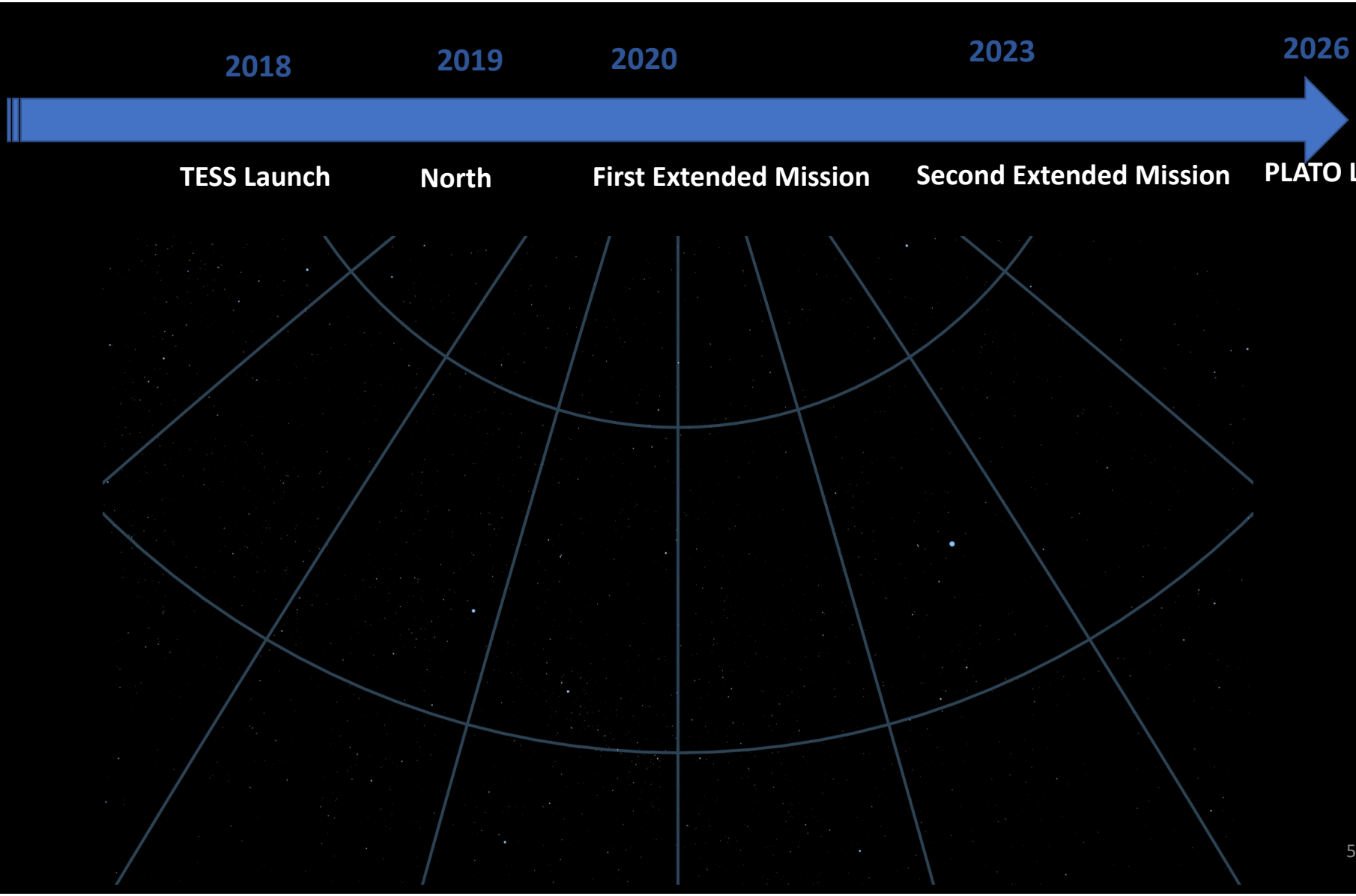
Dong et al to be submitted


Characterization of
multi-planet transiting systems


The hot Neptune desert


Young planets


Gas giants legacy


2018
2019
2020
2023
2026
TESS Launch
North
First Extended Mission
Second Extended Mission
PLATO Launch


AROUND the Earth


Credit (alphabetical order):
Exoplanet community
MAST (STSCI)
MIT TESS Science Office
MIT TESS Payload Operation Center
NASA AMES Research Center Science Processing Operations Center
NASA's Goddard Space Flight Center
Orbital Sciences Corporation
Smithsonian Astrophysical Observatory
TESS Follow Up Observing Program
TESS Science Support Center
…