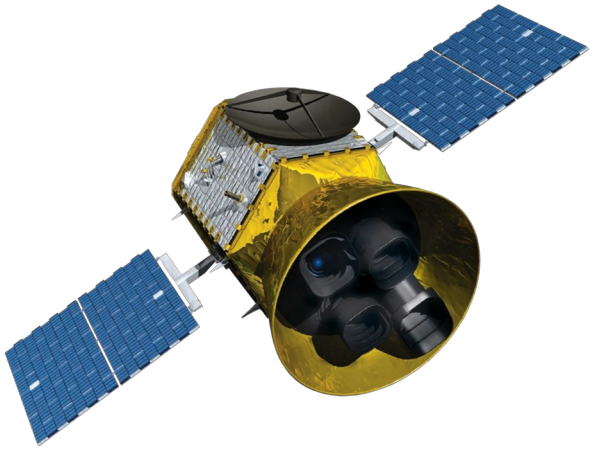
The role of PLATO in the era of TESS extended missions



Dr. Paul A. Strøm
PLATO Science Management Office
University of Warwick

NAM 2021

PLATO

PLAnetary Transits and Oscillations of stars

An ESA M3 mission expected launch in 5 years.

Main goal is to detect Earth-size planets in the habitable zones of stars similar to our own.

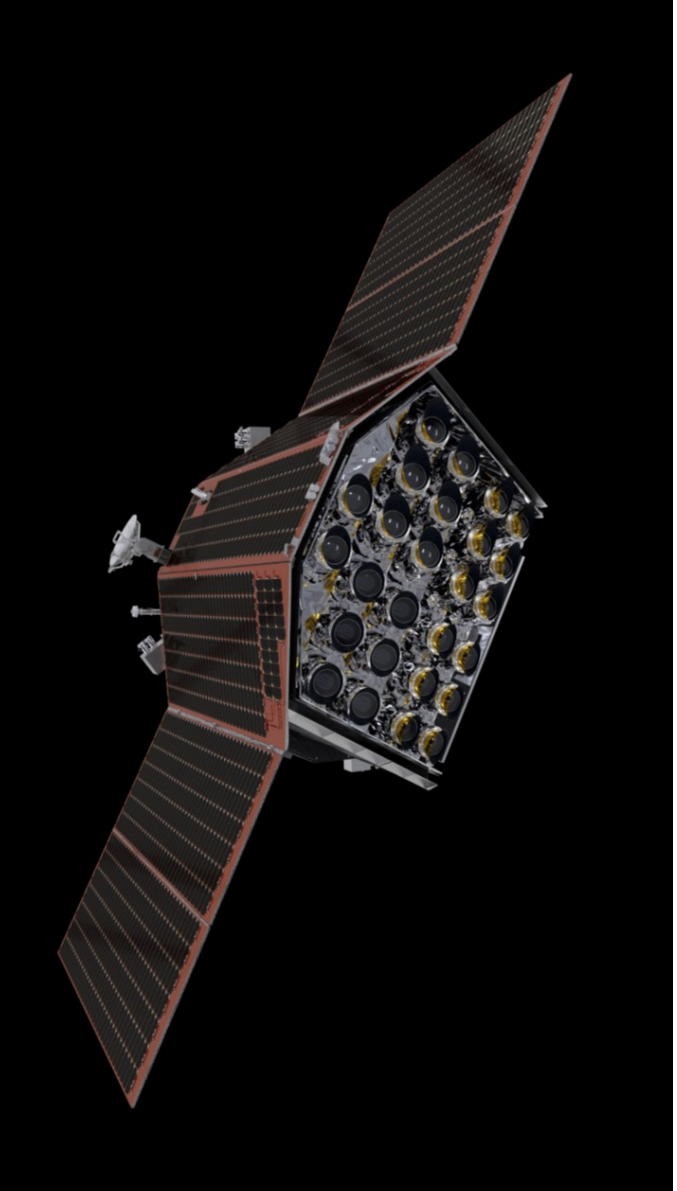
PLATO has also been designed to investigate seismic activity in stars, enabling the precise characterisation of the planet host star, including its age.

PLATO

Has an extensive **on ground follow-up network**

Together with the asteroseismology component this allows for **accurate bulk characterisation** of exoplanet systems.

Provides information about **typical architectures**, and how theses systems depend on the **properties of their host stars** and the **environment**.



PLATO

26 cameras:

- 24 regular cadence cameras (25s readout cadence) arranged into 4 groups
- 2 fast (2.5s readout cadence)

Photometry of **>15,000 solar-like stars** with $m_v \leq 11$ and a precision of <50 ppm in 1 hour.

Photometry of **> 245,000 stars** with $m_v \leq 13$.

RV spectroscopy for >100 stars (goal: 400) stars.

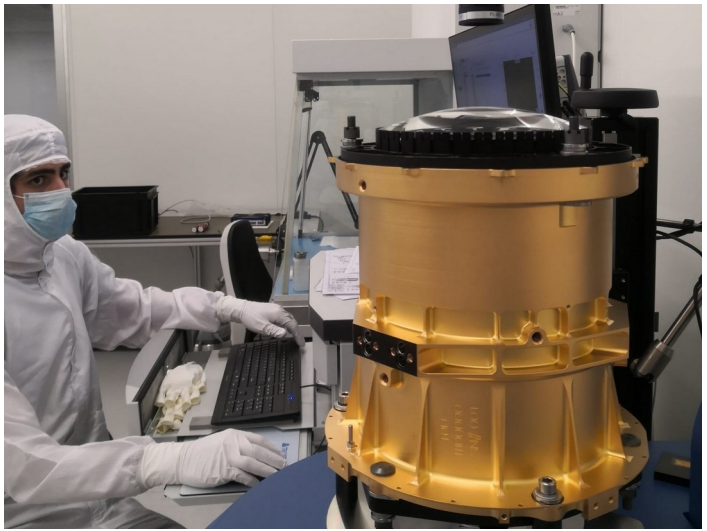
It will be placed at **Sun-Earth L2**

Recent progress

Engineers and scientist across Europe are busy **building and testing PLATO**.

The optical verification of the Telescope Optical Unit

Vibration and thermal vacuum testing of components



Credit: University of Bern TOU team

Credit: @RuagSpace

Similarities with TESS

PLATO and TESS have a number of similarities:

- Both are capable of detecting **Earth-sized exoplanets**
- Both are or will **observe over 250,000 pre-selected targets** (postage stamps)
- Both will detect exoplanets around bright stars which will be **ideal candidates for RV and follow-up** (e.g. JWST and ARIEL)

Comparison with TESS

There are two main differences as a result of **different science goals**:

The photometric precision:

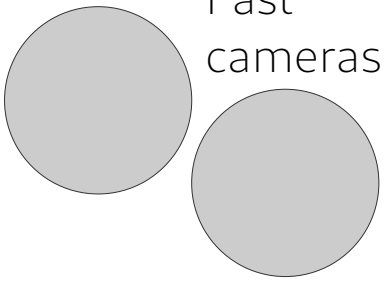
PLATO has a higher photometric precision making it capable of detecting small planets around Sun-like stars.

The observing strategy:

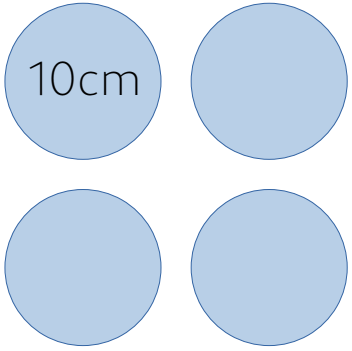
TESS wants to **maximise the exoplanetary detection yield** by covering as much of the sky as possible to find bright and nearby planets.

PLATO wants to increase the likelihood and sensitivity in detecting **longer period** planets with focus on **smaller planets** around FGK stars and will thus **observe a for longer at a given pointing** with **multiple cameras**.

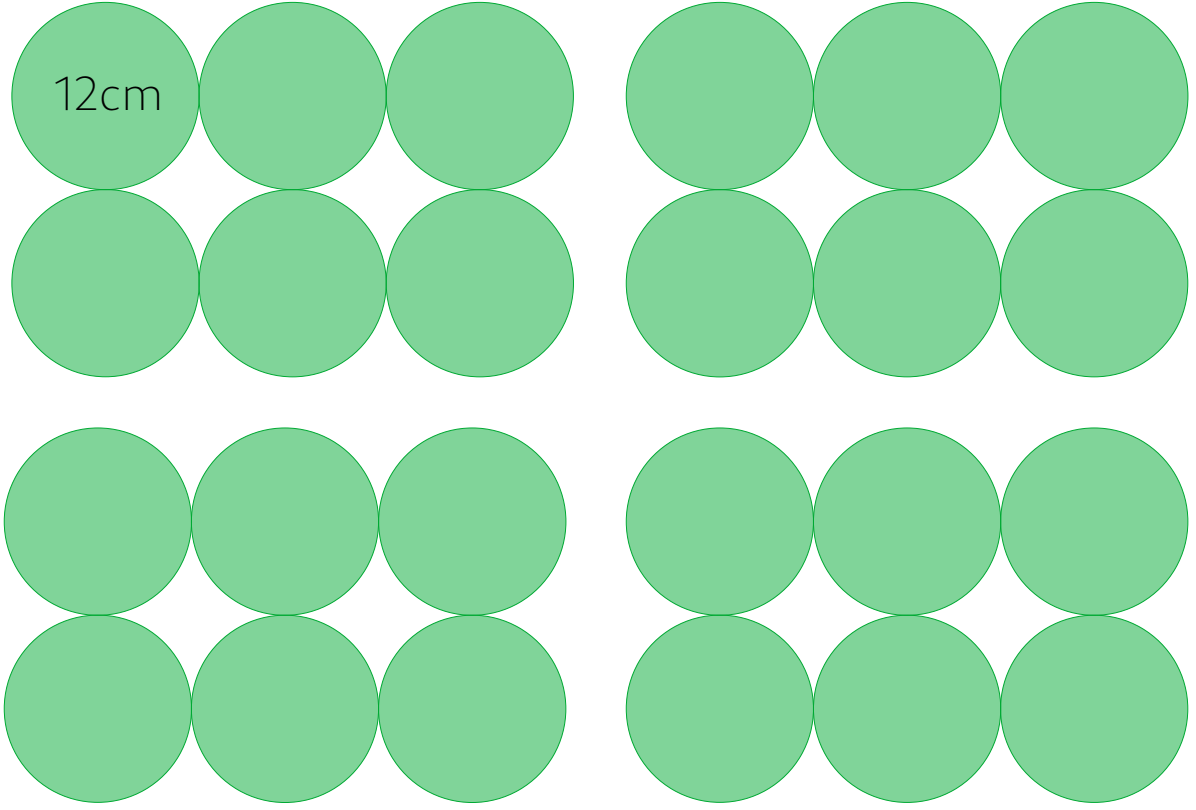
Photon collecting capacity



TESS

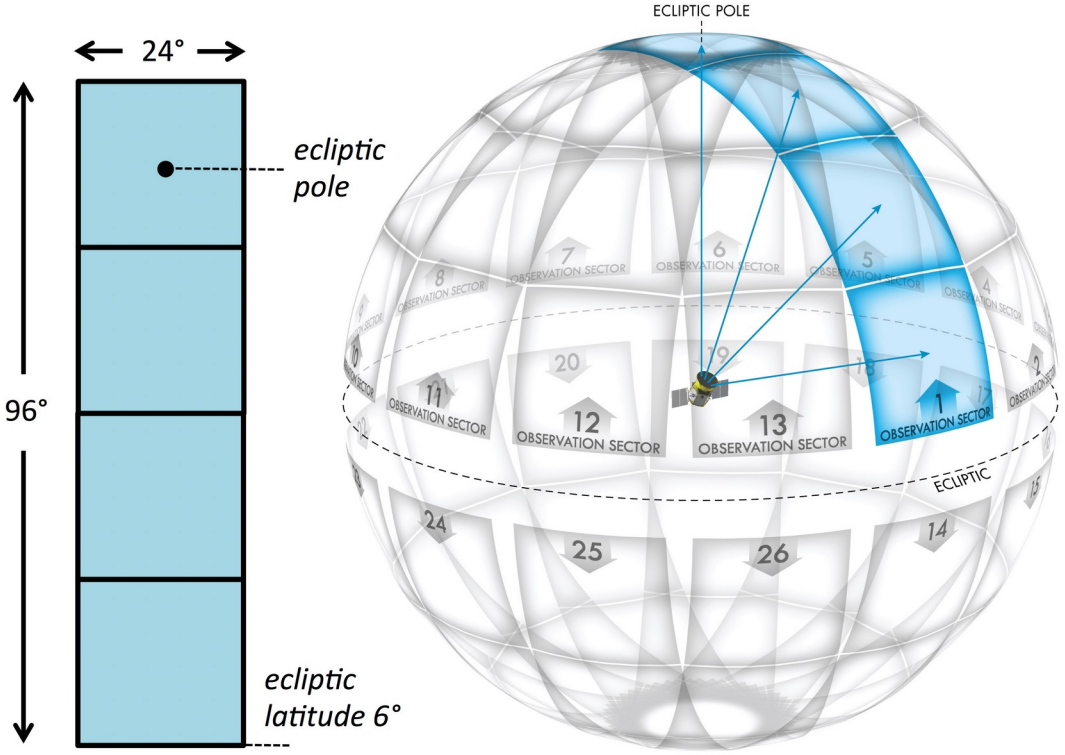


PLATO

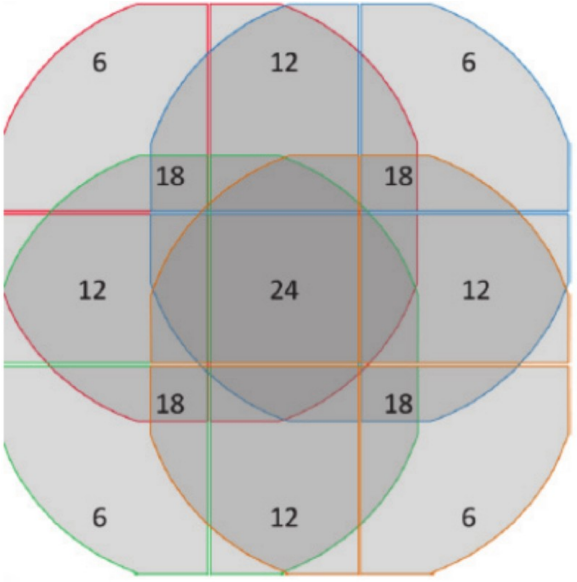


PLATO has ~9x the photon collecting capacity of TESS

TESS



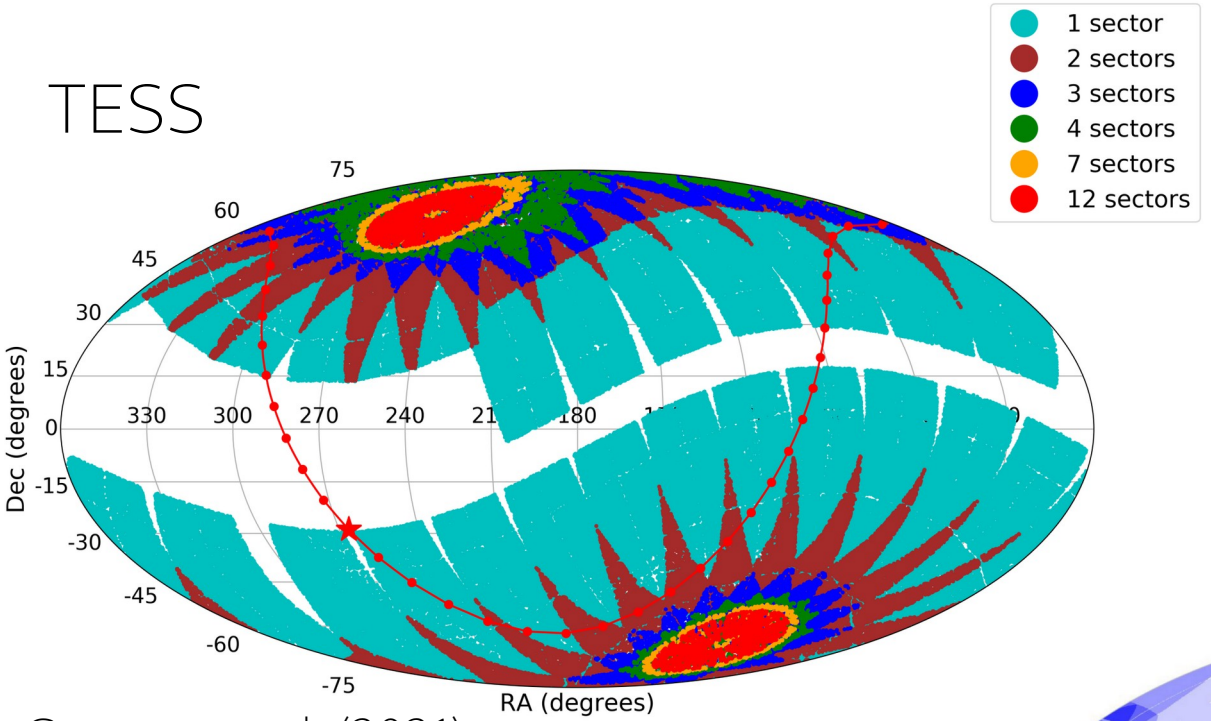
PLATO



Overlapping PLATO cameras ensures that ~8-34x more photons are collected compared to TESS for a given area.

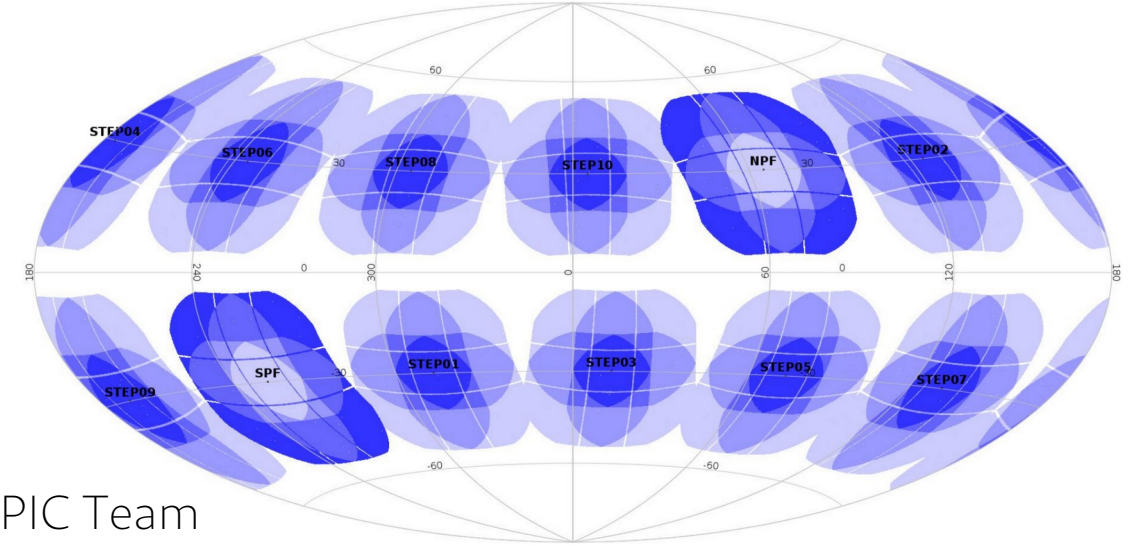
Observing strategy

TESS



Guerrero et al. (2021)

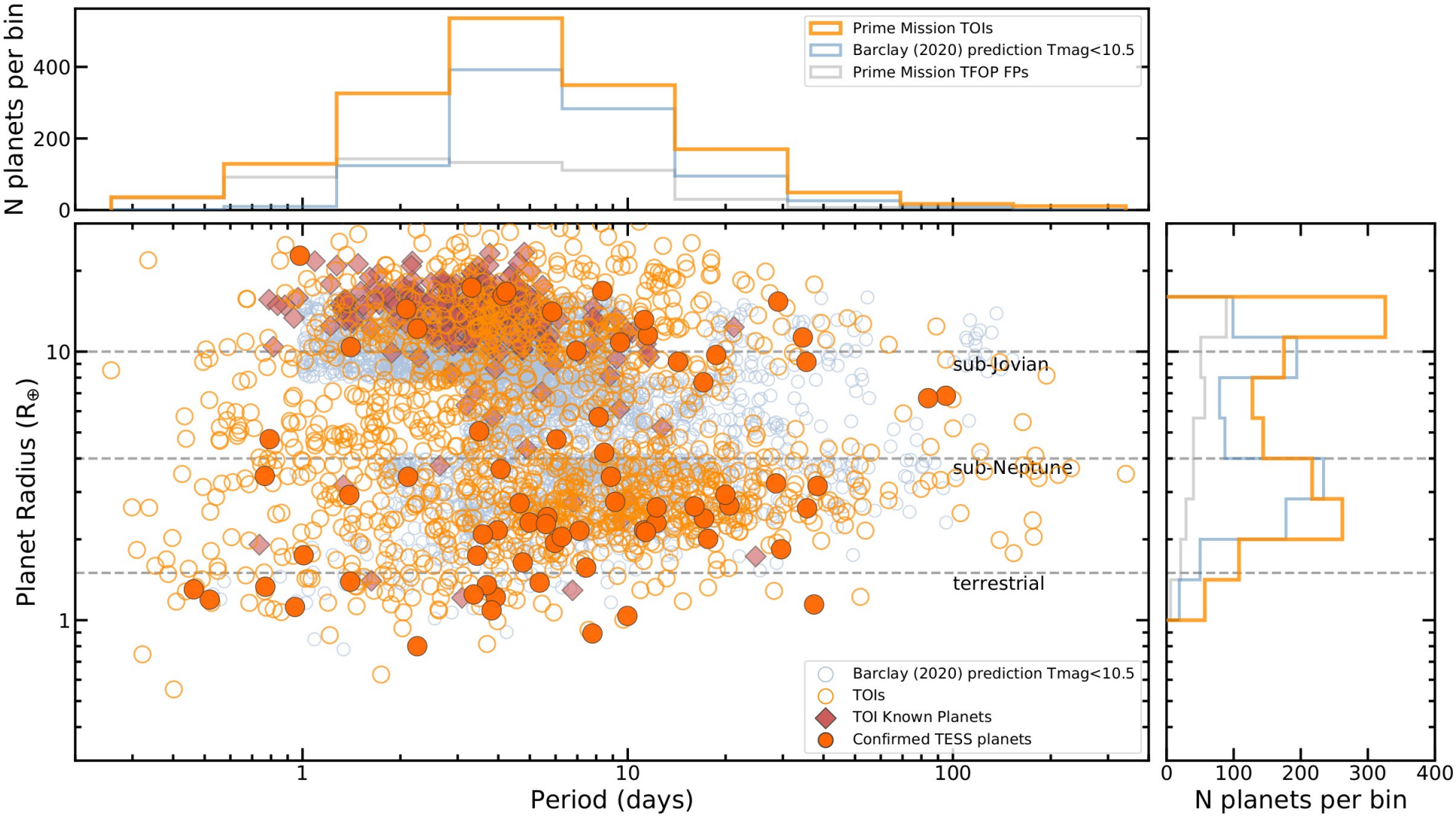
PLATO



PLATO PIC Team

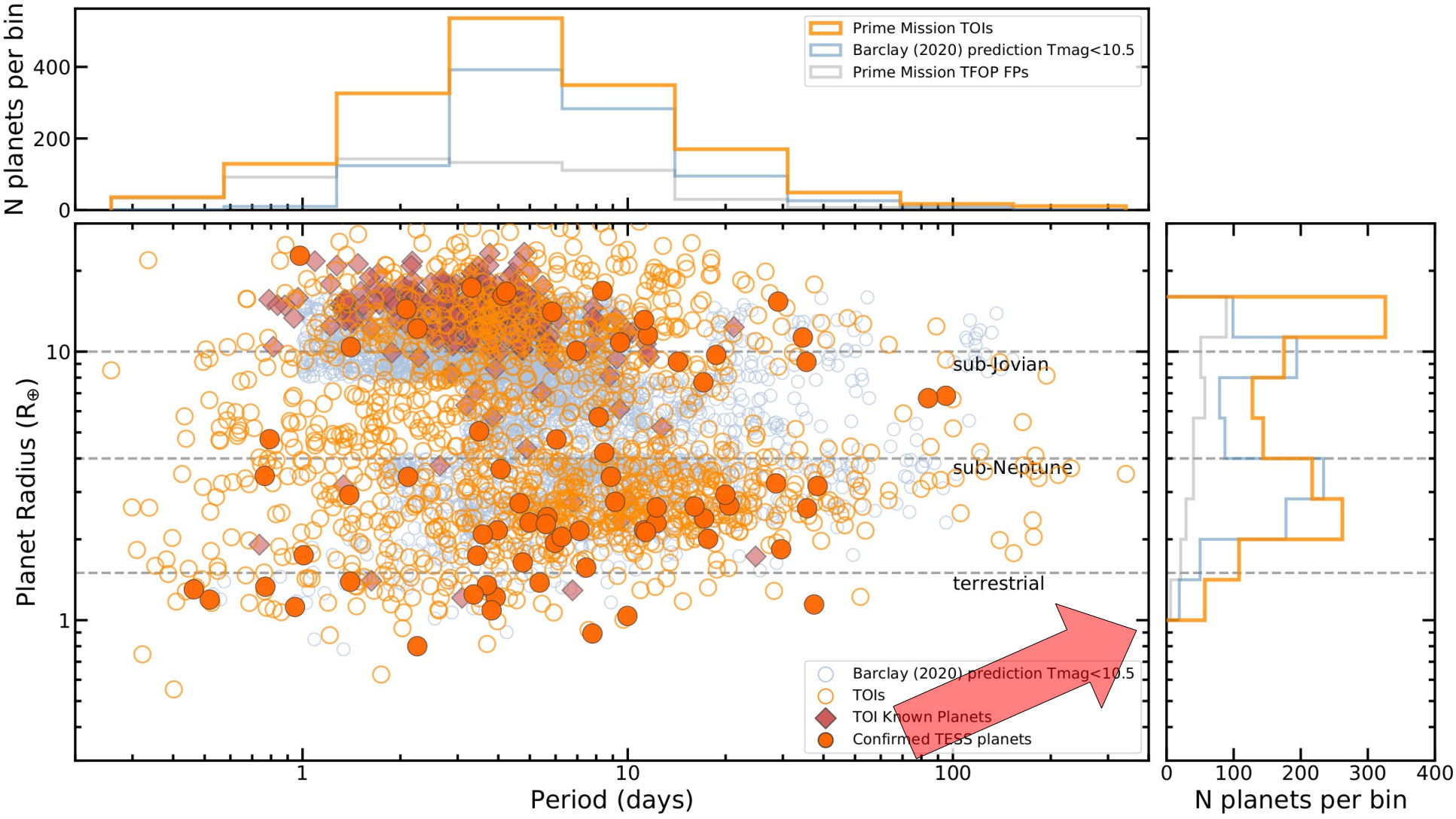
TESS Prime Mission TOI Catalog

Guerrero et al. (2021)



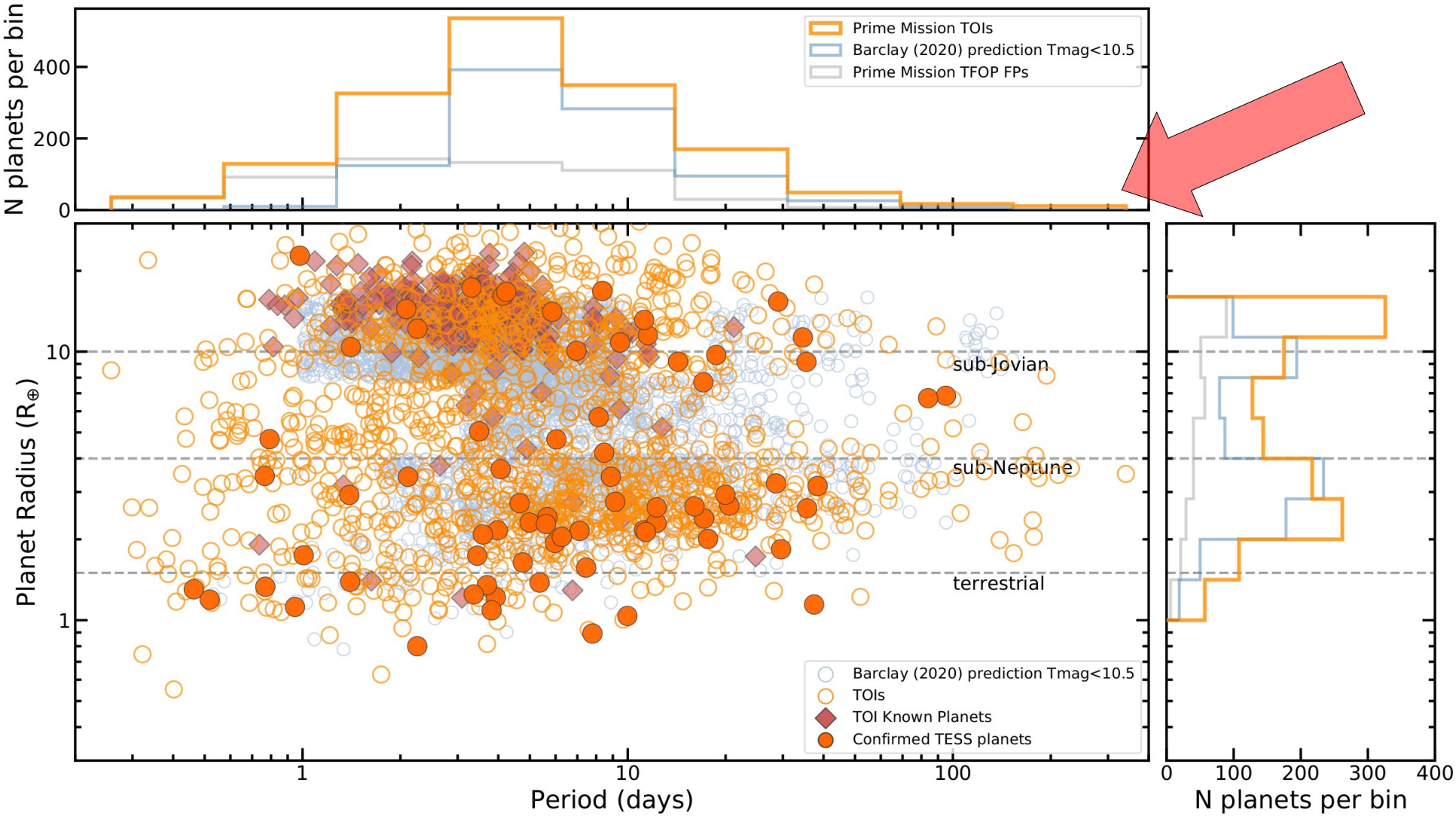
TESS Prime Mission TOI Catalog

Guerrero et al. (2021)



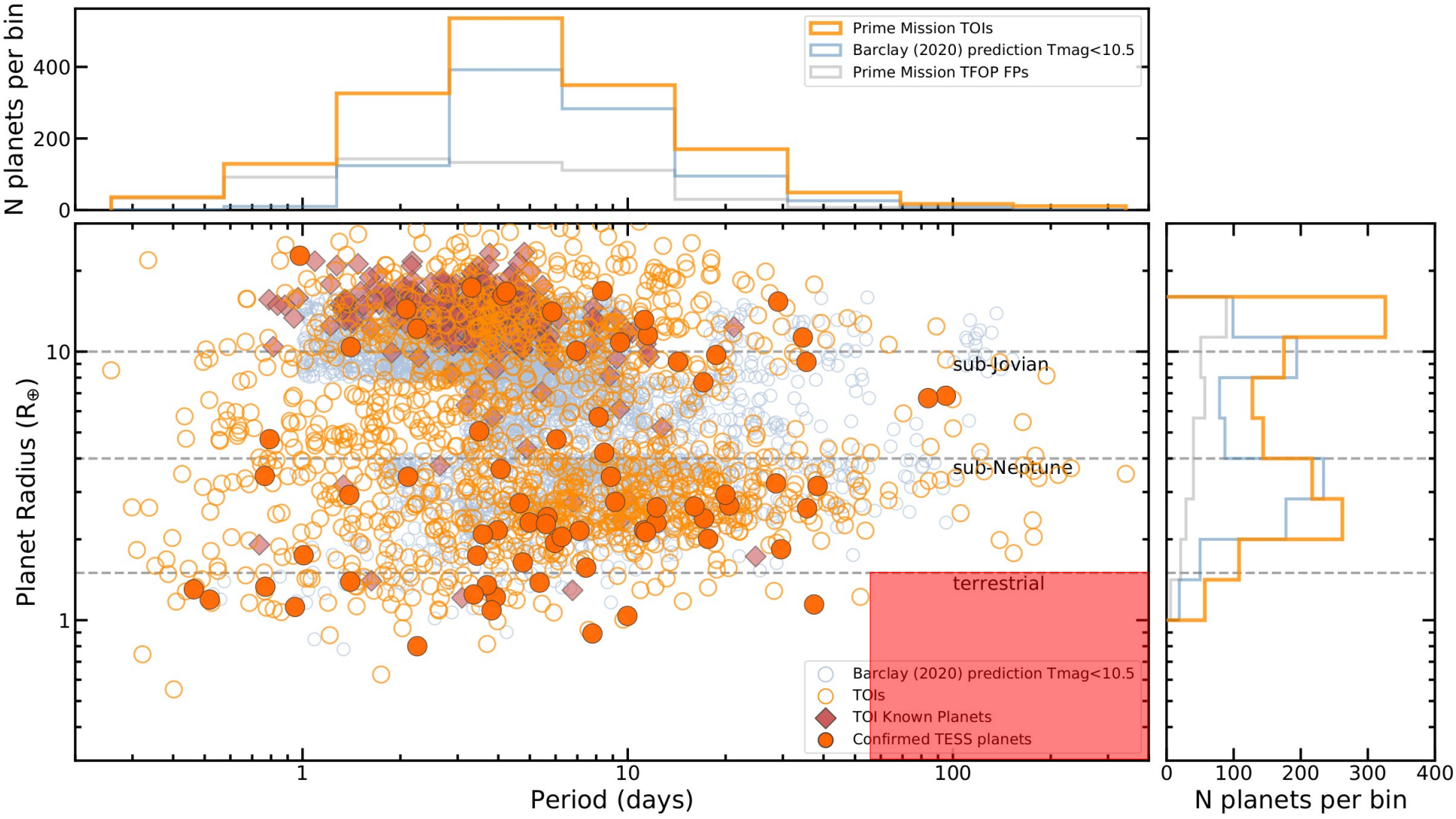
TESS Prime Mission TOI Catalog

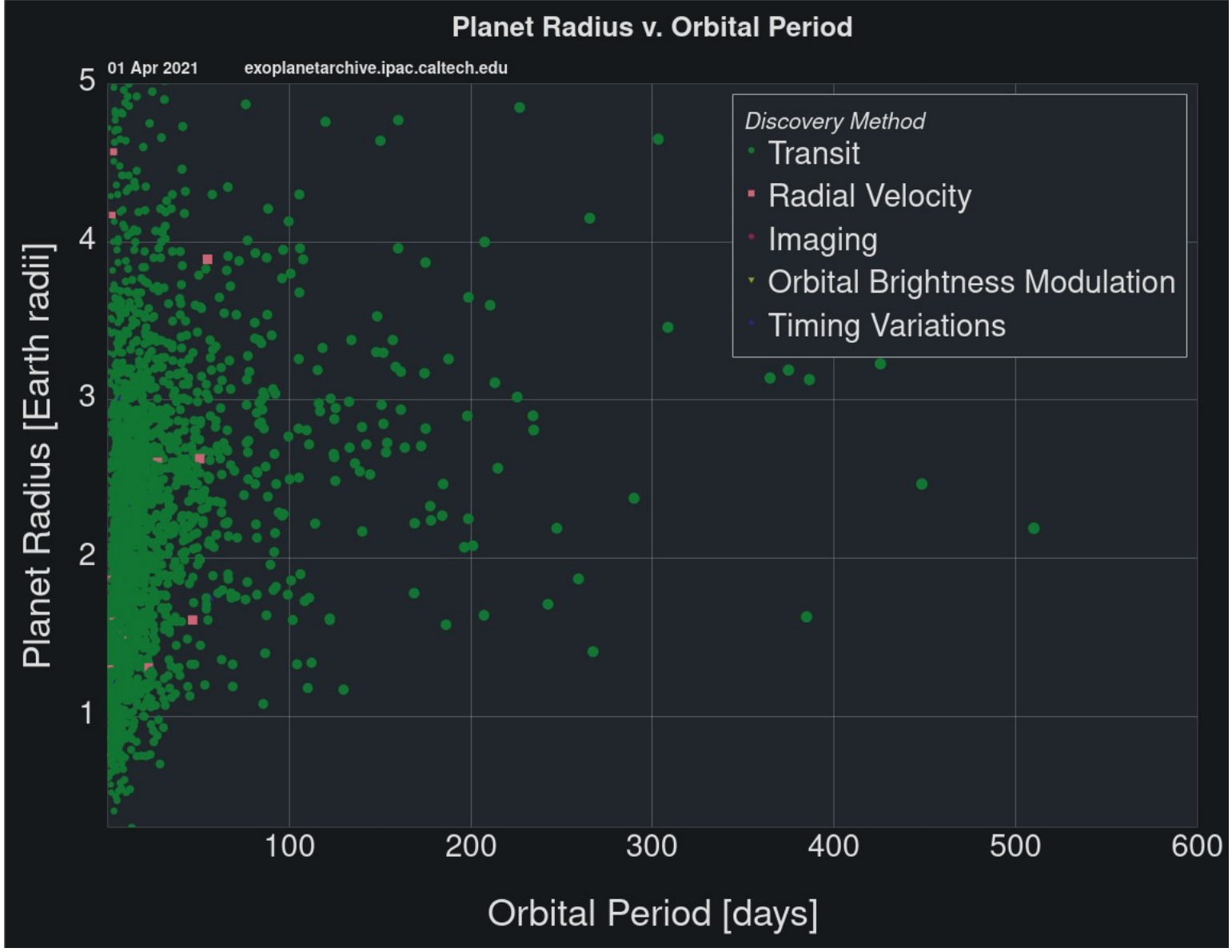
Guerrero et al. (2021)

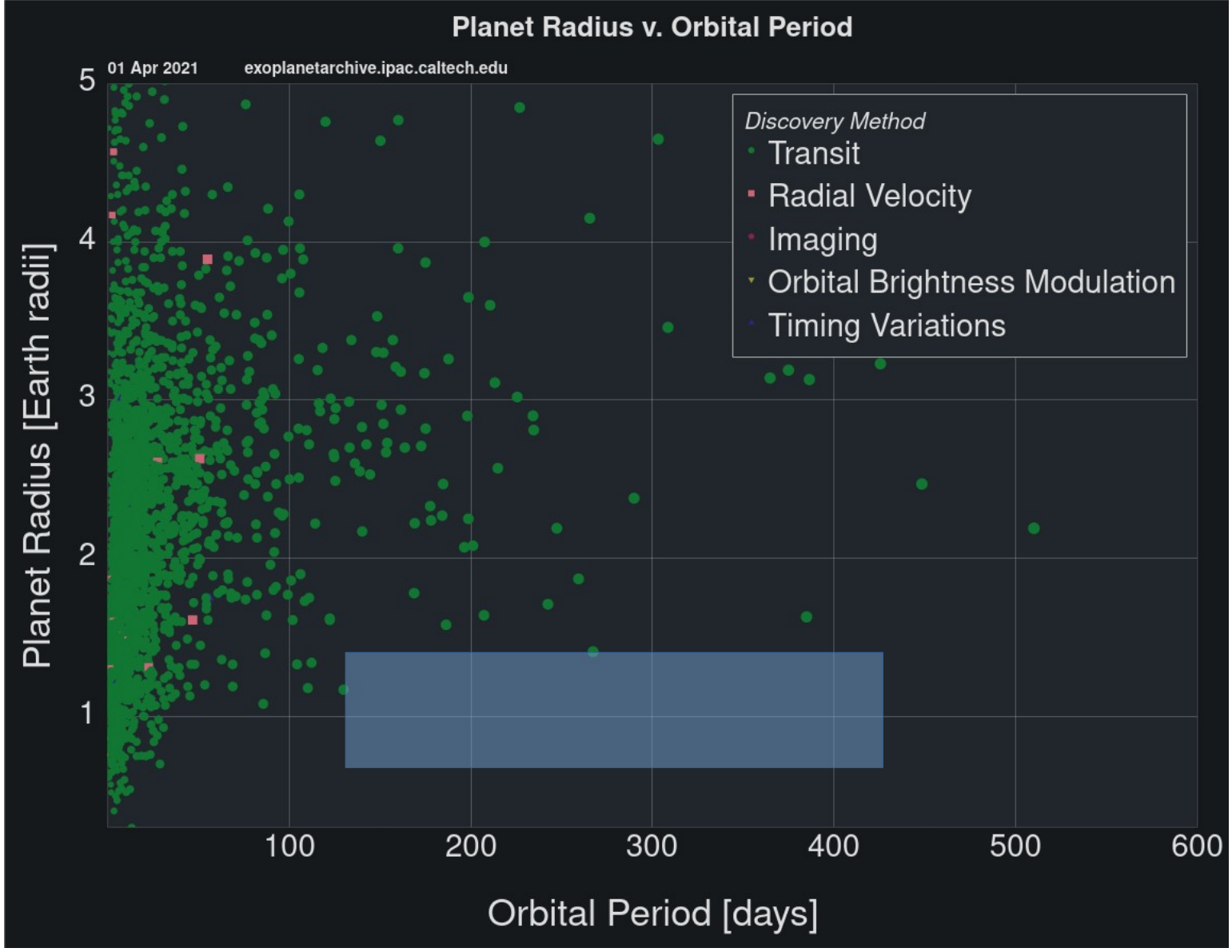


TESS Prime Mission TOI Catalog

Guerrero et al. (2021)




Planet Radius v. Orbital Period
01 Apr 2021
exoplanetarchive.ipac.caltech.edu
Discovery Method
Transit
Radial Velocity
Imaging
Orbital Brightness Modulation
Timing Variations
Planet Radius [Earth radii]
Orbital Period [days]
1
2
3
4
5
100
200
300
400
500
600

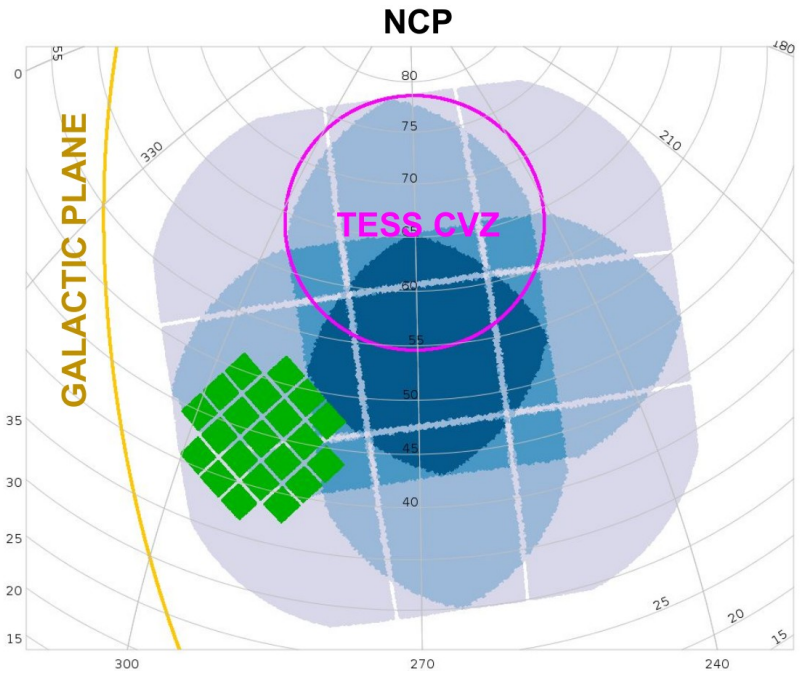

Planet Radius v. Orbital Period
01 Apr 2021
exoplanetarchive.ipac.caltech.edu
Discovery Method
Transit
Radial Velocity
Imaging
Orbital Brightness Modulation
Timing Variations
Planet Radius [Earth radii]
Orbital Period [days]
1
2
3
4
5
100
200
300
400
500
600

Synergies

TESS has and will continue to detect **mono-transits**. PLATO has the potential to continue the observations of these targets.

Like TESS, PLATO can also observe the **ecliptic poles**

TESS can provide information on what targets PLATO could observe.



Conclusion

TESS and PLATO **are similar** in many ways and will **both contribute** a lot to the **advancement of exoplanet science**.

PLATO will allow for the **accurate bulk characterisation of exoplanets** as part of the mission by combining an **asteroseismology component** with extensive **groud-based follow-up.**

PLATO is the only mission which will be capable of finding a **Earth-size planets** on **longer periods around Sun-like stars** (even if TESS observations continue for many years to come).

Additional slides

Common questions and answers

How will you find Earth-period planets with a 4 year mission and two pointings?

Both the observing strategy and pointing have not been set. Only needs to be set 2 years before launch.

We will in any case apply for a mission extension. Spacecraft will be verified for an in-orbit lifetime of 6.5 years with enough fuel to last 8.5 years.

Will I be able to access the full frame images, like in TESS?

No. PLATO will have 104 4kx4k CCDs which would generate more data than the bandwidth can handle at Sun-Earth L2.

Common questions and answers

Data release schedule

The public release of photometric data will be made after 6 months and no later than one year after the end of their validation period. Typically only 3 months will be needed data validation and pipeline updates.

A small number of stars (no more than 2,000 stars out of 250,000, 0.8%) will have proprietary status, meaning the data will only be accessible to members of the PLATO Mission Consortium for a given time period.

They will be selected using the first 3 months of PLATO observations for each field. The proprietary period is limited to 6 months after the completion of the ground-based observations or the end of the mission archival phase (Launch date + 7.5 years), whichever comes first.