Issue 40 – Dec 28, 2023

ExoClock Newsletter

Dear ExoClock participants,

Hope you are all doing well! We would like to wish you Merry Christmas and Happy New Year! Best Wishes for you and your families!

We would like also to welcome the new members!

We send out a newsletter like this at the beginning of every month, while you can read the past newsletters, watch the past meetings, and have access to other educational material at:

www.exoclock.space/users/material

***We organise meetings dedicated to new ExoClock members**. These meetings are held just after our regular monthly meeting. The beginner's meeting is usually held on the Friday after our regular meeting or the week after. In these meetings, newcomers can ask questions of any level related to the operation of the website, observations of transits, data analysis etc. Note that these meetings are not recorded.*

*Finally, **we have a Slack channel** for more direct communication and if you want to join, follow this link:*

https://join.slack.com/t/exoclock/shared_invite/zt-1t5l875v6-x0s8s553kT8nbCvbyo7boA

In this newsletter, we discuss:

1. Announcements

1.1 3rd ExoClock Annual Meeting

We are happy to share that the recordings and the photos from the **3rd annual ExoClock meeting** are now available on the ExoClock website.

You can access them here:

https://www.exoclock.space/annual_meetings

If you attended the meeting either online or in person, please give us your feedback by filling in the following survey:

https://forms.gle/MiJZgnTTXxDUSn1EA

We really appreciate your opinion, thank you!

Group photo from the 3rd annual meeting in Thessaloniki

Thank you everyone for attending our meeting, it was wonderful to meet you all!

1.2 Ariel updates - dedicated webpage

We are excited to share some amazing news for Ariel.

The mission has passed the Preliminary Design Review- PDR! This means that the team can start building up the spacecraft. ESA - European Space Agency has created a dedicated webpage to celebrate this news.

Find out more here:

https://www.esa.int/Science_Exploration/Space_Science/Ariel

We are even more happy to tell you that ESA created a dedicated ExoClock article within the Ariel page. You can read it here:

https://www.esa.int/Science_Exploration/Space_Science/Ariel/ExoClock_a_timely_collaboration?fbclid=IwAR0-Zi4xJUZZ6JeimMTPy83UUgwLyrI6lDIQq-r9_9RasGGMPXPMIh6Cx34

1.3 Next ExoClock publication

For the next publication, we decided with the Ariel team to include data from two years (2022 & 2023), with an initial release expected during spring. All co-authors will receive a message with details early in the new year.

We remind you to resubmit any data until **the 31st of December**. Please note also that any data submitted in 2024 will not be included in this paper but in future papers.

Finally, we remind you to fill your **author information box** or update it with new information if something has changed, here:

https://www.exoclock.space/users/my_author_information/

1.4 Remote Observing activities

Europlanet Telescope Network

We remind you that the Europlanet Telescope Network provides observing opportunities to both professional and amateur Astronomers. You can apply for observing time in telescopes of universities available in the list. Already the team has received applications from ExoClock participants, but the committee is welcoming new proposals. The deadline has been extended until the **31st of December 2023**. If you are interested, this is your last chance to apply for observing time. You can visit the link for more details:

https://www.europlanet-society.org/europlanet-2024-ri/networking-activities-na/europlanet-2024-ri-na-call-for-observations-at-the-europlanet-telescope-network/

ExoClock Unlocked

The ExoClock Unlocked call is still open to applications!
On this activity participants use remote telescopes by LCO (Las Cumbras Observatory) and Telescope live to observe ExoClock targets. Then, participants analyse the data and review them together with the team. The activities of the group include seminars and monthly meetings with a team of experts. The call is open to everyone, and priority will be given to people that lack telescope and camera.

We have also prepared a video which explains briefly what the call is about.

Please share this call with interested networks and communities, the link is:

https://www.exoclock.space/exoclock_unlocked

1.5 Certificates of contribution

Congratulations to the new entries in our top-contributors!

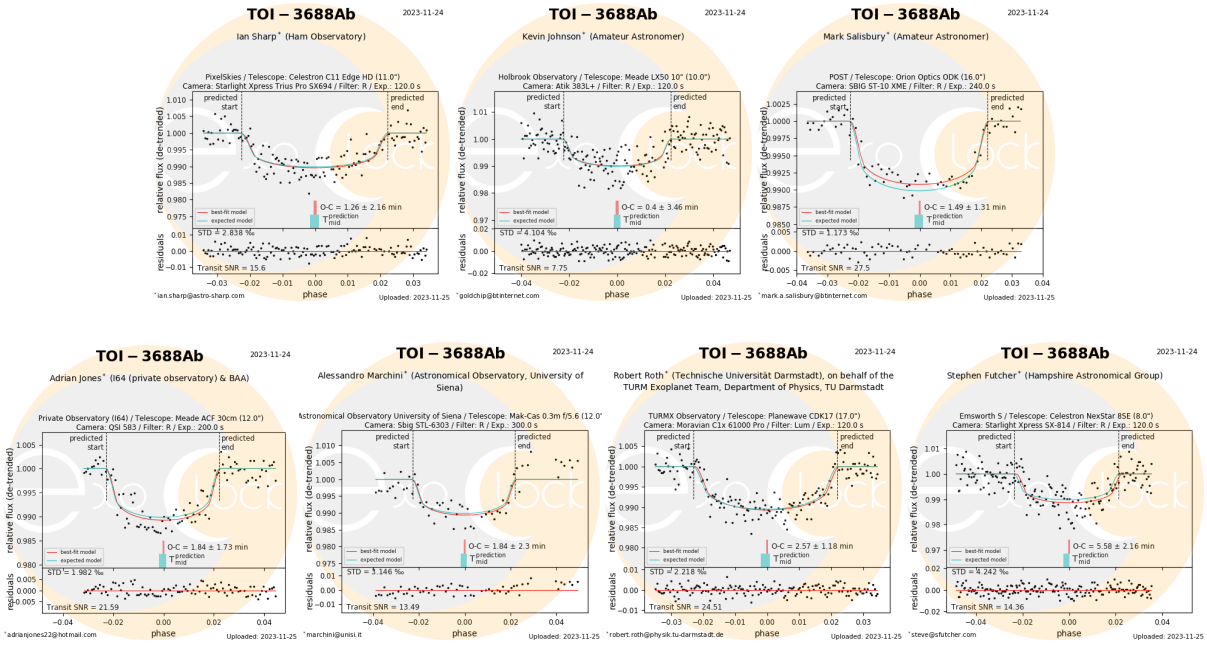
Bronze Observers (50+ observations): Miguel-Ángel Álava-Amatm, David Arnot, Dominique Daniel, Eric Miny, Mario Morales Aimar, Ramon Naves, David Quiles Amat, Marc Serrau, Dimitris Stouraitis

Silver Observers (100+ observations): Simon Dawes, Claudio Lopresti, Bryan Eric Martin

2. Highlighted Observations

We would like to thank you all for the observations you contributed to the previous months!

We have selected **TOI-3688Ab**, a high priority planet discovered by TESS. The target was observed by 7(!) ExoClock participants at the same night. Below you can see the observations by Ian Sharp, Kevin Johnson, Mark Salisburry, Adrian Jones, Robert Roth, Alessandro Marchini and Stephen Futcher.



Thank you all for your observations!

3. "Exoplanet CV of Kepler-6b"

As we mentioned in the previous newsletter, we started a new series of articles to enrich your background knowledge on the Ariel candidates. These articles feature one exoplanet each month and are written by our literature team. This month we are featuring **Kepler-6b**, the article is attached in the next page. Enjoy!

Clear Skies,
the ExoClock team

“CV” of Kepler 6-b

by Dionysios Gakis (Department of Physics, University of Patra, Greece), ExoClock literature team member

Kepler-6b is a transiting hot Jupiter exoplanet orbiting in 3.24 days around a solar-like star with unusually high metallicity. Its transits result in a depth of almost 12 mmag, making it observable by a telescope with minimum aperture of 8.07’’, and is thus quite popular among the ExoClock observers (Figure 1).

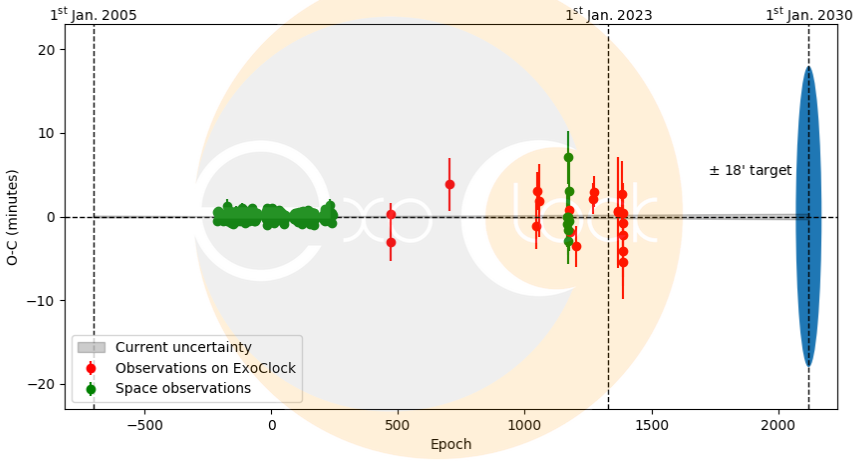


Figure 1: The O-C diagram of Kepler-6b.

Kepler-6b was discovered by Dunham et al. 2010 who studied light curves by the Kepler space mission, whereas follow-up ground-based observations were performed to confirm its existence. The planet was found to have approximately 2/3 of the mass of Jupiter and be larger than the latter by about 30%, rendering it a typical extra solar planet with density of 0.35 g cm^{-3}. No signs of eccentricity were identified by Monte Carlo methods, thus the orbit of Kepler-6b is considered circular of radius equal to 0.049 AU.

Kipping & Bakos 2011 found an interesting peak in the periodogram of Kepler-6b, but their TTV (Transit Timing Variations) and TDV (Transit Duration Variations) analysis did not yield a definite conclusion. They were only able to find minimum evidence for (though not exclude) the possibilities of an exomoon or a perturbing second planet in the system and assumed that the signal is most probably caused by stellar rotation. We note, however, that these outputs were obtained using the available data of that time (12 years ago), hence, a potential new analysis utilizing the large number of observations since then could provide more enlightening results.

The phenomena underlying the atmosphere of Kepler-6b are also worth mentioning. Firstly, the proximity of the planet to the star results in high irradiation of its atmosphere, while only a small part of the incident energy is distributed from dayside (the planetary hemisphere facing towards the star) to nightside (the planetary hemisphere facing away from the star). Additionally, models (Figure 2) suggest that the available atmospheric data of Kepler-6b are consistent with both thermal inversion (meaning that the temperature increases with height), as well as with non-inversion (Désert et al. 2011). Future studies of the photometry of the planet should shed more light on the energy budget of its atmosphere.

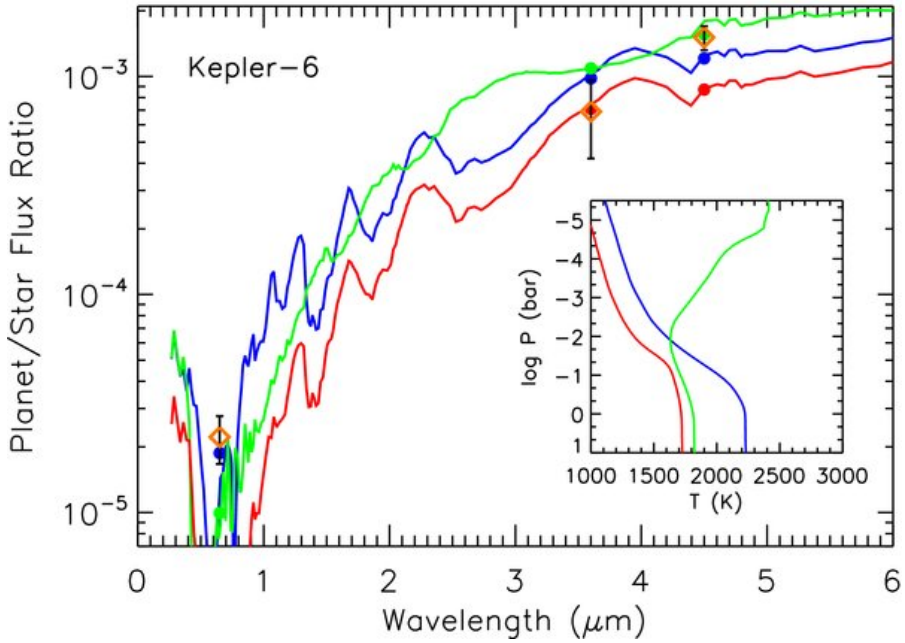


Figure 2: Dayside planet-to-flux ratios for three atmospheric models: blue (non-inverted atmosphere, no energy distribution to nightside), green (inverted atmosphere, no energy distribution to nightside), red (inverted atmosphere, full energy distribution to nightside). In the smaller window, the respective pressure – temperature profiles are presented.

References:

[1] Dunham, Edward W., et al. "Kepler-6b: A transiting hot jupiter orbiting a metal-rich star." *The Astrophysical Journal Letters*713.2 (2010): L136 (https://ui.adsabs.harvard.edu/abs/2010ApJ...713L.136D/abstract)

[2] Kipping, David, and Gáspár Bakos. "An independent analysis of Kepler-4b through Kepler-8b." *The Astrophysical Journal* 730.1 (2011): 50 (https://ui.adsabs.harvard.edu/abs/2011ApJ...730...50K/abstract)

[3] Désert, Jean-Michel, et al. "The atmospheres of the hot-Jupiters Kepler-5b and Kepler-6b observed during occultations with Warm-Spitzer and Kepler." *The Astrophysical Journal Supplement Series* 197.1 (2011): 11 (https://ui.adsabs.harvard.edu/abs/2011ApJS..197...11D/abstract)

NOTE: We remind you that you can find other exoplanet CVs in previous newsletters.