Issue 39 – Jul 20, 2023

ExoClock Newsletter

Dear ExoClock participants,

Hope you are all doing well!

We would like 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 also 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 have the opportunity to 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 Upcoming meetings

Our next monthly meeting will be happening on Thursday **the 27th of July at 16:00 BST**. Please send us any questions or topics for discussion soon so we can include them in our agenda.

The beginners' meeting will happen on Friday **the 28th of July at 16:00 BST.** Similarly, please send us any questions you might have for the beginners' meeting agenda before that date.

Note that in **August** we will not hold any meetings, our team will be on holidays. We will start again from the next academic year!

1.2 3rd ExoClock Annual Meeting

We are happy to release the registration page for the 3rd annual ExoClock meeting!

This year, we will hold the **3rd version** of the ExoClock annual meeting on the **21st & 22nd of October 2023**. The meeting will be hybrid and will be hosted by **the Aristotle University of Thessaloniki, in Greece.**

We welcome all the ExoClock community, but also attendees that are not ExoClock members, to join us in-person or remotely.

Registration and abstract submission is now open and will close on the 30th of September.
Both oral and poster contributions will be considered. The final agenda will be announced on the 5th of October.

Participants are also welcome to suggest topics for round table discussions and workshops.

A registration fee of 100€ will be requested **only from the professionals who would like to attend in-person**, after the agenda is finalised.

Visit the following page to register and/or submit an abstract:

https://www.eventbrite.com/e/3rd-exoclock-annual-meeting-tickets-680005403467

1.3 Remote Observing activities

Europlanet Telescope Network

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 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/

Remote Observing Group

During the 2022-2023 academic year, we organised the remote observing group for interested participants that lack equipment or observing opportunities. The activities included seminars and monthly meetings, and participants worked in teams of two to schedule, observe a transit and analyse the data. The observations were conducted in remote observatories by LCO and the telescope live network.

In total, the teams observed 8 transits that have been published on the ExoClock website.

We would like to congratulate and thank all the participants for being so actively involved and working so amazingly together as a team!

We are glad to announce that ExoClock has been awarded **another 45 hours** from LCO (Las Cumbras Observatory) for the next academic year and we plan to organise a new dedicated group.

Stay tuned if you are interested to join or if you know interested communities that would like to join!

1.4 School activities

ExoClock in the class!

ExoClock is utilised also in high schools, and students can participate in order to learn and contribute to the project. The students get a hands-on experience of modern Astronomy, they learn, have fun and be inspired about their professional orientation.

Recently, Adrian Jones – active ExoClock member and data reviewer – organised an entire project for the Newsland Girl school (class of year 12). Adrian prepared material and carried out all stages of the project himself! For the project, two datasets were used, one from LCO and one from Yves Jongen who kindly provided observing time for the students.

The project ended with a great success and two transit observations have been published in the name of the school!

The students share their experience on the following link (**see under the title science news**):

https://sway.office.com/i4HPDdYIU4GvRgO6?ref=email

ExoClock workshop for teachers

This Friday the **21st of July at 14:15 UTC**, Anastasia Kokori – ExoClock coordinator – will be conducting a dedicated workshop for teachers during the summer school "Other Worlds" organised by the IAC (Instituto de Astrofisica de Canarias).

In the workshop teachers will learn how to use ExoClock in the classrooms to engage students with exoplanet research.

More information about the school can be found here:

https://outreach.iac.es/peter/aeaci-2023/

If you are interested or know interested teachers, please share this information.

The link to join the meeting is:

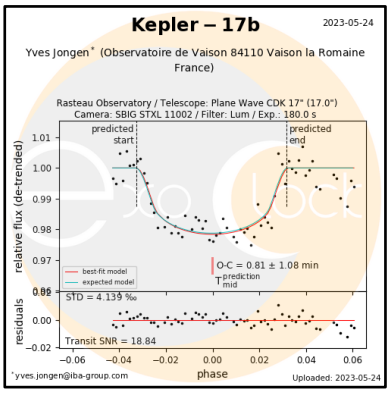
https://rediris.zoom.us/j/85489230430?pwd=Y1R6TjZUdWY5bVhhaVBUNmZrZStZdz09

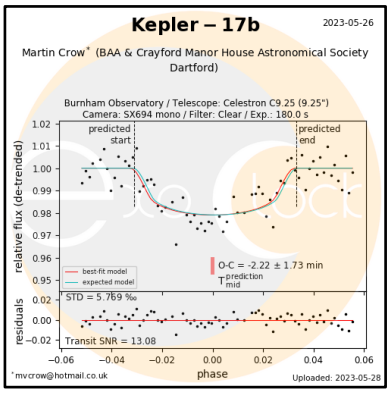
The login details:
Meeting ID: 854 8923 0430
Passcode: Trappist1

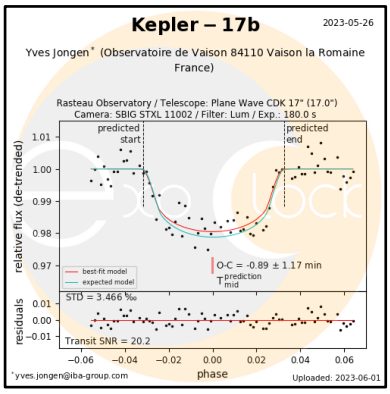
2. Highlighted Observations

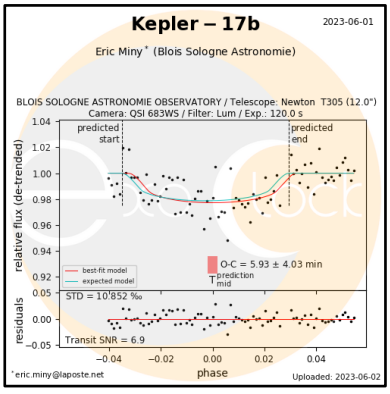
We would like to thank you all for the observations you contributed to the previous months!

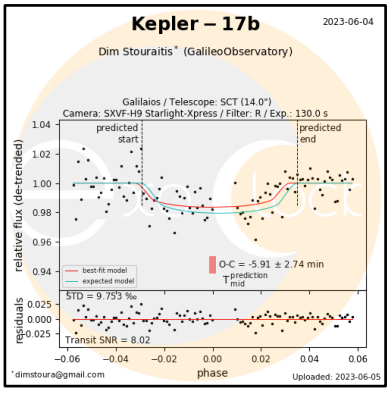
We have selected **Kepler-17b**, a planet orbiting around an active star. The planet was discovered in 2011 and recently was observed many times by several ExoClock participants. Below you can see the recent observations by Yves Jongen, Eric Miny, Dim Stouraitis and Brian Martin.

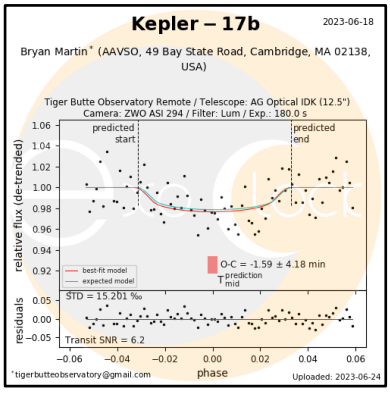












Thank you all for your observations!

3. “Exoplanet CV of Kepler-17b”

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-17b**, the planet which is featured in our highlighted observations. The article is attached in the next page. Enjoy!

Clear Skies,
the ExoClock team

“CV” of Kepler 17-b

by Georgios Lekkas (Department of Physics, University of Ioannina), ExoClock literature team member

Kepler-17b is a transiting hot Jupiter, orbiting an active solar-type star. The exoplanet has a period of 1.486 days. The host star is active with dark spots which are frequently occulted by the planet and has a stellar rotation of 11.89 days, 8 times the planet’s orbital period. This means that the planet makes multiple passes over the same starspots before they rotate out of view, causing stroboscopic effects on the occulted starspots (Désert et al. 2011, Figure 1).

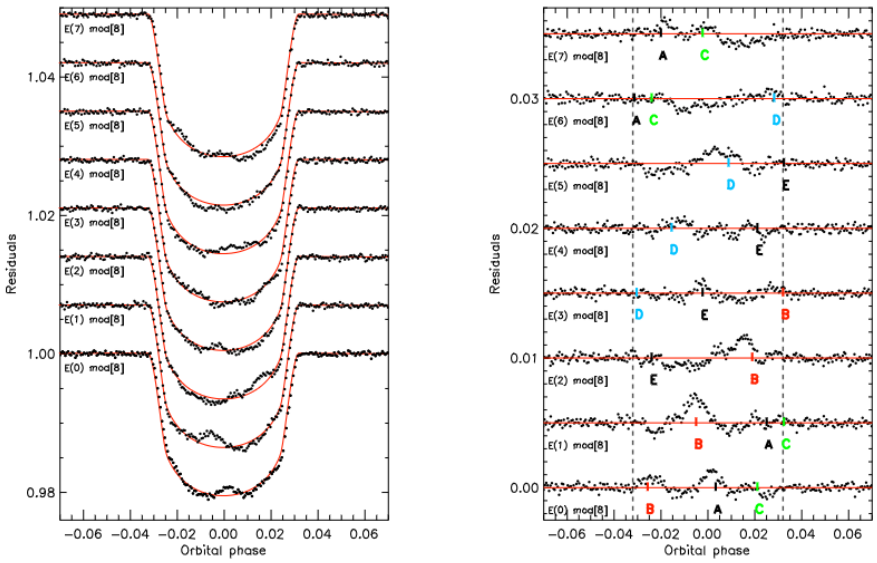


Figure 1: Left: Sequence of combined and binned transit light curve. Right: Five occulted stellar spots are indicated on the residuals (A, B, C, D and E) as they appear transits after transits at phase positions expected from the stellar rotation period.

The passage of the planet in front of the star may occult solar-like spots on the stellar surface, producing a slight increase in the luminosity detected during a short period (minutes) of the transit. This occurs because the spot is darker (cooler region) than the stellar photosphere, hence the planet obscures a smaller fraction of light when it is in front of a spot. (Estrela et al. 2016, Figure 2 & Namekata et al. 2020, Figure 3).

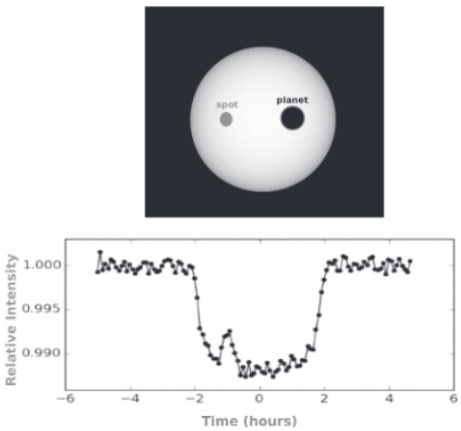


Figure 2: Top: 2D simulated image of a star with quadratic limb darkening and one spot, and its planet, assumed as a dark disk. Bottom: resulting light curve from the transit, with the “bump” due to spot-crossing by the planet.

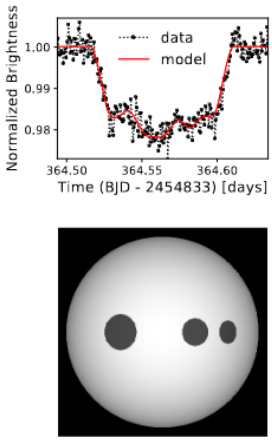


Figure 3: Top: One example of the modelling (red line) to the high-cadence in-transit data (black lines). Bottom: The reconstructed surface distribution of the star spot.

An MCMC analysis has been conducted by Davenport et al. 2015, spanning one rotation period of the host star, including eight transits. The planet's orbit is aligned with the stellar rotation axis, meaning we are probing along the equator with each transit. The best fit location for all eight starspots was close to the path of the planet (equator), creating bump features in every observed transit within this time window (Davenport et al. 2015, Figure 4).

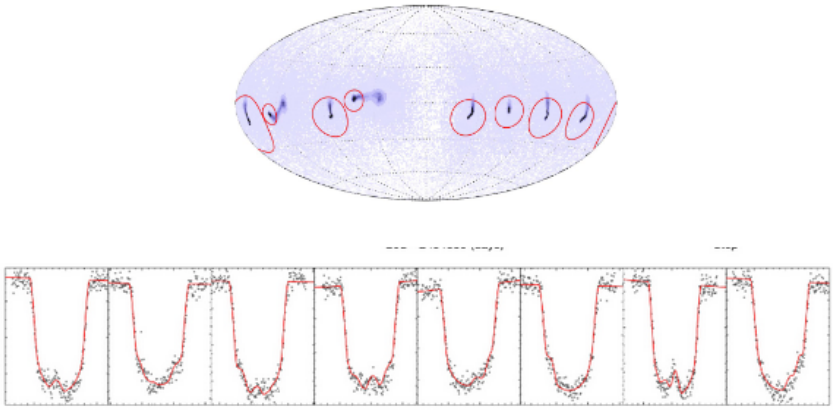


Figure 4: Top: A contour map of the stellar surface
Bottom: The best fit model with enlargements of all eight transits showing the presence of starspots (bump features in the transit depth).

The transit depth typically helps us measure the radius of the exoplanet but is sensitive to stellar surface inhomogeneities. So, if a star has dark starspots (or bright regions) distributed throughout the transit chord, the transit depth will be biased towards lower values, if the starspots effect is not taken into account. However, if one measures the duration of ingress/egress as compared to the total transit duration, this time-dependent quantity will be less affected by the presence of spots on the rest of the photosphere, and thus may give a more precise measurement of the planet-star radius ratio compared with measuring the radius ratio from the depth of transit. The transit and ingress/egress durations are simply a function of time, and do not depend upon the transit depth, and hence will not be affected by dilution by star spots (Morris et al. 2018, Figure 5).

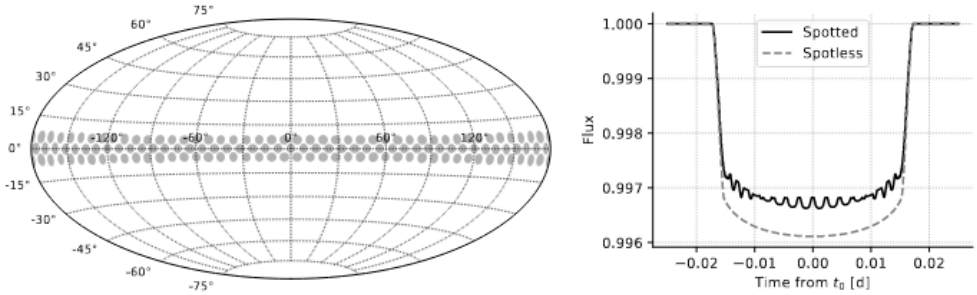


Figure 5: Left: Hypothetical spot map for a dense band of spots in an active latitude at the stellar equator. Right: The bottom of the spotted transit might simply appear flat and relatively shallow, but the ingress and egress durations are the same for both light curves, allowing us to recover the true planet radius from timing, independent of the transit depth which is affected by starspots.

In conclusion, stellar activity can heavily affect both the light curve of a transiting exoplanet (the transit depth) and the calculated radius from it. Kepler-17 is a perfect example of an active solar-type star, and the stellar monitoring of active stars can provide valuable insights to overcome these issues and produce trustful results.

References:

[1]: Désert et al. 2011 (https://ui.adsabs.harvard.edu/abs/2011ApJS..197...14D/abstract)
[2]: Estrela et al. 2016 (https://ui.adsabs.harvard.edu/abs/2016ApJ...831...57E/abstract)
[3]: Namekata et al. 2020 (https://ui.adsabs.harvard.edu/abs/2020ApJ...891..103N/abstract)
[4]: Davenport et al. 2015 (https://ui.adsabs.harvard.edu/abs/2015csss...18..399D/abstract)
[5]: Morris et al. 2018 (https://ui.adsabs.harvard.edu/abs/2018AJ....156...91M/abstract)