



ExoClock Newsletter

Dear ExoClock participants,

we hope that you are doing well! It seems that together with the Spring Equinox, the weather has improved in many places allowing many new observations. In particular, this month we received the largest amount of ever! **140 observations** including submissions by many new users. Thank you all!

In this newsletter, we are discussing:

- 1. ExoClock virtual meeting – March 2021
 - Logo Campaign winner
 - Working groups updates
 - Computer time synchronisation
 - Submitting partial light curves
 - Contaminated sources in photometry
 - Python workshop for exoplanet data analysis
- 2. Website updates: diagnostics for the evaluation of submitted data
- 3. Highlighted observations – example of synchronous transits
- 4. ALERTS

1. ExoClock virtual meeting – March 2021

This meeting, together with all the previous ones is accessible from:

www.exoclock.space/users/material

During our recent meeting we discussed several topics and here we briefly share some of main points:

- ExoClock Logo Campaign

The voting for the logo campaign has closed, and we would like to thank all of you for sharing your opinion with us. The three finalists were: *Léa Changeat*, *Claudio Lopresti* and *Laura Lewis*. The final winner has been chosen based on the votes of both the ExoClock community and the coordinating team. The winning logo belongs to *Léa Changeat*, congratulations Léa! You will notice that we have updated the website with the new logo (top of this page, too!).

The prize for Léa is kindly provided by *Telescope Live*. It includes one year of free subscription with access to educational material and data on astrophotography. Moreover, the prize includes observing time to observe one exoplanet transit. Léa does not have an astronomy background or equipment to carry out observations and we believe that this will be a great opportunity to involve her even more in the project. Congratulations Léa and many thanks to Marco Rocchetto for this kind offer!

Apart from the winner, Marco encourages ExoClock participants to subscribe to Telescope Live where they can use and try the platform for one month for free. To support the collaboration between ExoClock and telescope live, Marco will create also some promo codes especially for ExoClock users. These will be shared through the next newsletter. In the meantime, you can access the website of the network at: **telescope.live**

- Publication – reminders

We are currently working on the upcoming publication which includes ~1800 observations. We kindly remind you to re-submit any returned observations so we can finalise our results. Also, please add your name and affiliation(s) on the “Author Information” page as you would like them to appear in publications. You can find the box under the “My Profile” tab through your account:

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

- Working groups updates

During our recent meeting, members of the working groups gave brief updates on the current status of their work. These are the main points:

Synchronous Observations Working Group – coordinated by Alessandro Nastasi

- After the creation of a list with the equipment of each member, the group has started the first attempts of coordinating simultaneous transit observations through the Slack channel. Their efforts include the creation of a shared spreadsheet to collect observations plans. An additional suggestion is to use past ExoClock observations which were synchronous by chance in order to test some of the methods. A table with such past transits has been made and we will be discussing how this can be further used.

CMOS Working Group - coordinated by Roland Casali and David Rees

- The group has started composing a document that includes testing methods and practical results. It is aimed to finish and circulate the document after the Easter break. Coordinators have kindly asked the rest of the ExoClock participants to share some information regarding their cameras to help conducting their tests. This message is shared by the CMOS group:

To better understand which equipment ExoClock observers are working with and to create a baseline for which cameras and sensors should be tested in greatest detail, the CMOS working group has created an online spreadsheet for information to be entered. You can access it under this link:

<https://docs.google.com/spreadsheets/d/1-J0yXYvPMAiLVUu5v4hXsPFR4HIZPuZe8kmo3kxhS0s/edit?usp=sharing>

Note that the cells on the spreadsheets are editable. Because of this, although the spreadsheet will be backed up, please don't share this link outside of the ExoClock community. Enter your camera information along with some basic information about your acquisition following the quick instructions in column A.

Please fill in the document if you haven't done it so far!

Multi-colour observations Working Group- coordinated by Steve Futcher

- Due to restriction to access observatories in some countries, tests have been delayed. However, Steve has kindly prepared and shared a presentation that shows the response curves of a variety of filters. You can find the file through the Slack channel to get a further perspective on the topic.

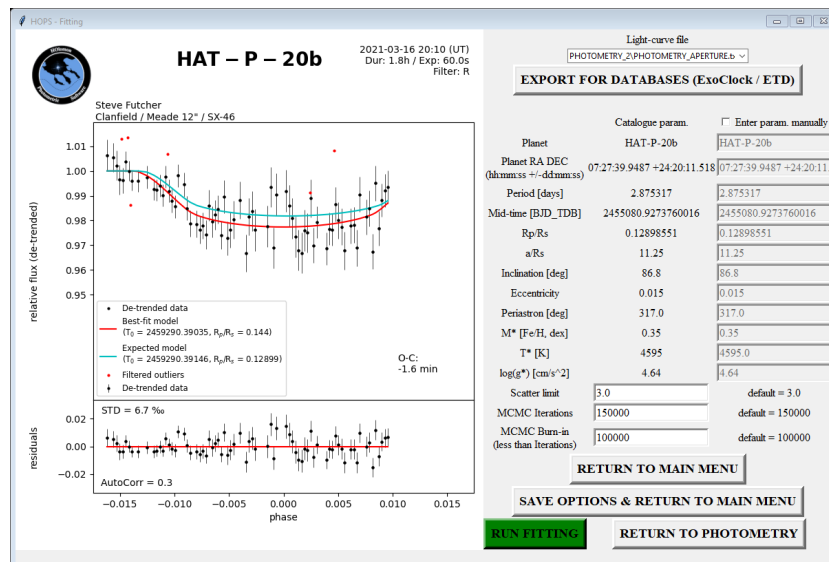
If you are interested in joining the Slack and/or one of the groups, please send us an email.

- Computer time synchronisation

The main time precision that is important for the purposes of the project is of the order of 1-2 seconds. So, make sure that your computers are synchronised with a software that reaches that level. During the meeting several programs were mentioned: *dimension4*, *NMEATime2*, *SGPro*, *TimeBoxUTC*.

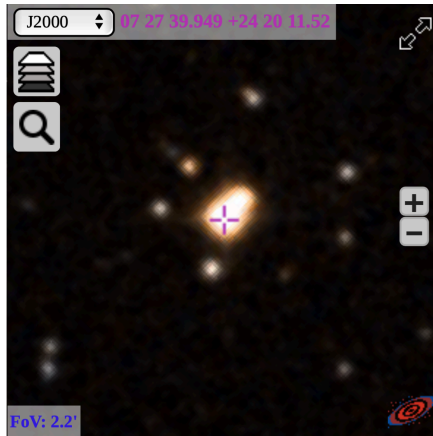
- Partial transits submissions to ExoClock

Many of you have been asking whether to submit to ExoClock observations that are partial. In general, we don't accept half transits because they are more sensitive to fitting biases. However, we will accept an observation that is more than half of the planned observation. It is important to have points at least before or after the actual transit. If for any reason you miss some pre-transit observations, make sure that you observe more time after the transit to substitute the missing part. An example of an acceptable partial transit is the following one, provided by Steve Futcher. As you can see, only a small part of the egress of the transit is missing.



- Contaminated sources in photometry

There are cases in which the target is contaminated by other nearby stars. In the photometry, please use an aperture that is large enough to include only the target star if possible. If not, it is better to include both of them. As you can see below, HAT-P-20 b is an example of a planet with a star lying very close to another star. Make sure you include both of them inside your aperture.



- Python workshop for exoplanet data analysis

We plan to hold to a workshop on analysing light curves in Python on the 15th of April at 14:00 GMT (15:00 UK time). This is aimed mainly at university students, but anyone interested in the topic is welcome to participate. The main requirements to attend the workshop are:

- basic scientific computing with Python (especially packages such as numpy, matplotlib, scipy)
- installation of Python on the computer

We will focus on how to use the Pylightcurve package which has been created by Angelos. We will use a variety of data including ExoClock and TESS light curves. At the end of the workshop, you will have also the chance to ask any questions you might have. In order to join, please register via the following link:

https://ucl.zoom.us/meeting/register/tJ0vce2hrT4sH9NVU8aKjIXz7k_SzUyB8v47

2. Website updates: diagnostics for the evaluation of submitted data

We have worked on improving the evaluation report that you get when uploading a light curve. This will further facilitate the process of self-evaluating your light curves before submitting. The main diagnostics to evaluate the quality of a light curve are (in this order):

- Rp/Rs
- Autocorrelation
- Outliers
- O-C

The automatic report to help you decide if there is room for improvements by providing warnings for each step.

- Rp/Rs
Observations with strong differences between the recovered Rp/Rs and the literature value (RED warning) are usually returned for re-analysis. The only exceptions are the cases of planets in binary systems (e.g. WASP-77A b) or planets with stars that are contaminated by

blended stars (e.g. HAT-P-20 b). In these cases the recovered R_p/R_s is expected to be lower than the literature value due to contamination.

- Autocorrelation i.e. systematics remaining in the residuals
Observations with strong systematics remaining in the residuals (RED warning) are usually returned for re-analysis. The only exceptions are light curves with a very large number of data points (above 1000) or light curves with evident non-detrendable effects like spot-crossing events (small bumps in the in-transit part).
- Outliers
Outliers alone are not a reason for us to return a light curve. However, they are usually causing other problems like wrong R_p/R_s values.
- O-C
Most probably we will not be able to use this observation with uncertainties greater than ± 10 minutes (Red warning). Otherwise, Red warning for differences between your results and results from other ExoClock members should not discourage you from submitting your light curve. Experience has shown that unexpected drifts can always happen. We will assess this cases individually and if necessary we will contact you.

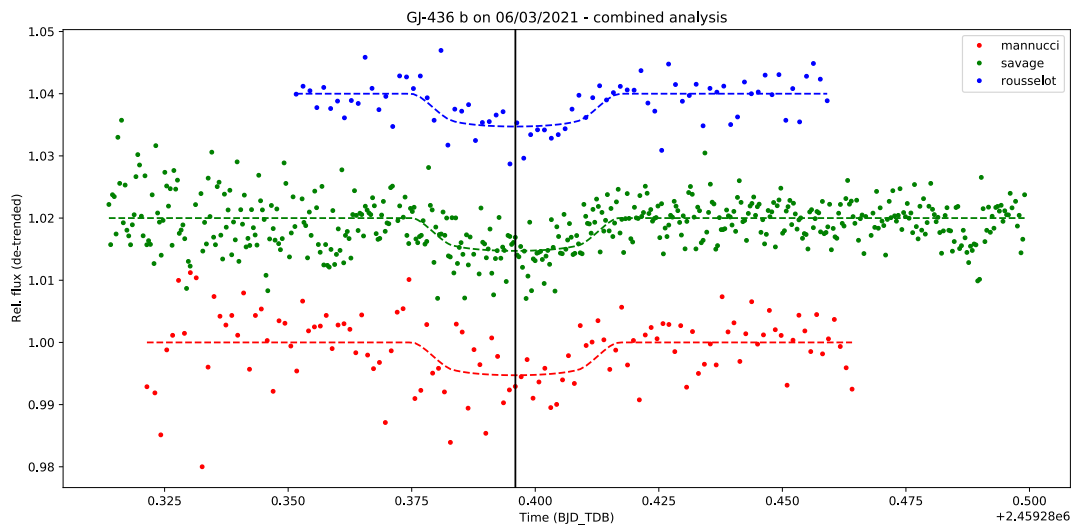
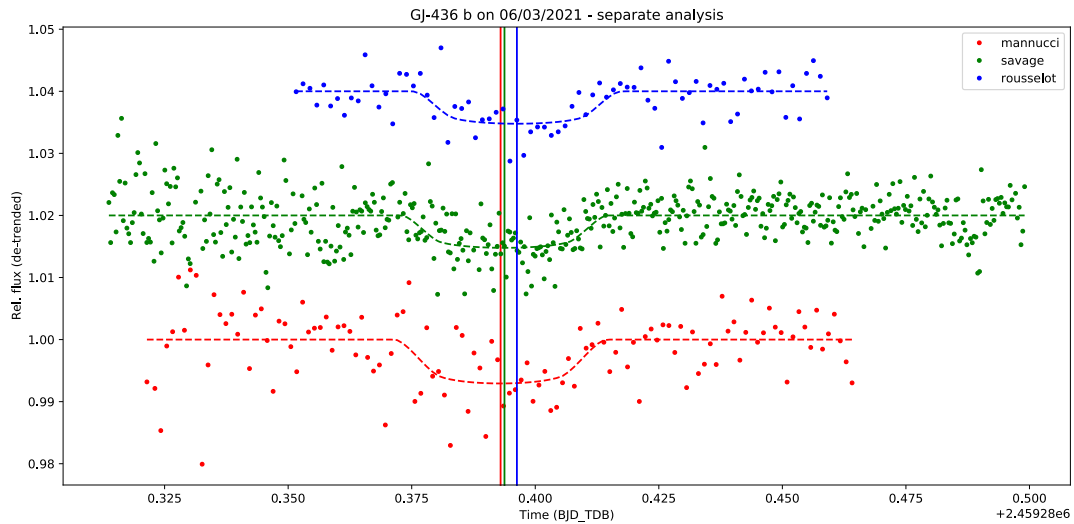
Tips to improve your results:

1. Try the different de-trending methods (the quadratic de-trending should be used for the more difficult cases).
2. Check that you have given the correct inputs (Planet, Filter, Flux format, Time format).
3. Check different comparison stars.
4. Check the quality of your flat frames (should be close to the 2/3rds of the full well depth).
5. Remove manually any strong outliers.
6. Remove data points from the start or the end of the observation if they seem to suffer from strong systematics.
7. If you performed a meridian flip, try using comparison stars that are symmetrically distributed around the target.

3. Highlighted observations

For this month, we have selected three simultaneous observations of GJ436b from participants at different locations. The star has an R magnitude of 10.27 and an R transit depth of 7.12 mmag, making it a challenging target. The transit was observed by Lionel Rousselot, John Savage and Massimiliano Mannucci. We have performed a combined analysis to show the advances in the final results that can be achieved by synchronous observations. In the case, the combined analysis gives a precision in the transit timing of ± 18 seconds!

Thank you all and we are looking forward for more such opportunities from the Synchronous Observations Working Group!



4. ALERTS

The following targets are in the current **alert system**:

- WASP-54b
- WASP-156b
- K2-237b
- HATS-33b
- NGTS-2b
- HAT-P-56b
- HAT-P-55b
- HAT-P-40b
- KELT-4Ab
- Kepler-5b
- HD17156b

Please check your personalised alert schedule at:

www.exoclock.space/schedule/alerts

and if you get a clear sky, and a long night, observe them!

We remind you also that many targets were not in the alert list, before an unexpected shift was identified by you, the ExoClock participants. This highlights the importance of observing targets that are also of low and medium priorities.

Clear Skies,
the ExoClock team

Check this out!

Translation of HOPS 3 manual in other languages

It would be really useful to provide the documentation with the guidelines for HOPS 3 in other languages to facilitate participants from different countries. If you can support us with the translation in other languages, please send us an email at exoclockproject@gmail.com