

## **EXPLORE Targets**

Updated 2025 July 18

### **Target selection**

The targets in this section considered suitable for observation by amateur astronomers include;

- [ExoClock database](#) entries identified as having TTVs
- entries in the [NASA Exoplanet Archive](#) whose 'Data show Transit Timing Variations' which also appear on the ExoClock database but not listed as exhibiting TTVs
- searches of the [NASA Exoplanet Archive](#) require a space after the planet number e.g. WASP-148 b whereas the ExoClock database does not e.g. WASP-148b.
- those listed in the paper '[Exoplanet Ephemerides Change Observations \(ExoEcho\). I. Transit Timing Analysis of 37 Exoplanets Using HST/WFC3 Data](#)'
- additional targets e.g. Warm Jupiters, Neptunes, Super Earths for which Radial Velocity and TTV data can be combined
- targets suitable for amateur astronomers would typically be in the range V mag 10-13 with a minimum transit depth of 10 mmag

### **Contiguous observations**

There are some exoplanets which exhibit very large TTVs and thus their transits are difficult to predict. Observing such transits could involve amateur astronomers from e.g.; Europe, the Americas and Japan to give coverage over a wide range of time zones. Negative observations would be useful as they would constrain the parameters of the subject exoplanet system and observers should not feel that they have wasted their time in such instances.

AAVSO and BAA members will be notified by email should such opportunities occur.

| <b>Planet</b>                                              | <b>ExoClock status</b> | <b>RA Dec</b>              | <b>V mag</b> | <b>Depth (mmag)</b> | <b>Period (days)</b> | <b>Minimum telescope aperture required (inches)</b> |
|------------------------------------------------------------|------------------------|----------------------------|--------------|---------------------|----------------------|-----------------------------------------------------|
| HAT-P-7b<br>(HAT-P-7 Ab<br>TOI-1265.01<br>TIC<br>414865156 | TTVs                   | 19:28:59.35<br>+47:58:10.2 | 10.48        | 7.41                | 2.2047               | 5.00                                                |

|                                                                  |       |                            |       |       |         |       |
|------------------------------------------------------------------|-------|----------------------------|-------|-------|---------|-------|
| Kep ID<br>10666592<br>KOI Name<br>K00002.01<br>Kepler-2b)        |       |                            |       |       |         |       |
| HAT-P-13b<br>(TOI-5374.01<br>TIC 20096620)                       | Low   | 08:39:31.81<br>+47:21:07.3 | 10.42 | 8.25  | 2.9162  | 5.73  |
| HAT-P-18b<br>(TOI-2127.01<br>TIC 21744120)                       | Low   | 17:05:23.15<br>+33:00:44.9 | 12.76 | 24.28 | 5.5080  | 6.95  |
| K2-19b<br>(TOI-5145.01<br>TIC<br>281885301<br>EPIC<br>201505350) | TTVs  | 11:39:50.48<br>+00:36:12.9 | 13.00 | 7.63  | 7.9210  | 12.53 |
| Qatar-1b<br>(TOI-1465.01<br>TIC<br>236887394)                    | Low   | 20:13:31.62<br>+65:09:43.5 | 12.84 | 25.4  | 1.4200  | 7.02  |
| TOI-216.01<br>(TIC<br>55652896)                                  | TTVs  | 05:49:36.41<br>-54:54:38.6 | 9.72  | 20.94 | 34.5073 | 5.55  |
| TOI-1130c<br>(TOI-1130.01<br>(TIC<br>254113311)                  | Alert | 19:05:30.22<br>-41:26:15.1 | 11.59 | 16.44 | 8.3498  | 5.0   |
| TrES-3b<br>(TOI-2126.01<br>TIC<br>116264089)                     | Low   | 17:52:07.02<br>+37:32:46.2 | 12.40 | 28.34 | 1.3061  | 5.82  |
| WASP-4b<br>(TOI-232.01<br>TIC<br>402026209)                      | Low   | 23:34:15.09<br>-42:03:41.0 | 12.48 | 31.37 | 1.3382  | 5.54  |
| WASP-12b<br>(TOI-1725.01<br>TIC 86396382)                        | TTVs  | 06:30:32.80<br>+29:40:20.3 | 11.57 | 17.81 | 1.0914  | 5.00  |
| WASP-19b<br>(TOI-655.01<br>TIC 35516889)                         | TTVs  | 09:53:40.08<br>-45:39:33.1 | 12.31 | 22.96 | 0.7888  | 5.92  |
| WASP-43b<br>(TOI-656.01<br>TIC 36734222)                         | Low   | 10:19:38.01<br>-09:48:22.6 | 12.4  | 29.73 | 0.8135  | 5.85  |
| WASP-148b<br>(TOI-2064.01<br>TIC<br>115524421)                   | TTVs  | 16:56:31.34<br>+44:18:09.5 | 12.04 | 8.79  | 8.8038  | 7.95  |

Alternative names are shown in brackets;

- TOI; TESS Object of Interest
- TIC; TESS Input Catalogue ID

Searches of the [NASA Exoplanet Archive](#) require a space after the planet number e.g. WASP-148 b whereas the ExoClock database does not e.g. WASP-148b.

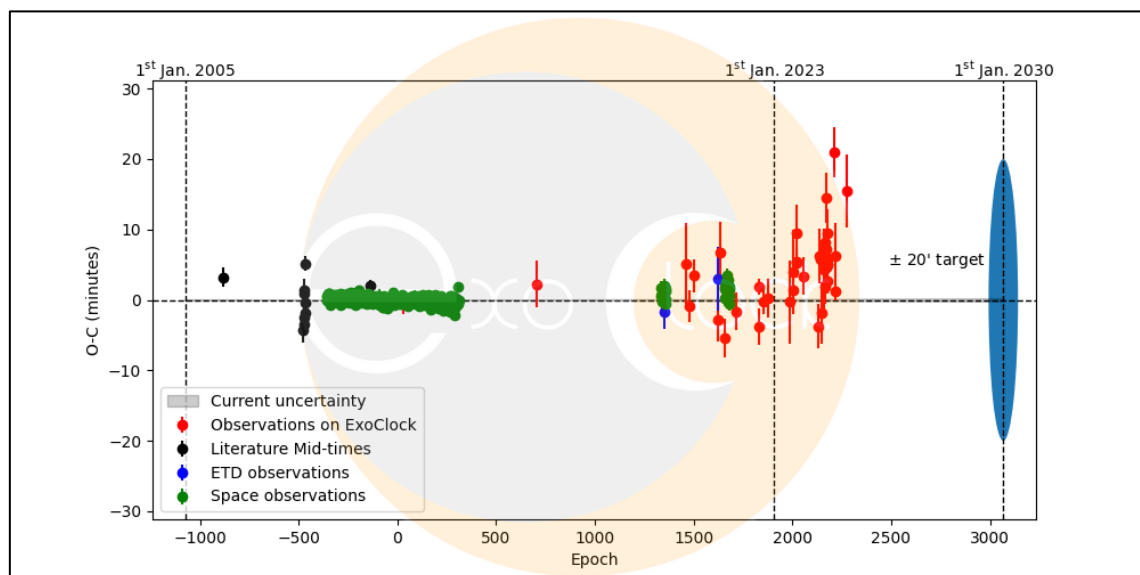
Transit predictions for an observer's location can be obtained from;

[The ExoWorlds Spies Transit Scheduler](#)

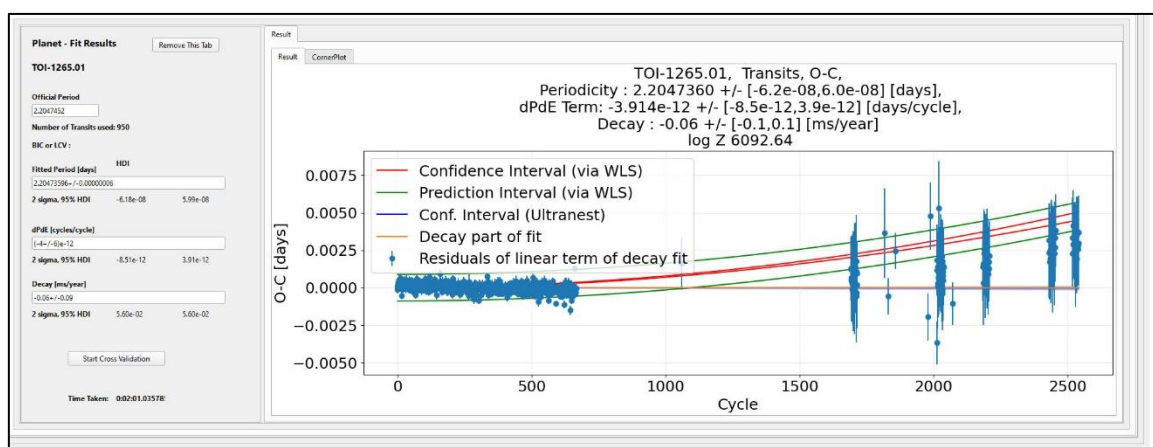
or

[Find Exoplanet Transits](#)

### HAT-P-7b



ExoClock database

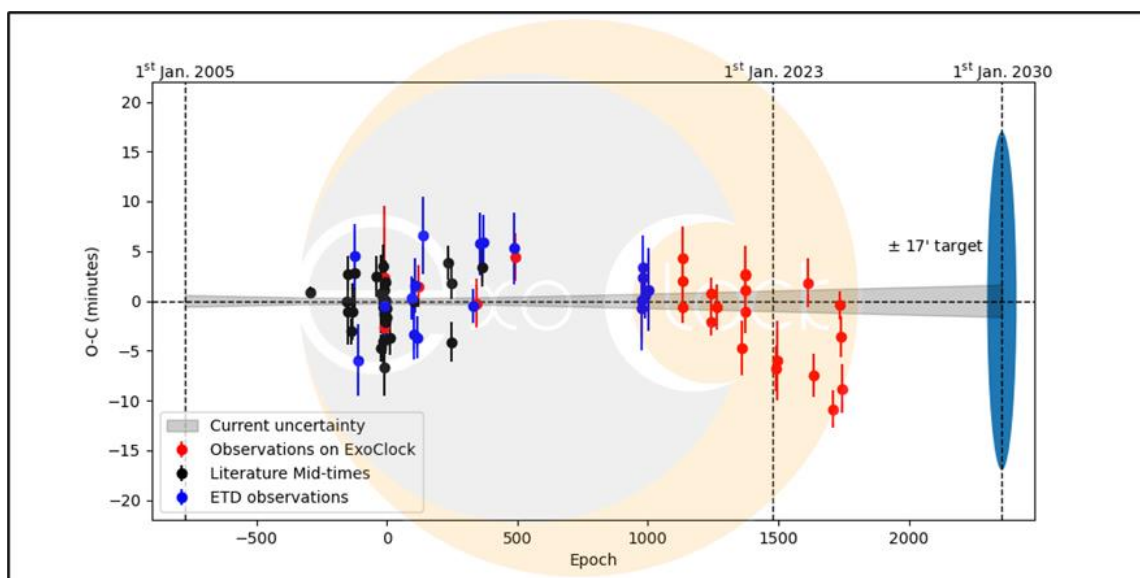


Exoplanetpie

Exoplanetpie analysis indicates an increasing orbital period or an evolving eccentric orbit. The latter is explored in a [paper](#) which describes the influence of a third star in the system.

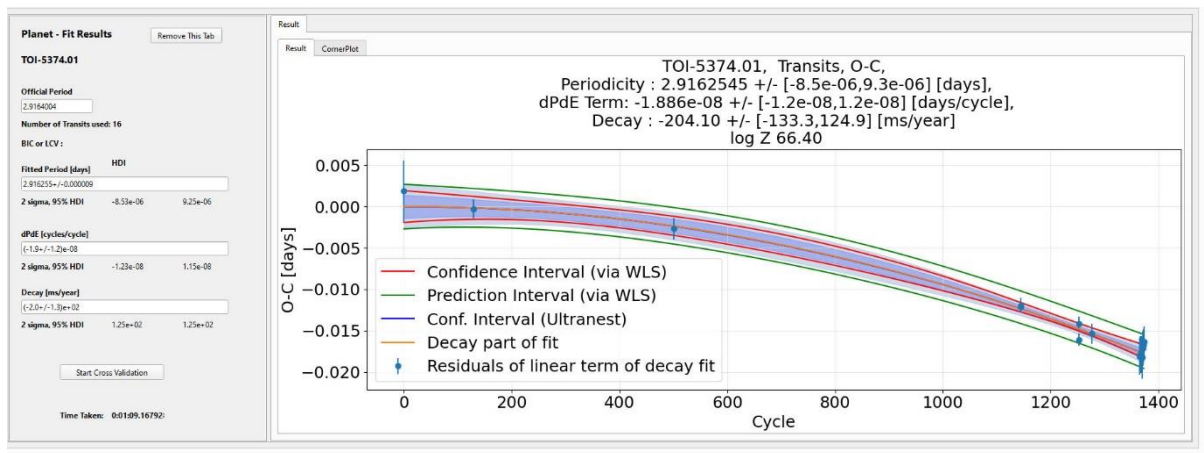
### HAT-P-13b

HAT-P-13c is a massive outer planet on a highly eccentric orbit, period  $428.5 \pm 3$  days. Orbital period of HAT-P-13b is 2.916 days. The high mass and eccentricity of the outer planet should induce TTVs of the inner planet - paper [HAT-P-13b,c: A TRANSITING HOT JUPITER WITH A MASSIVE OUTER COMPANION ON AN ECCENTRIC ORBIT\\*](#)



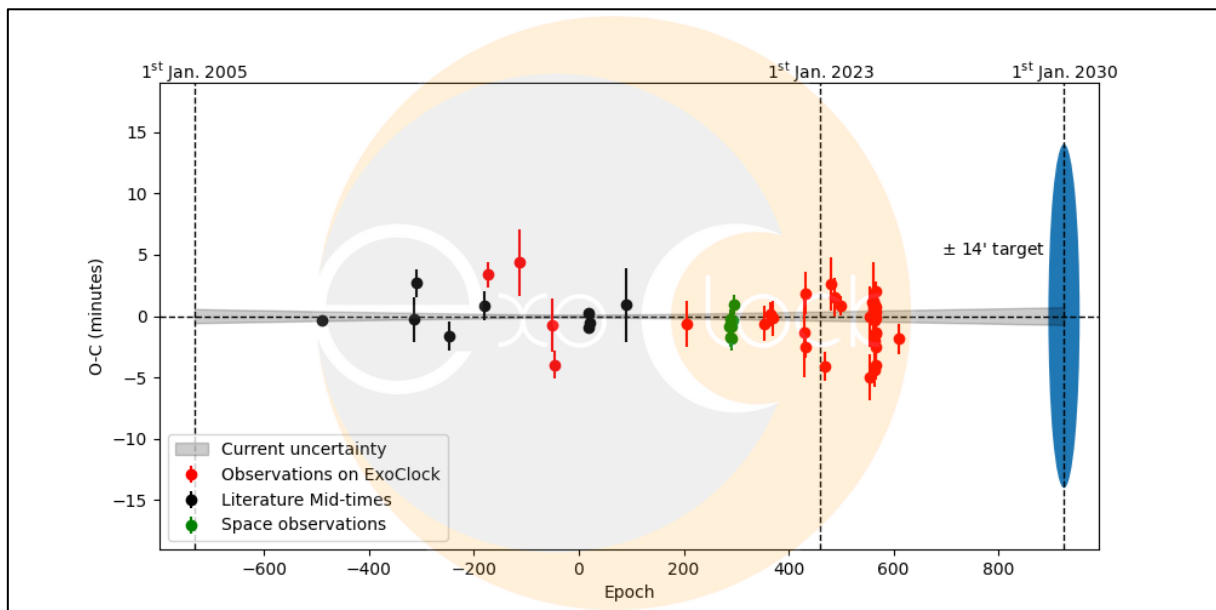
ExoClock database

Observations suggest an increasing and then decreasing orbital period. Possibly due to the presence of an additional exoplanet or a precessing eccentric orbit.

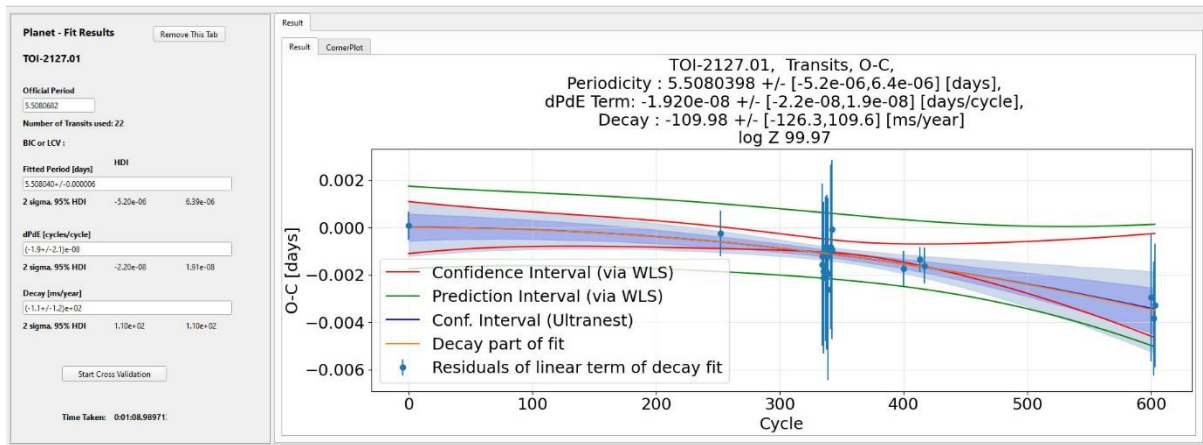


Exoplanetpie analysis indicates a decaying orbit.

## HAT-P-18b

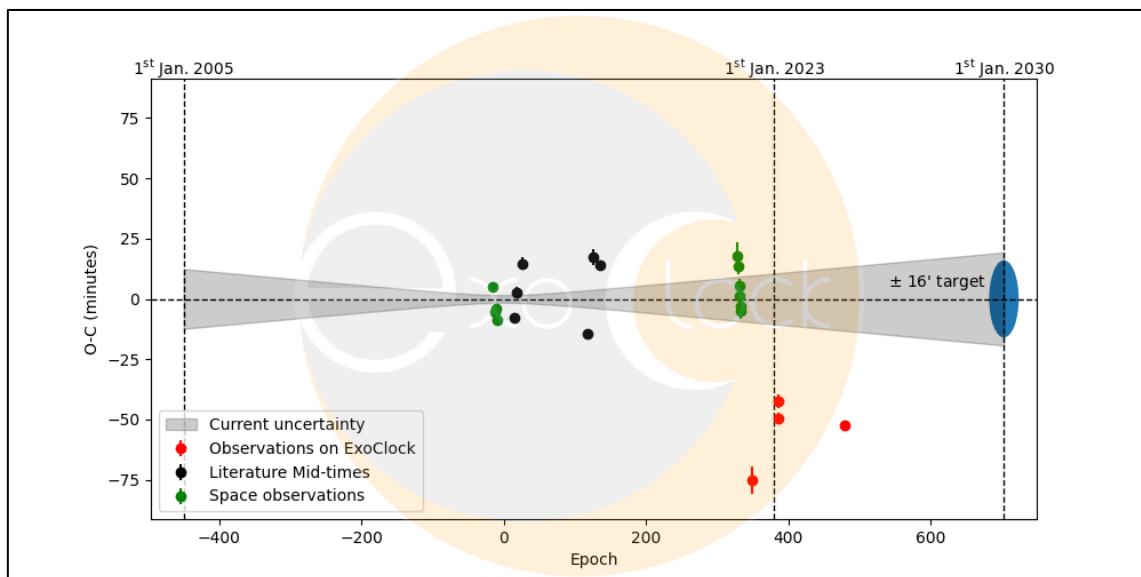


ExoClock database

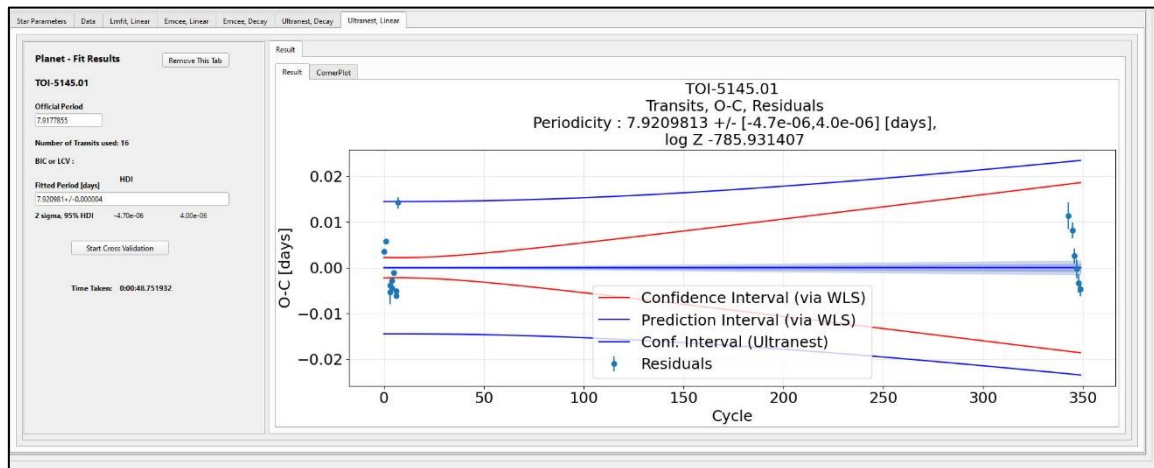


Exoplanetpie analysis suggests a decaying orbit

## K2-19b



ExoClock database

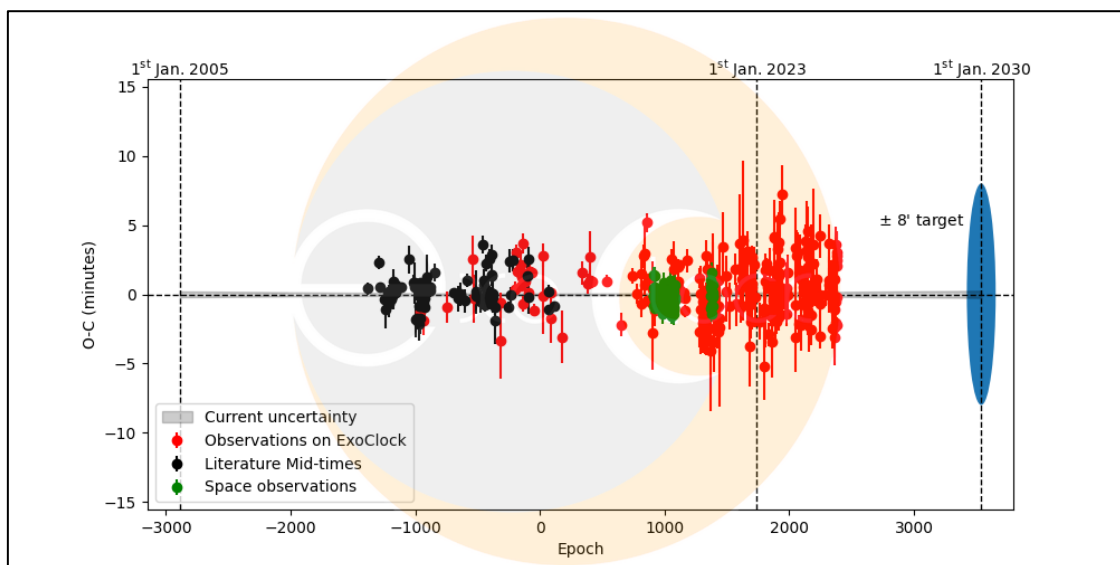


## Exoplanetpie

Too little data available to achieve a useful result but suggest we keep this planet under observation – see note below.

Note. K2-19b and c, are a two-planet system of Neptune-sized objects (4.2 and 7.2  $R_{\oplus}$ ), orbiting a K dwarf extremely close to the 3:2 mean motion resonance. The two planets each show transits, sometimes simultaneously owing to their proximity to resonance and the alignment of conjunctions.

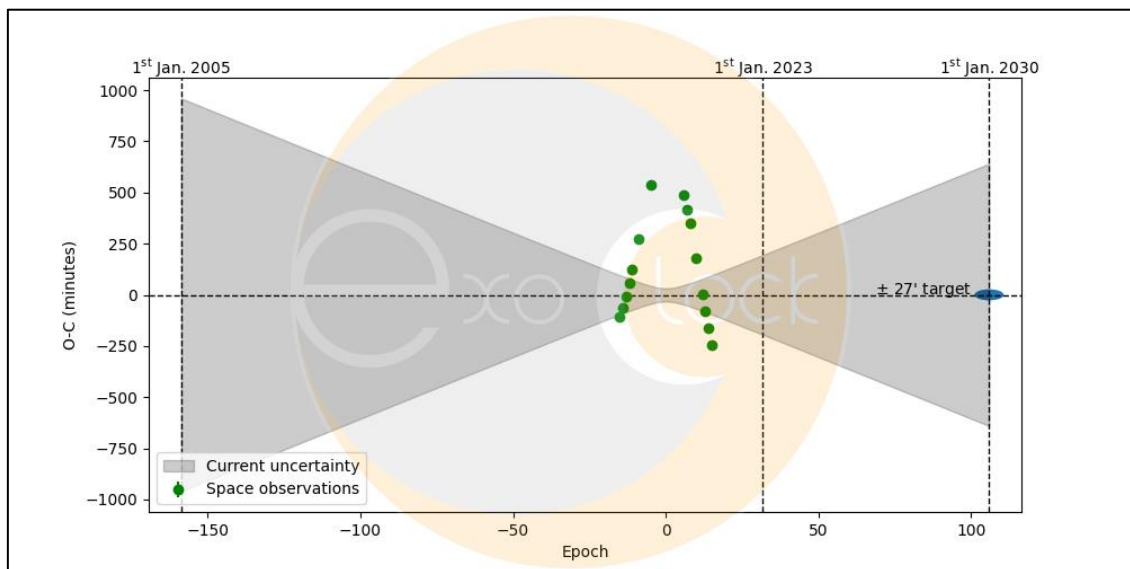
## Qatar-1b



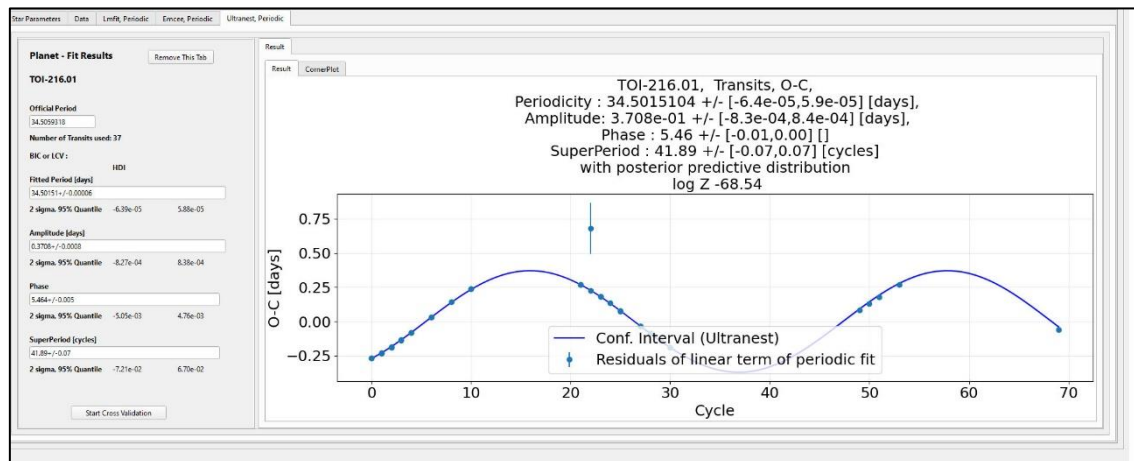
## ExoClock database

A paper [Qatar-1: indications for possible transit timing variations](#) proposes two causes of TTVs - a weak perturber in resonance with Qatar-1b, or by a massive body in the brown dwarf regime. More observations and radial velocity monitoring are required to better constrain the perturber's characteristics.

### TOI-216.01



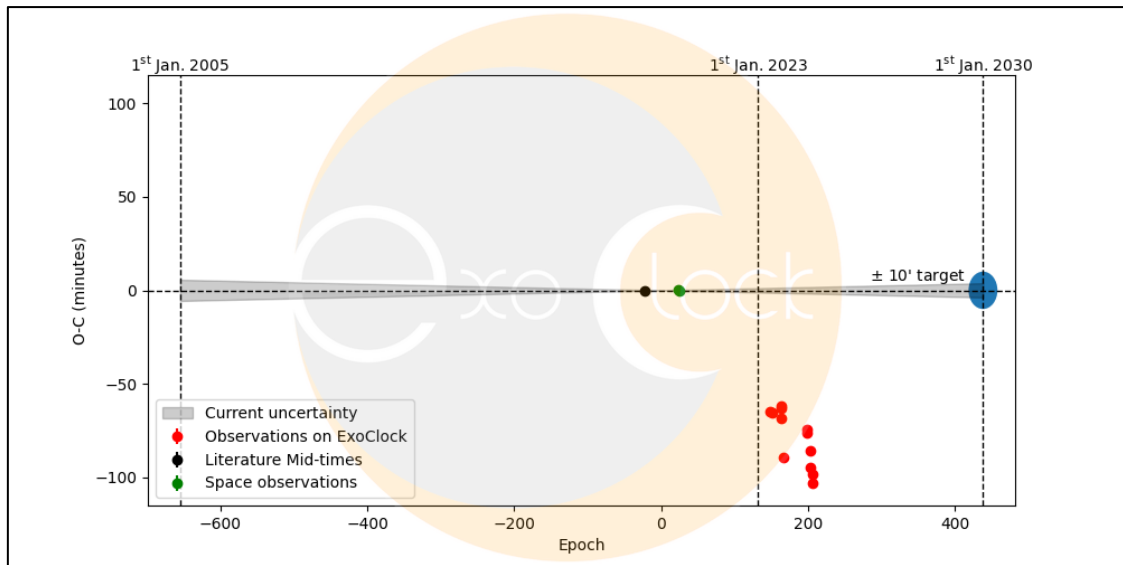
ExoClock database



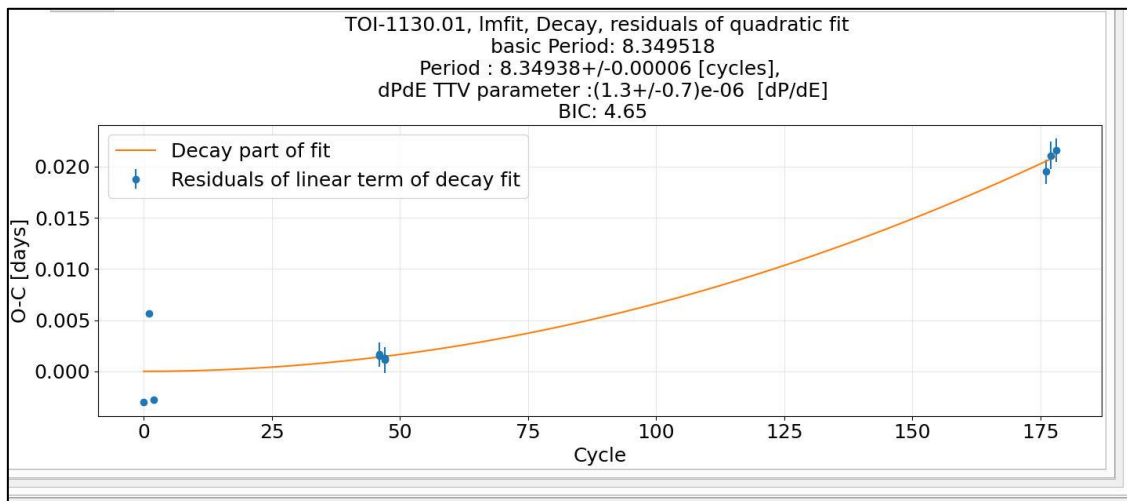
Exoplanetpie

Exoplanetpie analysis indicates the cyclical nature of the transits as does the ExoClock plot. This exoplanet is in a 2:1 resonant orbit with TOI-216.02 - 34.57 and 17.01 days respectively.

### TOI-1130c

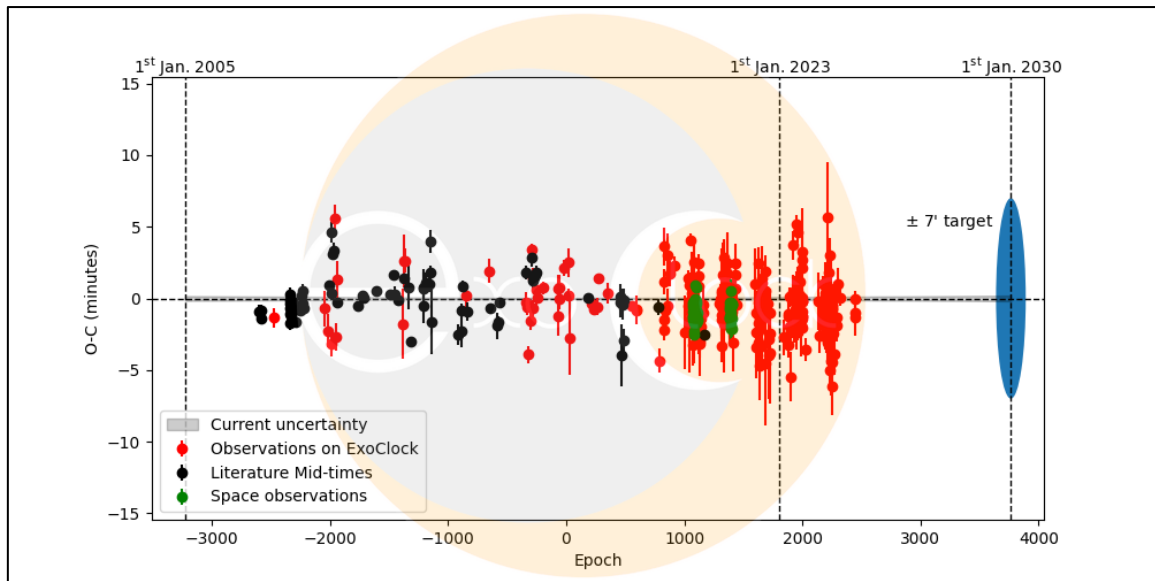


ExoClock database

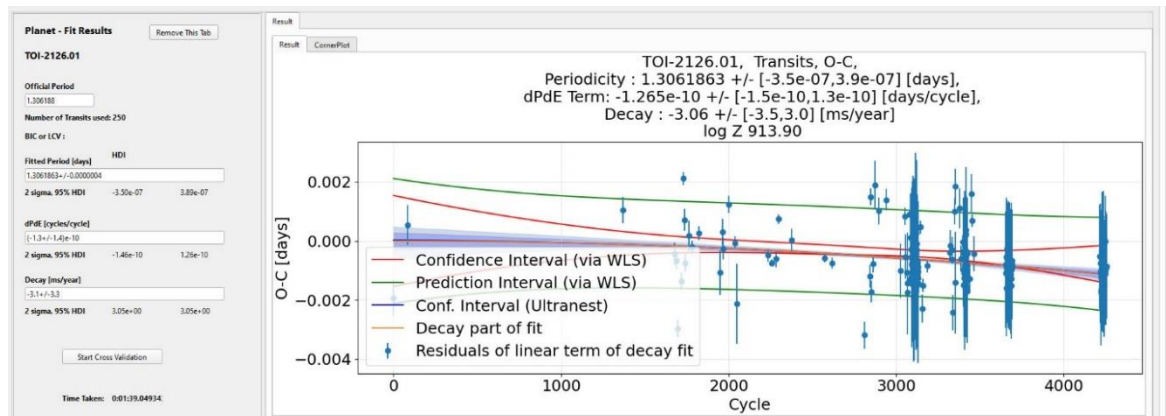


Exoplanetpie analysis -very little data but some indication of an increasing orbital period

TrES-3b

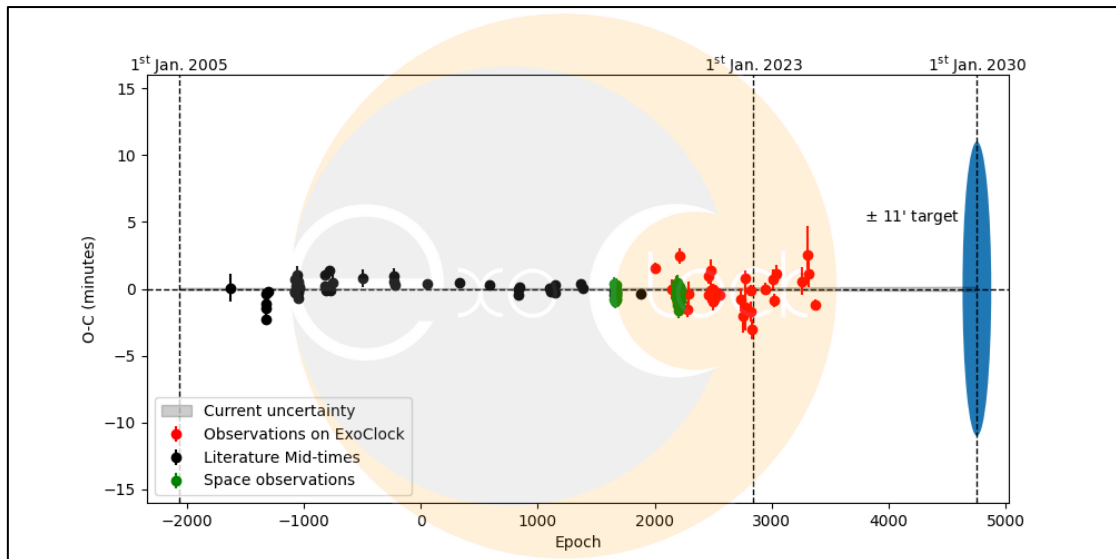


## ExoClock database

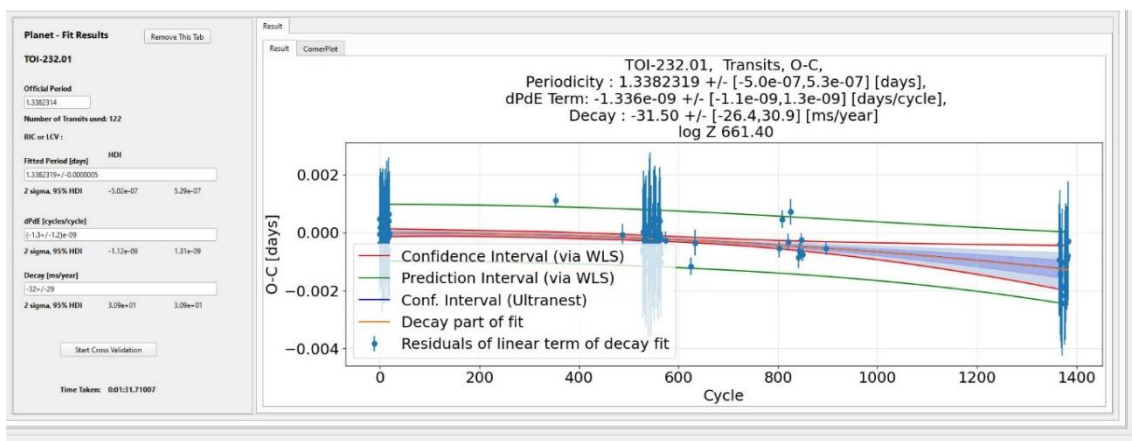


Exoplanetpie analysis suggests a decaying orbit

## WASP-4b



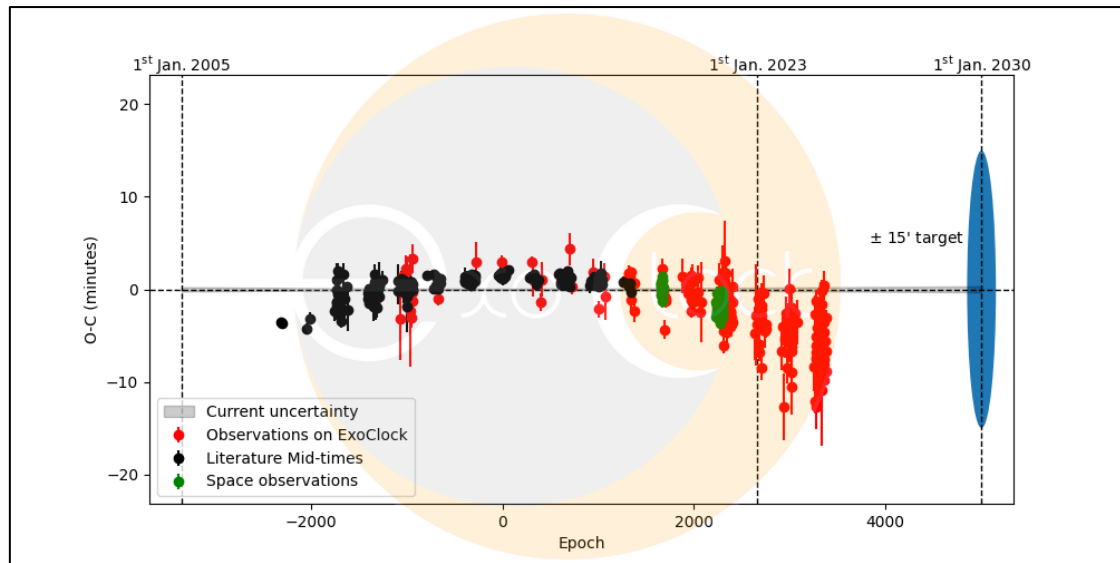
ExoClock database



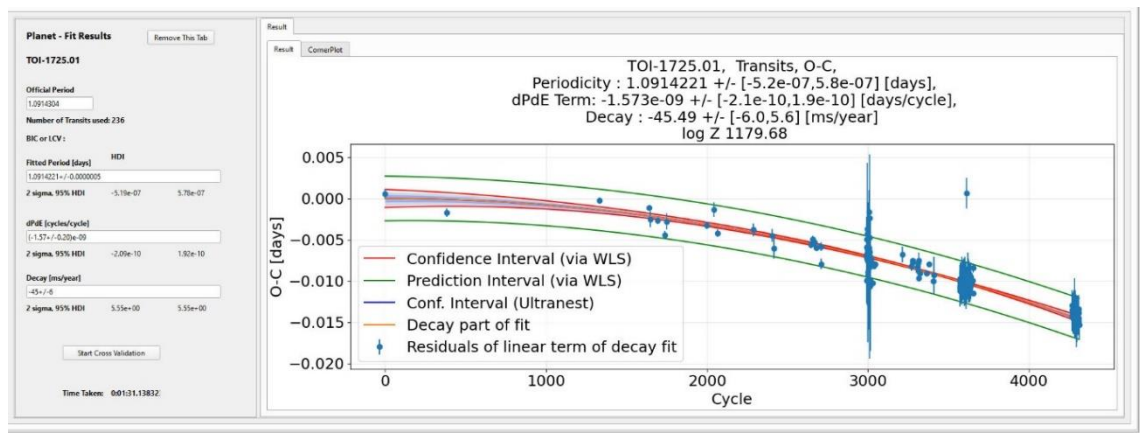
Exoplanetpie analysis suggests a decaying orbit which is confirmed in a paper

[The orbit of WASP-4 b is in decay](#)

WASP-12b



ExoClock database



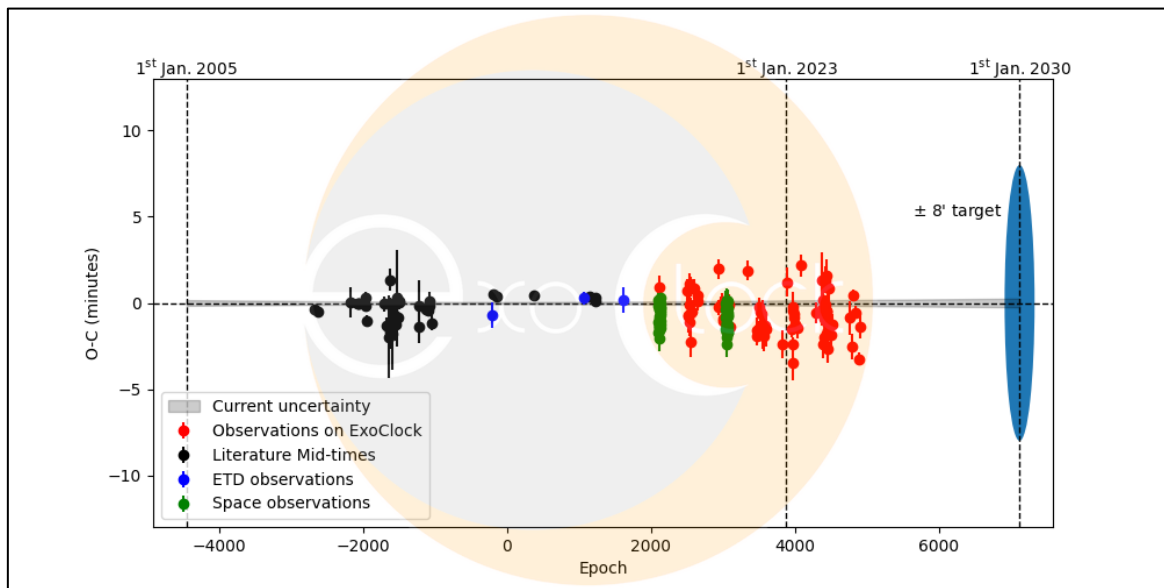
Exoplanetpie analysis indicates a decaying orbit but earlier ExoClock data might indicate a precessing eccentric orbit

[Study reveals mystery of decaying planetary orbits](#)

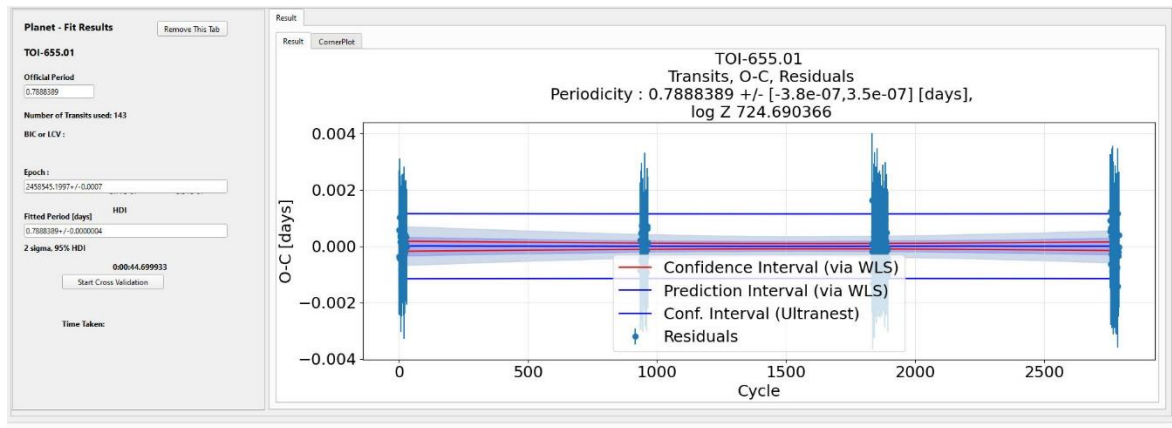
[The study](#), published Mon April 29 2025 in The Astrophysical Journal Letters, proposes that stellar magnetic fields play a crucial role in dissipating the gravitational tides responsible for the orbital decay of 'hot Jupiter' exoplanets.

Quote from the above link – 'At the moment, the only planet we know for certain to be spiralling into its star - and in the far future, possibly being destroyed - is WASP-12b'.

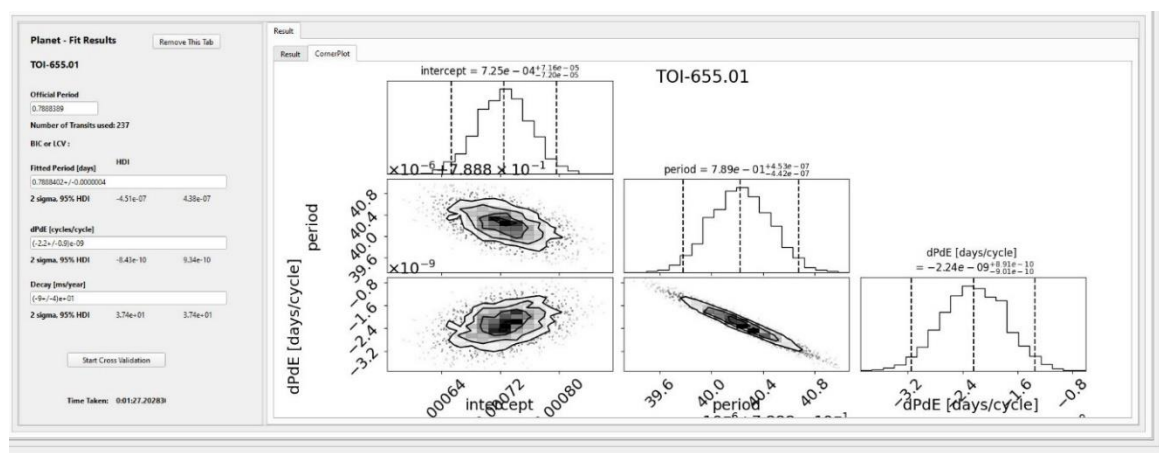
## WASP-19b



## ExoClock database



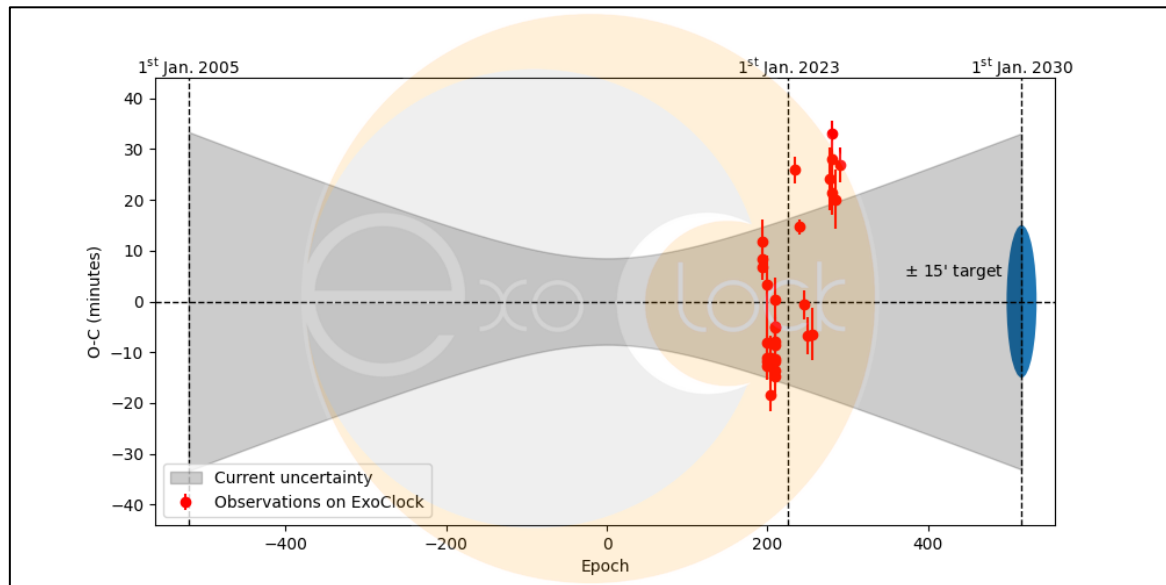
Exoplanetpie analysis indicates a stable orbit



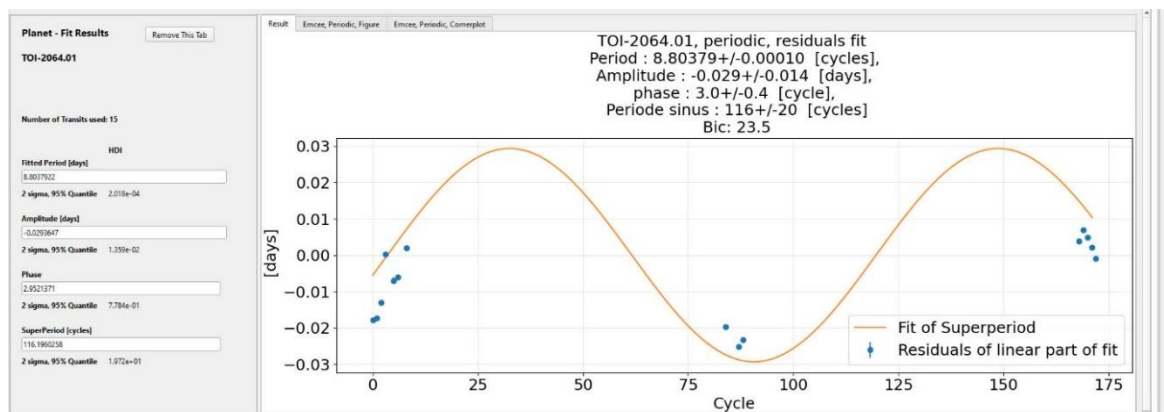
A paper [Investigating Transit Timing Variations in the Ultra-short Period Exoplanet WASP-19b](#) states 'Subsequent frequency analysis and sinusoidal model fitting indicate that the observed TTVs are more consistently explained by apsidal

precession of WASP-19b's orbit. Our findings suggest that stellar magnetic activity, potentially linked to the Applegate mechanism, may also contribute to the observed timing variations. **To further constrain the origin of the TTVs and assess the contributions of these mechanisms, continued high-precision photometric monitoring of the WASP-19 system is strongly recommended'.**

## WASP-148b



## ExoClock database



Exoplanetpie analysis – indication of a periodic variation but more results needed

Roger Dymock

BAA Asteroids and Remote Planets Section, Assistant Director Exoplanets Division