

Identification of features of TOI-560c and its similarities to the planets of the solar system

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ABSTRACT:

The results of TOI-560c were obtained thanks to the equations shown below and some data given. Thanks to this it was obtained that the Radius of TOI-560c is 2.38 R_{earth} , its orbital distance is 0.1242 and the density is 3.954 g/cm^3 . As well, it was given that the mass of the exoplanet is 9.70 M_{earth} , and it has an orbital period of 18.8797.

Then these characteristics were compared to the characteristics of the planets of the solar system. Based on this it was said that the exoplanet TOI-560c has a radius similar to Neptune, a similar mass to Uranus, a density similar to Mars and a similar Temperature to Mercury. Also, TOI-560c has an orbital period similar to none of the planets of the solar system.

Then it was concluded that TOI-560c is a gaseous planet. If TOI-560c was to start a transit today 20 of May 2023 then its next transit would be the 8 of June or 2023. As well, TOI-560c is probably not in the habitable zone of its star since it has a temperature of 225°C. This planet would not be able to hold liquid water on its surface as water needs to be between 0-100°C to stay in its liquid form. Although to affirm there are other factors to take into account, like the type and temperature of the star but only by knowing its temperature it is not in the habitable zone.

RESULTS AND ANALYSIS:

TOI-560c was discovered in 2021 by the sounding satellite TESS. It's a mini-neptune, which means that it has characteristics similar to Neptune, but in a smaller way. Its temperature is 225 °C with an error range of 15°C.

By using the equations provided:

- *Radius of the exoplanet:*

$$\text{Transit depth (\%)} = \frac{\pi R_p^2}{\pi R_s^2} \times 100$$

- *Orbital Distance:*

$$T^2 = \left(\frac{4\pi^2}{GM_{star}} \right) d^3$$

- density:

$$\rho = \frac{M}{V}$$

Where the V is :

$$V = \frac{4}{3} \pi R^3$$

On one side, It was determined that the Radius of TOI-560c is 2.38 R_{earth} (figure 2) Also, the orbital distance is 0.1242 and the density is 3.954 g/cm^3 . As well, it was given that the mass of the exoplanet is 9.70 M_{earth} , and it has an orbital period of 18.8797. Its mid-transit time is 0.44 and its orbital semi-major axis is 0.1242 AU (figure 3). On the other side, the mass of the star is 0.73 M_{sun} and its radius is 0.65 R_{sun} as can be seen in figure 2.

By using *allesfiter*(binder) it was determined the transit light curve of TOI-560c. As it can be seen in Figure 1.

Figure 1

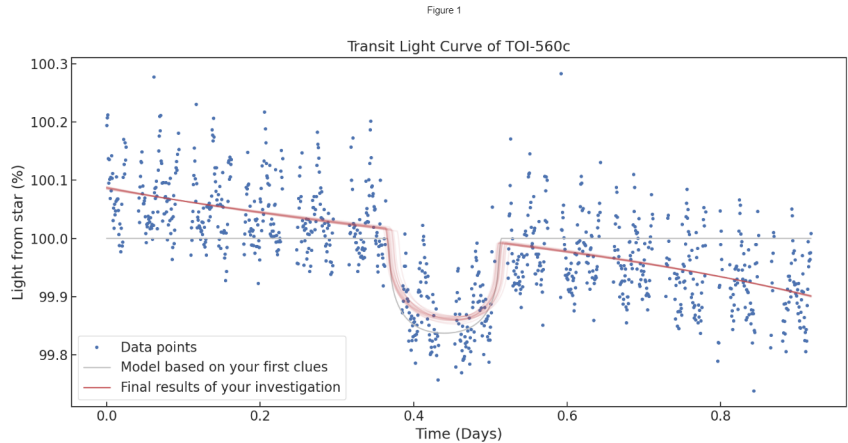


Figure 2

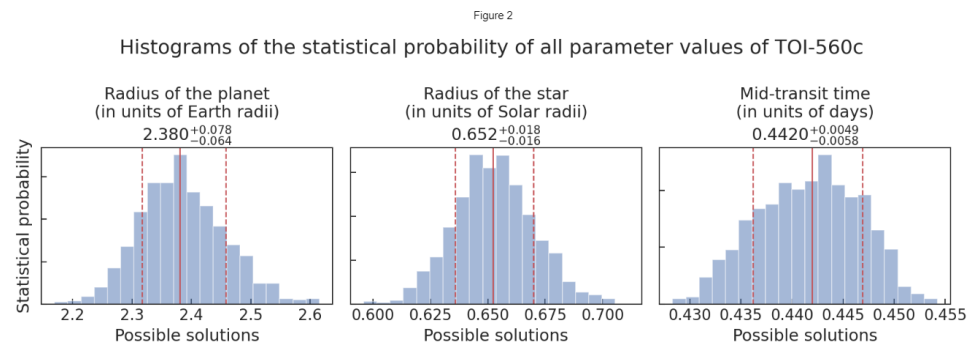


Figure 3

Name	Median value	Lower error	Upper error	Case note	Target
Radius of the planet (in units of Earth radii)	2.38	0.064	0.078	Cheops observations	TOI-560c
Radius of the star (in units of Solar radii)	0.652	0.016	0.018	Cheops observations	TOI-560c
Mid-transit time (in units of days)	0.442	0.0058	0.0049	Cheops observations	TOI-560c
Orbital period (in units of days)	18.8797			Other observations from the archive	TOI-560c
Orbital semi-major axis (in units of AU)	0.1242			Other observations from the archive	TOI-560c

After gathering the results of TOI-560c its characteristics can be compared to the characteristics of our solar system celestial objects. The radius of TOI-560c (2.38 R_{Earth}) is similar to Neptune, this one having 3.88 R_{Earth} . Has a similar mass to Uranus which has a mass of 14.5 M_{Earth} (TOI: 9.70 M_{Earth}). About the orbital period none of the planets in the solar system has a similar orbital period since TOI-560c has an orbital period of 18.88 days and the planet with the lower orbital period is Mercury with 88 days. The closest in density with this planet is Mars that has 3.93g/cm³(TOI: 3.95g/cm³). Mercury with a temperature of 167°C is the closest in temperature even though they have a difference of 58°C (TOI: 225°C).

CONCLUSIONS:

We can conclude that the radius that allessiter calculated was 2.38 R_{Earth} while what we manually calculated gave us a radius of 2.75 R_{Earth} which shows a 80% of a accuracy.

Also, If TOI-560c was to start a transit today 20 of May 2023 then its next transit would be the 8 of June or 2023. As well, TOI-560c is probably not in the habitable zone of its star since it has a temperature of 225°C. This planet would not be able to hold liquid water on its surface as water needs to be between 0-100°C to stay in its liquid form. Although to affirm there are other factors to take into account, like the type and temperature of the star but only by knowing its temperature it is not in the habitable zone.

After using the formula $M/V=d$ we concluded that TOI-560c has a density of 3.954g/cm³

Also TOI-560c has a gaseous composition and after comparing TOI-560c with all the planets of the solar system it can be said that it has no similarities with the earth since none of the characteristics are similar to the ones of earth. Nevertheless it has a huge similarity with Neptune. As it is a mini-neptune it has its characteristics like having a dense atmosphere of helium and hydrogen with layers of ice rock and sometimes liquid. Based on our results it also has a similar mass as Uranus and a similar and a similar radius as Neptune, both planets belong to the same type of planets. Being this a gaseous planet

References:

MNGuenther. (n.d.). MNGuenther/hackanexoplanet: Software package for the ESA hackanexoplanet educational activity focused on Cheops data. powered by a lightweight minimalist version of allesfilter . GitHub. <https://github.com/MNGuenther/hackanexoplanet>